CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER-6 OF NATIONAL WATERWAYS

DETAILED PROJECT REPORT: GURUPUR RIVER - (NW-43) & NETRAVATHI RIVER - (NW-74)
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Inland Waterways Authority of India (IWAI) - Government of India
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DPR – GURUPUR RIVER (10.041KM) NW-43 & NETRAVATHI RIVER (30.00KM) NW-74

Our ref.: **P.010256-W-10305-005**
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RESTRICTED

Client: **INLAND WATERWAYS AUTHORITY OF INDIA**

Project: **CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER – 6 OF NATIONAL WATERWAYS**

Subject: **DETAILED PROJECT REPORT – GURUPUR RIVER (10.041KM) NW-43 & NETRAVATHI RIVER (30.00KM) NW-74**

Comments:

Revision No.	Date	Prepared / Revision By	Description
00	2020 12 21	B C Jha	Submitted for Review and Approval.
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Inland Waterways Authority of India (IWAI) assigned the Consultancy Services for "Preparation of Second Stage Detailed Project Report (DPR) of Cluster – 6 of National Waterways". The study has been carried out for this assignment and the result has been compiled in the present study.

The consultant would like to put on record their deep appreciation of cooperation and ready access to information and advice rendered by IWAI.

The consultant is grateful to Mr. ASHUTOSH GAUTAM, Member (Technical), CDR. MAHENDRA KUMAR (Hydrographic Chief), S V K REDDY (Chief Engineer) and Mr Rajeev Singhal (SHS) who provided their valuable guidance from time to time to make this report success.

(B C Jha)
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REV.	YY/MM/DD	STAT.	WRITTEN	VERIFIED	APPROVED	VALIDATED

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M/s Tractebel Engineering Pvt., Ltd., (M/s TEPL), Gurgaon has been assigned with the Consultancy Services for the “Preparation of Second Stage Detailed Project Report (DPR) of Cluster – 6 of National Waterways” by Inland Waterways Authority of India (IWAI). Accordingly, the study on NW 43 – Gurupur River & NW – 74 Netravati River have been carried out for this assignment / analyzed / compiled based on the findings of the following field studies / investigations.

Detailed Hydrographic Survey along with the Topographical Survey was carried out from 04/02/2017 to 05/02/2017 on NW 43 & from 06/02/2017 to 18/02/2017 on NW 74.

Traffic Survey was carried out, as detailed and summarized in Annexure 4.2.

Terminal Land Survey was carried out on Gurupur River (adjacent to the New Mangalore Port) on 30/04/2017 & on Netravati River (D/s of Thumbe Barrage) on 30/04/2017.

Geotechnical Borehole was carried out Gurupur River (adjacent to the New Mangalore Port) from 19/06/2017 to 23/06/2017 & on Netravati River (D/s of Thumbe Barrage) from 14/06/2017 to 16/06/2017 and subsequently Laboratory Tests have been carried out on the collected samples.

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This Report can be updated at a later stage, when required by considering the fresh cargo analysis, change in requirement of the Government (or) change in policy either of State Government or Government of India.

B C Jha

Tractebel Engineering Pvt Ltd

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Abbreviations	Acronyms
BFL	Bombay Floating Light
CD	Chart Datum
Ch	Chainage
CRZ	Coastal Regulation Zone
CWC	Central Water Commission
DGPS	Differential Global Positioning System
DMIC	Delhi Mumbai Industrial Corridor
DPR	Detailed Project Report
FSL	Full Supply Level
GAIL	Gas Authority of India Ltd.
HC	Horizontal Clearance
IO	Iron Ores
IOCL	Indian Oil Corporation Ltd.
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transport
KIOCL	Kudremukh Iron Ore Company Limited
KP	Km Points
LAD	Least Available Depth
MHWS	Mean High Water Spring
MMTPA	Million Metric Tonne Per Annum
MnT	Million Tonnes
MOEFCC	Ministry of Environment, Forest & Climate Change
MOS	Ministry of Shipping
MRPL	Mangalore Refineries and Petrochemicals Ltd.
MSME	Micro Small & Medium Enterprises
MTPA	Metric Tonne per Annum
NH	National Highway
NMPT	New Mangalore Port Trust
NW	National Waterway
OMPT	Old Mangalore Port Trust
PGCIL	Power Grid Corporation of India Limited
PWD	Public Works Department
SEB	State Electricity Board
SH	State Highway
UPCL	Udupi Power Corporation Ltd
VC	Vertical Clearance
WRD	Water Resources Department
WRIS	Water Resources Information System of India

SALIENT FEATURES

Salient Features: Gurupur (NW 43)

#	Particulars	Details		
A	**GENERAL**			
1	***Location***			
a	Cluster	Cluster-6		
b	State(s)	Karnataka		
c	Co-ordinates & Name of Place	**Start**	**End**	
	Place	Manglore Port	Panjimogaru	
	Latitude	12°50'44.093"N	12°55'38.80" N	
	Longitude	74°49'44.783"E	74°49'40.25"E	
B	**TECHNICAL**			
1	***Waterway***			
a	National Waterway Number	NW-43		
b	Class	IV (up to 10.041km)		
c	Type (Tidal/Non-Tidal)	Tidal		
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**
		10.041km	10.041km	--
d	Average Tidal Variation, if applicable	1.10m		
e	Chart Datum			
	Description/Basis	Gauge 1	Gauge 2	
	Value (from Zero of Gauge)	0.163m	0.417m	
f	LAD Status (w.r.t. CD)			
		Stretch-1 (km)	**Stretch-2 (km)**	**Total (km)**
	Stretch (From…...To……)	0.00 – 5.00	5.00-10.041	
	Length with LAD < 1.2 m	2.7	0.6	3.30
	With LAD from 1.2-1.4 m	0.0	0.0	0.00
	With LAD from 1.5-1.7 m	0.0	0.15	0.15
	With LAD from 1.8-2.0 m	0.0	0.15	0.15
	With LAD > 2.0 m	2.3	4.5	6.80
g	Target Depth of Proposed Fairway (m)	2.00m		
h	Conservancy Works Required			
	Type of Work	**Stretch-1**	**Stretch-2**	
		(0.00-5.00)	(5.00-10.4)	
	Dredging Required including 10% (Cum.)	**3,37,000**	**93,000**	
	Bandalling	Nil	Nil	
	Barrages & Locks	Nil	Nil	

#	Particulars	Details			
	River Training/Bank Protection (Km.)	100m for 01 location		Nil	
i)	Existing Cross Structures				
	Name of Structure	**Type**	**Nos.**	**Range of Horizontal Clearance**	**Range of Vertical Clearance w.r.t. FRL/HFL**
	Dams/Barrages/Weirs/Aqueducts etc.	Nil	Nil	Nil	Nil
	Bridges	Nil	Nil	Nil	Nil
	HT/Tele-communication lines	Nil	Nil	Nil	Nil
	Pipelines, underwater cables, etc.	Nil	Nil	Nil	Nil
2	***Traffic***				
a	Present IWT Operations	At present, Ferry services are operational at the following three locations: • Sulthan Battery Ferry Line from Sulthan Battery to Thannirubhavi • Ferry Line from Old Mangalore South Port to MJM Road Bengre • BMS Ferry Line from Old Mangalore New South Port to Bengre			
b	Major industries in the hinterland (i.e. within 25 km. on either side)	Oil and Natural Gas Corporation (ONGC), Mangalore Refinery and Petrochemicals Limited (MRPL), Mangalore Chemicals & Fertilizer (MCF), BASF, KIOCL, Ultratech Cement, Hindustan Unilever Ltd. There are 6 industrial areas and 5 Industrial Estates in Mangalore. Also, there is Baikampady Industrial Estate & Ullal Industrial Estate & Yeyyadi Industrial Estate.			
c	Connectivity of major industries with Rail/Road network (Distances/Nearest Railway Stations etc.)	✓ Major roads – NH 66, NH 75, NH 13, NH 243, SH 88, SH 88C ✓ Major railway – The Southern Railway Division connects the district to the cities of Bengaluru, Chennai and Thiruvananthapuram The Konkan Railway division connects the district to major port cities of Mumbai and Kochi. Konkan Railway route passes through Mangalore district, connecting major cities of India. The Konkan Railway's Ro- Ro service operates in the district with a landing station at Surathkal near Mangalore.			
d	Commodities (Ton)	**In-bound**		**Out-bound**	
1	Hazardous Cargo (POL & LPG), Container	NMPT		Central Karnataka	
		Central Karnataka		NMPT	

#	Particulars	Details				
e	Future Potential (MMT)					
	Name of Commodity	**5 yr. (Fy-20)**	**10 yr. (Fy-25)**	**15 yr. (Fy-30)**	**20 yr. (Fy-35)**	**25 yr. (Fy-40)**
1	Hazardous Cargo (POL & LPG) & Container (Ton)	4.00	4.60	14.90	17.10	19.50
	(* Assuming 1 truck= 18 tons)					
3	***Terminals/Jetties***					
a	Terminal/Jetty	Ro-Ro				
	Location (Bank/city/district)	12°54' 13.27"N & 74° 48' 56.97"E near Mangaluru				
	Type/Services	Ro-Ro (Trucks)				
	Facilities	Ambulance is provisioned				
	Approach	Road is available				
	Land Ownership					
	Area (ha.)	1.37 ha (GMR owned)				
4	***Design Vessel***					
a	Type	Ro-Rovessels				
b	No. & Size	3 Ro-Rovessels at initial stages				
c	Loaded Draft	1.8m				
d	Capacity	15 TEU (15 Trucks)				
e	Size	56.00 LOA x 13.50 m Breadth x 1.8 m Loaded Draft / 2.0 m – 2.50 m Depth				
5	***Navigation Aids***					
a	Type	Buoy and Light				
b	Nos.	42				
b	Communication Facilities	Through RIS/AIS				
C	**FINANCIAL**					
1	***Project Cost***					
a	Capital Cost	Fairway	Ro-Ro	Vessel		
	Cost (MINR) - Only Gurupur	153.48	253.80	-		
b	O & M Cost (MINR)	-	-	-		
2	***User Charges***					
a	For IWAI	-				
b	For Operator	-				
3	***Financial Internal Rate of Return (%)***	Fairway	Ro-Ro	Vessel		
a	For IWAI	-	-9.1%	-		
b	Operator	-				
4		Fairway	Ro-Ro	Vessel		

#	Particulars	Details		
	Economic Internal Rate of Return (%)	-	-1.8%	-
5	***Any other Important Feature***	***Financials shown are for inter-wined development***		

<u>Salient Features: Netrawati (NW -74)</u>

#	Particulars	Details			
A	**GENERAL**				
1	***Location***				
a	Cluster	Cluster-6			
b	State(s)	Karnataka			
c	Co-ordinates & Name of Place	**Start**		**End**	
	Place	Bengre		Bantwal	
	Latitude	12°50'44.6904"N		12°53'53.50"N	
	Longitude	74°49'33.3734"E		75°02'57.30"E	
B	**TECHNICAL**				
1	***Waterway***				
a	National Waterway Number	NW-74			
b	Class	IV (upto Ch 22.90km)			
c	Type (Tidal/Non-Tidal)	Tidal			
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**	
		30.00km	22.90km	7.10km	
d	Average Tidal Variation, if applicable	0.86m			
e	Chart Datum				
	Description/Basis	Gauge 1	Gauge 2	Gauge 3	
	Value (from Zero of Gauge)	0.000	0.248	-0.124	
f	LAD Status (w.r.t. CD)				
		Stretch-1 (km)	**Stretch-2 (km)**	**Stretch-3 (km)**	**Total (km)**
	Stretch (From…...To……)	0.00 – 10.00	10.00-22.90	22.9-30.00	
	Length with LAD < 1.2 m	1.80	9.10	0.10	11.0
	With LAD from 1.2-1.4 m	0.40	0.00	1.20	1.60
	With LAD from 1.5-1.7 m	0.10	0.05	0.00	0.15
	With LAD from 1.8-2.0 m	0.00	0.00	0.00	0.00
	With LAD > 2.0 m	7.70	3.75	5.80	17.25
g	Target Depth of Proposed Fairway (m)	2.00m upto Ch 22.90km			
h	Conservancy Works Required				
	Type of Work	**Stretch-1**	**Stretch-2**	**Stretch-3**	
		(0.00-10.00)	(10.00-22.90)	(22.90-30.00)	
	Dredging Required including 10% (Cum.)	98000	7,15,000	134638.02 (u/s of Thumbe barrage, *beyond feasible length*)	

#	Particulars	Details		
	Bandalling	Nil	Nil	Nil
	Barrages & Locks	Nil	Nil	Nil
	River Training/Bank Protection (Km.)	250m for 2 locations		

#	Particulars				
i)	Existing Cross Structures				
	Name of Structure	**Type**	**Nos.**	**Range of Horizontal Clearance**	**Range of Vertical Clearance w.r.t. FRL/HFL**
	Dams/Barrages/Weirs/Aqueducts etc.	Barrage	1	--	--
	Bridges	Rail/Road	5	32.0-45.0m	5.884-6.725m
	HT/Tele-communication lines	HT line	3	268-450m	10.0m (One HT line at 8.16kms need upgradation)
	Pipelines, underwater cables, etc.	Nil	Nil	Nil	Nil

#	Particulars	Details
2	***Traffic***	
a	Present IWT Operations (type of services)	At present, Ferry services are operational at the following three locations: • Sajipanadu- Thumbe Ferry line • Jalakadakatte- Parangipet Ferry line • Adyar-Pavoor Ferry line
b	Major industries in the hinterland (i.e. within 25 km. on either side)	Oil and Natural Gas Corporation (ONGC), Mangalore Refinery and Petrochemicals Limited (MRPL), Mangalore Chemicals & Fertilizer (MCF), BASF, KIOCL, Ultratech Cement, Hindustan Unilever Ltd. There are 6 industrial areas and 5 Industrial Estates in Mangalore. Also, there is Baikampady Industrial Estate & Ullal Industrial Estate & Yeyyadi Industrial Estate.
c	Connectivity of major industries with Rail/Road network (Distances/Nearest Railway Stations etc.)	✓ Major roads - NH 66, NH 75, NH 13, NH 243, SH 88, SH 88C ✓ Major railway – The Southern Railway Division connects the district to Bengaluru, Chennai and Thiruvananthapuram ✓ The Konkan Railway division connects Mangalore district to Mumbai and Kochi. The Konkan Railway's Ro- Ro service operates in the district with a landing station at Surathkal near Mangalore.

#	Particulars	In-bound	Out-bound
d	Commodities	**In-bound**	**Out-bound**
1	Hazardous Cargo (POL & LPG), Container	NMPT	Central Karnataka
		Central Karnataka	NMPT
2	Food Grains, Building Material	Bantwal, Puttur	Lakshadweep island (Via OMPT)

#	Particulars					
e	Future Potential (MMT)					
	Name of Commodity (Ton)	**5 yr. (Fy-20)**	**10 yr. (Fy-25)**	**15 yr. (Fy-30)**	**20 yr. (Fy-35)**	**25 yr. (Fy-40)**
1	Trucks/ Hazardous Cargo/ Containers	0.00	0.00	30.0	34.40	39.30

#	Particulars	Details				
2	Food Grains	0.02	0.02	0.02	0.02	0.04
3	Building Material	0.02	0.02	0.04	0.04	0.06
	(* Assuming 1 truck= 20 tons)					
3	***Terminals/Jetties***					
a	Terminal/Jetty	Ro-Ro				
	Location (Bank/city/district)	12°52'23.06"N & 75° 0'3.71"E near Thumbe				
	Type/Services	Ro-Ro (Trucks)				
	Facilities	Ambulance is provisioned				
	Approach	Road is available				
	Land Ownership					
	Area (ha.)	**Govt.**	**Private**			
		NIL	3.3			
4	***Design Vessel***					
a	Type	Ro-Ro vessels				
b	No. & Size	3 Ro-Ro vessels at initial stages				
c	Loaded Draft	1.8m				
d	Capacity	15 TEU (15 Trucks)				
e	Size	56.00 LOA x 13.50 m Breadth x 1.8 m Loaded Draft / 2.0 m – 2.50 m Depth				
5	***Navigation Aids***					
a	Type	Buoy and Light				
b	Nos.	102				
b	Communication Facilities	Through RIS/AIS				
C	**FINANCIAL**					
1	***Project Cost***					
a	Capital Cost	Fairway	Ro-Ro	Vessel		
	Cost (MINR)	325.60	345.75	-		
b	O & M Cost (MINR)	-	-	-		
2	***User Charges***					
a	For IWAI	-				
b	For Operator	-				
3	***Financial Internal Rate of Return (%) - (Combined)***	Fairway	Ro-Ro	Vessel		
a	For IWAI	-	-9.1%	-		
b	Operator	-				
4	***Economic Internal Rate of Return (%) - (Combined)***	Fairway	Ro-Ro	Vessel		
		-	-1.8%	-		
5	***Any other Important Feature***	***Financials shown are for inter-wined development***				

EXECUTIVE SUMMARY

Gurupur River (NW 43)

Gurupur River is one of the waterways declared as National Waterway in March 2016 as NW 43. The Gurupur River is joining the "Netravati" River on its right side just before draining off into the Arabian Sea. The Gurupur River (also known as Phalguni River or Kulur River) originates in the Western Ghats at an elevation of 1100m above Mean Sea Level (AMSL) and joins the Arabian Sea at Mangalore in the Karnataka state of India. The Gurupur River passes through Dakshin Kannad Distt of Karnataka State. The river is having the end stretch of 15kms to 20 kms passes through Mangalore city and joins the Netravathi River from North to South. The total catchment area of Gurupur River basin is 824 sqkm. The catchment receives an average annual rainfall of about 4000mm. Gurupur River has a relatively small catchment area and its tributaries are small feeder streams and canals. The length of the Gurupur mainstream in the catchment from the origin to the outfall in the Arabian Sea is about 85km.

Out of the total length of 85 km of river, the stretch of the river from confluence of Netravathi river at Lat 12°50'45"N, Long 74°49'45"E to Mangalore Port Bridge near Panjimogaru at Lat 12°55'35"N, Long 74°49'37"E has been declared as new national waterway and proposed to undertake the two stage DPR. M/s Tractebel has been assigned with the work of Preparation of a two stage DPR. Subsequent to the completion of Stage I of the DPR, the stretch of Gurupur River in the Mangalore city area of 10.041 kms from Lat 12°50'44.093"N, Long 74°49'44.783"E is under consideration for Stage 2 Detailed Project Report (DPR) so as to assess the required developments and the IWT Traffic potential along with inter alia activities including the working out of Cost / Return factors for taking a decision on developments / investments.

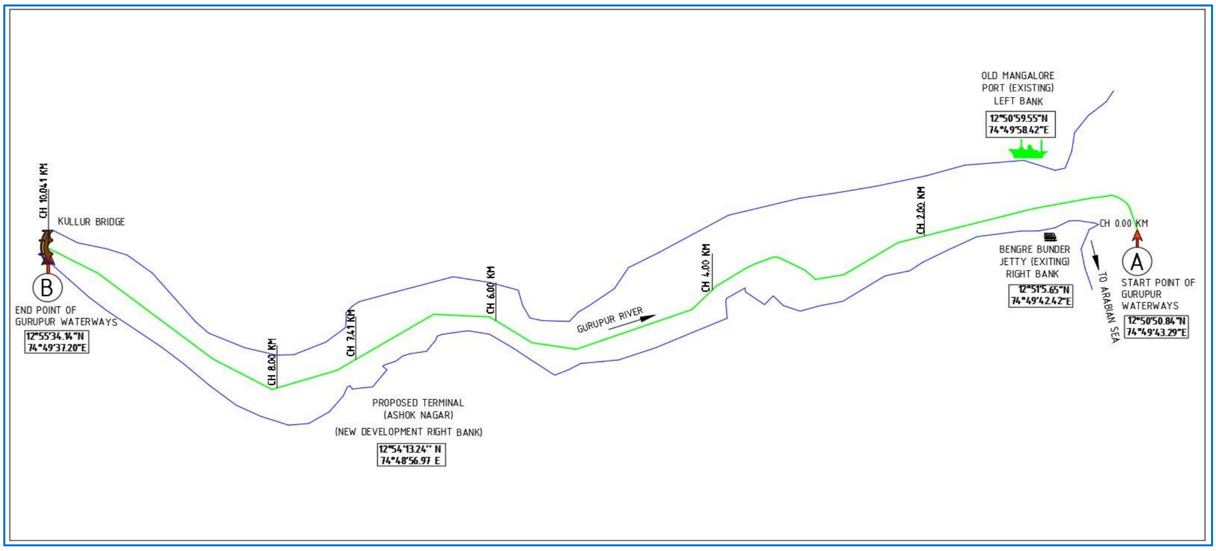
The major components in the DPR can be considered as Fairway Development; Traffic Confirmations; Terminal Development; Vessel Requirement and Financial Analysis. Bathymetric Survey of the study stretch has been carried out along with the Topographical Survey so as to arrive at the conservancy requirements including dredging; Channel demarcation and other Waterway requirements for safe navigation. The next one is Traffic Confirmations. The present Traffic scenario, possible divertible traffic to IWT is to be estimated. In sequence, Terminal Development, Vessel Requirement and Financial Analysis have been considered.

River Morphological analysis of the study stretch has been considered by analyzing the river regime of the past 15 to 20 years with 5 years span and the findings have been recorded. As such there is no major regime disturbance in the study stretch. Further, this analysis may not have any impact, since the study stretch is in between the firm banks.

Detailed Hydrographic Survey has been carried out so as to assess the required developments in the Fairway along with inter related activities. Based on the Hydrographic Survey data the entire stretch is in Tidal Zone and having a water depth of 2.0 m (LAD) for a considerable length. It has been noticed that no Bridges are located and No HT Lines are crossing the study area. No pipe line is crossing the study area. No Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts are located. Bend locations are marginal however one location having 100m bank protection been considered.

Fishing activity has been noticed and also the Ferry Services are on in the study stretch. The study stretch intertwined with Netravati River will have Cargo mobility, as estimated. Accordingly, there is an estimated potential of Ro-Ro generation of 82,326 MT (4,574 vehicles) P.A in FY 25 and expected to increase to 3,51,348 MT (19,520 vehicles) P.A in FY 40. Combined with Gurupur, total mobility on Netravati would be 8,08,125 MT (44,896 vehicles) in FY 25 and increase to 10,59,470 MT (58,859 vehicles) in FY 40

Gurupur river being in the close proximity of NMPT has the potential providing opportunity to IWT mobility. Govt. of Karnataka is very keen to develop various national waterways in the state and coordination meeting between IWAI & Ministry of Shipping, Govt. of India was held to find a way forward. MOM of meeting held on 07.01.2022 is referred which was circulated vide IWAI/NNW/GoKN/01/2020-21 dated 31.01.2022 (**Annexure 3.1**). It has been indicated that the study for these waterways needs updation in light of relevant data shared by Govt. of Karnataka and the DPR has been updated based on cargo traffic estimation data provided by office of the Director of Ports & IWT, Baithkol Karwar dated 12.01.2022. It has been proposed to consider the development of 1 Ro-Ro Terminal in Gurupur River at Ashoknagar (Ch.8.0kms) located at right bank and the other end Ro-Ro Terminal is proposed in the river Netravati located at (Ch.22.50kms) in the downstream of Thumbe barrage so as to facilitate the intertwined Ro-Ro development.



In order to meet the above suggested mobility of Ro-Ro Operation **Class IV** SPV system has been concluded. Accordingly, the Dredging quantities have been worked out. An estimated 4.3 Lakhs Cu. M of dredging quantity has been taken into consideration for the subject study.

The vessel requirement is being considered as Ro-Ro vessel operation with 21 TEU capacity Accordingly, the fairway requirement for Class IV has been taken into consideration with 50 m (Bottom Width) x 2.0 m / 2.2 m (Depth) with Bend Radius of 800. Clearance corridor of 50 m Horizontal Clearance (HC) and 10 m Vertical Clearance (VC) is the requirement specified at Cross structures for safe passage of Vessel / Convoy.

In order to provide safe navigable channel, along with the 4.30 Lakhs Cu. M of Dredging, 42 Nos of Day / Night Navigation markings have been considered. There are no Bridges and cross structures and hence no need of any modifications. Bend criteria suggests one location for bank protection. Nominal provisions have been suggested towards Communication system and Institutional requirements. IWAI Terminal requirement has been considered with 1 Roll-on Roll-off (Ro-Ro) IWT Terminal which has been proposed for Container / Truck operation.

A tentative Land requirement has been worked out and arrived at with 13643 Sq. M at Ashok Nagar Area in Mangalore Town. The Land Survey has been considered and Land Details of the location have been firmed up. It is in the Ashok Nagar area; Mangalore (Urban); Mysore District of Karnataka. Geotechnical Investigations have been completed and compiled in a separate Vol.-IV. As per the Class IV waterway classification, the maximum of 2000 T can be mobilized. The study stretch has been proposed for Ro-Ro activity to meet the handling of 19,520 Trucks operation.

SALIENT FEATURES OF BERTHING STRUCTURE

Description	Length(m)	Width (m)
1 Ro-Ro Terminal	75	16.5

Preliminary Designs have been worked out for Spurs; Bank Protection with Gabions; Navigational Aids through Buoys (Polyethylene) and Lights (4 NM); and Ro-Ro Jetty.
The following Vessel standards have been considered.

Ro-Ro Vessel:	**(15 TEU) – Double Ended Operation**
LOA	56.00 m
Breadth	13.50 m
Loaded Draft / Depth:	1.80 m
Propulsion:	Twin Engine Azimuth Drive
Propulsion Power:	2 x 250 kW

Speed (with Load): 8 Knots @ 100% MCR

Vehicle Capacities:

15 TEU (15 Trucks)

One Ro-Ro vessels may be required at the initial stages for Gurupur river however the total requirement of Ro-Ro vessel shall be three in case of combined or inter-wined development of Gurupur & Netravati river.

With regard to the environmental aspects, the requirements as per the norms have been suggested and also a Lump Sum provision has been catered to meet the expenditure on exigency. Regarding the Institutional requirements, it is proposed to look after the Waterways under Cluster 6 through Kochi office of IWAI covering Karnataka and Kerala along with appropriate manpower and other office infra requirements. Capital cost & other O&M cost has been considered accordingly.

The cost estimates for development of Gurupur waterway have been worked out (although Gurupur river has an intertwined development with Netravati river) and segregated into 2 Modules i.e., Fairway Module which is working out to 15.348 Cr (approx) followed with 1 Ro-Ro jetty at a capital cost of 25.38 Cr (approx).

Since the development of Gurupur river & Netravati river is intertwined, so a total of Rs.47.906 Crores is the estimated cost of fairway development from Ashoknagar in Gurupur river to Thumbe barrage in Netravati river and Rs.59.95 Crores is the estimated cost of two terminals one in each of the waterway. All the capital assets will be provisioned in 36 months after ascertaining the required confirmations and approvals from the concerned Departments. The FIRR and EIRR have been worked out and the details are placed.

Project Modules	FIRR	EIRR
Fairway (Combined)	-	-
Ro-Ro Terminal	-9.1%	-1.8%
Vessel	-	-

It is recommended to develop the entire study stretch of Gurupur River of about 10.041 kms with Class IV system of the NW standards to facilitate the Ro-Ro vessel mobility, intertwined with the development of river Netravati.

Netravati River (NW 74)

Netravathi River is one of the waterways declared as National Waterway in March, 2016 as NW-74. The Gurupur River is joining the "Netravathi" River on its right side just before draining off into the Arabian Sea. IWT mobility is intertwined with Gurupur River.

Netravathi River originates from Bangrabalige valley, Yelaneeru Ghat in Kudremukh in Chikkamagaluru district of Karnataka. The Netravathi River passes through Chikamangaluru & Dakshin Kannad Distt of Karnataka State. It flows through the famous pilgrimage place Dharmasthala and is considered as one of the Holy Rivers of India. The combined stream passes over a rocky bed to Bantwal and flows for a distance of 35km in plain area and joins Arabian Sea at Mangalore old port, south of Mangalore city. The catchment receives an average annual rainfall of about 5363 mm. Netravathi River has a relatively large catchment area and its tributaries are small feeder streams and canals. The total catchment area of Netravathi River basin is 3657 sq. km. The length of the Netravathi main stream in the catchment from the origin to the outfall in the Arabian Sea is about 103 km.

The total stretch of river Netravati of about 103 km, the stretch of Netravathi River of 30 kms from Lat 12°50'44.6904"N, Long 74°49'33.3734"E is under consideration for Stage 2 Detailed Project Report (DPR) so as to assess the required developments and the IWT Traffic potential along with inter alia activities including the working out of Cost / Return factors for taking a decision on developments / investments.

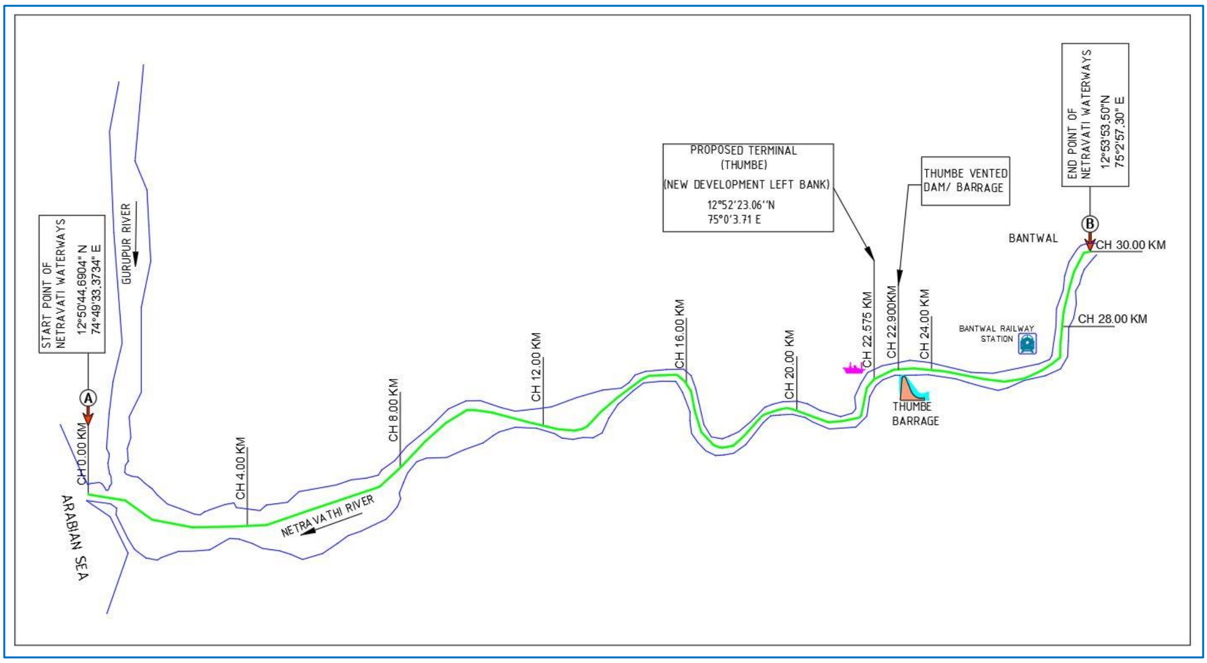
The major components in the DPR can be considered as Fairway Development; Traffic Confirmations; Terminal Development; Vessel Requirement and Financial Analysis. Bathymetric Survey of the study stretch has been carried out along with the Topographical Survey so as to arrive at the conservancy requirements including dredging; Channel demarcation and other Waterway requirements for safe navigation. The next one is Traffic Confirmations. The present Traffic scenario, possible divertible traffic to IWT is to be estimated. In sequence, Terminal Development, Vessel Requirement and Financial Analysis have been considered.

River Morphological analysis of the study stretch has been considered by analyzing the river regime of the past 15 to 20 years with 5 years span and the findings have been recorded. As such there is no major regime disturbance in the study stretch.

Detailed Hydrographic Survey has been carried out so as to assess the required developments in the Fairway along with inter related activities. Based on the Hydrographic Survey data the majority of the stretch is in Tidal Zone and having a water depth of 2.0 m (LAD) for a considerable length. It has been noticed that no bridges are located and no HT Lines are crossing the study area. Also no pipe line is crossing the study area. No Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts are located. Bend locations are marginal and suggested the required protection.

IWT mobility and limited activities are on near the Old Mangalore Port area and Fishing activities / Ferry Services are on in the Gurupur area. The study stretch intertwined with Gurupur River will have considerable Cargo mobility, as estimated. Accordingly, there is an estimated potential of Ro-Ro generation of 82,326 MT (4,574 vehicles) P.A in FY-25 and expected to increase to 7,08,122 MT (39,340 vehicles) P.A in FY 40. Combined with Gurupur, total mobility on Netravati would be 8,08,125 MT (44,896 vehicles) in FY 25 and increase to 10,59,470 MT (58,859 vehicles) in FY 40.

It has been proposed to consider the development of 1 Ro-Ro Terminal in Gurupur River at Ashoknagar (Ch.8.0kms) located at right bank and the other end Ro-Ro Terminal is proposed in the river Netravati located at (Ch.22.50kms) in the downstream of Thumbe barrage so as to facilitate the intertwined Ro-Ro development.



In order to meet the above suggested mobility of Ro-Ro Operation Class IV SPV system has been concluded. The vessel requirement is being considered as Ro-Ro vessel operation with 15 TEU capacity (Double Ended Operation). Accordingly, the fairway requirement for Class IV has been taken into consideration with 50 m (Bottom Width) x 2.0 m / 2.2 m (Depth) with Bend Radius of 800. Clearance corridor of 50 m Horizontal Clearance (HC) and 10 m Vertical Clearance (VC) is the requirement specified at cross structures for safe passage of Vessel / Convoy.

In order to provide a safe navigable channel, dredging of 8.13 Lakhs Cu. M in Ordinary Soils has been estimated along with the provision of 102 Nos of Day / Night Navigation Markings and Bank Protection works at 2 locations totalling to 250 m length. No Bridges and cross structures exist on the waterway and hence no need of any modifications.

There is one HT line at 8.16kms having a vertical clearance (VC) of 10.0m and needs upgradation as per IWAI guideline and provision has been made in the estimate. Nominal provisions have been suggested towards Communication System and Institutional Requirements.

IWAI Terminal requirement has been considered with 1 Roll-on Roll-off (Ro-Ro) IWT Terminal at downstream of Thumbe barrage (Ch.22.50kms) which has been proposed Container / Truck operation. A tentative Land requirement has been worked out and arrived at with 14243 Sq. M at Thumbe. The Land Survey has been considered and Land Details of the location have been firmed up. It is in the Thumbe village; Bantwal Taluka; Dakshin Kannada District in the state of Karnataka. Geotechnical Investigations have been completed and the Lab Tests and compilation are under progress.

As per the Class IV waterway classification, the maximum of 2000 T can be mobilized. The study stretch has been proposed for Ro-Ro activity to meet the handling of 58,859 vehicles operation per annum by FY-40.

SALIENT FEATURES OF BERTHING STRUCTURE

Description	Length(m)	Width (m)
1 Ro-Ro Terminal	123	16.8

Preliminary Designs have been worked out for Spurs; Bank Protection with Gabions; Navigational Aids through Buoys (Polyethylene) and Lights (4 NM); and Ro-Ro Jetty.
The following Vessel standards have been considered.

Ro-Ro Vessel:	**(15 TEU) – Double Ended Operation**
LOA	56.00 m
Breadth	13.50 m
Loaded Draft / Depth:	1.80 m
Propulsion:	Twin Engine Azimuth Drive
Propulsion Power:	2 x 250 kW
Speed (with Load):	8 Knots @ 100% MCR

Vehicle Capacities:

15 TEU (15 Trucks)

Three Ro-Ro vessels may be required at the initial stages. The above calculation concludes that one number of Ro-Ro vessel wil be sufficient to handle truck traffic proposed in river Gurupur & three numbers of Ro-Ro vessel will be required to handle total projected traffic in river Netravati. Since this is an intertwined development, total of three Ro-Ro vessel shall suffice to kickstart the operation and introducing more Ro-Ro vessel may be decided, once the positive development is witnessed over the period of time.

The entire project area falls under the tidal zone. As such the project shall require obtaining clearance under the CRZ Notification 2011. Consent to establish and consent to operate from the SPCB shall be required under the Air and Water Acts. No other major clearances/ approvals/ permits relating to social aspects are applicable to the project. No wildlife clearance is envisaged for the proposed waterway. Some structures of cultural, historical or archaeological importance have been noticed but are not affected by the development of the project. Archaeological Survey of India (ASI) or the State Department of Culture is envisaged for the project. With regard to the Environmental aspects, the requirements as per the norms have been suggested and also a Lump Sum provision has been catered to meet the expenditure on exigency.

Regarding the Institutional requirements, it is proposed to look after the waterways under Cluster 6 through Kochi office of IWAI covering Karnataka and Kerala along with appropriate Manpower and other office infra requirements. Capital cost & other O&M cost has been considered accordingly.

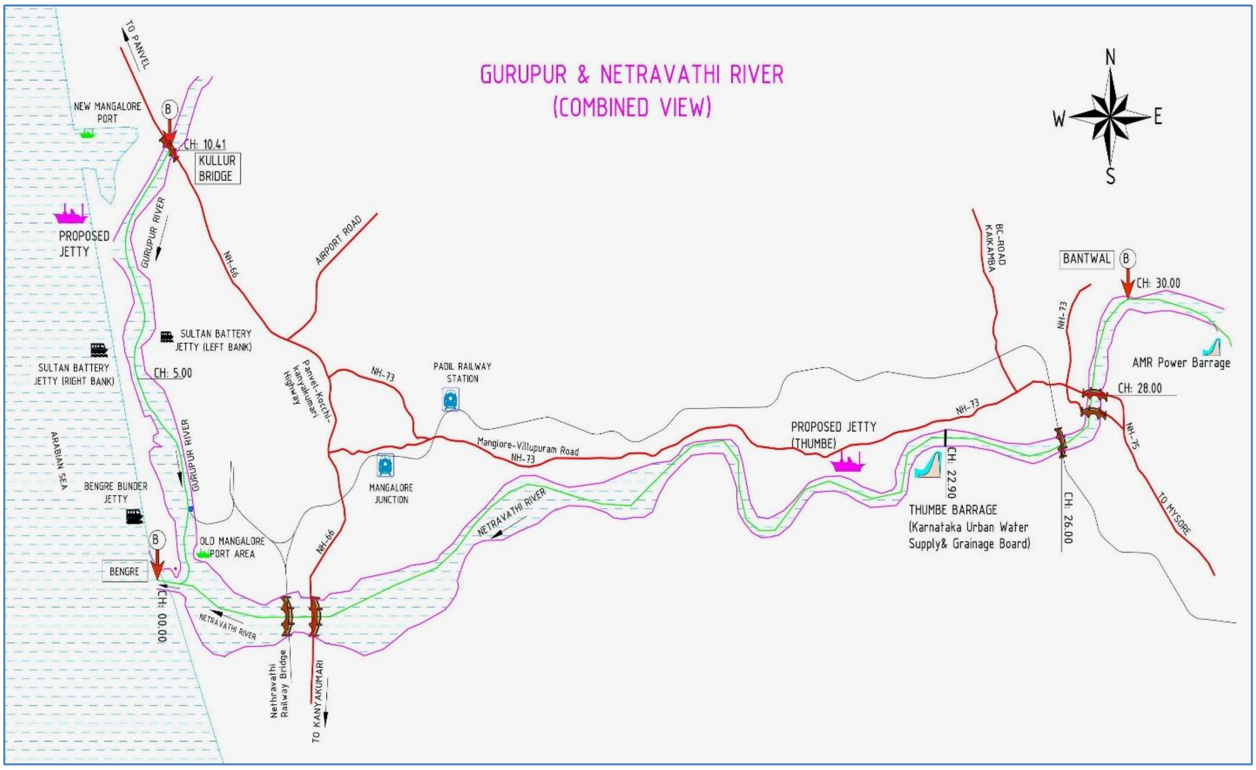
The cost estimates for development of Netravati waterway have been worked out and segregated into 2 Modules i.e., Fairway Module which is working out to 32.56 Cr (approx) followed with 1 Ro-Ro jetty at a capital cost of 34.57 Cr (approx). Since the development of Gurupur river & Netravati river is intertwined, so a total of Rs.47.906 Crores is the estimated cost of fairway development from Ashoknagar in Gurupur river to Thumbe barrage in Netravati river and Rs.59.95 Crores is the estimated cost of two terminals having one terminal in each of the waterway. All the capital assets will be provisioned in 36 months after ascertaining the required confirmations and approvals from the concerned Departments. The FIRR and EIRR have been worked out and the details are placed.

Project Modules	FIRR	EIRR
Fairway (Combined)	-	-
Ro-Ro Terminal	-9.1 %	-1.8 %
Vessel	-	-

It is recommended to develop the entire study stretch of Netravati River of about 22.90 kms with Class IV system of the NW standards to facilitate the Ro-Ro vessel mobility, intertwined with the development of Gurupur river.

Intertwined Development of GUrupur & Netravati Rivers

Both the rivers meet before meeting the Arabian sea as well feasible navigable length of the waterway in Gurupur river is about 10.0kms & 22.90kms in Netravati river, hence it has been mooted to develop both the waterway interwining with each other to make it more feasible. Intertwined river system is as below:



Snapshot of the project cost and viability indicators for for Gurupur (NW-43) &Netravati river (NW-74) under different scenarios:

Sl. No	Factors	Section	Unit	Financial Outcome
1	Project Cost	Fairway	Cr.	47.9
		Ro-Ro Terminal - Gurupur	Cr.	25.38
		Ro-Ro Terminal - Netravati	Cr.	34.58
2	Tariff	Vessel Berthing	INR Vessel/Day	1,500
		Terminal Charges	INR Per Vehicle	300
		Fairway Usage	INR GRT-Km	-
2	Traffic	Trucks	‘000 No. (FY40)	58.86
3	Revenue	Ro-Ro Terminal	Cr.	6.91
4	FIRR	Fairway	-	-
		Ro-Ro Terminals	-	-9.1%
5	EIRR	Fairway	-	-
		Ro-Ro Terminals	-	-1.8%
6	Cumulative	FIRR	-	Non-existent
		EIRR	-	Non-existent

The project does have cargo transportation however the volume is less and does not make it a commercially attractive venture however the intertwined development of the study stretches of Gurupur & Netravati river for about 10.141kms & 22.90kms with Class IV system of the NW standards shall kickstart a structured facility which will facilitate cargo movement in the region using the river waterway. So, there is a possibility of this mobility directly from NMPT / OMPT through IWT vessel traversing the Netravathi River in to the hinterland, which is the most advantageous scenario. In the most optimistic scenario, development of river Gurupur (NW-43) & Netravati river may be considered for Ro-Ro development as well as strengthening tourist and passenger services in the entire waterway region. The state govt. has to take a very proactive role to play in such kind of development through support like free land/ incentives/ regulatory framework to mandatorily transfer some type of cargo to be transported through river waterway. Also, actions by state govt. may be mooted to promote tourism in this region making this an action-packed waterway.

It is recommended to develop the entire study stretch of Gurupur river (10.0kms) intertwined with Netravathir river (22.90kms) totalling to 32.90 kms with Class IV system of the NW standards to facilitate the Ro-Ro vessel mobility.

CHAPTER 1.: INTRODUCTION

1.1 Project Background and Summary of previous study

Globally, the renewal of Inland Water Transport (IWT) is under serious consideration predominantly due to its energy efficient aspect and cheaper mode on comparison. Further overburdening of the Rail and Road network are also the dominant factors. Transport planners are now leaning towards the development of IWT system for transportation of bulk / IWT sensitive cargo.

India has about 14,500km of navigable waterways which comprise Rivers, Canals, Backwaters, Creeks, etc., out of which about 5200km of the river and 4000km of canals can be used by mechanized crafts. Yet, IWT mode remains underdeveloped / underutilized in India and its share in overall internal cargo transport remains abysmally low. IWT sector presently has a meager modal share of 0.1% in India compared to other large countries and geographic areas like the United States, China and the European Union.

Inland Waterways Authority of India (IWAI), a statutory authority under the Ministry of Shipping, came into existence on 27th October 1986 with the prime responsibility of development and regulation of inland waterways for shipping and navigation including the development and maintenance of IWT infrastructure on national waterways. It does the function of building the necessary infrastructure in these waterways, surveying the economic feasibility of new projects and also administration. The head office of the Authority is at Noida (Uttar Pradesh). The regional offices of IWAI are at Patna (Bihar), Kolkata (West Bengal), Guwahati (Assam) and Kochi (Kerala) whereas sub-offices are at Allahabad & Varanasi (Uttar Pradesh), Bhagalpur (Bihar), Farakka & Hemnagar (West Bengal), Dibrugarh (Assam), Kollam (Kerala), Vijayawada (Andhra Pradesh), Chennai (Tamilnadu) and Bhubaneshwar (Orissa).

There are now one hundred and eleven national waterways (NW) across the country which includes five existing national waterways besides 106 waterways which have recently been declared as national waterways through a central legislation i.e., through a bill passed in the Parliament in March 2016.

NW 1, the Ganga – Bhagirathi – Hooghly river system between Haldia (Sagar) & Allahabad was declared in October 1986 for a Length of 1620 km.

NW 2, the Dhubri – Sadiya stretch of Brahmaputra River was declared in September 1988 for a Length of 891 km.

NW 3, the Kottapuram – Kollam stretch of the West Coast Canal along with the Udyogmandal Canal and Champakkara Canal was declared in February 1993 for a Length of 205 km.

NW 4, the Kakinada – Puducherry stretch consisting of canals and the Kaluvelly Tank along with Bhadrachalam – Rajahmundry stretch of River Godavari and Wazirabad – Vijayawada stretch of River Krishna was declared in November 2008 for a Length of 1095 km.

NW 5, the Talcher – Dhamra stretch of the Brahmani River, the Geonkhali – Charbatia stretch of the East Coast Canal, the Charbatia – Dhamra stretch of Matai river and the Mangalgadi – Paradip stretch of the Mahanadi River Delta was declared in November 2008 for a Length of 623 km.

Regarding the 106 Newly Declared National Waterways**,** IWAI is carrying out feasibility studies / Detailed Project Report (DPR) preparation through a number of consultants. Two stage preparation of DPR for 53 Waterways have been initiated through 8 Clusters, whereas M/s Tractebel Engineering had been awarded with 2 Clusters i.e., Custer-VI (consisting of 11 waterways – 7 waterways in Karnataka & 4 waterways in Kerala) & Cluster-VII (consisting of 10 waterways – 7 waterways in Maharashtra & 3 waterways in Goa).

The Waterways considered for the study of DPR under Cluster VI are detailed herewith.

TABLE 1-1: List of Rivers/Creeks of under Cluster VI in the States of Karnataka and Kerala (Length-453.895km)

Sl. No.	Name of Rivers/ Creeks	National Water Way (NW)	Length (km)	State
1.	West Coast Canal	NW-3	169.794	Kerala
2.	Alappuzha- Changanassery Canal	NW-8	29.300	Kerala
3.	Alappuzha- Kottayam – Athirampuzha Canal	NW-9	51.700	Kerala
4.	Kottayam-Vaikom Canal	NW-59	18.800	Kerala
5.	Gurupur River	NW-43	10.041	Karnataka
6.	Kabini River	NW-51	23.171	Karnataka
7.	Kali River	NW-52	53.415	Karnataka
8.	Netravathi	NW-74	30.000	Karnataka

Sl. No.	Name of Rivers/ Creeks	National Water Way (NW)	Length (km)	State
9.	Panchagangavali (Panchagangoli) River	NW-76	23.000	Karnataka
10.	Sharavati River	NW-90	28.674	Karnataka
11.	Udayavara River	NW-105	16.000	Karnataka
	Waterways restricted to Stage I study.	**Total**	**453.895**	

Accordingly, the Stage II study for the Netravathi River (NW 74) is under consideration in the present DPR.

1.2 Brief Scope of Work and Compliance statement

The Scope of the Work for the present study is well defined in the Work allocation along with the Terms of Reference (ToR). The same is annexed herewith at Annexure 1.1.

The ultimate requirement from the study is to get a conclusion on the aspect of implementation. Whether the study stretch under consideration is amenable for implementation or not is the final derivative from the study. In order to get this conclusion, the study is subjected to the Infrastructure Requirement for development, the cost for the development with the Expenditure schedules and the viability of the project with the possible revenues and by meeting the social commitment and responsibilities.

The IWT project for development of a waterway stretch can be broadly segregated into the following aspects viz., Fairway Development; Traffic Confirmations; Terminal Development; Vessel Requirement; Financial Analysis.

1.2.1 Fairway Development

In order to ascertain the existing condition of any waterway, the Bathymetric Survey data along the full stretch at the specified intervals and specified width and the Topographical Survey at important / appropriate locations are required. Based on these site surveys, Conservancy requirements including dredging; Channel demarcation requirements can be arrived at.

1.2.2 Traffic Confirmations

The present Traffic scenarios in the hinterland and along the waterway are to be ascertained and possible volumes of divertible traffic to IWT including the type of cargo are to be assessed for planning and development. The possibility of Passenger and Tourism potential are also to be ascertained.

1.2.3 Terminal Development

Terminal development may have to be initiated with the Site confirmation linking up with various intricacies including the origin and destination of the Traffic. According to the type of cargo and quantum of cargo, the Terminal Infrastructure requirements are to be firmed up. The possibility of moulding the Terminal operation and maintenance as a separate business unit also can be looked into.

1.2.4 Vessel Requirement

Based on the type of cargo, quantum of cargo, distance to be moved etc., also keeping in view the travel time, the type of vessel and No. of vessels requirement are to be worked out. As per the existing / present industry standards, the vessel deployment and its operation and maintenance will not form part of the development except the projection of the requirements for the project, as a whole. Hence this aspect is only indicative.

1.2.5 Financial Analysis

Any project, without the mention of the Cost and economic viability will end up as incomplete. Hence, the detailed Cost analysis; Firming up of the cost for all the items indicated for development; implementation schedule and phasing of the project; operation and maintenance cost etc., are the key factors to be looked into. Working out the possible revenues will be the other key factor. Subjecting the above for a critical Financial and Economic analysis will provide clarity on the implementation of the project, as a whole.

1.3 Brief Methodology & Approach

The Terms of Reference of the subject study, the scope of work defined for the study itself are indicative about the Methodology to be adopted for the study. Further, the Approach and Methodology had already been explained in the Stage I report and at this juncture, it is prudent to mention the sequential and systematic approach to the project. Accordingly, a flow diagram has been placed at Annexure 1.2, which is self explanatory and by following the activities as specified, the project report will be in complete shape.

1.4 Project Location / Details of Study Area

Stage 1 study was completed for all the 11 National Waterways under Cluster VI and the Feasibility Study Reports of individual National Waterways have been presented to IWAI. Based on the inputs of the FSR, IWAI asked M/s Tractebel to go ahead with the Stage II study on 9 out of 11 National Waterways i.e., 5 in the state of Karnataka and 4 in the state of Kerala, as detailed.

TABLE 1-2: Waterways for Stage II study

Sl. No.	NW-No. / Name of the Waterway	Defined Limits
Cluster 6 (Karnataka)		
1.	NW-43 / GURUPUR RIVER	10.041 kms from starting point Lat 12°50' 44.093" N, Long 74° 49' 44.783" E.
2.	NW-51 / KABINI RIVER	23.171 kms from starting point Lat 11°56'0.9311" N, Long 76°14'17.5004" E.)
3.	NW-52 / KALI RIVER	53.415 kms from starting point Lat 14°50'33.5786" N, Long 74°07'19.7098" E.
4.	NW-74 / NETRAVATHI RIVER	30.00 kms from starting point Lat 12°50’44.6904" N, Long 74°49'33.3734" E.
5.	NW-90 / SHARAVATI RIVER	28.674 kms from starting point Lat 14°17’56.5621" N, Long 74°25'36.4534" E.
Cluster 6 (Kerala)		
1.	NW-3 / WEST COAST CANAL	169.794 kms from starting point Lat 10°11'38.9421" N, Long 76°12'04.152" E.
2.	NW-8 / ALAPPUZHA – CHANGANASSERY CANAL	29.3 kms from starting point Lat 9°30'03"N, 76°20'37"E.

3.	NW-9 / ALAPPUZHA-KOTTAYAM-MANIYAPARAMBU CANAL	51.7 kms from starting point Lat 9°31'1.31"N, 76°22'44.15"E.
4.	NW – 59 / VECHOOR – ATHIRAMPUZHA CANAL	18.8 kms from starting point Lat 9°40'0"N, 76°24'11"E.

The present study is combinedly about the Gurupur River – NW 43 and Netravati River – NW 74.

The Gurupur River – NW 43 (also known as Phalguni River or Kulur River) for a distance of 10.041km from the confluence of Netravathi River near Old Mangalore Port to upstream upto Panjimogaru. The detail description of the Gurupur River has been compiled in below Table.

TABLE 1-3: Description of Gurupur River (NW-43)

Sl No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Gurupur River (NW-43)
2	State/ District through which river passes	The Gurupur River passes through Dakshin Kannad Distt of Karnataka State.
3	Length of the river / canal	The length of the Gurupur main stream in the catchment from the origin to the outfall in the Arabian Sea is about 85km. Out of the total length of 85 km of river, 10.041 km length of the river from confluence of Netravathi river at Lat 12°50'44.093"N, Lon 74°49'44.783"E to Mangalore Port Bridge near Panjimogaru at Lat 12°55'34.14"N, Lon 74°49'37.20"E has been declared as new national waterway and proposed to undertake the two stage DPR.
4	Map	The index map of Gurupur River showing proposed waterway stretch, topographic features and road networks are shown in Figure1.1. The study stretch of the Gurupur River for the Detailed Project Report (DPR) is presented in **Volume-II Dwg No. P. 010256-W-20301-A02 (Sheet – 1).**
Characteristic of River		

Sl No.	Introductory Consideration	Description of the River
5	River Course	The Gurupur River (also known as Phalguni River or Kulur River) originates in the Western Ghats at an elevation of 1100m above Mean Sea Level (AMSL) and joins the Arabian Sea at Mangalore in the Karnataka state of India. Once the river formed the northern boundary of Mangalore city and Netravathi River as the southern boundary. The catchment receives an average annual rainfall of about 4000mm.
6	Tributaries / Network of Rivers / Basin	Gurupur River has a relatively small catchment area and its tributaries are small feeder streams and canals.
7	Catchment Area	The total catchment area of Gurupur River basin is 824 sqkm.

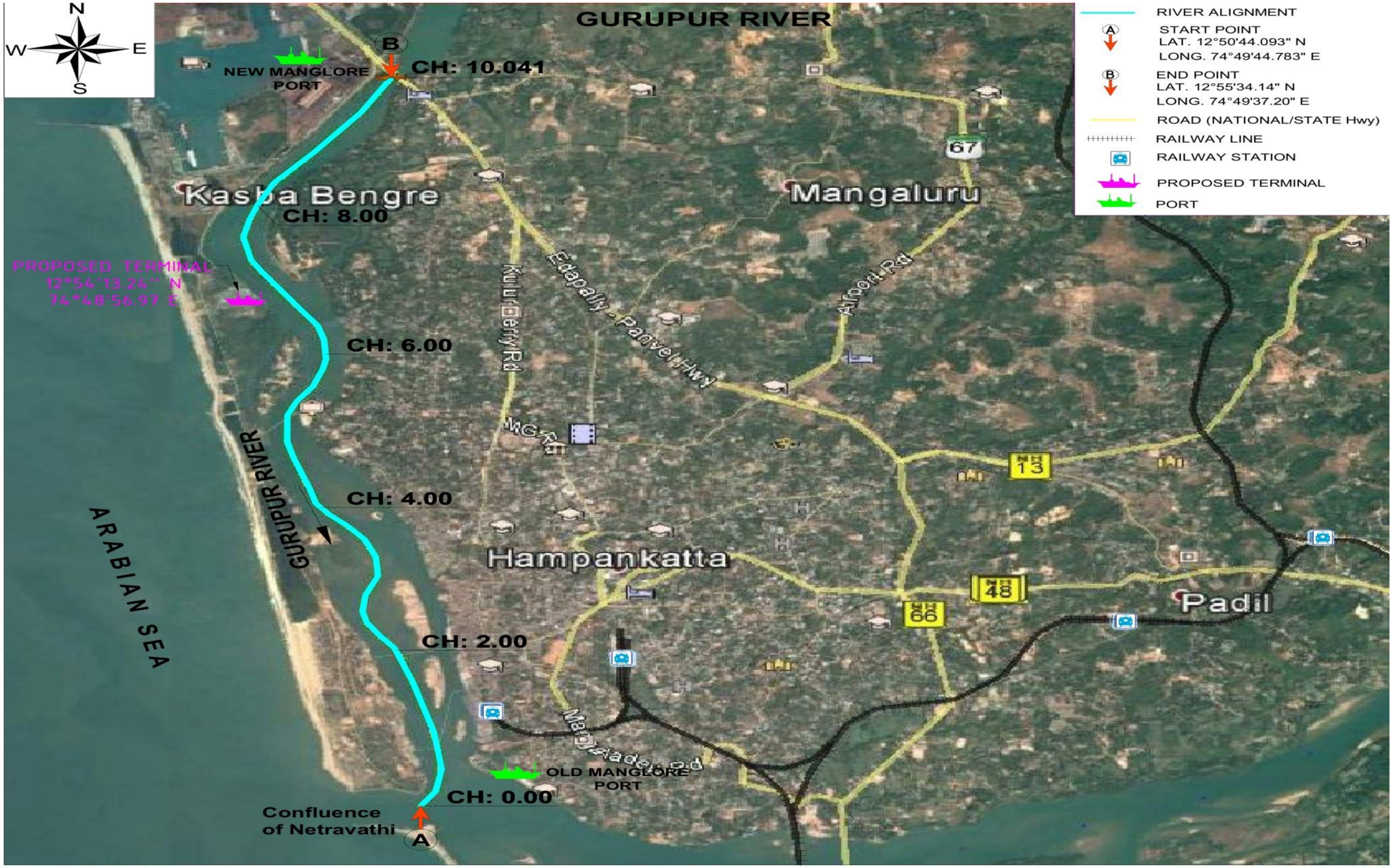


FIGURE 1.1 : INDEX MAP

The the Netravathi River – NW-74 for a distance of 30.00km from the Arabian Sea mouth at Bengre to upstream upto Bantwal. The detail description of the Netravathi River has been compiled in below Table.

TABLE 1-4: Description of Netravathi River (NW-74)

Sl No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Netravathi River (NW-74)
2	State/ District through which river passes	The Netravathi River passes through Chikamangaluru & Dakshin Kannad Distt of Karnataka State.
3	Length of the river / canal	The length of the Netravathi main stream in the catchment from the origin to the outfall in the Arabian Sea is about 103.0km. Out of the total length of 103.0 km of river, 30 km length of the river from Bantwal, Lat 12°53'53.50"N, Long 75°2'57.30"E to confluence with Arabian sea at Bengre Lat 12°50'44.6904"N, Long 74°49'33.3734"E has been declared as new national waterway and proposed to undertake the two stage DPR.
4	Map	The index map of Netravathi River showing proposed waterway stretch, topographic features and road networks are shown in Figure1.1. The study stretch of the Netravathi River for the Detailed Project Report (DPR) is presented in **Volume-II Drawing No. P. 010256-W-20301-A05.**
	Characteristic of River	
5	River Course	Netravathi River originates from Bangrabalige valley, Yelaneeru Ghat in Kudremukh in Chikkamagaluru district of Karnataka. It flows through the famous pilgrimage place Dharmasthala and is considered as one of the Holy Rivers of India. The combined stream passes over a rocky bed to Bantwal and flows for a distance of 35km in plain area and joins Arabian Sea at Mangalore old port, south of Mangalore city. The catchment receives an average annual rainfall of about 5363mm.
6	Tributaries / Network of Rivers / Basin	Netravathi River has a relatively large catchment area and its tributaries are small feeder streams and canals.
7	Catchment Area	The total catchment area of Netravathi River basin is 3657 sq. km.

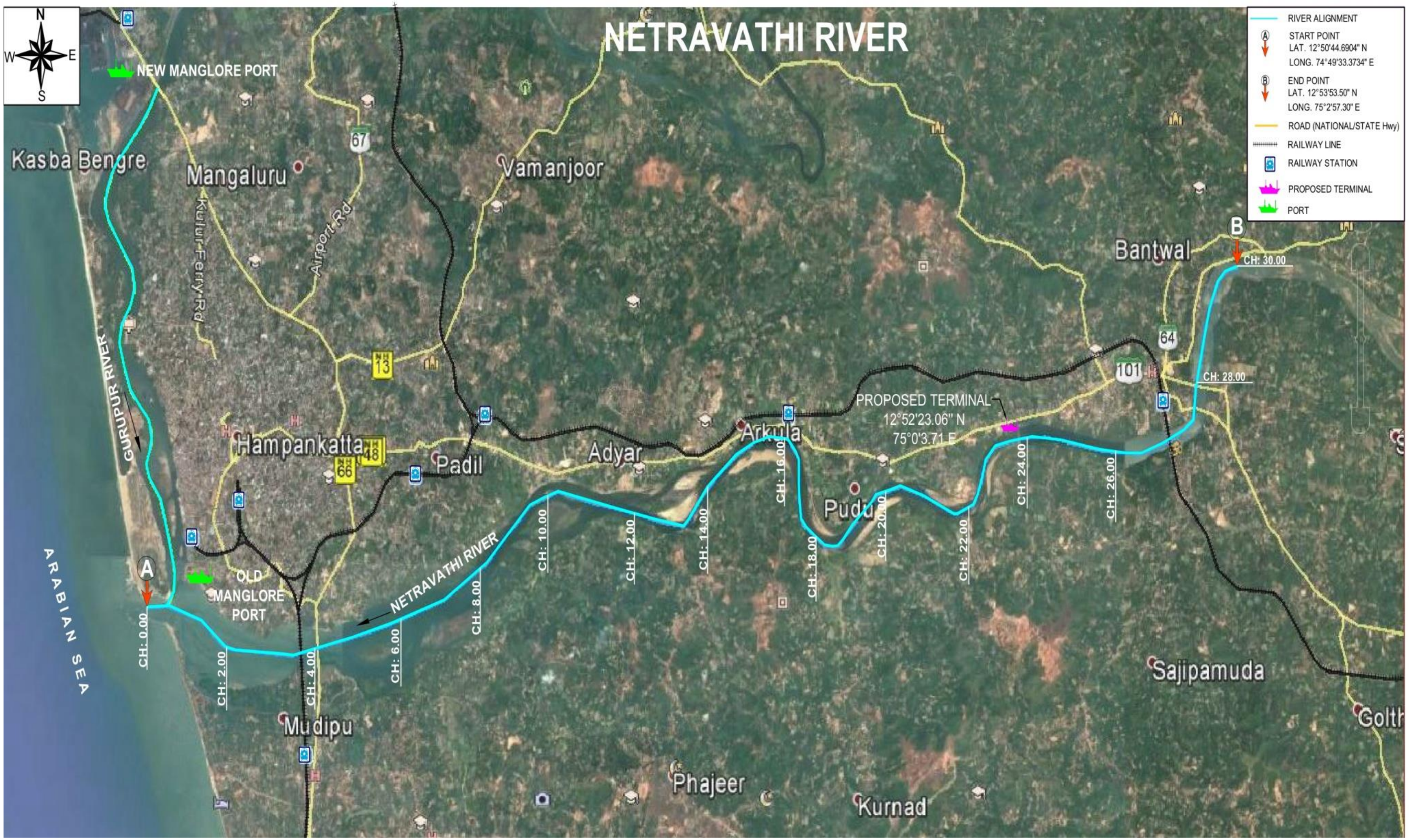


FIGURE 1.2 : INDEX MAP

CHAPTER 2.: WATERWAY / DETAILED HYDROGRAPHIC SURVEY

2.1 Hydrographic Survey

Hydrographic survey is the science of measurement of Water depths and description of features which affect maritime navigation, marine construction, dredging, offshore oil exploration / offshore oil drilling and related activities. Hydrographic survey is being carried out for one or more of the following activities like measurement of tides for sea coast works (e.g. construction of sea defense works, harbors etc.), determination of bed depth of water bodies, by soundings (for navigation, location of rocks, sand bars, navigation light).

2.1.1 Waterway in General and Hydro-morphological Characteristics

Waterway in General (Gurupur River)

The Gurupur River (also known as Phalguni River or Kulur River) originates in the Western Ghats at an elevation of 1100m above Mean Sea Level (MSL) and joins the Arabian Sea at Mangalore in the Karnataka state of India. Gurupur River is one of the main rivers of Mangalore because Mangalore is situated in the backwaters of the rivers Gurupur and Netravathi. The New Mangalore Port and Mangalore Chemicals and Fertilizers are situated on its northern banks. Once the river formed the northern boundary of Mangalore city and Netravathi River as the southern boundary. The length of the Gurupur main stream in the catchment from the origin to the outfall in the Arabian Sea is about 85km. Present study focusses on lower 10.041km end-stretch.

The Gurupur River is bounded by Padukodi, Kasba Bengre, Kodikal, Urva, Gandhinagar, Bunder and Bengre.

FIGURE 2.1: Catchment Area Map of Gurupur River (Source: Google Earth)

The total catchment area of Gurupur River basin is 824 sqkm. The catchment receives an average annual rainfall of about 4000mm. A map showing Gurupur catchment basin is shown in the above figure. The figure indicates that the river flows close to the coastal region; thus the lower stretch of river is expected to be tidal affected zone. Given the size and terrain of the river, lower reaches may have navigation potential.

Waterway in General (Netravati River)

Netravathi River originates at Bangrabalige valley, Yelaneeru Ghat in Kudremukh in Chikkamagaluru district of Karnataka, India. It flows through the famous pilgrimage place Dharmasthala and is considered as one of the Holy Rivers of India. Kumaradhara River (which originates from Kumara-Parvata near Subramanya range of Western Ghats) joins the river Netravathi at Uppinangadi village. The combined stream passes over a rocky bed to Buntwal and flows for a distance of 35km in plain area and joins Arabian Sea at Mangalore old port, south of Mangalore city. Earlier in the last century it was known as the Bantwal River. This river is the main source of water to Bantwal and Mangalore.

The Netravathi River is bounded by Bantwal, Panemangalore, Munnuru, Thumbe and Puddu in the upper stretch, Arkula, Inoli, Adyar and Kannur in the middle stretch and Pandeswara, Amblamogru, Permannur and Mudipu in the lower stretch. The present study focusses on 30 km.

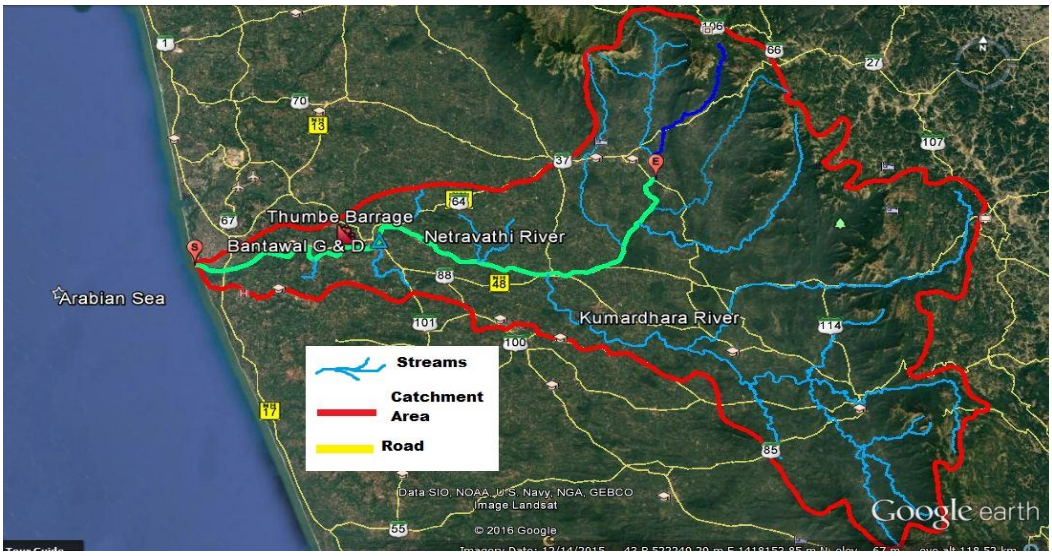


FIGURE 2.2: Catchment Area Map of Netravathi River (Source: Google Earth)

The total catchment area of Netravathi River basin is 3657 sq-km (Ref. HP Hydrology Project, MoWR & CWC; http://hydrology-project.gov.in/Surface%20Water.html). The catchment area has been verified from Google Earth and has been found to be in order. The catchment receives an average annual rainfall of about 5363mm. The total length of the river from origin to its outfall in the Arabian Sea is 103.0km. A map showing Netravathi catchment basin is shown in the above figure. Beltangadi, Neriya Hole, Haridravathi, Hurlihole, Nandihole, Hilkunj, Mavinahole, Yenne Hole and Nagodi Hole are the tributaries of Netravathi River. Yettina Hole and Kumardhara are major tributaries of Netravathi River. The lower stretch of the river is expected to be tidal affected zone.

Hydro-morphological Characteristics

The combined study of hydrology and morphology gives a clear picture of hydromorphological characteristics of any water body.

Hydro morphology of the study area

Karnataka experiences lowest temperature during the month of January and then the temperature gradually increases. The temperature begins to soar rapidly during the month of March. The southern parts of the state generally experience the highest temperature during the month of April while in the coastal plains the temperature reaches its maximum during the month of May. Post monsoon, during the months of October and November the temperature decreases in the state and comes down further during the month of December. The average high temperature during summer is 34 degrees Celsius across the state. The average day temperature is 29 degrees Celsius in the monsoon season. During winter temperatures range from 32 degrees Celsius to below 20 degrees Celsius.

Monsoon season starts from June and lasts till September, as prominent downfalls in temperature are noted but at this time the percentage of humidity gets a little higher in atmosphere. The average annual rainfall in Coastal Karnataka is about 3456 mm, which is much more than the rainfall received in the other parts of the state. North Interior Karnataka receives the least amount of rainfall in the state and the average annual rainfall is just 731 mm. This zone experiences semi-arid type of climate. South Interior Karnataka receives an annual average of 1286 mm rainfall.

Eleven groups of soil orders are found in Karnataka viz. Entisols, Inceptisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, Aridisols, Vertisols, Andisols and Histosols. The common types of soil groups found in Karnataka are:

i. Red soils: Red gravelly loam soil, Red loam soil, Red gravelly clay soil, Red clay soil

ii. Lateritic soils: Lateritic gravelly soil, Lateritic soil

iii. Black soils: Deep black soil, Medium deep black soil, Shallow black soil

iv. Alluvio-Colluvial Soils : Non-saline, saline and sodic

v. Forest soils: Brown forest soil

vi. Coastal soils: Coastal laterite soil, Coastal alluvial soil.

The soil texture of the river bed has been observed during the reconnaissance survey. It has it is observed that red loamy soil is found in the most parts of the river under study stretch with coastal alluvial soil in the initial stretch of the waterway. Exposed rock is observed on the banks in the upper stretches.

Formation of braiding pattern is popularly attributed to heavy sediment load in a river having a wide and shallow cross section. Rise in river bed levels, rise in flood levels, accumulation of silt rendering channels shallow, bank erosion as a result of development of multiple channels and sudden change in flow direction are some of the conditions associated with braided rivers. However, from the survey it was seen that there is no braiding in this river course.

Any part of river falls under rapid zone, i.e. having relatively steep gradient in the river bed may cause increase in velocity and turbulence. Thus rapid zone characterization is important as it indicates whether navigation will be safe or not. The slopes of this river indicate that the study stretch does not fall under rapid zone.

Geomorphology

According to the classification of the waterway from class I to class VII, the minimum width required and minimum depth required has been given as 100 m and 2.75 m for two way navigation. Though the river was classified as class II for the entire stretch at the FSR stage, the present analysis has been relooked with the possibilities for 100 m width and 2.75 m depth.

Gurupur River (Ch 0.00 km - Ch 5.00 km)

The satellite image for the stretch of first 5 km for four time periods have been placed (December, 2006; November, 2010; January, 2013 and December, 2016).

FIGURE 2.3: River stretch from Ch 0.00km to 5.00km in December, 2006 (Source: Google Earth)

FIGURE 2.4: River stretch from Ch 0.00km to 5.00km in November, 2010 (Source: Google Earth)

FIGURE 2.5: River stretch from Ch 0.00km to 5.00km in January, 2013 (Source: Google Earth)

FIGURE 2.6: River stretch from Ch 0.00km to 5.00km in December, 2016 (Source: Google Earth)

From the above figures, it is observed that there are three shoals between Ch 1.00 km to Ch 4.00km. These settlements of soils show negligible movement over the time period.

In 2013, minor effect of accretion can be seen throughout the stretch. However the water depth appears to be sufficient in other time periods.

Gurupur River (Ch 5.00 km - Ch 10.041 km)

The satellite image for the stretch of last 5.41 km for four time periods have been placed (December, 2006; November, 2010; January, 2013 and December, 2016).

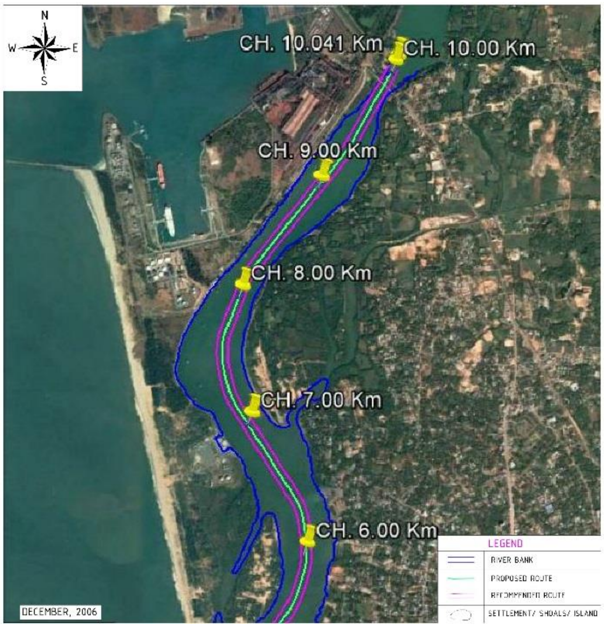


FIGURE 2.7: River stretch from Ch 6.00km to 10.041km in December, 2006 (Source: Google Earth)

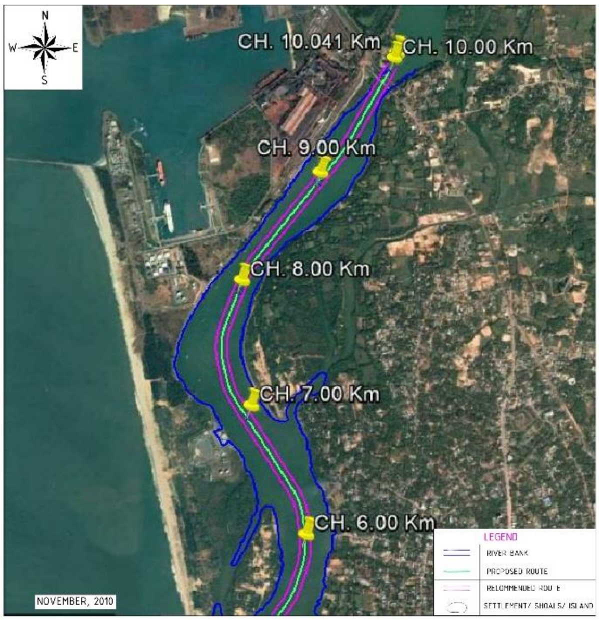


FIGURE 2.8: River stretch from Ch 6.00km to 10.041km in November, 2010 (Source: Google Earth)

FIGURE 2.9: River stretch from Ch 6.00km to 10.041km in January, 2013 (Source: Google Earth)

FIGURE 2.10: River stretch from Ch 6.00km to 10.041km in December, 2016 (Source: Google Earth)

From the above figures, it is observed that a tributary joins the river at the left bank near Ch 7.00 km. It is also noted that two adjacent road bridges are present near Ch 10.00 km. There are no shoals in this stretch and no other significant variation is observed.

Netravathi River (Ch 0.00 km - Ch 10.00 km)

The satellite image for the stretch of first 10 km km for four time periods have been placed (December, 2006; November, 2010; January, 2013 and December, 2016).

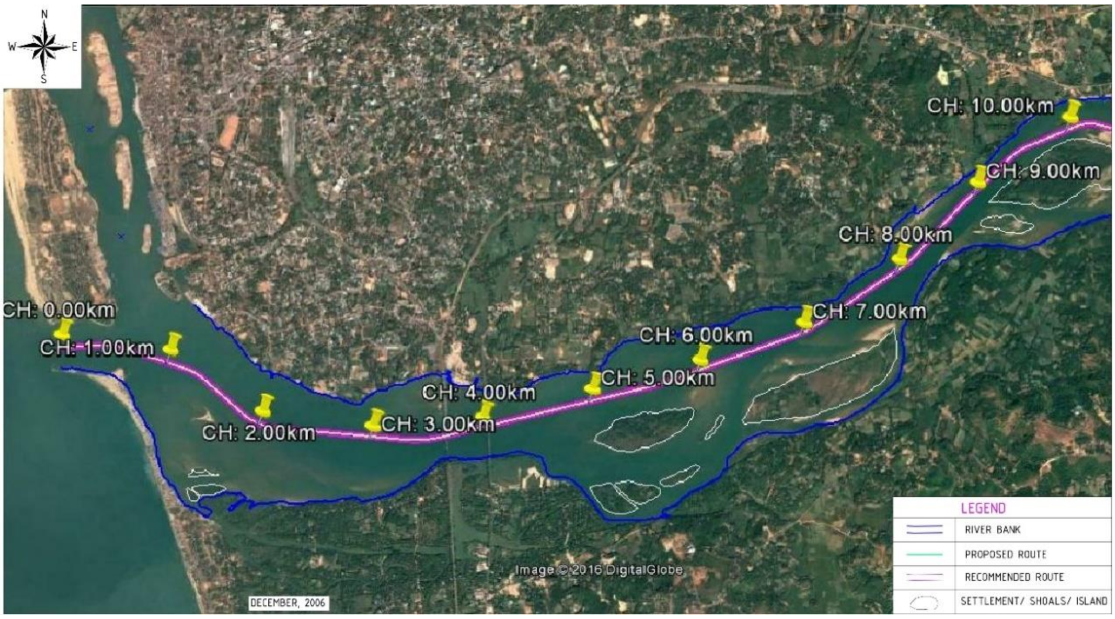


FIGURE 2.11: River stretch from Ch 0.00km to 10.00km in December, 2006 (Source: Google Earth)

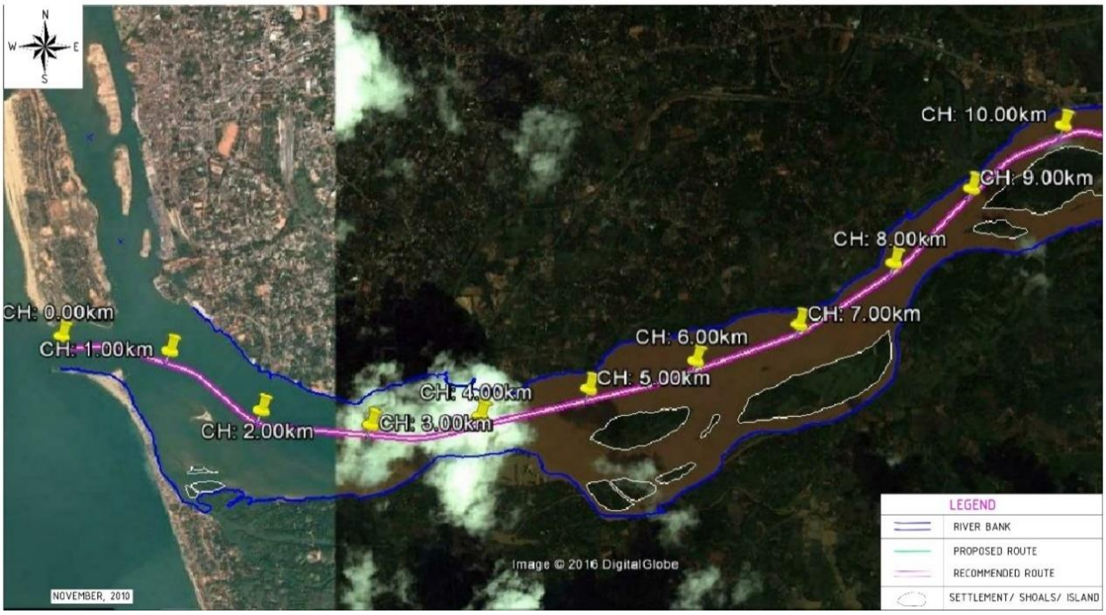


FIGURE 2.12: River stretch from Ch 0.00km to 10.00km in November, 2010 (Source: Google Earth)

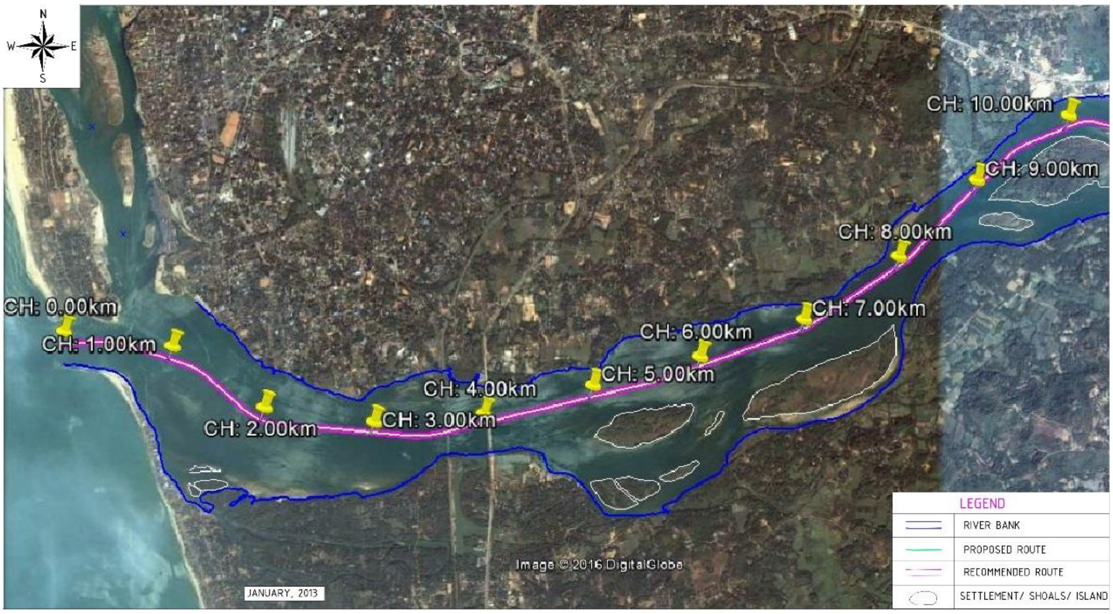


FIGURE 2.13: River stretch from Ch 0.00km to 10.00km in January, 2013 (Source: Google Earth)

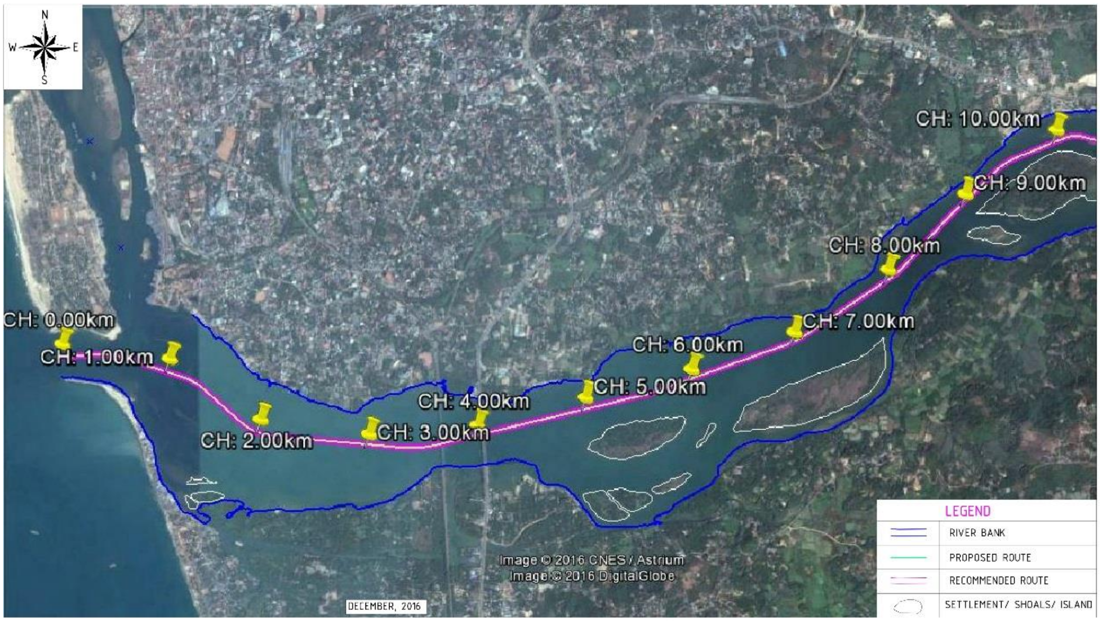


FIGURE 2.14: River stretch from Ch 0.00km to 10.00km in December, 2016 (Source: Google Earth)

There are two big shoals and few smaller shoals between Ch 5.00 km and Ch 7.00 km. One big shoal and one small shoal are present between Ch 9.00 and Ch 11.00 km. The settlements of soil do not show any migration in the above mentioned time period.

From all the figures, it can be seen that there is minor effect of accretion throughout the stretch in December, 2006. Prominent effect of accretion is observed in January, 2013 mainly upto Ch 7.00 km from the mouth of the river. Sediment deposition can be clearly seen near the settlements.

In all the figures a rail and road bridge is located near Ch 4.00 km.

Netravathi River (Ch 11.00 km - Ch 20.00 km)

The satellite image for the stretch of last 10 km for four time periods have been placed (December, 2006; November, 2010; January, 2013 and December, 2016).

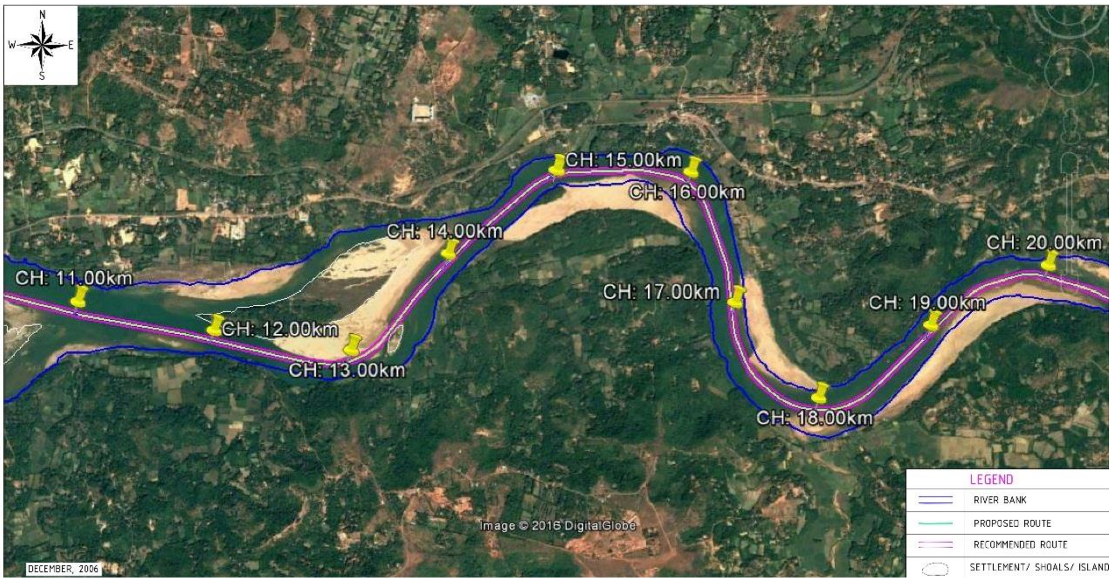


FIGURE 2.15: River stretch from Ch 11.00km to 20.00km in December, 2006 (Source: Google Earth)

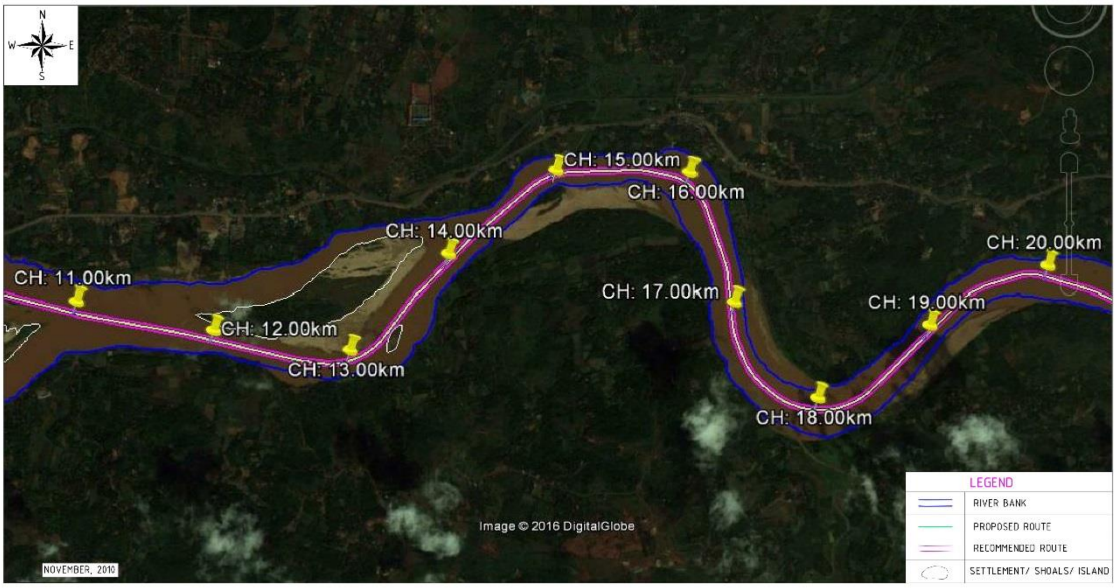


FIGURE 2.16: River stretch from Ch 11.00km to 20.00km in November, 2010 (Source: Google Earth)

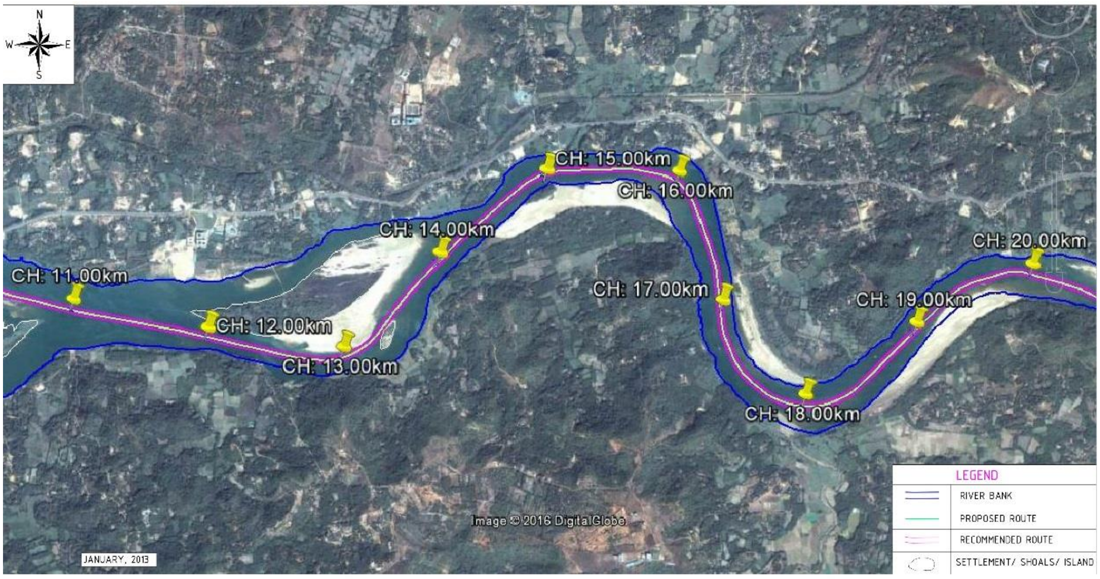


FIGURE 2.17: River stretch from Ch 11.00km to 20.00km in January, 2013 (Source: Google Earth)

FIGURE 2.18: River stretch from Ch 11.00km to 20.00km in December, 2016 (Source: Google Earth)

This part of the stretch clearly shows that the river experiences heavy sediment deposition on the sides of the banks. There are two bends from Ch 14.00 km to Ch 20.00 km which significantly suffers siltation, thus narrowing the river width.

There is one shoal present near Ch 12.00 km whose relative position remains same throughout the above-mentioned time period. The settlement of soil also shows sediment deposition on one of its sides towards the left bank.

Netravathi River (Ch 21.00 km - Ch 30.00 km)

The satellite image for the stretch of last 10 km for four time periods have been placed (December, 2006; November, 2010; January, 2013 and December, 2016).

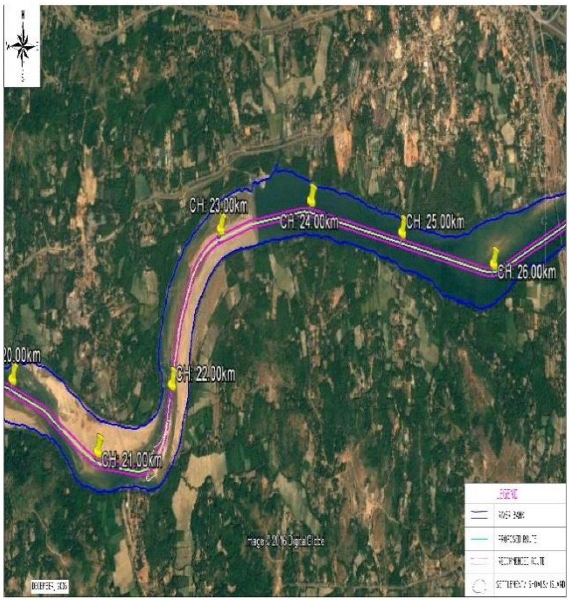


FIGURE 2.19: River stretch from Ch 21.00km to 25.00 km in December, 2006 (Source: Google Earth)

FIGURE 2.20: River stretch from Ch 21.00km to 25.00 km in November, 2010 (Source: Google Earth)

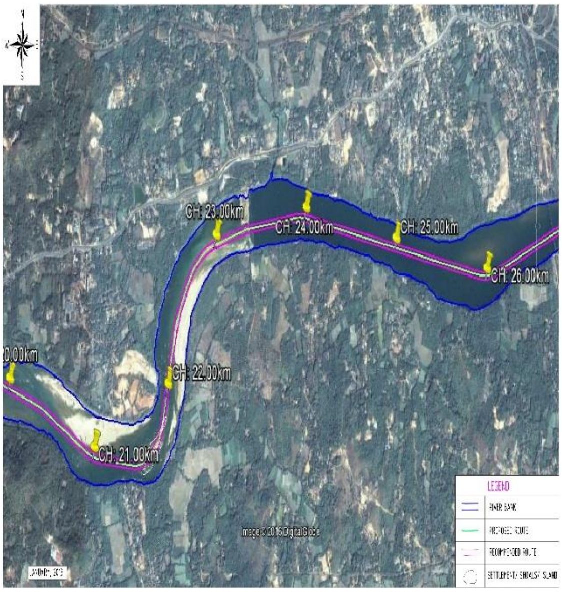


FIGURE 2.21: River stretch from Ch 21.00km to 25.00 km in January, 2013 (Source: Google Earth)

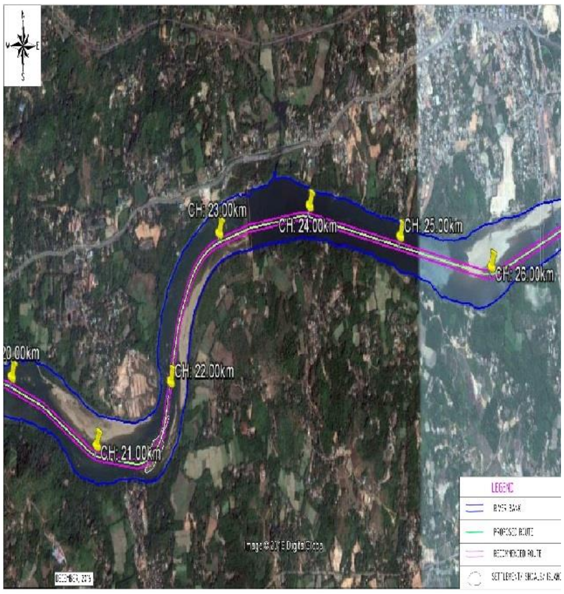


FIGURE 2.22: River stretch from Ch 21.00km to 25.00 km in December, 2016 (Source: Google Earth)

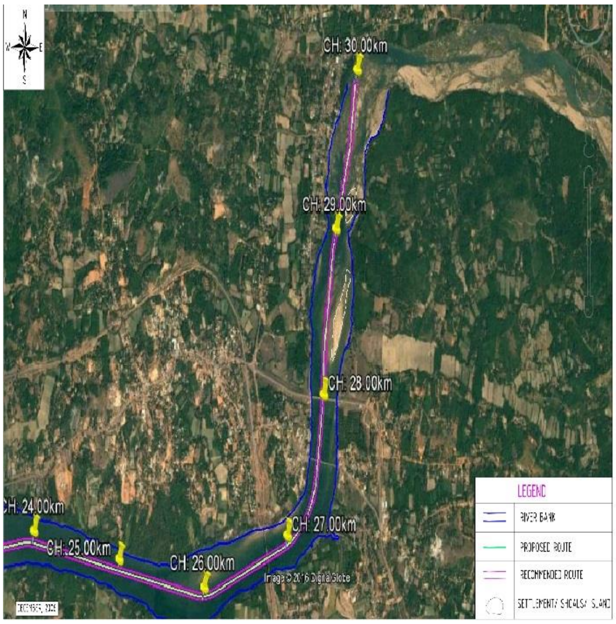


FIGURE 2.23: River stretch from Ch 26.00km to 30.00 km in December, 2006 (Source: Google Earth)

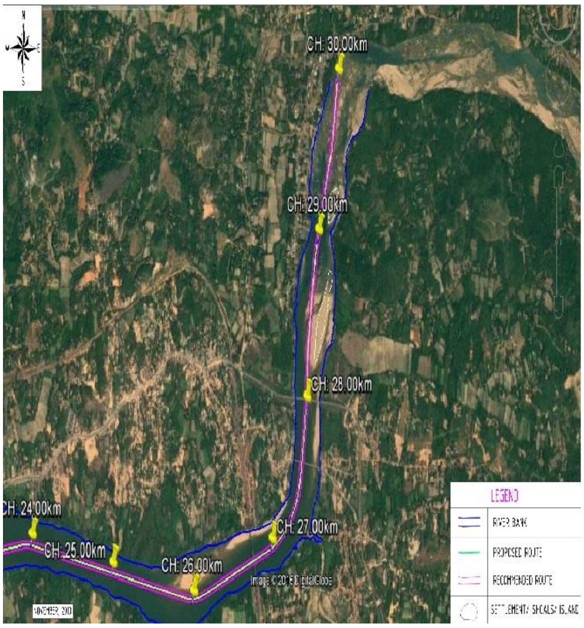


FIGURE 2.24: River stretch from Ch 26.00km to 30.00 km in November, 2010 (Source: Google Earth)

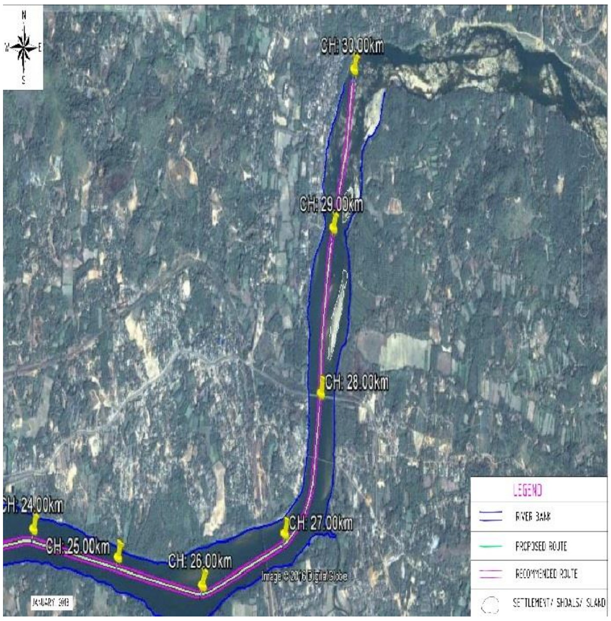


FIGURE 2.25: River stretch from Ch 26.00km to 30.00 km in January, 2013 (Source: Google Earth)

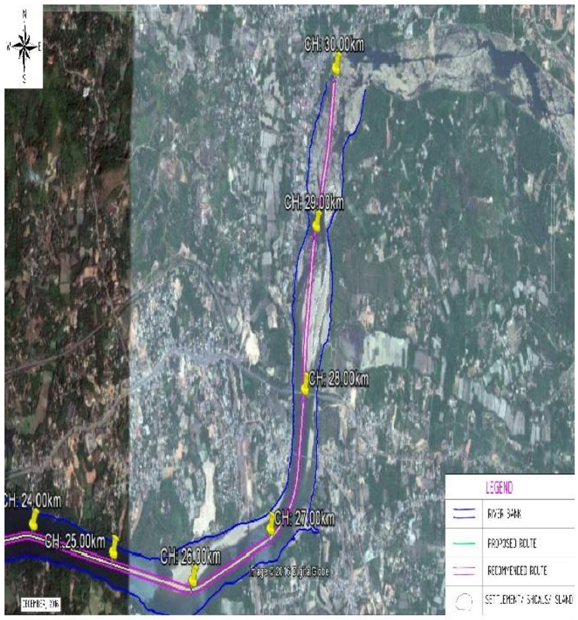


FIGURE 2.26: River stretch from Ch 26.00km to 30.00 km in December, 2016 (Source: Google Earth)

Comparing all the figures it is observed that the river stretch is covered with sand deposition upto the Thumbe barrage which is present between Ch 23.00 km and Ch 24.00 km in 2006. But, the depth seems to increase a bit after 2010 and therefore the effect of accretion can be mainly seen on the banks between January, 2013 and December, 2016. However, dredging may be required for maintaining sufficient depth for navigation.

In December, 2016, stones or small rocky patches are observed to be scattered near the bend between Ch 21.00 km and Ch 22.00 km as well as between Ch 28.00 km and Ch 30.00 km. Minor effect of accretion is observed after Ch 26.00 km in December, 2006. Prominent effect of accretion can be seen in November, 2010 and December, 2016.

From all the figures, it is noted that a railway bridge is present between Ch 26.00 km and Ch 27.00 km. Also, two road bridges are present between Ch 27.00 km and Ch 28.00 km.

2.1.2 Existing Hydrological / Topographical Reference levels

The value of Bench mark situated in the verandah of custom office near Old Mangalore Port office was provided Old Mangalore Port Authority. The GTS BM cut is on the floor of verandah near the door of custom office. The value of the Bench mark is 3.444 meters above the Chart Datum and 2.514 m above MSL.

TABLE 2-1: Accepted Station coordinates (WGS-84)

Bench Mark	Chainage (Km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	BM Height above MSL (m)	BM Height above CD/SD (m)
*NR-1/ *GR-1	0.65/ 0.93	12°50'57.7462"	74°50'02.0829"	481978.36	1420484.46	1.958	2.888
GR-2	10.26	12°55'33.99"	74°49'34.01"	481137.97	1428970.79	3.516	4.331
NR-2	9.65	12°51'48.7697"	74°54'12.3181"	489521.22	1422047.96	4.001	4.807
NR-3	20.73	12°51'45.261"	74°59'28.4825"	499050.09	1421938.23	2.551	3.076
NR-4	27.91	12°52'57.925"	75°02'23.7693"	504332.73	1424170.65	10.586	6.636

*GR-1 & NR-1 Bench on same location near confluence of Gurupur & Netravathi River

2.1.3 Chart Datum / Sounding Datum

The water depths have been determined as a result of short period observations at both an established gauge (where the chart datum is known) and new gauge (where the chart 2 datum has been established) in the area. The four consecutive low waters and the three intervening high waters have been recorded during spring tide, when the range of differences between high and low waters was the greatest. The locations with coordinates of established gauge and new gauge that have been used to reduce the soundings along the surveyed stretch are tabulated below.

TABLE 2-2: Transfer of sounding datum

Transfer of Sounding datum									
Established Gauge (Old Mangalore Port) Observation Date: 01.05.2018 to 03.05.2018					New Gauge (NTP-1/GTP-1) Position : 074°50'01.9599" E, 12°50'57.6312" N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.883	1	-	0.883	-----	0.883	1	-	0.883
1.652	-----	1	1.652	-	1.652	-----	1	1.652	-
-----	0.28	3	-	0.84	-----	0.28	3	-	0.84
1.78	-----	2	3.56	-	1.78	-----	2	3.56	-
-----	0.904	3	-	2.712	-----	0.904	3	-	2.712
1.599	-----	1	1.599	-	1.599	-----	1	1.599	-
-----	0.338	1	-	0.338	-----	0.338	1	-	0.34
Sum			6.811	4.773	Sum			6.811	4.773
Mean			1.70	0.60	Mean			1.70	0.60
Range			R	1.11	Range			r	1.11
Observed mean tide			M'	1.15	Observed mean tide			m'	1.15
				d	0.000				
Value of Chart Datum					0.000	Above zero of tide pole			

Transfer of Sounding datum									
Established Gauge (Old Mangalore Port) Observation Date: 01.05.2018 to 03.05.2018					New Gauge (GTP-2) Position : 74°49'33.81" E, 12°55'32.21" N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.883	1	-	0.883	-----	1.34	1	-	1.34
1.652	-----	1	1.652	-	2.164	-----	1	2.164	-
-----	0.28	3	-	0.84	-----	0.771	3	-	2.313
1.78	-----	2	3.56	-	2.297	-----	2	4.594	-
-----	0.904	3	-	2.712	-----	1.375	3	-	4.125
1.599	-----	1	1.599	-	2.138	-----	1	2.138	-
-----	0.338	1	-	0.338	-----	0.803	1	-	0.80
Sum			6.811	4.773	Sum			8.896	8.581
Mean			1.70	0.60	Mean			2.22	1.07
Range			R	1.11	Range			r	1.15
Observed mean tide			M'	1.15	Observed mean tide			m'	1.65
				d	0.452				
Value of Chart Datum					0.452	above zero of tide pole			

Transfer of Sounding datum									
Established Gauge (Old Mangalore Port) Observation Date: 01.05.2018 to 03.05.2018					New Gauge (NTP-2) Position : 074°54'12.4117" E, 12°51'45.1901" N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.883	1	-	0.883	-----	1.657	1	-	1.657
1.652	-----	1	1.652	-	2.892	-----	1	2.892	-
-----	0.28	3	-	0.84	-----	0.704	3	-	2.112
1.78	-----	2	3.56	-	3.145	-----	2	6.29	-
-----	0.904	3	-	2.712	-----	1.71	3	-	5.13
1.599	-----	1	1.599	-	2.847	-----	1	2.847	-
-----	0.338	1	-	0.338	-----	0.817	1	-	0.82
Sum			6.811	4.773	Sum			12.029	9.716
Mean			1.70	0.60	Mean			3.01	1.21
Range			R	1.11	Range			r	1.79
Observed mean tide			M'	1.15	Observed mean tide			m'	2.11
				d	0.248				
Value of Chart Datum					0.248	Above zero of tide pole			

Transfer of Sounding datum									
Established Gauge (Old Mangalore Port) Observation Date: 01.05.2018 to 03.05.2018					New Gauge (NTP-3) Position : 074°59'33.6627"E, 12°51'35.0275" N				
Heights above chart datum					Heights above the zero of tide pole				
High Water	Low Water	Factor	HW	LW	High Water	Low Water	Factor	HW	LW
-----	0.883	1	-	0.883	-----	0.747	1	-	0.747
1.652	-----	1	1.652	-	1.606	-----	1	1.606	-
-----	0.28	3	-	0.84	-----	0.259	3	-	0.777
1.78	-----	2	3.56	-	1.758	-----	2	3.516	-
-----	0.904	3	-	2.712	-----	0.755	3	-	2.265
1.599	-----	1	1.599	-	1.553	-----	1	1.553	-
-----	0.338	1	-	0.338	-----	0.246	1	-	0.25
Sum			6.811	4.773	Sum			6.675	4.035
Mean			1.70	0.60	Mean			1.67	0.50
Range			R	1.11	Range			r	1.16
Observed mean tide			M'	1.15	Observed mean tide			m'	1.09
				d	-0.124				
Value of Chart Datum					-0.124	below zero of tide pole			

2.2 Existing Waterway Structures

2.2.1 Bridges

There are no bridges present in the entire survey stretch of Gurupur River. However, at the end of the stretch (Beyond), 2 Bridges are located, as detailed.

Sl No	Structure Name	Chainage (km)	Type of structure	Location	Position (Lat Long)	Position (UTM)	Length (m)	Width (m)	No of Piers	Horizontal Clearance	Vertical clearance	Remarks
06	Road Bridges	10.33	RCC	Kullor	12°55'34.44"N 74°49'37.84"E	481253.38E 1428984.49N	200.0	7.0	06	30.0	5.5	Gurupur waterways
07	Road Bridges	10.38	RCC	Kullor	12°55'35.87"N 74°49'38.78"E	481281.80E 1429028.37N	195.00	7.0	06	30.0	4.0	Gurupur waterways

There are five bridges present in the entire survey stretch of Netravathi River, keeping in view of the vertical clearance available at these existing bridges, the deployment of the vessel to this stretch to be considered in a way that these vessels are amenable to this waterway, therefore, there are no modification cost considered for the modification of the existing structures.

Sl No	**Structure Name**	**Chainage (km)**	**Type of structure**	**Location**	**Position (Lat Long)**	**Position (UTM)**	**Length (m)**	**Width (m)**	**No of Piers**	**Horizontal Clearance**	**Vertical clearance**
01	Railway Bridge	3.478	RCC	Ullal	12°50'34.8129"N 074°51'22.4874"E	484401.419E 1419778.534N	675.4	20.0 m	15	45.0	6.147
02	Bridge	3.861	RCC	Guruvana	12°50'31.3475"N 074°51'35.6700"E	484798.704E 1419671.864N	576.9 7	22.0 m	18	32.0	5.884
03	Railway bridge	26.33	RCC	Bantwala	12°52'23.8133"N 075°02'05.9572"E	503796.074E 1423122.722N	360.5 5	10.0 m	8	45.0	5.984
04	Bridge	27.25	RCC	Panemang alore	12°52'36.8722"N 075°02'23.3982"E	504321.646E 1423523.944N	350.6 1	8.0m	10	35.0	6.725
05	Bridge	27.61	RCC	Panemang alore	12°52'48.6909"N 075°02'23.9977"E	504339.657E 1423886.995N	280.6 9	10.0 m	08	35.0	6.145

2.2.2 Electric Lines / Communication Lines

There are no high-tension lines present in the entire survey stretch of Gurupur River.

There are three high tension lines present in the entire survey stretch of Netravathi River. The vertical clearance required for power cables or telephone lines is 19 m. The support base of these HT line will have to be raised by 9.0 m to get the required clearance.

Sl No	Structure Name	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	Horizontal Clerence	Vertical clerance
01	HT LINE	8.16	Near Bajala area	12°51'07.2285"N 074°53'40.4190"E	488559.29E 1420772.27N	450.00 mtr	10.00 mtr
02	HT LINE	22.97	Near Manglore Masoor highway- NH-48	12°52'20.0321"N 075°00'17.9830"E	500541.97E 1423006.32N	330.00 mtr	10.00 mtr
03	HT LINE	23.7	Munnuru Area	12°52'20.8097"N 075°00'41.7259"E	501257.53E 1423030.23N	268.00 mtr	10.00 mtr

Sl No	Structure Name	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	Horizontal Clerence	Vertical clerance
01	HT LINE	8.16	Near Bajala area	12°51'07.2285"N 074°53'40.4190"E	488559.29E 1420772.27N	450.00 mtr	10.00 mtr
02	HT LINE	22.97	Near ManglоreMasoor highway- NH-48	12°52'20.0321"N 075°00'17.9830"E	500541.97E 1423006.32N	330.00 mtr	10.00 mtr
03	HT LINE	23.7	Munnuru Area	12°52'20.8097"N 075°00'41.7259"E	501257.53E 1423030.23N	268.00 mtr	10.00 mtr

2.2.3 Pipe Lines / Cables

No Pipe lines, under water cable present in the entire survey stretch of Gurupur River & Netravathi River.

2.2.4 Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts

No Dams, weirs, anicut, Locks etc. are present in Gurupur River & Netravathi River in the entire survey stretch. However, Thumbe Barrage is located at Ch 22.9KM.

TABLE 2-3: Barrage details

Sl No	Structure Name	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	Dam Deck level	Remarks
				Left Bank	Right Bank	Left Bank	Right Bank				
	Thumbe Vented Dam	22.9 km	Thumbe	12°52' 25.4003"N 075°00' 15.2490"E	12°52' 14.3262"N 075°00' 17.1743"E	500459.572 E 1423171.218 N	500517.602E 1422831.045N	343.50m	---	12.00m	Netravathi waterways

2.1 Bends

The Bends observed on Gurupur River are tabulated and provisioned herewith. The river bend radius in the entire stretch is sufficient for Class IV vessel.

TABLE 2-4: River Bend Radius in Gurupur River

Sr. No.	Chainage (Km)	Radius
1	1.16	655.00
2	3.26	855.00
3	5.37	930.00
4	6.26	750.00
5	7.95	1160.00

The Bends observed on Netravathi River are tabulated and provisioned herewith. The river bend radius in between Ch 27.00km to Ch 29.00km may need smoothening.

TABLE 2-5: River Bend Radius in Netravati River

Sr. No.	Chainage (Km)	Radius
1	8.50	800
2	9.60	1350
3	13.00	900
4	15.50	890
5	17.80	600
6.	19.70	1020
7.	21.80	490
8.	23.25	1025
9.	26.00	900
10.	27.50	450

2.3 Velocity and Discharge Details

The period of survey is February, which is a normal flow condition. As per the statistics collected, the maximum velocity is 3.5 m/s.

The waterway stretch from Ch 0.00km to 22.9km comes under tidal, so no discharge has been calculated. From Ch 22.9km to Ch 30.00km the water flow is being regulated by Thumbe barrage. Hence discharge calculation is not relevant.

Sample No.	Chainage (km)	Latitude Longitude	Easting (m) Northing (m)	Observed Depth (m)	Velocity (m/sec)	Discharge (cum/sec)	Remarks
1	0.5	12°50'57.0343"N 074°49'52.7586"E	481697.303 1420462.774	3.0	2	Discharge is total depended on high water and low water. In non-tidal area it is controlled by Thumbe vented Dam Authority	Gurupur
2	10.22	12°55'31.86"N 74°49'34.84"E	481162.85 1428905.30	4.6	2		Gurupur
3	9.77	12°51'23.9798"N 074°54'35.0734"E	490206.776 1421286.21	1.1	0.3		Netravathi
4	20.23	12°51'41.5645"N 074°59'11.7046"E	498544.415 1421824.7	2.5	0.3		Netravathi
5	29.05	12°53'33.2346"N 075°02'35.2313"E	504677.974 1425255.349	2.5	0.0		Netravathi

2.4 Waterway description

2.4.1 Gurupur River (Ch 0.0km to Ch 10.041km)

Gurupur River (Ch 0.00km – Ch 5.00km)

FIGURE 2.27: Gurupur River from Ch 0.00km to Ch 3.00km

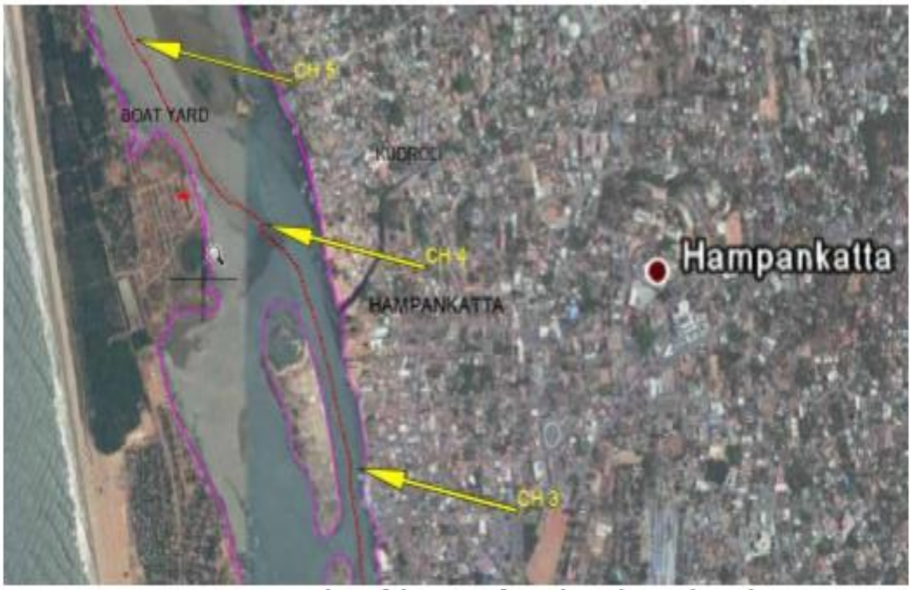


FIGURE 2.28: Gurupur River from Ch 3.00km to Ch 5.00km

TABLE 2-6 : Reduced depth from Ch 0.00km to Ch 5.00km

Chainage (km)		**Reduced depth with respect to Sounding Datum**				
		Reduced Depth (m)		**Length of Shoals (m)**	**Dredging Qty (Cu.M)**	**Cumulative Qty. (Cu.M)**
From	**To**	**Min**	**Max**			
0	1	2.0	8.5	0	0.00	0.00
1	2	-0.4	4.1	400	35002.27	35002.27
2	3	-0.6	0.9	1000	112814.40	147816.67
3	4	-0.6	2.3	800	117865.88	265682.55
4	5	-0.7	2.7	500	40984.51	306667.06

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). The starting stretch of the Gurupur River is close to the Mangalore Port. From Ch 1.00km to Ch 5.00km on the left bank of the river there are some small Jetties and on the right bank of the river there are 2 Jetties. On left side there is Mangalore Fishing Dock at Bunder. Big shoals can be seen close to the mouth of the river. Some local boat yard can be seen close.

Gurupur River (Ch 5.00km – Ch 10.041km)

FIGURE 2.29: Gurupur River from Ch 5.00km to Ch 7.00km

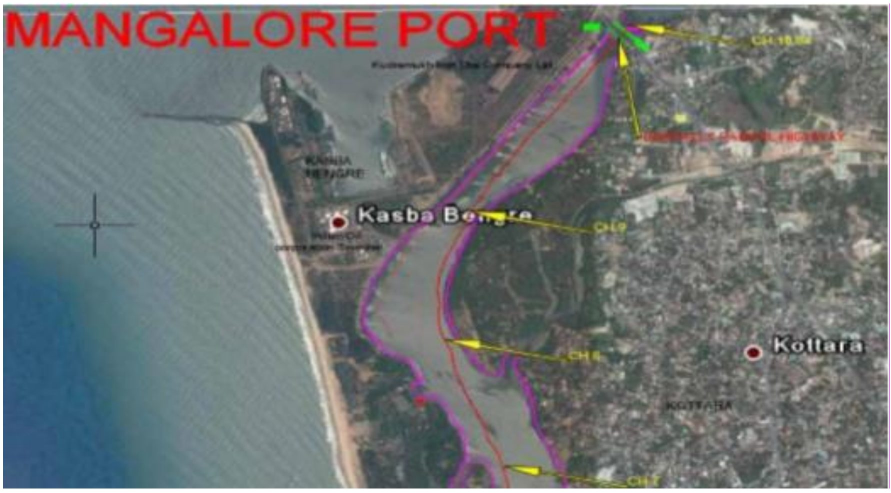


FIGURE 2.30: Gurupur River from Ch 7.00km to Ch 10.041km

TABLE 2-7 : Reduced depth from Ch 5.00km to Ch 10.041km

Chainage (km)		Reduced w. r. to Sounding Datum				
		Reduced Depth (m)		Length of Shoals (m)	Dredging Qty (Cu.M)	Cumulative Qty. (Cu.M)
From	To	Min	Max			
5	6	2.1	3.4	0	0	0
6	7	1.5	3.0	50	149.49	149.49
7	8	0.3	2.6	600	45378.68	45528.17
8	9	0.6	2.7	500	39300.43	84828.60
9	10	1.7	3.6	100	286.43	85115.03
10	10.4	1.9	5.0	50	3.58	85118.61

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). At Ch 5.00km the river turns left to the north. Due to closeness to the sea, there remains the tidal effect and change in the level of water depth at different places. Some important village like Gandhinagar, Kollara village, Kasba Bengre are there. Close to Ch 6.00km to Ch 7.05km an island can be seen. At the end of the chainage or survey stretch or close to Mangalore Port, Indian Oil Corporation

Terminal may be seen and on the left side Coastal Area/Residential area is seen. Mumbai-Kochi Highway bridges with vertical clearance of 7m is present at the end of survey stretch.

2.4.2 Netravathi River (Ch 0.00km – Ch 10.00km)

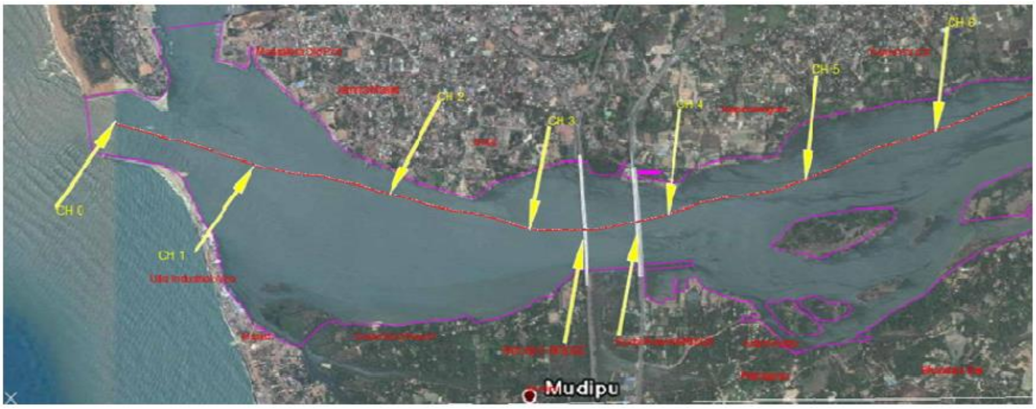


FIGURE 2.31: Netravathi River from Ch 0.00km to Ch 5.001km

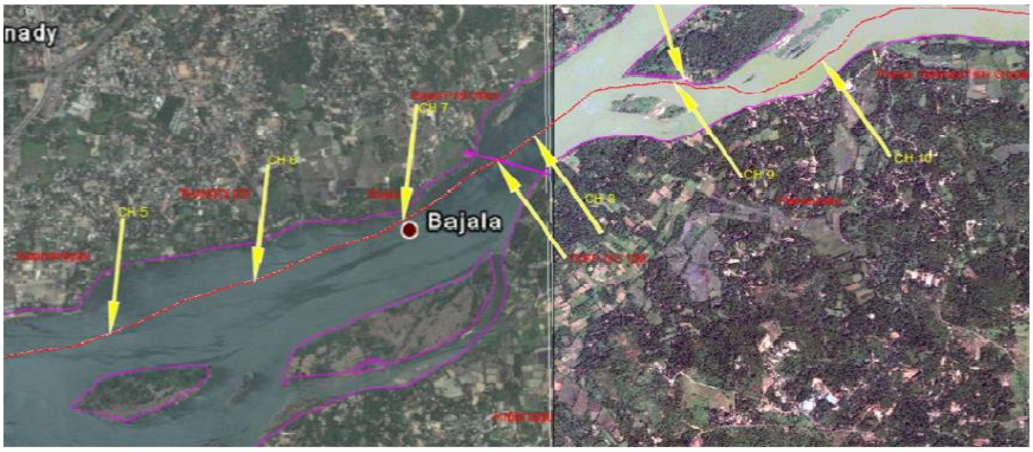


FIGURE 2.32: Netravathi River from Ch 5.00km to Ch 10.00km

TABLE 2-8 : Reduced depth from Ch 0.00km – Ch 10.00km

hainage (km)		Reduced depth with respect to Sounding Datum				
		Reduced Depth (m)		Length of Shoals (m)	Dredging Qty (cum)	Cumulative Qty (cum)
From	To	Min	Max			
0	1	2.3	8.0	0	0	0
1	2	2.6	4.3	0	0	0
2	3	2.3	3.9	0	0	0
3	4	2.5	6.4	0	0	0
4	5	2.6	5.0	0	0	0
5	6	1.1	2.6	700	14792.92	14792.92
6	7	1.3	2.5	400	15272.50	30065.42
7	8	1.0	3.2	100	3030.19	33095.61
8	9	1.4	4.1	100	434.78	33530.39
9	10	0.1	3.6	1000	55615.87	89146.26

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). Mangroves were observed on the left bank. Railway Bridge crosses at Ch. 3.43km. Kochi Panvel Highway Bridge crosses at CH 3.82km. At Ch. 4.75km, river bifurcates into two streams and it makes a shoal in the center of the river Ch. 5.0km and Ch. 6.0km there are shoals in the middle and left side of the river. HT line crosses at Ch. 7.35km. Island is observed at Ch. 8.7km. Few habitations was observed on the Island.

2.4.3 Netravathi River (Ch 10.00km – Ch 23.0km)

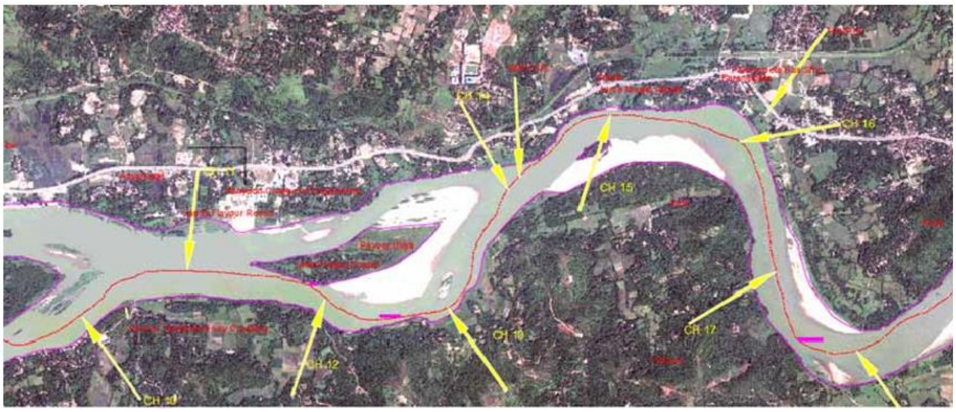


FIGURE 2.33: Netravathi River from Ch 10.00km to Ch 15.00km

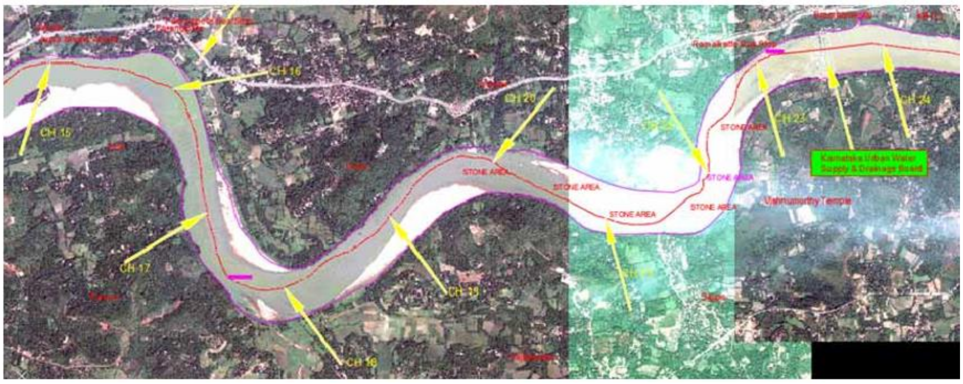


FIGURE 2.34: Netravathi River from Ch 15.00km to Ch 23.00km

TABLE 2-9 : Reduced depth from Ch 10.00km – Ch 23.00km

Chainage (km)		Reduced w. r. to Sounding Datum				
		Reduced Depth (m)		Length of Shoals (m)	Dredging Qty	Cumulative Qty.
From	To	Min	Max			
10	11	0.3	4.3	1000	32494.09	32494.09
11	12	1.4	4.3	50	0.18	32494.27
12	13	0.0	5.1	500	23773.43	56267.70
13	14	0.2	2.9	600	34144.96	90412.66
14	15	1.2	7.1	100	426.87	90839.53
15	16	0.3	4.6	500	17615.98	108455.51
16	17	0.5	3.4	900	19836.54	128292.05
17	18	0.6	2.5	1000	45117.35	173409.40
18	19	0.6	2.9	600	31060.64	204470.04
19	20	-0.2	2.3	1000	87131.62	291601.66
20	21	-0.3	2.3	1000	80450.27	372051.93
21	22	-0.3	-0.3	1000	152480.46	524532.39
22	22.9	-0.3	-0.3	900	126033.31	650565.70

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). Forest area and agriculture area are observed on the left bank whereas residential areas on the right bank are observed in this stretch. Ravoor Hare Kala Ferry Crossing is seen at Ch 10.45km. An Island is seen from Ch 11.40km to Ch 13.90km stretch in the middle of river. Infant Jesus Chapel is seen on this Island. Mangroves are observed on both the bank in this stretch. Masjid Arkula is seen near right bank. Stones are observed in the center of river from Ch 20.00km to Ch 23.00km.

2.4.4 2.5.4 Netravathi River Ch 22.00km (Thumbe Vented Dam) to Ch 30.0km

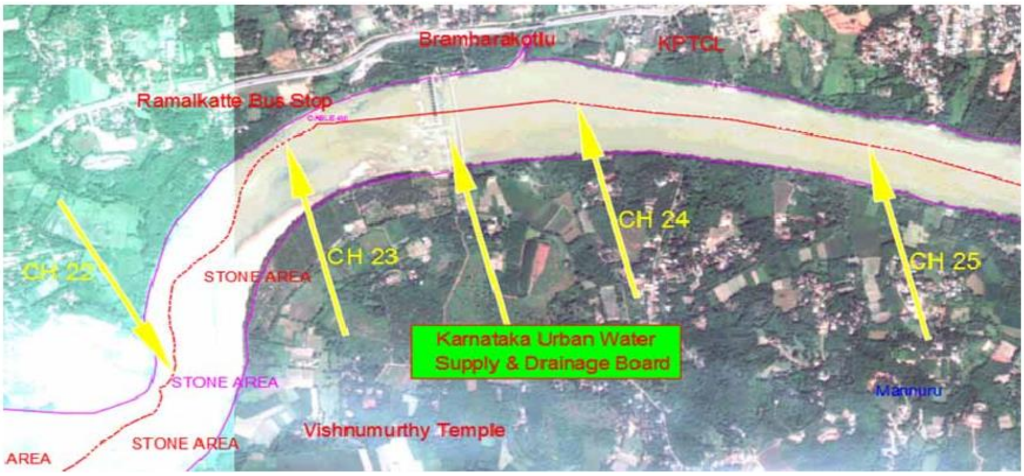


FIGURE 2.35: Netravathi River from Ch 23.00km to Ch 25.00km

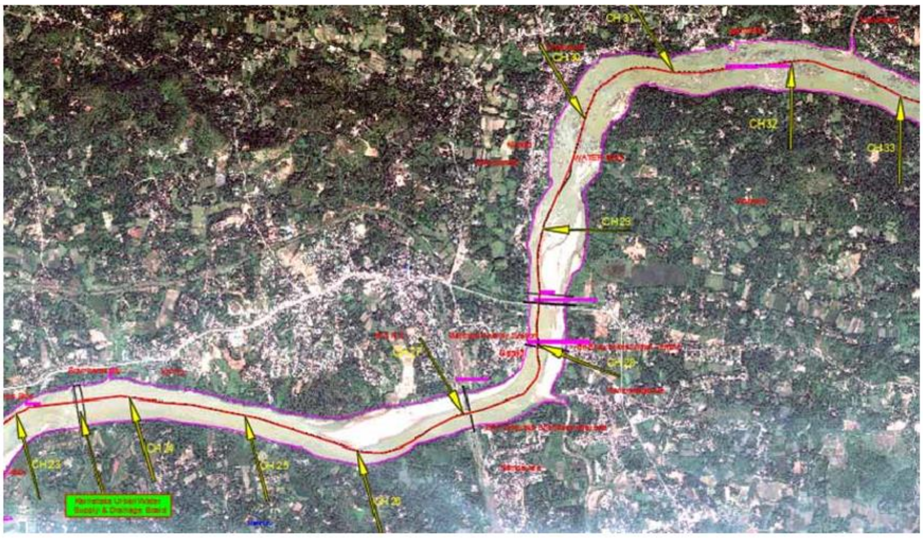


FIGURE 2.36: Netravathi River from Ch 25.00km to Ch 30.00km

The maximum and minimum LAD for the above-mentioned stretch is given in the above table (as per class IV). Bramharakotlu village is on the right bank at Ch 23.50km. Karnataka Urban Water Supply & Drainage Board Barrage also known as Thumbe Barrage is observed on the river at Ch 23.50km. Water is supplied to Mangalore town from this barrage. Exposed rocks in banks are observed in this stretch. Residential area on the right bank and forest area on the left bank are observed. Railway Bridge crosses the river at Ch 27.05km. Nandawara Village is on the right bank and Bantwal

Village is on the right bank. Mangalore Mysore highway bridges cross the river at Ch 28.00km and at Ch 28.36km. HT line crosses the river at Ch. 28.4km. Shoal is observed in the river from this bridge up to 29.4km. Hindupura village is on the right bank at Ch 30.00km.

TABLE 2-10 : Reduced depth from Ch 23.50km – Ch 30.00km

Chainage (km)		**Reduced w. r. to Sounding Datum**				
		Reduced Depth (m)		**Length of Shoals (m)**	**Dredging Qty (cum)**	**Cumulative Qty. (cum)**
From	**To**	**Min**	**Max**			
22.9	23	-0.3	4.2	100	7049.72	7049.72
23	24	3.8	6.6	0	0	7049.72
24	25	4.3	5.2	0	0	7049.72
25	26	2.6	5.2	0	0	7049.72
26	27	3.2	6.3	0	0	7049.72
27	28	2.1	4.6	0	0	7049.72
28	29	1.2	5.1	200	3139.27	10188.99
29	30	-0.3	1.1	1000	124449.03	134638.02

2.5 Water and Soil Samples analysis and Results

Gurupur

TABLE 2-11 : Water sample results

SAMPLE NO.	**Latitude**	**Longitude**	**WATER SAMPLES**	
			Sediment concentration (ppm)	**pH**
Gurupur-1	12°50'57.0343"N	074°49'52.7586"E	1152	7.18
Gurupur-2	12°55'31.8600"N	074°49'34.8400"E	1388	7.22

The river water is slightly basic in nature with average pH being 7.7.

TABLE 2-12 : Soil sample results

Sr. No.	**Sample No.**	**Specific Gravity**	**Latitude**	**Longitude**	**Grain size analysis (%)**				**Cu**	**Cc**
					Mechanical analysis		**Hydrometer analysis**			
					Gravel	**sand**	**Silt**	**Clay**		
1	Gurupur-1	2.65	12°50'57.0343"N	074°49'52.7586"E	0	99	1		1.372	0.214
2	Gurupur-2	2.62	12°55'31.8600"N	074°49'34.8400"E	0	98	2		2.656	0.865

From the above table the river bed can be concluded to be sandy sand throughout the study stretch.

Netravathi

TABLE 2-13 : Water sample results

SAMPLE NO.	Latitude	Longitude	WATER SAMPLES	
			Sediment concentration (ppm)	pH
NR-0	12°50'57.0343"N	074°49'52.7586"E	1152	7.18
NR-1	12°51'23.9798"N	074°54'35.0734"E	1070	7.22
NR-2	12°51'41.5645"N	074°59'11.7046"E	972	7.23
NR-3	12°53'33.2346"N	075°02'35.2313"E	955	7.05

The river water is slightly basic in nature with average pH being 7.17.

TABLE 2-14 : Soil sample results

Sr. No.	Sample No.	Specific Gravity	Latitude	Longitude	Grain size analysis (%)				Cu	Cc
					Mechanical analysis		Hydrometer analysis			
					Gravel	sand	Silt	Clay		
1	NR-0	2.65	12°50'57.0343"N	074°49'52.7586"E	0	99	1		1.372	0.214
2	NR-1	2.66	12°51'23.9798"N	074°54'35.0734"E	0	26	61	13	-	-
3	NR-2	2.65	12°51'41.5645"N	074°59'11.7046"E	0	21	62	17	-	-
4	NR-3	2.65	12°53'33.2346"N	075°02'35.2313"E	1	28	56	15	2.698	1.025

From the above table the river bed can be concluded to be sandy with silt throughout the study stretch

CHAPTER 3. FAIRWAY DEVELOPMENT

3.1 Proposed Class / Type of Waterway

The Fairway availability and its utilization along with the developments required etc., are to be concluded based on the detailed Hydrographic survey, Traffic mobilization including the hinterland requirement, future planning of the hinterland amenability and the stake holder’s view point etc.,

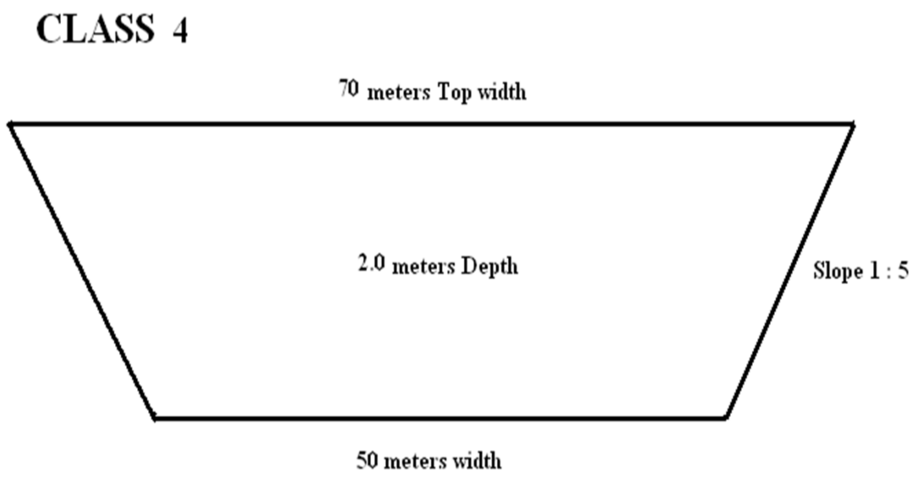
The detailed Hydrographic survey conducted on river Gurupur & Netravathi and survey charts prepared have been referred. It is to be noted that the Gurupur River after joining Netravati River, jointly draining into Arabian Sea, facilitating through put traffic mobility to the hinterland passing through New Mangalore Port & Old Mangalore Port. As per the data available through office of the Director of Ports & IWT, Baithkol, Karwar, vide communication dated 12.01.2022, the project development of Gurupur River (NW-43) & Netravati (NW-74) in the state of Karnataka has been conceived with respect to their cargo traffic estimation, the combined study stretch of the waterway is amenable for up to ***class IV*** of the waterway from the Fairway point of view so as to consider the Ro-Ro operation.

The stretch of 10 kms + 30 kms is traversing through the thickly clustered habitant zone in the Mangalore town area and presently linked with various riverine activities including the fishing etc.

Keeping in view the above factors, the most amenable class will be Class IV waterway to facilitate the Ro-Ro type of vessels, for the mobilization of the container traffic originating from and destinating to the Port area in the vicinity. The destination and origin in the reverse direction is in the river “Gurupur” from / to the hinterland of “Netravati”. Accordingly, the present study can be limited to ***Class IV*** waterway.

3.2 Details of Shoals (Length, Width and proposed development works)

Dredging quantities have been worked out for the suggested Class IV Waterway standards.



GURUPUR RIVER

(CLASS-IV)

Observed							Reduced w. r. t. Sounding Datum			
Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)		Reduced depth (m)		Length of Shoal	Dredging quantity
From	To	Max.	Min.		Per km drg		Max	Min	(m)	(cu.m.)
0.0	5.00	TIDAL ZONE					8.5	-0.7	2700	306667.06
5.00	10.041						5.0	0.3	1300	85118.61
Total									**4000**	**391785.67**

NETRAVATI RIVER

Observed						Reduced w. r. t. Sounding Datum			
Chainage (km)		Observed depth (m)		Length of Shoal (m)	Dredging quantity (cu.m.)	Reduced depth (m)		Length of Shoal	Dredging quantity
From	To	Max.	Min.		Per km drg	Max	Min	(m)	(cu.m.)
0.0	10.00	TIDAL ZONE				8.00	0.10	2,300	89146.26
10.00	22.90					7.1	-0.30	9,150	650565.70
Total (upto Thumbe Barrage)								**11,450**	**7,39,711.96**
22.90	30.00					6.60	-0.30	1300	134638.02
Total								**1300**	**134638.02**

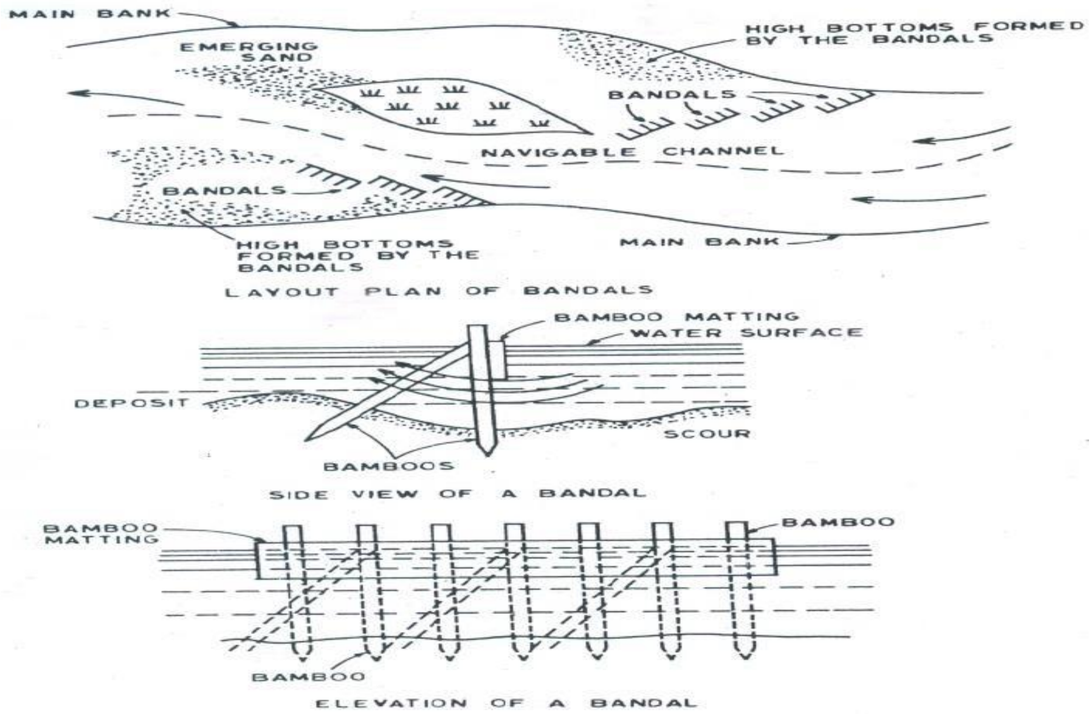
3.3 Proposed Conservancy Activities

Rivers are the natural channels of drainage carrying water along with sediments from the catchment to the sea. The main river course will be joined with various tributaries depending on its catchment configuration carrying the water from run-off and also carrying the sediments enroute. The dynamic equilibrium of such river flow tends to change the course of the river on the Geometric cross section and on the Gradient. The braiding channel of the river will create meandering streams leading to multiple channel flow. This type of distribution of the cross-section discharge into multiple channels is a major threat for safe navigation in the particular stretch of the river / waterway. The meandering tendency of a particular stretch / river always leads to the formation of loops / bends. Hence, the perspective appreciation over the behaviour of the river / study stretch for navigation is most essential to arrive at a dependable River Training measures for achieving the safe navigational fairway of the study stretch.

The taming of the river / study stretch for provision of a safe fairway for navigation is ultimately depending on the cost criteria and also the economics. Certain low cost solutions are already in practice in the national waterways on NW 1 and NW 2 systems viz., Bandalling; Bottom Panelling; Submerged Vanes etc., Considering the seasonal aspects in the river like Lean season and Flood season and in order to meet the quick time lines for providing the safe channel, the dredging of the river is also under consideration. However, to have a sustainable channel with long term requirement, the permanent solution of taming the river through the training measures viz., Spurs; Groins etc.,. Bank protection measures also can be adopted at certain critical locations as Training measures.

3.3.1 Low Cost structures

Bandalling” is a low cost and ancient technique adopted in NW 1 & NW 2 in order to improve the navigation conditions. Bandalling is the temporary structure made up of “Bamboos” and “Bamboo Mats”. The ideology of this structure is to divert the flow of secondary channel to main channel, where split discharge observed. Bamboos will be driven in line for 25m to 30m (1 Chute) and arranged with the screen made up of Bamboo Mats placed / immersed from the surface of water by a third of the depth. This structure will be placed at 35 degrees to 45 degrees to the secondary channel flow. No. of Chutes will vary on the width of the secondary channel. These Chutes will be supported by cross Bamboos to withstand the flow. This can improve the channel depths from 1.8 m to 3.0 m. The process ultimately silts up the secondary channel and improves the velocity / discharge in the main channel. The below mentioned Figure will give an idea about the structure. The Bandalling locations may have to be identified, during the receding stage of the Flood and are to be placed while considerable flow is observed both in main and secondary channels.



In the study stretch, there is no need of any conservancy activity due to the existing tidal flow in the area.

3.3.2 Dredging

"Dredging" is the removal of sediments and debris from the bottom of lakes, rivers, harbors, and other water bodies. It is a routine necessity in waterways around the world because of the sedimentation process (the natural process of sand and silt washing downstream and gradually fills channels and harbors). Dredging often is focused on maintaining or increasing the depth of navigation channels, anchorages, or berthing areas to ensure the safe passage of boats and ships. Vessels require a certain amount of water in order to float and not touch bottom. This water depth continues to increase over time as larger and larger ships are deployed and with the increased volumes of bulk cargo operation, dredging plays a vital role in the nation's economy.

Dredging is also performed to reduce the exposure of fish, wildlife, and people to contaminants and to prevent the spread of contaminants to other areas of the water body. Environmental dredging is often necessary because sediments in and around cities and industrial areas are frequently contaminated with a variety of pollutants. The sediment management and disposal of dredged material are also important issues to be managed and carried out effectively.

Dredging used to be carried out in the river by various types of Dredgers viz., Bucket and grab dredgers; Suction and cutter-suction dredgers; Trailing hopper dredgers etc.,. However, the most acceptable form of the dredger is “Cutter Suction Dredger” (CSD) being deployed on National Waterways by IWAI.

In the study stretch of Gurupur River, dredging has been identified to maintain the channel for the mobility of Ro-Ro vessel. The shoal length for ***Class IV*** is 4000 m with an estimated quantity of dredging as 3.91 Lakhs Cu. M. In order to maintain a depth of 2.0 m, estimated additional quantity of 0.39 Lakhs Cu. M is being added, totalling to approx 4.30 Lakhs Cu. M. in Gurupur River. The dredging quantity in the Gurupur river corresponds to the feasible length of waterway from mouth of Arabian Sea (ch. 0.00kms) to Kullur bridge (ch. 10.00kms approx.) out of the total study stretch of 10.041kms.

In the study stretch of Netravati River, dredging has been identified to maintain the channel for the mobility of Ro-Ro vessel. The shoal length for ***Class IV*** is 9150m (upto 22.90kms) with an estimated quantity of dredging as 7.39 Lakhs Cu. M. In order to maintain a depth of 2.0 m, estimated additional quantity of 0.739 Lakhs Cu. M is being added, totalling to 8.13 Lakhs Cu. M. It is estimated that a quantity of 8.13 Lakhs Cu. M shall fall in the category of ordinary soil. The dredging quantity in the netravati river corresponds to the feasible length of waterway from mouth of Arabian Sea (ch. 0.00kms) to Thumbe Barrage (ch. 22.90kms) out of the total study stretch of 30.0kms.

3.3.3 River Training

River Training is nothing but taming of a river section to achieve the objective / purpose with the encroachment over the natural flow condition. Navigation and Flood Control are generally the common purposes for taming the river with various training measures.

In general, there are two types of waterway training structures: Re-directive and Resistive. Re-directive, as the name implies, is the use of the River’s energy and Managing the energy in a way that benefits the system i.e., enhance the navigation channel. A resistive structure acts to maintain the system as status quo i.e., reducing bank erosion.

Re-directive structures are usually a series of dikes placed along the inside of a river bend where sediment usually deposits. Dikes have been known by a variety of names, such as groins (or groynes), contracting dikes, transverse dikes, cross dikes, spur dikes, spur dams, cross dams, wing dams, and spurs. The most common dikes in use today are shown in the Figure, as under.

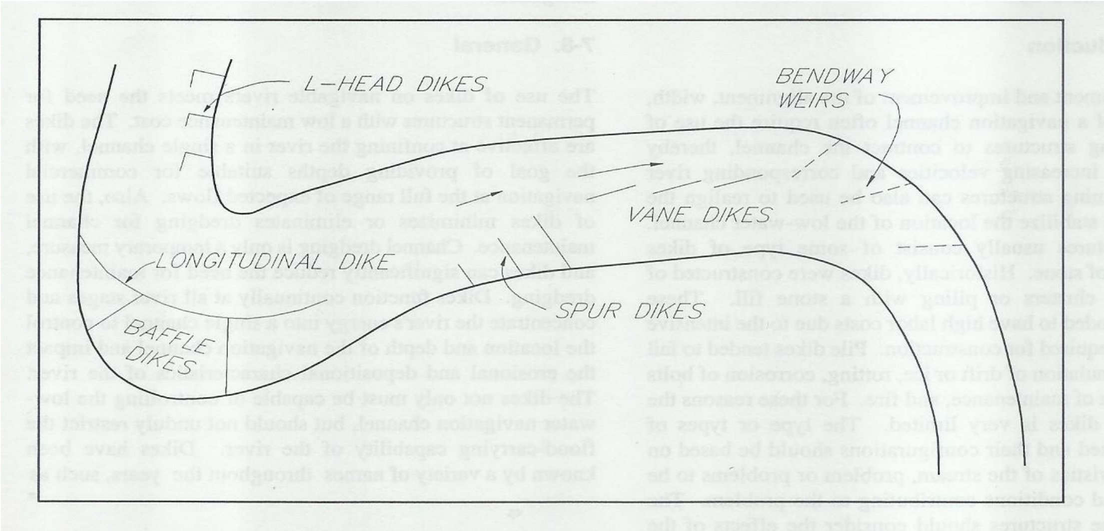


FIGURE 3.1: Types of dike structures

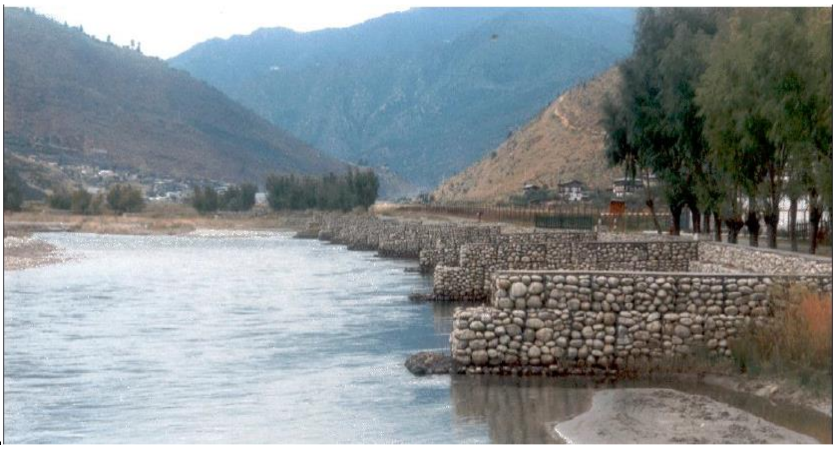
Resistive structures are primarily used to prevent bank erosion and channel migration to establish or maintain a desired channel alignment. Revetments and Bank Protection works are examples for such structures.

In the rivers of Karnataka, especially the west flowing rivers, in general have the tendency of rapid draining off due to the comparative limitation in traverse length between the lower mountain range and the Arabian Sea.

Keeping in view the above, the suggested River Training works are Spurs; R. C. C. Porcupines; Bamboo Porcupines. Further the Bank Protection / Revetments also can be considered as a part of the River Training at certain amenable locations. The structures are detailed with the figures and the preliminary designs have been placed in appropriate chapter (Chapter 6).

The “Gabions with Boulders” type of structure can be considered as Spurs and also as Bank Protection on these rivers, as detailed in the Figure.

In wider reaches, it is suggested the provision of spurs with “Gabions with Boulders” as detailed in the Figure, given below. The preliminary Design details have been placed in Chapter 6



River Training works may be essential, in general, at the sharp bend locations and at other locations where there is a need of taming the river with morphological variations / disturbances creating hurdle for smooth navigation.

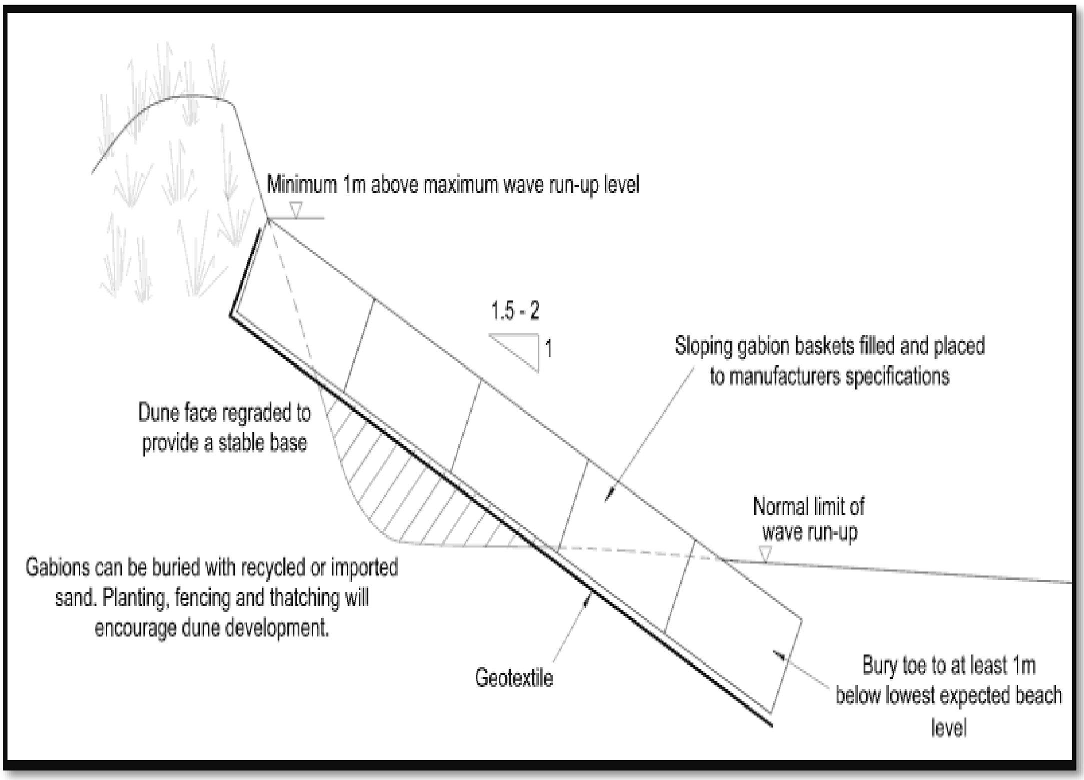
In the present study stretch, there is no need of any River Training requirements.

3.4 Bank Protection / Embankment Strengthening

In the rivers, wherever bends or curves exist, the concave side of the river will always be subjected to the erosion. The pace of erosion will depend on the soil condition and terrain and also the velocity of the flow at the location.

As early as the seventeenth century, the Germans were protecting the banks of rivers with masses of brush formed into fascines (bundles). This method of bank protection, called blesswerk, was also used for bank and shore protection in Holland.

As explained earlier, the characteristics of the rivers originating from Western Ghats are unique. In such a condition, Gabions filled with rocks will be the most advantageous type of the Bank Protection. Further, the basic raw material, rock, is abundantly available within a reasonable leads. Gabions are wire mesh baskets filled with crushed rock. They are filled in situ, with locally available material (rocks) and thus have a low capital cost. Because they are flexible and porous, they can absorb some wave and wind energy, thereby reducing the scour problems.



It has been proposed to consider the Bank Protection in the vulnerable locations. In the Gurupur River, apparently no bank protection is needed except at one bend having lower radius and a nominal length of 100.0m has been kept for estimating purpose. In Netravathi river stretch from Arabian sea to D/s of Thumbe Barrage, 2 Bend locatons at Ch. 17.8 km and at Ch. 21.8 km may need with protection work & a length of 250.0m has been kept for estimation purpose.

Accordingly, Bank Protection requirement of has been suggested at two of the above identified bend locations for a length of 125 m at each location totalling to about 250 m of Bank Protection.

3.5 Navigation Markings / Navigation Aids

Keeping in view the River width / Channel width etc., the Navigational Markings can be considered, either in the Shore or in the River with floating condition. The Shore markings can be considered with a reasonable Beacon type structure fitted with Light at the top, whereas, the marking in the river can be considered with the floating Buoys as per the IALA standards fitted with Light at the top.

In the Terrain of west flowing rivers, it is amenable to keep the light on a 15 m Trestle Tower with a reasonable illumination of Light for a considerable distance. IWAI is having 2 NM / 4 NM Light systems on NW 1, NW 2 and NW 3 (already operational) and hence it is preferred to consider 15 m Trestle Tower fitted with 4 NM light on the top. The 4 NM illuminations will have a visibility for about 9.0 km and with a rational approach. However, the present study stretch is mostly in habitant zone for which the Beacon type Markings may not be amenable, hence not suggested.

Regarding the Buoy & Light system, considering the clear visibility range as 500 m and in Zigzag position (i.e., 1 Left Mark then 1 Right Mark and 1 Left Mark), it is estimated to provide 42 Nos {10000/ 500) x 2 + 2 Bends) in Gurupur river & 102 Nos {24000/ 500) x 2 + 6 Bends) in Netravati river of Buoy and Light unit (with chain attachments etc.). A provision of Tug – cum – Buoy laying vessel has been considered, which will act as a multi-purpose vessel to assist in the survey operations of the waterway.

The preliminary design of Beacon & Light sytem along with the specification are palced at Chapter 6, appropriately. The technical specifications of Buoy & Light, as available in the market as a proprietary item are also detailed in Chapter 6.

3.6 Modification Requirement in existing Bridges / Cables / Dams / Barrages / Locks / Weirs / Anicuts / Aqueducts

No Bridges are there across river Gurupur in the study stretch. 5 Bridges are present on river Netravati, of which 3 Bridges at Ch. 26.35km; Ch. 27.285km and Ch. 27.66km are U/s of Thumbe Barrage and not in the stretch of navigation. 2 Bridges at Ch. 3.52km and Ch. 3.91km are having 45 m and 32 m Horizontal clearance / 6.147 m and 5.88 m vertical clearance respectively. The vertical clearance aspect can be mitigated by taking the advantage of tide and hence not suggested any modification.

No power cable on river Gurupur (across the waterway). 3 HT Line on river Netravati is crossing, out of which one at Ch 8.16km (in the feasible navigation stretch upto Thumbe barrage at 22.90kms) is existing and one of the HT line need to be upgraded by raising the vertical clearance of 20.1m corresponding to 220.0kVA from the existing vertical clearance of 10.0m.

No cross structures viz., Dams / Barrages & Locks / Weirs / Anicuts / Aqueducts are observed in the present study stretch. Hence, modification doesn't arise.

3.7 Proposed Dams / Barrages / Locks / Weirs to improve depth

In order to improve the fairway, including the depth, there is no requirement of Dams / Barrages & Locks / Weirs in the present study stretch.

3.8 Land Acquisition

No Land Acquisition requirement was observed for Fairway Development in the present study stretch. Land Acquisition requirement for Terminal purpose is being considered, as a part of Terminal development, wherever required.

3.9 Fairway Costing

3.9.1 Capital Cost

The combined stretch of Gurupur River and Netravati River is not having any IWT Traffic, as on date. It has been proposed to develop the stretch with Class IV system of NW standards to facilitate Ro – Ro vessel mobility. Further, 2 IWT Terminals are proposed for the mobility. The implementation of development is suggested in one phase only. Accordingly, the Capital Cost for the fairway has been considered for 4.3 Lakhs Cu. M in Gurupur & 8.13 Lakhs Cu. M of dredging in Netravati (INR 30.49 Cr); 350 m of bank protection (INR 4.71 Cr) and 144 Nos. of Buoys with Light (INR 5.18 Cr). Cost estimates are placed with details in Chapter 11.

3.9.2 O&M Cost

The item wise Operation and Maintenance cost have been considered as per the circulated parameters, as defined, by IWAI, which have been analyzed and considered. Some more assumptions have been considered appropriately, wherever required.

CHAPTER 4.: TRAFFIC STUDY

4.1 General

Netravathi and Gurupur River are two main rivers of Dakshin Kannada (South Canara) district in Karnataka state. Netravathi River originates from Bangrabalige valley, Yelaneeru Ghat in Kudremukh in Chikkamagaluru district. Netravathi is navigable from Bantwal. As it approaches Mangalore, its channel gets wider and several small islands called Kudru are formed from the sedimentary load of the river. These islands are extremely fertile and yield good rice and sugarcane crops. At Mangalore, Netravathi flows towards north to join Gurupur river and merges in Kumaradhara River at Uppinangadi before flowing into the Arabian Sea.

Netravathi river is considered as one of the Holy rivers of India and it flows through some famous pilgrimage places like Dharmasthala, Bantwal, Mangalore & Belthangady of Dakshina Kannada. This river is the main source of water to Bantwal and Mangalore talukas. The river drains an area of about 1,353 square miles. Bantwal town is located on the banks of the river; earlier the river was known as Bantwal River. Bantwal town often inundated due to the spillover of Netravathi river during monsoon. The years 1974 and 1928 had witnessed major floods due to the overflow of Netravathi.

According to the 'Gazetteer of Southern India', Netravathi river has an apparent breadth of approximately 200 yards. The river bed of Netravathi was encumbered by mainly horneblend rock. The river bed basically contains small garnets and spangles of mica. Sientes are also found in the river bed of Netravathi at Mangalore.

The navigable length of the river is 23.50 km. Based on the deepest bathymetry single line survey carried out during the study and as per the classification of “Inland water ways” as per Ministry of Shipping, Govt. of India notification; it can be classified as “Class II” for the entire study stretch.

Gurupur River originates in the Western Ghats and flows into Arabian Sea through Mangalore taluka. Gurupur river is also known as Phalguni River or Kulur River. The name Gurupur is derived from the town Gurupura, located on the bank of the river. The river originates at an elevation of 1,400-1,600 m. the Western Ghats after a confluence with 2 tributaries; it drops by 10 m. at the junction.

The navigable length of Gurupur river is 10 km. Based on the deepest bathymetry single line survey carried out during the study and as per the classification of “Inland water ways” as per Ministry of Shipping, Govt. of India notification; it can be classified as “Class V” for the entire study stretch.

As Gurupur River (navigability - 10 km) and Netravathi River (navigability- 78 km) merges with Arabian Sea at the same confluence area, a continuous navigable length of 88 km is available for cargo to move through Inland Water Transportation. New Mangalore Port is in the vicinity of the north bank of the river and Old Mangalore Port (OMPT) at the south bank of the river.

FIGURE 4.1: Macro Map of Hinterland of Netravathi&Gurpur

4.1 Influence area / Hinterland Analysis

The Basin of Netravathi and Gurupur River covers Dakshina Kannada district. This district is situated in the southern coastal part of Karnataka and covers an area of 4,861 sq.km. It is surrounded by the Lakshadweep Sea on its west and Western Ghats on the east. The district is surrounded by Udupi district on the north, on the Chikmagalur and Hassan districts on east, Kodagu on the south-east, Kasargod & Cannanore districts of Kerala on the south-west and Arabian Sea on the west.

Dakshina Kannada district has two regions and five talukas. Coastal region covers Mangalore and Bantwal talukas and Malnad region covers Puttur, Belthangady and Sullia talukas. Mangalore is the administrative headquarter and a developing city. The three talukas of Dakshina Kannada are considered in the study. These talukas, namely Mangalore, Bantwal and Puttur are located on the catchment area of Netravathi and Gurupur River. Among these talukas, Mangalore and Puttur are 2 revenue sub divisions. Apart from Dakshina Kannada district, the consultant has considered industries of Udupi district for the study. Udupi district is considered because there is a

Coal based Thermal power plant in Udupi. The potential opportunity from Udupi Power Corporation Ltd. is discussed in the Industry Section.

FIGURE 4.2: Netravathi River

FIGURE 4.3: Open land near Bidarahalli – Kandegala village on the bank of Gurupur river

4.1.1 Population of Hinterland

This section would study population of the catchment area of Netravathi and Gurupur river. In primary catchment area, only those talukas of Dakshina Kannada are considered for study, which are within 25 km catchment area.

As per census 2011, total population of Dakshina Kannada is about 20,89,649 (Urban- 2,14,490, Rural- 10,93,563), which is 8th highly populated place of the state. In Mangalore taluka, rural population is 2,10,033 and urban population is 1,95,123. In Bantwal taluka, rural population is 2,79,482 and urban population is 75,743. In Puttur, rural population is 2,26,977 and urban population is 7,813.

TABLE 4-1: Population of talukas in Dakshina Kannada in the catchment Area

Taluka	Population 2011
Mangalore	4,05,156
Bantwal	3,55,225
Puttur	2,34,790
Total	**9,95,171**

Source: Census, 2011

As seen in the above table, Mangalore taluka has higher population in Dakshina Kannada. Apart from the three talukas mentioned in the above table, there are two more talukas, Belthangady & Sullia; but they are far from the catchment area of Netravathi River, so they are not included in the study.

4.1.2 Economic profile of Primary Catchment Area

Dakshina Kannada's GDP is INR 14,290 Crore in FY 12-13. The district's share is third largest in the state economy, i.e. 4.8%. The below table shows sector wise GDP and percentage of contribution in the district's economy.

TABLE 4-2: Sector wise contribution in Dakshina Kannada's GDP (FY 13)

Sectors	GDP	Contribution (%)
Primary (Agriculture, Fisheries, Forestry)	1,652	11.5
Secondary (Industry-Manufacturing, Mining, Construction)	3,397	23.77
Tertiary (Services- Restaurants, Banking, Legal services)	9,240	64.66
Total	**14,290**	**100.00**

TABLE 4-3: Sector wise % share of GDP of talukas in the catchment area

Taluka	GDP (Per Capita Income in Lakhs)	Primary	Secondary	Tertiary	Total
Mangalore	94,716	1.6	21.2	17.6	**40.4**
Bantwal	54,572	3.9	2.8	3.5	**10.2**
Puttur	53,245	1.4	2.0	3.2	**6.6**

Source: Karnataka State Strategic Statistical Plan (2008-09)

4.1.1.1 PRIMARY SECTOR

Primary sector of Dakshina Kannada district consists of Agriculture, Forestry, Fishing, Animal husbandry & Mining & Quarrying. Fishing is one of the major activities of the region. Agro processing and fish processing activities also take place on a large scale.

- **Agriculture**

Agriculture is an important occupation for the people of Dakshina Kannada. The district has 21.57% of its land under cultivation. Cultivable lands of the district are classified mainly into rice land and garden lands. Out of total cultivated land, food grains are grown in 38% land and horticulture crops, vegetables, oilseeds, sugarcane etc. are grown in remaining 62% land.

The Net Sown Area (NCA) is 1.31 lakh ha. and forms 27% of the geographical area of 4.77 lakh ha. Small and marginal land holdings account for more than 90% of total land holdings and 61% of the cultivated land. Paddy is the principal agricultural crop of the district. It is grown nearly in one third of the GCA (Gross Cropped Area). Black gram & green gram is also grown majorly in the district. The other major crops are Coconut (16,296 ha), Arecanut (28,232 ha), Cashew (31,288 ha), Rubber (10,838 ha) etc.

The main occupation of the people who live on the bank of Netravathi and Gurupur river is agriculture and fishing.

TABLE 4-4: Area under cultivation in the Catchment Area (in Ha) (FY 14-15)

Taluka	**Cereals & Minor Millets**	**Pulses**	**Horticulture Crops**	**Commercial Crops**	**Plantation Crops**	**Total**
Mangalore	16,919	1,380	4,782	20	-	23,319
Bantwal	15,595	210	8,248	-	-	24,448
Puttur	4,946	256	9,828	-	-	15,887
Total Area of Catchment	37,460	1,846	22,858	20	-	63,654
Total Production of Catchment (in Tonnes)	98,883	808	94,803	1,733	2,17,412	4,13,639
Total Area (Dakshina Kannada)	52,349	2,971	39,179	20	-	1,27,308
Total Production (Dakshina Kannada) (in Tonnes)	1,38,185	1,300	1,25,433	1,733	3,03,826	5,70,477

Source: Dakshina Kannada District at a Glance 2014-2015

- **Horticulture**

This district is in the tropical region and has a hot and humid climate. This climate is favorable for cultivation of horticultural crops. Coconut, Areca and Cashew are the major plantation crops in the district. Cashewnut, arecanut, pepper, cloves and coconut are the important cash crops of Dakshina Kannada. The spices grown in the district are pepper, ginger, cardamom, clove, nutmeg and cinnamon. Vanilla is also grown here. Seasonal fruits such as Mango, Jackfruit, Papaya, Pineapple and Banana are available in plenty in this district. The district produces most of the sugarcane in the state as cultivation of this crop is wide spread. Sugarcane is produced in 32 Ha, with total production 1,535 Tonnes in FY 10-11. The main centres of manufacture of jaggery from sugarcane are Kuloor, Ullal and Udupi.

Cocoa cultivation in Puttur taluka is identified by NABARD for further development during FY16-17. The department of Horticulture is providing supply of quality planting material and necessary technical training to farmers through various schemes.

TABLE 4-5: Production of Important Horticulture Crops in Dakshina Kannada (FY 14-15)

(Tonnes)

Taluka	Banana	Mango	Lemon	Pineapple	Guava	Sapota	Jackfruit	Papaya
Bantwal	13,360	3,948	–	4,102	290	425	12,455	2,941
Mangalore	3,400	3,583	18	10,742	102	195	8,030	776
Puttur	19,544	4,491	48	1,263	203	204	4,210	475
Total	**36,304**	**12,022**	**66**	**16,107**	**595**	**824**	**24,695**	**4,192**

Source: Dakshina Kannada District at a Glance 2014-2015

TABLE 4-6: Taluka wise Horticulture Production near Netravathi & Gurupur (FY 14-15)

Taluka	Production (T)
Mangalore	26,846
Bantwal	37,520
Puttur	30,437
Total	**94,803**

Source: Dakshina Kannada District at a Glance 2014-2015

Due to availability and demand for perishable items like fruits and vegetables in the district, cold storages can be set up for fruits, vegetables, flowers, pulses, etc. Cold storages could be established in Mangalore and Puttur talukas. Most of the horticulture products are consumed locally or distributed in neighboring talukas & districts; hence it would not provide opportunity for the proposed waterway.

- **Sericulture**

Mulberry is cultivated in an area of around 11 Hectares in Bantwal, Mangalore & Puttur talukas near the catchment area. Total 24 villages are involved in sericulture in the nearby talukas in the catchment area. Since, statistics is not available for the production of silk, so based on the data of cocoon production, it could be analysed that silk production is miniscule in this area, which worth around INR 6.9 Lakhs. As production of cocoon and silk is very less in volume, so it would not provide any opportunity for the waterway. Also, silk is a high value commodity, so it would not be transported through waterway.

TABLE 4-7: Sericulture Production in the Catchment Area (FY 14-15)

Taluka	Area under Mulberry (Heets)	Cocoon Production (in Tonnes)	Villages engaged in Mulberry (in No.)	Value of Silk produced (INR in lakhs)
Bantwal	5.9	0.37	13	1.37
Mangalore	2.2	0.36	4	1.32
Puttur	2.8	0.05	7	0.2
Total	**10.9**	**0.78**	**24**	**2.89**

Source: Dakshina Kannada District at Glance 2014-2015

- **Forestry**

Dakshina Kannada is a forest district. Out of total geographical area of the district, forest area is spread on 26.93% area, i.e. 128,476 hectares, out of 486,100 hectares are covered by forests. Forest area is more in Belthangady taluka (49,837 Ha), followed by Puttur taluka (27,386 Ha). Sullia taluka has 43,282 Ha forest area, which is second largest in the district; however, Belthangady & Sullia talukas are out of the catchment area. There is vast scope for development of ecotourism in forest area.

Originally, tropical evergreen forest, also known as Western Ghat Forest is the prominent forest type of the district. However, gradually the district comprises of different types of forest ranging from evergreen, deciduous & shrub. There are many major and minor items of forest production in the district. Industrial wood particularly softwood, used in plywood and match industry, constitutes a major production of the forest. Other wood consists of sleeper, firewood, bamboos, timber of durable species. The minor forest products are pepper, tamarind, bursera, bamboo, sheekakai (soapnut), lac, rampathri etc. Cardamom is found over the Ghat forests, but the chief cultivation of plantation is extensively cultivated throughout the district. Tasty varieties of cardamom are found in and around Mangalore. The cultivation of betel leaf is common in Dakshina Kannada.

The chief forest produce of hard timber of economic importance in the district is rosewood, teak and genteak. Among minor forest produce are cardamom, cinnamon leaves and bark, canes, bamboo, wood oil, myrobalans, catechu and matti bark. Natural rubber is also available in good quantity in the district. Rubber is used by industries to manufacture coir foam, surgical hand gloves, rubberized coir mattress, latex crepe, cycle tyres, tubes, furniture from rubber wood, footwear, floor mats, rings etc. The volume of forest produce needs to be high to move through IWT. The forest production of the catchment area is less; hence it would not provide any opportunity for the proposed waterway.

- **Fisheries**

Dakshina Kannada has a thriving fishery industry with one minor fishing harbour near Old Mangalore Port. Bunder, the Old Mangalore Port is mostly used for fishing activities. As per District Profile, Government of Karnataka 2016, Marine fish production is around 90,000 MT and the inland fish production is around 1,065 MT in the district. Activities like prawn farming are promoted in different regions with the utilization of coastal brackish water.

TABLE 4-8: Fish Catch & Storage Infrastructure in the Catchment Area

Taluka	Fish Catch (T)	Ice Plants (No.)	Ice Plant Capacity (T)	Cold Storage (No.)	Cold Storage Capacity (T)
Mangalore	1,51,098.20	70	7,95,240	11	387
Bantwal	118.6	NA	NA	NA	NA
Puttur	101	NA	NA	NA	NA
Total	**1,51,317.80**	**70**	**7,95,240**	**11**	**387**

Source: Dakshina Kannada District at a Glance 2014-2015

TABLE 4-9: Fisheries in Dakshina Kannada District

Year	Marine Fish (T)
2011-12	1,37,435
2012-13	1,38,146
2013-14	1,48,272
2014-15	1,50,525
2015-16	1,51,458

Source: Fisheries Department, Dakshina Kannada District

Among the talukas in the catchment area of Netravathi and Gurupur river, only Mangalore has coastal fishing because it is the only taluka with a long coast. Rest other two talukas, Bantwal & Puttur have inland fishing. In Dakshina Kannada, marine fishing is more popular than inland fishing. It can be due to lack of much freshwater resources and also due to lack of knowledge on implementing inland fish culture activities. During rainy season when marine fishing activities are completely banned, there will be great demand for freshwater fish. During these months, inland fishing could be one prime source of providing food. There is potential to develop inland fishing in the district.

Fish products like fish oil, fish soluble, fishmeal, Sardine fish oil, refined fish oil, crude fish oil, marine foods, shrimps, squid, frozen foods etc. are exported. Fish export to Europe, China and Bangkok are handled by NMPT. Fish are packed in reefer containers and exported. These exported fish would not provide opportunity for waterway. Fish catch of the catchment area could not be potential commodity for the proposed waterway as most of the fish is consumed locally or distributed in nearby regions.

- **Mining & Quarrying**

Production of minerals in the coastal district of Dakshina Kannada is comparatively less than other land locked districts. Though not rich in mineral wealth, the district contains some useful minerals such as Corundum, Iron Ore, Kyanite, Silica Sand, Limestone and Clay in considerable quantities. Major minerals available in the district are Building Granite and Laterite Stone. Other minerals namely Quartz, Dolerite, Lime Shell, Silica Sand & Bauxite are available in a minor quantity. Production of Minerals in Dakshina Kannada is discussed in Commodity Section. The table below shows taluka wise mineral resources of Dakshina Kannada.

TABLE 4-10: Taluka wise Mineral Resources of Dakshina Kannada

Taluka	Major Mineral	Minor Mineral
Mangalore	Limestone, Silica Sand	Dyke, Building Stone, Ornamental Stone
Bantval	-	Ordinary Sand, Building Sand
Puttur	Iron Ore, Lateritic Iron Ore	Building Stone, Ordinary Sand

Source: Census 2011

4.1.1.2 SECONDARY SECTOR

Secondary Sector of the economy consists of Manufacturing, Construction, Electricity, Gas & Water Supply of Dakshina Kannada. The district boasts of large and mega industrial units; a large number of micro and small enterprise are also coming up. As per District profile, Government of Karnataka 2016, Dakshina Kannada district is the home of total 23 large and medium industries and 21,986 small-scale industries.

In Dakshina Kannada district, industries such as tile, beedi, cashew kernel, coconut oil, food and beverages and manufacturing activities like rubber/plastic goods, wooden products etc. had a prominent presence. The tile industry has witnessed decline due to non-availability of quality clay and firewood in addition to labour shortage and public preference for concrete structures in the modern era. Beedi rolling industry is one of the major home industries of the district. It is also a dominant household activity among rural women.

Historically, Dakshina Kannada district has been a major exporter of commodities like Tiles, Leaf springs, Spices, Cashew nuts, Handicrafts etc. Recently the district has started exporting Engineering goods, Readymade Garments, Chemicals, Minerals & Ores, Food items, Fish Meal & Oil, Flowers, Gherkins, Polished Granite etc.

4.1.1.3 TERTIARY SECTOR

The tertiary sector consists of Tourism, Infrastructure, Hotels, Real estate, Service sector, Transport, Education, Storage, Communication, Banking & insurance, Business Services, Public administration & other services etc. Tertiary sector has grown steadily over the years in Dakshina Kannada. IT/ITES activities based companies are also growing rapidly in the district. Large IT companies like Infosys have set up their offices in the IT Park at Deralekatte.

The district is an education hub and also known for religious tourism and medical facilities. Mangalore has been shortlisted in the list of Smart Cities by the Government of India. The service sector comprising of tourism is the major contributor to the district's GDP i.e. INR 3,555 CR, which is more than 50% of Uttar Kannada's GDP.

Tertiary sector consists of mostly service-based industry, so it would provide opportunity for passenger and tourism traffic through waterway in Netravathi and Gurupur river. Growing Tourism sector in the district would boost tourist traffic on the waterway. Tourist Traffic section shows the famous tourist places in the catchment area, which would provide opportunity for tourist traffic.

4.1.3 Connectivity Infrastructure Analysis

Infrastructure plays a vital role in the economy of any region. It boosts industrial, tourism and other sectors. Connectivity around Netravathi and Gurupur river is well developed and would help in evacuation of cargo and passengers through IWT and multi modal transportation.

Road Connectivity

- The length of National Highways in the district is 211 Km. The district encompasses 3 major National Highways. NH 66 (135.5 Km) passes all along the coast of Dakshina Kannada district (Mangalore) connecting Goa and Mumbai on one side (north) and Cochin (Kerala) on the other side (south).
- NH 75 (220.8 Km) connects Mangalore to the State capital Bangalore. NH 13 (153.4 Km) connects Mangalore to Solapur in the neighboring state of Maharashtra.
- Another State Highway upgraded as National Highway. NH 243 connects Mangalore and Charmadi in and ends up connecting Kota in Andhra Pradesh and Villipuram Port in Tamil Nadu.
- There are 8 State highways crossing all over 5 Talukas in the district. The district has good connectivity with the neighboring district, Udupi. Also, there is good road connectivity with Mysore, Shivamogga and Kodagu districts. State Highway 88C connects Kalladka in the district to Kanhagad entering Kerala.
- The state highway SH 88 connects Mangalore with Mysore district.

Rail Connectivity

- The district has rail length of 227 Km. There are 8 railway stations in the district. The Southern Railway Division connects the district to the cities of Bengaluru, Chennai and Thiruvananthapuram and Konkan Railway division connects the district to major port cities of Mumbai and Kochi.
- Konkan Railway's Ro-Ro service, where loaded trucks are mounted on rail wagons, operates in the district with a landing station at Surathkal near Mangalore. Konkan Railway operates 2-3 times on Konkan rail route with an average of 50 trucks loaded per rake and upto 3 rakes loaded per day. The service is cost-effective as well as environment friendly.
- The major city on the catchment of Netravathi and Gurupur river, Mangalore is well connected by Railways. Konkan Railway connects Mangalore with northern India, Southern Railway Zone connects it with southern India.
- Konkan Railway route passes through the district (Mangalore) connecting major cities of India. The 2 Major Railway stations are - Mangalore City Railway Station (in the heart of Mangalore city) and Kankanady Railway Station (5 Km. away from the heart of Mangalore city).

Air Connectivity

- Dakshina Kannada district is well connected by Air. There is an international airport at Mangalore, known as Mangaluru Airport or Bajpe Airport. It is 18 Km. from the heart of Mangalore city. There are daily domestic flights to major cities of India, like Mumbai, Bangalore, Goa, Hyderabad, Chennai, Delhi etc. and weekly/bi-weekly International flights to Dubai, Abu Dhabi, Muscat, Doha Qatar, Kuwait, Dammam and Bahrain.

4.1.4 Existing Infrastructure of Primary Catchment Area

New Mangalore Port (NMPT)

New Mangalore Port is the only major port of Karnataka. NMPT is closer to Gurupur and Netravathi river. This port is crucial as most of the EXIM trade of Karnataka is handled at New Mangalore Port. It is a deep-water, all-weather port at Panambur, Mangalore. It has been functioning as a backbone for the economic development of this region and caters the needs of the shippers. The port serves hinterland of Karnataka state and to some extent state of Kerala. NMPT is evaluating feasibility for deepening of Channel and Lagoon at the port.

Existing facilities at New Mangalore Port:

- ✓ Deepest inner harbour on the west coast with 15.4 m. depth at the entrance channel
- ✓ Total capacity of all berths- 77.77 MTPA
- ✓ Two transit sheds of 3,192 sq. m. and 4,560 sq. m., with capacity 7,980 MT & 11,400 MT respectively.

Old Mangalore Port (OMPT)

This port is situated on the confluence of Netravathi and Gurupur rivers and is approximately 30 Km. south of Padubidri Port and South of NMPT. The port provides safe anchorage for vessels in the lagoon or backwaters 5 Km. long and 700 m. wide, separated by a sand pit with an average width of 300 m. It is a seasonal port and functional only during the fair-weather season from September to May. From May to September 15, the port stops its function. The Port has good road, rail connectivity. Konkan Railway Line and NH 66 pass very close to the port.

Existing facilities at Old Mangalore Port:

- ✓ Berthing facilities for coastal vessels of 4.50 m. draft/ lighterage/ mechanised fishing vessels.
- ✓ The port has covered and open storage and loading and unloading tackle.

4.1.5 Existing Jetties/ Landing Points

At present, Ferry services are operational at the following three locations on Netravathi River: Sajipanadu-Thumbe, Jalakadakatte-Parangipet and Adyar-Pavoor.

FIGURE 4.4: Existing Landing Points at Netravathi River

At present, Ferry services are operational at the following three locations on Gurupur River:

- Sulthan Battery Ferry Line from Sulthan Battery to Thannirubhavi
- Bengre Ferry Line from Old Mangalore South Port to MJM Road Bengre

- BMS Ferry Line from Old Mangalore New South Port to Bengre

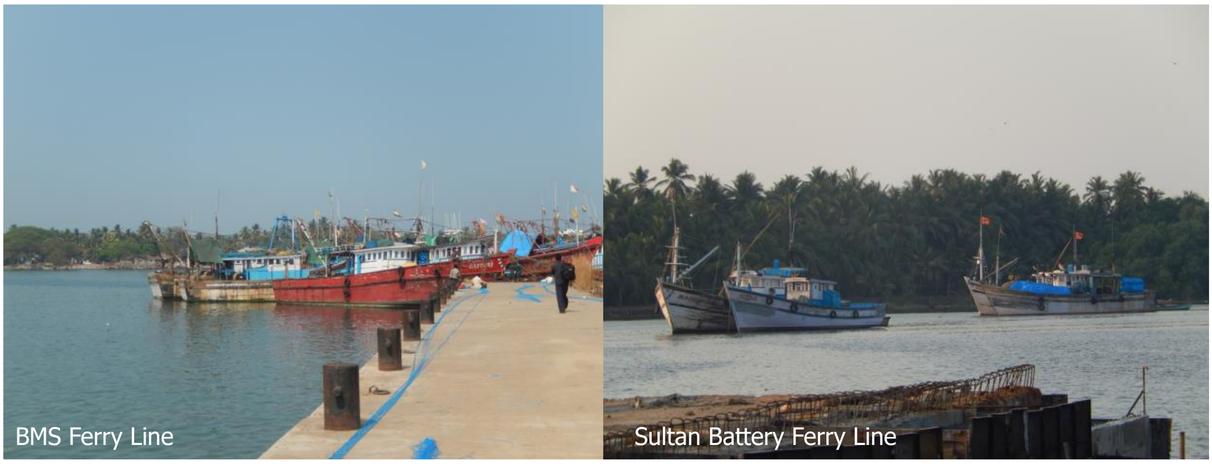


FIGURE 4.5: Existing Landing Points at Gurupur River

FIGURE 4.6: Landing point at Gurupur River

Bridges

FIGURE 4.7: The New Bridge on Netravathi River

Netravathi Bridge- Netravathi Bridge is built on NH 66 in Mangalore over Netravathi River. This bridge is also called Ullal Bridge, as it is located at Ullal. There is a new bridge parallel to the old bridge. The old bridge was 2 lanes wide, while the new bridge can cater to 4 lanes of traffic and 2 ways for pedestrians. The bridge is 830 m. long and connects Karnataka and Kerala

FIGURE 4.8: The Old Bridge on Netravathi River

FIGURE 4.9: Kuloor Bridge on Gurupur River

Kuloor Bridge- Kuloor Bridge is built across Gurupur river on National Highway 66, Panvel- Kochi- Kanyakumari Highway.

Upcoming Infrastructure

- ✓ There is also a proposal from Ministry of Road Transport & Highways to provide an Expressway Corridor, connecting port cities of Mangalore-Karwar-Panaji as part of Indian National Expressway Network. This expressway will be parallel to NH 66 and will be located majorly in Coastal Karnataka. Expressway is expected to be a 6/8 lane access-controlled 3D Right of Way designed Expressway.

- ✓ Shiradi Ghat road patch of NH 75 is being upgraded. With upgradation of the road connectivity between Bangalore- Hassan-Mangalore, it is expected that a share in the ICD container traffic would divert to New Mangalore Port from Bangalore via road. Development of Shiradi ghat and doubling the Mangalore-Hassan railway track would attract more cargo for the NMPT; but it would also be a potential threat to the waterway in Netravathi and Gurupur river. The waterway would face tough competition from roadways.

4.1.6 Existing & Proposed Industries

As per District profile, Government of Karnataka 2016, Dakshina Kannada district is the home of total 23 large and medium industries with aggregated Investment INR 9,216 Crore and 21,986 small- scale industries (MSME) with aggregated Investment INR 545 Crore. The enterprises in the district provide employment to nearly 44,000 people. Talukas in Dakshina Kannada district have been divided into two zones for industrial incentives namely,

- Zone 3: Bantwal, Mangalore (excluding Corporation limits), Puttur, Sullya & Belthangadi
- Zone 4: Mangalore (Corporation limits)

Mangalore is the industrial hub in the catchment area of Netravathi river. There are 6 industrial areas and 5 Industrial Estates in Mangalore. Oil and Natural Gas Corporation (ONGC), Mangalore Refinery and Petrochemicals Limited (MRPL), Mangalore Chemicals & Fertilizer (MCF), BASF are the major players in Mangalore. Large industrial units like MRPL, MCF, KIOCL, Ultratech Cement, Hindustan Unilever Ltd., etc. employ nearly 10,000 persons. At present, industries in hinterland are moving their cargo either by Roadways or Railways. The proposed multimodal route via Netravathi and Gurupur River is beneficial to those industries whose road/rail distance is more than proposed route. Companies might consider shifting their cargo to IWT, provided cost benefits with additional infrastructure benefits.

Proposed Industries-

- ✓ MRPL has proposed an Oil refinery project with an investment of INR 8,640 Crore in Dakshina Kannada.
- ✓ There are two proposed industrial parks at Niddodi and Badag Mijar.

The table below presents a list of industries, located in Mangalore, within the catchment area of Netravathi and Gurupur river.

TABLE 4-11: Potential from Industries in the catchment area

	Industries	Category	Potential	Reasoning
Near NMPT	MCF	Chemical Manufacturer	✗	MCF uses NMPT for importing Fertilizer and raw materials. Fertilizer is subsidized by the Government. Railway has monopoly on fertilizer transportation, hence MCF’s cargo is evacuated by trains. This arrangement restricts any potential for the proopoosed waterway from MCF.
	KIOCL	Pellet Plant	✗	KIOCL has a captive berth, Berth 18 at NMPT to handle Iron ore. KIOCL is in process to lay its own lines inside the marshalling yard of NMPT and would use rail to unload ore at the port; hence KIOCL would not provide any opportunity for IWT.
	HPCL	Petroleum Products	✗	HPCL, Mangalore moves its cargo through pipeline. HPCL has comissioned a new pipeline. As the river navigability stretch would not help the company to save time and cost of transportation, hence they are not willing to use waterway.
	MRPL	Petroleum Products	✓	MRPL could use waterway for transportation of hazardous cargo. LPG/ POL products, which are hazardous, could be shifted from roadways to waterways.
	IOCL Mangalore	Terminal; Petroleum Products	✗	These industries are located closer or adjacent to NMPT. Road connectivity is good; hence these industries would not use the proposed waterway.
	UltraTech Cements	Bulk Packaging Terminal		
	Hi Build Coatings	Paint Manufacturer		
	Kanachur Seasoning	Plywood Industries		
	Eswari Metal Industries	Manufacturing		
	Everest Plastic Industries	Plastic Fabrication		
	Hindustan Unilever	Chemical, Detergent		
	Mukka Sea Food	Fish Meal Processing		

	BASF India	Chemical Industry		
	Mangala Cashew	Manufacturing		
	Murugan Industries	Manufacturing; Machinery Parts	May be	These industries could use waterway to distribute products in the hinterland to avoid road congestion problem based on commercial viability.
	SRR Industries	FMCG manufacturer	May be	
	S.K. Hose Pipe	Hydraulic Hose Pipe	May be	
	Raihan Wood Industries	Woodworking Supply	May be	
	Kanara Wood and Plywood	Plywood store	May be	
	Reliant Pavers	Manufacturing	May be	
	Vinayak Industries	Steel Fabricator	May be	

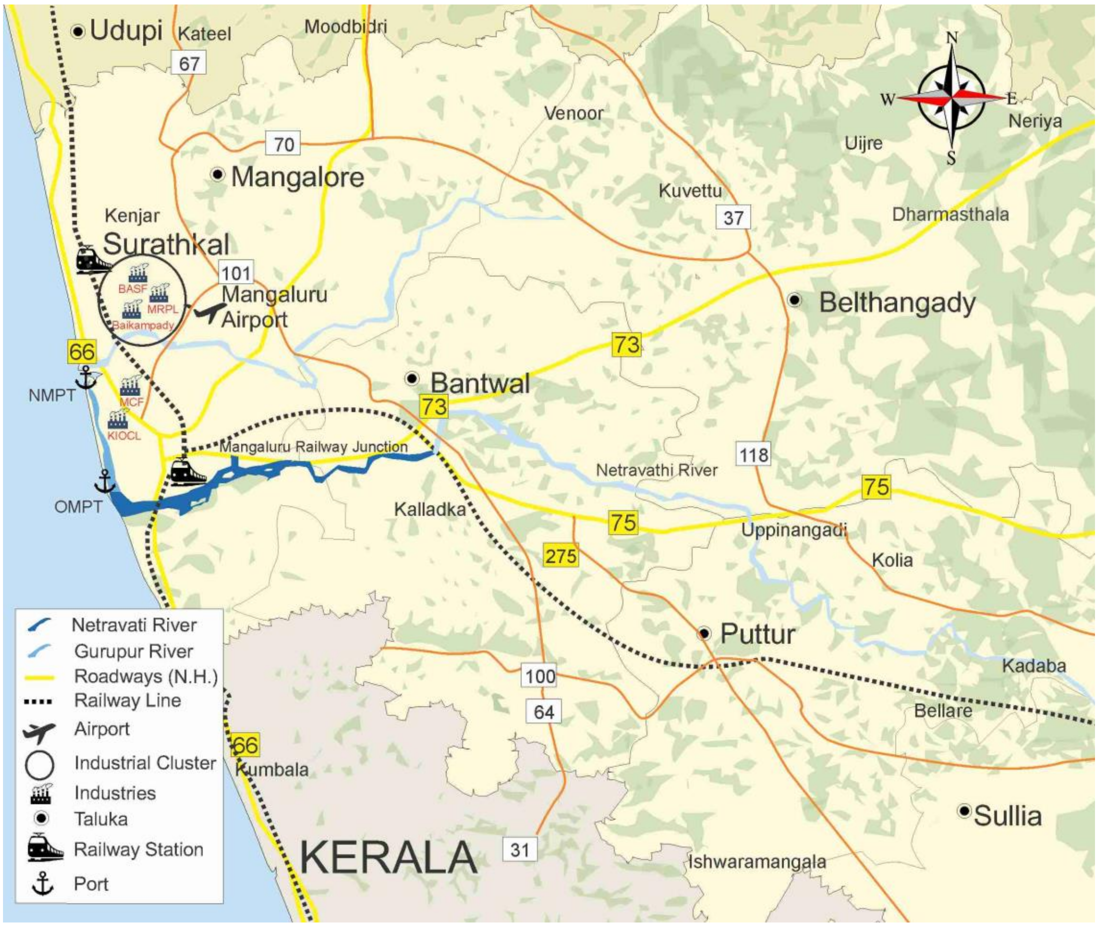


FIGURE 4.10: Connectivity around Industries in the hinterland

Major Industrial Players

- **Mangalore Chemical & Fertilizers Limited (MCF)**

It is the largest manufacturer of chemical fertilizers in Karnataka and its factory is strategically located at Panambur, in front of NMPT. It is a subsidiary of Zuari Fertilisers and Chemicals Ltd., which holds 53.03% equity shares.

The company is engaged in the manufacture of urea and complex fertilisers. About 60% of the company's products are sold in Karnataka. The plant has capacity to manufacture 217,800 MT of Ammonia and 380,000 MT of Urea annually. MCF imports fertilizer raw material through NMPT.

During FY15-16, production of 3,79,500 MTs of Urea, 2,05,308 MTs of Complex fertilizers (DAP/ NP) and 12,172 MTs of Ammonium Bi-Carbonate was achieved. The data shows increase in production from the previous year. The plant imports Phosphoric Acid, liquid Ammonia and Naphtha as feedstock through NMPT and the volumes are 0.2 Million Tonne, 0.06 million ton and 0.175 Million Tonne per annum respectively totalling 0.435 Million Tonne. In FY 2017-18, the company has plan to import substantial quantity of fertilizers to meet the growing demand.

Expansion Plan: MCF has proposed expansion of its existing capacity of various kinds of fertilisers in Mangalore. The plan is to set up an additional Diammonium phosphate (DAP) and NPK fertiliser capacity of 1 Million Tonnes per annum, 1,40,400 TPA of Urea, 81,000 TPA of Ammonia and 18,000 TPA of Poly Carboxyl Ether (PCE).

Potential from MCF- MCF plant is located adjacent to NMPT. MCF uses rail for cargo evacuation because as per Government policy, fertilizer freight movement/distribution by railway is subsidized; hence, it is unlikely that MCF would use the waterway for cargo movement**.**

- **Kudremukh Iron Ore Company Ltd. (KIOCL)**

It is located at Panambur, Mangalore. It is one of the major exporters of iron ore pellets. KIOCL uses NMPT for EXIM trade. KIOCL has one Pellet Plant Unit & one Blast Furnace Unit in Mangalore.

The annual production capacity of the Pellet Plant (Iron Ore) is about 3.5 Million Tonnes. It is a captive user of NMPT. It owns a berth (Berth No. 8), which is known as Kudremukh Berth and loading arm to handle iron ore pellets. KIOCL uses NMPT to handle imported cargo of POL coal and iron ore.

In FY10-11, NMPT handled 2.1 Million Tonnes of iron ore pellets cargo belonging to KIOCL Ltd. NMPT allotted 11 acres of land on lease of 5 years to KIOCL Ltd. to lay its own lines inside the marshalling yard. This rail will help the company unload ore at the port.

Potential from KIOCL- KIOCL Ltd. is in process to lay its own lines inside the marshalling yard of NMPT and it would use rail to unload ore at the port. With this development, it is evident that KIOCL would not use IWT on Gurupur & Netravathi river.

- **Mangalore Refinery and Petrochemical Ltd. (MRPL)**

It is a public sector enterprise under the Ministry of Petroleum & Natural Gas. It is located at the north of Mangalore. The capacity of this plant is 15 MMT per annum. It uses NMPT for handling cargo at oil berths. MRPL, with its parent company Oil and Natural Gas Corporation Limited (ONGC), owns and operates ONGC Mangalore Petrochemicals Limited (OMPL), a petrochemical unit with 1 million tonne production capacity of Para Xylene. OMPL is situated in the adjacent Mangalore Special Economic Zone (MSEZ).

MRPL is in the process of expanding its markets reach to sell 440 TMT of Polypropylene per year. MRPL is setting up its own infrastructure for storage of Polypropylene.

During FY 15-16, the Company's refinery processed 15.53 MMT of crude achieving an average utilization rate of 103.5% as against 14.63 MMT during FY 14-15. During FY 15-16, the total production of MRPL was 13,769 thousand MT.

MRPL consumes Crude oil (imported and indigenous), Hydrogen, Paraffin Raffinate, Reformate, CRMB Modifier, Naphtha Stream, Aromatic Stream as raw material.

Expansion Plan: MRPL is in process for an allotment of 1050 acres of land for Phase IV expansion.

Potential from MRPL- Various POL products that are produced at MRPL are transported to other parts of Karnataka and neighboring states by Road Tankers. These tankers mostly ply on NH 66, NH 275 and NH 75. As MRPL is not located on the National Highway, the tankers take other district roads to approach the National Highway. The tankers may take detour from the National Highway to other roads to reach their final destination in far-flung areas in the district. Tankers, which move from NMPT towards Mani Junction and further to Uppinagady and from NMPT towards Thalapady State Border, could be shifted to Gurupur/ Netravathi River through Ro-Ro services.

- **India Potash Ltd.**

It is the largest manufacturer of fertilizers, which distributes fertilizers in Karnataka. The company imports and distributes Muriate of Potash (MOP), Sulphate of Potash (SOP), Di-ammonium Phosphate (DAP), Rock Phosphate, Gypsum and other fertilisers. IPL handles fertiliser shipments of more than 3 MTPA at all the major and minor ports in the country. It does not have a plant in Mangalore or in the catchment area of Netravathi/ Gurupur river, but it uses NMPT to import fertilizer and distributes it in the entire state.

India Potash Ltd. imports finished products from Arab, Jordan and distributes it in Karnataka. India Potash imports raw material from Germany, China, Canada & Jordan. It uses NMPT port for import and moves its cargo by road from the port. The company witnessed decline in import and sale of DAP during FY 12-13 & FY 13-14. However, in FY 15-16, there is growth in sales of DAP, MOP and NPKs.

Potential from India Potash Ltd.- NMPT is located on the bank of Gurupur river; hence if India Potash would be willing to use waterway, it could use Gurupur River and further Netravathi river for cargo movement.

- **BASF India Ltd.**

It is a German chemical company, located at Katipalla, Mangalore. At present, BASF uses NMPT for import and from the Port, cargo is transported by road to BASF plant.

Potential from BASF- BASF's plant at Mangalore presents no opportunity for the waterway. BASF plant would not use the waterway because the plant is located only 7 km away from NMPT. The distance using the waterway would be more; hence BASF would not provide any opportunity for the proposed waterway.

- **Baikampady Industrial Estate, Mangalore**

Baikampady Industrial Area is located on North of Panambur, Mangalore. Baikampady Industrial Area encompasses an area of around 1,407 acres of land that is spread across Panambur, Kulai and Baikampady villages. There are many small-scale industries located at this estate. Baikampady Industrial Estate has many electrical, engineering, leaf spring, hollow blocks and pharmaceutical industries, food processing and plastic companies.

TABLE 4-12: Industries in Baikampady Industrial Estate

Sr. No.	Industries	Category
1	Strides Arco Lab & Speciality Ltd.	Chemical bulk drugs
2	Adani Wilmar (formerly Rajshree Packagers)	Manufacturer Refined edible oil
3	Ruchi Soya Industries Ltd.	Manufacturer Refined edible oil
4	Vishwas Industries	Brick Manufacturer
5	Kalbhavi Cashew Industries	Dry Fruit Store
6	Jaypee Industries	Electrical Equipment Manufacturer
7	Blue Water Foods & Exports Ltd	Exporters; Wholesale Suppliers
8	Bharath Fibreglass Industries	Fibre glass Supplier
9	Aruna Masalas	Food Processing Company
10	Elite Engineering Industries	Industrial Equipment supplier
11	Manipal Springs	Industrial Manufacturers
12	Magna Springs	Manufacture and supply
13	Vinayak Engineering Works	Manufacturer
14	Primacy Industries Limited	Manufacturer
15	Rodricks Industries	Manufacturer
16	Lamina Suspesion	Manufacturer
17	Bharat Petroleum Bottling Plant	Oil & Natural gas Company

Sr. No.	Industries	Category
18	Ruchi Soya Industries	Edible oil packaging unit
19	Plastex Industries	Plastic Fabrication Company
20	Gurucharan Industries	Plastic Fabrication Company
21	Deccan Plast Industries	Plastic Wholesaler
22	Delta Industries	Roofing Sheet Supplier
23	J K industries	Tyre industry

Potential from Baikampady Industrial Estate - Baikampady is adjacent to NMPT and it has good rail/ road connectivity. Panambur Marshalling Yard Railway Station is also nearby. Hence, it is unlikely that cargo from Baikampady Industrial Area will move through Netravathi/Gurupur River.

- **Ullal Industrial Estate, Mangalore**

Ullal Industrial Estate is located at the southern part of Netravathi river in Mangalore. There are two Fish meal and processing companies here, Bawa Fishmeal Oil & Co. and Fahad Fishmeal & Oil Co. As there are not many industries in this Industrial Estate; hence it would not provide much opportunity to the proposed waterway.

- **Yeyyadi Industrial Estate, Mangalore**

This Industrial Estate is Mangalore's oldest industrial area and home of several small-scale industries. It includes food processing, baking, fabrication, printing, die making, coir products, wooden furniture, plastic articles and machinery manufacturers. There is one machine manufacturing industry here, namely Spectrum Industries. There does not exist any large industry in Yeyyadi, and the locality lacks infrastructure and other facilities. Hence, it is very unlikely that this Industrial Estate would provide any opportunity to the waterway.

- **Udupi Power Corporation Ltd (UPCL), Udupi**

UPCL, a subsidiary of Adani Power Ltd. is a coal-based thermal power plant at Padubidri in Udupi District. It has 2 units and the total capacity is 2 X 600 MW (1200 MW). The commercial production from Unit 1 began in 2010 and Unit 2 in 2012. The plant has proposed to expand its production to an additional 1,600 MW by 2020. The plant imports about 4 mn TPA coal from Indonesia. UPCL has its captive jetty at NMPT to handle imported coal. The company has plan to develop an additional jetty at New Mangalore Port with an investment of about INR 500 Crore. It will further add another 6 mn TPA handling capacity in the next three years.

Potential from UPCL - UPCL already uses NMPT to handle imported coal and its plant is well connected with NH 66 and Konkan Railway. At present, the company uses Konkan Railway to transport coal from the Port to the thermal plant in Udupi. The plant is about 27 km from Gurupur river and 40 km away from Netravathi river, but it is unlikely that the plant would use the waterway.

Industries in Udupi- Other than UPCL, Udupi has two major industrial areas, Shivally and Nandikur. Shivally is located at Manipal in Udupi. It is spread across 90 acres of land and home to small & medium scale industries, which are most agro-based. Many industries are also based on fishing and home products in the coastal area. Nandikur, which is a new Industrial area is developed on 42.33 acres of land and consists of small & medium scale. The three major types of industries in Udupi are Cashew Processing, Printing & Binding, Fabrication & General Engineering. The industries located in Udupi have good road, rail connectivity. Konkan Railway and NH 66 cross over the district. These industries would not provide any opportunity for waterway in Gurupur & Netravathi river.

4.1.7 Traffic from Major & Non Major Ports

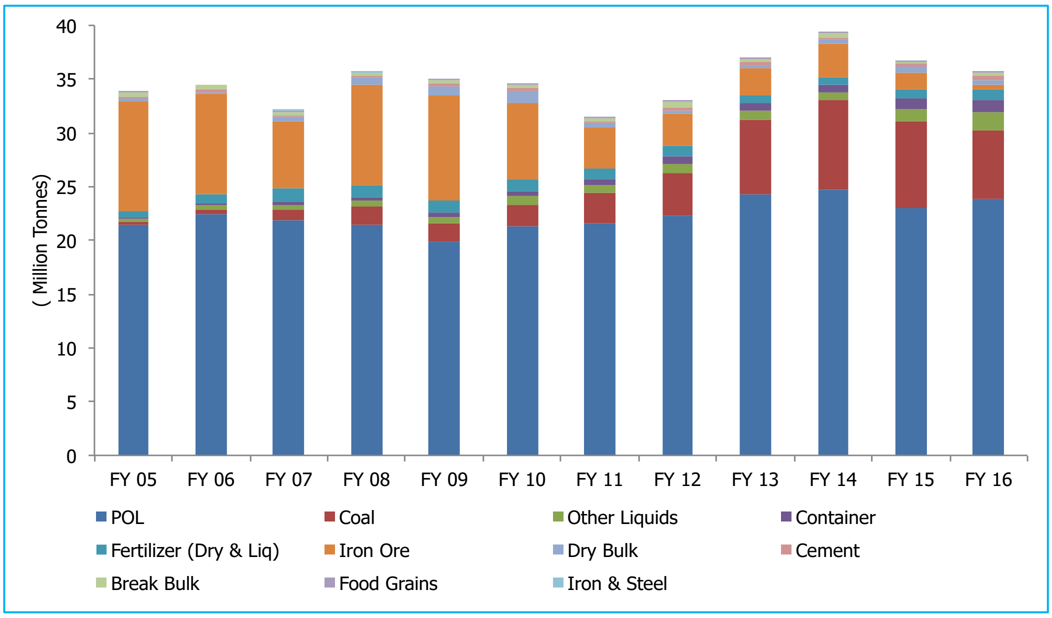
This section discusses the opportunities for IWT with respect to Major and Non major ports located in the region. This section would discuss the strategic location and infrastructural advantages of the ports in brief.

In the catchment area of Netravathi and Gurupur River, there exists one major port New Mangalore Port and one non-major port, i.e. Old Mangalore Port. In FY 14-15, out of 0.65 MMTPA of cargo handled at all 9 Non-Major Ports in Karnataka, about 0.12 MMTPA (18%) was handled at Old Mangalore Port and 36.56 MMTPA was handled by NMPT, i.e. 6.29% of all major ports traffic in India during the same period.

- **New Mangalore Port (NMPT)**

NMPT is the only major port in Karnataka and is the gateway for the EXIM trade of state. It has got a very vast hinterland that includes Hassan, Bengaluru, Mysore, Madikeri, Chikamagalur, Shimoga, Chitradurga, Hospet, Bellary, Haveri, all the way up to Kannur in Kerala. Lots of cargoes from these regions move to and from the port.

The major commodities exported through NMPT are Iron ore Pellets, POL products, Granite, Stones, Coffee and Containerized cargo. The major imports of the port are Crude and POL products, LPG, Coal, Limestone, Timber logs, Wood pulp, Finished fertilizers, Liquid Ammonia, Phosphoric Acid, Other Liquid Chemicals, Edible oil, Cashew and Containerized cargo. NMPT handled traffic of 36.69 MTA and the most LPG 1.91 million MT of all major ports in India in FY 10-11.



Source: Indian Port Authority

FIGURE 4.11: Commodity wise historic Traffic handled at NMPT

TABLE 4-13: Commodity wise Imports of NMPT (mn T)

Commodities	**FY 12**	**FY 13**	**FY 14**	**FY 15**	**FY 16**
POL	15.6	16.5	16.8	16.2	18.2
Other Liquids	0.7	0.7	0.6	0.7	0.8
Iron Ore	1.2	1.5	1.7	1	0.1
Fertilizer	1	0.7	0.7	0.9	1
Coal	4	6.9	8.3	8.1	6.3
Cement	0.3	0.3	0.2	0.3	0.4
Dry Bulk	0.3	0.2	0.3	0.4	0.4
Break Bulk	0.4	0.3	0.3	0.1	0.1
Container	0.3	0.3	0.4	0.5	0.6
Total	**23.7**	**27.3**	**29.3**	**28.3**	**28**

Source: Indian Port Authority

TABLE 4-14: Commodity wise Exports of NMPT (mn T)

Commodities	FY 12	FY 13	FY 14	FY 15	FY 16
POL	6.6	7.8	7.9	6.8	5.7
Container	0.4	0.4	0.4	0.4	0.5
Iron Ore	1.9	1.1	1.5	0.5	0.4
Food Grains	0.1	0.2	0.1	0	0
Others	0.2	0.2	0.2	0.4	0.9
Total	**9.3**	**9.7**	**10.1**	**8.2**	**7.6**

Source: Indian Port Authority

- Ratio of Imports to Exports at NMPT was 3:1 in FY 15-16. Total traffic handled at the port has reduced to 35.6 MTPA in FY15-16 from 36.5 MTPA in FY 14-15. The major drop was reported in iron-ore traffic and also in crude oil imports.

- Out of the 36.56 MMTPA of cargo handled at NMPT, Overseas cargo to coastal cargo percentage is 86:14%, with import to export percentage being 80:20%.

- POL coal and iron ore are the main cargo handled at NMPT, mostly by captive users like MRPL, UPCL, KIOCL and Mangalore Special Economic Zone (MSEZ).

- **Container Cargo-** Coffee exports and raw cashew imports dominate container cargo at the port. In fact, coffee exports and raw cashew imports respectively accounted for 8,557 TEUs and 7,149 TEUs of the total 62,808 TEUs cargo handled by NMPT in FY15.

NMPT exports Coffee, Reefer cargo, Brake drums, cashew kernels, leaf springs, cocoa powder, fish meal & oil, tiles, plywood etc. In FY 11-12, the total export of these items was around 355 Tonnes. As the volume of export is very less; hence it provides no opportunity for the waterway.

NMPT has a container Berth B1, handling 60,000- 62,000 containers per annum. As per the business plan prepared for NMPT, the cargo is likely to increase to 84 MMTPA with container traffic increasing to 2.55 lakh TEU's in the next 10 years.

- Various hazardous chemicals imported at NMPT are transported by Road Tankers. These tankers mostly ply on the NH 66, NH 275 and NH 75.

Container cargo at NMPT is dominated by agricultural products. In 2016, raw cashew accounted for 36% of the total container imports. Similarly, coffee constituted over 27% to NMPT's total container exports. Together, these two commodities contributed nearly 32% to the Port's total container traffic for the said year. Year-over-year (y-o-y), both these cargoes have shown a healthy climb, both growing by 4%- 6%. Besides the prominent cargo of raw cashew and coffee, wooden logs, chemicals, salt, reefer cargo, and fishmeal were some of the majorly traded containerized commodities at NMPT.

These and other break-bulk cargoes account for not more than 8% of the Port's total containerized cargo volume. Just like most container terminals in the world, empty containers feature in NMPT's container traffic, too. These occupied 44% in Port's import traffic, 17% in its export traffic, and over 30% in Port's overall container EXIM for FY16. Below figure shows share distribution of top 5 containerized cargoes handled by NMPT in FY16:

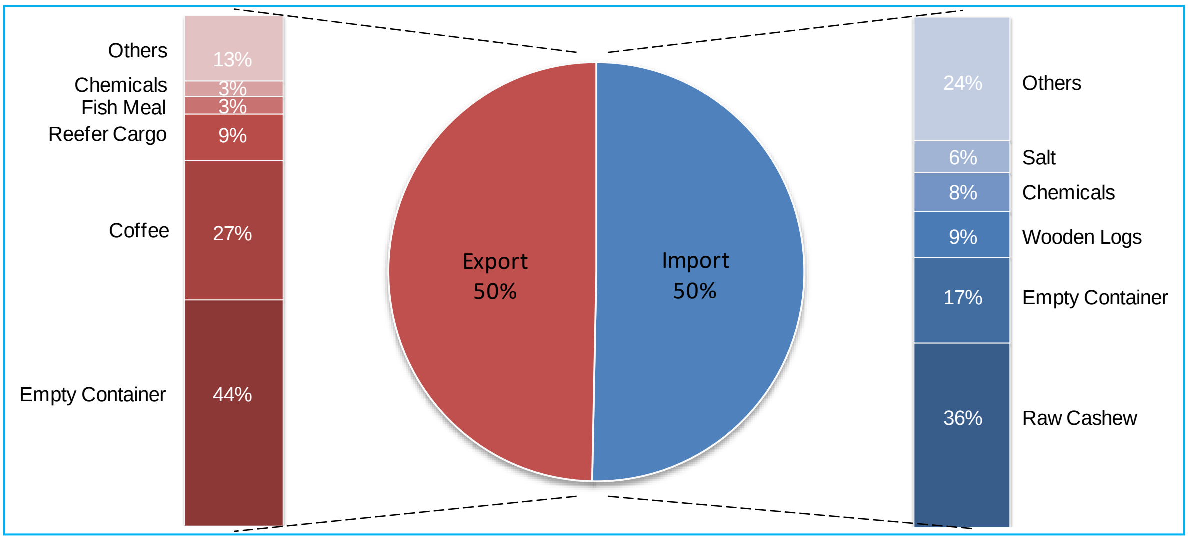


FIGURE 4.12: Commodity wise historic Traffic handled at NMPT

TABLE 4-15: Commodity wise Container Movement from NMPT

Commodities (TEU)	CY13		CY16*		Major Countries traded with
	Export	Import	Export	Import	
Food Products	11,257	6,587	12,118	8,647	Africa, Mediterranean, South East Asia, Red Sea, Middle East, China, USA
Liquid	335	851	1,166	1,936	China, North Continent, Middle East, USA, Canada, UK, Japan, Africa
Wood & Products	90	1,843	197	1,914	Africa, North Continent, Far East, China
Machineries	283	769	920	1,364	North Continents, China, Africa, USA, UK, Middle East
Metal &Metal Products	310	227	343	591	China, Far East, Africa, South East Asia, USA
RMG/Textile	56	125	568	318	USA, China, Middle East, South East Asia
Construction Materials	349	88	164	194	China, USA, Mediterranean, Far East
Electrical Goods	18	73	25	159	China, Middle East, UK, USA
Plastic & Products	41	50	51	65	Far East, Middle East, China

Commodities (TEU)	CY13		CY16*		Major Countries traded with
	Export	Import	Export	Import	
Frozen Food	3,460	64	2,319	32	Far East, South East Asia, China Mediterranean, USA
Rubber & Products	2	12	85	28	USA, China
Others	518	1,724	1,181	2,560	China, USA, Africa, Japan, Far East etc
Total	**16,719**	**12,413**	**19,137**	**17,808**	

Source: Khambadkones, *As per 2016 (Jan to Oct)

Some of the commodities of container traffic handled at NMPT as mentioned in above table could be potential commodity to be transported on Ro-Ro.

- **Fertilizers-** Finished fertilizer is imported by firms like India Potash Ltd, Indian Farmers Fertilizer Cooperative, Krishak Bharati Cooperative, Zuari Agro Chemicals Ltd etc. at NMPT for distribution in Karnataka.
- Most of fertilizer cargo traffic at NMPT is of imports from overseas destinations. Urea, DAP and MOP are the major import commodities. A declining trend in imports has been observed in both finished and raw fertilizers. The overall import volume of fertilizer at NMPT has declined at rate of 8.74% over last 6 years.
- Fertilizer imports have stagnated at around 0.70 million Tonne over last 3 years. As per report by Ministry of Chemicals and Fertilizers, there is estimated to be 2.5% year-on-year increase in consumption of fertilizers in Karnataka. Taking same scenario, NMPT can see increase in fertilizer cargo imports in coming years.

Possibility of Diversion from NMPT

NMPT is strategically located on the bank of Gurupur river. As this port is the major port in the vicinity and handles EXIM trade of most of the large industries in the catchment area, so NMPT plays a vital role for the proposed waterway.

Though NMPT have good rail and road connectivity, but congestion on connecting roads lead to increase in transportation time and cost. To get rid of such issues, Industries might consider IWT, to distribute their cargo in hinterland, which is congestion free and cost-effective. It would be convenient for these industries to use rivers to evacuate cargo from NMPT or move cargo to NMPT. Cargo from the Port could be diverted through Gurupur and then to Netravathi river.

Opportunity from Hazardous Cargo

Dakshina Kannada is one of the highly industrialised districts of Karnataka with 8 Potentially Hazardous Industrial units. Most of these units are concentrated around the NMPT area at Panambur in Mangalore. These units import, store, handle and export various hazardous chemicals, both flammable and toxic.

LPG and various POL products are handled in large quantities throughout the district, and their storages are mostly concentrated in and around Panambur area. LPG is imported at NMPT as well as manufactured by MRPL.

The transportation from the port to various storage tanks at Bala is done through pipelines. From there LPG is mostly transported to various parts of the state by road tankers. There are chances of Fire / Explosion involving these hazardous chemicals.

Various POL products that are produced at MRPL are transported to other parts of Karnataka as well as to neighboring states by road tankers. Similarly, various other hazardous chemicals, imported at NMPT are also transported by road tankers. These tankers mostly ply on NH 66, NH 275 and NH 75. As MRPL is not located on the national highway, the tankers take other district roads to approach the national highway.

TABLE 4-16: Hazardous Cargo handled at NMPT (in MTPA)

Road No.	Segment From: To	Important Towns Junctions & Route	Details of Hazardous chemical movement	
			Chemicals	Tankers per Day
NH 66, NH 73, NH 75	Surathkal-NMPT-Pumpwell Circle-Mani Junction- Uppinangady	Baikampadi, Kulai, Hosabettu, Kulur, Kottara KPT	LPG/ POL Products	45/ 60
NH 66	Surathkal-NMPT-Pumpwell Circle - Thalapady (State Border)	Ullal, Paramunur, Kotekar	LPG/ POL Products	03/12

Source: Disaster Management Plan, Dakshina Kannada

According to Disaster Management Plan, Dakshina Kannada, the above-mentioned locations, specially Junction near MCF/NMPT on NH 66, before Kullur Bridge and Road from MRPL to NH 66 at Surathkal are vulnerable for mishaps due to handling of hazardous cargoes. Movement of traffic is haphazard at times near MCF/NMPT and it is common to find many tankers parked in the area resulting in further traffic congestion in the area. The overhead conveyor of KIOCL passes over the area.

Parking of tankers in the region should be discouraged. The LPG tanker traffic in road from MRPL to NH 66 at Surathkal is maximum, as all the tankers from MRPL/ HPCL pass through this road before joining NH – 66. This road also suffers from traffic congestion. Other observation specific to this stretch of this road is the haphazard parking of Tankers just by the side of the road at several locations especially in front of BASF.

The above-mentioned problems due to hazardous cargoes movement through the city could be solved by shifting the hazardous cargoes transportation to the proposed waterway. POL and LPG Products handled at NMPT would provide opportunity for waterway on Netravathi and Gurupur river. Tankers with POL & LPG products move from NMPT towards Thalapady State Border on daily basis. These routes run parallel to Netravathi and Gurupur River; hence there is a potential to move this hazardous cargo through Ro-Ro service.

- **Old Mangalore Port (OMPT)**

OMPT is in the vicinity of the South end of Gurupur River. New Mangalore Port is 10 km northwards from OMPT. OMPT is a designated port for handling cargo to Lakshadweep islands, loading 100,000 MTPA (92%) of cargo to the islands through sailing vessels. OMPT has been catering the needs of Lakshadweep for many decades. Essential commodities and construction materials are the major export cargoes to Lakshadweep Island. Lakshadweep sends copra, scrap items and dry fish to Mangalore. The commodities handled at OMPT is presented in the below table.

TABLE 4-17: Cargo handled in last 5 years at OMPT (in MTPA)

Commodities	2011-12	2012-13	2013-14	2014-15	2015-16
Building Material	50,445	69,557	95,419	93,494	88,703
Cement	16,594	14,302	16,686	13,429	17,495
Granite Boulders	5,691	18,530	25,060	44,189	-
Granite Jelly	16,511	14,312	22,984	-	37,661
Sand	1,010	13,308	18,200	26,645	24,939
Clay Bricks/Tiles	10,639	8,753	10,717	7,462	5,782
Timber	-	-	260	328	417
Steel/Scrap	-	352	1,512	1,441	2,409
Food Grains	9,750	9,153	8,932	13,594	13,684
Rice	-	6,365	3,595	4,686	4,210
Sugar	-	690	-	-	-
Salt	-	-	-	-	699
Food Grain	-	-	4,515	7,819	8,439
Copra	1,877	2,075	597	865	208
Coconut shells	-	-	86	-	-
Mass/Dry fish	20	-	139	223	128
SMR Cattle Feed	891	-	-	-	-
POL	122	-	9	-	-
Oxygen Cylinder	-	-	9	-	-
Petrol ATF	84	-	-	-	-
LPG Gas	45	-	-	-	-

Commodities	2011-12	2012-13	2013-14	2014-15	2015-16
Chemicals	5,390	6,978	9,858	10,468	8,759
Soda Ash	5,390	6,978	9,858	10,468	8,759
Others	22,277	49,345	6,046	10,544	7,886
Misc.	22,277	49,345	5,851	10,433	7,698
Vehicle	-	-	195	111	188
Total	**87,991**	**1,35,033**	**1,20,264**	**1,28,100**	**1,19,032**

Source: Old Mangalore Port Trust

- ✓ Building materials: In FY 15-16, 88,581 MTPA Building material comprising of Cement, Sand, Granite and Steel are loaded for supply to Lakshadweep Islands.
- ✓ Food Grains: In FY 15-16,13,347 MTPA rice, other Food Grains and Salt are supplied from OMPT to Lakshadweep Island.
- ✓ Chemicals: In FY 15-16, 8,759 MTPA Soda Ash has been regularly unloaded at OMPT.
- ✓ Other cargo: 7,311 MTPA of other miscellaneous items and vehicles are also moved to Lakshadweep Island through OMPT in FY 15-16.

FIGURE 4.13: Cargo Handling at OMPT

Possibility of Diversion from OMPT

Out of the above-mentioned cargo, a portion of building material could be potential traffic for the waterway, as OMPT is located near Netravathi river. In FY 15-16, around 88,703 MTPA building material moved through OMPT to Lakshadweep. A portion of this, i.e. about 15,000- 18,000 MTPA building material (Granite and Laterite) could move through waterway to OMPT.

Food grain and Horticulture products that is exported to Lakshadweep are mainly produced in Mangalore and Buntwal taluka. However, it is unlikely that these products would be transported to OMPT by using IWT. At present, Cargoes that are exported to Lakshadweep use roadways to reach OMPT. If Government makes regulations to shift cargo of roadways to waterway to decongest roads, then OMPT destined cargo would provide opportunity for the proposed waterway. Below table shows the traffic generated in the hinterland and the % share that could be diverted to the waterway.

TABLE 4-18: Identification of Potential Traffic for Netravathi River

Commodities	Traffic Source	Potential	Reasoning
Food Grains	Produced in the catchment area	✓	Most food grains are consumed in the region; a portion can be moved to Lakshadweep through OMPT. This volume could be transported to OMPT using IWT.
Fertilizer	Catchment area	✗	Allotted in the region, could be transported by Ro-Ro; however volume is very less to be moved by Ro-Ro.
POL/LPG	NMPT, MRPL	✓	Hazardous cargo could be removed from roadways and shifted to waterway.
Building Material	Catchment area	✓	A portion of Building material that is moved to OMPT could be diverted to waterway.
Container	Catchment area	✓	Commodities that move on roadways towards NMPT and hinterland could be shifted to the waterway.

As shown in the above table, there is potential to move food grains, POL/ LPG & Building material through waterway on Ro-Ro.

4.2 Commodity Composition

At present, no cargo traffic is moving in Netravathi and Gurupur River, except at the confluence of both the rivers, where cargo from OMPT moves to Lakshadweep Islands.

4.2.1 Minerals

The Table below shows the possibility of minerals diversion on the proposed waterway with appropriate reasoning.

TABLE 4-19: Major Mineral Production in the catchment (FY 10-11)

Mineral	Mangalore	Bantwal	Puttur	Total (MT)	Potential	Reasoning
Building Granite	2,85,703	1,65,000	15,900	4,66,603	May be	Mostly consumed locally, a portion moves to Lakshadweep by OMPT
Laterite Stone	21,315	4,474	9,350	35,139	No	Less Volume
Dolerite	107	-	-	107	No	Less Volume
Lime Shell	624	-	-	624	No	Less Volume
Total	**3,07,749**	**1,69,474**	**25,250**	**5,02,473**	-	-

Source: Department of Mine & Geology, Mangalore 2010-11

4.2.2 Food Grains

About 2.9 lakh MT of Food grains, Rice, Pulses and Horticulture products are produced in Mangalore, Buntwal & Puttur taluka and a part of it can be transported through Gurupur/Netravathi river to OMPT. As per preliminary estimates about 4% of the total production of the catchment area, i.e. about 16,545 Tonnes of cargo could be transferred to IWT.

4.2.3 Fertilizers & Chemicals

About 13,048 Tonnes of Fertilizer is allotted to Mangalore, Buntwal & Puttur taluka of Dakshina Kannada District, as shown in the below table. Currently this is moving through Road. A part of it is supplied through MCF, the major Fertilizer manufacturer in the vicinity near NMPT. Out of it, about 10% (1,300 T) could move through Ro-Ro on waterway; however, this quantity is very less. Apart from this allotted fertilizer, MCF would not provide any opportunity to the waterway, as it is strategically located near NMPT.

There is decline in import of both finished and raw fertilizers in NMPT. The overall fertilizer imports volumes at NMPT have declined at rate of 8.74% over last 6 years. Government policy for providing no subsidy to naphtha based urea plants has contributed in decline.

TABLE 4-20: Taluka wise Distribution of Chemical Fertilizer (in Tonnes) (FY 14-15)

Taluka	Nitrogen	Phosphorus	Potash	Total
Mangalore	2,405	878	1,554	**4,837**
Bantwal	2,105	872	1,557	**4,534**
Puttur	1,398	878	1,401	**3,677**

Source: Dakshina Kannada District at a Glance 2014-2015

4.2.4 Fish Catch

About 1.5 lakh tonnes of Marine fish catch are procured in the catchment area. A part of this fish catch is packed in iceboxes and moved through trucks to various parts of the district from Old Mangalore Port. As this fish catch is consumed locally and distributed in nearby regions, so it would not present opportunity for waterway.

4.2.5 POL/ LPG Products

POL and LPG Products handled at NMPT would provide opportunity for proposed waterway on Netravathi & Gurupur river. About 38,325 Trucks of hazardous cargo could be moved on the waterway using Ro-Ro. However, this opportunity would realize only based on commercial viability.

4.3 Originating & Terminating commodities

Below table shows the potential traffic generated in hinterland of Gurupur/ Netravathi River along with source and reasoning.

TABLE 4-21: Identification of Potential Traffic for waterway

Commodity	Traffic Source	Potential	Reasoning
Fertilizer	Catchment Area	✗	Allotted in the region, could be transported by Ro-Ro; however, the volume is very less to be moved by Ro-Ro.
POL & LPG	NMPT, MRPL	✓	Hazardous cargo could be removed from roadways and shifted to IWT.
Container	NMPT	✓	Commodities that move on roadways towards NMPT could be diverted to the waterway to remove congestion on roads.

As shown in the above table, fertilizer volume is very less, hence it could not be moved on Ro-Ro. There is potential to move only POL/ LPG and containers through Gurupur waterway on Ro-Ro.

4.4 Passenger Traffic

More than 5 lakh people reside in Mangalore and Bantwal talukas. As per the Survey undertaken in 2006, about 1,400 passengers daily and more than 5 lakh passengers annually cross Netravathi River by the existing ferry service. About 7,000-8,000 passengers daily and about 23-27 Lakh passengers annually cross Gurupur River by the existing ferry service.

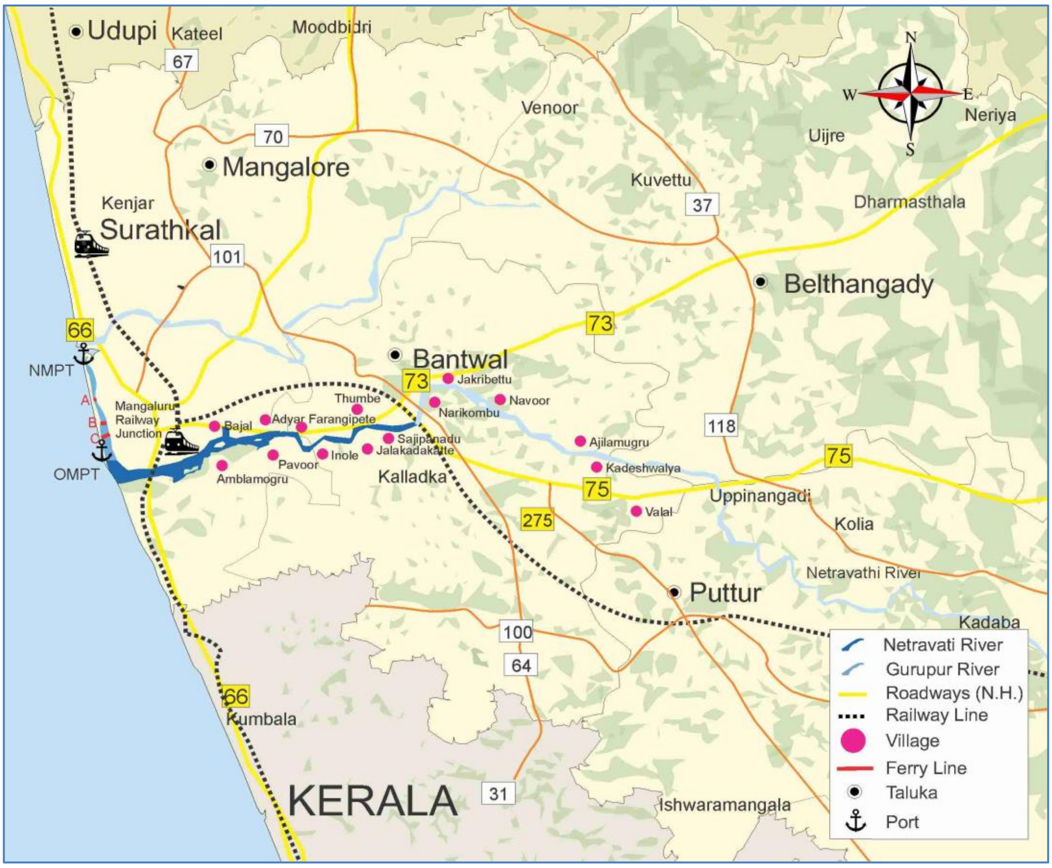


FIGURE 4.14: Ferry Movement at Netravathi River

The population of nearby talukas of Netravathi & Gurupur river is likely to grow in next 10 years. To handle the increased number of passengers, additional infrastructure like Ferry Terminals, additional Fleet, dredging & maintenance of waterway would be required. The below images depict existing ferry routes on both the rivers.

FIGURE 4.15: Ferry Movement at Gurupur River

TABLE 4-22: Ferry Passengers Traffic at Netravathi River

Survey Location	Passenger Traffic (1 day)	Per Year (2005)
Pavoor-Adyar	220	80,300
Arthola- Inoli	310	1,13,150
Bajal-Ambligolur	72	26,280
Paringapete-Inoli	61	22,265
Paringapete-Jalakadakatte	82	29,930
Tumbe-Talerogaru	71	25,915
Jakribettu-Narkombu	49	17,885
Navoora-Narkombu	10	3,650
Ajilamagaru-Kadeshivaaya	9	3,285
Serpadi-Barinarur	60	21,900
Talepadavy-Sajapamannur	60	21,900
Talapadi-Mundakodi	98	35,770
Beleyaru-Pavanachalaka	14	5,110
Sajapanadu-Tumbe	138	50,370
Valalu-Mogarj	158	57,670
TOTAL	**1,412**	**5,15,380**

Source: Directorate of Ports and Inland Water Transport, GOK: Development of IWT in Karnataka, 2006/ RITES Ltd.

TABLE 4-23: Ferry Passengers Traffic at Gurupur River

Survey Location	Passenger Traffic (1 day)	Per Year (2005)
Mangalore- Bangre (South Wharf)	2,960	10,80,400
Mangalore- Bangre (New South Wharf)	4,350	15,87,750
Sultan battery- Tannir bhavi	265	96,725
Total	**7,575**	**27,64,875**

Source: Directorate of Ports and Inland Water Transport, GOK: Development of IWT in Karnataka, 2006/ RITES Ltd.

At present, about 5,000- 10,000 passengers per annum move through OMPT to Lakshadweep islands. The passenger movement was highest, i.e. 10,704 in FY 14-15.

The figure below shows the present passenger handling at Bengre Jetty (as on Dec 2022). Presently there are 6 passenger boats (~200 Pax Capacity) deployed at 3 different jetties in Bengre (2 at each jetty). These jetties are used by local people to travel other side of the river (majority of them go to beach area), boat service is available in every 10 mins. In figure below, 1st picture showing around 70-80 people waiting to board boat.

FIGURE 4.16: Ferry Service at Bengre Terminal (as on Dec 2021)

More than 4.5 lakh people reside in Mangalore taluka and about 35,000 people live adjacent to Gurupur river. Village wise population near Gurupur river is mentioned in the below table.

TABLE 4-24: Ferry Passengers Traffic at Gurupur River

District	Village	Population
Dakshina Kannada	Thiruvelu	6,336
Taluka Mangalore	Ullaibettu	3,982
	Kandavara	3,278
	Mallur	2,664

District	Village	Population
	Adyapadi	2,257
	Addur	5,132
	Mogaru	2,708
	Tankaulipadi	2,092
	Muthur	1,487
	Kilenjaru	2,856
	Kolavur	2,410
Total	**-**	**35,202**

4.5 Tourism Traffic

Dakshina Kannada being a coastal region and forest region forms an attractive place for tourism. Some of the popular heritage destinations are Mangaladevi Temple, Kadri Manjunath Temple, St. Aloysius Chapel, Jain temple (Thousand Pillars Temple) at Moodbidri, Sultan Battery, Pilgrim Centre and Beach Resort at Ullal and Karala Temples. There is significant increase in inflow of tourists throughout the year to these destinations. Every year a large number of tourists visit Mangalore.

The major tourist circuits include Mangalore and Udupi. As per Tourist Statistics from Department of Tourism, Govt. of Karnataka, In FY 16, around 35,20,000 domestic and 247 foreign tourists visited Kateelu. The number of tourists is around 6,01,651 in Pilikula Nisargadhama, 1,21,387 in Thousand Pillars Temple and 51,95,120 in Dharmastala respectively. However, all these famous tourist places of Mangalore and nearby talukas would not provide opportunity for waterway because they are easily accessible by roadways. Waterway would attract only those tourists who intend to visit the tourist sites near the river.

TABLE 4-25: Inflow of Tourists during Peak Season (Dec. - March) in Mangalore & Udupi

Year	Tourist Inflow	Percentage Growth
2006	49,942	-
2007	57,559	15.25
2008	62,276	8.2

Source: Department of Tourism, Mangalore 2008

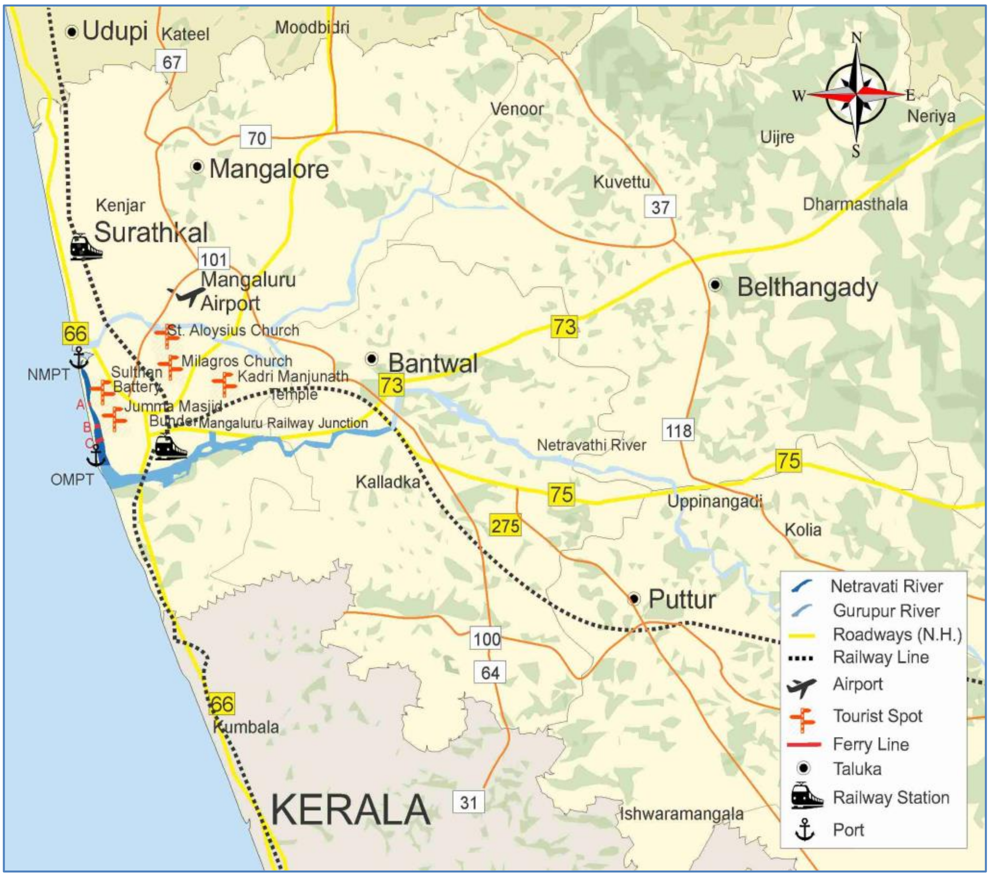


FIGURE 4.17: Popular Tourist Spots in the catchment area

Tourism Department of Karnataka state is planning to develop Backwaters of Netravathi and Gurupur River for houseboats, motorboats and water sports. Tourism Department is already planning to develop Cruise Tourism in the district. Tourists could travel along the backwaters and visit various destinations enroute to experience the diversity of the Western Ghats with its vibrant forests, waterfalls, wildlife, exquisite temples, beaches and the rich culture of Karnataka. The regular movement of cruise ships would open opportunities for the proposed waterway.

TABLE 4-26 Statistics of Tourists in popular tourist spots (FY 16)

Name of Tourist Place	Taluka	Total number of Tourists
Kadri Temple	Mangalore	10,00,000
Mangaladevi Temple	Mangalore	8,00,000
St Aloysius Chapel	Mangalore	2,00,000
Ullal Darga	Mangalore	3,00,000
Milagros Church	Mangalore	3,00,000

Some famous tourist attractions in the catchment of Netravathi and Gurupur river are described below. Most of these places are located in Mangalore. Located on the backwaters formed by joining of Gurupur and Netravathi river, the calm and scenic beauty of Mangalore makes it a brilliant tourist attraction. The main tourist attractions are Mangala Devi Temple, Kadri Manjunatha Temple, Kudroli

Gokarnath Temple, Pilikula Nisagardhama, Someshwar (Somnath) Temple and Ullal Darga. About 8,000 tourists visited Somnath Temple and Ullal Dargah of Syed Mohammed Shereeful Madani in 2005.

- Someshwar Temple (Somnath Temple) – Located in Ullal, this temple is near Someshwar beach, making it a picturesque temple. It is about 13 km away from Mangalore. Nearest major railways station is Mangalore Railway Station. Local trains stop at Ullal Railway Station, which is just 1 km from the temple. The best time to visit this temple is morning or evening time.

- Ullal Darga- The Dargah of Syed Mohammed Shereeful Madani, who is said to have come to Ullal from Madina, 400 years ago is also famous. An Urus is held once in five years here. About 8,000 tourists visited Somnath Temple and the Dargah of Syed Mohammed Shereeful Madani in 2005.

- Mangla Devi Temple – Built in 10^{th} century, this temple is situated about 3 Km from Mangalore city. The city got its name from the deity the Goddess Mangla.

- Kadri Manjunatha Temple – Based on Kadri hills this temple forms a major tourist attraction. Dating back to 1068 A.D. the temple has one of the oldest idols of Lord Manjunathaswamy. Pilgrims from distant location visit this temple. Idols of deities, ponds and green gardens are the major attarction of this temple. The Lokeshwara bronze statue of the Kadri Manjunatha Temple is tipped to the best bronze statue in India.

- Sultan Battery – Sultan battery is a watchtower of great historic importance built during Tippu Sultan’s rule in Mysore State. This watchtower was built to keep an eye on the possible invaders via Gurupur River and the Arabian Sea. This place attracts nature lovers to get a great view of the sea and the river. The ferry ride to this place itself is a pleasant experience for tourists.

- St. Aloysius Chapel– This Church is situated 1 Km away from Mangalore city centre. The walls of the church are adorned with the paintings of Antony Moshaini, an artist of Italy. The Church was built in year 1899-1900.

There are tourist attractions in Bantwal, like Sri Karinjeshwara Temple, Narahari Parvata, Nandavara, Shri Tirumala Venkatramana Swamy and Sri Mahalingeshwara Temple. Bantwal is located near the tail of the navigable length of Netravati River. It is likely that tourists would use waterway to reach tourist places in Bantwalby enjoying the scenic beauty of surrounding while sailing through.

The main tourist attractions in Puttur are Bendre Theertha, Beeramale Hill and Aithal Snake Park. Above mentioned tourist places could create traffic potential for Netravati waterway.

4.6 Road Survey Analysis

As part of the Detailed Project Report, the consultant has collected primary traffic movement data from the study area. Vehicular traffic was enumerated in the Traffic Volume Survey to forecast the traffic volume till 2040.

The survey was conducted covering two weekdays during the month of March 2017. Primary data collection was conducted at strategic location, i.e. Thumbe Bus Stop at Mangalore- Bangalore Highway. The location of the road survey is shown in below images.

Survey location was determined on the basis of following criteria:

- Thumbe Bus Stop is strategically located between Bantwal and Mangalore. Cargo movement to/from Bantwal to NMPT is crucial to understand the potential for the proposed waterway.
- Thumbe Bus Stop is located near the proposed terminal for the waterway in Netravathi/ Gurupur River.
- Safety and security of the surveyors, equipment and moving traffic.

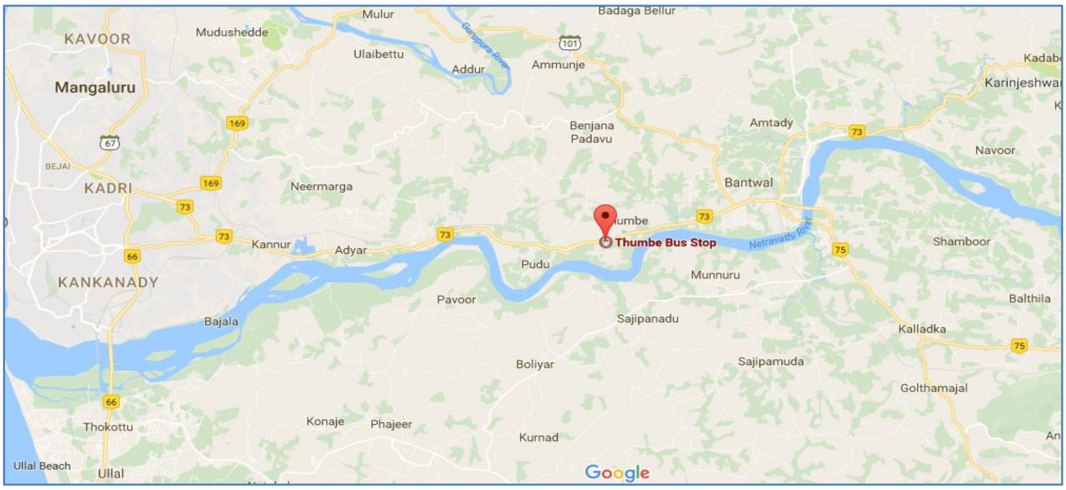


FIGURE 4.18: Macro Map of Traffic Survey Location (Thumbe Bus Stop)

FIGURE 4.19: Traffic Survey Location (Thumbe Bus Stop)

Cameras were installed at Thumbe Bus Stop and data recorded for continuous two week days. Average 24-hour total traffic flow per direction for each day is taken during the survey.

Manual Counts conducted at one location; i.e. Thumbe Bus Stop for 24 hours on 2 typical weekdays (Monday & Tuesday). These counts recorded the number of Government and private vehicles in each category as follows:

- Car/Jeep/Van
- Taxi
- Auto Rickshaw (3 w)
- Two wheeler
- Tata Magic/ Shared Auto
- Motorised vehicles- Bus (Minibus/Govt. bus/Private bus), School bus
- Goods vehicles- Mini Lcv, Lcv, 2 Axle, 3 Axle, Multi Axle trucks
- Agriculture Tractors- Tractor, Trolly
- Non-motorised vehicle- Hand/animal cart
- Cycle- Cycle, Rickshaw

The below image shows manual traffic count done by Road survey team and vehicles passing on the highway near Thumbe Bus Stop.

FIGURE 4.20: Manual Traffic Count at Thumbe Bus Stop

Table below shows Manual Counts of Goods trucks (2 Axle, 3 Axle and multi- Axle) at the Survey Location. Only these vehicles are considered for the study because Goods trucks are relevant for Ro-Ro projection, not other passenger vehicles.

TABLE 4-27 Traffic count data from Thumbe Bus Stop)

Day 1				
Bantwal to Mangalore				
Time (Interval of 4 hours)	**2 Axle Truck**	**3 Axle Truck**	**Multi Axle Truck**	**Total**
08.00- 12.00	287	163	167	617
12.00-16.00	223	223	164	610
16.00-20.00	189	159	155	503
20.00-00.00	142	98	135	375
00.00-04.00	19	29	48	96
04.00-08.00	75	66	87	228
Mangalore to Bantwal				
Time (Interval of 4 hours)	**2 Axle Truck**	**3 Axle Truck**	**Multi Axle Truck**	**Total**
08.00- 12.00	120	75	68	263
12.00-16.00	124	120	76	320
16.00-20.00	112	99	92	303
20.00-00.00	72	65	76	213
00.00-04.00	9	11	20	40
04.00-08.00	41	31	38	110
Day 2				
Bantwal to Mangalore				
Time (Interval of 4 hours)	**2 Axle Truck**	**3 Axle Truck**	**Multi Axle Truck**	**Total**
08.00- 12.00	213	97	173	483
12.00-16.00	227	125	166	518
16.00-20.00	285	169	181	635
20.00-00.00	169	131	136	436
00.00-04.00	50	65	85	200
04.00-08.00	90	70	91	251
Mangalore to Bantwal				
Time (Interval of 4 hours)	**2 Axle Truck**	**3 Axle Truck**	**Multi Axle Truck**	**Total**
08.00- 12.00	71	47	55	173
12.00-16.00	123	57	88	268
16.00-20.00	177	76	91	344
20.00-00.00	102	92	104	298
00.00-04.00	27	33	40	100
04.00-08.00	49	28	42	119

The table above shows traffic of trucks at four hours' interval. Traffic of every 4 hours is added to reach at the number of 4 hours' interval. It can be derived from *Table 4-23* that total number of Trucks passed through Mangalore Bangalore Highway during the survey is 4,952 on typical weekdays. In Day 1, number of vehicle movement is higher in the morning and afternoon than Day 2. However, in Day 2, number of vehicles was recorded slightly higher during evening hours.

Day 1

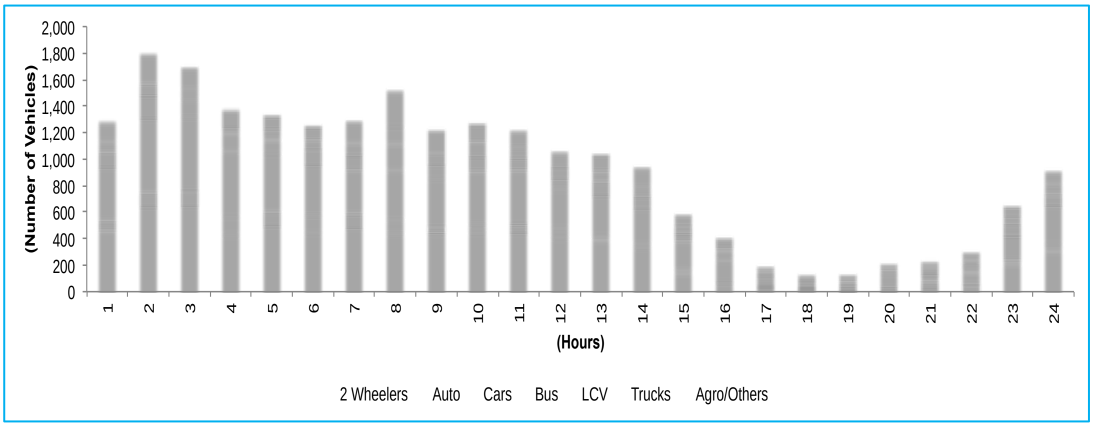


FIGURE 4.21: Traffic Count of Day 1 (Monday) based on category of vehicles and time

Day 2

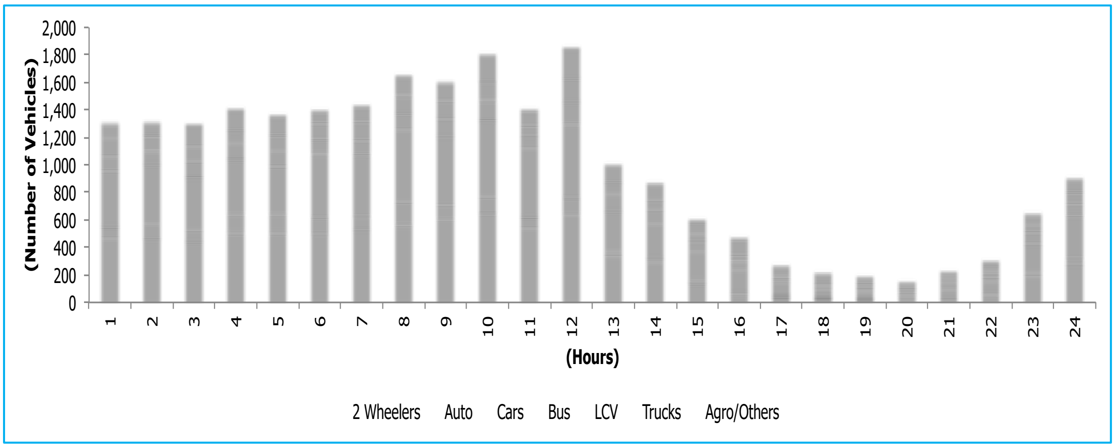


FIGURE 4.22: Traffic Count of Day 2 (Tuesday) based on category of vehicles and time

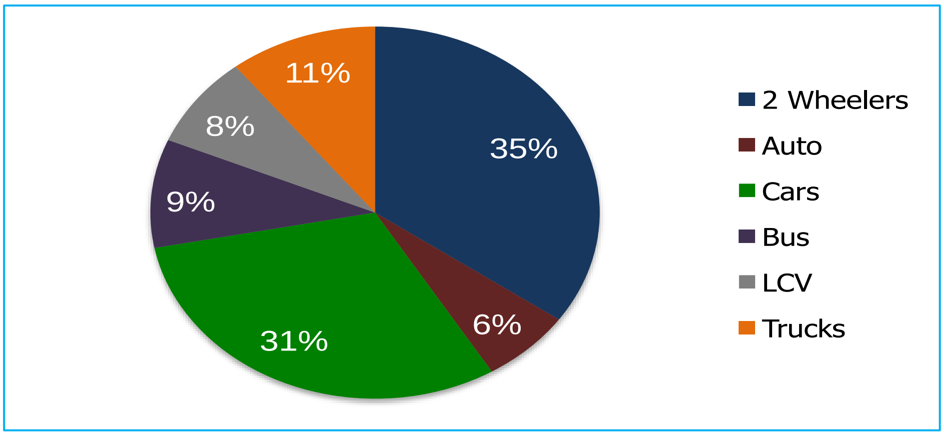


FIGURE 4.23: Chart of Manual Traffic Count

The above graphs depict total number of vehicles moving on Mangalore-Bangalore Highway during 2 days of traffic survey. The graphs clearly show that two wheelers movement dominate, followed by cars, jeeps and vans. It is also clear from the graph that traffic movement was higher in Daytime than night time.

The above Figure shows a summary of the average vehicle classification distribution across the traffic survey site at Thumbe Bus Stop. 2 Wheelers account for the vast majority of traffic (35%), car, jeep, van and taxi are 31% of the flow. Auto rickshaws, Tata Magic shared auto makes 6% of the traffic. 2 Axle 3 Axle and multi-axle Vehicles are just 11% of the total traffic. Buses, consist of mini bus, government bus, private bus and school bus are 9% of the traffic flow.

It is evident that cargo is transported by trucks. The traffic survey shows dominance of 2 Axle, 3 Axle and multi- Axle trucks in the route. As other small and large vehicles, like auto rickshaw, cars, buses are irrelevant for the Detailed Project report; hence the consultant has not considered them for calculation of average traffic. Daily and annual traffic is based on the number of 2 Axle, 3 Axle and multi-Axle trucks.

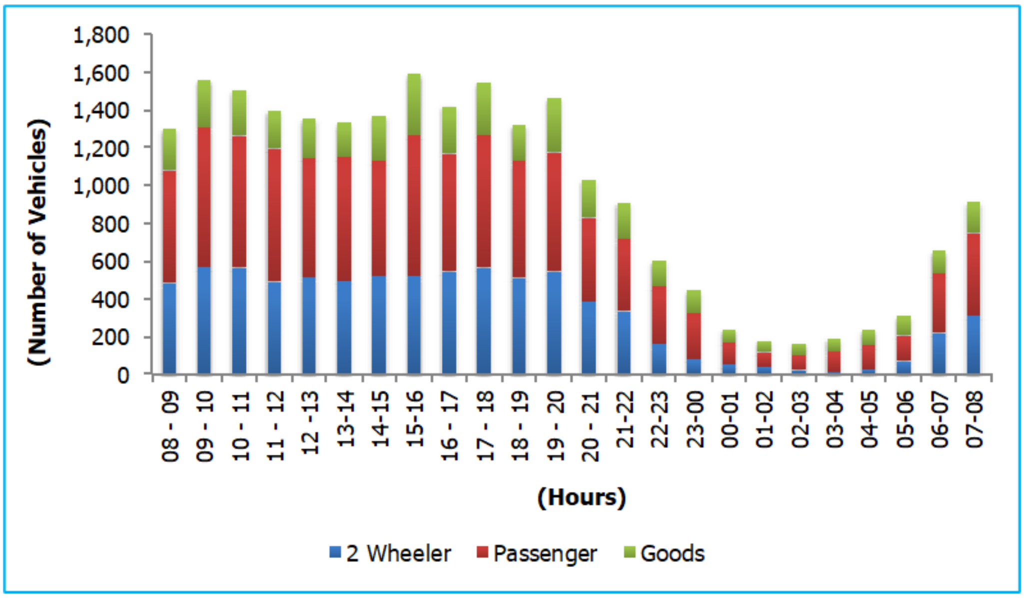


FIGURE 4.24: Average of Contribution of different vehicles in total traffic

The above graph shows average of vehicle traffic at the survey location. Number of 2 Wheelers and Passenger vehicles are more than Goods vehicles. Passenger vehicles include cars, jeep, vans, taxi, auto rickshaws, mini bus, Govt. bus, private bus and school bus. Goods vehicles include mini Lcv, Lcv, 2 Axle, 3 Axle and multi Axle trucks.

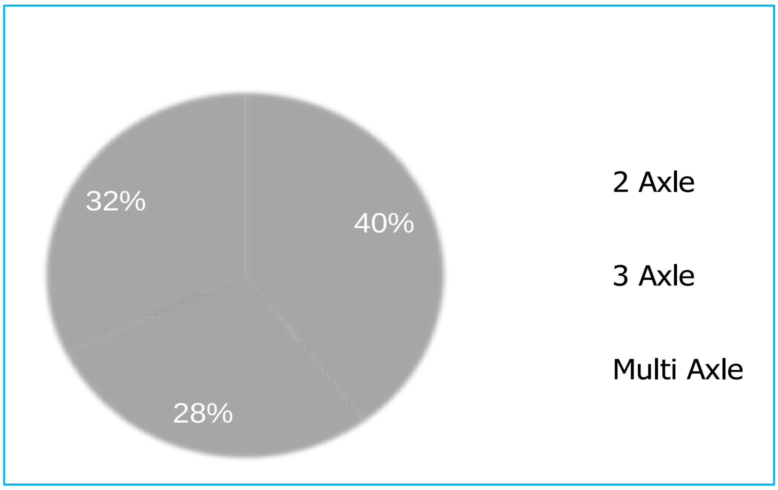


FIGURE 4.25: Contribution of different types of Trucks in total cargo truck traffic

The traffic survey undertaken to assess truck movement between Bantwal to Mangalore indicates dominance of 2 Axle trucks, followed by Multi Axle trucks. The percentage shown in the above pie chart indicates percentage of different types of trucks in total goods truck category. The movement of these goods trucks is throughout the day.

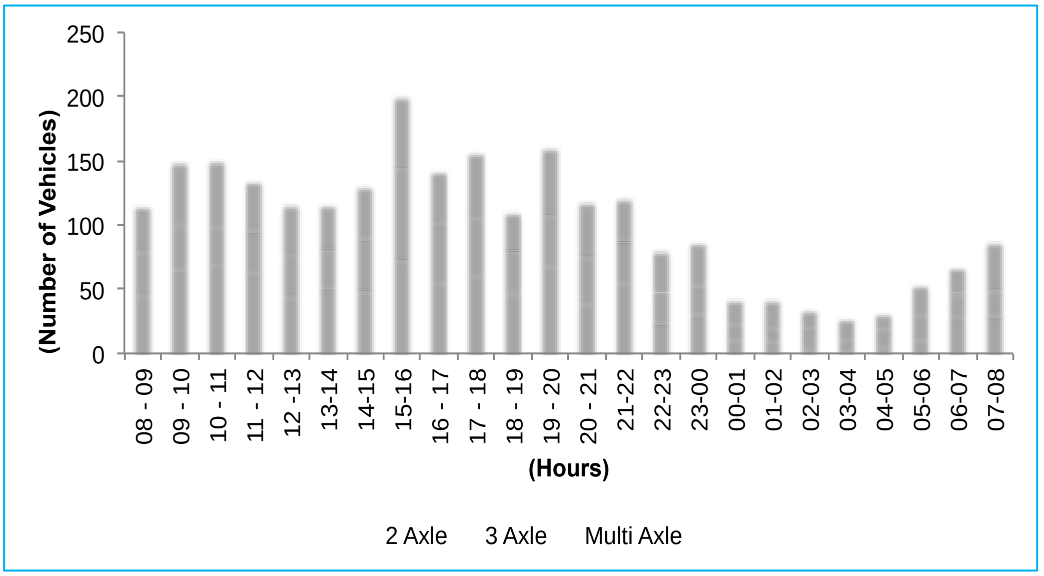


FIGURE 4.26: Average of Contribution of Cargo Trucks in total truck traffic

The above Figure shows average traffic of various good trucks in hourly basis. Traffic was at peak during 3 pm-4 pm.

Daily traffic pattern and peak flows at each lane during the survey are presented in the below graph.

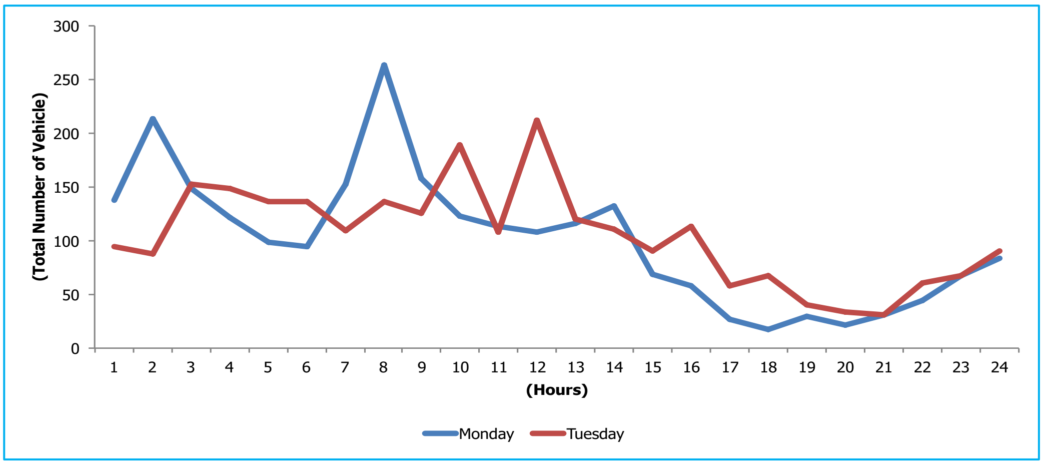


FIGURE 4.27: Daily Traffic pattern and peak flows on Monday & Tuesday

In the above daily traffic flow pattern graph, it is evident that Monday has two peak flow mounts during morning and afternoon, whereas Tuesday has two peak flow mounts during evening. In the above graph, 24 hours are shown for indicating time. Here, 1 in Horizontal line (hours) denotes 8- 9 am.

Conclusion of Road Survey

Based on the analysis of Road Survey done on Thumbe Bus Stop, the following conclusion is drawn.

- Consultants undertook road survey for movement of vehicles. Road survey included volume count of all types of vehicles moving from Bantwal to New Mangalore Port and vice versa. Percentage distributions of types of vehicles are derived from the survey data, collected between 06 March 2017 and 07 March 2017 to get classified vehicle counts.
- Traffic of truck is higher from Bantwal to Mangalore. Survey done in 2 days reflects that around 4,952 number of 2,3 and multi Axle trucks moved from Bantwal to Mangalore.
- Number of trucks from Mangalore to Bantwal was 2,551, which is about half the numbers of traffic from Bantwal to Mangalore.
- Movement of goods is mostly for export, import through NMPT and consumption in the hinterland. Hence, these movements would be undertaken to understand potential to divert cargo traffic to the waterway. This Road survey is crucial for future projection of Ro-Ro traffic on Netravathi and Gurupur river.

4.7 Growth Trend

4.7.1 Ro-Ro Traffic

The below table shows number of cargo trucks, observed during Road Survey at Thumbe Bus Stop near Brahmarakotlu. These numbers of trucks are analysed to reach at present daily and annual traffic, including hazardous and non-hazardous commodities.

TABLE 4-28 Methodology for Ro-Ro Traffic based on number of trucks at Thumbe Bus Stop

(Unit- in Number)

	2 Axle Truck	**3 Axle Truck**	**Multi Axle Truck**
Cargo (Net Average both ways)	493	349	397
LPG	0	0	45
POL Products	20	20	20
Total Average Hazardous Cargo	20	20	65
Total Average Non Hazardous Cargo	473	329	332
Market Share - Non Hazardous Cargo- 20%			
Market Share - Hazardous Cargo- 100%			
Assumed Traffic (Daily)	115	86	132
Total daily traffic (2, 3, Multi-Axle Trucks)	333		
Annual Traffic	**1,21,545**		

As shown in the above table, it is evident that Total Average hazardous cargo is less. Total Average of hazardous cargo is excluded from Net average cargo (both ways) to reach at the number of total average of Non hazardous cargo. The consultant has considered 100% market share of hazardous cargo as potential market for the waterway, assuming that Government would make policies to remove hazardous cargo from roadways for safety. Hence, all the hazardous cargo would be shifted to the proposed waterway.

The consultant has considered 20% of Non-hazardous cargo to shift to the waterway, assuming that industries would be resistant to switch the mode of transportation and other factors. After taking the market share of both types of commodities, daily traffic is assumed. Based on daily traffic, annual traffic is calculated, which is 1,21,545 trucks, including 2, 3 and multi-Axle trucks.

- ✓ **Hazardous Cargo-** Hazardous cargo, like POL and LPG products move from/to NMPT and Bantwal. At present, these hazardous cargoes are moved in tankers by roadways. The routes on which these tankers are moved, run parallel to Netravathi and Gurupur River, there is a definite case of moving this hazardous cargo through Gurupur/ Netravathi river through Ro-Ro services. This potential to move about 38,325 Trucks of POL and LPG products annually through the proposed waterway can be evaluated further

  The below table shows cargo movement by trucks from NMPT towards Bantwal and vice versa. The data is a result of Road Survey done in this route for two days at Thumbe Bus Stop, refer Section 4.7 Road Survey Analysis. Based on the below data, traffic for Ro-Ro is calculated and future projection is done.

TABLE 4-29 Cargo Movement by trucks from NMPT to/from Bantwal on number of trucks at Thumbe Bus Stop

	2 Axle Truck	**3 Axle Truck**	**Multi Axle Truck**
Bantwal to NMPT			
Day 1	3	9	10
Day 2	3	11	12
Average	3	10	11
NMPT to Bantwal			
Day 1	6	10	7
Day 2	14	7	14
Average	10	9	11
Net Average both ways traffic			
Net Average	**7**	**10**	**11**

- ✓ **Food Grains-** About 4% of total food grains produced, about 16,545 Tonnes of food grains can be transferred to IWT through Ro-Ro.
- ✓ **Fertilizers-** Out of 13,048 Tonnes of Fertilizer is allotted to Mangalore, Buntwal & Puttur taluka, about 10% (1,300 T) can move through Gurupur/ Netravathi River through Ro-Ro facilities.
- ✓ **Minerals-** The mineral reserves on the catchment area produce very less minerals. Other reserves do not extract ores, as their volume is very less. Hence, there exists no potential from minerals for the proposed waterway.
- ✓ **Industries-** Industries in the catchment area are mostly located near NMPT and have good road/rail connectivity; hence at present, there is no potential for Ro-Ro traffic from industries. If in future, Government makes regulations to shift road cargo to waterway to decongest roadways, then the regional industries would provide opportunity for the waterway.
- ✓ **Cargo from OMPT**- A portion, about 15,000- 18,000 Tonnes of building material, Granite and Laterite could be moved through Netravathi river to OMPT.

Gurupur and Netravati rivers have wide range of commodities for transportation of waterways. The diversified number of commodity requires different types of vessels for transportation on waterways. The volume of commodtities traded is small. This would lead to under utilization of vessels deployed for transportation of cargo on rivers.

For example, a river bulk carrier could carry building materials and Food grains after clearning the cargo hold. This translates into an annual volume of 30,000 tonnes. A vessels of 1,500 DWT would be able to make only 20 trips during whole year. The vessel vessels would remain idle for rest of the time.

Selection and deployment of Ro-Ro vessels would bring uniformity in cargo transportation over rivers of Mangalore (Gurupur and Netravati). Same vessel could be used to carry Food grains, Building materials or any other cargo. This would increase utilization of vessels, reduce vessels related capital and operational cost. The Ro-Ro vessels would also bring down handling cost at river terminals. Hence, Ro-Ro vessel is the most suitable type of vessels for carrying diversified cargo.

However, the above-mentioned diversion would only take place through regulatory interferences to reduce congestion of Mangalore city roads. The multimodal routes incur additional cost on end to end transportation due to multiple cost and time involved while changing modes of transporation. Cost of proposed multimodal route is further evaluated in the following section.

Logistics Cost Analysis

The section below discusses the logistics cost comparison between existing mode (Road) and proposed IWT for ro-ro movement. This will help to understand the commercial viability of ro-ro movement on River Netravati and Gurupur.

The ideal condition that could drive the business in IWT's favour will rest primarily on the integrated logistics costs involved. The current transportation logistics adopted by the industries is indicative of their preference for moving their cargo to/from NMPT. Proposing traffic shift to a different mode requires a strong and a practical driving factor. Lower integrated logistics cost, as compared to road logistics cost, can act as the most ideal distinguishing criterion in this regard. The following illustrates time and distance difference between the current roadway movement and potential ro–ro operation using the River Netravati and Gurupur:

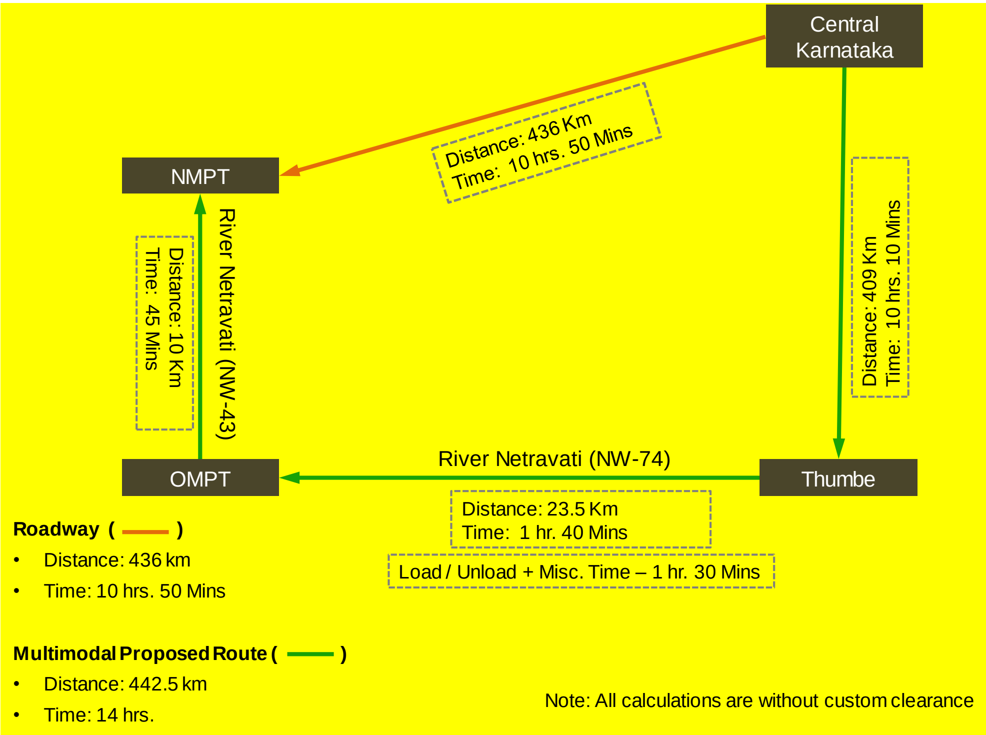


FIGURE 4.28: Time & Distance Comparison

It is clear from the graphical representation above that time required to cover the distance to reach NMPT is more in case of multimodal route. Therefore, time and cost involved in multimodal transportation is also more compared to roadway. Proposed IWT route also involves multiple handling of trucks. This adds to the total logistic cost involved in transportation. The table below shows the assumptions considered while calculating logistics cost differences between roadways and proposed IWT.

TABLE 4-30 Assumptions for Calculating Logistics Cost

Assumptions	Unit	Case I	Case II
Route	-	Central Karnataka - NMPT	
Road Distance	km	436	
Road Distance (Central Karnataka - Thumbe)	km	409	
River Distance (Thumbe - NMPT)	km	33.5	
Ro-Ro Vessel Capacity	Trucks	15 (15 TEU)	
Berth Hire charge	Vessel/ Day	1,500	
Terminal Charges	per Truck	300	
Fairway Usage Cost	GRT/Km	-	
Engine Power	kw	2 x 250	2 x 150
Engine fuel requirement	l/hr	87	31
Ro-Ro Vessel Speed	Knots	8	8
Fuel Price	INR	94	94
Charter Rates (INR/Trip)	INR/trip	90,000	90,000

The chart below shows logistics comparison in two different cases under Ro-Ro cost dynamics. In Case I, IWAI designed and built Ro-Ro vessels has been considered. IWAI built 10 vessels of this specification at Cochin Shipyard for deployment in National waterwasys of India. These vessels have a cumulative engine power of 250 kw and they can carry 15 TEU. For a further elaborate comparision and sensitivity analysis based on reducing engine capacity has been made as part of Case II. In Case II, same vessels operating cost has been calculated and compared with a reduced engine power of 150 kw.

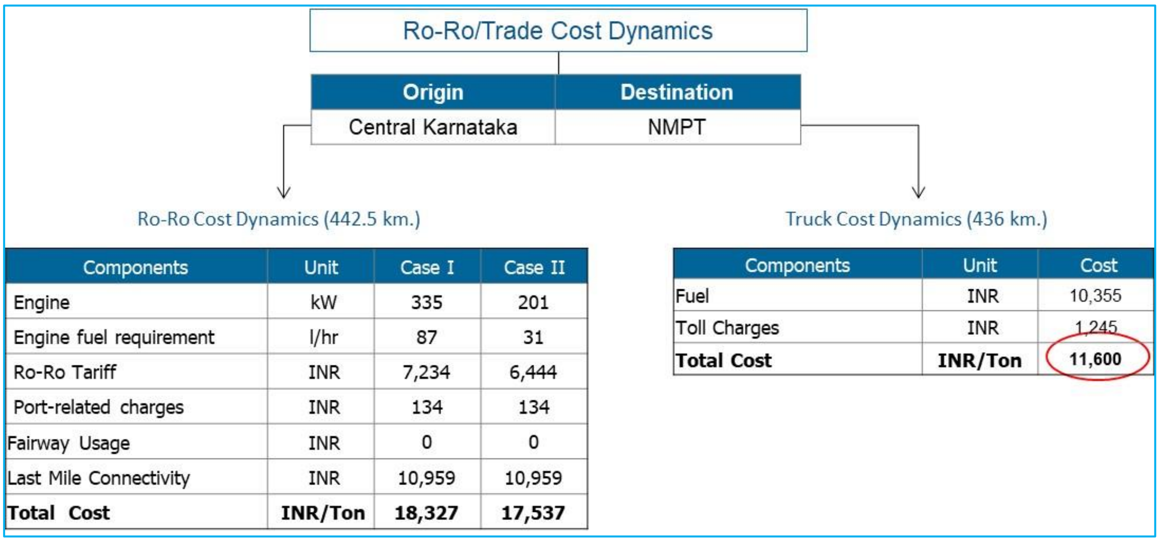


FIGURE 4.29: Logistics Cost Comparison

Two synopses have been considered to arrive at logistic cost for a possible Ro-Ro service on the proposed IWT route. In case of Ro-Ro logistics cost analysis, Ro-Ro Tariff assumes costs related to the multi-modal logistics. This includes nominal fairway charges, charges associated with vessel chartering and the associated fuel cost, and port-related charges (berth hire and port dues). Traffic diversion from road to waterway encompass cost saving in relation to truck transportation cost. Primarily, this saving is on fuel cost and toll charges. While calculating Ro-Ro cost dynamics, these haven't been considered, as these costs would never factor in Ro-Ro transportation logistics. In case of truck cost dynamics, there are other parameters that influence the total roadway logistics cost. These include Repair & Maintenance cost, driver/crew wages, truck finance cost, profit & other costs. Including these for truck logistics analysis will necessitate inclusion of the same cost factor in case of Ro-Ro cost dynamics.

However, these costs will be abolished, as their impact on both the logistics cost dynamics would result in a similar growth in cost leading to a similar logistics cost difference.

It is assumed that IWAI would develop the entire infrastructure (Terminal & Navigation), and hand it over to the operator without looking to recover the development cost. It is also assumed that IWAI would not take Terminal charges, Fairway usage charges, etc. in order to promote any Ro-Ro service on the proposed waterway.

Costs involved in both the Ro-Ro cases are on the higher side when compared to roadways. The difference between the two discussed transportation modes is in the range of INR 6,000 to INR 7,000 per truck. In case of just Ro-Ro cost comparison, Case II is marginally cheaper than Case I i.e INR 790/truck.

- **Ro-Ro terminal with subsidy**

It is visible from the logistics cost comparison that both the cases of waterway movement are costlier than current mode of transportation using roadways by a significant margin. As per Case I (higher engine power 250 kw), the logistics cost difference for roadway and waterway is INR 6,993/truck. Cost of transporting per truck on the waterway with considered engine configuration would be more than twice as expensive as roadway. In Case II (Lower engine power 150 kw), leads to reduced cost difference (INR 6,203/truck).

In case of development of inland waterway on Netravathi and Gurupur river, IWAI needs to provide the cost difference per truck as subsidy to transporters. It is necessary to provide subsidy as well as incentives due to increase time and distance of transportation through waterway and to shift existing traffic to waterway. IWAI should carry costs associated with maintenance of the Terminal (repairs and maintenance) and the navigation infrastructure (dredging, night navigation, buoys, etc.). Only in case of subsidy and incentives, projected traffic (Table 4-30) could be attained on the proposed waterway on Netravathi and Gurupur River.

- **Ro-Ro terminal without subsidy**

Industry could be directed to shift to waterway by local authorities on account of safety and congestion reduction on the roads of Mangalore city. The trucks carry high value hazardous cargo on the roads. The cost differential of Rs 6,000 to Rs 8,000 per truck would create minimal impact on their operational profits. The transportation industry would not volunteerly shift to watereways incurring higher costs. Hence, implementation of regulatory guideline by local authorities is mandatory for shift.

The industry would need either regulatory guidelines or subsidy equivalent to the cost differential between road and waterway.

4.7.2 Passenger and Tourist Traffic

- ✓ At present, about 7,500 passengers cross Gurupur River every day. About 23- 27 lakh passengers use the Ferry services to cross Gurupur River annually.
- ✓ The entire passenger traffic moves across the river stretches for crossing purpose.
- ✓ About 35,000 people live adjacent to Gurupur River.
- ✓ Passenger traffic is an existing opportunity for the waterway.
- ✓ Tourist traffic in Netravathi river in 2005 was 8,000. Keeping tourist traffic 8,000 of 2005 as base year, it could be estimated that tourist traffic of 2016 would be 13,683.
- ✓ Karnataka Tourism Policy 2015-20 have identified 319 tourism destinations in Karnataka. Mangalore falls in the list of 41 focus tourism destinations which are prioritized for development. This development is going to increase the tourist footfalls in the region. IWT development on River Netravati and Gurupur would attract tourists in the region and boost local economy. Tourists would use proposed IWT service for touring around and grab an opportunity to have a closer look at beauty of nature by sightseeing.

4.7.3 FSR & DPR Comparison

The below table shows comparison of FSR and DPR study. Commodities that are considered for DPR are presented along with reasoning. Commodities, which were considered for FSR, but were not considered in DPR are also mentioned with reasoning.

TABLE 4-31 Analysis of FSR Study

Commodity	Company (Source)	Considered in DPR	DPR (Potential)	Reasoning
Mineral (Building Material)	Extracted from catchment area/ OMPT	✓	✓	Mostly consumed locally, a portion moves to Lakshadweep by OMPT, which can be diverted to waterway.
Food Grains	Produced in catchment area	✓	✓	Available in less quantity
Fish Catch	Mangalore & catchment area	✓	✗	Available in less quantity, consumed locally & distributed in neighboring districts
Fertilizer & Chemicals	MCF, India Potash, Allotted in catchment area	✓	✗	Available in less quantity
Hazardous cargo (POL & LPG)	NMPT, MRPL	✓	✓	For removing hazardous cargo from city roads, they could be diverted to waterway, using Ro-Ro,
Containers	NMPT	✓	✓	Containers could be diverted to waterway to decongest NH 73 & NH 66.
Industries	MCF, KIOCL, BASF, Industrial Estate	✓	✗	NMPT is near; there is good road/rail connectivity. Industries would not opt for waterway.
Passengers	Population of catchment area	✓	✓	Ferry service is available.
Tourism	Tourist sites near the river	✓	✓	Tourism likely to grow in future.

4.8 Forecasting & Potential IWT Assumption

The below mentioned factors are considered for forecasting traffic for the proposed waterway.

4.8.1 Cargo Traffic

Consultant had undertaken road survey to quantify port-based cargo moving on the roads of Mangalore city. Mostly high value, hazardous cargo could be diverted to river.

- POL/ LPG movement could be shifted to IWT on Ro-Ro vessels Hazardous cargo needs to be removed from roadways. Government policies for removal of hazardous cargo from roadways would promote the use of waterway.
- Containers could also be moved using Ro-Ro on Netravathi and Gurupur river to remove congestion on roads.
- Food grains and Building material are potential cargo, which would reach OMPT. These cargos would be destined to Lakshadweep Island.

The state Government of Karnataka prepared a DPR for transportation of cargo on the rivers of Netravati and Gurupur. The projected traffic by state government has been confirmed by the Ministry of Shipping and IWAI for development of river transportation on Gurupur and Netravati.

The consultant has considered the projected traffic based on the development plans of Govt. of Karnataka and Road Survey. Following table shows projection for future traffic in the waterway based on data provided by state Govt. of Karnataka.

TABLE 4-32 Future Cargo Traffic (MT) and No of Trucks

Year	Gurupur	Netravati	Total	Annual Trucks	Daily Trucks
2019	70,000	-	70,000	3,889	13
2020	71,918	-	71,918	3,995	14
2025	82,326	-	82,326	4,574	16
2030	268,128	540,397	808,524	44,918	148
2035	306,930	618,601	925,531	51,418	170
2040	351,348	708,122	1,059,470	58,859	194

Source: Directorate of Ports and Inland Water Transport, Govt. of Karnataka

4.8.2 Passenger Traffic

There exists 3 ferry lines on River Gurupur for across the river movement. Around 7,000 to 8,000 of passengers are handle by these ferry lines on daily basis, i.e., makes up to 27 lakhs annually. Ullal and Mangalore are the busiest node in the region. More than 5.5 lakhs people resides in the villages nearby. Based on the traffic handled at existing ferry lines, it is assumed that atleast 20% of the local population from nearby villages would annually using proposed IWT route i.e River Gurupur. Population figure is taken as per the census 2011. Assumed passenger traffic for River Gurupur is further projected at the growth rate of 1.5% year on year. The table below shows the passenger traffic projections that River Gurupur would handle till FY40.

TABLE 4-33 Passenger Traffic Projections

Year	Annually Traffic	Daily Traffic
2011	2,876,952	9,590
2020	3,277,894	10,927
2025	3,524,310	11,748
2030	3,789,249	12,631
2035	4,074,105	13,581
2040	4,380,375	14,602

One terminal is proposed near Ashok Nagar on River Gurupur for handling above projected local tourist and passenger traffic. This service will be operational for the people travelling between Mangalore and Bengre / Ullal. Existing jetties near Bengre could be used to embark/disembark on the other end of the River Gurupur. Few jetties already exist near Bengre and Ullal, developing additional jetty is not required.

4.8.3 Tourist

As discussed in above section, catchment area of River Gurupur and Netravati falls under list of 41 destination that are on priority list of tourism development. As per the coastal study conducted by state government, in FY15 Mangalore and Udupi experienced 35.5 lakhs of tourist footfalls. It is estimated that 1.5% of these tourists would use IWT service for sight-seeing. Estimated tourist traffic is further projected based on the year-on-year growth rate of 8.5%. The table below shows the tourist traffic projections for the proposed waterways.

TABLE 4-34 Tourist Traffic Projections

Year	Annually Traffic	Daily Traffic
2016	53,000	177
2020	73,000	244
2025	110,000	367
2030	166,000	554
2035	250,000	834
2040	377,000	1,257

Terminal proposed to handle above projected tourist traffic is near Thumbe Village on River Netravati. Ferry service for tourists would be operated between both the proposed terminals i.e Near Ashok Nagar on River Gurupur and near Thumbe Village on River Netravati. Development of River Netravati would be undertaken in Phase II, based on the success rate of River Gurupur.

4.9 Proposed IWT Terminal Location

As per detailed analysis, it has been proposed to develop 2 IWT terminals on the proposed waterway; one at Gurupur river and the other at Netravati river. At present, there exist ferry services operational at the navigable stretch of Netravati and Gurupur river. Point A and Point B Location are identified to develop IWT terminal. Both the rivers are proposed to develop in phased manner. The development is proposed FY:23-24 onwards to handle local Ro-Ro and passengers/tourists' traffic.

Point A (Near Ashok Nagar) - This terminal on Gurupur river is proposed near Ashok Nagar. The location of this proposed IWAI Terminal is near the Ch. 8 km, located in the back side of the NMPT with approx. Lat 12°54‘13.27"N and Long 74°48‘56.97"E on the right bank.

NMPT guesthouse and Kasba Bengre are near to this proposed terminal. A small road passes through this proposed terminal. This landing point is close to NMPT. Proposed terminal would be used to reach Old Mangalore and Bengre. OMPT and Existing jetties near Bengre could be used to embark/disembark on the other side of the Gurupur river.

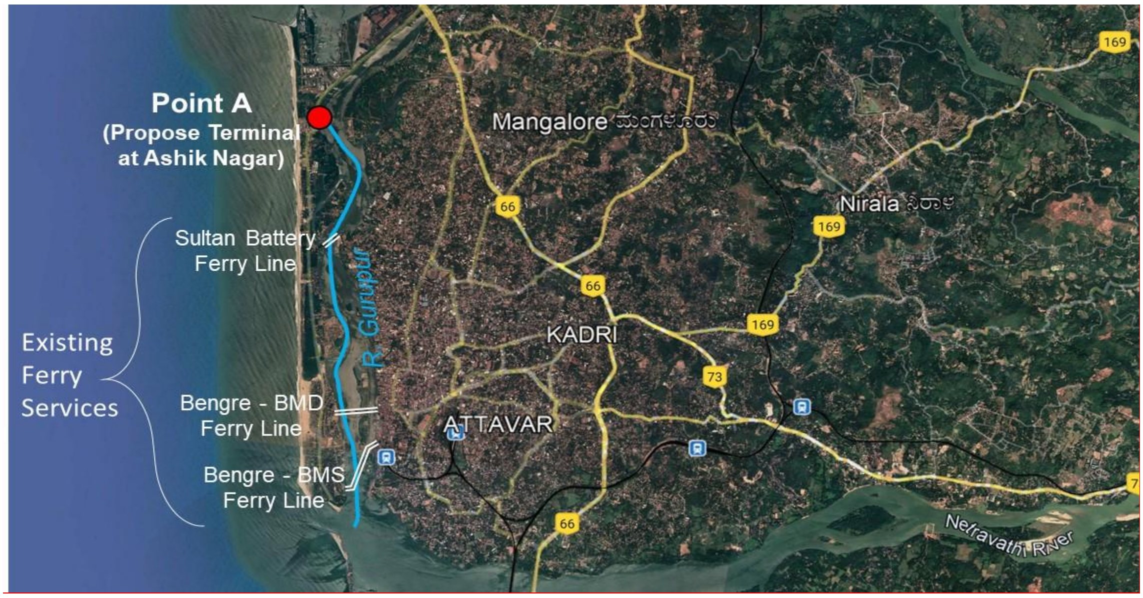


FIGURE 4.30: Proposed Terminal Location- Point A

Point B (Thumbe Village)- This proposed IWAI terminal on Netravati river would be located at Thumbe village. It is near the Ch. 22.50 km located in the downstream of Thumbe Barrage with approx. Lat 12°52'23.06"N and Long 75°00'03.71"E on the right bank. NH 73 passes through this proposed terminal. The terminal would be used for Ro-Ro to reach NMPT and Passenger/ tourist movement to enjoy sightseeing through sailing on River Netravati.

FIGURE 4.31: Proposed Terminal Location- Point B

TABLE 4-35: Terminal & Commodity Wise Projection

No	Name of Cargo	Type of Cargo	Origin	Origin Terminal on NW	Co-ordinates (Origin)	Final Destination	Destination Terminal on NW	Co-ordinates (Destination)	Unit p.a.	Fy-19	Fy-20	Fy-25	Fy-30	Fy-35	Fy-40
Proposed Terminal Opportunity for IWAI															
1	Local Cargo	Ro-Ro	Mangalore	Ashok Nagar	12°54'13.27"N 74°48'56.97"E	OMPT	-	-	'000 MT	70.0	71.9	82.3	268.1	306.9	351.3
									'000 Trucks	3.9	4.0	4.6	14.9	17.1	19.5
2	POL/LPG/ Containers	Ro-Ro	Central Karnataka	Thumbe	12°52'23.06"N 75° 0'03.71"E	NMPT	Ashok Nagar	12°54'13.27"N 74°48'56.97"E	'000 MT	0.0	0.0	0.0	540.4	618.6	708.1
									'000 Trucks	0.0	0.0	0.0	30.0	34.4	39.3
	Total Cargo Traffic								**'000 MT**	**70.0**	**71.9**	**82.3**	**808.5**	**925.5**	**1,059.5**
									'000 Trucks	**3.9**	**4.0**	**4.6**	**44.9**	**51.4**	**58.9**
3	Residents	Passengers	Mangalore	Ashok Nagar	12°54'13.27"N 74°48'56.97"E	Bengre	-	-	No. in Lakhs		32.8	35.2	37.9	40.7	43.8
4	Tourists	Tourists	Thumbe	Thumbe	12°52'23.06"N 75° 0'03.71"E	Mangalore	Ashok Nagar	12°54'13.27"N 74°48'56.97"E	No. in Lakhs				1.7	2.5	3.8
	Total Passenger Traffic								**No. in Lakhs**	**0.0**	**32.8**	**35.2**	**39.6**	**43.2**	**47.6**

4.10 Conclusion

Two locations have been identified for development of Ro-Ro terminal on River Gurupur and Netravati i.e Ashok Nagar on River Gurupur and Thumbe on River Netravati. Both the terminals would be constructed as an intertwined development of tese two waterways.

4.10.1 Cargo Traffic

The State Government should encourage industries to use IWT for cargo movement, to remove congestion on existing modes. A shift from road and railway to IWT could lead to emission savings. Implementation of Ro-Ro could happen through regulatory migration & subsidy, incentives provided by the Government. Government should implement policy & directive to industries to stop using road/ rail for transporting hazardous cargo and shift them to waterway. Waterway is an environmentally safe and clean mode of transportation. Trucks and trailers carrying LPG and other petroleum products from MRPL to Bangalore have been frequent cause of accidents on NH 48, Mangalore-Bangalore National Highway. This necessitates an urgent need to divert vehicles like trucks, lorries, oil tankers bound for Bangalore to IWT.

4.10.2 Passenger and Tourist Traffic

River Gurupur is proposed to cater to the Mangalore – Bengre traffic. Few jetties already exist on River Gurupur near Bengre / Ullal. These jetties could use to embark / disembark on the other mouth of the river. Proposed terminal on River Netravati would be used for tourist movement. Tourists can board the ferry from Thumbe and take a tour till Mangalore to enjoy the scenic beauty and nearby tourist spots. Ferry service for Passenger and local tourists would get started in Phase I (FY23) on River Gurupur, while tourist ferry service on River Netravati is proposed to develop in Phase II (FY30). Mangalore and Udupi are identified as one of the 41 focused tourist destination for development on priority basis. This development will enhance the tourism sector of the region and attract more tourist footfalls. Developing IWT for tourism purpose will further help to augment the tourism of the taluka and boost the local economy.

Abbreviation	**Full Form**
km	Kilometer
km^2	Square Kilometer
NCA	Net Sown Area

GCA	Gross Cropped Area
Ha	Hectare
FY	Financial Year
IWT	Inland Water Transport
Sq. km.	Square Kilometre
Sq. Ft.	Square Feet
MW	Mega Watt
Mn TPA	Million Tonne Per Annum
T	Tonne
MT	Metric Tonne
MMT	Million Metric Tonne
NH	National Highway
Pvt. Ltd.	Private Limited
Ltd.	Limited
INR	Indian Rupee
CR	Crore
Misc.	Miscellaneous
GDP	Gross domestic product
MSME	Micro, Small & Medium Enterprises
SEZ	Special Economic Zone
MSEZ	Mangalore Special Economic Zone
PCE	Poly carboxyl Ether
DAP	Diammonium Phosphate
Ro-Ro	Roll-on Roll-off

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CHAPTER 5. TERMINALS

5.1 General Review

Terminals act as a connecting center for shift of cargo and passengers from one mode to other mode. Inland Waterway Terminal (IWT) is a hub centre with a facility of connecting transport mode from / to the vessels on the water body to land provisioned with all the related infrastructure facilities like structure for berthing of vessels; facilities for loading / unloading of cargo; embarkation / disembarkation of passengers; storing / resting of cargo / passengers; connectivity to other modes of transport etc.

5.2 Identification and Site Location

Planning of the Inland Water Terminal location predominantly depends on the Traffic Origination and Traffic Destination criteria, which gives impetus to movement of traffic in inland waterways. Subsequent to the above, the site location in the vicinity can be considered duly taking into consideration of various influencing parameters, as below. In most of the cases the site location may not fulfil the idealistic scenario. However, the possibility of zeroing to a most suitable site may be possible based on certain basic parameters, as detailed.

Backup Land availability / Stability of Bank / Water Depth availability in Lean season / Velocity & Discharge both in Lean season and Flood season / Approach Road / Possibility of Rail connectivity / Nearness to City or Town / Availability of essential services / Impact of Social, Ecological & Environmental aspects etc.

In the morphological rivers, due to seasonal precipitation there are fluctuations in river flow and the rapid changes in water flow causes shift in the location of the deep channel and also results in erosion of banks and siltation. Accordingly, the basic requirement of an inland terminal is to ensure a permanent access to the navigational channel throughout the year. Keeping in view the above all, the terminal site locations have been considered on Gurupur River & Netravathi River.

5.2.1 Gurupur River

Gurupur River passes through the Kannad district of Karnataka.The Gurupur River (also known as Phalguni River or Kulur River) originates in the Western Ghats at an elevation of 1100m above Mean Sea Level (AMSL) and joins the Arabian Sea at

Mangalore in the Karnataka state. The Gurupur river forms the northern boundary of Mangalore city.

The river in the study stretch is well connected with both Rail & Road network within 5.0km of distance from the nearest industrial area.

At present, it is being utilised by ferry service from Mangalore Port to Begna Village. Four Ferry Services are operational, BMS Ferry, Bengre Ferry, Sulthan Ferry & Fatima Ferry. This stretch is being utilized extensively by Fishing Trawlers berthing on the banks on both the sides.

Important industries within 50 km of Gurupur River are

1. New Managalore Port (NMPT) on the North Bank
2. Old Mangalore Port (OMPT) at the South Bank
3. Mangalore Chemicals and Fertilizers Ltd
4. Kudremukh Iron Ore Company Limited (KIOCL)
5. Baigampady Industrial Area
6. Bharti Ship Yard
7. Old fishing dock

Taking into the consideration the origin, destination and fairway, the most probable location for terminal have been considered at approx Lat 12°54' 13.27"N and Long 74°48' 56.97"E. The development shall be considered of the study stretches of Gurupur river for about 10.141 Kms with Class IV system of the NW standards.

FIGURE 5.1: Route between the end points of Gurupur waterway

The traffic volumes, as identified at Gurupur are liquid cargo & Ro-Ro. A tentative land requirement has been worked out before undertaking the Land Survey etc., duly considering the following requirements for the proposed Ro-Ro operation.

Gurupur River - Terminal Land Area Requirement				
Sl No.	**Facility**	**Nos.**	**Size**	**Area (in Sq-m)**
1	Open Mobility Area	1	60 m x 40 m	2400
2	Covered Storage Godown (Nominal)	1	40m x 20m	800
3	Vehicles Parking	1	15m x 10m	150
4	40' Container Stack Yard	1	40m x 20m	800
5	Parking for Handling equipments		15m x 10m	150
6	Main Parking Area	1	30m x 30m	900
7	Public Utility	1	6m x 4m	24
8	Weigh bridge	1	8m x 3m	24
9	Utility Room (Near Weigh Bridge)	1	3m X3m	9
10	Area under internal & external Roads	1	600m x 7.5m	4500
11	Administration building	1	12 m x 15 m	180
12	Staff Parking Area-4 wheelers	1	13.5m x 6m	81
13	Staff Parking Area-2 wheelers	1	8m x 2m	16
14	Security shed for watch and ward	2	4m x 4m	32
15	Electrical facility	1	5m x 5m	25
16	Fuel Bunkers	1	10m x 5m	50
17	Water Supply Room	1	3m x 4m	12
18	Fire and Safety Room	1	3m x 4m	12
19	DGPS receiver & transmitter shed	1	8m x 4m	32
20	DG shed	1	5m x 5m	25
21	Canteen with Store	1	12m x 8m	96
22	Sewerage Treatment Plant (STP)	1	15m x 15m	225
23	Overhead Tank	1	10m dia	100
24	Green Area	1		1000
25	Future Requirement	1		2000
	Total Area			**13643**

5.2.2 Netravathi River

The Netravathi River passes through Chikamangaluru & Dakshin Kannad Distt of Karnataka State. The River originates from Bangrabalige valley, Yelaneeru Ghat in Kudremukh in Chikkamagaluru district of Karnataka. It flows through the famous pilgrimage place Dharmasthala and is considered as one of the Holy Rivers of India. The combined stream passes over a rocky bed to Buntwal and flows for a distance of 35km in plain area and joins Arabian Sea at Mangalore old port, south of Mangalore city.The river is under tidal effect of the Arabian Sea (backwater effect) up to Brahmarakotlu about 23.5 km from sea. There are one barrages and five dams existing across the declared stretch of Netravathi River (NW-74) waterway.

Netravati River - Terminal Land Area Requirement				
Sl No.	**Facility**	**Nos.**	**Size**	**Area (in Sq-m)**
1	Open Mobility Area	1	75 m x 40 m	3000
2	Covered Storage Godown (Nominal)	1	40m x 20m	800
3	Vehicles Parking	1	15m x 10m	150
4	40' Container Stack Yard	1	40m x 20m	800
5	Parking for Handling equipments		15m x 10m	150
6	Main Parking Area	1	30m x 30m	900
7	Public Utility	1	6m x 4m	24
8	Weigh bridge	1	8m x 3m	24
9	Utility Room (Near Weigh Bridge)	1	3m X3m	9
10	Area under internal & external Roads	1	600m x 7.5m	4500
11	Administration building	1	12 m x 15 m	180
12	Staff Parking Area-4 wheelers	1	13.5m x 6m	81
13	Staff Parking Area-2 wheelers	1	8m x 2m	16
14	Security shed for watch and ward	2	4m x 4m	32
15	Electrical facility	1	5m x 5m	25
16	Fuel Bunkers	1	10m x 5m	50
17	Water Supply Room	1	3m x 4m	12
18	Fire and Safety Room	1	3m x 4m	12
19	DGPS receiver & transmitter shed	1	8m x 4m	32
20	DG shed	1	5m x 5m	25
21	Canteen with Store	1	12m x 8m	96
22	Sewerage Treatment Plant (STP)	1	15m x 15m	225
23	Overhead Tank	1	10m dia	100
24	Green Area	1		1000
25	Future Requirement	1		2000
	Total Area			**14243**

At present, it is being utilised by Ferry Services at 3 routes, namely, Sajipanadu-Thumbe, Jalakadakatte-Parangipet and Adyar-Pavoor through various routes. Cargo movement is only at the mouth of the river i.e. at Old Mangalore Port (OMPT). Passenger transport is significant in this waterway and about 1.36 lakh passengers are using ferry services per year.

Important industries within 50 km are BASF India Limited, Bharat Petroleum LPG Bottling Plant, Total LPG India, Strides Arco Lab & Speciality Ltd., Mangalore Chemicals & Fertilizers and Mangalore Refinery & Petrochemicals Ltd. Taking into the consideration the origin and destination and fairway, the most probable location has been considered at approx Lat 12°52'23.06"N and Long 75°00'3.71"E. The development shall be considered of the study stretches of Netravati river for about 22.90kms upto thumbe barrage with Class IV system of the NW standards.

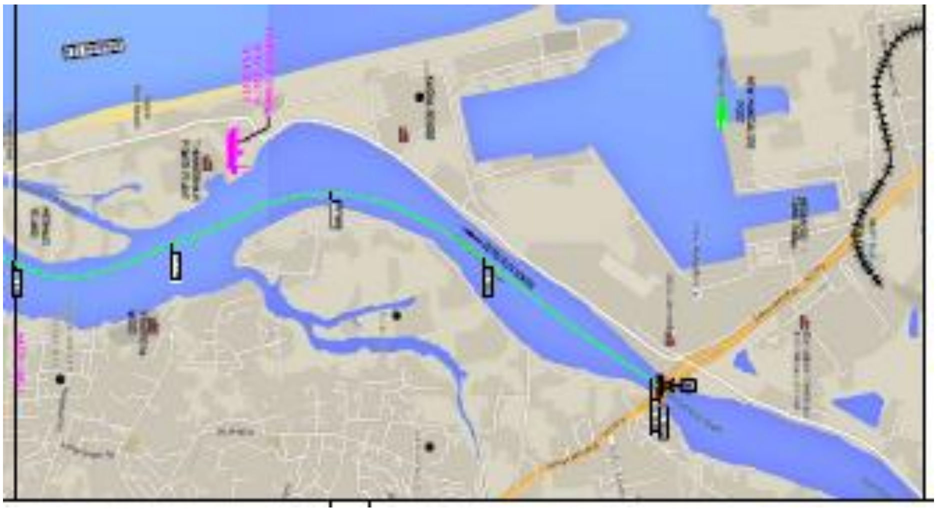


FIGURE 5.2: Route between the end points of Netravati waterway

However, keeping in view the Traffic identified at Netravathi, 1 Roll-on Roll-off (Ro-Ro) Berthing facility and IWT Terminal has been planned. Thus, these expected traffic arrivals are to be taken into consideration for IWAI Terminal development on Netravathi River. A tentative Land requirement has been worked out before undertaking the Land Survey etc., duly considering the following requirements for the proposed Ro-Ro operation.

5.3 Terminal Layout / Master Planning including phases of development

5.3.1 GURUPUR

The Ro-Ro terminal on Gurupur River (NW-43) is located at Ashok Nagar, Kasba Bengre on at Ch.7.51kms & downstream of Thumbe barrage proposed at Ch. 22.50kms on the right bank to cater the Ro-Ro traffic which will also serve to cross the river. The riverine and landside infrastructure proposed for the Ro-Ro terminal are robust structures and provide safe birthing of the vessels.

The Gurupur Terminal layout of the identified site based on the site land survey data available has been prepared. Refer Volume-II Drawing No. **P.010256-W-20351-X02**. With regard to the land, there is no need of consideration of any phased development, since the ground development shall be taken up at initial phase itself. Accordingly, a layout plan demarcating the infrastructure requirement is developed Refer Volume-II Drawing No. **P.010256-W-20311-A02** for details.

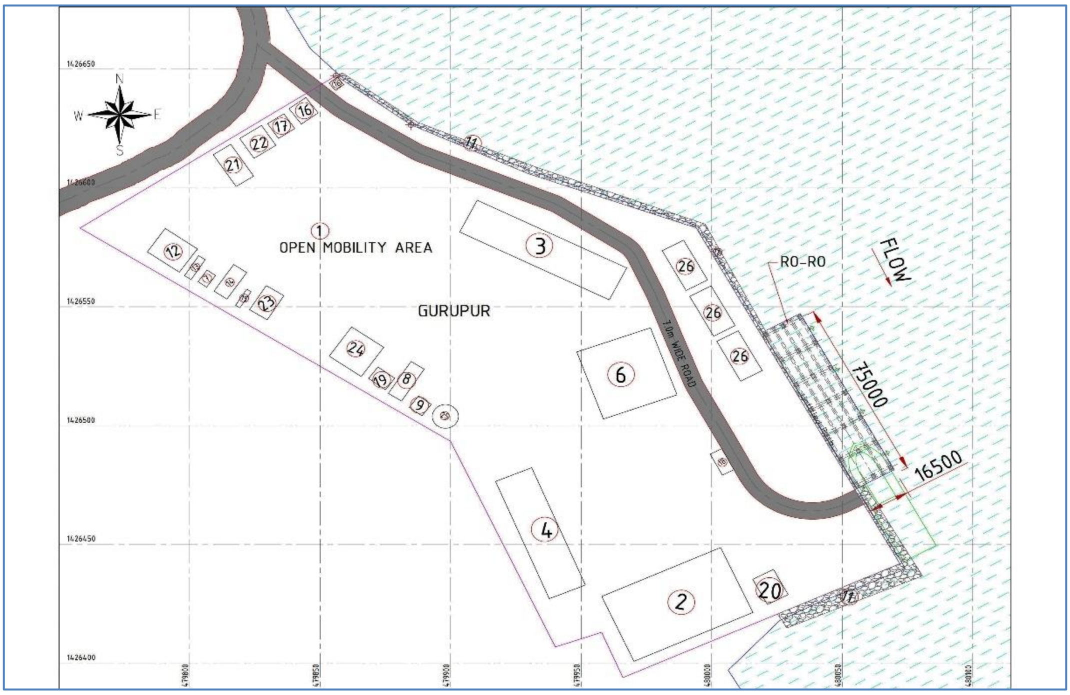


FIGURE 5.3: Site Layout plan of proposed Ro-Ro terminal (A) at Ashok Nagar (Gurupur)

5.3.2 NETRAVATI

The Netravati Terminal layout of the identified site based on the site land survey data available has been prepared. Refer Volume-II Drawing No. **P.010257-W-20351-X05**. With regard to the Land, there is no need of consideration of any phased development, since the ground development shall be taken up at initial phase itself.

Accordingly, a Netravati terminal layout plan demarcating the infrastructure requirement is developed in the downstream of Thumbe barrage Refer Volume-II Drawing No. **P.010257-W-20311-A05** for details.

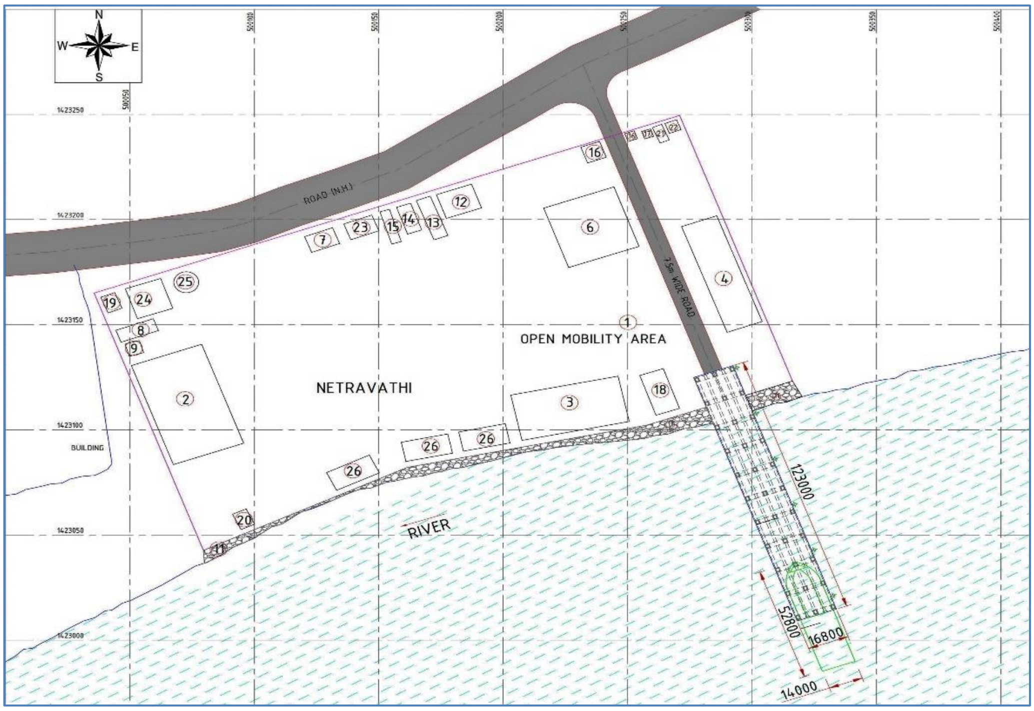


FIGURE 5.4: Site Layout plan of proposed Ro-Ro terminal (B) at downstream of Thumbe Barrage (Netravati River)

5.4 Land Details

The Land area identified on both the rivers are placed herewith

Terminal Land Details on Gurupur River

Coordinates (UTM) N/E	**1426491.94**	**480020**
Coordinates (DMS) N/E	**12°54' 13.27"N**	**74° 48' 56.97"E**
Village	Ashok Nagar	
Taluka	Mangalore (Urban)	
District	Dakshin Kannada	
State	Karnataka	
Nearest Town	Mangaluru	
Distance of town (km)	1	
Land use	GMR owned land	
Ownership	GMR owned land	
Water Distance	on edge	
Nearest Road	on NMPT internal road	
Road Distance (m)	100	
Nearest Railhead	NMPT Rail Terminal	
Railhead Distance	5km	

Coordinates (UTM) N/E	**1426491.94**	**480020**
Coordinates (DMS) N/E	**12°54' 13.27"N**	**74° 48' 56.97"E**
Nearby major Structure	NMPT port	
Terrain	Flat land/ Fenced land	
Soil/Subsurface strata	Blackish Yellow Medium Dense Silty Sand followed with Reddish Yellow Dense Silty Sand	
Surveyed Area (Approx)	40542 Sq.m	

Terminal Land Details on Netravati River

Coordinates (UTM) N/E	**1423099**	**500111.81**
Coordinates (DMS) N/E	**12°52'23.06"N**	**75° 0'3.71"E.**
Village	Thumbe	
Taluka	Bantwal	
District	Dakshin Kannada	
State	Karnataka	
Nearest Town	Thumbe	
Distance of town (km)	2	
Land use	Barren land/open land	
Ownership	Private	
Water Distance	on edge	
Nearest Road	Mangalore-Mysore Highway	
Road Distance (m)	on edge	
Nearest Railhead	Bantwal Rly stn	
Railhead Distance	5km	
Nearby major Structure	Thumbe Barrage	
Terrain	river bank land with mild slopes	
Soil/Subsurface strata	sandy silty mixed clay with cobbles, pebbles etc	
Surveyed Area (Approx)	29264 (m^2)	

5.5 Geotechnical Investigations

Geotechnical investigation has been carried out at the proposed terminal location to find out the subsoil stratification in the project area and to collect data for deciding type of foundation and the design foundation. The scope of geotechnical investigation work consists of one bore hole at terminal estimated up to a depth of 25.6m below EGL.

5.5.1 Regional Geology

GURUPUR RIVER

Karnataka forming a part of the Indian Shield is constituted of rock formations ranging in age from 3300 m.y. to 5 m.y. Barring a narrow coastal strip of about 5000 sq.km of Tertiary and Quaternary sediments and another 31,250 sq.km of Deccan basalts, the remaining area is dominated by Archaean-Proterozoic rocks. Mysore Plateau, geologically constituted of Dharwar Craton comprises of greenstone-granite belts, gneisses and granulites. Greenstone belts essentially consist of meta-volcano sedimentary sequences, surrounded and dissected by Peninsular Gneiss. At the southern end of the craton these give way to granulite suite of rocks. The craton preserves a billion-year orogenic history from 3400 m.a. to 2400 m.a. Epicratonic or intracratonic sedimentary basins called Purana Basins occupy the northern segment of the craton whose northern part in turn is concealed by Deccan basalts. Thus younging of lithosequence from south to north is evident.

The majority of the rock sequences of Karnataka are lateritised due to their exposure to suitable climatic conditions for a prolonged period. These laterites occur as extensive cappings in the Western Ghats and in coastal plains. Their thickness ranges from a few cm to as much as 60 m. Based on their elevation level, two types are identified, one at +600 m elevation confined to Western Ghats and the other fringing the coastal lines along the west. The later type is gravelly to sandy in texture and appears to be transported, whereas those confined to Ghats are homogenous and less sandy. In the hinter land of southern Karnataka also vast tracts of laterite are reported in the north and northeastern part of Bangalore district and in parts of Kolar district. In the Deccan Plateau region, thick carpet of laterite capping the Deccan basalts and sandstones of Badami sequence are a common feature. Lateritisation is considered to have taken place during Pliocene-Pliestocene period since the Warkhali Beds of Miocene too were lateritised.

Geologically, the project area is covered under the survey of India toposheet no 48L13 and is covered under the geological quadrangle map 48L (Kasargod-Mangalore quadrangle Karnataka-Kerala) prepared by Geological Survey of India. **Figure 5.1** shows the project area on the geological quadrangle map while **Figure 5.2** shows the enlarged view of the same. According to this map prepared by Geological survey of India, the selected area/site is covered with alluvial, coastal sands of Holocene age.

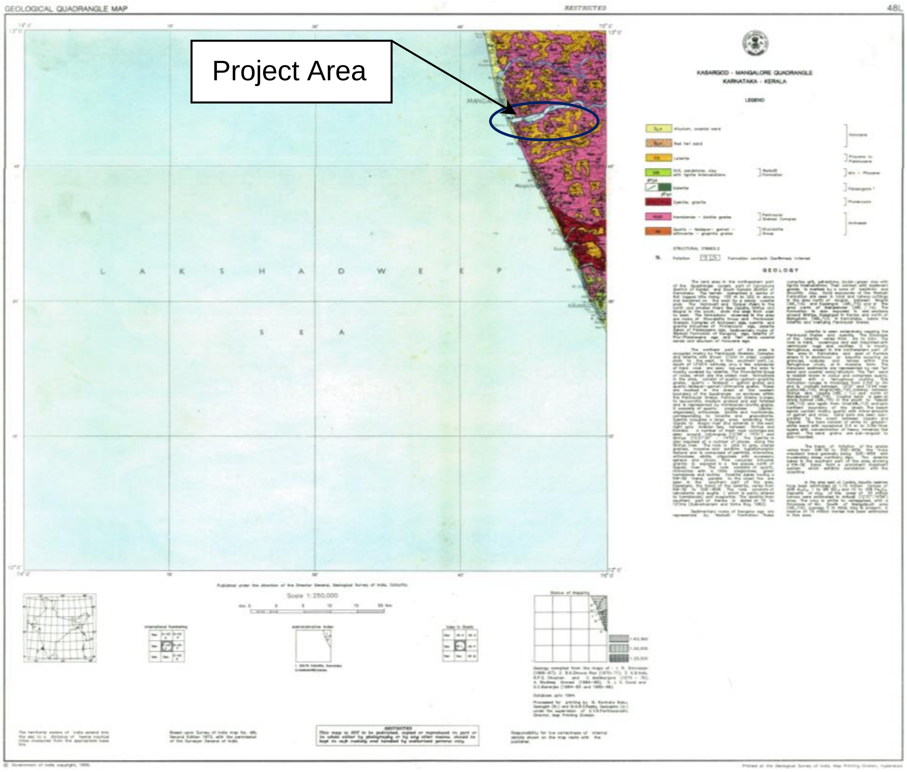


FIGURE 5.5**:** Geological Quadrangle Map of SOI Toposheet No. 48 L showing Project Area

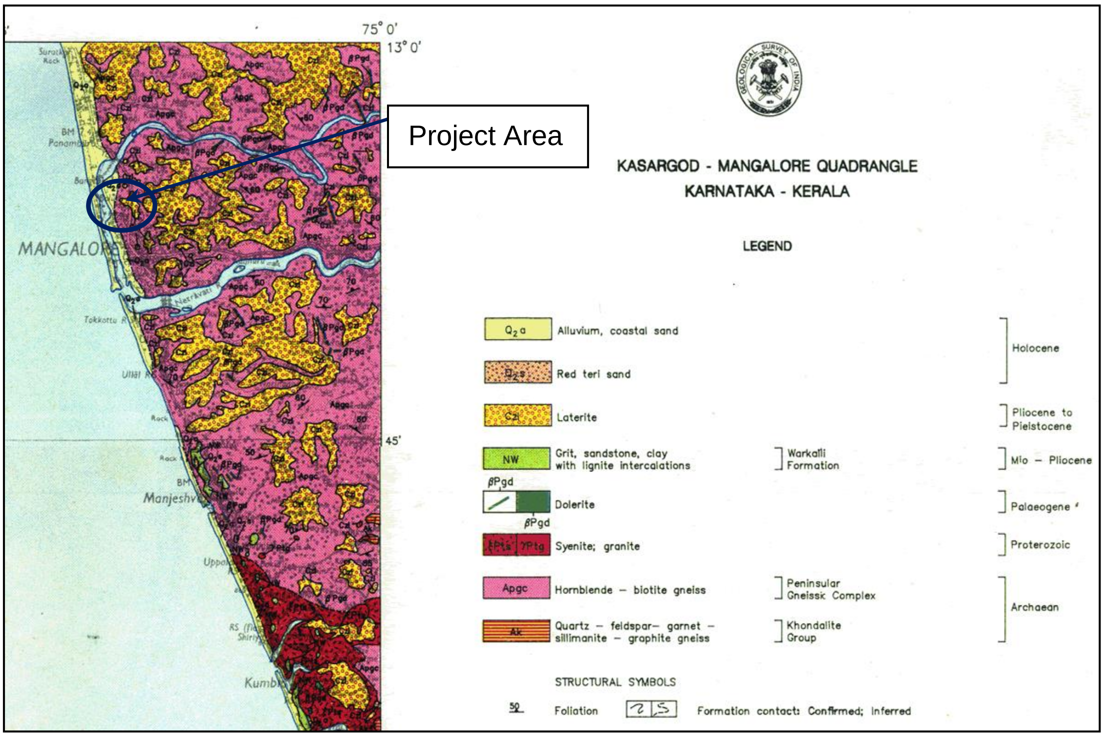


FIGURE 5.6**:** Enlarged view of Geological quadrangle map of SOI Toposheet No. 48 L showing Project Area

(Source: Geological Survey of India)

NETRAVATI RIVER

The area forms the westernmost parts of the Western Dharwar Craton (WDC) of South Indian Shield. The Netravati area occurs just north of the granite-granulite transition area of southern granulite terrain of India. Rocks belonging to the Peninsular Gneissic Complex (PGC) occupy major parts of both the areas. Rocks of the Dharwar Supergroup, Sargur Complex, younger intrusives and Quaternary formations form the minor component. Ananthanarayana (1990) correlated the lithounits in the Kalinadi area with major lithounits of Dharwar Supergroup of Precambrian Archaean age exposed in the adjoining areas. The lithounits included those of PGC, Dharwar Supergroup, younger acid, basic and ultrabasic intrusives, and supracrustals.

The intrusive granite occurring as granitic plugs and domes, represents the later phases of igneous activity in the area. Rocks of Sargur Complex mainly contains amphibolite whereas PGC includes granite to granodiorite migmatitic gneiss. Supracrustal rocks belonging to Barcem Formation are represented by metabasalt, schistose metabasalt, banded magnetite quartzite, and acid volcanics. Some parts of the area are occupied by laterite which is very thick (upto 20 m approximately) at few places. The huge lateritization is due to tropical climate and heavy rainfall in the area.

Geology of the Netravati area

In the Netravati area, rock formations ranging in age from Archaean to Recent are present and depicted in **Figure 5.3**. Generalized straigraphic succession of the rocks in Netravati area is given in **Table 5.1**.

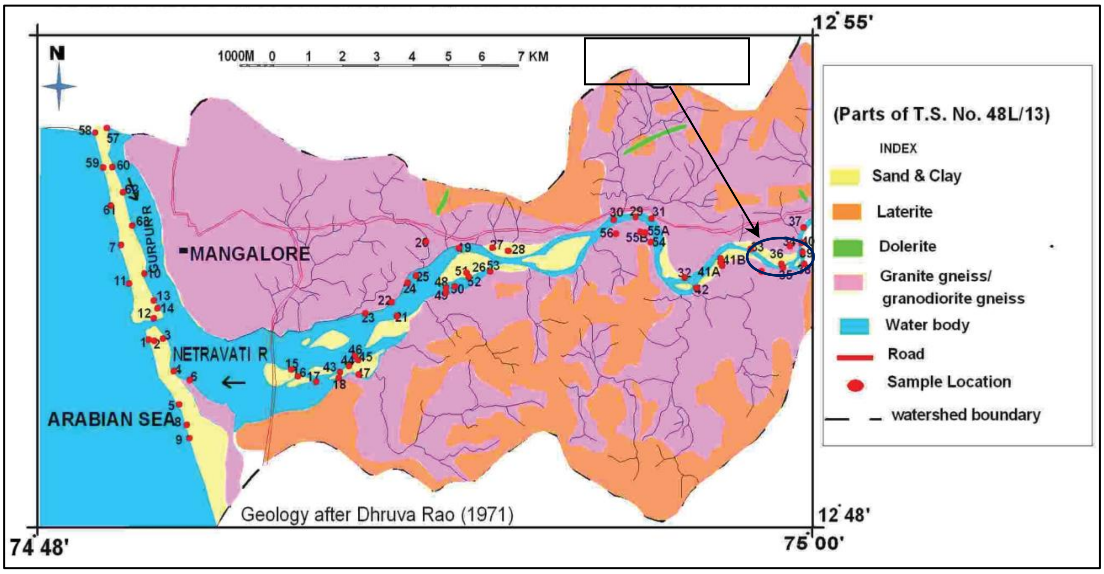


FIGURE 5.7: Geological Map of Netravati Area Showing Project Area (Source: Geological Survey of India)

TABLE 5-1: Generalized Geological Succession in The Mangalore-Invalli Area, Netravati Estuary, Dakshin Kannad District, Karnataka (After Dhruva Rao, 1971)

Sand and clay (Coastal and alluvial) Laterite	Quaternary	Holocene
Sand and Clay	Warkalli Formation	Mio-Pliocene
Gabbro/Dolerite	Basic intrusive	Palaeogene
Granite gneiss/granodiorite gneiss	Peninsular Gneissic Complex	Archaean

Netravati river basin consists of various rock formations, which include Archaean gneisses, charnockites, felsic and mafic dykes, metavolcanics, metasediments, laterite, alluvium and sand deposits of marine and fluvial origin. Most of the area is underlain by the granite to granodiorite gneiss belonging to the PGC of the Archaean age and capped by laterite of Holocene age. Few small linear bodies of dolerite occur in the area. The laterite is hard, cavernous and well-indurated with vermicular vugs and cavities. Its thickness varies from 3 m to 20 m.

Geologically, the project area is covered under the survey of India toposheet no 48L13 and is covered under the geological quadrangle map 48L (Kasargod-Mangalore quadrangle Karnataka-Kerala) prepared by Geological Survey of India. **Figure 5.4** shows the project area on the geological quadrangle map while **Figure 5.5** shows the enlarged view of the same. According to this map prepared by Geological survey of India, the selected area/site is occupied by hornblende biotite Gneiss of Peninsular gneissic complex of Archean age.

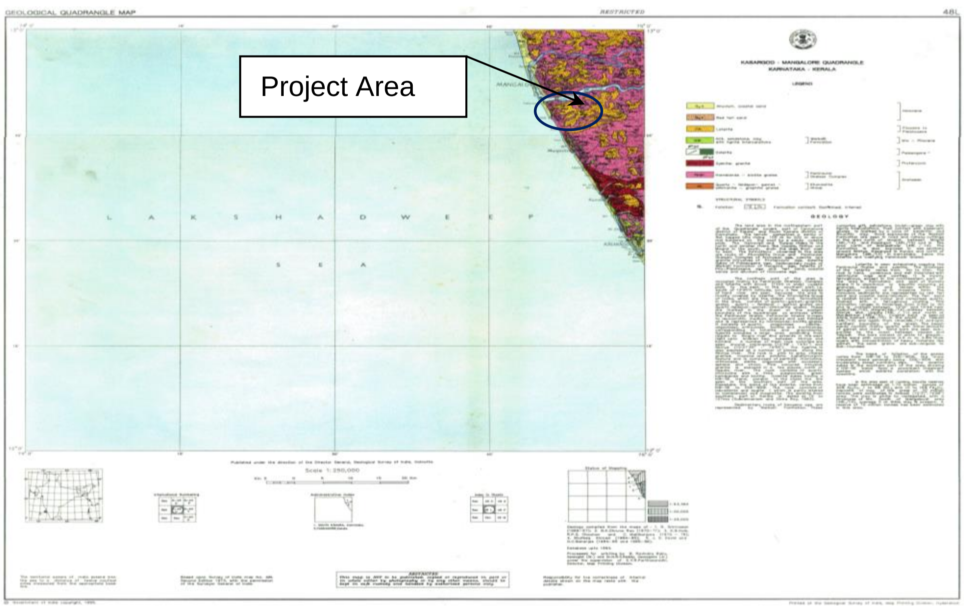


FIGURE 5.8: Geological Quadrangle Map of SOI Toposheet No. 48 L Showing Project Area

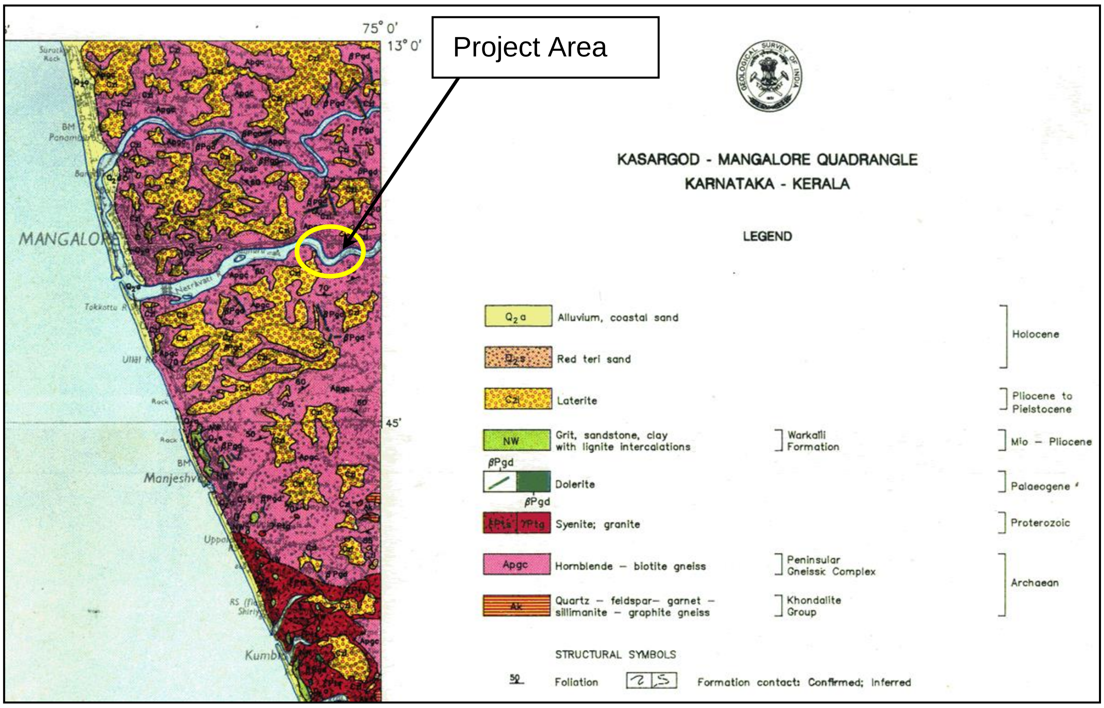


FIGURE 5.9**:** Enlarged view of Geological quadrangle map of SOI Toposheet No. 48 L showing Project Area (Source: Geological Survey of India)

5.5.2 Physical Condition and Drainage

GURUPUR RIVER

Geomorphologically, Dakshina Kannada District can be divided broadly into three well-defined physiographic units viz. i) Coastal plain ii) Upland pediplain area iii) Eastern hilly area forming part of the Western Ghats. The Coastal plain is a narrow, thickly populated and intensely cultivated area adjoining the coast. There is considerable extent of barren land along the coast partly because it is sandy, rocky, and marshy. The area near sea is covered with coconut gardens. The Upland pediplain area interspersed with low hills between the Western Ghats and the coast, which is moderately cultivated with a considerable extent of fallow land, which can be put to agricultural use. The Eastern hilly area in the eastern part of the district is hilly with thick forest cover, which forms part of the Western Ghats. The hills of the area range in elevation from 1200 to 1500m a.m.s.l. and are capped with laterite, which form plateau usually of oval or elongated configuration. The hill ranges are dissected by numerous streams and rivulets. The prominent peaks in the area are Balihalli (1240m), Amadikul betta (1298m) Attiberi Gudda (1522m), Banganabagile Gudda (1513m) etc. The project area lies in the zone of coastal plains.

The soil in the area and district is mostly lateritic type, found distributed in the Pediplain area characterised by high iron and aluminium content. Lateritic soil is mostly red in colour and yellow loamy, pale to bright red colours is also seen. Lateritic soil is suitable for Paddy, Sugarcane, Arecanut and Plantation crops, viz. crops like Cardamom & plantains. Loamy red soils are distributed in the lower reaches of valleys. Red lateritic soil is the most dominant soil type in the area. The texture of the soil varies from fine to coarse. The soil in valleys and intermediate slopes is rich in loam whereas in upper slopes it is much coarse in nature. The soil responds well to irrigation and other soil -management practices. Silty and loamy soils are of transported origin and are found mostly along river banks and in valley plains. They have good infiltration capacity and are well-suited for agriculture due to their fertility.

Drainage:

Gurupur forms the primary drainage in the area which flows from North east to southwest and joins the Arabian sea near mangalore city. The project area/selected site forms a part of Gurupur river basin which constitutes the major drainage of the area. The location of the selected site on Google earth is shown as **Figure 5.6** while the enlarged view of the same is shown as **Figure 5.7** and the figures showing the actual condition of the site is shown as **Figure 5.8.**

FIGURE 5.10: Google Earth Image showing holistic Project Area

FIGURE 5.11: Enlarged view of Google earth image showing Project area (in Circle)

FIGURE 5.12: Image Showing General View of Project Area

NETRAVATI RIVER

In Netravati, general geomorphological features include various marine, fluvial, fluviomarine, and denudational geomorphic units and associated Quaternary formations. In higher reaches, the terrain comprises a series of flat-topped hills rising from 100m to 200m above MSL, bordered on the west by sandy coastal plain. The coastal tract (0-100m altitude) in the west is a highly dissected landmass. The marine landforms mainly encountered in the area are present-day beaches, tidal flats, mangrove swamps, beach ridges and palaeo-beach ridges. The area in the immediate vicinity of the river is low-lying and marshy with development of mangroves. The fluvial landforms are river terraces, bars, channels, etc. The units included mainly long sandy beaches formed by accumulation of sediments deposited by waves and currents in the shore zone. Beaches are narrow and straight in the Netravati. Alluvial plains contain unconsolidated sediments mainly consisting of sand and silt. But the flood plain deposit found associated with alluvial plains contains sand, silt and clay. The residual hills in the area are formed by denudational process and are represented by mounds and hillocks of granitoids. Laterite covers these granitoids at many places. In the Netravati the highest point (207) is near Kurnad village in the southern part of the Netravati area.

Drainage:

The Netravati and Gurpur rivers in the north, drain the area from E to W. Both the areas are occupied by many nalas forming 1st or 2nd order drainage pattern of dendritic type.The project area/selected site forms a part of Netravati river basin which constitutes the major drainage of the area. The location of the selected site on Google earth is shown as **Figure 5.9** while the enlarged view of the same is shown as **Figure 5.10** and the figures showing the actual condition of the site is shown as **Figure 5.11.**

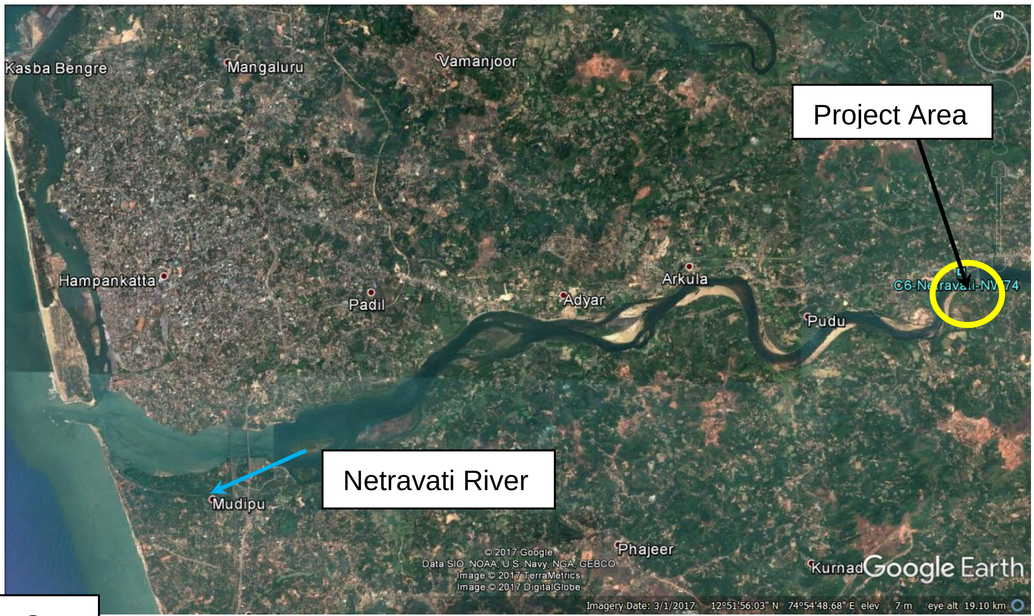


FIGURE 5.13: Google Earth Image Showing Project Area

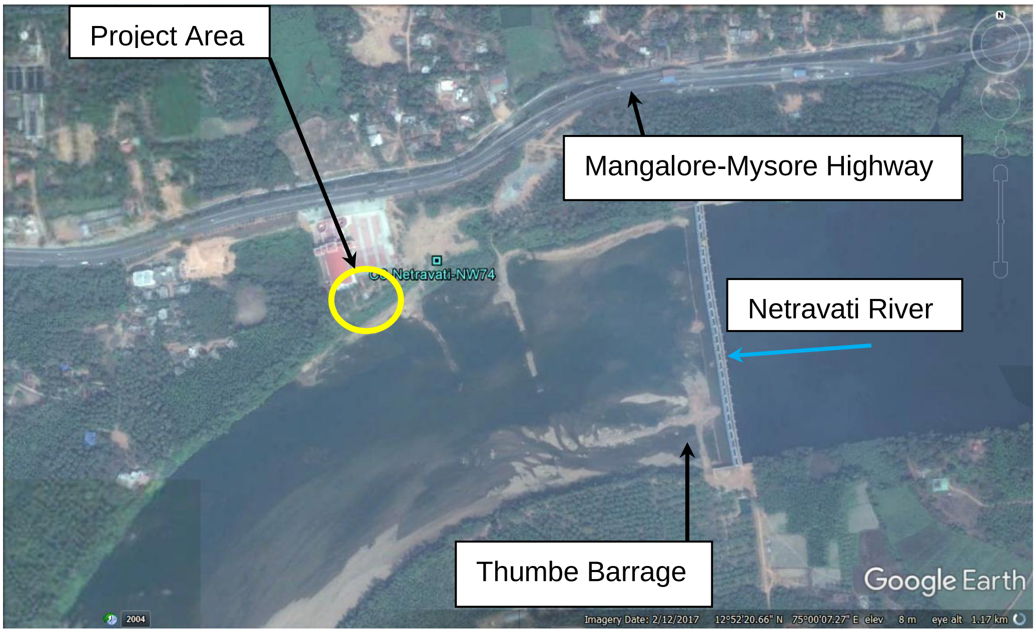


FIGURE 5.14: Enlarged View of Google Earth Image Showing Project Area

FIGURE 5.15: General view of the selected site

5.5.3 General Geology and Stratigraphy

GURUPUR RIVER

The Project area/selected site is located in Mangalore taluk, Dakshina Kannada district of Karnataka and forms a part of Quaternary Formations. Quaternary formations occur as a narrow long strip all along the West Coast from Mangalore to Karwar, covering an area of about 5000 sq.km. Sand blankets, loamy soil, transported lateritic red soil are some of the major constituents of the Quaternary units. They are of Pleistocene to Holocene in age. Deposits of silica sand of moulding sand type occur along the coastal belt from Mangalore to Udipi, Uliyargoli, Udiyavara, Tekkatte, Bailur and Murudeshwar.

Generalised regional lithostratigraphy worked out for Karnataka, is presented below, followed by a brief description of major groups. The project area comes under the Quaternary deposits of Western block of the classification as given below. The drill hole completed within the project area reveals the stratification as below:

Strata I: Blackish Yellow Medium Dense Silty Sand

Strata II: Reddish Yellow Dense Silty Sand

NETRAVATI RIVER

The Project area/selected site is located in Mangalore taluk, Dakshina Kannada district of Karnataka and forms a part of hornblende biotite Gneiss of Peninsular gneissic complex of Archean age. Generalised regional lithostratigraphy worked out for Karnataka, is presented below, followed by a brief description of major groups.

GENERALISED REGIONAL STRATIGRAPHY OF KARNATAKA

Eon/Era/Epoch	Suite/Assem-blage Supergroup	Group/Formation and other lower ranks	Lithology
WESTERN BLOCK			
Recent			Alluvium/soil
Quaternary			Undifferentiated fluvial/coastal sediments; transported red soil/ alluvium
Neogene			Laterite
Mio-Pliocene		Warkhali Beds	Sandstone, clay, marl and limestone.
Late Cretaceous To Paleogene 67-65 ma		Deccan Trap	Continental flood basalt of tholeiitic chemistry; inter-trappean beds of chert & marl
Neo Proterozoic 900-540 ma		Bhima Group	Predominantly Mg poor carbonate sequence with shale; sandstone and conglomerate at the base
Neo Proterozoic ≈ 800 ma		Chamundi granite	K-rich porphyritic to homophanous granite
Meso-Neo Proterozoic 1600-1000 ma	Kaladgi Supergroup	Badami Group	Horizontally bedded multistorey sequence of arenite; shale and limestone in lesser amounts
		Bagalkot Group	Two mega cycles of repeated sequence of argillite followed by chemogenic precipitates predominantly of sandstone and dolomite; quartzites and conglomerates forming the base

Eon/Era/Epoch	Suite/Assem-blage Supergroup	Group/Formation and other lower ranks		Lithology
Palaeo-Proterozoic 2530-2450 ma	Closepet Granite			Alkali granite, monzogranite/adamellite to granodiorite
			Ranebennur Subgroup	Greywacke/BIF/ polymict conglomerate/ volcanics (Mardihalli, Bellara, Medur)

Late Archaean to Palaeo-proterozoic To Late Archaean 2900-2600 ma	Dharwar Supergroup	Chitradurga Group 2700-2600 ma	Vanivilas Subgroup	Polymict conglomerate, cross bedded quartzite, pelite, stromatolitic carbonates, biogenic chert, BIF & manganese formations (Ingaldhal volcanics-thoeliitic basalt-rhyolite suite (Tekkalvatti, Jagar))
		Bababudan Group 2900-2800 ma		BIF & carbonaceous phyllite, basalt-dacite suite (locally pillowed) with minor ultramafics/ alternations of amygdular basalts/cross bedded quartzites, pelite/minor BIF/basal quartz pebble conglomerate
Late Archaean <3000 ma	Peninsular Gneiss-I			Tonalite-trondhjemite-granodiorite
Middle Archaean 3000 ma		Charnockite Group		Metamorphic equivalents of earlier formed rocks
Middle Archaean >3000 ma		Sargur Group		Ultramafic-mafic intrusive complex (Holenarsipur-Nuggihalli)/ serpentinised komatiites, komatiitic and thoeliitic amphibolites, chert, BIF/garnet-biotite schist (with kyanite, sillimanite and staurolite)/local marble and calc sillicates/fuchsite quartzite with chromite and baryte layers
Lower to middle Archaean ≈ 3400 ma	Older Gneiss	Gorur Gneiss/ Hunsur Gneiss		Trondjhemite, granodiorite, grey banded biotite ortho gneiss

The drill hole completed within the project area reveals the stratification as below:

Strata I: Reddish / Yellowish Medium Dense to Dense Silty Sand

Strata II: Yellowish Grey Fractured Granite

5.5.4 Sub-surface Investigations

GURUPUR RIVER

The selected site has been investigated by one drill hole (BG-1) which has been drilled for depth of 25.60 m. The detail of the drill hole is tabulated below table:

TABLE 5-2: Summary of Drill hole

Sl. No	Hole No.	Location	Total Drilled Depth (m)	Depth		Thickness (m)	Description of Strata	N-Value	Core Recovery	RQD	Remarks
				From (m)	To (m)				%	%	
1.	BG-1 (NGL – 5.3 m)	Right bank of Gurupur river (12^0 54' 13.27'' N, 74^0 48' 56.97'' E)	25.60	0	12.0	12.0	Blackish Yellow Medium Dense Silty Sand	11 - 27			
				12.0	25.6	13.6	Reddish Yellow Dense Silty Sand	33 - 46			

The description of the drill hole is as given below.

BG-1: Drill hole BG-1 has been drilled over the terminal location area on the Right bank of Gurupur river on GMR Owned Land near OMPT, Magalore Port, Karnataka. The drill hole has been drilled vertically down to the depth of 25.6m from EL.5.3m to EL. -20.3m. The drill hole has encountered 12.0 m thick Blackish Yellow Medium Dense Silty Sand underlain by 13.6 m thick Reddish Yellow Dense Silty Sand upto the bore hole termination level.

The drill hole log and photographs of execution of drill hole and core box are appended in Volume IV- Geotechnical Investigation Report.

NETRAVATI RIVER

The selected site has been investigated by one drill hole (BN-1) which has been drilled for depth of 11.30 m. The detail of the drill hole is tabulated below table:

TABLE 5-3: Summary of Drill hole

Sl. No	Hole No.	Location	Total Drilled Depth (m)	Depth		Thickness (m)	Description of Strata	N-Value	Core Recovery	RQD	Remarks
				From (m)	To (m)				%	%	
1.	BN-1 (NGL – -1.6 m)		11.30	0	7.3	7.3	Reddish / Yellowish Medium Dense to Dense Silty Sand	19-34			

Sl. No	Hole No.	Location	Total Drilled Depth (m)	Depth From (m)	Depth To (m)	Thickness (m)	Description of Strata	N-Value	Core Recovery %	RQD %	Remarks
		Right bank of Netravati river (12^0 52' 23.06'' N, 75^0 00' 3.71'' E)		7.3	11.3	4.0	Yellowish Grey Fractured Granite		10-70	0-70	

The description of the drill hole is as given below.

BN-1: Drill hole BN-1 has been drilled over the terminal location area on the Right bank of Netravati river Near Thumbe, Dakshin Kannada, Karnataka. The drill hole has been drilled vertically down to the depth of 11.30m from EL -1.6m to EL. -12.9m. The drill hole has encountered 7.3m thick Reddish / Yellowish Medium Dense to Dense Silty Sand, 4.0 m thick Yellowish Grey Fractured Granite.

The drill hole log and photographs of execution of drill hole and core box are appended in Volume IV- Geotechnical Investigation Report.

5.5.5 Geotechnical Results and Analysis

GURUPUR RIVER

In-situ Test Results

Seventeen Standard penetration test (SPT) has been carried out in accordance of IS 2131 in the drill hole to ascertain the consistency of the different soil strata. The depth wise N-values from the SPT for soil strata are as tabulated in below table:

TABLE 5-4: Summary of In-Situ Test Results

Sl. No.	Strata Description	Depth From	Depth To	SPT 'N' Value Observed	SPT 'N' Value Corrected
1	Blackish Yellow Medium Dense Silty Sand	1.5	2.1	11	16
		3.0	3.6	13	16
		4.5	5.1	15	17
		6.0	6.6	18	18

Sl. No.	Strata Description	Depth		SPT 'N' Value	
		From	To	Observed	Corrected
		7.5	8.1	19	18
		9.0	9.6	25	20
		10.5	11.1	27	21
2	Reddish Yellow Dense Silty Sand	12.0	12.6	33	23
		13.5	14.1	34	23
		15.0	15.6	38	24
		16.5	17.1	40	24
		18	18.6	39	23
		19.5	20.1	42	24
		21	21.6	43	23
		22.5	23.1	45	24
		24	24.6	44	23
		25	25.6	46	23

Laboratory Test Results

Testing on soil samples from SPT & Undisturbed Samples (UDS)

9 SPT soil samples has been collected from the drill hole from different depths and has been tested in laboratory to know the engineering properties of sub-surface strata like Mechanical analysis, Consistency Limits (atterberg limits), Shear strength parameters, consolidation test, Natural Moisture content, Density, soil classification, specific gravity etc. The details of the soil sample collected and summary of results of the various tests are tabulated in below table:

Summary of Laboratory Test Results on Soil Samples of the site on Gurupur River

Bore Hole	Strata Description	Depth		Sample Type	Density		Natural Moisture Content, w	Mechanical Analysis				Consistency Limits				IS Soil Classification	Shear Strength			Consolidation		Specific Gravity
					Wet	Dry		Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index, I_P	Shrinkage, S_L		Type	Cohesion	Friction	Compression Index	Initial Void Ratio	
		From	To		Kg/cm³		%	%	%	%	%	%	%	%	%			Kg/cm²	degree	C_C	e_0	G
BG-1	Blackish Yellow Medium Dense Silty Sand	3.0	3.60	SPT	1.815	1.578	15.00	0	79	21	---	Non - plastic				SM	UU	0.03	27	---	---	2.63
		6.0	6.60	SPT	1.734	1.517	14.30	0	66	34	---	Non - plastic				SM	UU	0.04	30	---	---	2.63
		9.0	9.60	SPT	1.775	1.560	13.80	0	79	21	---	Non - plastic				SM	UU	0.00	30	---	---	2.61
	Reddish Yellow Dense Silty Sand	12.0	12.60	SPT	1.810	1.588	14.00	0	89	11	---	Non - plastic				SM	UU	0.00	31	---	---	2.64
		15.0	15.60	SPT	1.824	1.583	15.21	0	85	15	---	Non - plastic				SM	UU	0.00	31	---	---	2.65
		16.5	17.10	SPT				0	81	19	---	Non - plastic				SM				---	---	2.60
		19.5	20.10	SPT	1.853	1.654	12.00	0	77	23	---	Non - plastic				SM	UU	0.03	32	---	---	2.65
		22.5	23.10	SPT				0	81	19	---	Non - plastic				SM				---	---	2.65
		25.0	25.60	SPT	1.875	1.678	11.74	0	71	29	---	Non - plastic				SM	UU	0.00	34	---	---	2.63

NETRAVATI RIVER

In-situ Test Results

Four Standard penetration test (SPT) has been carried out in accordance of IS 2131 in the drill hole to ascertain the consistency of the different soil strata. The depth wise N-values from the SPT for soil strata are as tabulated in below table:

Table 5-5: Summary of In-Situ Test Results

Sl. No.	Strata Description	Depth		SPT 'N' Value
		From	To	Observed
1	Reddish / Yellowish Medium Dense to Dense Silty Sand	1.5	2.1	19
		3.0	3.6	22
		4.5	5.1	34
		6.0	6.6	34

Laboratory Test Results

Testing on soil samples from SPT & Undisturbed Samples (UDS)

SPT soil samples has been collected from the drill hole from different depths and has been tested in laboratory to know the engineering properties of sub-surface strata like Mechanical analysis, Consistency Limits (atterberg limits), Shear strength parameters, consolidation test, Natural Moisture content, Density, soil classification, specific gravity etc. The details of the soil sample collected and summary of results of the various tests are tabulated in below table:.

Summary of Laboratory Test Results on Soil Samples of the site on Netravati River

Bore Hole	Strata Description	Depth		Sample Type	Density		Natural Moisture Content, w	Mechanical Analysis				Consistency Limits				IS Soil Classification	Shear Strength			Consolidation		Specific Gravity
					Wet	Dry		Gravel	Sand	Silt	Clay	Liquid Limit	Plastic Limit	Plasticity Index, I_p	Shrinkage, S_L		Type	Cohesion	Friction	Compression Index	Initial Void Ratio	
		From	To		Kg/cm³		%	%	%	%	%	%	%	%	%			Kg/cm²	degree	C_C	e_0	G
BN-1	Reddish / Yellowish Medium Dense to Dense Silty Sand	1.50	2.10	SPT	1.78	1.56	14.50	0	73	27	---	Non - plastic				SM	UU	0.053	31			2.64
		3.00	3.60	SPT	1.89	1.67	13.57	0	81	19	---	Non - plastic				SM	UU	0.1	30			2.61
		4.50	5.10	SPT	1.88	1.67	12.57	0	69	31	---	Non - plastic				SM	UU	0.02	30			2.63
		6.00	6.60	SPT	1.92	1.68	14.00	0	76	24	---	Non - plastic				SM	UU	0.05	33			2.63

Testing on Rock Core Samples

Four core samples of bed rock recovered from the drilling has been tested in laboratory to know the engineering parameters of the bed rock like crushing load, Point load index, UCS, Water absorption, porosity, Dry density & rock type. The details of the rock sample collected and results of the various tests are tabulated in below table:.

Table 5-6: Summary of Laboratory Test Results on Rock Samples

Bore Hole	Strata Description	Depth		Crushing Load	Point load Index	Uniaxial Compressive Strength	Modulus of Elasticity	Poisson's Ratio	Water Absorption	Porosity	Dry Density
		From	To	Kg	Kg/cm^2	Kg/cm^2	Kg/cm^2		%	%	gm/cm^3
BN-1	Yellowish Grey Fractured Granite	9.3	10.3	13550		636.66	2.371 E+05	0.21	0.79	1.96	2.47
		9.3	10.3	730	24.76						
		10.3	11.3	15000		670.83	2.943 E+05	0.23	0.53	1.08	2.58
		10.3	11.3	430	14.86						

Pile Capacity Calculations

The pile capacity is calculated for 1.2m dia and 1.4m dia piles for Gurupur and Netravati terminals is given in **Annexure-5.1**.

5.6 Terminal Infrastructure including equipment

The land area identified on Gurupur River is measuring to about 35202 Sq. m and proposed to be taken through Land acquisition. The land requirement with the requirement of facilities for the terminal has been worked out to 13,643 Sq. m, which can be accommodated within the Land proposed to be taken on Acquisition.

The land area identified on Netravati River is measuring to about 33065 Sq. m and proposed to be taken through Land acquisition. The land requirement with the requirement of facilities for the terminal has been worked out to 14,243 Sq. m, which can be accommodated within the Land proposed to be taken on Acquisition.

Considering the Class IV waterway classification, Ro-Ro facility shall be planned for each of the above identified terminal locations.

Note: The suggested Terminal details are only to the extent of Preliminary Engineering / Design. At this juncture, it is pertinent to mention that the Appropriate provisions and infrastructure are to be catered for "Disposal of Operational waste including the waste oil from vessels berthing at the terminal locations" and the related aspects are to be addressed to / attended to in accordance with the Gazette Notification vide No. 480 dt. 13/07/2016 of Ministry of Shipping {GSR No. 687 (E)} at the stage of Detailed Engineering / Design. In the similar way, the collection and disposal of Pollutants generated, on board vessel, also to be addressed during the Detailed Engineering / Design.

5.7 Berthing Structure

The berthing structures shall be designed such that they provide safe berthing of barges/vessels without damaging the barges/vessels as well as the structure. The requirements of the berth differ depending on the nature of traffic being handled at the berth. The size of the structure shall depend on the largest vessel likely to use the berth. The berth shall be designed for all possible loads that are likely to act on the structure as per BS 6349 & IS 4651. The total number of berths required for the proposed terminal shall be fixed based on the nature of cargo (if any), traffic, and water level variation. The Ro-Ro berth has been designed for 40ft container loading as per IRC classification.

Deck Level

As per IS 4651 _IV, the deck level of the Ro-Ro structure shall be fixed based on the variations in water levels during the monsoon and non monsoon season. Keeping this in view, the deck of Ro-Ro is maintained in a slope of 1:12, maintaining the deck level at the shore side at 1m above the FRL of Thumbe Barrage. On the river side, the deck level is fixed maintaining under keel clearance of 0.5m below the vessel. The position of vessel approaching the berth shall vary corresponding to the water depth available at site. The fixed ramp shall be submerged in water corresponding to the variations in water level available at site.

Deck Dimensions

The dimensions of the berthing structure are decided on the basis of the dimensions of the largest vessel that are likely to use the terminal facilities as well as the function of the terminal.

TABLE 5-5: Salient Features of Ro-Ro Structures

Description	Length(m)	Width (m)
Gurupur Ro-Ro	75	16.50
Netravati Ro-Ro	123	16.80

The structural arrangement of the berth including the preliminary design has been explained in the chapter 6. (Refer Volume-II Drawing)

Note: The above Ro-Ro structure has been considered based on the preliminary designs, as advised. Before taking up the work in the site, Detailed Engineering / Design are to be considered.

5.8 Terminal Costing

5.8.1 Capital Cost

The Capital Cost for the fairway has been considered in Chapter 11 along with the proposed development for Ro-Ro terminal facilities at the defined locations. The Capital Cost of terminal works out to be about 25.38 Crores at Gurupur & about 34.57 Crores at Netravati.

5.8.2 O&M Cost

The item wise Operation and Maintenance cost have been considered as per the circulated parameters, as defined by IWAI, which have been analyzed and considered. Some more assumptions have been considered appropriately, wherever required.

CHAPTER 6. PRELIMINARY ENGINEERING DESIGNS

6.1 River Training (including Barrages and Locks, if proposed)

River training covers those engineering works which are constructed on a river, so as to guide and confine the flow to the river channel. The river training works may serve the objectives as below:

- To prevent the river from changing its course and to avoid outflanking of structures like, weirs, aqueducts, etc.
- To protect the river banks by diverting the river away from the attacked banks.
- To ensure effective disposal of sediment load.
- To provide minimum water depth required for navigation.

Barrages are the structures to be constructed to channelize the flow condition duly building up the water depths and controlling the flow according to the requirements in the downstream. For safe navigation with controlled discharges in the waterways, this ideology is applicable. However, the problem of difference in the depth due to the pondage etc., shall be considered by constructing a lock structure for safe passage of the vessels in this zone. This type of "Barrages & Locks" combination is a comparatively costly proposal and such proposals may not be found viable in normal conditions. If such construction has other concurrent advantages, may be economical. Further in the inevitable situation of crossing the deep depth variation, such crossings may be recommended.

6.1.1 River Training through Spurs

Spurs or Groynes are constructed transverse to the river flow extending from the bank into the river. This form of river training works performs one or more functions which includes training the river along the desired course to reduce the concentration of flow at the point of attack by deflecting high velocity flow away from the vulnerable bank. Effectively designed spur-dikes encourage sediment deposition between the spurs and consequently the re-establishment of an eroded bank line. Spurs structures restrict the width of a river channel in low flows, thereby improving its navigability. Different types of spurs are shown in the Figure.

Impermeable spurs do not permit appreciable flow through them whereas permeable ones permit restricted flow through them. Impermeable spurs are constructed of a core of sand or sand and gravel or soil as available in the river bed and protected on the sides and top by a strong armor of stone pitching or concrete blocks. Spur-dikes can be constructed from gabions mattresses which may be economical form of construction when the required stone sizes are available from the river bed.

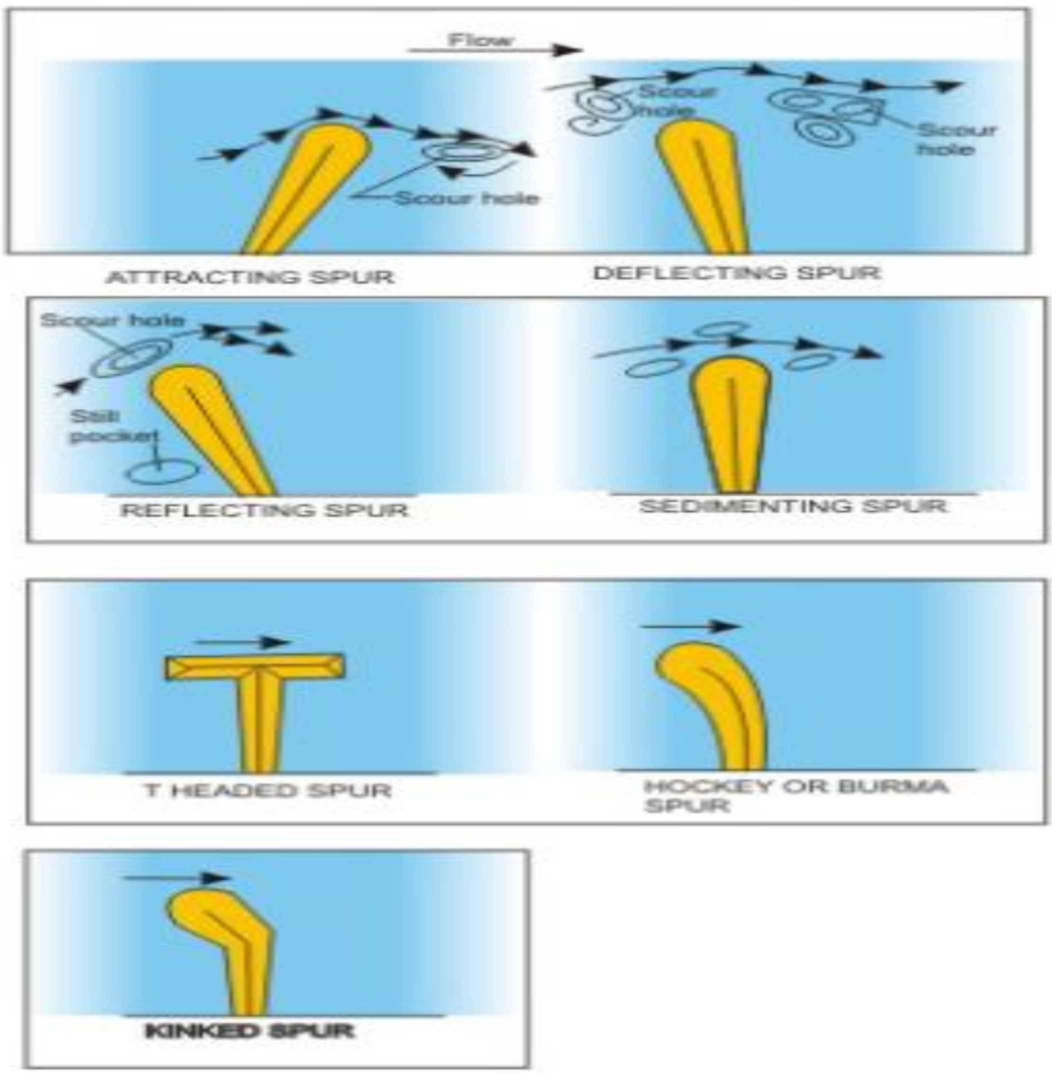


FIGURE 6.1: Different types of Spur

General Design Considerations

Layout of Spurs

Spurs are much more effective when constructed in series as they create a pool of nearly still water between them which resists the current and gradually accumulates silt forming a permanent bank line in course of time. In general, in the T-shaped spurs, greater length of the cross spurs projects upstream and a smaller portion downstream of the main spurs. Typical plan view of system of spur-dikes is shown in below Figure.

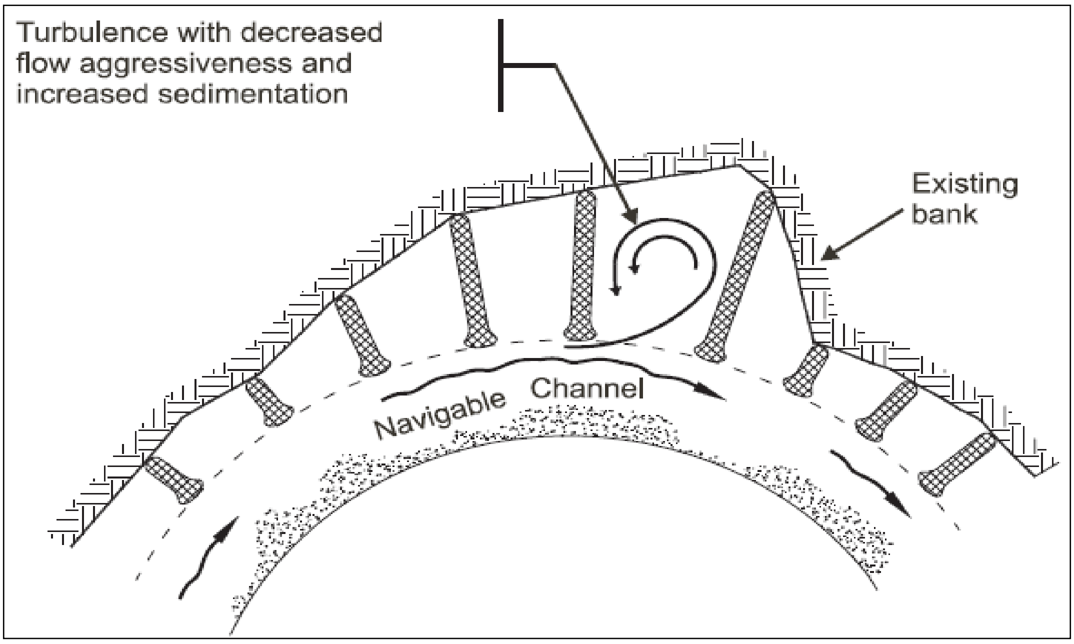


FIGURE 6.2: Plan view of system of spur-dikes constructed to control and stabilize the erosion of the outer band

Spacing

Each spurs protects only a certain length. The stability of eddies is govern by the non-dimensional spur ratio, $e_{sp.}$, which is ratio of the head loss in the river between two spurs, $U^2 S_{SP} / (C^2 h)$ (m), to the velocity head $U^2 / (2g)$ (m) of the river.

Where,

U = depth-averaged velocity (m/s)

S_{SP} = spacing between spur-dikes (m)

C = Chezy coefficient of the river ($m^{0.5}/s$)

h = cross-sectional average water depth of the river (m)

$e_{SP} = (2g\ S_{SP}) / (C^2\ h)$,

e_{SP} should never exceed 1.

For the navigational requirement

$S_{SP} / B = 0.5$ to 2

Where B= width of the constricted river (m) as shown in Figure below.

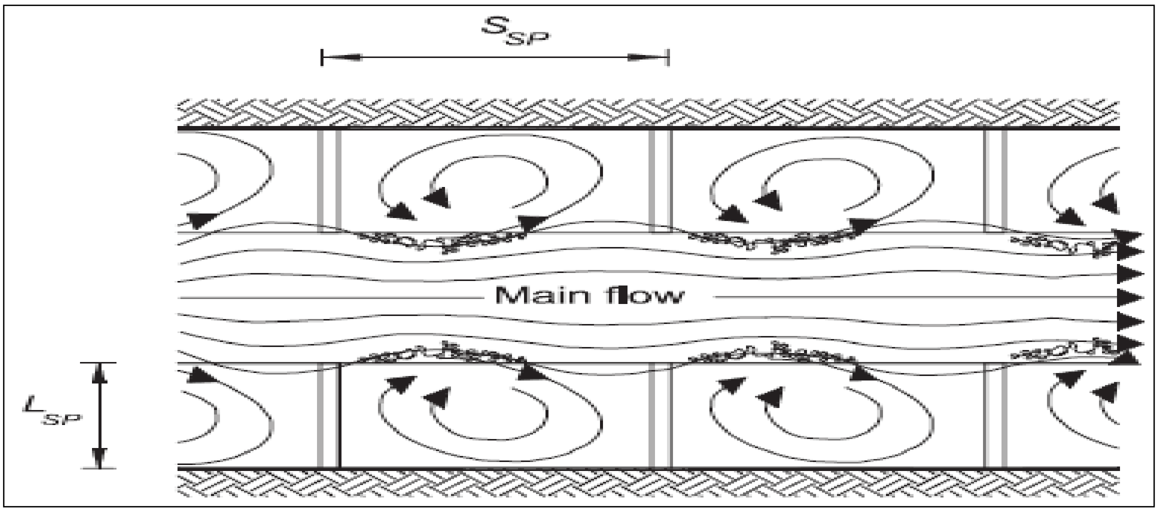


FIGURE 6.3: Diagram showing the length and spacing of the individual dikes with respect to the river width

In general, the prime factor for spur spacing between adjacent spurs is their lengths.

Generally, spur spacing adopted = 2 to 2.5 time the length of spur at convex banks and Spur spacing = Length of spur at concave banks

Length

The ratio of spacing of spur to its length (SSP / LSP) varies from 1 to 6.

Length of spurs depends upon the position of the original bank line and the designed normal line of the trained river channel. In erodible rivers, too long spurs may get damaged and cause failure. Hence, it is suggested / recommended to construct shorter ones in the beginning and extend them gradually, after due site observations.

Top width of spur

The top width of spur is kept as 3 to 6 m at formation level.

Free board

The top level of spur is kept with a free board of 1 to 1.5 m above the highest flood level for 1 in 500 years flood or anticipated highest flood level, whichever is more.

Side slope

Slope of upstream shank and nose is generally kept not steeper than 2:1. Downstream slope is kept which varies from 1.5:1 to 2:1.

Size of stone of pitching

Stones are placed over filters so that fines do not escape through the interstices of the pitching. For average velocity up to 2 m/s, burnt clay brick on edge are used as pitching material. For average velocity of 3.5m/s, pitching of stone weighing from 40 to 70 km (0.3 to 0.4 m in diameter) and for higher velocities, cement concrete blocks of depth equal to the thickness of pitching can be used.

Thickness of pitching

Thickness of pitching is determined from the formula, T = 0.06 Q 1/3,

Where, Q = design discharge in Cumecs.

Thickness of stone need not be provided the same through-out the entire length of spur. It can be progressively reduced from the nose.

Provision of filters

In general, Filters are provided below the pitching at nose and on the upstream face for a length of 30m to 45m from the nose. The thickness of the same may be 20 cm to 30cm. The thickness for the next 30m to 45 m on the upstream face may be reduced to about 15cm and beyond that, it can be omitted. However, may also refer the codal provisions, if available. A typical layout of a spur is shown in Figure.

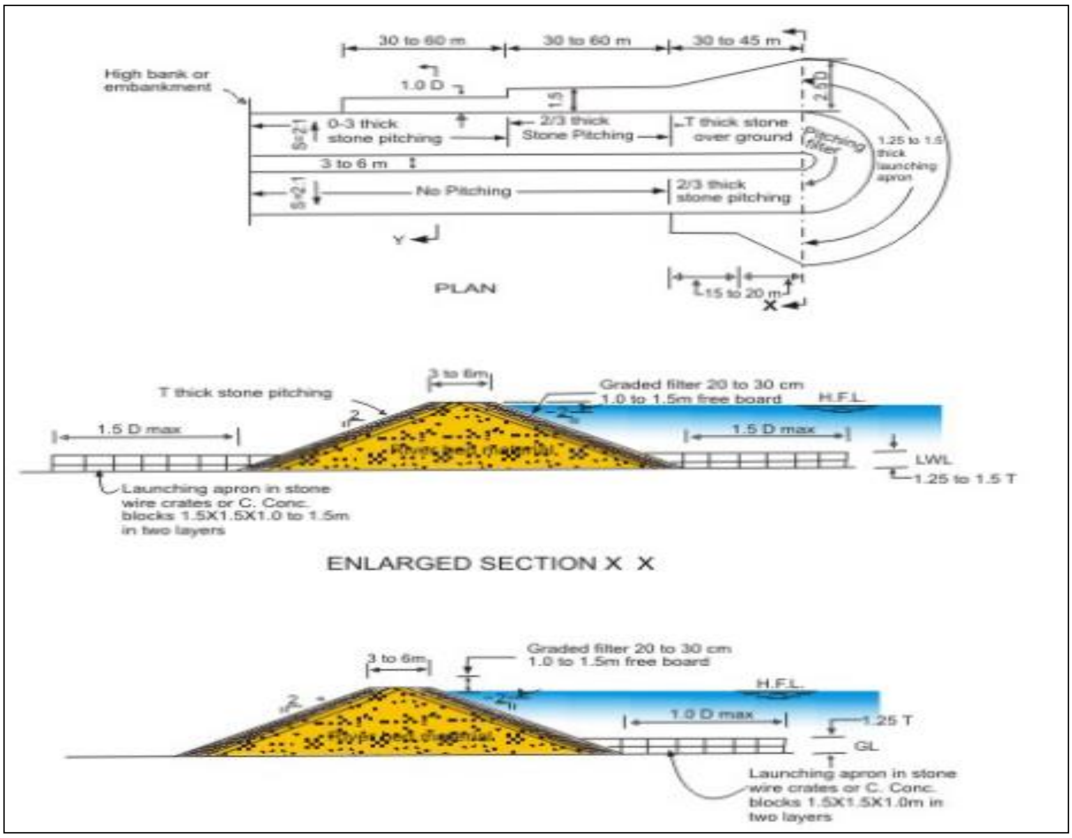
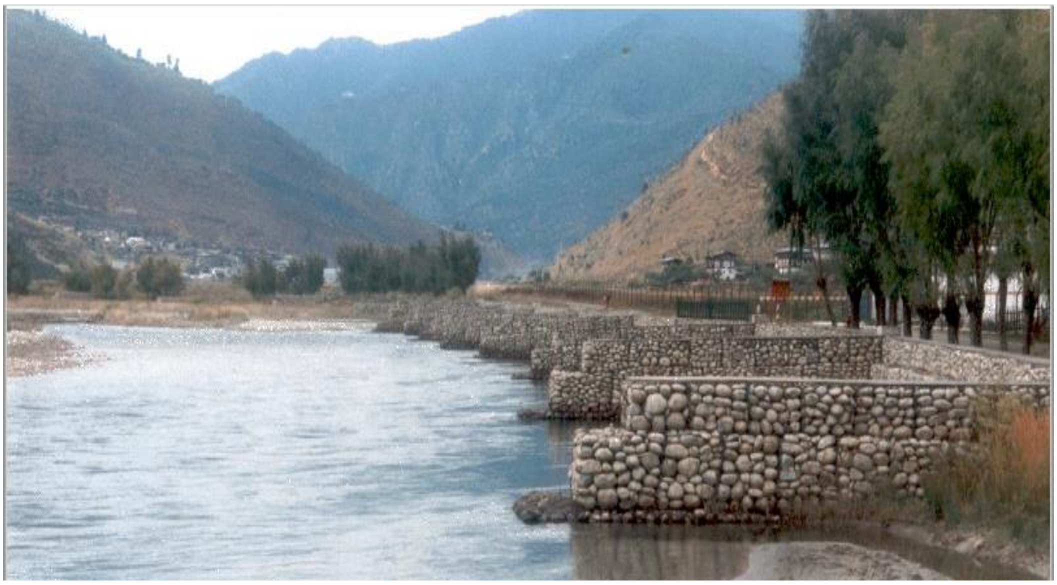


FIGURE 6.4: Typical layout and section of spur

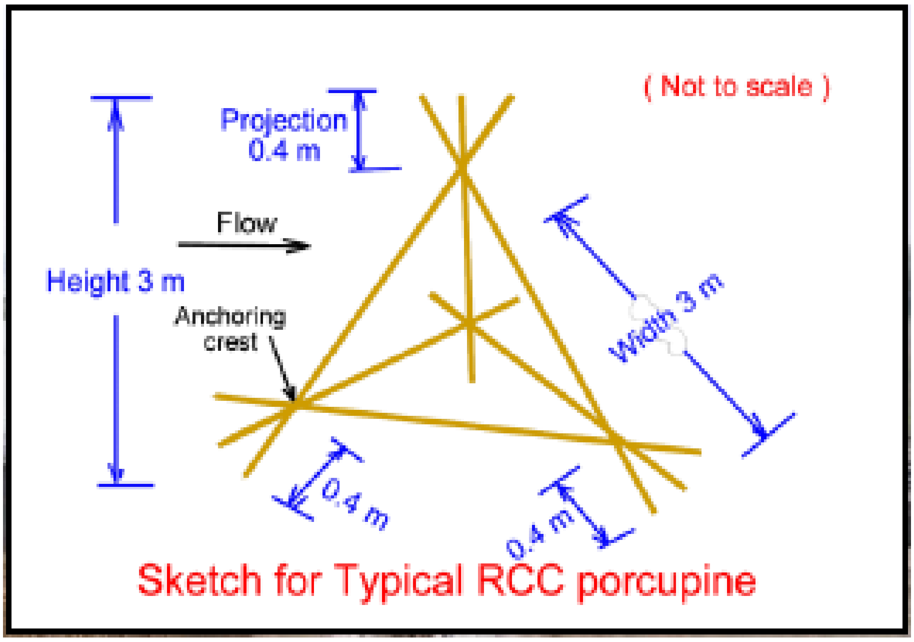
Impermeable spurs



Series of spurs

6.1.2 River Training through Porcupines

River Training through RCC Percupines are coming up nowadays and the same is under consideration on NW 1 for various activities including the Flood mitigation and taming of the river. Accordingly, the same also is under consideration for the study dtrech, wherein the Design and Photos are placed herewith.



6.2 Bank Protection

6.2.1 Basis of Design

The following specifies design principles, criteria and requirements to be taken into account for the design of the Bank Protection / Revetments.

All the banks are within a floodplain and made up by sand, silt and clay. This soil type may present different failure modes, such as scour, loss of fines, erosion, piping, etc. A special attention is to be paid to overall and local geotechnical failures. It is suggested to consider the required investigations at site and Detailed Engineering Designs etc., based on the soil parameters at the site.

There are many materials available in the market to be used for revetments, i.e., box gabions, block stone, cabled concrete blocks, dense stone asphalt, gabion mattresses, grouted stone, hand-pitched stone, in-situ poured concrete, loose concrete blocks, precast concrete slabs, open stone asphalt, soil reinforcement systems, etc… The selection of the type of material is based on a trade-off between hydraulic/geotechnical performances, construction related aspects (availability and supply, equipment and labor, access and infrastructure, etc…) and costs

Gabion revetments at the site shall be considered in the present study stretch. As the gabions do not need special equipment nor high-skilled labour for execution, their maintenance is not cumbersome and further they are more durable and economical than geotubes or geobags.

A. Design Principles

Applicable Codes, Standards and Guidelines

The following national design guidelines shall be used while carrying out the design of the revetment and the embankment:

- IS1893 (Part1): 2002. Criteria for earthquakes resistant design of structures
- IS7894: 1975. Code of practice for stability analysis of earth dams
- IS8408:1992. Planning and design of groins in alluvial rivers
- IS10751:1994. Planning and design of guide banks for alluvial rivers
- IS12094:2000. Guidelines for planning and design of river embankments
- IS14262:1995. Planning and design of revetment guidelines
- IS11532:1995. Construction and maintenance of river embankments.
- Escarameia M. (1998). River and Channel revetments: a design manual. Thomas Telford Publications, London.
- Bezuijen A. and Vastenburg E.W. (2013). Geosystems: Design Rules and Applications. CRC Balkema.
- PIANC (2015). Guidelines for Protecting Berthing Structures from Scour Caused by Ships. Report no. 180.
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- Lafleur, J. (1999). Selection of geotextiles to filter broadly graded cohesionless soils. Geotextiles and Geomembranes, 17(5), p. 299-312.

- BAW (1993). Code of practice - Use of geotextile filters on waterways. BAW, Karlsruhe.
- Craig, R.F. (1987). Soil mechanics. Chapman and hall, 4th edition.
- Maccaferri (2014). *Stone fill for gabions.*
- PIANC (1987) Guidelines for the design and construction of flexible revetments incorporating geotextiles for inland waterways.
- Gary E.F and J. Craig. (2000). Gabions for Streambank Erosion Control.
- EN 1997 Eurocode 7 – Geotechnical Design.
- BAW (2010). Principles for the Design of Bank and Bottom Protection for Inland Waterways (GBB).
- Blaauw H.G. & van de Kaa E.J. (1978). Erosion of bottom and sloping banks caused by the screw race of manoeuvring ships. Publication no. 202, July 1978. Delft Hydraulics Laboratory.
- Dash S.K., Dutta S., Sreedeep S. and Rao G.V. (2013). Design of a Bank Protection System on River Brahmaputra at Jamuguri. *The Masterbuilder*, October 2013.

B. Design Vessel

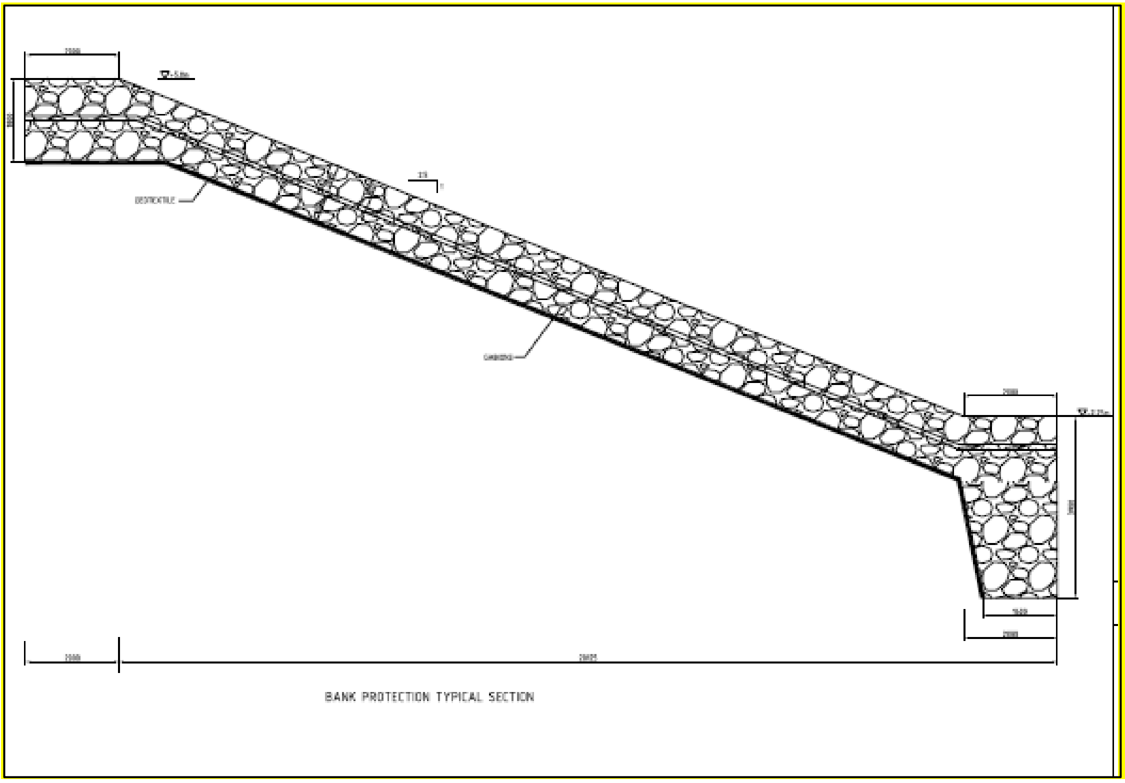
Vessel features are important in the design because moving vessels induce waves and currents in the river, which are a hydraulic load on the bank and river bed. These parameters will influence the design of the free board, the hydraulic stability of the structure and the size of the scour protection respectively for the revetments and the embankments.

C. Design requirements for Revetments

Gabions are wire mesh baskets filled with crushed rock. They are filled in situ, with locally available material and thus have a low capital cost. Because they are flexible and porous, they can absorb some wave and wind energy, thereby reducing the scour problems.

Gabions should be placed as sloping revetments with a preferable slope of 1:2.

Subdivided into equal sized cells, standard gabion baskets are of thickness 1, 1.5 and 3 feet and are available in lengths of 6, 9 and 12 feet.



D. Filter

A geotextile filter is required to prevent the underline sand being washed out through the gabions.

E. Toe protection

To prevent the sliding and failure of the revetment on the slope, a toe protection is required.

F. Anchoring

Proper anchoring is required for keeping the revetment in place. For this purpose the revetment will be extended both upstream and downstream.

Anchorage is required at the top of the submerged bank. It needs to be extended and anchored in the upper bank with a top key.

G. Hydraulic and Geotechnical Design

1) Revetment

a. Stone size

The minimum size of the stones should not be less than the ones specified in Figure. The figure is based on following assumptions:

- δ = friction angle between the geotextile bag surface and the subsoil, 20 degrees is recommended to be a conservative value;
- α = slope angle of the structure, because the slope angle is unknown, an assumption of 1V:2H is made;

- The specific gravity of the stones is 2.65.

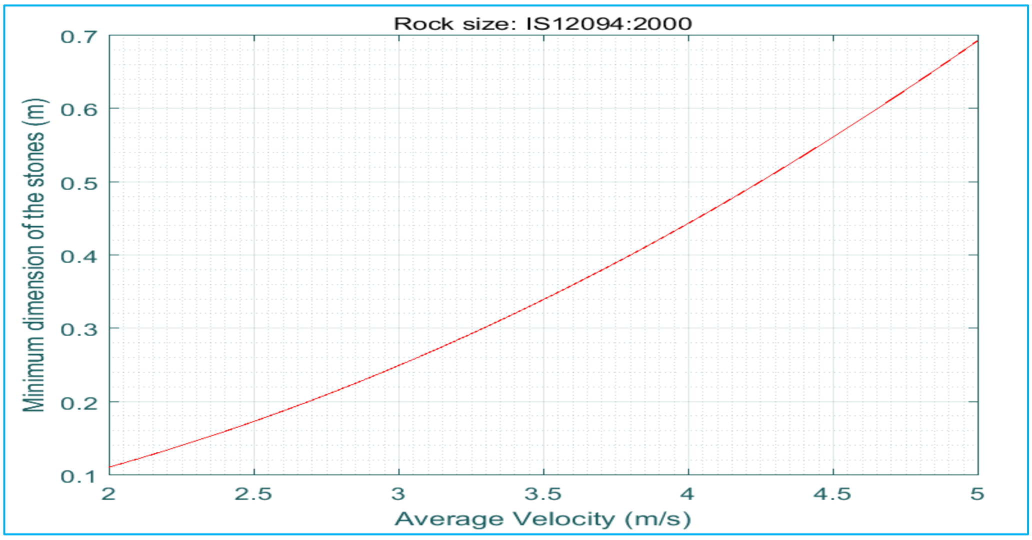


FIGURE 6.5: Minimum rock size according to the IS12094

From the above figure, it can be inferred that for average velocities higher than 3-4 m/s the rock size becomes very high. Under such circumstances small stones in crates or gabions are generally used. Therefore the use of gabions is proposed as alternative for the revetment.

b. Gabion size

The formulation of Pilarczyk allows accounting for additional phenomena compared to the national codes (IS12094). This formulation is referred to standard guidelines such as PIANC. Therefore it is proposed to use that formula to perform a sensitivity analysis and to include more local effects (like the turbulence expected in the bends, difference between continuous layer and edges/transitions and influence of the propeller jet). It should be kept in mind that near the terminal the river current and the propeller can act together, for that case the formulation can be expressed as:

$$\Delta D = \phi_{sc} \frac{0.035}{\psi_{cr}} k_s^{-1} \frac{(k_{h1} k_{t,r}^2 V_h^2 + k_{h2} k_{t,p}^2 V_r^2)}{2g}$$

Where :

- D = characteristic dimension/ thickness [m];
- Δ = relative density of the system (=1.17). According to the IS12094 the porosity for gabions can be computed as follows:

$$\Delta_t = (1-e) \cdot \frac{\rho_s - \rho_w}{\rho_w}$$

$$e = 0.245 + \frac{0.086}{D_{50}^{0.21}}$$

- D_{50}= mean diameter of the stones (= 0.30)
- *Sb* = Specific gravity of the stones, 2.65
- V_h = Maximum velocity of the propeller jet at the bottom [m/s];
- V_r = Maximum velocity of the currents at the bottom [m/s]

- ϕ = stability parameter, depending on the application (1, for gabions placed in edges or transitions and 0.75 for continuous top layer)
- Ψ = Shields parameter (0.07, gabions)
- $k_{t,r}^{2}$= turbulence factor of the river current (1.5 higher turbulence at river bends)
- $k_{t,p}^{2}$= turbulence factor of the propeller yet (3-4, load to the water jet)
- K_s = factor related to the slope angle

$$K_s = \sqrt{1 - \left(\frac{\sin \alpha}{\sin \delta}\right)^2}$$

- δ = friction angle between the gabion surface and the subsoil, 20 degrees is recommended to be a conservative value (for rip-rap is equal to 40 degrees)
- α = slope angle of the structure, because the slope angle is unknown, an assumption of 1V:2H is made
- K_{h1} = factor related to the depth (1 for a very rough current). This factor translates the depth-averaged flow velocity into the flow velocity just above the bottom protection. The roughness of the gabion depends on the stone size and the height of the gabion, among other things. Therefore, a value of 1 is chosen as a very conservative value to account for uncertainties in the vertical velocity field distribution and the roughness of the gabion.
- K_{h2} = factor related to the depth. For propeller jet PIANC (2016) recommends to use 1

In **Figure**, the minimum rock size for the gabions is shown. Assumptions have been taken for the calculation of the velocity and turbulence factors applied for the river currents.

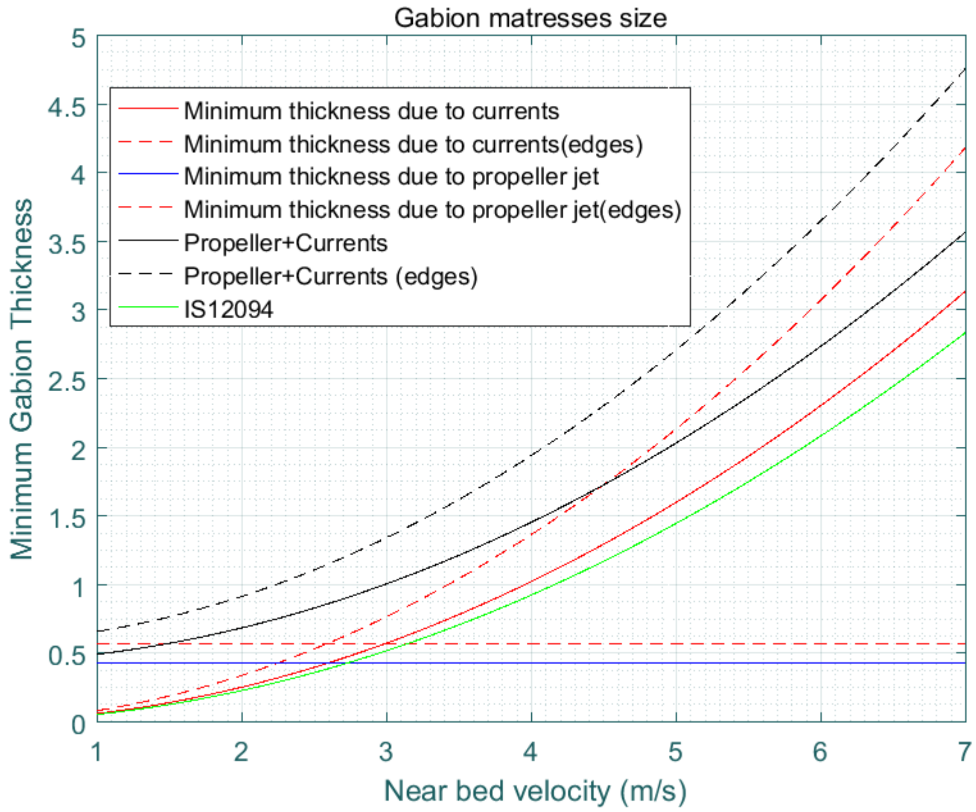


FIGURE 6.6: Minimum required thickness for revetment

The values given by Pilarczyk are chosen for the design since they allow for certain optimization. It should be noticed that, when changing slopes, the thickness of the gabion mattresses should be increased to account for the effects of the turbulence present on the transitions. The scour protection is considered as an edge of the revetment because high turbulence is also expected.

It is expected that the waves / currents calculated in section will not have any impact in the design. For revetments the required thickness to withstand wave / current loads can be worked out with next conservative formula (Klein & Pylarczyk, 1998):

$$\frac{\mathrm{H_s}}{\Delta \mathrm{D}} = \frac{9\cos(\alpha)}{\varepsilon_{op}^{2/3}}$$

- *D* = characteristic dimension/ thickness [m];
- Δ = relative density of the gabion
- *α* = slope angle of the structure, because the slope angle is unknown, an assumption of 1V:2H is made
- ε_{op}= Breaking parameter

$$\varepsilon_{op} = \frac{\tan(\alpha)}{\sqrt{\frac{\mathrm{H_s}}{1.56Tp^2}}}$$

c. Rock specifications

It is proposed to use a light grading which is appropriate for amour layers produced in bulk, usually by crusher opening. The size of the stone should be such that its length, width and thickness should be more or less the same. Round stones or very flat stones having small thickness should be avoided.

Standard grading should be used whenever possible. Determination of the gradation of the granular material is important for a number of reasons: 1) the packing and the volumetric layer porosity depend on the overall slope of the grading curve, 2) phenomena such as filtering and piping are governed by the gradation.

In Table 6.1 Some assumption for the rock grading are shown according to EN13383. Different rock layers are required to fill a determined gabion. In this sense the same table provides guidance on the amount of layers needed to fill a gabion.

TABLE 6-1: Typical Values for a grading of 10 to 60 Kg [1](following EN13383)

Grading (kg)	ELL	NLL	NUL	EUL	D_{n50}	D_{50}	Kt	nlayer	Ltmin
10-60	2	10	60	120	0.25	0.30	0.96	1	0.24
10-60	2	10	60	120	0.25	0.30	0.96	2	0.48
10-60	2	10	60	120	0.25	0.30	0.96	3	0.73
10-60	2	10	60	120	0.25	0.30	0.96	4	0.97
10-60	2	10	60	120	0.25	0.30	0.96	5	1.21
10-60	2	10	60	120	0.25	0.30	0.96	6	1.45

The major consideration in the design of gabion structures is the expected velocity at the gabion face. The gabion must be designed to withstand the force of the water in the stream. However the median stone size for gabion mattresses has to be in such a way that movement of the filler stone in the mattresses is prevented. This eliminates deformation that can occur when stone sizes are not large enough to withstand the forces of the water. The result of mattress deformation is stress on the basket wire and increases the resistance to flow and the likelihood of basket failure. A recommended value of a d_{50} in function of the water depth depends on manufacturer experiences; however some formulas are available in the literature (Gary E.F, J. Craig, 2000):

[1] *G=Grading Denomination, ELL= the mass below which no more than 5 per cent passing by mass is permited, NLL= the mass below which no more than 10 per cent passing by mass is permited, NUL= the mass below which no more than 70 per cent passing by mass is permited, EUL= the mass below which no more than 97 per cent passing by mass is permited, Dn50=Maximum Foreseen medium nominal diameter, D50= mean stone diameter (D50=Dn50/0.84), Kt= Layer thickness coefficient, Lt= layer thickness*

$$d_m = S_f C_s C_v d\left[\left(\frac{\gamma_w}{\gamma_s - \gamma_w}\right)^{0.5} \frac{V}{\sqrt{gdK_1}}\right]^{2.5}$$

Where :

- C_s = Stability coefficient (= 0.1), C_v = Velocity coefficient (= 1.25), S_f = safety factor (= 1.1)
- d_m = average rock diameter in gabions
- d = local flow depth at V
- V = depth average velocity (= 4 m/s)
- γ_s = unit weight of stone (2650 kg/m^3)
- γ_w = unit weight of the water (1000 kg/m^3)
- K_1 = side slope factor (= 0.98 for a slope of 1:3)

Figure below shows that for a medium stone diameter of 0.3 m and for the design velocity of 2.5 m / sec, the grading 10-60 kg is suitable.

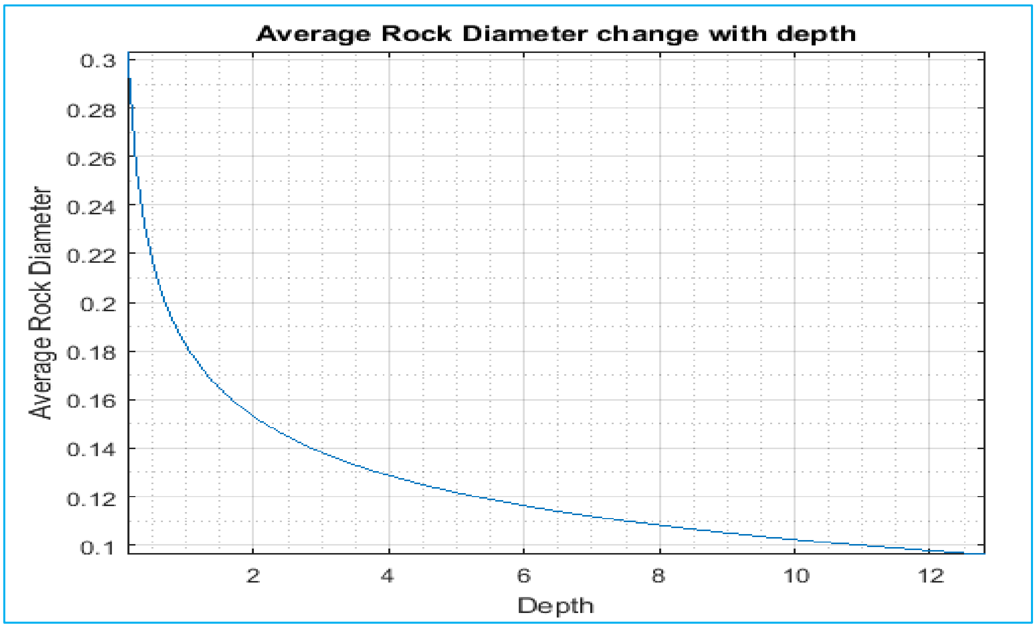


FIGURE 6.7: Minimum average rock diameter

The table below shows the properties from a well-known supplier (Maccaferri, 2014) for a durable stone fill for gabions:

TABLE 6-2: Technical specs for stone fill for gabions

Property	European standard references	Suggested requirements
Mechanical strength	Los Angeles, LA (EN 1097-2:1998) Fragmentability, FR (EN 1097-2:1998)	LA < 45 or LA > 45 and FR < 7
Resistance to attrition	Micro-Deval (EN 1097-1:1996) Fragmentability FR (EN 1097-2:1998)	MDE < 45 or MDE >45 and FR < 7

Property	European standard references	Suggested requirements
Resistance to freeze and thawing	EN 13383-1:2002	Category for FT_A (as assessed by loss of mass during testing): Loss of mass < 0.5%
Density of rock	EN 13383-2:2002	Apparent density > 2.2 t/m3
Amour stone grading	EN 13383-1:2002	CP90/180 or equivalent
Type of rock	Petrography	Calcareous, siliceous, metamorphic or igneous rock

d. Gabion specifications

The gabion basket is a double twisted wire mesh of variable sizes, uniformly partitioned in cells. A typical gabion has dimensions of 2 m length x 1 m width x 1 m height and comprises of a mesh type 80 mm x 100 mm. At the terminals, a mesh of 80 mm x 100 mm and a height of 1.4 m is proposed. A gabion mattress consists of gabions with relatively small height dimensions compared to length and width and would usually be of a smaller mesh type. A typical gabion mattress would have dimensions of 6 m length x 2 m width x 0.6 m in height and comprise mesh type 60 mm x 80 mm. At the terminals, a mesh of 60 mm x 80 mm and a height of 1-1.4 m is proposed.

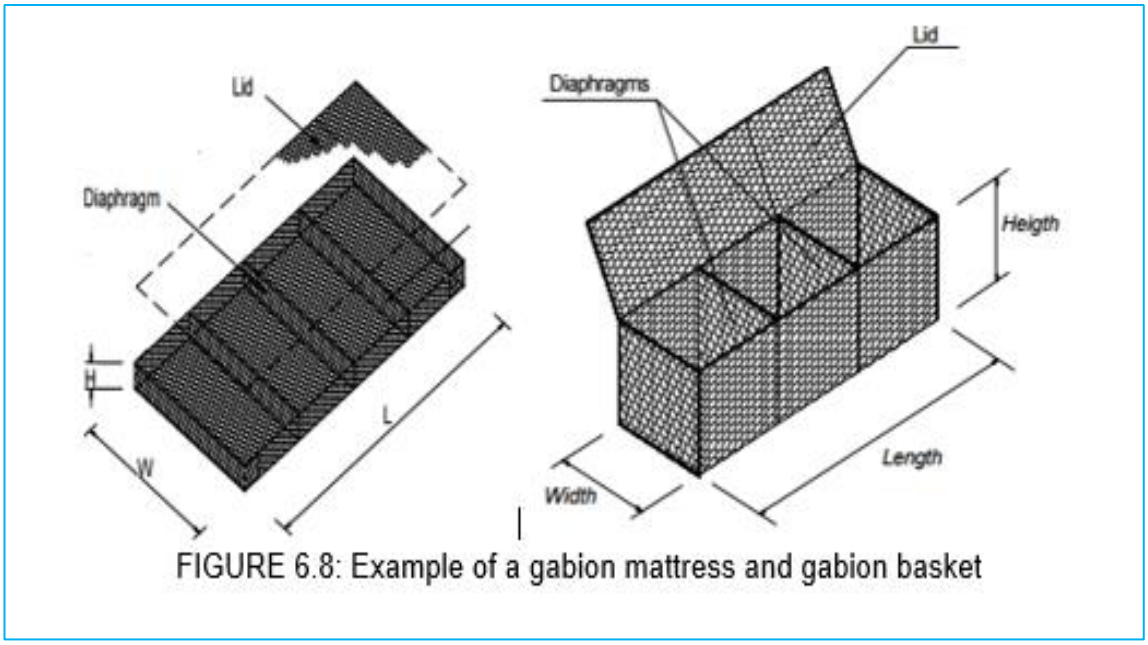


FIGURE 6.8: Example of a gabion mattress and gabion basket

According to IS14262:1995 gabions should be laid with the longer dimension along the slope of the bank. The size of the mesh of the crate should be smaller than the smallest stone in the crate. The mesh should be double knotted. Wire of minimum diameter of 4 mm should be used for crates. Crate units may be tied to each other by 5 mm wire.

A summary of the relevant European standards for gabions are given in table below, some suggestions are cited following the recommendations of the Rock Manual (CIRIA et al., 2007). Notice IS rules are more strict than EN for wire minimum diameter and those should be respected.

TABLE 6-3: European standards for the wire mesh

Wire Properties	European testing	Content
Steel wire composition	EN 10218-2:1997	Steel composition, strength
Steel mesh composition	EN 10223-3:1998	Mesh 60 mm x 80 mm wire: d = 2.2 or 2.4 mm Selvedge wire= 2.7 mm Mesh 80 mm x 100 mm wire: d = 2.7 mm Selvedge wire = 3.40 mm
Corrosion protection (galvanising)	EN 10244-1:2001 EN 1024402:2001	Thickness of the coating conforms to class A, mass of coating mc, depends on wire diameter: d = 2.2or 2.4 mm, mc = 23- g/m^2 d = 2.7 mm, mc = 245 g/m^2
Corrosion protection (polymer coating)	EN 10245-1:2001 EN 10245-2:2001 EN 10245-3:2001	Requirements for organic coating, PVC or PE, thickness, composition, strength, durability, flexibility
Tensile strength	EN 10223-3	60 mm x 80 mm: Tensile = 35 kN/m 80 mm x 100 mm: Tensile = 51 kN/m
Elongation	EN 10233-3	Elongation shall not be less than 10%

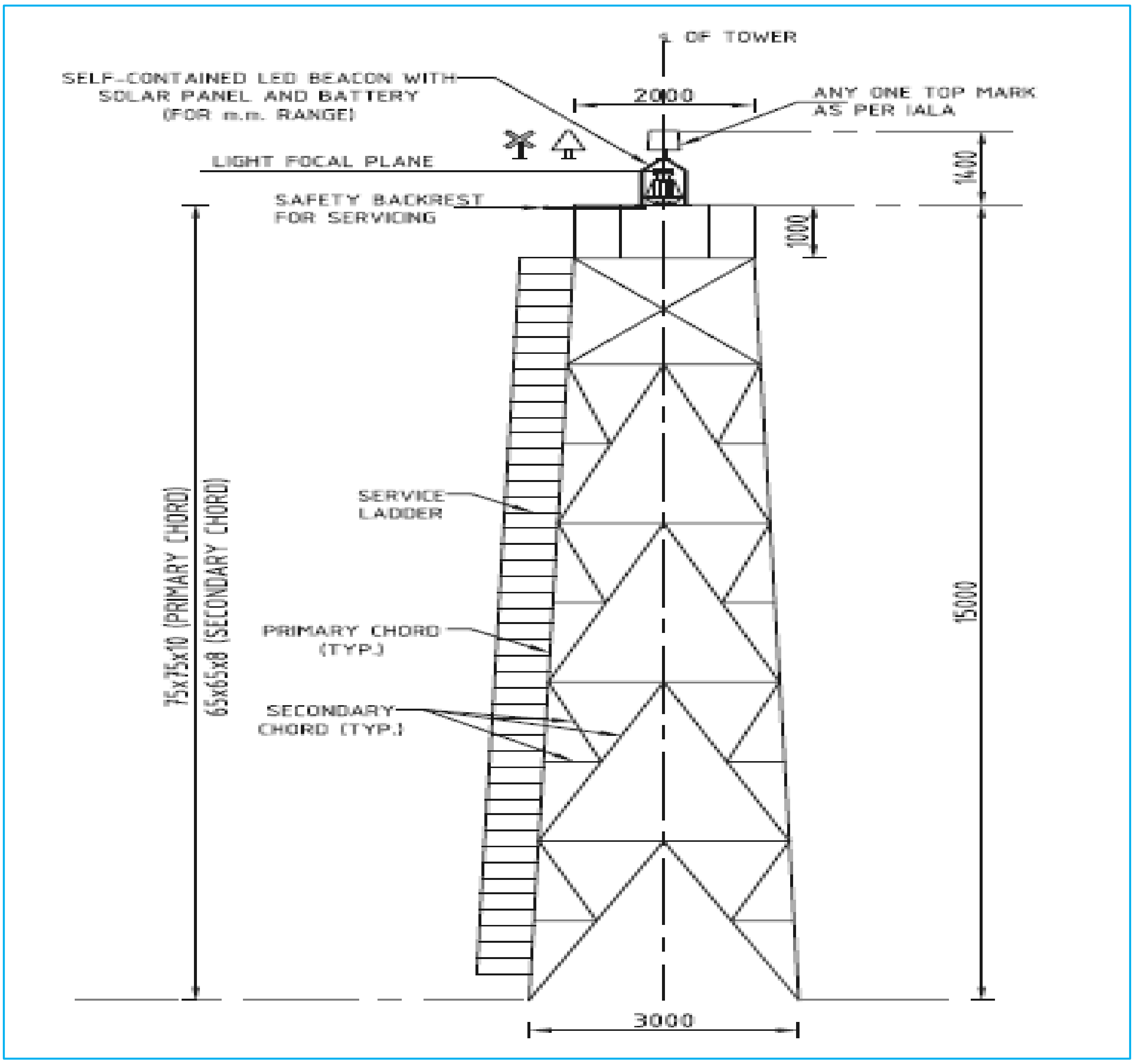
6.3 Navigation Aids

The Navigation system is of Two Types i.e., one is shore based and the other is water body based. The provision of Light is common in both the cases showing the Day / Night Marking system. The left / right marking during the day / night can be controlled through colour coding system. These aspects are being elaborated with guidelines by IALA at international level and is being followed in India also.

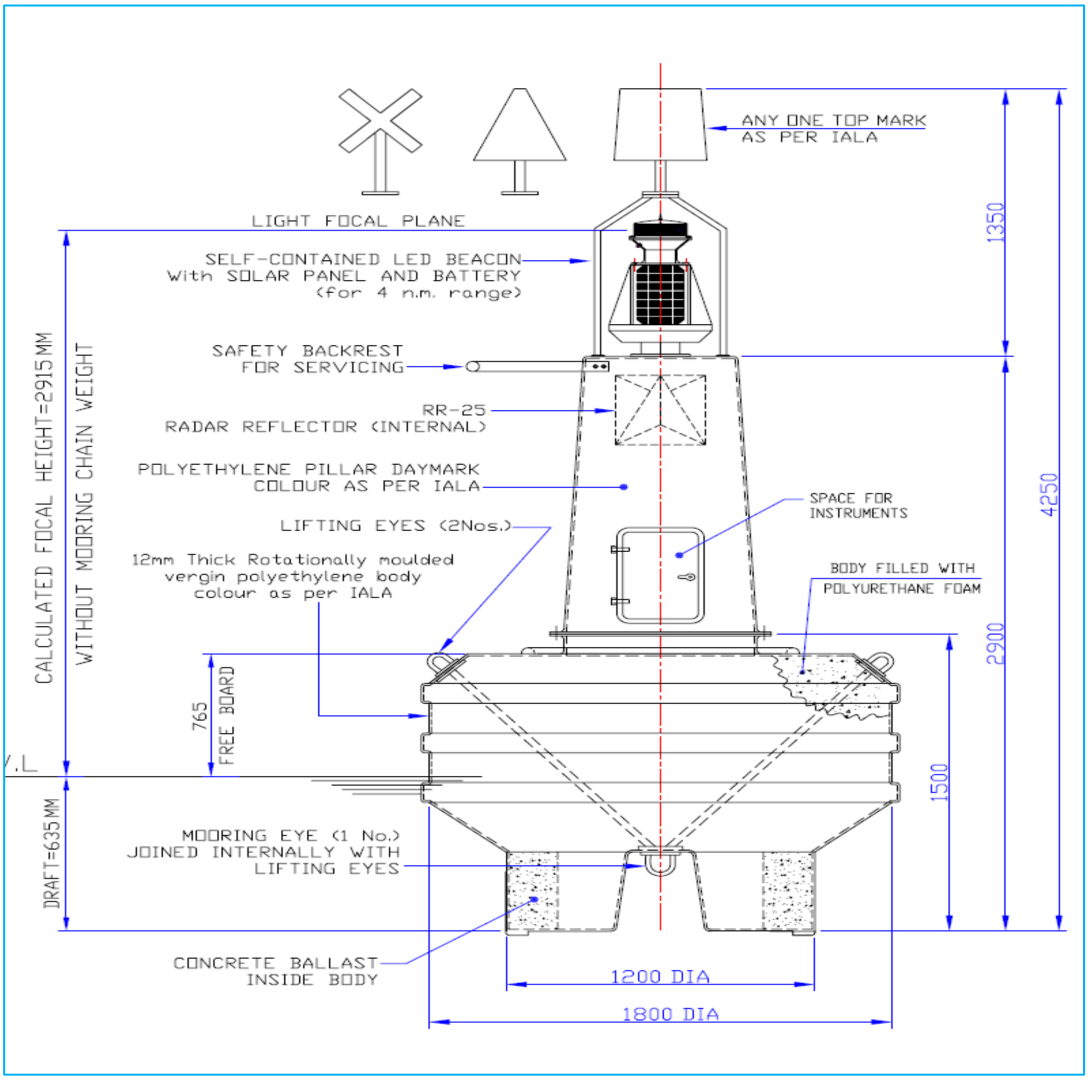
In the Shore based system, for the west flowing Nayional Waterways of Cluster 7 and Cluster 6, it has been preferred to have a Beacon / Light system, wherein the Buoy / Light system has been preferred.

The standard preliminary Design with drawing / along with specifications are placed hereunder.

BEACON WITH LIGHT SYSTEM:



BUOY WITH LIGHT SYSTEM:



Specifications of BUOY & LIGHT:

<u>POLYETHYLELENE CHANNEL MARKING BUOYS: (PORT HAND) 1 No. - PEB/1 800 Polyethylene Buoys, each complete with Day mark, Top Mark and Radar Reflector. Main features are as given below:</u>

Body Diameter: 1800 mm / Wall Thickness : 12 mm thick body / Body Material : Rotationally moulded in low density UV-Stabilized virgin polyethylene / Foam : Body filled with Closed Cell Polyurethane Foam / Weight without Mooring : 645kg (approx) / Focal Height : 29 15 mm / Draft : 635 mm / Free Board : 765 mm / Reserve buoyancy : 1893 kgs / Displacement : 26.0 kg./cm of immersion / Mooring Eyes : 1 No. of Steel / Lifting Eyes : 2Nos / Body Colour : As per IALA system, UV- stabilised colour pigments mixed thoroughly with polyethylene powder before moulding operation / Daymark : P E Module (as per IALA system) / Radar Reflector : RR - 25 as specified (25M2).

<u>1 Set - Mooring gear – Each set comprised of the following:</u>

1 No. - 3M x 26 mm dia open link chain with enlarged end links.

1 No. - 15M x 26 mm dia open link pendant chain with enlarged end links.

4 Nos. - 26 mm nom. dia forelock end shackles.

1 No. - 26 mm nom. dia swivel piece with end links.

1 No. - 250 kg. M.S. stockless Anchor.

Note: The chains shall be made as per 1S4692, shackles and swivel as per IS 4484 and stockless steel Anchor. The chain shackles and swivel shall carry proof load test certificate witnessed by the IRS. All the above shall be given one coat of coaltar paint.

Solar Operated LED lighting 1 No. MLB-200-4 Self contained LED beacon fitted with PLC-12 programmable LED controller. Specification of Each Light is as detailed below:

Luminous range: 4 n. miles. (T 0.74) / Light Colour: as per IALA System. (Red) / Light Source : High intensity Light Emitting diodes (LEDs) with UEP to 60,000 hrs of burning life / Optical system : 200 mm dia clear polycarbonate UV stabilized diffuser lens / Lantern Body : High impact polystyrene / Cable entry : M l6 Cable glands fitted / Fixing : 4 fixings for Ml 0 bolts at 200 mm PCD / Lantern weight : 3.0 kg (approx).

1 No. - PLC 12 programmable microprocessor based LED controller (fitted in the base of the Lantern). Main description is given as below:

Input Voltage: 12 V to 18 V d. c / Output Voltage: Switch-mode stabilized to suit LED operating current / LED load (max): upto 12 Amp. at 12 V d.c / Light Character: Any of the 256 IALA character can be selected / Solar charge regulator: Provided in the PLC-12 circuit / Light control : Automatic ON/ OFF by Photo diode / Protection : Against reverse polarity and excessive input voltage / Temperature range : -20°C to + 60°C.

SOLAR SUPPLY SYSTEM FOR MLB-200-4 LED Light: 1 Set — Solar supply system as detailed below:

4 Nos. - 12V 5 watt solar panel / 1 No. – 12 V 42 AH sealed, maintenance free battery / Autonomy period = 21 days Light Assembly: Lantern, Solar panel and battery are mounted on the GRP box, all assembled and wired as one self contained unit, ready for fitting on top of buoy structure.

6.4 Cargo Terminals and River Ports

Design Criteria

All structures shall be designed using limit state design approach. 3-D structural analysis of the structure shall be carried out under all specified loads and load combinations as per Indian Standards as explained in this report using STAAD Pro software. The design shall be done manually using the results of the analysis obtained from STAAD.

Design Life

All permanent structures shall be designed for a design life of 50 years.

Material Properties

Density of reinforced concrete	25.0 kN/m3
Density of Steel	78.5 kN/m3
Density of plain concrete	24.0 kN/m3

Density of Backfill soil 18.0 kN/m3 (May vary based on soil fill proposed during detail design)

Structural Steel

Minimum yield stress: 250 N/mm²

However, higher grade of steel (310/355 Mpa) shall be used based on the availability during the detailed design stage and subject to owner's approval.

Reinforcing Steel (Corrosion Resistant)

The grade of steel to be used as reinforcement in the structural concrete members shall comply with IS 1786 and will have minimum strength and elongation as mentioned below.

Yield Strength	500 Mpa
Elongation	14.5%

However, use of higher grade steel in the detail design is subject to availability of higher grade steel meeting the ductility requirements (as per revised latest code).

Cover to Reinforcement

The clear cover to main reinforcement shall be as follows:

Piles	100 mm
Deck Slab	75 mm
Longitudinal beams:	75 mm
Columns:	75 mm
Cross Beams	75 mm

Concrete Grades

Grade of RCC members	M40 for Piles
	M40 for Beams and Slab
	M40 for all precast elements
Grade of reinforcement	Fe500 confirming to IS 1786

Overall Deflection Criteria

The criteria for deflection shall be so limited that it shall not produce difficulties in serviceability conditions nor shall it cause damage to the structures and its components.

Deflection limits

Pile deflection at the deck level is normally considered as H/350 under extreme condition, where H is the distance from the point of fixity of piles to the top elevation of deck.

Crack Control

The crack width criteria shall comply with the provisions of IS: 4651(Part 4).

However, the assessed surface width of cracks (for service load combinations only) at points nearest to the main reinforcement will be restricted to 0.004 times the cover to the main reinforcement.

Corrosion Protection Painting

All steel surfaces in the splash zone and atmospheric zone shall be painted in accordance with the painting specifications. Areas and joints that are inaccessible for maintenance and thereby susceptible to corrosion shall be suitably sealed by methods such as boxing with plates.

All appurtenances such as walkway bridges shall be painted as per technical specifications of corrosion resistance suitable for the environment.

Classification of Loads

A. General Loading

The Self weight of the structure shall be calculated using the following

Density of reinforced concrete	25.0 kN/m3
Density of Steel	78.5 kN/m3
Density of plain concrete	24.0 kN/m3
Density of Backfill soil	18.0 kN/m³ (May vary based on soil fill proposed during detail design)

In addition, superimposed dead load and live load shall be considered

The various loads acting on the berthing structure are classified as:

1. <u>Loads from the River Side</u>:

The loads from the river side include the horizontal forces caused by the river currents and the forces caused by berthing and vessel’s pull from bollard. The forces caused by the berthing of the vessels are determined from the velocity and angle of approach of the vessels.

2. <u>Loads from Deck</u>

The important loads from the deck are the vertical loads caused by self weight of the deck and the superimposed loads from handling equipments. Also horizontal loads due to wind and seismic forces are considered.

3. <u>Loads from Shore</u>

Seismic loading

Earthquake loads shall be adopted as applicable for the site as per IS 1893 – 2002. The river fall under Zone II, as per the seismic map of India shown in IS 1893-2002. Design horizontal seismic coefficient shall be evaluated as per procedure detailed in IS 1893-2002.

The horizontal seismic coefficients are as follows:

TABLE 6-4: Seismic Loading

Seismic zone	**II**
Design horizontal seismic coefficient, Ah	Z I (Sa/g)/ (2R)
Zone Factor Z	0.10
Importance factor, I	1.5
Response Reduction Factor, R	3 (for ordinary RC moment resisting frame)
Average response acceleration coefficient Sa/g	Depending on time period of structure

Time period of specified structures shall be evaluated by STAAD analysis considering Dead Load + 50% Live load.

Scour

Scour depth is considered in calculating the total length of the pile.

The scour depth has been estimated as below:

Design discharge adopted Q = 31007 m^3/s

Particle size, D50= 4.75 mm

Silt factor, f= 1.76 * Sqrt (D50) = 3.84

Lacey's regime scour depth = 0.473 * (Q/f) (1/3) = 10.07 m

Scour depth from HFL= 2*10.07= 20.15 m

HFL= 11.18 m (amsl)

Scour Level from Lacey Regime depth formula= 11.18 -20.15 = -8.97 m

The pile is taken upto RL -14.0m

Existing bed level close the location = -1.0 m

The pile termination level is kept at -14.0m which will provide a 5.0m developmental length having socketing arrangement with surrounding rock. This is for Netravati & similarly the termination level of pile in Gurupur river is -22.0m. Therefore, the average length of pile in Gurupur shall be 20.0m & for Netravati river 28.0m

Loads & Load Combinations

All the structural members shall be designed to sustain safely the effect of the combination of various loads/forces and stresses that can possibly co-exist. The load combinations shall comply with the requirements of Indian reference standards both for limit state of collapse & serviceability.

Structural Design of Berthing Structure

Structural Arrangement

The Ro-Ro berthing structure shall consist of a concrete deck supported on piles. i.e the sub structure shall comprise of piles at 7.5 m c/c in transverse direction, whereas the super structure shall comprise of the pile caps and concrete deck & precast planks supported on longitudinal beams and cross beams. The pile caps span in the transverse direction with the longitudinal beams resting on the pile caps.

The structure shall be designed for its self weight and also for forces arising due to wind / seismic loads, current forces, vehicular loads etc as explained below.

For Ro-Ro berthing structure, an overall width of approx 16.5 m is provided in Gurupur and approx. 16.8 m is provided in Netravati.

The deck of Ro-Ro shall be submerged in water with varying water levels, depending on the season. Expansion loops shall be provided along the stretch at almost every 35-40 m.

Towards the Gurupur terminal facility i.e the shore end the deck has been considered above MHWS of 1.68 m and towards Netravati terminal facility i.e the shore end the deck has been considered above the FRL =7 m of Thumbe Barrage.

A staged construction approach is assumed in the design viz:

- Piles,
- Precast pile caps and placement of cross head beams,
- Placement of precast longitudinal beams with precast planks for slab
- Placement of concrete for cast-in-situ ties between beams and deck slab.

The Ro-Ro berthing structures considered in design has salient features as below:

TABLE 6-5: Salient Features of Gurupur Ro-Ro

Description	Total Length(m)	Total Width (m)
Ro-Ro	75	16.50

TABLE 6-6: Salient Features of Netravati Ro-Ro

Description	Total Length(m)	Total Width (m)
Ro-Ro	123	16.80

Design Loads on Berthing Structures

a) Dead Load

The dead load comprises of the weight of all components of the structure as well as the weight of all permanent connections.

For Ro-Ro berthing structures, the member load has been defined directly by STAAD Pro using the self weight command. The weight of concrete slab & precast panels has been applied in STAAD Pro software using floor load command.

b) Live Load

In general, the vertical live loads comprise of loads from vehicular traffic of all kinds including trucks and trailers. The vertical live loads as defined in IS 4651 (III) shall be considered in the analysis and design of the berthing structure.

TABLE 1 TRUCK LOADING AND UNIFORM LOADING

FUNCTION OF BERTH	TRUCK LOADING (IRC CLASS)	UNIFORM VERTICAL LIVE LOADING T/m²
(1)	(2)	(3)
Passenger berth	B	1·0
Bulk unloading and loading berth	A	1 to 1·5
Container berth	A or AA or 70 R	3 to 5
Cargo berth	A or AA or 70 R	2·5 to 3·5
Heavy cargo berth	A or AA or 70 R	5 or more
Small boat berth	B	0·5
Fishing berth	B	1·0

NOTE — The relevant Indian Road Congress (IRC) codes may be referred for axle load. The spacing of the loads may be changed to suit individual design requirements.

For Ro-Ro berthing structure, vehicular loading as per IRC 6 Class 70R as defined below shall be considered

1. A Tracked vehicle of 70-ton load or
2. Wheel load of 100 ton or
3. Bogie axle load of 40 tons, whichever is critical.

Moving loads has been applied in STAAD Pro software for all the three load cases defined above to obtain the maximum value of bending moment and shear force.

c) Seismic Forces

The river is in zone III as per IS 1893:2002(part I). Dynamic analysis has been done to calculate the time period of the structure. The spectral acceleration is calculated based on the time period of the structure obtained for its mode as per IS 1893:2002 for rocky soil types.

The maximum mass participation is observed for mode 1 in X direction and for mode 2 in Z direction.

The time period obtained is of the order of 3 secs in X direction and 3 secs in Z direction

Hence based on the acceleration value the horizontal seismic coefficient is worked out as

Ah = (Z/2) x (I/R) x (Sa/g).

Z = zone factor =0.10

I= importance factor =1.5

R = reduction factor =3

Sa/g= spectral acceleration based on time period

50 % Live load is considered for the dynamic analysis of the structure.
Thus Ah = 0.03 (in X direction) and Ah = 0.03 (in Z direction)

d) Wind Forces

Wind loads on the structure shall be applied according to IS: 875 (Part 3) -1987

Wind Pressure $Pz = 0.6\ Vz^2$

Where

Pz = Design Wind Pressure in N/m2 at height Z

Vz = Design wind speed at any height in m/s

Vb = Basic wind speed at any height in m/s

K1 = Probability factor (risk coeff)

K2= Terrain height and structure size factor

K3 = Topographic factor

Pz is calculated as 0.96 KN/m2 taking Vb as 33 m/s

The wind force is applied on piers and deck slab in both X and Z direction in STAAD Pro software.

e) Mooring Load

The Mooring loads are the lateral loads caused by the mooring lines when the vessel is pulled into or along the deck or hold it against the forces of wind or current. The maximum mooring forces are due to wind force, on exposed area, on the board side of the vessel.
IS 4651_III, gives Bollard Pulls of vessel as below

For 2000 Tonnes displacement Line pull = 100 KN (total)

TABLE 4 BOLLARD PULLS

(*Clauses* 5.3.4 *and* 6.1)

DISPLACEMENT (TONS)	LINE PULL (TONNES)
(1)	(2)
2 000	10
10 000	30
20 000	60
50 000	80
100 000	100
200 000	150
Greater than 200 000	200

NOTE 1 — For ships of displacement tonnage 50 000 and over the value of line pulls given above should be increased by 25 percent at quays and berths where there is a strong current.

NOTE 2 — Main bollards at the ends of individual large vessel berths at river structures should be designed for a line pull of 250 tons for ships up to 100 000 tons displacement and for double the values given above for larger ships.

f) Current Forces

As per IS 4651 III, pressure due to current is applied to the area of vessel below the water line when fully loaded.

i. Gurupur Terminal

Current force F = w $v^2/2g$ per m^2

Where v = velocity =2.5 m/s

W= 10 kN/m^2

F = 3.185 kN/m2

ii. Netravati Terminal

Current force F = w $v^2/2g$ per m^2

Where v = velocity =3.1 m/s

W= 10 kN/m^2

F = 4.89 kN/m^2

Load Combinations

The load combinations as per IS 4651(IV): General Design Considerations are considered in design of structure. Suitable partial safety factors as per IS: 4651 - 1989 applied to the loads for limit state design are considered.

All operational load combinations will be checked to satisfy the serviceability criteria.

TABLE 6-7: Partial Safety Factors for Loads in Limit State Design

Loading	**Partial Safety Factor**					
	Limit State Serviceability		**Limit State of Collapse**			
Dead load [4.1(a)]	1.0	1.0	1.5	1.2 (or 0.9)	1.2 (or 0.9)	1.2 (or 0.9)
Vertical live load [4.1(b)]	1.0	1.0	1.5	1.2 (or 0.9)	1.2 (or 0.9)	1.2 (or 0.9)
Earth Pressure [4.1(f)]	1.0	1.0	1.0	1.0	1.0	1.0
Hydrostatic and hydrodynamic forces [4.1(g)]	1.0	1.0	1.0	1.2	1.0	1.0
Berthing and mooring forces [4.1(h) and 4.1(j)]	-	1.0	1.5	-	-	-
Secondary stresses [4.1(m)	1.0	-	-	-	-	-
Wind forces [4.1(k)	-	-	-	-	1.5	-
Seismic forces [4.1(p)	-	-	-	-	-	1.5

NOTE: For the limit states of serviceability, the values given in the table are applicable for short terms effects. While assessing the long term effects due to creep, the dead load and the part of the live load, likely to be permanent, may only be considered.

Structural Analysis and Design of Berthing Structures

Based on the structural arrangement and loadings described above, a 3-D model was developed in Staad Pro software for Ro-Ro Berthing structures. The structure is modelled with its deck (long & cross beams) along with piles at every 7.5 m in transverse direction.

Linear elastic analysis has been carried out using the Staad model for estimating the actual forces in structural length of the pile for all loads considered. The design is carried out the most critical load combination. The pile foundation design is presented in **Annexure 5.1**.

RCC members are designed manually considering limit state design approach as per latest available Indian standards.

A one-third increase in permissible stresses shall be allowed in seismic case as per clause 6.3.5.1 of IS 1893 part-1 2002.

Gurupur Ro-Ro

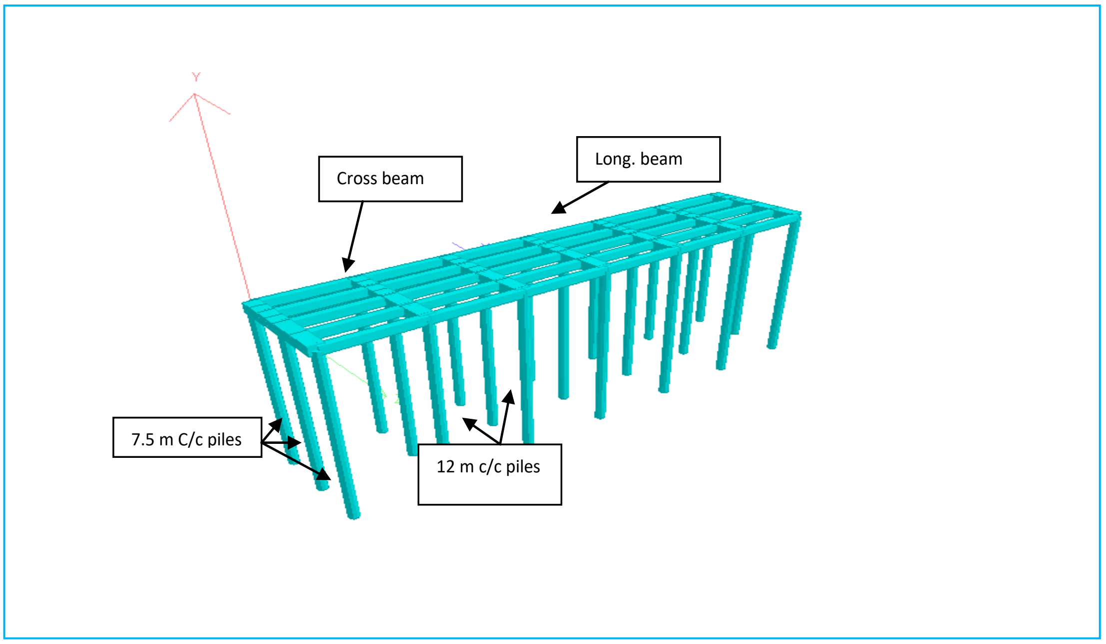


FIGURE 6.9: Perspective view of 3 dimensional model prepared in STAAD for RO-RO

SIZING OF RO-RO

Member Description	Length (m)	Member Sizes(m)			Material
		Width	Depth	Thick	
Cross Beams	7.5	1.8	1.5		Concrete
Longitudinal Beams	12	1.0	1.25		Concrete
CastIn situ Slab				0.15	Concrete
Pile Diameter, OD		1.2			Concrete

A. **Netravati RO-RO**

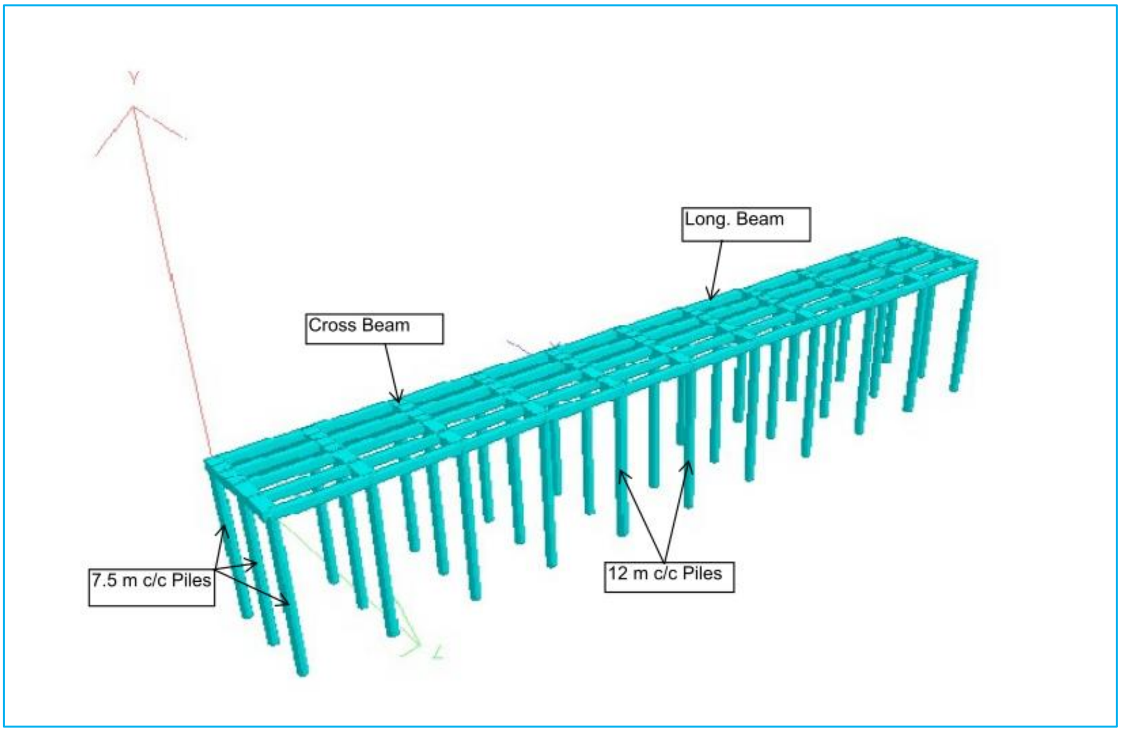


FIGURE 6.10: Perspective view of 3 dimensional model prepared in STAAD for RO-RO

SIZING OF RO-RO

Member Description	Length (m)	Member Sizes(m)			Material
		Width	Depth	Thick	
Cross Beams	7.5	2	1.5		Concrete
Longitudinal Beams	12	1.0	1.25		Concrete
CastIn situ Slab				0.15	Concrete
Pile Diameter, OD		1.4			Concrete

6.5 Construction Schedule

Construction schedules of different structures will be discussed and elaborated as a part of the implementation schedule in the appropriate chapter.

CHAPTER 7.: VESSEL DESIGN

7.1 General Review

River Netravati and Gurupur (NW 74 & 43) are proposed for development of Ro-Ro, passenger and tourist ferry service. Trucks and trailers moving between MRPL to Bangalore have been frequent cause of accidents on NH 48. This necessitates an urgent need to divert vehicles like trucks, lorries, oil tankers bound for Bangalore from roadways to IWT. Ullal – Mangalore is the busiest route in the region. Passengers moving on this route often faces heavy congestion. Some share of this traffic could be diverted on River Gurupur.

Development of two terminals is proposed, each at River Gurupur and Netravati. Terminal proposed on river Gurupur is near Ashok Nagar (backside of NMPT). Another terminal is proposed on Rrver Netravati at Thumbe Village. This is an intertwined development. River Gurupur would handle Ro-Ro and passenger traffic between Ashok Nagar and Bengre/Ullal, while river Netravati holds potential for trucks movement to/from central Karnataka and tourists to enjoy boat ride between Thumbe and Ashok Nagar.

The predominant factors in vessel designing are Fairway and Traffic i.e., the Fairway availability and Traffic Type and Volumes to be transported. The Fairway details have been discussed in Chapter 03 and the IWT Traffic scenario has been discussed in Chapter 04. The present status on the vessels plying in the study stretch have been collected and placed in chapter 4.

7.2 Design Basis

Vessel design is usually influenced by the factors like traffic type and density, channel type and characteristics, flow current, operational and navigational factors, etc. The selection of vessels for River Gurupur & Netravati (NW-43 & NW-74) have been made using traffic type and volume. Higher traffic / volumes and lower transport cost induce need for larger vessels or deployment of smaller vessels in several numbers.

7.2.1 Vessel Classification adopted in Indian Inland Waterway

Ministry of Shipping and Inland Waterways Authority of India has classified the Inland waterways into seven categories for rivers and canals for safe plying of self-propelled vessels (Ref: IWAI, Gazette Notification 2006). The classification criteria of waterways are mentioned in **Table 7.1** for Rivers.

TABLE 7-1: Classification of Inland Waterways for Rivers

Class of Waterways	Rivers				
	Minimum Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance (m)
I	1.2	30	300	4	30
II	1.4	40	500	5	40
III	1.7	50	700	7	50
IV	2.0	50	800	10	50
V	2.0	80	800	10	80
VI	2.75	80	900	10	80
VII	2.75	100	900	10	100

Vertical clearance for power cables or telephone lines or cables for any transmission purpose for all the classes of waterways mentioned shall be as follows:

- Low voltage transmission lines including telephone lines - 16.5 metres
- High voltage transmission lines, not exceeding 110 kilo volt - 19.0 metres
- High voltage transmission line, exceeding 110 kilovolt - 19.0 metres + 01 centimetres extra for each additional kilovolt

7.3 Type of proposed Vessels

The most suitable river vessel is to be considered based on the following aspects viz., Fairway availability; Availability of Day / Night navigation system; Obstructions enroute like Locks; Navigational clearances free cross structures; Haulage distance; Type and Nature of Cargo; Terminal facilities etc. The study stretches of River Gurupur (NW-43) & Netravati (NW-74) have been considered as Class IV. Class IV waterways can operate passenger carrying vessels. It has been proposed to have 01 Terminal in River Gurupur (NW-43) at Ashok Nagar & 01 terminal in Netravati (NW-74) at Thumbe village.

Vessel requirement for a waterway can be segregated mainly into two parts i.e., Waterway maintenance vessels and Cargo/Passenger vessels. There are many vessels required for maintenance of waterway viz., Dredgers; Tugs; Survey vessels; Navigational Equipment maintenance vessels; Patrol Boats; Pilot Boats; Inspection Vessels etc. River Gurupur (NW-43) & Netravati river (NW-74) due to its small stretch and limited commercial opportunity cannot have exclusive vessels for maintenance of waterway. Vessels required for maintenance of waterways has been discussed in the "Institutional Requirement".

7.4 Proposed Vessel Size and Specifications

Targeted depth of River Gurupur (NW-43) & Netravati (NW-74) is considered as 2.0 m. IWAI designed and built Ro-Ro vessels has been considered to accommodate proposed truck traffic in River Gurupur and Netravati. Any passenger vessel with less than targeted depth is suitable for navigating in the defined stretch. Specification of considered Ro-Ro and passenger vessels are mentioned below.

7.4.1 Ro-Ro Vessel

- 56ft. Ro-Ro Ferry Vessel
  - ✓ Size (L x B x D) – 56m x 13.5m x 1.8m
  - ✓ Capacity – 15 Trucks
  - ✓ Engine – 2 Engines of 250 kW

FIGURE 7.1: 56Ft. Ro-Ro Ferry Vessel - IWAI

7.4.2 Passenger Vessel

Presently 6 vessels are plying on Gururpur river for across and along the river movement. These vessels are single screw with 120 pax capacity and 450 bhp engine power. One of these vessels are shown in the figure below. Similar vessels are recommended to handle proposed passenger traffic in Gurupur and Netravti river.

- ✓ Capacity – 120 Pax
- ✓ Engine – 335 kW Single Screw

FIGURE 7.2: 120 Pax Passenger Vessel in Gurupur River

7.5 Turn around Time

Turn Around Time (TAT) for the Inland Navigation is the most critical analysis, involving many practical issues, linked with the Fairway constraints; Terminal Operational Constraints; Availability of Day / Night Navigation system; Vessel speed etc. The navigable stretch of both the waterways are as mentioned below

- River Gurupur (NW-43): 8km (Ashok Nagar – Bengre/Ullal)
- River Netravati (NW-74): 22.5 km (Thumbe Village – Bengre/Ullal)

The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel on both the stretches.

TABLE 7-2: Turn Around Time Calculation for Single Ro-Ro Vessel

Sl No.	Parameters	Unit	(Gurupur)	(Netravati + Gurupur)
1	River Stretch	Km.	8	30.5
2	Traffic Type Proposed	Type	Ro-Ro	Ro-Ro
3	Terminal Proposed	No.	1	1
4	Load / Unload (both side)	Mins	60	60
5	Misc. Waiting	Mins	30	30
6	Total Handling Time	Mins	90	90
7	Sailing Speed	Knots	8	8
8	Sailing Time	Mins	32	125
9	**Total Turn-around Time**	**Mins**	**122 (2 Hrs)**	**225 (3 Hrs 45 Mins)**

Based on the above assumptions, one side trip would take at least 2 Hrs in Gurupur and around 3.5 hours for Ashok Nagar – Thumbe route. Vessel speed and operational time consumed at terminal and in transit are the primary influencing factor of turnaround time.

TABLE 7-3: Turn Around Time Calculation for Single Passenger Vessel

Sl No.	Parameters	Unit	(Ashok Nagar – Bengre, Along River)	(Bengre – Across River)	(Thumbe – Ashok Nagar)
1	River Stretch	Km.	8	~1	30.5
2	Traffic Type Proposed	Type	Passenger & Tourist	Passenger	Tourists
3	Terminal Proposed	Type	Ferry Terminal	-	Ferry Terminal
4		No.	1	-	1
5	Load / Unload (both side)	Mins	20	10	30
6	Misc. Waiting	Mins	-	-	15
7	Total Handling Time	Mins	20	10	45
8	Sailing Speed	Knots	10	8	10
9	Sailing Time	Mins	25	5	99 (1 Hr 39 Mins)
10	**Total Turn-around Time**	**Mins**	**45**	**15**	**144 (2 Hrs 24 Mins)**

Based on the above assumptions, one side trip would take at least 45 mins in Gurupur for along river and 15 mins for river crossing, and around 2 hours 24 mins for Ashok Nagar – Thumbe route. Vessel speed and operational time consumed at terminal and in transit are the primary influencing factor of turnaround time.

7.6 Number of Vessels Required

This section discusses the number of vessels required to handle projected traffic on the of River Netravati and Gurupur (NW 74 & 43). Below listed are the relevant factors are considered to arrive at the requirement of number of vessels;

- Nature and Type of Traffic
- Fairway Length (distance between proposed terminals)
- Physical Hindrances
- Vessel Capacity
- Permissible Speed
- Operational (Days & Hours), etc.

The table below shows the assumptions considered to arrive at Ro-Ro vessel calls and number of vessels required to cater to the projected truck traffic till FY-40.

TABLE 7-4: Assumptions for Calculating Passenger Vessel Requirement

Sr. No.	Parameters	Unit	Gurupur River	Netravati River
1	Operational Days	Days	300	300
2	Daily Operational	Hours.	12	12
3	Carrying Capacity	Trucks	15	15
4	Vessel Speed	Knots	8	8
5	Loading and Unloading Time	Mins	60	60
6	Miscellaneous Time	Mins	30	30
7	Chainage	Km.	8	22.5

Based on the above assumptions, number vessels required on the of River Netravati and Gurupur (NW 74 & 43) is represented in the table below.

TABLE 7-5: Number of Ro-Ro Vessel Requirement in Gurupur River

Sl No.	Unit	FY25	FY30	FY35	FY40
Traffic (Trucks)	No.	4,574	14,896	17,052	19,519
Annual Vessel Calls	No.	305	994	1,137	1,302
Daily Vessel Calls	No.	2	4	4	5
Vessels Requirement	No.	1	1	1	1
Additional Vessel Requirement	-	0	0	0	0

TABLE 7-6: Number of Ro-Ro Vessel Requirement in Netravati River

Sl No.	Unit	FY25	FY30	FY35	FY40
Traffic (Trucks)	No.	-	30,022	34,367	39,340
Annual Vessel Calls	No.	-	2,002	2,292	2,623
Daily Vessel Calls	No.	-	7	8	9
Vessels Requirement	No.	-	3	3	3
Additional Vessel Requirement	-	-	0	0	0

The above calculation concludes that one number of Ro-Ro vessel wil be suffient to handle truck traffic proposed in River Gurupur & three numbers of Ro-Ro vessel will be required to handle total projected traffic. Since this is an intertwined development, total of three Ro-Ro vessel shall suffice to kickstart the operation and introducing more Ro-Ro vessel, once the positive development is witnessed over the period of time. The table below shows the assumptions considered to arrive at passenger vessel calls and number of vessels required to accommodate the projected passenger and tourist traffic till FY-40.

TABLE 7-7: Assumptions for Calculating Passenger Vessel Requirement

Sr. No.	Parameters	Unit	Gurupur (Along River)	Gurupur (Across River)	Netravati
1	Operational Days	Days	300	300	300
2	Daily Operational	Hours.	12	12	12
3	Carrying Capacity	No.	120	120	120
4	Vessel Speed	Knots	10	8	10
5	Loading and Unloading Time	Mins	30	10	30
6	Miscellaneous Time	Mins	-	-	15
7	Chainage	Km.	8	1	22.5

TABLE 7-8: Number of Passenger Vessel Requirement in Gurupur – Along River

Sl No.	Unit	FY24	FY30	FY35	FY40
Traffic (Boat Ride)	No.	1,042,076	1,136,775	1,222,232	1,314,113
Annual Vessel Calls	No.	8,684	9,474	10,186	10,951
Daily Vessel Calls	No.	29	32	34	37
Vessels Requirement	No.	2	3	3	3
Additional Vessel Requirement	-	-	1	-	-

TABLE 7-9: Number of Passenger Vessel Requirement in Gurupur – Across River

Sl No.	Unit	FY24	FY30	FY35	FY40
Traffic (Boat Ride)	No.	2,431,511	2,652,474	2,851,874	3,066,263
Annual Vessel Calls	No.	20,263	22,104	23,766	25,553
Daily Vessel Calls	No.	68	74	80	86
Vessels Requirement	No.	2	2	2	2
Additional Vessel Requirement	-	-	-	-	-

TABLE 7-10: Number of Passenger Vessel Requirement in Netravati River

Sl No.	Unit	FY31	FY34	FY37	FY40
Traffic (Boat Ride)	No.	180,167	230,342	294,646	377,000
Annual Vessel Calls	No.	1,502	1,920	2,456	3,142
Daily Vessel Calls	No.	6	7	9	11
Vessels Requirement	No.	1	1	1	1
Additional Vessel Requirement	-	0	0	0	0

The above calculation concludes that initially 2 Nos. of vessels and additional 1 No. in FY29 onwards will be required to cater to the proposed traffic (majorly includes local passengers) for along the river movement and 2 Nos. of similar vessels for along the river movement in Phase I.

7.7 Vessel Specification

The deployement of ferry for tourism would be by 3rd party tour operators. IWAI would not make any investment in acquiring vessel or operating it. Hence, Capital Cost of the vessel is not part of financial analysis or project cost calculation. It has been noted that the Capital Vessel Building Subsidy is under consideration by IWAI / Administrative Ministry of Shipping, which is being recommended herewith to give boost to this sector. The indicative ferry acquisition cost, as ascertained from the Market, is being furnished herewith. The recommended specification of Ro-Ro and Passenger vessels that can be deployed in River Gurupur (NW-43) & Netravati (NW-74) for tourism and passenger movement is as follows.

- Ro-Ro Vessel: (15 TEU) – Double Ended Operation
- LOA 56.00 m
- Breadth 13.50 m
- Loaded Draft / Depth: 1.80 m
- Propulsion: Twin Engine Azimuth Drive
- Propulsion Power: 2 x 250 kW
- Speed (with Load): 8 Knots @ 100% MCR

Vehicle Capacities:

- 40 ft Trailor Trucks: 3 Nos.
- 20 ft Trailor Trucks: 3 Nos.
- 20 ft Trucks: 6 Nos.

7.7.1 O&M Cost

The Operation & Maintenance cost (O & M Cost) for the Vessels being considered in the IWT project, in general, consists of running cost of the vessels; Crew Cost; Repair Cost; Depreciation Cost; Insurance factor and Interest Factor. The vessel mobility is under consideration of 3 Ro-Ro Vessel, for which working the O&M cost is only indicative & will not have any bearing at this point of time. The cost factors are as below.

1 Ro-Ro Vessel (For 1 Year)

- 1 Ro-Ro vessel Running cost for 330 days operation with 3 ½ Hrs mobility in a cycle and having 3 cyclic maximum operations in a day, cost per annum will be as detailed.
- 990 cycles x 3 .75 Hrs x {0.1 Liter per hour x 2 Engines x 250 kW} x INR 85 per Liter = **INR 157.78 Lakhs Per Annum**.
- 8 Nos. Crew on 1 Ro-Ro vessel @ INR 0.50 Lakhs per month.

- Crew cost for 12 months will be 12 x 8 x 0.5 = **INR 48 Lakhs Per Annum** per Unit.
- Repair Cost is @ 2 % P. A of CAPEX i.e., 0.02 {1 x 1000} = **INR 20.00 Lakhs Per Annum.**
- Depreciation is proposed by considering the life of vessels as 20 Yrs.
- Interest factor is proposed as per the industry norms.
- Insurance factor is proposed as per the industry norms.

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CHAPTER 8. NAVIGATION AND COMMUNICATION SYSTEM

8.1 General Requirements

A fool proof communication system in the River Navigation is a most important requirement in order to maintain the safety of the entire system. Safety is one of the important parameters that has to be considered for the development of the inland navigation along with the protection of the environment and efficiency. In order to have undisturbed and uninterrupted development and maintenance of Inland Navigation System, safe communication is most important.

Safety implies that navigation risks on the waterway stretch need to be at an acceptable level. In particular, the risks of:

- Ship-to-ship collisions;
- Ship-bridge collisions;
- Groundings;

need to be minimised, rather to be nullified. Accordingly, to accomplish, an adequate visual marking of the fairway has to be done. Even if more advanced and potentially more accurate systems are deployed, visual fairway markings are used to verify proper navigation and are also a necessary backup in case of system failures.

8.1.1 VHF / HF

Communication is essential for navigation in Inland Waterways. Due to the VHF the captains of the vessel can communicate with each other. The VHF communication can be recorded if the system will be equipped with VHF-transceiver. The recordings of the VHF can be used to investigate incidents or near-incidents to prevent future incidents.GPS

The DGPS system provides the RIS-system with a correction value. This correction value increases the accuracy of the AIS transponders onboard of the vessels. The AIS base station transmits the correction signal through the designated AIS message or DGPS correction..

8.1.2 GPS

The DGPS system provides the RIS-system with a correction value. This correction value increases the accuracy of the AIS transponders onboard of the vessels. The AIS base station transmits the correction signal through the designated AIS message or DGPS correction.

8.1.3 RIS / AIS / Radar / VTMS

RIS is a concept for harmonised information services which supports traffic and transport management in inland navigation, including interfaces to other transport modes. The general technical solution is depicted in Figure below

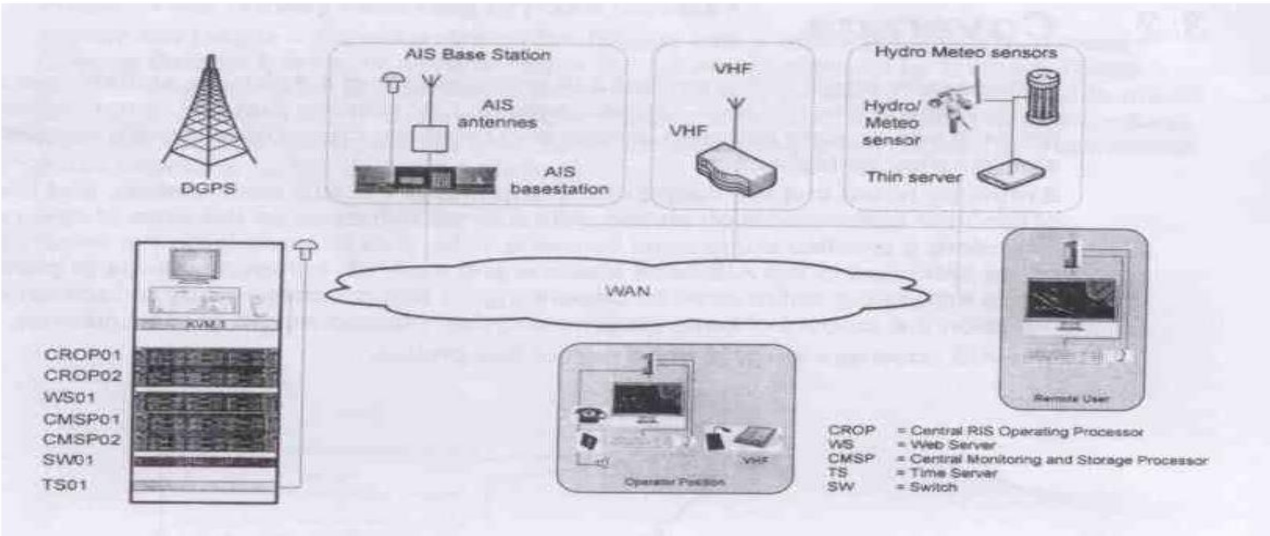

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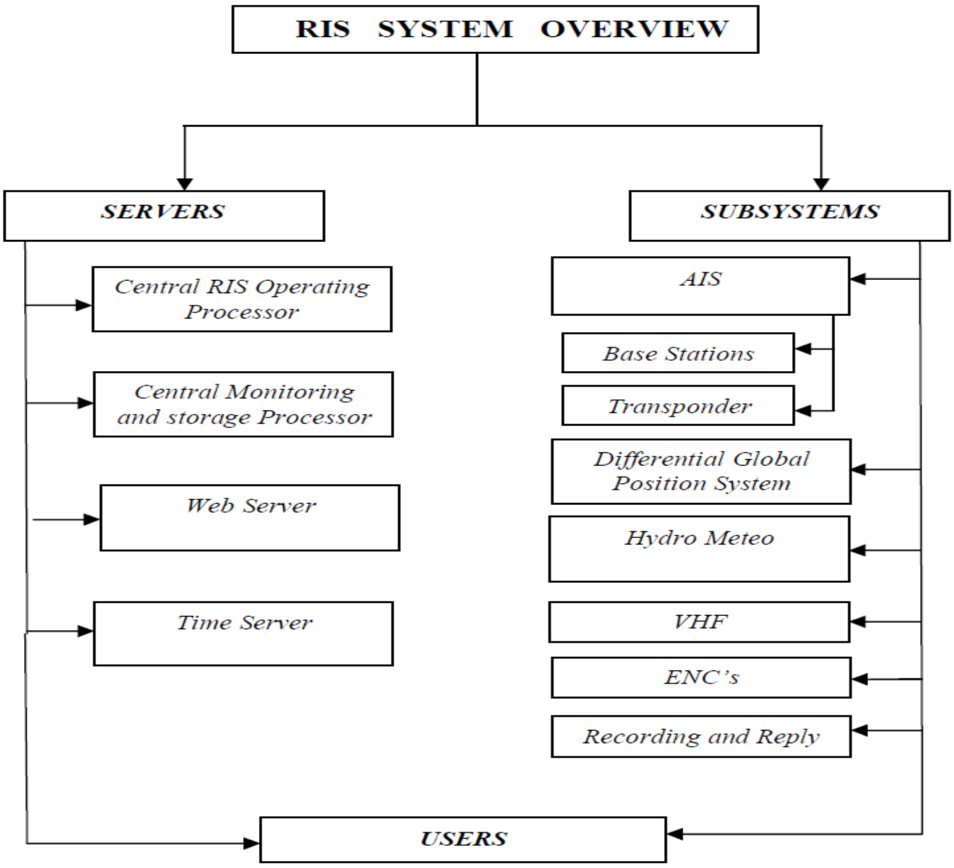
Fig 8.1 Main components of the RIS system are given below in flowchart:



Servers

The system consists of several central servers (or processors). For availability reasons these servers should be duplicated. Duplication in two different locations requires a good Quality of service of the connection, on and a fair amount of bandwidth between these locations.

CROP (Central RIS Operating Processor)

The Central RIS Operating Processor (CROP) is the main unit of the RIS-system. It receives all the received ship reports from the AIS base stations. The CROP filters all duplicated AIS Ship reports and provides the operator with a real time over-view of the Traffic.

CMSP (Central Monitoring and Storage Processor)

The Central Monitoring and Storage Processor (CMSP) provide 2 basic functions for the RIS-system. These functions are the storage of all received data and the monitoring of the availability of the servers and the subsystems.

The data that will be stored by the CMSP will all be stored at the moment the data is received. The CMSP will fingerprint all received data. A notice will be given during replay in case the data is corrupt or has been changed. The data that will be stored by the CMSP are:

- Received AIS Data;
- Hydro and Meteo Data;
- VHF communications;
- Operator Actions;
- System Status (availability)
- WS (Web Server)
- The web server is used to provide a traffic image to third party users. These third-party users are the one that benefit from the data as provided by the RIS-system but who don't have direct access to the RIS-servers. In this case the third parties are limited to a few responsible persons as mentioned below:
- Harbour master at Port;
- Logistic supply chain manager at Port;
- Harbour master at another Terminal;
- Logistic supply chain manager at another Terminal;
- Vessel operators (or owner).
- The benefits by using the web server are:
- Real time overview of the vessel position;
- Overview of the expected time of arrival (ETA) of each vessel;
- Delays in logistic deliveries (Coal) are known in due time;
- Optimisation in logistic deliveries.
- The functions of the web server are:
- Provide traffic image to the WS-users;
- WS user profile selection
- TS (Time Server)

- The time server is used to align all servers in the server centre to exactly the same time. This is important with respect to the registration, display and replay of data.
- Subsystems
- The subsystems and their anticipated function as used in the RIS-system are described as under.
- AIS (Automatic Identification System)
- There are two types of AIS i.e., Shore stations and the ships transponder.
- Base Stations
- The AIS base stations are the main sensor in the RIS-system. The AIS base station should comply with all regulations with respect to AIS.
- The function of the AIS base stations will be:
- Receipt of the ship reports
- Transmission of virtual buoys
- Transmission of Hydro and meteo information
- Transmission of DGPS correction message
- Transmission of AIS messages to skippers or certain areas
- Transponder
- The function of the AIS transponder on board of the vessel will be:
- Transmission of own position;
- Transmission of own configuration (in case of barges)
- Receipt of other ships positions equipped with an AIS transponder
- Receipt of hydro and meteo information
- Receipt of safety related messages
- On board of the vessels the AIS transponder should be integrated with the radar and with the display. VTMS i.e., Vessel Track Monitoring System is also to be integrated as a part of projection of visual features to identify the location with its real time pictures. This will be a cumbersome proposal.
- Hydro Meteo
- Knowing the accurate level of the water in the river is essential to be able to increase the efficiency of the logistic chain. The required data can be forwarded to the:
- RIS-operators
- Skippers;
- Logistic simply chain managers (a decreased depth might negatively influence the coal supply).
- ENC's

The RIS-system should be equipped with an ENC chart. This ENC chart can be displayed on the operator positions at the traffic centre and on the electronic chart display system onboard of the vessels.

Inland Waterways Authority of India (IWAI) is already in the process of development of Digitized Charts of all the National Waterways, which are the ENCs and these ENC charts are already being updated on a regular base. The updated ENC charts are adaptable to the virtual aids to navigation.

8.1.4 Recording and Replay

The system will be equipped with a recording and replay function. The recorded data will be fingerprinted, so one can check whether the data is correct or has been changed afterwards. The recordings can be stored on the CMSP-server. It is advised to have the data stored online for at least 30 days. After these 30 days the data can be stored on a medium like tape or on DVD.

The Recording and Replay function should also be equipped with a function to make a movie of the traffic image on DVD or other kind of storage device.

The recording and replay system can be used for:

- Registration of acquired data;
- Incident Evaluation;
- Near incident Evaluation;
- Check on procedures;
- Operational analysis (statistical).

Additional requirement

- The following infrastructure is required to operate the RIS-system:
- Fixed energy supply
- Uninterruptable Power Supply (UPS)
- Diesel generator
- Mast for antennas
- Shelter for equipment
- Foundation for shelter and Mast
- Lightning protection
- Fence to protect shelter and mast
- Wide Area Network (WAN) connection at each site
- Other infrastructure that might be required could be:
- Microwave link
- Air-conditioning
- Fire detection equipment
- Fire Fighting
- Burglar detection

Users

The RIS-system will have multiple users. These users will either have a different task. Depending on the task of the user the authorization on what the user can do or what data the user is allowed to see can change.

Depending on the specific needs of the IWAI, or its clients, these users can be expanded and/or changed.

The following users/ roles are:

- User management
- Traffic Operator
- Emergency response
- Incident evaluation
- Maintenance

8.1.5 Vessel / Hydrographic Survey equipment

The RIS-system also requires that certain systems are available and working on the used vessels. The system should be connected and integrated with each other. The required systems are:

- AIS transponder
- VHF
- Radar
- Hydro and meteo sensors
- Echo sounder
- Electronic chart display capable of displaying virtual buoys.

8.2 Existing System

IWAI is already having the communication system on NW 1 / NW 2 along with Day / Night Navigation system which have been developed considering the AIS and DGPS stations. Further, the adaptable Digitized charts are already being used linked with Survey Equipments viz., Echo-sounders and GPS with a provision for updating the charts. Provision also is under consideration to link up with the Day / Night Navigation Buoys.

8.3 Additional requirement

The communication system technology is rapidly changing with Technology change. Accordingly, within a short gap of time, the existing system is leading to an obsolete scenario. Hence, development of a sustainable system is very difficult. However, an attempt has been made and a workable rather reliable system has been worked out and placed as Annexure 8.1. Further, the specification of AIS Base Station Transponder is enclosed at Annexure 8.2 and AIS Embedded Server specifications are enclosed at Annexure 8.3. As observed, this system is not cost effective and left the details in this report, as an Academic data for consideration at later date, if found feasible.

Further to the above, an attempt has been made to ascertain the details on the alternative real time ship tracking system viz., Vessels Traffic Management System (VTMS). It was observed that the same is costlier than the RIS system and has not been discussed. Subsequent to the discussions with the stakeholders, it was noticed that the Ministry of Shipping, Govt. of India has already initiated the working about feasibility and implementation of “National Coastal Grid of VTMS”, in which a considerable distance of the rivers joining the sea also is under consideration. This proposal is from the strategic safety point of view and is expected to take some more time. It is suggested to have a dialogue at later date by IWAI for a full proof communication / navigation system in the National Waterways joining the sea in both West / East coast.

At this stage, it is recommended to proceed ahead with the available Mobile Networking system and later on an amenable system can be adopted, subsequent to the considerable progress on “National Coastal Grid of VTMS”.

8.4 Costing

Based on the market survey and quotations, the cost implications are placed herewith,

8.4.1 Capital Cost

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**RIS Centre**				
1	Land Cost		1	1,50,000	1.50
2	Equipments		1	10,20,700	10.21
3	Tower & installation		1	7,50,000	7.50
4	Other Incidentals		1	8,50,000	8.50
	Total RIS Centre				**27.71**
B	**AIS Base Station (One Number)**				
1	Land Cost		1	10,00,000	10.00

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
2	Equipments		1	10,20,700	10.21
3	Tower & installation		1	7,50,000	7.50
4	Other Incidentals		1	8,50,000	8.50
	Total AIS Base Station				**36.21**
C	**Vessels**				
	As in Fairway Development				
D	**Buoys**				
	As in Fairway Development				
	Total Cost				**63.91**

Cost with GST & the Cost to be divided equally in Gurupur & Netravati

8.4.2 O&M Cost

A. Repair & Maintenance of Equipments @ 10 % on 63.91 Lakhs 6.39

B. Contingencies @ 3 % on 63.91 Lakhs 0.19

C. 2 Lease Lines @ 2.5 Lakhs per annum for 2 WWs 5.00

D. Other Incidentals 2.00

Total **Say 13.58 Lakhs Per Annum**

:

CHAPTER 9. ENVIRONMENTAL & SOCIAL ASPECTS

9.1 Objective of Environmental and Social Studies

The objective of the environmental and social studies is to assess the environmental and social impacts due to the proposed development works and suggest a suitable environmental management plan (EMP) to mitigate adverse impacts, if any, including its cost. In addition, Consultant has to identify the authorities who will give the clearance for EIA / EMP.

9.2 Environmental Setting in the Project Area

The proposed national waterway no. 43 is located on Gurupur river in the Dakshina Kannada district of Karnataka State. It is a 10.04 km stretch of the Gurupur river beginning from the confluence of Netravathi river with the Arabian Sea at Lat 12°54'44.04"N, Lon 74°49'44.51"E to the Mangalore Port Bridge at Lat 12°55'34.81"N, Lon 74°49'37.34"E.

The proposed national waterway no. 74 is located on Netravathi river in the Dakshina Kannada district of Karnataka State. The total length of the Netravathi mainstream in the catchment from the origin to the outfall in the Arabian Sea is about 103 km. The Netravathi River passes through Chikamangaluru & Dakshin Kannad Districts of Karnataka State. It flows through the famous pilgrimage place Dharmasthala and is considered as one of the Holy Rivers of India.

Out of the total length of 103 km, about 78 km of the stretch of the river from Netravathi Dam, Dharmasthala, to its confluence with the Arabian Sea at Bengre has been declared as new national waterway (NW-74). Based on the findings during Stage I of the DPR Study for NW-74, only a 30.0 km stretch out of the originally identified 78 km length of the Netravathi river has been considered for the present study i.e. for Stage II of the DPR study. The 30 km stretch under consideration begins from the confluence of Netravathi with the Arabian Sea at Bengre at Lat 12°50'44.6904"N, Lon 74°49'33.3734"E and ends near Bantwal at Lat 12°53'53.50"N, Lon 75°02'57.30"E.

The environmental setting in the project area is described in the sections that follow.

9.2.1 Physiography

Karnataka is situated on the western edge of the Deccan Peninsular region of India. It is located approximately between 11.5° North and 18.5° North latitudes and 74° East and 78.5° East longitudes. Karnataka comprises the Deccan Plateau, the Western Ghats Mountain Range and the Coastal Plains.

Physiographically, Karnataka is part of two well-defined regions of India: the Deccan Plateau and the Coastal plains and Islands.

The state can be divided into four physiographic landforms – the Northern Karnataka Plateau, the Central Karnataka Plateau, the Southern Karnataka Plateau and the Coastal Karnataka Region.

1. Northern Karnataka Plateau

The Northern Karnataka Plateau covers the districts of Belgaum, Bidar, Bijapur and Gulbarga. The area is mainly composed of the Deccan Trap. It represents an extensive deforested plateau landscape. The Northern Karnataka Plateau has an elevation of 300 metres to 600 metres from the sea level. The plateau slopes towards the east. The landscape is mainly covered with rich black cotton soils.

The vast expanse of treeless plateau is interspersed with river plains, watersheds, residual hills and ridges. The river plains are represented by those of River Bhima, River Ghataprabha, River Krishna and River Malaprabha.

2. Central Karnataka Plateau

The Central Karnataka Plateau is located between the Northern Karnataka Plateau and the Southern Karnataka Plateau. It consists of districts like Bellary, Chikmagalur, Chitradurga, Dharwad, Raichur and Shimoga. The elevation of the Central Karnataka Plateau varies between 450 metres and 700 metres. The general slope of this plateau is towards the east.

This region is the location of the Tungabhadra River basin.

3. Southern Karnataka Plateau

The Southern Karnataka Plateau includes the districts of Bangalore Urban, Bangalore Rural, Hassan, Kodagu, Kolar, Mandya, Mysore and Tumkur. This plateau region is covered by a high degree of slope. It is encircled by the Western Ghats on the west and the south. The Southern Karnataka Plateau has a general elevation of 600 metres to 900 metres. But the Biligirirangan hills of Mysore district and the Brahmagiri range of Kodagu district have residual heights ranging between 1,500 metres to 1,750 metres.

The Cauvery River basin forms a significant part of this plateau.

4. Karnataka Coastal Region

The Karnataka coastal belt starts from the Western Ghats in the west and extends till the edge of the Karnataka Plateau in the east. The Karnataka Coastal Region includes the districts of Udupi, Uttara Kannada and Dakshina Kannada.

The terrain of this region consists of rivers, creeks, waterfalls, ranges of hills and peaks. The Karnataka Coastal Region can be divided into two main geographical divisions, known as the Western Ghats and the plains. The coastal belt has an average width of 50 km to 80 km. It covers a distance of around 267 km from north to south.

Dakshina Kannada district is one of the three districts of the State located in the coastal region. It is located in the western belt covering a geographical area of 4861 sq.km. The district is bounded on the north by Udupi district, on the east by Chikmagalur and Hassan districts and on the south-east by Kodagu, on the south-west by Kasargod and Cannanore districts of Kerala State and on the west by the Arabian Sea. The district has a coastal line of about 40-45 km. The district is separated from the rest of the south Indian peninsula by the the Western Ghats.

Dakshina Kannada District can be divided broadly into three well-defined physiographic units viz. i) Coastal plain ii) Upland pediplain area and iii) Eastern hilly area forming part of the Western Ghats.

The Coastal plain is a narrow, thickly populated and intensely cultivated area adjoining the coast. There is considerable extent of barren land along the coast partly because it is sandy, rocky, and marshy. The area near sea is covered with coconut gardens.

The Upland pediplain area is interspersed with low hills between the Western Ghats and the coast, which is moderately cultivated with a considerable extent of fallow land.

The Eastern hilly area in the eastern part of the district is hilly with thick forest cover, which forms part of the Western Ghats. The hills of the area range in elevation from 1200 to 1500m a.m.s.l. and are capped with laterite, which form plateau usually of oval or elongated configuration. The hill ranges are dissected by numerous streams and rivulets. The prominent peaks in the area are Balihalli (1240m), Amadikul betta (1298m) Attiberi Gudda (1522m), Banganabagile Gudda (1513m) etc.

Karnataka has seven river systems and their tributaries flowing through the state. The river systems of Karnataka are:

- Cauvery
- Godavari
- Krishna
- North Pennar
- South Pennar
- Palar
- The West Flowing Rivers

Netravati, Gurpur and Kumaradhara are among the principal rivers of the Dakshina Kannada District. River Netravati is navigable from Bantval. Netravati rises in the Ghat to the east of Kudremukh and flow down the Bangadi valley past Belthangdi, after which it is joined by the Kumaradhara river near Uppinangady. As it approaches Mangalore, it has a wider channel and the river is studded with several small islands called "kudru" which are exceedingly fertile and are known to yield very good rice and sugarcane crops. At Mangalore, the Netravati flows towards north to join the Gurupur river and form a large estuary through which both discharge their combined waters to the sea.

The Gurupur River, where the waterway under consideration is located, originates in the Western Ghats at an elevation of 1100m above Mean Sea Level (AMSL) and joins the Arabian Sea at Mangalore in the Karnataka state of India. The length of the Gurupur river from its origin to its outfall in the Arabian Sea is about 85km. Gurupur River is also known as Phalguni River or Kulur River.

The total catchment area of Gurupur River is 824 sq km. The catchment receives an average annual rainfall of about 4000mm.

(Source: 1. http://gazetteer.kar.nic.in/gazetteer/specialPublications.html# 2. District Census Handbook: Dakshina Kannada, Census of India 2011)

9.2.2 Geology and Seismicity

The geology of Karnataka is largely confined to the two oldest eras; the Archean and the Proterozic. The rest of the great periods from Cambrian to recent are hardly represented but for minor sediments of recent age exposed along the coastal margin to the West. A substantial part of North Karnataka is covered by Deccan trap, representing phenomenal outburst of volcanic activity at the dawn of the Cenozoic era.

The state is exposed oldest rocks in Gorur area, Hassan district, Karnataka date back to about 3300 million years. The Precambrian craton of Karnataka is made up of western and eastern segments. The Precambrians of Karnataka have been divided into older Sargur supracrustals (about 3000 to 3300 million year old) and younger Dharwar supracrustals (about 3000 to 2600 million year old. The Dharwar supracrustals Supergroup has been further divided into older Bababudan Group (ca.3000 to 2700 million years) and younger Chitradurga Group (ca.2700 to 2500 million years). The schist belts of the Eastern craton, like Kolar, Hutti, Sandur etc., appear to be approximately equivalent to the Chitradurga Group.

The Karnataka craton has been extensively intruded by granites and granitoids of the ca. age2600 to 2500 million years. The eastern Karnataka abounds in these granites and granitoids. The northern part of Karnataka is made up of Kaladgi and Badami and Bhima Group of sediments, approximately of Proterozoic age. Further north the terrain is covered by extensive volcanic flows known as Deccan traps of Cretaceous -Tertiary age.

Geologically, with the exception of the coastal strip, the Dakshina Kannada district contains rock formation belonging to the earliest period of the earth's history namely the Archean Epoch. The coastal region contains recent and sub-recent deposits and the lateritic formations. The older metamorphic rocks constitute mainly the Dharwars and these are represented by the banded ferruginous quartzites and by the talc and hornblende schists.

The Karnataka state is categorized as moderate to low seismic risk zone. The state of Karnataka has reported more than 500 earthquake tremors in the last three decades with most of them having low magnitude.

As per the seismic zoning map of India, the project area falls under seismic zone III (moderate damage risk zone).

(Source: Disaster Risk Profile: Karnataka, National Disaster Risk Reduction Portal, National Institute of Disaster Management, Ministry of Home Affairs, Government of India)

9.2.3 Climate

The climate of Karnataka ranges from arid to semi-arid to humid tropical. Two annual monsoons bring rainfall to Karnataka: the North-East monsoon and the South-West monsoon. The mean annual rainfall in the State is around 1355 millimetres. The coastal region of Karnataka receives the maximum rainfall while parts of North Karnataka are among the major rainfall deficit areas of the state.

Karnataka experiences four seasons in a year. Summer starts from March and extends till May. Monsoon begins in June and lasts until September. During this season the state receives rainfall due to the southwest monsoon winds. Post-monsoon season extends from October to December. This season is quiet pleasant as humidity reduces significantly. Winter stays in Karnataka during the months of January and February. The state experiences low temperature and reduced humidity.

The climate of the Dakshina Kannada district is marked by high humidity and high temperature in the hot season. The period from March to May constitutes the summer season and this is followed by the rainy season, i.e., the south-west monsoon season lasting from June to September. The months of October and November constitute the post Monsoon season followed by the winter season. There are considerable climatic variations between the areas nearer to the Western Ghats and those that are nearer to the Arabian Sea. Being a coastal district, seasonal variations in temperature tend to be quite little. May is usually the hottest month of the year. While the maximum temperature remains around 32.6°C, the minimum stays around 26.1°C. During the period from December to February, the day temperature remains very high.

(Source: https://www.karnataka.com/profile/physiography/)

9.2.4 Soils

According to soil survey data, the soils of Karnataka can be divided under nine groups. These groups are:

- Red Sandy Soils
- Red Loamy Soils
- Shallow Black Soils
- Medium Black Soils
- Deep Black Soils
- Mixed Red and Black Soils
- Laterite Soils
- Laterite Gravelly Soils
- Coastal Alluvium

The Dakshina Kannada district is characterized by sandy soil along the coastal belt and lateritic soil in other parts with high iron and aluminum contents. Laterite soil usually occurs in heavy rainfall zone with an annual precipitation of over 100 inches or 3000 mm. This type of soil is suitable for paddy, sugarcane, areca nut and plantation crops like cardamom and plantain. The soil reaction tends to be on the acidic side in the heavy rainfall region of the district and have high percentage of nitrogen and very low content of phosphorus and potash. Soil erosion is noticed all over the district due to the peculiarity of the terrain.

(Source: https://www.karnataka.com/profile/physiography/)

9.2.5 Land Use Pattern

Land use is the surface utilization of all developed and vacant lands on a specific space at a given time. Lands are used for forest, pastures, transportation, settlement, industrial and commercial purposes. Whereas, uncultivable waste land, barren and fallow land are unused lands.

Mixed land use is found on both side of the waterway stretch comprising presence of agricultural land, settlements, industries, ports, fishing docks etc.

9.2.6 Ambient Air and Noise Quality

The overall ambient air quality in the project area is found to be of acceptable standards. The impact on the existing ambient air and noise quality is largely limited to the emissions due to vehicular movement. The project area has a few settlements and some industries with emission norms regulated by the SPCB.

Primary data on ambient air quality monitoring in the project area may be collected at a later stage as required.

9.2.7 Ambient Water Quality

There are some industries are established on the banks of Gurupur river comprising the NW-43 stretch. However, discharge of effluents by these industries is regulated by the State Pollution Control Board and the Gurupur river water quality in the proposed stretch does not appear to be impacted adversely in any significant manner by industrial effluents.

Water quality samples have been collected and tested for two sample locations along the NW-43 stretch as part of the hydrographic survey carried out for preparation of the present DPR. The pH value of the two samples is found to be over 7, which indicates that water in the project area is alkaline in nature.

The Central Pollution Control Board (CPCB) has established a network of monitoring locations on aquatic resources across the country. The present network operated under Global Environmental Monitoring System (GEMS) and Monitoring of Indian National Aquatic Resources System (MINARS) covers 445 rivers in 29 States and 6 Union territories having 1275 locations.

Based on an analysis of the water quality data for the years 2009-2012, CPCB published a report in February 2015 titled 'River Stretches for Restoration of Water Quality' (Monitoring of Indian National Aquatic Resources Series: MINARS/37 /2014-15).

In the said report, the rivers have been prioritized based on the concentration of BOD in five classes from Priority I to V. The criteria of each priority are elaborated indicating the concentration range of BOD in mg/l. The degree of violation is with respect to water quality criteria for drinking water source with conventional treatment with respect to BOD. The polluted locations in a continuous sequence are defined as polluted river stretches.

<u>Criteria for Priority I</u>

Monitoring locations exceeding BOD concentration 30 mg/l.

<u>Criteria for Priority II</u>

Monitoring locations having BOD between 20-30 mg/l.

Criteria for Priority III

Monitoring locations having BOD between 10-20 mg/l.

Criteria for Priority IV

Monitoring locations having BOD between 6-10 mg/l.

Criteria for Priority V

Monitoring locations having BOD between 3-6 mg/l.

According to this report, water quality of rivers in Karnataka is measured at 61 locations on 25 rivers and among them 38 locations are non-complying to the Water Quality Criteria with respect to BOD.. These 38 locations are on 15 rivers. The names of 15 polluted rivers are; Arkavathi, Bhadra, Bhima, Cauvery, Ghatprabha, Kabini, Kagina, Kali, Krishna, Lakshmantirtha, Malprabha, Manjira, Shimsha, Tungabhadra and Tunga. These rivers are classified in priority class IV and V based on the level of BOD. Thus, no polluted stretches are reported for Gurupur and Netravati rivers.

Additional primary data on water quality in the project area may be collected at a later stage as part of the EIA study to be carried out separately by IWAI.

9.2.8 Susceptibility to Natural Hazards

Karnataka state is vulnerable to various natural hazards. The coastal districts namely Dakshina Kannada, Udupi, Uttara Kannada with a coastal line of 322 kms and coastal population of 43.64 Lakhs are under the direct threat of cyclones and severe cyclones originating in Arabian Sea and indirect attack of cyclones originating along the Eastern coastline.

Nearly all districts of Karnataka experience moderate to severe floods. Floods are associated with cloud bursts, cyclones or depressions in the Bay of Bengal and Arabian Sea.

Hilly regions of Western Ghats spread in the districts of Kodagu, Chikmagalur, Hassan,

Shimoga, D. Kannada and U. Kannada record a very high rainfall of 2000mm to 4000mm. Landslides are common in these districts.

Karnataka stands Second only to Rajasthan in terms of Drought Affected areas. The state is highly vulnerable to drought as compared to its neighbouring states. About 152.1 Lakhs ha (80%) out of 190.238 Lakh ha is affected by drought in Karnataka.

According to Disaster Management Plan (2019-20) prepared by the Government of Karnataka for Dakshina Kannada District, following are the possible natural disasters in Uttara Kannada.

Cyclones / Storm

The district falls within the cyclone area of storms originating in the Arabian Sea and those that enter across the Indian Peninsula from the Bay of Bengal. 2019 District experienced 4 major cyclones in Arabian Sea (Vaayu, Hika, Kyarr, Maha) due to cyclonic affect Heavy rain fall recorded. However, historically it is seen that cyclones are not as severe as and as frequent as in the Bay of Bengal along the eastern coast of India. Historically, the worst cyclone to hit the district was during the year 1979. No major damage was reported during that period.

Flood

There are two major rivers fowing in the district namely Netravathi and Gurpur Rivers. Netravathi River flows through Belthangady, Puttur and Bantwal taluk's before joining the Arabian Sea at Ullal in Mangalore Taluk. Similarly, the Gurpur River flows through Belthangady and Bantwal taluk's before joining the Arabian Sea at Thannirbhavi in Mangalore Taluk. In addition to these, there are other smaller rivers like Mulki River, Pavanje River etc., fowing through the district.

The highest amount of Rainfall expressed (400mm) in Mangaluru Taluk on May 29, 2018 which caused Urban Flooding. Historically there have been incidences of foods in the low-lying areas along the major rivers especially Netravathi and Gurpur.

Drought

Drought is a natural hazard that differs from other hazards since it has a slow onset, evolves over months or even years, affects a large spatial extent, and cause little structural damage. Like other hazards, the impacts of drought span economic, environmental and social sectors and can be reduced through mitigation and preparedness.

Mangaluru and Bantwal have been declared by state government as drought affected Talukas in Dakshina Kannada district in 2016-17.

Earthquake

The entire Dakshina Kannada falls under the Zone 3 of the earthquake classification as per Indian Standards, which is relatively safe. Historically there has been no incident of earthquake during last one hundred years.

Forest Fire

Dakshina Kannada has dense forests along its eastern border in Belthangady and Sullia Taluk's. Historically there has been no incidence of forest fires in the district. However, chances of a forest fire or a bush fire in the district cannot be totally ruled out.

9.2.9 Estuary and Coastal Zone

The entire National Waterway 43 project area falls under the tidal zone. The stretch of NW-74 from Ch 0.00 km to Ch 23.5 km falls under the tidal zone.

The Ministry of Environment and Forests, Govt. of India, under the provisions of the Environment (Protection) Act, 1986, had issued a notification in February, 1991, declaring an area of 500 m. from the high tide line along the sea coast, bays and estuaries and up to 100 m from the rivers and creeks as a Coastal Regulation Zone. The developments within this zone are required to be regulated in accordance with the provisions of the notification and the Coastal Zone Management Plan which the State Govt. is required to prepare for the area.

The CRZ Notification 1991 was later amended and a new Notification was issued in 2011 namely CRZ Notification, 2011. The notification imposes certain restrictions on the setting up and expansion of industries, operations or processes and the like in the CRZ.

As per the CRZ categorization provided in the CRZ Notification, 2011, the NW-43 project area falls in CRZ – I. Accordingly, the proposed project will require clearance under the CRZ Notification 2011.

9.2.10 Archaeological and Heritage Locations

Masjid Arkula exists on the right bank of the river between Ch 10.00 km to Ch 23 km of NW 74. The island present in the middle of the river from 11.40 km to Ch 13.90 km houses a religious structure named as Infant Jesus Chapel. However, the project will not interfere with these structures in any manner.

No other structures of archaeological, cultural or historical importance will be impacted due to the two proposed project.

Prohibited and Regulated Areas are defined in the Ancient Monuments and Archeological Sites and Remains (Amendment and Validation) Act, 2010, and the definition of the two terms is as follows:

Prohibited Area: Every area, beginning at the limit of the protected area or the protected monument, as the case may be, and extending to a distance of one hundred metres in all directions shall be the prohibited area in respect of such protected area or protected monument.

Regulated Area: Every area, beginning at the limit of prohibited area in respect of every ancient monument and archaeological sites and remains, declared as of national importance and extending to a distance of two hundred metres in all directions shall be regulated area in respect of every ancient monument and archeological site and remains.

As per the information available on the website of Archaeological Survey of India, there are 133 centrally protected monuments under the jurisdiction of Bengaluru Circle of Archaeological Survey of India. None of these monuments are located in Dakshina Kannada District.

9.2.11 Flora and Fauna

Karnataka State has a geographical area of 1,91,791 Sq. Km and the reconstituted expert committee-1 formed by Government of Karnataka vide GO NO FEE 270 FGK 2002 has identified 41,590.46 Sq.km is total area of forest in Karnataka. The total forest area includes reserved forests, Protected Forests, Unclassified forests, Village forests and Private forests. This further inclues, Betta, Bane, Jamamalai, forest poramboke, Kan, Kumki, Paisari, Amritmahal Kaval, Assessed waste land, Kharab lands, Inam lands, thickly wooded areas, plantations and other lands as well. (Source: Annual Report, 2019-20, Karnataka Forest Department)

Nearly 22.6% of the State's total geographical area comprises forest area. Notified forests comprise 17.3% of the State's geographical area and include reserved, protected, village and private forests.

Based on Champion and Seth's system of classification (1968) the following major types of forests are recognized in Karnataka:

- Southern tropical wet evergreen forests;
- Southern tropical semi evergreen forests;
- South Indian tropical moist deciduous forests;
- Southern tropical dry deciduous forests;
- Southern tropical thorn forests;
- Subtropical broad leaved hill forests;
- Littoral and swamp forest.

The biodiversity of Karnataka is estimated to have more than 1.2 lakh known species including 4,500 flowering plants, 800 fishes, 600 birds, 160 reptiles, 120 mammals and 1,493 medicinal plants.

The Western Ghats support a diverse fauna. Among the vertebrates, birds represent the largest number of known species (508 species), followed by fishes (218), reptiles (157), mammals (137), and amphibians (126).

largest number of known species (508 species), followed by fishes (218), reptiles (157), mammals (137), and amphibians (126).

9.2.12 National Parks, Forests, Wildlife Sanctuaries and Reserves

The Karnataka state has five national parks and 27 wildlife sanctuaries covering 6,794 km^2 of forest areas.

Dakshina Kannada district has large tracks of tropical evergreen forest called Western ghat forest which is one of the biodiversity hot spots in the world. This district has forest area of 128,476 Hectares. Forest area is more in Belthangady taluk (49,837 Ha) followed by Sullia taluk (43,282 Ha) and Puttur taluk (27,386 Ha).

The forests in the Dakshina Kannada district are both evergreen and deciduous. Many of the trees, notably the poonspar (Carlophyllum elatum) and Kiral bhogi attains an immense size especially on the slopes of the Ghats. Teak is abundant in the Puttur taluk though it is found in varying degrees all over the State. At present, practically all types of forests contribute to the flora of the district such as evergreen in the Ghat belt, semi-evergreen in the foothills and deciduous in the outer ridges. In the dry deciduous areas bamboo is of common the chief cultivation of plantation is extensively cultivated throughout the district and very tasty varieties are found in and around Mangalore.

The cultivation of betel leaf is common in the district. The chief forest produce of hard timber of economic importance in the district are rosewood, teak and genteak. Among the items of minor forest produce are cardamom, cinnamon leaves and bark, canes, bamboo, wood oil, myrobalans, catechu and matti bark.

The large extent of forest land in the district affords a safe home to wild animals. The bison is found along the line of the ghat from north to south. Next to the bison, sambar is found in large number in the grassy areas on the slopes of the ghats. In the more open jungle, herds of the spotted deer can be seen. The little mouse deer is also found but is not very common. Monkeys, wild dogs and wild bears, rabbits, foxes and squirrels are found all over the district. The mongoose is very familiar to sight and there are no games preserves or sanctuaries in the district. A large variety of snakes are found such as cobra, king cobra, rat snakes, vipers, crates etc. Chitas are also found in the forests.

The project is not located close to any protected area such as a national park or a wildlife sanctuary.

9.2.13 Socio-economic Profile

As per the 2011 census, the total population of the state amounts to 6,11,30,704. Out of which the males constitute to about 3, 10, 57,742 and females to about 3,00,72,962. The literacy of the state is 55.98%. Population density is 319 per km sq. The sex ratio is 968 females to 1000 males

Description	2011
Population	61,130,704
Population Growth	15.67%
Population Density	319 persons / sq km
Male	31,057,742
Female	30,072,962
Sex Ratio	968
Percentage of Total Population	5.05%
Literacy	75.60%
Male Literacy	82.85%
Female Literacy	68.03%

Dakshina Kannada is a maritime district located in the south-western part of Karnataka adjoining the Arabian Sea. Mangalore town is the district headquarters. Administratively, Dakshina Kannada District has two revenue sub divisions viz., Mangalore and Puttur and five Taluks viz., Mangalore, Bantwal, Puttur, Belthangady and Sullia/Sulya.

Agriculture is an important livelihood for the people of Dakshina Kannada besides fishing. The total geographical area of the district is 4,86,100 hectares and 1,28,476 hectares consist of forest area. Cultivable lands of the district are classified mainly into rice land and garden lands. Rice lands are further categorised with reference to availability of water and fertility of the soil. The first-class land called Bailu comprises low lying fields with an abundant supply of water. The best type of Bailu is called Kolake-gadde which yields three crops of rice in a year. While the ordinary type of Bailu-gadde yields two crops of rice and one crop of grain and the Bettagadde remains inundated during the first few months of the monsoon yields only one rice crop. The garden land suitable for raising arecanut and coconut plantation are called Bagayat land.

Paddy is the principal agricultural crop of the district. There are three well defined agricultural seasons, called the Yenelu or Karthi from June-July to September-October, Suggi from October-November to January-February and Kalke from January-February to April- May. The crop under yenelu are raised under rain fed conditions and during the other two seasons the crop require certain amount of irrigation. The other crops raised during the season are arecanut, cashewnut, black gram and green grams. Sugarcane is confined to the coastal taluks. Cashewnut, arecanut, pepper, cloves and coconut are the important cash crops in the district.

Fisheries constitute the major economic and characteristic feature of the district. The district is known for marine fishing and the export of fish and fish products. With a considerably large coastal line, the district has a rich continental shelf which abounds in pelagic fisheries in addition to a rich prawn fishery. The estuaries of the rivers are noted for the richness of their fish fauna. In view of the abundance of Mackerels, this part of the west coast is popularly known as the

Mackerel Coast. However, with preponderance of marine fisheries, the inland fisheries hold a secondary place.

Dakshina Kannada district is renowned for the production of tiles, beedis and cashew besides chemical and fertilizers. The most important industry of the district is the Mangalore Refineries and Petrochemicals Limited, popularly known as MRPL. The district is famous for manufacturing of tiles, which have over the decades, come to be known as “Mangalore tiles.”

Socio-economic features of the project area are further detailed out in Chapter 4 of the DPR.

9.3 Potential Environmental and Social Impacts of the Project

The proposed project involves the following major construction activities:

i. Construction of terminal buildings
ii. Construction of access roads
iii. Bank protection works
iv. Dredging of the river in the proposed waterway stretch

These activities will involve mobilization of manpower and equipment at site, movement of vehicles, use of water existing resources and use of DG sets for construction power. The proposed construction period is of three years.

Taking into consideration the scale of construction and operation relating to the project, limited significant adverse impacts are anticipated on account of the project. Most of the impacts will be limited to the construction phase and can be suitably mitigated by following good industry practices.

Limited land use change will occur due to the construction of terminals for the operation of the proposed waterway.

Impacts on air and noise, arising out of vehicular movement and fugitive dust emission, will be largely limited to the construction period.

Potential impacts on water quality of the river can be suitably mitigated by constructing the labour camps away from the river banks and by not allowing any debris to be thrown into the river during the construction and operation phases.

The project involves moderate dredging for creation of a navigable channel. All the dredged material is proposed to be disposed of within the flood banks of the river and alternatively disposal can be considered in the low-lying areas and in the sea as per the site conditions. As such there is no significant adverse impact on the land environment is anticipated due to the disposal of dredged material. The nature of impacts on aquatic ecology due to dredging envisaged for the project shall have to be confirmed as part of the EIA study.

The positive impacts on the project will include improved waterway facilities and other allied infrastructure facilities the local population. It will also generate some employment and small business opportunities for the local population.

9.4 EMP and Mitigation of Environmental Effects

As already stated most of the potential impacts will be limited to the construction period. The management measures required to mitigate the potential impacts of the project on the ambient air quality during construction period include suppression of fugitive dust by water sprinkling, transportation of construction debris in covered vehicles, maintaining the specified stack height of DG sets under use and ensuring that the vehicles and equipment used during the construction period are in well maintained condition. To ensure that the ambient air quality remains within the prescribed standards by the Central Pollution Control Board (CPCB), periodic monitoring of ambient air quality should be undertaken through an accredited laboratory. Suitable corrective measures should be implemented if the ambient air quality is found to exceed the prescribed limits.

The measures to ensure that there is no adverse impact on the water quality on account of the project during the construction period would include setting up of labour camps at a safe distance from the river banks. In addition, no construction debris should be allowed to flow or be thrown into the river. The batching pants and concrete mixing plants should be located away from the river banks and these should be set up and operated strictly in accordance with the conditions stipulated by the SPCB.

To mitigate land, air and water contamination by the construction workers, adequate fuel, water and sanitation facilities should be provided to the construction workers. Hunting or poaching of wildlife should be strictly prohibited by any of the construction workers or employees. Also, it should be ensured that no unauthorized tree / forest cutting is undertaken by anyone engaged on the project.

Minimum required land should be acquired for the project. The private land owners, if any, whose land is to be acquired for the project, should be compensated adequately in accordance with law.

The project should take care that the traditional fishing rights of the local population are not impacted adversely in any manner. Adequate consultation with the local population should be undertaken as required.

The project authorities should ensure that the Contractors engaged on the project have an approved environment management plan in place and that this management plan forms a part of the Contract document so as to ensure its effective implementation by the Contractors.

9.5 Applicable Legal and Regulatory Framework

The Karnataka State Pollution Control Board (KSPCB) acts as the nodal agency for environmental management, prevention & control of pollution and for the enforcement of following important acts & rules:

- Water (Prevention & Control of Pollution) Act, 1974
- Water (Prevention & Control of Pollution) Cess Act, 1977
- Air (Prevention & Control of Pollution) Act, 1981
- Environment (Protection) Act, 1986
- Notifications issued under Environment (Protection) Act, 1986
- Noise Pollution (Regulation & Control) Rules, 2000

Key legal and regulatory provisions as applicable to the project are described below.

Consent to Establish and Consent to Operate

The project will require obtaining the Consent to Establish from the SPCB under the Air and Water Acts prior to commencement of construction. Prior to commencement of operation, it shall require obtaining the Consent to Operate from the SPCB under the same Acts.

CRZ Clearance

The entire project area falls under the tidal zone. Based on the categorization provided in CRZ Notification, 2011, the NW-43 project shall fall under CRZ – I. Accordingly, the project shall require obtaining clearance under the CRZ Notification 2011.

The initial 22.90 km length of the NW-74 9from Ch 0.00 km to Ch 23.5 km) stretch falls under the tidal zone. Based on the categorization provided in CRZ Notification, 2011, this 22.90 km stretch of NW-74 project shall fall under CRZ – I.

The Ministry of Environment and Forests, Govt. of India, under the provision of Environment (Protection) Act, 1986, had issued a notification in February, 1991, declaring an area of 500 m. from the high tide line along the sea coast, bays and estuaries and up to 100 m from the rivers and creeks as a Coastal Regulation Zone. The developments within this zone are required to be regulated in accordance with the provisions of the notification and the Coastal Zone Management Plan which the State Govt. is required to prepare for the area.

The CRZ Notification 1991 was later amended and a new Notification was issued in 2011 namely CRZ Notification 2011.

The CRZ Notification, 2011 declares the following areas as CRZ:

i. the land area from High Tide Line (HTL) to 500 mts on the landward side along the sea front.

ii. the land area between HTL to 100 mts or width of the creek whichever is less on the landward side along the tidal influenced water bodies that are connected to the sea and the distance up to which development along such tidal influenced water bodies is to be regulated shall be governed by the distance up to which the tidal effects are experienced which shall be determined based on salinity concentration of 5 parts per thousand (ppt) measured during the driest period of the year and distance up to which tidal effects are experienced shall be clearly identified and demarcated accordingly in the Coastal Zone Management Plans (hereinafter referred to as the CZMPs).

Explanation - For the purposes of this sub-paragraph the expression tidal influenced water bodies means the water bodies influenced by tidal effects from sea, in the bays, estuaries, rivers, creeks, backwaters, lagoons, ponds connected to the sea or creeks and the like.

iii. the land area falling between the hazard line and 500mts from HTL on the landward side, in case of seafront and between the hazard line and 100mts line in case of tidal influenced water body the word 'hazard line' denotes the line demarcated by Ministry of Environment and Forests (MoEF) through the Survey of India (SoI) taking into account tides, waves, sea level rise and shoreline changes.

iv. the land area between HTL and Low Tide Line (LTL) which will be termed as the intertidal zone.

v. the water and the bed area between the LTL to the territorial water limit (12 Nm) in case of sea and the water and the bed area between LTL at the bank to the LTL on the opposite side of the bank, of tidal influenced water bodies.

The coastal zone is categorized for the purposes of regulation in the following categories:

(i) CRZ-I,–

A. The areas that are ecologically sensitive and the geomorphological features which play a role in the maintaining the integrity of the coast,-

(a) Mangroves, in case mangrove area is more than 1000 sq mts, a buffer of 50 meters along the mangroves shall be provided;

(b) Corals and coral reefs and associated biodiversity;

(c) Sand Dunes;

(d) Mudflats which are biologically active;

(e) National parks, marine parks, sanctuaries, reserve forests, wildlife habitats and other protected areas under the provisions of Wild Life (Protection) Act, 1972 (53 of 1972), the Forest (Conservation) Act, 1980 (69 of 1980) or Environment (Protection) Act, 1986 (29 of 1986); including Biosphere Reserves;

(f) Salt Marshes;

(g) Turtle nesting grounds;

(h) Horse shoe crabs habitats;

(i) Sea grass beds;

(j) Nesting grounds of birds;

(k) Areas or structures of archaeological importance and heritage sites.

B. The area between Low Tide Line and High Tide Line;

(ii) CRZ-II,-

The areas that have been developed up to or close to the shoreline.

Explanation.- For the purposes of the expression "developed area" is referred to as that area within the existing municipal limits or in other existing legally designated urban areas which are substantially built-up and has been provided with drainage and approach roads and other infrastructural facilities, such as water supply and sewerage mains;

(iii) CRZ-III,-

Areas that are relatively undisturbed and those do not belong to either CRZ-I or II which include coastal zone in the rural areas (developed and undeveloped) and also areas within municipal limits or in other legally designated urban areas, which are not substantially built up.

(iv.) CRZ-IV,-

A. the water area from the Low Tide Line to twelve nautical miles on the seaward side;
B. shall include the water area of the tidal influenced water body from the mouth of the water body at the sea upto the influence of tide which is measured as five parts per thousand during the driest season of the year.
(v) Areas requiring special consideration for the purpose of protecting the critical coastal environment and difficulties faced by local communities,-
A. (i) CRZ area falling within municipal limits of Greater Mumbai;
(ii) the CRZ areas of Kerala including the backwaters and backwater islands;
(iii) CRZ areas of Goa.
B. Critically Vulnerable Coastal Areas (CVCA) such as Sunderbans region of West Bengal and other ecologically sensitive areas identified as under Environment (Protection) Act, 1986 and managed with the involvement of coastal communities including fisherfolk.
The development or construction activities in different categories of CRZ are regulated by the concerned Coastal Zone Management Authority (CZMA) in accordance with the norms as defined under the CRZ Notification 2011.

Forest Clearance

The project does not involve any forest land diversion. Therefore, no Forest Clearance is required from the MoEF & CC for the project.

9.5.1 Need for Environmental Clearance

Inland waterways are not listed as an activity that requires prior environmental clearance under the EIA Notification 2006. The Notification, as amended in 2009, includes 'Dredging' as an activity for which prior environmental clearance is required.

However, as per the MoEFCC letter dated 21 December 2017, National Waterway projects are exempt from the requirement of prior Environmental Clearance on account of maintenance dredging for creation of navigational channel. The project, therefore, does not need to obtain Environmental Clearance from the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. The MoEFCC letter to this effect is enclosed as Annexure 9.1 of the DPR.

The project shall, however, have to comply with the conditions stipulated in the said letter.

9.5.2 Other Major Clearances / Approvals / Permits Applicable to the Project

Other clearances required for the project shall include those that need to be obtained by the Contractors such as the Certificate of Registration from the Labour Department under various applicable labour laws, permission from SPCB for setting up of batching plants, license for storing petroleum / diesel etc.

The project area is not located close to any Protected Areas. Therefore, the project shall not require Wildlife Clearance from the MoEF, Government of India.

Since no structures of cultural, historical or archaeological are anticipated to be impacted due to the project, no clearance from the Archaeological Survey of India (ASI) or the State Department of Culture is envisaged for the project.

A summary of major clearances / approvals / permits and their applicability to the project is provided in Table 9-1 below.

TABLE 9-1: Major Clearances / Approvals / Permits And Their Applicability To The Project

S. No.	Clearance Approval	Applicability to the Project	Applicable Legislation	Remarks

1.	Environmental Clearance	No	EIA Notification 2006	Exempted by MoEFCC vide its letter dated 21 December 2017.
2.	Forest Clearance	No	Forest Conservation Act, 1980	The development of the two waterways does not involve any diversion of forest land.
3.	Wildlife Clearance	No	Wildlife Protection Act, 1972	The project is not located close to any protected areas.
4.	CRZ Clearance	Yes	CRZ Notification 2011	The entire NW 43 project falls in CRZ I.

9.6 Cost Implications

As per the scope of services for further environmental and social impact assessment (EIA & SIA) studies and requirement of obtaining all mandatory statutory clearances for the project approximately 1 to 1.5 year is adequate period for consultancy services (1 year for non-CRZ and 1.5 year for CRZ waterways) related to EIA & SIA studies. In this regard, the project authority may engage to QCI/NABET accredited EIA consultant for Category – A projects, who shall conduct rapid EIA & SIA studies and shall prepare a stand-alone EMMP (EMP & EMoP) for inclusion in the contractor bid documents. The generation of environmental baseline data at pre-construction stage along with environmental monitoring during construction and operation stages shall be carried out by the NABL/MoEF&CC approved laboratory to assess the project performance during entire project cycle.

The estimated cost for conducting EIA-EMP & SIA studies along with obtaining all mandatory statutory clearances at pre-construction stage and timely and effective implementation of EMMP (EMP & EMoP) during construction and operation stages have been described in the following sections.

9.6.1 Estimated Cost at Pre-Construction Stage

The statutory fee shall be paid by the project authority for obtaining all mandatory statutory clearances. The estimated environmental and social budget for EIA-EMP & SIA studies have been summarized below:

Table 9-2: Summarized Estimated Cost For Consultancy Services

Sl. No.	Particulars of Estimated Budget	Amount (in Rs. Lakh)	Remark (if any)
1.	Salary of 12 Professionals/Domain Experts on intermittent based input (as per QCI/NABET scheme)	40	Lump-sum cost on intermittent basis
2.	Cost of one Time Baseline Data Generation at Pre-Construction Stage	3.20	To be done for one season **(Table – 9-3).**
3.	Public Consultation Meeting (PCM)	4	Lump-sum cost
4.	Reports / Document Printing	1	Lump-sum cost without break-up
5.	Travelling Cost for Site Visits (Bus, Taxi, Boat *etc.*)	5	Lump-sum cost
6.	Lodging & Boarding Cost	5	Lump-sum cost
7.	Cost for collection of metrological data and other information like Maps *etc.*	5	Lump-sum cost
	Grand Total (Rs)	**63.20**	
	In words: *Rs. Sixty Three Lakhs Twenty Thousand only*		

Note: No. of Key Experts: 12 as per QCI/NABET Scheme on intermittent basis. Which may increase or decrease by the project proponent as per actual scope of work.

(i) Above consultancy Fee is without Service Tax.

(ii) The breakup of Sl. No. 2 is given in Tables 9-3.

Table 9-3: Estimated Sub-Cost for One Time Baseline Data Generation At Pre-Construction StagE

Sl. No.	Environmental Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations	Unit Rate (Rs)	Amount (Rs)
1.	Ambient Air Quality	PM 2.5, PM10, CO, SO2, NO2 etc.	24 Hourly sampling (Day & Night time) to be done at each location.	Per Sample with various parameters	4	20,000	80,000

2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity, ***Chemical Properties:*** TSS, Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.	Surface and ground water to be monitored separately	Per Sample with various parameters	4	15,000	60,000
3.	Noise Quality monitoring	Day & Time monitoring to be done at each location	24 Hourly sampling (Day & Night time) to be done	Per Sample with various parameters	4	10,000	40,000
4.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.	Per Sample with various parameters	4	10,000	40,000
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.	One-time study at this stage.	-	4	25,000	100,000
	Sub-Total (Baseline Environmental Data Generation Cost)						**320,000**
	In Words: *Rs. Three Lakh Twenty Thousand only*						

Note: 1 monitoring station @ 10 Km/station = tentatively 4 locations shall be monitored.

9.6.2 Estimated Cost at Construction Stage

The civil work contractor during construction stage shall depute a well experience environmental & safety Officer (ESO), who shall conduct Environmental Monitoring at Construction Stage as per stipulated conditions in the contractor documents. He shall also prepare environmental monitoring report that to be submitted timely to the project proponent and statutory authorities as per project requirement.

Table 9-4: Estimated Cost For Environment Management During Construction

Sl. No.	Particulars of Estimated Budget	Cost (Rs. Lakhs)	Remark (if any)
1.	Environmental Monitoring Cost at Construction Stage once in a year for three years	9.60	Shall be carried on yearly basis for entire construction period (**Table 9-5)**
2.	Greenbelt Development nearby terminal Premises by Contractor	6	Lump-sum cost
3.	Solid Waste Management	6	Lump-sum cost
4.	Sanitary facilities at labour camps	6	Lump-sum cost
5.	Disaster Management Plan	5	Lump-sum cost
6.	Any other/miscellaneous	2	Lump-sum cost
	Total (Lakhs)	**34.60**	
	In Words: *Rs. Thirty Four Lakh Sixty Thousand only*		

Table 9-5: Environmental Monitoring Cost For Construction Stage

Sl. No.	Env. Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations (for 3 Years)	Unit Rate (Rs)	Amount (Rs)
1.	Ambient Air Quality	PM 2.5, PM10, CO, SO2, NO2 etc.	24 Hourly sampling (Day & Night time) to be done at each location.	Per sample with various parameters	4X3 = 12	20,000	240,000
2.	Water Quality monitoring	***Physical Properties:*** pH, Temp., DO, Conductivity, ***Chemical Properties:*** TSS, Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease, Phenolic compounds, Residual Sodium Carbonate. ***Bacteriological Properties:*** Total Coliform.	Surface and ground water to be monitored separately	Per sample with various parameters	4X3 = 12	15,000	180,000
3.	Noise Quality monitoring	Day & Time monitoring to be done at each location	24 Hourly sampling (Day & Night time)	Per sample location with	4X3 = 12	10,000	120,000

Sl. No.	Env. Attributes	Parameters	Monitoring Frequency	Unit	No. of Tentative Locations (for 3 Years)	Unit Rate (Rs)	Amount (Rs)
			to be done	various parameters			
4.	Soil	Bulk Density, Colour, Texture, Soil Type, pH, Electrical Conductivity, N, P, K *etc.*	Composite sample shall be prepared based on at least 3 replicates from each location.	Per sample with various parameters	4X3 = 12	10,000	120,000
5.	Aquatic Ecology	Trophic Status, Primary Productivity, Species diversity & densities of Phytoplankton, Zooplankton, Benthic Organism (Benthos, Macro-benthos), Fish and Macrophytes, Shanon Weiner Diversity Index.	One-time study at this stage.		4X3 = 12	25,000	300,000
Total (Rs)							**960,000**
		In Words: *Rs. Nine Lakh Sixty Thousand only*					

9.6.3 Estimated Cost at Operation Stage

Like pre-construction stage, the environmental monitoring and supervision to be done by the project proponent.

Table 9-6: Estimated Environment Management Cost During Operation

Sl. No.	Particulars of Estimated Budget	Cost (Rs. Lakhs)	Remark (if any)
1.	Environmental Monitoring Cost at Operational Stage once in a year.	3.20	Shall be carried for one season as per Table 9-14 given above for pre-construction stage.

2.	Maintenance & Supervision of Greenbelt Developed during construction stage	2	Lump-sum cost
3.	Solid Waste Management	2	Lump-sum cost
4.	Sanitary facilities nearby terminals	2	Lump-sum cost
5.	Disaster Management Plan (if applicable)	2	Lump-sum cost
6.	Any other/miscellaneous	2	Lump-sum cost
	Total (Lakhs)	**13.20**	Per Year
	In Words: *Rs. Thirteen Lakh Twenty Thousand only*		

9.6.4 Summary of Estimated Environmental & Social Budget

This covers the consultancy fee at pre-construction stage along with implementation of EMMP (EMP & EMoP) during construction and operational stages of the project. The statutory fee along with the cost of private and government land acquisition shall be borne by the project proponent. This has been summarized in Table 9-7 given below:

Table 9-7: Summary Of Estimated Environmental & Social Costs For Various Stages

Sl. No.	Project Stages	Cost (Rs. Lakh)	Remark
1.	Pre-Construction Stage	63.20	Lump-sum
2.	Construction Stage	34.60	
3.	Operational Stage	13.20	
Total Estimated Budget (Except Statutory Fee & Land Acquisition & R&R Costs)		111.00	
In Words: *Rs. One Crore Eleven Lakh only*			

Provision has already been catered in the proposed estimates appropriately.

CHAPTER 10. INSTITUTIONAL REQUIREMENTS

10.1 Organizational Set up / Establishment

The Inland Waterways Authority of India (IWAI) has been carved out duly taking over the responsibilities etc., of the erstwhile Inland Water Transport (IWT) directorate under Ministry of Surface Transport / Ministry of Shipping with a vision of more thrust on the IWT sector along with more Autonomy, by an Act of Parliament (IWAI Act 82 of 1985). Accordingly, IWAI is vested with the functions / duties and responsibilities connected to the safe navigation in the National Waterways and in the interconnected waterways, where IWT is considered for development. The Para 14 of IWAI ACT 82 of 1985 is provisioned with the Functions and Powers of authority, as detailed, which is self explanatory.

Functions and Powers of the authority:

14. (1) The Authority may-

(a) carry out surveys and investigations for the development, maintenance and better utilization of the national waterways and the appurtenant land for shipping and navigation and prepare schemes in this behalf; (b) provide or permit setting up of infrastructural facilities for national waterways;

(c) carry out conservancy measures and training works and do all other acts necessary for the safety and convenience of shipping and navigation and improvement of the national waterways;

(d) control activities such as throwing rubbish, dumping or removal of material, in or from the bed of the national waterways and appurtenant land, in so far as they may affect safe and efficient, shipping and navigation, maintenance of navigable channels, river training and conservancy measures;

(e) remove or alter any obstruction or impediment in the national waterways and the appurtenant land which may impede the safe navigation or endanger safety of infrastructural facilities or conservancy measures where such obstruction or impediment has been lawfully made or has become lawful by reason of long continuance of such obstruction or impediment or otherwise, after making compensation to person suffering damage by such removal or alteration;

(f) provide for the regulation of navigation and traffic (including the rule of the road) on national waterways; (g) regulate the construction or alteration of structures on across or under the national waterways;

(h) disseminate navigational meteorological information about national waterways;

(i) ensure co-ordination of inland water transport on national waterways with other modes of transport; and (j) establish and maintain pilotage on national waterways;

(k) enter into joint ventures concerning inland shipping by way of equity participation.

14. (2) The Authority may also-

(a) advise the Central Government on matters relating to inland water transport;

(b) study the transport requirement with a view to co-coordinating inland water transport with other modes of transport;

(c) carry out hydrographic surveys and publish river charts;

(d) assist, on such terms and conditions as may be mutually agreed upon, any State Government in formulation and implementation of scheme for inland water transport development;

(e) develop consultancy services and provide such services, on such terms and conditions as may be mutually agreed upon, in India and abroad in relation to planning and development of waterways for shipping and navigation or any facility thereat;

(f) conduct research in matters relating to inland water transport including development of craft design mechanization of country crafts, technique of towage, landing and terminal facilities, port installations and survey techniques;

(g) lay down standards for classification of inland waterways;

(h) Arrange programme of technical training for inland water transport personnel within and outside the country; and

(i) Perform such other functions as may be necessary to carry out the provisions of this Act.

14. (3) Any dispute arising out of or concerning the compensation referred to in clause(e) of subsection (1) shall be determined according to the law relating to like disputes in the case of land required for public purposes.

14. (4) Every scheme, prepared by the Authority to carry out functions under sub-sections (1) and (2), involving capital expenditure exceeding the amount as may be prescribed, shall be submitted to the Central Government for approval.

14. (5) The Central Government may either approve the scheme submitted to it under sub-section (4) without modification or with such modifications as it may consider necessary or reject the scheme with directions to the Authority to prepare a fresh scheme according to such directions.

In order to consider a planned and systematic implementation with the assigned functions of the authority, a strong Institutional mechanism is required.

If we keenly observe the Institutional systems of similar administrations / establishment globally and the parallel administrations / establishments nationally, the key factor emerging out of the same is only the Policy and procedure of implementation of the assigned responsibilities. It is yet a debatable aspect i.e., whether to have a full pledged organization so as to undertake the works through contractual agencies or to have a mechanism of Outsourcing the work along with supervision to different contractual agencies (Outsourcing the work to an agency and the Project Management to other agency).

10.2 Man Power Requirement

It is suggested that the Outsourcing the work to a contractual agency is the best alternative for the subject study and accordingly, the Manpower requirement is under consideration

As ascertained, IWAI is having an Institution Mechanism consisting of a Board along with Functional Manpower having the inverted conical organization pattern. The major functional aspects have already been segregated as Project; Planning; Survey; Marine; Traffic; Finance and Administration. Hence, dislocation of the existing system is not suggested. The present requirement within the study stretch should be unique, which should be amenable to the existing system in the office of Policy making with Control.

Accordingly, the Controlling office (at NOIDA) has been depicted in the pictorial form and will have 1 Chief Engineer to look after the Central part of the country (Hyderabad) to deal with the Waterways / National Waterways in the states of Maharashtra; Goa; Karnataka; Orissa; Telangana; Andhra Pradesh; Tamilnadu & Kerala (including NW 3). Refer the Annexure 10.1.

The present study stretches of Cluster 6 having 6 National Waterways will be looked after by a Directorate (suggested / recommended) with an office within the Geographical zone, preferably accessible to all the Waterways / National Waterways. The Organizational requirement has been depicted in Annexure 10.2. A skeleton staff requirement of 3 Nos. also has been projected as a support requirement in the Chief Engineer's office.

10.3 Training Requirement / Capacity Building

IWAI is having various disciplines within the organization viz., Civil Engineering; Mech. Marine Engineering; Hydrographic Survey; Traffic; Administration / Establishment; Finance etc.,

It is suggested and recommended to have an intra discipline and inter discipline training for all the employees of the IWAI at entry level i.e., at Technical Assistant / Assistant Director; Junior Hydrographic Surveyor / Assistant Hydrographic Surveyor; Junior Accounts Officer / Accounts Officer; Section Officer / Assistant Secretary etc., The National Inland Navigation Institute (NINI) of IWAI at Patna premises can be used for such training. It is preferred to have such Trainings as onsite training, while the works are under progress.

10.4 Infrastructure

The Infrastructure for the Institution will not have much implication, except the Land for the Office premises, if at all to have the own building of IWAI. However, the infrastructure for functional aspects may be essential within the accessibility of the site controlling office viz., the office of the Director.

The functional requirement can be identified as Survey Vessels; Survey Instruments in order to carry out the mandatory periodical Survey works on the National Waterways. Likewise, to maintain the Night Navigation system, there should be a survey – cum – Buoy maintenance vessel available within the bounds of the office. Accordingly, 1 units of Survey Instruments with Software; 1 No. of Survey– cum – Buoy maintenance vessel; are suggested / recommended to look after the requirements of the National Waterways in Gurupur & Netravati rivers within its jurisdiction.

10.4.1 Immovable

The immovable asset, Land is not suggested at this point of time. In the long run, even if identified the need of having own office, this will be considered at one of the terminal locations, amenable with ease approach. Hence there is no suggestion / recommendation of land / immovable asset under Institution.

10.4.2 Movable

As discussed above, the asset requirement for attending the functions and responsibilities catered will be considered for procurement. The details have been tabulated directly as a financial Implication with segregation of Capital Cost Implication and Monthly Cost Implication, including the Manpower monthly implication in the forth coming Paras. Keeping in view the Organization requirement, as derived, the implication has been worked out duly taking into consideration of the 7Th Pay Commission Pay system, so as to have an implementable approach.

10.5 Cost Implications

The cost implication for the apportioned project has been worked out and placed herewith.

TABLE 10-1: FINANCIAL IMPLICATION – CAPITAL AND MAINTENANCE

Institutional Cost (Gurupur- NW 43 + Netravati River- NW-74)			
Sl. No.	**Name of the Item**	**Capital Cost (INR)**	**Financial Implication per month (INR)**
1	Office premises	*	-
2	Furniture and Office Appliances etc.,	20,00,000	0
3	Pay and Allowances for Employees (1-JHS/ !-JAC/02-Supervisor/02-Attendents).	--	4,49,163
4	Vehicle 1 No.	0	--
5	Computer Systems including UPS etc.,1Nos. @ 2 lakh each	2,00,000	5,000
6	Printers 2Nos. @ 0.25 lakhs each	40,000	20,000
7	Alternate Uninterrupted Power Supply with D. G set 2 No @ 2.0 Lakhs per no.	5,00,000	60000
8	One Unit of Survey Instruments (9.5 lakhs each) + Software (6.5 lakhs) + Laptop (1 lakh each) etc.,	17,00,000	10000
9	One Nos. survey – cum – Buoy Maintenance vessel	4000000	1,50,000
10	Other General Office maintenance including stationery, consumables etc.,	--	1,50,000
Total		**8440000**	**6,94,163**

+ The Cost implications for segregated functions like Fairway Development Cost; Terminal Development Cost; Vessel maintenance Cost; Navigation and Communication system implementation cost etc., have been taken into consideration at the appropriate heads in above table and being provisioned for undertaking the requisite functions under the Institution requirements.

+ The above expenditure may have to be considered for 2 National Waterways (Gurupur & Netravati interwined) and accordingly the apportioned cost for River Gurupur & Netravathi i.e., Capital cost will be INR 84.40 Lakhs and maintenance cost per month will be INR 6.94 Lakhs.

CHAPTER 11. PROJECT COSTING

11.1 General and Financial assumptions

Project Costing is an important aspect, which is to be worked out rationally to assess the apt requirement of the project with a reasonable costing structure so as to ascertain the end result of returns and also will play a vital role in decision making on the implementation of various project components. It is also essential to define certain financial requirements, in terms of assumptions for the project, which are to be rational i.e., not to be irrational.

In this context, certain parameters, as defined, by IWAI have been analyzed and considered in the cost working and Return working. The circulated data has been placed at Annexure 11.1. However, the same may not suffice the requirements in working out the cost / returns and hence some more assumptions have been considered appropriately, wherever required.

11.2 Basis of Costing

In general, the costing used to be worked out based on the quantity requirements along with rate per unit quantity. The quantities for the subject project have been arrived at based on the actual item wise requirements. The estimated costs have been worked out based on the relevant Schedule of Rates (SoR) of the DSR-2021/concerned region / state of Karnataka. Rates for the non available items have been proposed based on the Market Rates or based on the realistic budgetary quotations, to the extent possible.

11.3 Development Cost

The Netravathi River is having some IWT mobility near the Old Mangalore Port area, as on date and according to the estimation and forecast, there is a opportunity for Ro-Ro operation, with its hinterland spread to eastern Karnataka with its originating Traffic through River “Gurupur”.

In view of the above, the costing has been considered intertwined with the development of River “Netravati” i.e. Fairway development in Gurupur and Netravathi and development of Ro-Ro facility in these two proposed IWAI terminal locations, i.e., one in Gurupur and other in Netravathi.

11.4 Capital Expenditure

As explained above, the Fairway related development cost has been worked out and placed herewith.

TABLE 11-1: ABSTRACT OF COST FOR NETRAVATHI AND GURPUR FAIRWAY DEVELOPMENT FOR CAPTIVE TERMINAL OPERATIONS

Sl No.	**Item Description**	**Total Amount (in Lakh Rs.)**	**Waterways**	
			(Gurupur-NW43) - In Lakhs	**(Netravati-NW74) - In Lakhs**
A	**Fairway**			
1	Dredging			
(i)	General Soil	3049.39	1055.86	1993.52
(ii)	Hard Soil	0.00	0.00	0.00
2	Low Cost River Structures			
(i)	Bandaling	0.00	0.00	0.00
(ii)	Bottom Paneling	0.00	0.00	0.00
3	River Training Works	0.00	0.00	0.00
(i)	Spurs	0.00	0.00	0.00
(ii)	Bank Protection Works for river (Need Based)	471.94	134.84	337.10
(iii)	Porcupine			
4	Navigational Aids			
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	518.09	151.11	366.98
(ii)	Shore Marking with Latiice Bridge & Lighting Equipments	27.00	9.00	18.00
5	Land Acquisition	0.00	0.00	0.00
	Sub-total (A)	**4066.42**	**1350.81**	**2715.60**
B	**Modification of Structures**			
(i)	Bridges	0.00	0.00	0.00
(ii)	Cables	0.00	0.00	0.00
(iii)	Dams	0.00	0.00	0.00
(iv)	Barrages	0.00	0.00	0.00
(v)	HT Line Shifting	61.45	0.00	61.45
	Sub-total (B)	**61.45**	**0.00**	**61.45**
C	**Communication System**			
(i)	RIS Centre	27.71	13.85	13.85
(ii)	AIS Base Station	36.21	18.10	18.10
(iii)	Vessels	40.00	0.00	40.00

Sl No.	Item Description	Total Amount (in Lakh Rs.)	Waterways	
			(Gurupur-NW43) - In Lakhs	(Netravati-NW74) - In Lakhs
	Sub-total (C)	**103.91**	**31.96**	**71.96**
D	**Institutional Requirement**			
	Office Development Cost	**84.40**	**0.00**	**84.40**
	Sub-total (C)			
	Sub-total (A)+(B)+(C)+(D)	**4316.18**	**1382.77**	**2933.41**
E	Enviornmental Management Plan Cost@5% of Prime cost as per Ch 9 of the DPR.	215.81	69.14	146.67
F	Project Management & consultancy Charges @3% of Prime cost	129.49	41.48	88.00
G	Contingencies and Unforseen Items of Works @3% of Prime cost	129.49	41.48	88.00
	Project total Hard Cost	**4790.96**	**1534.87**	**3256.09**
	Breakup of Fairway Development		**NW-43**	**NW-74**
	Dredging	**3049.39**	1055.86	1993.52
	Bank Protection Works for river	**471.94**	134.84	337.10
	Navigational Aids	**545.09**	160.11	384.98
	Modification of Structures	**61.45**	0.00	61.45
	Communication System	**103.91**	31.96	71.96
	Institutional Requirement	**84.40**	0.00	84.40
	EIA/EMP/PMC/Contingencies	**474.78**	152.10	322.68
	Total	**4790.96**	**1534.874**	**3256.090**

The Ro-Ro facility requirement has been worked out and placed herewith.

TABLE 11-2: Abstract of Cost for Netravathi Ro-Ro Facility

Sl No.	Item Description	Amount (in Lakh Rs.)
A	**Terminals (Downstream of Thumbe Barrage)**	
	Terminal	

Sl No.	Item Description	Amount (in Lakh Rs.)
(i)	Land	515.38
(ii)	Riverine Components	1219.52
(iii)	Infrastructure Components including internal roads	840.35
(iv)	Approach Road (External) Cost	11.00
(v)	Bank Protection Works for terminal	455.94
	Sub-total (A)	**3042.18**
B	**Vessels**	
(i)	Vessel Size	0.00
(ii)	Vessel Capacity	0.00
	Sub-total (B)	**0.00**
C	**Equipments for Both Terminals**	
(i)	Ambulance - 1 no.	18
(ii)	Dumper Trucks 16 T Capacity - 1 no.	0
(iii)	Cranes with 50 T Capacity - 1 no.	0
(iv)	Fork lift trucks 20 T Capacity - 1 no.	54.69
	Sub-total (C)	**72.69**
	Sub-total (A)+(B)+(C)	**3114.87**
D	Enviornmental Management Plan Cost@5% of Prime cost	155.74
E	Project Management & consultancy Charges @3% of Prime cost	93.45
F	Contingencies and Unforseen Items of Works@3% of Prime cost	93.45
	Project total Hard Cost	**3457.51**

TABLE 11-3: Abstract of Cost for Gurpur Ro-Ro Facility

Sl No.	Item Description	Amount (in Lakh Rs.)
A	**Terminal (Near Ashok Nagar)**	
	Terminal	
(i)	Land	264.45
(ii)	Riverine Components	681.05

Sl No.	Item Description	Amount (in Lakh Rs.)
(iii)	Infrastructure Components including internal roads	804.37
(iv)	Approach Road (External) Cost	12.50
(v)	Bank Protection Works for terminal	451.43
	Sub-total (A)	**2213.81**
B	**Vessels**	
(i)	Vessel Size	0.00
(ii)	Vessel Capacity	0.00
	Sub-total (B)	**0.00**
C	**Equipments for Both Terminals**	
(i)	Ambulance - 1 no.	18
(ii)	Dumper Trucks 16 T Capacity - 1 no.	0
(iii)	Cranes with 50 T Capacity - 1 no.	0
(iv)	Fork lift trucks 20 T Capacity - 1 no.	54.69
	Sub-total (C)	**72.69**
	Sub-total (A)+(B)+(C)	**2286.50**
D	Enviornmental Management Plan Cost@5% of Prime cost	114.32
E	Project Management & consultancy Charges @ 3% of Prime cost	68.59
F	Contingencies and Unforseen Items of Works @ 3% of Prime cost	68.59
	Project total Hard Cost	**2538.01**

11.5 Operational and Maintenance Expenditure

The operation & Maintenance expenditure has been considered as at Annexure 11.1 and as per the industrial standards.

11.6 Phasing of Expenditure

It is proposed to develop all the Infrastructure requirements of Fairway and Terminal in 36 months time span so as to provide the support sytem for Inland Navigation to facilitate the proposed Ro-Ro operation.

CHAPTER 12. IMPLEMENTATION SCHEDULE

12.1 Time Frame

The development of river Netravathi is intertwined with the development of river Gurupur. The Time Frame for the development of waterway considered with the target completion in 36 Months.

In order to facilitate the estimated Ro-Ro traffic, both the modules will be completed as parallel activity. In the module of Fairway development, the activities of Dredging; River Training works; Day / Night Navigation facilities; Communication System; Institutional Requirements along with Environmental Management Plan (EMP) have been proposed. With the development of fairway, the revenue collection can be considered for the traffic with possible expandable traffic. The Implementation Schedule in Pictorial form is placed at Annexure 12.1.

Further to the above, to meet the cargo growth, it is proposed to develop 1 Ro-Ro Jetty Terminal in Gurupur river near Ashoknagar & other in Netravati river in the downstream of Netravati river to facilitate the mobility of the identified IWT divertible Traffic, which is proposed to be developed in phased manner. The Implementation Schedule in pictorial form is placed at Annexure 12.2.

12.2 Phasing

The fairway development is in 36 months. Ro-Ro Terminal development also has been proposed in 36 months, as a parallel activity. The vessel requirement will be taken care by Entrepreneurs.

12.3 Suggested Implementation Mechanism

The implementation will be considered through the Project Management Consultancy, as provisioned. However, it is suggested that the overall supervision will be under the control of the IWAI supervision mechanism.

CHAPTER 13. : ECONOMIC AND FINANCIAL ANALYSIS

The table below depicts the development & operational period of Gurupur – Netravati River.

Development in Phases

Sub-sector	2023	2024	2025	2030	2035	2040
Fairway	Development					
			Operational			
2 Ro-Ro Terminals (each in Gurupur & Netravati)	Construction					
			Operational			

Source: Tractebel; Consultant

Gurupur and Netravathi have been declared as separate National Waterways. However, their projected traffic is intertwined. Cargo originating along Netravathi River will be destined for the terminal on Gurupur River, alongside NMPT. The same is true for vice-versa cargo movement. Owing to these reasons, separate financial models for these rivers are not representative for depicting the appropriate viability of the entire project. Even though the separate fairway development has been envisaged, a cumulative financial analysis is needed to derive project viability and the incidental returns. For these reasons, investment in fairway development for both the rivers have been combined with 2 different terminals. This has been carried out under the fair assumption that the entire estimated traffic movement will be along a single stretch of river, albeit categorized as separate waterways.

Based on these reasons, Gurupur-Netravathi River development has been approached with twin potential prospects for cargo handling along the whole stretch. Citing optimistic conditions, the first objective is to develop the fairway to facilitate the movement of Ro-Ro cargo currently carried out via NH-66, NH-75, and other district roads. These roads run in parallel to the earmarked stretch. Development of two terminals, each on Netravathi and Gurupur rivers, is the second objective to handle the estimated Ro-Ro cargo traffic. Passenger traffic is also proposed for these rivers for along and across the river movement. Fairway and Ro-Ro terminals, once developed, could also start accommodating ferry vessel for passenger and tourist movement. However, the Ro-Ro traffic is the focused and core objective of this development, therefore financial analysis is done only based on the Ro-Ro traffic and revenue generating out of it.

Proposed IWT route involves multiple cargo handling, this adds to the total logistic cost involved in transportation. Total time and cost involved in this multimodal transportation is more as compared to roadway. An elaboration on the impact on overall logistics cost difference is depicted in the logistics cost comparison chart between the two modes in the following

Ro-Ro/Trade Cost Dynamics

Origin	Destination
Central Karnataka	NMPT

Ro-Ro Cost Dynamics (442.5 km.)

Components	Unit	Case I	Case II
Engine	kW	335	201
Engine fuel requirement	l/hr	87	31
Ro-Ro Tariff	INR	7,234	6,444
Port-related charges	INR	400	400
Fairway Usage	INR	0	0
Last Mile Connectivity	INR	10,959	10,959
Total Cost	**INR/Truck**	**18,593**	**17,803**

Truck Cost Dynamics (436 km.)

Components	Unit	Cost
Fuel	INR	10,355
Toll Charges	INR	1,245
Total Cost	**INR/Truck**	**11,600**

FIGURE 13.1: Logistic cost comparison

As per Case I (higher engine power 335 kW), the logistics cost difference for roadway and waterway is INR 5234 per truck. In Case II (Lower engine power 150 kW), this cost difference reduces to INR 6,444/truck. This logistic assessment clearly indicates the unviability of operating a Ro-Ro Terminal on the River. Costs involved in both the Ro-Ro cases are on the higher side when compared to roadways. In case of just Ro-Ro cost comparison, Case II is marginally cheaper than Case I.

IWAI prescribed terminal tariff (May 2021) has been assumed for the Logistics Cost calculations in above figure. Terminal handling charges at origin and destination of proposed route have been considered as per the rates provided by IWAI. The table below shows the scale rates of IWAI.

TABLE 13-1: Tariff Structure of IWAI

Sr. No	Contents	As per IWAI
1	Vessel Berthing Charges	INR 1,500 per Vessel/Day
2	Terminal Charges (Ro-Ro)	INR 300 per Vehicle

Source: IWAI and Scale rate of MbPT

13.1 Input Sheet

The following table lists all the assumptions and input values used in the financial modeling of Gurupur – Netravati River. This includes financial analysis for the navigation infrastructure (fairways), and terminal operations (Ro-Ro):

TABLE 13-2: Input Sheet for NW 43 & 74

Description	Unit	Fairway	Ro-Ro
Loan Tenure	Years	10	10
Moratorium Period (Years Construction)	Years	3	3
Rate of Interest	Annual	11%	11%

Description	Unit	Fairway	Ro-Ro
Corporate Tax	Annual	25%	25%
Cargo Revenue Escalation	Annual	6%	6%
Other Revenue Escalation	Annual		6%
Administrative Cost	of Revenue	3%	2%
Manpower Cost Escalation	Annual	5%	5%
Cargo / Dredging Costs Escalation	Annual	5%	
Other Costs Escalation	Annual		6%
Fairway Chainage	km	33.5	
Chainage (mouth of the river to Ro-Ro Terminal) – Gurupur / Netravati	Km		8 / 23.5

Tariff for Revenue Calculation

Various Revenue Sources	Unit	Fairway	Ro-Ro
Revenue prospects from Ancillary Activity			
Truck Parking Charges	Per Day		-
Leasing Space Coffee Shops	Per Day		500
Lease space for Rest/Retiring	Rs/Day/Truck		30

Operation & Maintenance

Description	Unit	Fairway	Ro-Ro
Civil Infrastructure	Cost		1%
Dredging		10%	
Machinery Infrastructure			5%
Insurance Cost	Capex	2%	2%

Assumptions for EIRR

Parameters	Unit	Value	Reference
Economic loss due to Road Accidents	of GDP	3%	Tractebel
GDP of India@ Current Prices	Rs Lakhs Crores	125.41	
Value of economic loss due to road accidents	Rs Lakhs Crores	3.7623	
Total Road network in India	Lakh KM	0.4865	
Safety Index (IWT as base)	times safer than road	50	
	times safer than rail	5	
Accidental Loss			
Road	Rs Lakhs/KM	7.73	Tractebel
IWT	Rs Lakhs/KM	0.15	
Fuel Cost (1 liter of fuel moves)			
Road	t-km	24.00	Tractebel
IWT	t-km	105.00	
Total Distance	KM	33 x 2	
Fuel price	Rs/Litre	67.00	
Vehicular Operating Cost (VOC)			
Road	Rs/t-km	2.57	Tractebel
IWT	Rs/t-km	1.06	
Direct Employment Creation			
Road	Per Million t-km	20	Tractebel
IWT	Per Million t-km	0.5	
Employment cost	Rs Lakhs per Annum	2.5	

Description	Unit	Fairway	Ro-Ro
Emission Reduction			
Road	INR/Trip	650	Tractebel
IWT	INR/Trip	105.5	
Shadow Factor			
CAPEX/O&M Cost- To convert financial cost to economic cost		0.85	Tractebel
O&M Cost escalation	p.a.	5%	

Source: Consultant, Market standards

All the necessary assumptions for financial modeling are either market driven or provided by IWAI. Terminal tariff have been taken from IWAI. In EIRR, round-trip distance is considered in each of the sub-sector's economic viability evaluation.

13.2 Revenue

Revenue for the cumulative stretch of Gurupur - Netravati River will be generated from the core operations, which include operation at the Ro-Ro terminal. Secondary revenues sources, labeled "Ancillary Revenue", will be generated from sources like land leasing for commercial operations (tea-stall, coffee shops, inn, etc.), and leased resting area for truck operators. The revenue break-up and total revenue for IWAI on Gurupur – Netravati River are presented in the table below:

TABLE 13-3: Revenue for NW 43 & 74 (INR Lakhs)

Description	FY23	FY24	FY25	FY30	FY35	FY40
Ro-Ro Terminal	-	-	26.2	295.9	452.2	691.4
Fairway	-	-	-	-	-	-
Total	**-**	**-**	**26.2**	**295.9**	**452.2**	**691.4**

Source: Consultant

IWAI has waived of fairway tariffs in their circular May, 2021. They would not be charging any tariff for use of waterways by vessels. It is believed that IWAI will maintain desire navigable depth in waterway to meet their mandate of making National Waterways navigable.

Since, IWAI would be creating and maintaining navigable fairway without any charges from users, the financials of fairway development is not desired. The revenue on account of fairway with "0" (Zero) tariff would be "0" (Zero). There would be no profit and loss statement. There would be no return on investment as IWAI will be investing in creation and maintenance of fairway without any revenue.

13.3 Costs

This section presents the total project cost. IWAI would be developing fairway and maintaining navigable depth without charging its users. Hence, financial for fairway cannot developed.

The capital cost of development is estimated and presented in this section to ascertain quantum of investment required by IWAI to make rivers navigable. The following table shows these cost-heads for all the three core business operations:

TABLE 13-4: Project Cost (INR Lakhs)

Description	Total	FY23	FY24	FY25
Fairway				
Fairway	3,521.3	1,408.5	1,056.4	1,056.4
Navigational Aids	545.1	0.0	327.1	218.0
Structure Modification	61.5	61.5	0.0	0.0
Communication System	103.9	0.0	62.3	41.6
Institutional Requirement	84.4	33.8	25.3	25.3
Environmental Management Plan Cost@5% of Prime cost	215.8	86.3	64.7	64.7
Project Management & consultancy Charges @ 3% of Prime cost	129.5	51.8	38.8	38.8
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	129.5	51.8	38.8	38.8
Total Project Cost	**4,791.0**	**1,693.7**	**1,613.6**	**1,483.8**
Ro-Ro Terminal - Gurupur				
Terminal	2,213.8	885.5	664.1	664.1
Cargo Handling Equipment	72.7	29.1	21.8	21.8
Environmental Management Plan Cost@5% of Prime cost	114.3	45.7	34.3	34.3
Project Management & consultancy Charges @ 3% of Prime cost	68.6	27.4	20.6	20.6
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	68.6	27.4	20.6	20.6
Total Project Cost	**2,538.0**	**1,015.2**	**761.4**	**761.4**
Ro-Ro Terminal - Netravati				
Terminal	3,042.2	1,216.9	912.7	912.7
Cargo Handling Equipment	72.7	29.1	21.8	21.8
Environmental Management Plan Cost@5% of Prime cost	155.7	62.3	46.7	46.7
Project Management & consultancy Charges @ 3% of Prime cost	93.4	37.4	28.0	28.0
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	93.4	37.4	28.0	28.0
Total Project Cost	**3,457.5**	**1,383.0**	**1,037.3**	**1,037.3**

The onus of vessel acquisitions is left with the private operator and not IWAI. Hence, these costs have not been factored in to develop financial model for the Ro-Ro Terminals on both the rivers together.

13.4 Financial Analysis / FIRR

The financial indicators dictating FIRR for individual ventures, viz. fairways development and terminal construction have been presented tables below. These indicators help measure the financial return on investment, which will enable IWAI in taking an informed decision in regard to implementing the project.

However, before presenting FIRR for the project, some major components such as Salary, Depreciation, and P&L statement are provided in the following four tables, respectively:

TABLE 13-5: Employment schedule and salary expenditure (INR Lakh)

Parameter	No.	CTC p.a. / person (INR Lakh)	FY23	FY24	FY25	FY30	FY35	FY40
JHS	1	12.3	-	-	13.5	17.2	22.0	28.1
JAC	1	12.3	-	-	13.5	17.2	22.0	28.1
Supervisor	2	9.1	-	-	20.1	25.6	32.7	41.8
Attendent	2	5.6	-	-	12.3	15.7	20.1	25.6
Total Salary (INR Lakh)	**6**	**39.2**	-	-	**59.4**	**75.8**	**96.8**	**123.5**

Source: Consultant

Manpower cost has been considered in Total Project Cost under "Institutional Requirement". However, this investment component toward manpower will accommodate expenses only for the initial years, covering construction period. Manpower expenses in case of the Ro-Ro terminals isn't necessarily directed towards IWAI. It will be borne by whosoever operates the terminal. IWAI can either own and operate the infrastructure or lease it to a private third party on a suitable PPP model.

TABLE 13-6: Depreciation (Using SLM Method) (INR Lakh)

Depreciation & Amortization	FY23	FY24	FY25	FY30	FY35	FY40
Ro-Ro Terminals						
Gross Block	2,398.2	4,196.9	5,995.5	5,995.5	5,995.5	5,995.5
Depreciation & Amortization	-	320.9	458.4	339.6	339.6	39.4
Cumulative Depreciation & Amortization	-	320.9	779.3	2,869.5	4,567.6	5,965.5
Net Block	2,398.2	3,876.0	5,216.2	3,126.0	1,427.9	30.1

Source: Consultant

Depreciation has been calculated using the Straight-Line Method (SLM). Under this method, cost of asset is evenly distributed across its useful life. Gross Block in each case is sum of total hard cost and pre-operative expenses, which includes environmental management plan @ 5% of the Capex.

TABLE 13-7: O&M Cost (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Ro-Ro Terminals						
Direct Operating Cost	0.0	0.0	2.2	29.0	44.5	68.2
Maintenance & Other Cost	24.8	45.9	129.4	173.9	228.4	300.7
Total O&M	**24.8**	**45.9**	**131.6**	**202.9**	**272.9**	**368.8**

TABLE 13-8: P&L Statement (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Ro-Ro Terminals						
Revenue	0.0	0.0	26.2	295.9	452.2	691.4
O&M Cost	24.8	45.9	131.6	202.9	272.9	368.8
PBDIT	-24.8	-45.9	-105.4	93.0	179.3	322.6
Depreciation	0.0	320.9	458.4	339.6	339.6	39.4
Interest	171.5	300.1	428.7	154.4	0.0	0.0
PBT	-196.3	-666.9	-992.5	-401.0	-160.3	283.2
Tax	0.0	0.0	0.0	0.0	0.0	70.8
PAT	**-196.3**	**-666.9**	**-992.5**	**-401.0**	**-160.3**	**212.4**

Source: Consultant

Ro-Ro Terminals does not generate any positive returns till FY40. The following table is the overall assessment of the viability of the individual projects under the development of the Gurupur-Netravati River:

TABLE 13-9: FIRR for NW 43 & 74 (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
Ro-Ro Terminals						
Project Cashflow (Pre-tax)	- 2,423.0	- 1,844.6	- 1,904.0	93.0	179.3	322.6
Project IRR (Pre-tax)	**-8.8%**					
Project Cashflow (Post-tax)	- 2,423.0	- 1,844.6	- 1,904.0	93.0	179.3	251.8
Project IRR (Post-tax)	**-9.1%**					

Source: Consultant

Revenue prospect for all the sectors generates no rate of returns. It's because of very low traffic and high cost of project. All the sectors are likely to be loss-making. Based on the EIRR for the Ro-Ro sub-sector, viability Gap Funding (VGF) can be sought. In contrast to the above project component-wise FIRR, the following table provides FIRR for the project as a whole:

TABLE 13-10: FIRR for NW 43 & 74 – Whole Project (INR Lakh)

Parameter	FY23	FY24	FY25	FY30	FY35	FY40
			Whole Project			
Project Cashflow (Pre-tax)	- 4,372.8	- 3,316.3	- 3,452.2	- 93.7	- 67.1	- 3.7
Project IRR (Pre-tax)	Non-existent					
Project Cashflow (Post-tax)	- 4,372.8	- 3,316.3	- 3,452.2	- 93.7	- 67.1	- 3.7
Project IRR (Post-tax)	Non-existent					

Source: Consultant

Fairway and two Ro-Ro terminals all-together generate no returns till FY40. Cumulative Financial IRR depicts that development of both the rivers for projected traffic is not self sustainable.

13.5 Economic Analysis / EIRR

Economic Internal Rate of Return (EIRR) includes all the financial benefits of a project as well as the non-financial benefits of that project.

Non-financial benefits would include reduction in CO2 emission, decreased health care interventions, reduced traffic, and other quantified benefits that a project can have on a region considered for a project. The EIRR looks at any investment decision from the perspective of improving the welfare of the society in general. The table below shows the estimated EIRR for each of these sub-sectors is presented in the table below:

TABLE 13-11: Project EIRR (INR Crores)

Parameters	FY23	FY24	FY25	FY30	FY35	FY40
			Ro-Ro Terminals			
Economic Cash Outflow	-2.2	-7.1	-9.0	4.6	7.7	12.1
Net Cash Flow to Project	-26.2	-25.1	-27.0	4.6	7.7	12.1
Project EIRR	**-1.8%**					

Source: Consultant

Similar to calculating FIRR of the whole project, the following table shows the EIRR of the whole project:

TABLE 13-12: Project EIRR – Whole Project (INR Crores)

Parameters	FY23	FY24	FY25	FY30	FY35	FY40
			Whole Project			
Economic Cash Outflow	-4.2	-13.2	-18.7	-3.0	0.2	5.8
Net Cash Flow to Project	-87.2	-89.5	-43.0	31.8	45.7	66.5
Project EIRR	**Non-existent**					

Source: Consultant

13.6 Sensitivity Analysis

Variations in tariff rates and project cost (+/- 10%) have been applied to measure the overall impact these could have on the project's earnings and profitability. Sensitivity Analysis for each of the sub-sectors is shown in the table below:

TABLE 13-13 Sensitivity Analysis (+10% Revenue, +10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Ro-Ro Terminals					
Revenue	**0.0**	**28.3**	**322.9**	**493.6**	**754.8**
PAT	**-215.9**	**-1,086.1**	**-433.1**	**-165.9**	**243.8**
Project IRR (Pre tax)	-8.4%				
Project IRR (Post tax)	-8.8%				

Source: Consultant

TABLE 13-14 Sensitivity Analysis (+10% Revenue, -10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Ro-Ro Terminals					
Revenue	**0.0**	**28.3**	**322.9**	**493.6**	**754.8**
PAT	**-176.6**	**-894.8**	**-315.9**	**-73.5**	**274.2**
Project IRR (Pre tax)	-6.2%				
Project IRR (Post tax)	-6.6%				

Source: Consultant

TABLE 13-15 Sensitivity Analysis (-10% Revenue, +10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Ro-Ro Terminals					
Revenue	**0.0**	**24.1**	**268.9**	**410.9**	**628.0**
PAT	**-215.9**	**-1,090.1**	**-486.1**	**-247.0**	**150.6**
Project IRR (Pre tax)	-11.7%				
Project IRR (Post tax)	-12.1%				

Source: Consultant

TABLE 13-16 Sensitivity Analysis (-10% Revenue, -10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Ro-Ro Terminals					
Revenue	**0.0**	**24.1**	**268.9**	**410.9**	**628.0**
PAT	**-176.6**	**-898.8**	**-368.9**	**-154.6**	**181.0**
Project IRR (Pre tax)	-9.3%				
Project IRR (Post tax)	-9.6%				

Source: Consultant

Under no scenario terminal generates positive FIRR and this primarily because of traffic is too low to show any positive return. This means that even in imaginable optimistic conditions of higher revenue and lower cost, it is very unlikely that project would generate positive returns in the projected period up to FY40.

13.7 Risk Factors & Mitigation

The major risk associated with the Project is the unwillingness of industries to shift from existing mode of transportation i.e. roadways to proposed waterway due to the seasonal behavior of river & most importantly the cost factor. This happens when industries find end-to-end logistics cost of fairway & Ro-Ro Terminal higher than the existing mode of transportation i.e. roadways. In this situation, industries may reject using this mode & continue using roadways. Other risks typically impressing upon such a project are technical, environmental, and financial in nature. A broad assessment of such risks for the Gurupur-Netravathi River waterway development project is depicted in:

TABLE 13-17: Risk Factors & Mitigation measures

Risk	Description	Likelihood*	Impact**	Risk Rank#	Mitigation / Management
Unwillingness of industries	Cost/Time Factor & Multiple handling reduces logistics advantage of waterway cargo movement, against the competing existing road and rail movement.	3	3	9	• Incorporate industries' expectations in terms of infrastructure and facilities • Tariff low enough to appeal prospective industries, and to retain profitable operation for IWAI
Low or Uncertain Future traffic	Cargo volume, albeit low, assigned from Puttur to OMPT is speculative in nature. Assumed growth rate is also very optimistic.	3	3	9	• Target other traffic opportunities that utilize the stretch between Brahmarakotlu and Adarsh Nagar terminals. • Appealing logistics and subsidies in per-ton cargo handling to attract more share and more industries.
Project delay	The cause could either be due to delay in acquiring necessary permissions and clearances, meeting environmental regulations and guidelines, delay in procurement of necessary equipment, local resistance, natural disaster, etc. or, the delay could be the result of any combination of above determinants.	2	3	6	• Project Insurance • Increased lending to bridge gap due to cost overruns

*, ** - Severity increases with the scale; # - Likelihood x Impact

13.8 Necessity of Govt. Support (VGF / PPP)

Difficulty in securing funds aside, some projects are not even considered to be financially viable, although they might be economically justified and indispensable. To take care of such projects and to carry them towards their successful completion, the government has designed Viability Gap Funding (VGF). Viability Gap Funding is the grant provided by the government towards financing projects that are termed financially unviable but are economically justified & capable of holding trigger to associated developments. The scheme and the projects are monitored by the Ministry of Finance and amount is allocated through annual budget. The usual grant given by the government is 20% of the total capital cost of the project, which can be supplemented by the state government through an additional 20% grant.

Ro-Ro Terminals and fairway both the projects are commercially unviable while all there comes economically viable. The table below shows the outcome of return under 20% and 40% grant.

TABLE 13-18: Probable impact of VGF on project returns

Reduction in Project Cost	Ro-Ro Terminals		Cumulative	
	-20%	-40%	-20%	-40%
Project IRR (Pre Tax)	-6.3%	-3.4%	Non-existent	-17.2%
Project IRR (Post Tax)	-6.7%	-4.0%	Non-existent	-17.5%

Source: Consultant

Even at considering 40% funding support from government, the project does not generate any positive return. This is basically due to the high investment cost and lower returns due to less traffic, forgoing the fairway use charge.

13.9 Conclusion

The following table gives a snapshot of the project cost and viability indicators for all the sub-sector developments for NW 43 & 74 under different scenarios:

TABLE 13-19: Critical indicators for the NW 43 & 74 under different Scenarios

No	Factors	Section	Unit	Financial Outcome
1	Project Cost	Fairway	Cr.	47.90
		Ro-Ro Terminal - Gurupur	Cr.	25.38
		Ro-Ro Terminal - Netravati	Cr.	34.58

No	Factors	Section	Unit	Financial Outcome
2	Tariff	Vessel Berthing	INR Vessel/Day	1,500
		Terminal Charges	INR Per Vehicle	300
		Fairway Usage	INR GRT-Km	-
2	Traffic	Trucks	‘000 No. (FY40)	58.86
3	Revenue	Ro-Ro Terminal	Cr.	6.91
4	FIRR	Fairway	-	-
		Ro-Ro Terminals	-	-9.1%
5	EIRR	Fairway	-	-
		Ro-Ro Terminals	-	-1.8%
6	Cumulative	FIRR	-	Non-existent
		EIRR	-	Non-existent

Source: Consultant

The project does have cargo transportation however the volume is less and does not make it a commercially attractive venture in the beginning years however the intertwined development of the study stretches of Gurupur & Netravati river for about 10.141kms & 22.90kms with Class IV system of the NW standards shall kickstart a structured facility which will facilitate cargo movement in the region using the river waterway. So, there is a possibility of mobility directly from NMPT / OMPT through IWT vessel traversing the Netravathi River in to the hinterland, which is the most advantageous scenario. In the most optimistic scenario, development of river Gurupur (NW-43) & Netravati river may be considered for Ro-Ro development as well as strengthening tourist and passenger services in the entire waterway region. The state govt. has to take a very proactive role to play in such kind of development through support like free land/ incentives/ regulatory framework to mandatorily transfer some type of cargo to be transported through river waterway. Also, actions by state govt. may be mooted to promote tourism in this region making this an action-packed waterway.

CHAPTER 14. : CONCLUSIONS AND RECOMMENDATIONS

The study of Second Stage Detailed Project Report (DPR) for Development of Netravathi River (NW 74) in the stretch of 30 Kms from Lat 12°50'44.6904" N, Long 74°49'33.3734" E has been carried out as per the Terms of Reference (ToR)

A summary of the recommendations and conclusions as a result of the study is placed herewith:

- At the outset, it is to place that the development of "Netravathi River" is intertwined with "Gurupur River" due to the mobility of Traffic with origination / destination from one waterway is having its destination / origination to other waterway.
- Based on the Detailed Hydrographic Survey carried out / Site data collected and subsequent to the Morphological analysis etc., the required developments in the fairway along with interrelated activities have been identified.
- In order to provide a safe navigable fairway along the waterway dredging corresponding to achieve 2.0 m waterway depth for class IV (4.31 Lakhs Cu. M in Gurupur river & 8.13 Cu.M in Netravati river); Day / Night Navigation (42 Nos of Buoy / Light in Gurupur river & 102 in Netravati river)); Bank Protection (1 Nos location for 100.0m in Gurupur & 250.0m in Netravati river) totaling to 350.0m); Communication System (RIS / AIS / Locating the Vessels / Buoys); Institutional Requirements etc., have been considered. No need of Modification of structures, since there is no structure obstructing the IWT mobility. One HT line is to to upgraded in Netravati waterway from 10.0m to 20.2m.
- Keeping in view the proximity of New Mangalore Port (NMPT) / Old Mangalore Port (OMPT) in the river stretch, the possibility of Ro-Ro mobility could be established with estimated potential of Ro-Ro generation of 82,326 MT (4,574 vehicles) P.A in FY 25 and expected to increase to 3,51,348 MT (19,520 vehicles) P.A in FY 40. Combined with Gurupur, total mobility on Netravati would be 8,08,125 MT (44,896 vehicles) in FY 25 and increase to 10,59,470 MT (58,859 vehicles) in FY 40. So, there is a possibility of this mobility directly from NMPT / OMPT through IWT vessel traversing the Netravathi River into the hinterland, which is the most advantageous scenario.
- Roll-On Roll-Off (Ro-Ro) IWT Terminal has been proposed taking into the consideration of the origin and destination and fairway. The most probable location identified is just D/s of the Thumbe barrage, on the right side of the river, Lat 12°52'23.06"N and Long 75° 0'3.71"E. This location is having good accessibility to the road and the tentative land requirement in Netravati river has been arrived at with

14,243 Sq. M in the Thumbe Village; Bantwal Taluka; Dakshin Kannada District of Karnataka state. Similarly land requirement in Gurupur river has been 13,643.0 Sq. M.

➢ Terminal Infrastructure has been considered to suit to the Ro-Ro operation with the length of the Berthing structure as 75.0m in Gurupur river & 123.0m in Netravati river and width as 16.50m to 16.80m.

➢ In order to facilitate the Ro-Ro operation, following Vessel type and size have been considered i.e., the type as Ro-Ro Vessel with 15 TEU capacity LOA 56.00m; Breadth 13.50 m; Loaded Draft / Depth 1.8 m / 2.2 m; Propulsion with Marine Diesel Engines of 2 x 250 kW and with Average Speed (with Load) of 8 knots at 100% MCR. The indicative cost is about INR 1000 Lakhs.

➢ The cost estimates have been worked out and segregated into Fairway Module with capital cost of 47.91 Cr. followed with Ro-Ro jetty Module at a capital cost of 25.38 Cr. In Gurupur river & 34.57 Cr. In Netravati river. All the capital assets will be provisioned in 24 months.

➢ The Revenue factor, however, is to be considered along with the development of fairway in Gurupur & Netravati river and also one Ro-Ro Terminal each in these waterways.

➢ The FIRR and EIRR & other financial parameters have been worked out and the details are placed below.

No	Factors	Section	Unit	Financial Outcome
1	Project Cost	Fairway	Cr.	47.90
		Ro-Ro Terminal - Gurupur	Cr.	25.38
		Ro-Ro Terminal - Netravati	Cr.	34.58
2	Tariff	Vessel Berthing	INR Vessel/Day	1,500
		Terminal Charges	INR Per Vehicle	300
		Fairway Usage	INR GRT-Km	-
2	Traffic	Trucks	‘000 No. (FY40)	58.86
3	Revenue	Ro-Ro Terminal	Cr.	6.91
4	FIRR	Fairway	-	-
		Ro-Ro Terminals	-	-9.1%
5	EIRR	Fairway	-	-
		Ro-Ro Terminals	-	-1.8%
6	Cumulative	FIRR	-	Non-existent
		EIRR	-	Non-existent

➢ It is recommended to develop the entire study stretch of Gurupur river of about 10 kms with Class IV system of the NW standards to facilitate the Ro-Ro vessel mobility, intertwined with the development of river Netravathi having feasible navigable length of 22.50kms upto downstream of Thumbe barrge at 22.90kms.

CHAPTER 15. TEMPLATES

15.1 Environmental & Social Screening Template

Screening Question	Yes	No	Details / Remarks
1. Is the project located in whole or part in / near any of the following Environmentally Sensitive Area? If yes, please provide the name and distance from the project site			
a) National Park		✓	
b) Wildlife/ Bird Sanctuary		✓	
c) Tiger or Elephant Reserve		✓	
d) Biosphere Reserve		✓	
e) Reserved / Protected Forest		✓	
f) Wetland		✓	
g) Important Bird Areas		✓	
h) Mangroves Areas	✓		
i) Estuary with Mangroves	✓		
j) Areas used by protected, important or sensitive species of fauna for breeding, nesting, foraging, resting, over wintering, migration		✓	
k) World Heritage Sites		✓	

Screening Question	Yes	No	Details / Remarks
l) Archeological monuments/ sites (under ASI‟s Central / State list)		✓	
2. Is the project located in whole or part in / near any Critically Polluted Areas identified by CPCB?		✓	
3. Is, there any defense installations near the project site?		✓	
4. Whether there is any Government Order/ Policy relevant / relating to the site?	✓		CRZ Notification 2011 Water Act, 1974 Air Act, 1981
5. Is the project involved clearance of existing land, vegetation and buildings?	✓		Only for construction of terminal buildings
6. Is the project involved dredging?	✓		
7. Is the project area susceptible to natural hazard (earthquakes, subsidence, erosion, flooding, cyclone or extreme or adverse climatic conditions)	✓		
8. Is the project located in whole or part within the Coastal Regulation Zone?	✓		The entire stretch of NW-43 falls under CRZ – I and 23.5 km of NW-74 falls under CRZ – I.
9. Is the project involved any demolition of existing structure?		✓	

Screening Question	Yes	No	Details / Remarks
10. Is the project activity require acquisition of private land?	✓		For terminal construction
11. Is the proposed project activity result in loss of direct livelihood / employment?		✓	
12. Is the proposed project activity affect schedule tribe/ caste communities?		✓	

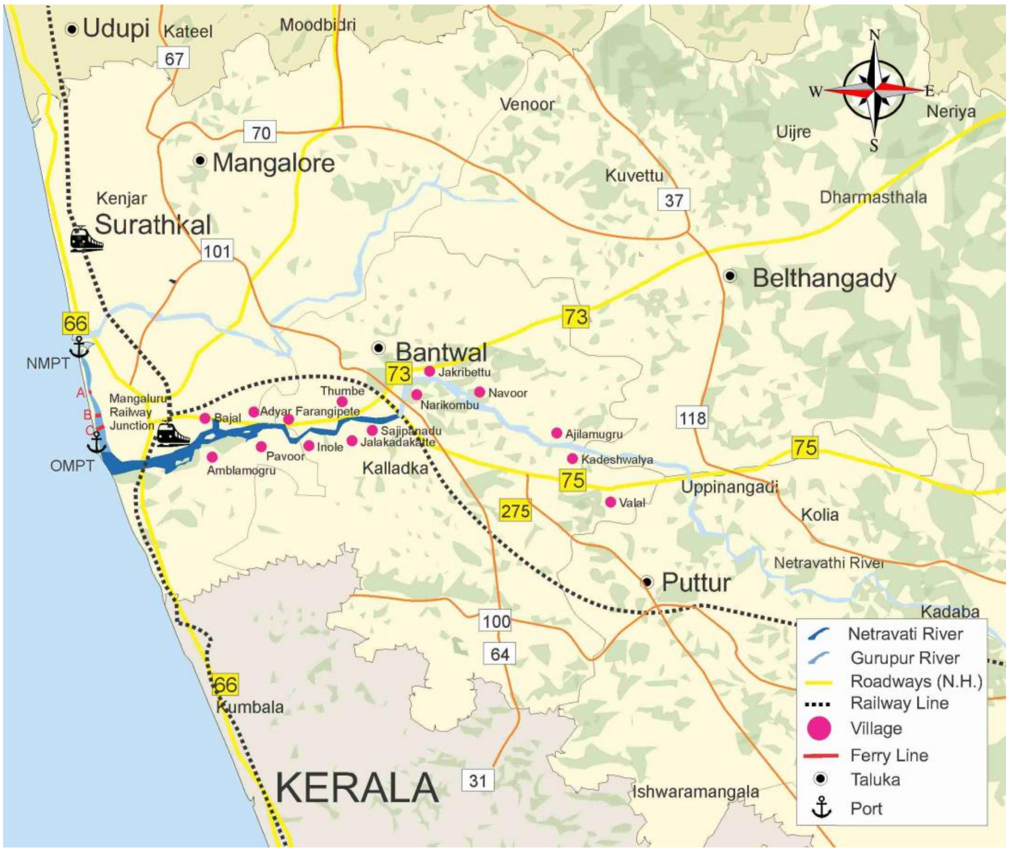
S. N.	Result of Screening Exercise	(Yes / No)
1.	Environment Impact Assessment is Required	Yes
2	CRZ Clearance is Required	Yes
3.	Environmental Clearance is Required	Yes (for dredging)
4.	Forest Clearance is required	To be confirmed
5.	Wildlife Clearance is required	No
6.	NOC from SPCB is required	Yes
7.	Social Impact Assessment is Required	Only as part of EIA study
8.	Abbreviated RAP is required	No
9.	Full RAP is required	No
10.	Any other clearance is required	Clearance requirements with respect to Masjid Arkula and Infant Jesus Chapel need to be confirmed.

15.2 Traffic Template

15.2.1 Catchment Baseline

- Local Economic Geography - Netravathi river origin – Bangrabalige Valley, Yelaneeru Ghat in Kudremukh in Chikkamagaluru district. It is navigable from Bantwal.
- Catchment Area - Mangalore, Bantwal & Puttur talukas in Dakshina Kannada district.

- Population – As per census 2011, total population of Dakshina Kannada is about 20,89,649.
- Total population residing in Mangalore taluka is 4,05,156, Bantwal taluka is 3,55,225 and Puttur taluka is 2,34,790.
- Economic Activites- Paddy, Coconut, Areca and Cashew production come under Agriculture activities. Marine & Inland Fishing is done in the catchment area. In Mining, major minerals are Building Granite and Laterite Stone; other minerals like Quartz, Dolerite, Lime Shell, Silica Sand & Bauxite are produced in a minor quantity. The district has 23 large and medium industries and 21,986 small- scale industries. Tourism is also growing in the district.
- Major Industries - Oil and Natural Gas Corporation (ONGC), Mangalore Refinery and Petrochemicals Limited (MRPL), Mangalore Chemicals & Fertilizer (MCF), BASF, KIOCL, Ultratech Cement, Hindustan Unilever Ltd. There are 6 industrial areas and 5 Industrial Estates in Mangalore. Also, there is Baikampady Industrial Estate & Ullal Industrial Estate & Yeyyadi Industrial Estate.
- Connectivity
  - ✓ Major roads – NH 66, NH 75, NH 13, NH 243, SH 88, SH 88C
  - ✓ Major railway – The Southern Railway Division connects the district to the cities of Bengaluru, Chennai and Thiruvananthapuram and the Konkan Railway division connects the district to major port cities of Mumbai and Kochi. Konkan Railway route passes through Mangalore district, connecting major cities of India. The Konkan Railway's Ro-Ro service operates in the district with a landing station at Surathkal near Mangalore.
- Specific Developments
  - ✓ There is a proposal for an Expressway Corridor, connecting port cities of Mangalore-Karwar-Panaji as part of Indian National Expressway Network. This expressway will be parallel to NH 66 and will be located majorly in Coastal Karnataka.
  - ✓ Shiradi Ghat road patch of NH 75 is being upgraded.
- Catchment Area Map



15.2.2 Navigation Baseline

- Existing Waterway Usage
  - ✓ There exists a major port, i.e. NMPT and a non- major port, OMPT in the catchment of Netravathi river. NMPT handles EXIM trade of the region. The major commodities exported through NMPT are Iron Ore Pellets, POL products, Granite, Stones, Coffee and Containerized cargo. The major imports of the port are Crude and POL products, LPG, Coal, Limestone, Timber logs, Wood pulp, Finished fertilizers, Liquid Ammonia, Phosphoric Acid, Other Liquid Chemicals, Edible oil, Cashew and Containerized cargo. IN FY 16, the port imported 28 mn T cargo and exported 7.6 mnT cargo.
  - ✓ Ferry services are operational at the following three locations: Sajipanadu-Thumbe, Jalakadakatte- Parangipet and Adyar-Pavoor.

15.2.3 Market Baseline

- Potential Market
  - ✓ Ro-Ro – POL & LPG, Containers, Food Grains, Building Material.

Commodity	Source	Reasoning
Mineral (Building Material)	Extracted from catchment area/ OMPT	A portion of Building material that go to OMPT could be shifted to waterways.
Food Grains	Produced in catchment area	Most food grains are consumed in the region; 4% of food grains can be moved to Lakshadweep through OMPT. This volume could be transported to OMPT through waterway.
Hazardous cargo (POL & LPG)	NMPT, MRPL	For removing hazardous cargoes from roads of the city, they could be diverted to waterway using Ro-Ro.
Containers	NMPT	Containers could be diverted to waterway to remove congestion on NH 73 & NH 66.
Fertilizer	Allotted in the catchment area	The volume is very less to be moved by Ro-Ro.

15.2.4 Forecasting Years

- IWT Share

  - ✓ To remove hazardous cargo from roads, it could be shifted to the waterway by Ro-Ro. Assuming that Government would make policies to remove hazardous cargo from roadways for safety, IWT share in this case is 100%.
  - ✓ Based on road survey, it is assumed that 20% share of Containers could be shifted to the waterway.
  - ✓ Food grains prodcued in the catchment area is mostly consumed locally. Hence, there is a potential to shift about 4% of total food grains to IWT through Ro-Ro.
  - ✓ Building material are moved from OMPT to Lakshadweep. About 19-20% of Builidng Material could be shifted to IWT to be transported to OMPT.
  - ✓ Out of total allotted Fertilizer in Mangalore, Buntwal & Puttur Talukas, about 10% can be shifted to IWT through Ro-Ro facilities. However, the volume is too less to be shifted to IWT.

Sr. No	Name of Cargo	Type of Cargo	Origin	Origin Terminal on NW	Final Destination	Destination Terminal on NW	Co-ordinates	Unit p.a	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40	Terminal Land Area in Sq. Mtr
Existing Terminals on River (No terminal present on the river)															
Proposed Terminal on River (Opportunity for IWAI)															
1	Food Grain	Bulk	NMPT Port	N.A.	Central Karnataka	B1 (Brahmarakotlu)	12°52'23.08" N 75° 0'6.79"E	('000 Trucks)	0	1	1	1	1	2	
2	POL/ LPG/ Container	Liquid							0	121	147	179	218	265	
3	Building Material	Bulk/Break bulk							0	1	1	2	2	3	
* BULK/BREAK BULK/BULK LIQUID/ TRUCKS (in No.), etc.															

15.2.5 Forecast of traffic (combining Netravathi and Gurupur river)

Name of the waterway: NW 74 Netravathi River-78 km & NW 43 Gurupur River-10 km

Sr. No	Name of Cargo	Type of Cargo	Origin	Origin Terminal on NW	Co-ordinates (Origin)	Final Destination	Destination Terminal on NW	Co-ordinates (Destination)	Unit p.a	Fy-16	Fy-20	Fy-25	Fy-30	Fy-35	Fy-40
Existing Terminals on River															
Proposed Terminal Opportunity for IWAI															
1	Food Grain	Ro-Ro	Bantwal, Puttur	B1 (Brahmarakotlu)	12°52'23.08"N 75° 0'6.79"E	Lakshadweep Island (via OMPT)	N.A.	N.A.	('000 Trucks)	0	1	1	1	1	2
2	Building Material						N.A.	N.A.		0	1	1	2	2	3

3	POL/LPG/Container		NMPT	Ashok Nagar	12°54' 13.27"N 74° 48' 56.97"E	Central Karnataka	B1 (Brahmarakotlu)	12°52'23.08"N 75° 0'6.79"E		0	61	74	90	109	133
			Central Karnataka	B1 (Brahmarakotlu)	12°52'23.08"N 75° 0'6.79"E	NMPT	Ashok Nagar	12°54' 13.27"N 74° 48' 56.97"E		0	61	74	90	109	133
Total										**0**	**123**	**149**	**182**	**221**	**270**

* BULK/BREAK BULK/BULK LIQUID/ TRUCKS (in No.), etc.

* For Food Grains and Building Material, cargo could be evaculated at OMPT facility, to be transported to Lakshadweep Island.

* 50% share of Liquid, Bulk, break bulk is considered for each of the ways, between NMPT and Brahmarakotlu.

15.2.6 Presentation of Forecast

Sr. No	Name of Cargo	Type of Cargo	Origin	Final Destination	Unit p.a	FY 16	FY 20	FY 25	FY 30	FY 35	FY 40
Existing Terminal on River (No terminal present on the river)											
Proposed Terminal on River (Opportunity for IWAI)											
1	POL/ LPG/Container	Ro-Ro	NMPT Port	Central Karnataka	(Tonnes - Km)	0	1,91,664	2,32,848	2,83,536	3,45,312	4,19,760
2	Food Grains					0	1,584	1,584	1,584	1,584	3,168
3	Building Material					0	1,584	1,584	3,168	3,168	4,752
	Total					0	1,94,832	2,36,016	2,88,288	3,50,064	4,27,680

15.2.7 Market Success Factors

The river Netravati is intertwined with the river Gurupur regarding the IWT mobility is concerned. The close proximity of New Mangalore Port (NMPT) and Old Mangalore Port (OMPT) along with the industrial belt is the major success factor.

In order to grab the IWT mobility, the suggested Ro-Ro system is another advantageous factor for the combined development of Netravati & Gurupur.

Netravati end point / Bantwal, having its connectivity to eastern Karnataka also establish the market growth.

15.2.8 Forecasting Methodology

- Hazardous cargoes, like POL and LPG products move from/to NMPT and Bantwal. At present, these hazardous cargoes are moved in tankers by roadways. The routes on which these tankers are moved, run in parallel to Netravathi and Gurupur River; there is a definite case of moving this hazardous cargo, like POL/LPG through Gurupur/Netravathi River on Ro-Ro vessels. Ro-Ro terminal facilities could be developed near Brahmarakotlu. There is potential to move about 38,325 Trucks POL and LPG products through waterways annually. Hazardous cargo needs to be moved away from roadways. Government policies to remove hazardous cargo from roadways would promote the use of waterway.
- About 4% of total food grains produced in the catchment area, i.e. about 16,545 Tonnes of food grains can be transferred to IWT through Ro-Ro.
- Out of 13,048 Tonnes of Fertilizer is allotted to Mangalore, Buntwal & Puttur Talukas, about 10% (1,300 T) can move through Gurupur/ Netravathi River through Ro-Ro facilities. However, the volume of fertilizer is very less to be moved by Ro-Ro.
- A portion about 15,000- 18,000 Tonnes of building material, Granite and Laterite could be moved through Netravathi river to OMPT. These bulding materials move from OMPT to Lakshadweep.
- Average carrying capacity of trucks is 18-20 tons.

15.3 Project Costing Template

Cost type	Cost categories	Components to be itemized
Capital costs	Waterway Infrastructure	☐ Land, compensation and resettlement: No ☐ Capital dredging:12.44lakhs cu.m Ordinary soil–30.49cr ☐ River training/bank protection: 350m for 2 locations ☐ Locks: No ☐ Barrages: No ☐ Channel marker: No ☐ Night navigation: 5.45cr ☐ Other: Communication system – 1.04 cr
Terminal Infrastructure		Ro-Ro facility ☐ Fixed infrastructure: berths, moorings, hard-standing etc. (itemized) ☐ Loading/uploading and other equipment (itemized) ☐ Buildings: Considered in infrastructure ☐ Other: -- Considered
Operation and maintenance (O & M) costs	Waterways	☐ Maintenance dredging ☐ Markings and nav.-aids ☐ Bank maintenance ☐ Other Considered as per standard
	Terminals	☐ Terminal operations ☐ Terminal maintenance ☐ Other Considered as per standard
	Vessel: (NB vessel operating costs/tons-km fall sharply with larger capacity vessel, when there is sufficient traffic to utilize them)	☐ Crew ☐ Fuel ☐ Maintenance ☐ Registration & insurance ☐ Fees and charges ☐ Vessel capital amortization (or leasing cost equivalent) ☐ Total costs Considered as per standard ☐ (Cost/tons-km for use in evaluation)

Cost type	Cost categories	Components to be itemized
Recurrent costs		Periodic major capital costs that may occur over life of assets: Considered as per standard
Price levels		All costs to be expressed in 2022 price levels. Costs derived from other years to be indexed to 2022 price levels: Considered accordingly
Value engineering		Not all investments will be necessary in all projects. Value engineering should be applied to project scoping and specification to avoid "gold-plating" of costs and undermining viability of project: --
Cost verification		Costs that are estimated on a „bottom-up" basis should be verified or tested for reasonableness against actual costs for such activities evidenced in the market place: Considered as per standard

15.4 Economic Evaluation Template

Item	Requirements
Objective	To assess economic internal rates of return (EIRR) on a consistent basis between different river projects.
Economic evaluation approach	Economic evaluation of each river upgrading project may include: **Capital Cost:** (a) Navigation infrastructure – INR 47.91 crore (b) Gurupur Terminal Cost - INR 25.38 crore (c) Netravati Terminal Cost -INR 34.58 crore O & M costs: (a) Ro-Ro Terminal cost – INR 3.69 crore Savings in transport resource costs between IWT and rail and/or road transport **Saving on Fuel** (a) Ro-Ro Terminal cost – INR 4.6 crore **Saving on Vehicle Operating Cost** (a) Ro-Ro Terminal cost – INR 0.7 crore Savings in road/rail accident costs

	(a) Ro-Ro Terminal Costs - INR 3.8 crore Saving in carbon emissions (a) Ro-Ro Terminal Costs - INR 3.8 crore
Standard values	To ensure consistency between evaluations of different waterways the following has been used: Vehicle operating Cost Road: INR 2.57/tons-km IWT: INR.1.06/tons-km Road accident Loss: INR 7.73 Lakhs/km Carbon shadow price: 20 dollars/tons
Other benefits	Other significant economic benefits such as direct employment creation has also been considered in the evaluation. Employment cost has been taken as INR 2.5 Lakhs per annum.
Cash flows in real terms	Economic cost has been considered as 85% of actual values without any escalation.
Resource cost adjustments	Market prices has been taken on 2017 price level as equivalent to resource costs for the purposes of the economic evaluation.
Evaluation period	Initial construction period has been adopted as 3 years for Navigation infrastructure and Ro-Ro terminals. Fairway will be developed in single phase. Construction for fairway and terminals will be from FY23 to FY25. A total 15 years for operation period have been taken (FY25 – FY40)
EIRR	The EIRR for all the individual projects under development of the Netravati-Gurupur River is positive. However, these projects are not commercially viable, because FIRR for all the sub-segment projects are either negative or non-existent. Immediate prospects for fairway utilization exist, and cargo volume is expected to grow in the coming future as per the growth of secondary sector. This bodes well for fairway, and significant revenue could be generated, provided market driven tariff rates are applied (as against IWAI rates used in the financial model). It is also essential to develop the fairway at Netravati-Gurupur along with night navigation.

	At present, industries located in catchment area are using roadways to reach NMPT for EXIM trade. Development of Netravati-Gurupur as an alternate mode for transportation of raw materials and finished products for industries is likely to generate employment. The waterway would decongest the roads by traffic diversion and likely to save fuel used in road transportation along with reduction in environment pollution. The reduction of vehicular operating cost due to use of Netravati-Gurupur is also likely to generate overall benefits to the project. Economic IRR of Ro-Ro Terminals is negative at -1.8%.
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

Financial Evaluation Template

Consultants shall adhere to the following standard approaches in estimating financial internal rate of return (FIRR) and payback period.	
Item	Requirements
Objective	To assess financial internal rates of return and financial payback periods of Netravati - Gurupur River
Financial evaluation approach	Financial evaluation of each river upgrading project should estimate and present actual cash flows (cost and revenues) at market prices within the inland waterway sector. **Returns for Terminal Operations are:** Total Revenue: INR 6.91 cr. in FY40 O&M Cost: INR 3.69 in FY40 Tax: INR 0.71 in FY40 (@ 30% on EBITDA) EBIDA: INR 3.23 cr. In FY40 Project Capital Cost (with escalation): INR 59.96 cr. Net Cash Flow: INR 2.52 cr. In FY40

Disaggregation	Cash flow streams and FIRRs have been attached as annexures in Financial Evaluation chapter-13 for Navigation Structure and terminals separately. It is not considered as a whole. Payback is also considered separately for all 2 facilities. **Returns for Terminal Operations are:** Total Revenue: INR 6.91 cr. in FY40 O&M Cost: INR 3.69 in FY40 Tax: INR 0.71 in FY40 (@ 30% on EBITDA) EBIDA: INR 3.23 cr. In FY40 Project Capital Cost (with escalation): INR 59.96 cr. Net Cash Flow: INR 2.52 cr. In FY40
Evaluation period	Construction period has been adopted as 3 years for all the sub-segment projects. For fairway, a total 20 years for operation period has been taken into account for the entire operation (FY23-FY40). For both the terminals, the operation period is from FY25 to FY40.
FIRR and payback period	Estimate both FIRR (sector and sub-sectors) and overall sector payback period, the latter being the year in which the cumulative sector each flows becomes positive: Described in financial evaluation
Ramp-up period	Unless good reasons otherwise, assume 4 years ramp-up period from first operational year to long-term trend" levels of traffic: 5 years ramp up period considered
Commentary on FIRR	Explain overall sector FIRR results and distribution between sub-sectors. Identify main drivers of the results and sensitivity to assumptions: The project for development of Netravati-Gurupur River exhibit negative rate of return on investment (FIRR) for terminals. Factors influencing healthy financial returns of the project are:

	Potential revenue likely to be generated across the board is not high enough, mainly because of low traffic potential and high construction cost. Indicatively, total logistics cost for Ro-Ro is higher as compared to existing mode of transportation. This will keep the industries from diverting to waterways. The tariff rates supplied by IWAI are too low, which further impacts revenue potential, and eventually, viability of the project within the projected period up till FY40. Therefore, rates considered for calculating IRR in this project is taken higher than actual IWAI rates.
Risks to financial out-turn	Identify main risks to the estimated project out-turn or viability and their underlying causes e.g. market risks (traffic, tariffs, and competition), hydrology risks, engineering risks, operational risks etc.: Industries are very much concerned about the time & cost factor. There are high chances of rejecting the utilization of waterways if overall logistics cost including tariff charged for usage of terminal & fairway is higher than existing mode of transportation for them.
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

ANNEXURES

ANNEXURE 1.1 – TOR OF THE AGREEMENT

SECTION-6 TERMS OF REFERENCE

1.0 OBJECTIVE OF THE STUDY:

Government of India intends to explore the potential of additional waterways across the country for year round commercial navigation, for this it is planned to conduct a Feasibility Study and recommending thereafter the possibility of Composite and Integrated development of proposed waterways to achieve navigation and to develop water transport facilities across India. After carrying out the feasibility study if there is scope for navigation and potential to develop waterway transport facility, a Detailed Project Report needs to be prepared for those waterways which would include detailed hydrographic surveys and investigation, traffic survey, proposed location for terminals and cost assessment etc.

The study would consist of 2 stages:

1. **Stage-1**
2. **Stage-2**

1.1 STAGE-1

Stage-I is only for feasibility of the waterway for navigation, which may have the potential for year round navigation or at least for a few months in a year.

Stage-1 would consist of the following activities:

1A. Reconnaissance Survey

1B. Collection and review of available data

1C. Feasibility Report

1.1.1 Reconnaissance Survey

The detailed field reconnaissance survey may be taken up immediately after the analysis of available data. The primary tasks to be accomplished during the reconnaissance surveys include:

i- Single line longitudinal survey (Bathymetric survey or Topographic survey) in the deepest depths or lowest height lands, with the help of DGPS using Automatic Hydrographic Survey System. Bathymetric surveys in the proposed waterways are to be carried out in the deepest route. Deepest route can be accessed by taking two or three longitudinal line soundings at equal interval. Topographic survey, if required, is to be taken up at lowest ground levels, which can be decided on visual assessment.

ii- Details (horizontal and vertical clearances above High Flood Level of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route are to be collected and indicated on the chart and also included in the report along with their co-ordinates and location. Details about Barrages, Dams, Locks enroute are also to be collected. horizontal and vertical clearance is to be given as approximate on visual assessment. Photographs are required to be submitted in the report.

iii- Topographical features of the proposed Inland Waterways.
iv- Typical physical features along the alignment i.e. land use pattern:
v- Preliminary identification of stretches having year round flow and critical depth for navigational purpose.
vi- Preliminary Traffic identification on the proposed Inland Waterways.
vii- Inventory of major aspects including proposed Inland Waterway width, Terrain, Bridges and structures across the proposed Inland Waterways (Type, size and location), urban areas (location extent). Geologically sensitive areas environmental features. Hydrological features
viii- Critical areas requiring detailed investigations and
ix- Requirements for carrying out supplementary investigations
x- Soil (textural classifications) (only visual inspection at every 10km) and drainage conditions.
xi- Type and extent of existing utility services along the alignment.
xii- Identification of various agencies of the govt. from whom the concerned project clearances for implementation are to be sought.

The data derived from the reconnaissance surveys may be utilized for planning and programming the detailed surveys and investigations. All field studies including the traffic surveys should be taken up on the basis of information derived from the reconnaissance surveys. For the critical locations, River cross sections survey needs to be carried out.

1.1.2 Collection and Review of Available Data

A review has to be done based on the existing data available with the State Agencies and Central Water Commission for the proposed Inland Waterways for determining the nature, extent, adequacy, validity of the available data and identifying the data gaps. Consultant has to collect available data for the proposed Inland Waterways from the State Agencies and Central Water Commission. An introductory letter will be issued by IWAI for collecting information from State / Central Government.

An inception report has to be prepared which would consist of the findings based on the analysis of the existing data and reconnaissance surveys.

1.1.3 Feasibility Report

The Consultant has to prepare Feasibility Report for the proposed waterways based on the available data and reconnaissance survey. It must include the following prospects:

1. **Introductory considerations:**
   The Consultant shall provide an introduction, describing the scope of the assignment, its methodology in fulfilling the assignment and the expected outcome of the assignment.

2. **Analysis of present state of affairs:**
   The Consultant shall provide a quantitative and qualitative description of the current utilization of proposed inland waterways. In addition, the Consultant shall describe the status of goods transport, including utilization of road and transport, as well as river facilities.

3. **Market Analysis:**
   The consultant shall analyze the market and potential usage of proposed Inland Waterways. This analysis shall examine both the existing market and the potential future market. Contractor has to collect the details of available Industries along the waterway, type of production in these industries, ferry services, type of crop along the waterway, previous history of movement of cargo in the waterway etc. Above is to be collected after discussion with local village people while conducting reconnaissance survey etc. and also after interaction with State Govt. Officials, Irrigation / Water Resources departments.

4. **Reconnaissance Survey:**
   Analysis of the data collected in the reconnaissance survey should reflect the possibility of year round flow in the proposed Inland Waterways to achieve the commercial navigation. It should also consist the map of proposed Inland Waterways indicating existing cross structures viz. bridges, dams etc. Navigability of the waterway (for the periods) is to correlate with CWC/Irrigation water level data.

The Consultant has to submit the Feasibility Report for proposed Inland Waterways. Consultant also has to emphasize that which stretches of proposed inland waterways has potential of possible navigation. Only for those stretches of proposed inland waterways, which have potential of possible navigation, Stage 2 has to be carried out.

After obtaining approval from IWAI for identified stretches, Consultant may proceed for Stage - 2. Based on the feasibility report, IWAI will accord the approval for Stage-II, and stretch for DPR will be based on feasibility study.

1.2 STAGE-2

For Stage-2, Consultant has to carry out detailed hydrographic survey, topographic survey, traffic survey and selection of terminal locations.

Stage-2 would consist of the following activities:

1A. Hydrographic Survey & hydro-morphological survey

1B. Traffic Survey & Techno economic feasibility

1C. Preparation of Detailed Project Report

1.2.1 HYDROGRAPHIC SURVEY & HYDROMORPHOLOGICAL SURVEY

Based on the recommendation after reconnaissance survey of proposed Inland Waterways, Hydrographic survey may be carried out as per the International Standards including the following for finding the potential of proposed Inland Waterways for inland navigation:-

(i) The detailed hydrographic survey is to be carried out in WGS'84 datum.

(ii) The horizontal control is to be made using DGPS with minimum 24 hours observations at some platform/base.

The vertical control is to be established with respect to the chart datum / sounding datum from the following methods:-

i. Chart datum/ sounding datum already established by Port Authorities (Chart Datum), Central Water Commission (Average of last six years minimum Water Level) / State Irrigation Department (Full Supply Level (FSL)) and at their gauge stations along the river/canal. Secrecy undertaking forms etc. will be provided by IWAI for collection of CWC data. Introductory letter will be issued to the successful Consultant for collection of other required information from State Departments.

ii. Standard method shall be adopted for transfer of datum in rivers/canals. For tidal reaches standard transfer of datum as per Admiralty Manual shall be adopted.

iii. **By erection of tide gauges – at every 10km interval and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc.**

Other Terms of Reference for the survey work shall be as given below: -

1.2.1.1 BENCH MARK PILLARS

a. Construct Bench Mark Pillars of dimension 0.3m x 0.3m x 1.5m (0.6m above GL) RCC pillar with 6mm thick 50mm dia GI pipe inserted (as per construction drawing of Survey Pillar in the tender document), at every 10km interval. Detailed description of the bench mark along with its position and value to be given in the report for future recovery.

1.2.1.2 WATER LEVEL GAUGES

i. Water level gauges are to be erected at every 10 km interval along the canal/river **and also at upstream and downstream of Locks, Sluice gates, Barrages, Dams etc. simultaneously.** Readings are to be taken at 1 hr interval for 12 hours (6 AM to 6 PM) or for the entire period of survey. The gauges are to be connected to a nearest Bench Mark by leveling and its datum value shall be established w.r.to MSL & CD. Water level gauges are to be installed temporarily during the survey period.

ii. At least 2 gauges (one U/s and one D/s at 10 Km apart) shall be read simultaneously and soundings to be carried out within the gauge stations. Soundings are to be reduced for datum of a gauge for 5km length of the canal/river on both side of a gauge.

1.2.1.3 BATHYMETRIC AND TOPOGRAPHICAL SURVEY

Sl. No.	Name of the River / Canal	Description of Inland Waterway
	CLUSTER-2	
1	DHANSIRI / CHATHE	110 km length of the river from Bridge near Morongi T.E. village Lat 26°24'40.65"N, Lon 93°53'46.75"E to Numaligarh Lat 26°42'1.20"N, Lon 93°35'15.42"E
2	LOHIT RIVER	100 km length of the river from Parasuram Kund Lat 27°52'40.06"N, Lon 96°21'39.70"E to Saikhowa Ghat, Sadiya Lat 27°47'49.14"N, Lon 95°38'13.84"E

3	SUBANSIRI RIVER	111 km length of the river from Gerukamukh Lat 27°27'3.14"N, Lon 94°15'16.12"E to Brahmaputra confluence at Lat 26°52'24.93"N, Lon 93°54'31.26"E
4	TIZU and ZUNGKI RIVERS	42 km length of the river from Longmatra at Lat 25°46'11.98"N, Lon 94°44'35.04"E to Avanghku at Myanmar border Lat 25°35'2.94"N, Lon 94°53'6.12"E and in Zungki river from bridge at Lat 25°48'26.10"N, Lon 94°46'35.96"E to confluence of Zungki and Tizu rivers at Lat 25°46'58.03"N, Lon 94°45'20.51"E
	CLUSTER-3	
1	BIDYA RIVER	55 km length of the river from Lot No. 124 at Lat 21°54'42.88"N, Lon 88°41'8.48"E to near Uttar Danga at Lat 22°11'47.93"N, Lon 88°51'54.93"E
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	15 km length of the river from near Rajani ferry ghat Lat 22°19'57.49"N, Lon 88°54'21.40"E to near Nazat at Lat 22°26'5.40"N, Lon 88°50'11.69"E
3	DVC CANAL	130 km length of the canal from Durgapur Barrage Lat 23°28'47.36"N, Lon 87°18'19.04"E to Confluence point of DVC canal with Hooghly river near Tribeni Lat 23° 0'30.95"N, Lon 88°24'54.72"E
4	GOMAR RIVER	7 km length of the river from near Ramkrishnapur Lat 22°11'53.35"N, Lon 88°44'41.97"E to near Gosaba Kheya ghat at Lat 22°10'5.44"N, Lon 88°47'37.17"E
5	HARIBHANGA RIVER	16 km length of the river from Bangladesh Border Lat 21°53'18.81"N, Lon 89° 1'23.61"E to confluence with Jhila river at Lat 21°58'17.66"N, Lon 88°55'8.38"E
6	HOGLA (HOGAL)-PATHANKHALI RIVER	37 km length of the river from near Parandar Lat 22°12'22.05"N, Lon 88°40'42.77"E to near Sandeshkhai Ferry Ghat at Lat 22°21'12.26"N, Lon 88°52'47.99"E
7	KALINDI (KALANDI) RIVER	8 km length of the river from Bangladesh Border at Hingalganj Lat 22°28'8.48"N, Lon 88°59'46.19"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
8	KATAKHALI RIVER	23 km length of the river from Bangladesh Border near Barunhat Lat 22°30'31.44"N, Lon 88°58'24.53"E to Lebukhali ferry at Lat 22°21'45.36"N, Lon 88°57'30.27"E
9	MATLA RIVER	98 km length of the river from Bay of Bengal at Lat 21°33'4.13"N, Lon 88°38'25.65"E to Canning ferry ghat at Lat 22°18'38.87"N, Lon 88°40'42.65"E
10	MURI GANGA (BARATALA) RIVER	27 km length of the river from Bay of Bengal near Bisalakshmipur Lat 21°37'51.94"N, Lon 88°10'0.24"E to near Kakdwip at Lat 21°52'17.39"N, Lon 88° 9'7.52"E
11	RAIMANGAL RIVER	52 km length of the river from Hemnagar at Lat 22°11'40.58"N, Lon 88°58'1.08"E to Rajnagar at Lat 22°33'56.95"N, Lon 88°56'16.64"E
12	SAHIBKHALI (SAHEBKHALI) RIVER	14 km length of the river from near Ramapur Lat 22°17'52.04"N, Lon 88°56'34.78"E to Bangladesh Border near Khosbash at Lat 22°24'41.40"N, Lon 88°58'20.68"E
13	SAPTAMUKHI RIVER	37 km length of the river from Bay of Bengal at Henry Island Lat 21°34'57.35"N, Lon 88°19'8.47"E to near Chintamanipur at Lat 21°51'14.01"N, Lon 88°18'40.50"E
14	THAKURRAN RIVER	64 km length of the river from Bay of Bengal at Lat 21°33'31.95"N, Lon 88°27'45.40"E to Madhabpur at Lat 22° 2'52.19"N, Lon 88°33'27.96"E
	CLUSTER-4	
1	BAITARNI RIVER:	49 kms length of the river from Dattapur village at Lat 20°51'44.61"N, Long 86°33'30.45"E to confluence with Dhamra river near Laxmiprasad Dia at Lat 20°45'13.32"N, Long 86°49'15.36"E

2	BIRUPA / BADI GENGUTI / BRAHMANI RIVER SYSTEM:	102 kms length of the river from Birupa Barrage at Choudwar at Lat 20°30'49.00"N, Long 85°55'20.17"E to confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E including alternative route of 25 kms from Samaspur village at Lat 20°35'40.59"N, Long 86° 6'31.50"E to near Kharagpur village at Lat 20°38'27.77"N, Long 86°17'31.81"E and additional 54 kms length of Brahmani river from confluence of Birupa & Brahmani rivers near Upperkai Pada village at Lat 20°37'36.25"N, Long 86°24'19.13"E to Brahmani river at Katana Lat 20°39'26.28"N, Long 86°44'52.86"E
3	BUDHA BALANGA:	56 kms length of the river from Barrage (approx 300m from Patalipura village) at Lat 21°38'12.96"N, Long 86°50'53.17"E to confluence of Budha Balanga river with Bay of Bengal at Chandipur Fishing Port Lat 21°28'12.14"N, Long 87° 4'11.60"E
4	MAHANADI RIVER:	425 kms length of the river from Sambalpur Barrage at Lat 21°27'34.33"N, Long 83°57'49.80"E to Paradip at Lat 20°19'38.12"N, Long 86°40'16.96"E
	CLUSTER-5	
1	PENNAR RIVER:	29 kms length of the river from Penna Barrage, Pothireddypalem at Lat 14°28'8.38"N, Long 79°59'9.31"E to confluence with Bay of Bengal near Kudithipalem at Lat 14°35'36.75"N, Long 80°11'30.61"E
2	KAVERI / KOLLIDAM RIVER:	364 kms length of the river from Uratchikottai Barrage at Lat 11°29'3.09"N, Long 77°42'13.68"E to confluence with Bay of Bengal at Pazhaiyar Lat 11°21'37.97"N, Long 79°49'53.23"E
3	PALAR RIVER:	141 kms length of the river from rail bridge at Virudampattu, Vellore Lat 12°56'14.07"N, Long 79° 7'29.70"E to confluence with Bay of Bengal at Sadurangapattinam Lat 12°27'52.16"N, Long 80° 9'13.47"E
4	PAZHYAR RIVER:	20 kms length of the river from Bridge near Veeranarayana Mangalam village at Lat 8°13'48.97"N, Long 77°26'27.34"E to confluence with Arabian Sea at Manakudi at Lat 8° 5'15.01"N, Long 77°29'7.61"E
5	PONNIYAR RIVER	125 km length of the river from Sathanur Dam at Lat 12°11'0.06"N, Lon 78°51'1.25"E to Cuddalore at confluence of Bay of Bengal at Lat 11°46'21.76"N, Lon 79°47'41.70"E
6	TAMARAPARANI RIVER:	64 kms length of the river from Sulochana Mudalir bridge, Tirunelveli at Lat 8°43'43.17"N, Long 77°42'53.94"E to confluence with Bay of Bengal near Punnaikayal at Lat 8°38'24.90"N, Long 78° 7'37.85"E
	CLUSTER-6	
1	West Coast Canal	160 kms length of the canal as extension of NW-3 towards north of Kottapuram - from Kottapuram at Lat 10°11'38.32"N, Long 76°12'4.39"E to Kozhikode at Lat 11°13'38.83"N, Long 75°46'43.90"E
2	ALAPPUZHA- CHANGANASSERY CANAL	28 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Changanassery Jetty at Lat 9°26'41.61"N, Lon 76°31'41.76"E
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	38 km from Boat jetty, Alappuzha at Lat 9°30'2.85"N, Lon 76°20'37.05"E to Athirampuzha market Lat 9°40'04"N, Lon 76°31'54"E
4	KOTTAYAM-VAIKOM CANAL	28 km from Kottayam, near Kodimatha at Lat 9°34'38.67"N, Lon 76°31'7.67"E to Vechoor joining National Waterway no. 3 at Lat 9°40'0.19"N, Lon 76°24'10.65"E
5	GURUPUR RIVER	10 km length of the river from confluence of Netravathi river at Lat 12°50'44.04"N, Lon 74°49'44.51"E to confluence of Mangalore Port Bridge at Lat 12°55'34.81"N, Lon 74°49'37.34"E

6	KABINI RIVER	23 km length of the river from Kabini Dam Lat 11°58'24.52"N, Lon 76°21'9.69"E to Beeramballi at Lat 11°56'9.55"N, Lon 76°14'17.58"E
7	KALI RIVER	54 km length of the river from Kodasalli Dam Lat 14°55'8.24"N, Lon 74°32'6.90"E to confluence of Kali river with Arabian Sea near Sadashivgad bridge at Lat 14°50'30.95"N, Lon 74° 7'21.32"E
8	NETRAVATHI RIVER	78 km length of the river from Netravathi Dam, Dharmsthala Lat 12°57'55.23"N, Lon 75°22'10.19"E to confluence with Arabian sea at Bengre Lat 12°50'42.73"N, Lon 74°49'28.86"E
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	23 km length of the river from Gangoli Port at Lat 13°38'1.30"N, Lon 74°40'8.43"E to Bridge at Badakere at Lat 13°44'50.01"N, Lon 74°39'15.13"E
10	SHARAVATI RIVER	29 km length of the river from Honnavar Port Sea Mouth at Lat 14°17'56.23"N, Lon 74°25'27.04"E to link at highway at Gersoppa Lat 14°14'14.73"N, Lon 74°39'6.15"E
11	UDAYAVARA RIVER	16 km length of the river from Arabian Sea Mouth at Malpe Lat 13°20'57.24"N, Lon 74°41'28.22"E to Bridge near Manipura Lat 13°17'32.70"N, Lon 74°46'25.56"E
	CLUSTER-7	
1	CHAPORA RIVER	33 kms length of the river from Bridge at State highway # 124 (1Km from Maneri village) Lat 15°42'47.31"N, Long 73°57'23.38"E to Confluence of Chapora river with Arabian Sea at Morjim Lat 15°36'33.27"N, Long 73°44'0.93"E
2	MAPUSA / MOIDE RIVER	27 kms length of the river (including Moide river) from bridge on NH17 at Mapusa Lat 15°35'20.79"N, Long 73°49'17.20"E to confluence point of Mapuca & Mandovi rivers at Porvorim Lat 15°30'20.01"N, Long 73°50'42.09"E
3	SAL RIVER	14 kms length of the river from Orlim Deusa Bridge at Lat 15°13'11.41"N, Long 73°57'29.77"E to confluence with Arabian Sea at Mobor Lat 15° 8'31.93"N, Long 73°56'59.89"E
4	AMBA RIVER	45 kms length of the river from Arabian Sea, Dharamtaar creek near village Revas at Lat 18°50'15.14"N, Long 72°56'31.22"E to a Bridge near Nagothane ST Stand at Lat 18°32'19.82"N, Long 73° 8'0.29"E
5	DABHOL CREEK/VASHISHTI RIVER	45 km length of the river from Arabian Sea at Dabhol Lat 17°34'51.33"N, Lon 73° 9'17.83"E to bridge at Pedhe Lat 17°32'39.45"N, Lon 73°30'35.56"E
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	145 km length of the waterway from Arabian Sea at Navi Mumbai Lat 18°55'49.78"N, Lon 72°53'21.67"E via Ulhas river to bridge on State Highway No.76 near Malegaon T. Waredi Lat 19° 2'38.20"N, Lon 73°19'53.79"E Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan Lat 19°14'6.39"N, Lon 73° 8'49.13"E to Kalyan Lat 19°15'35.03"N, Lon 73° 9'27.77"E Vasai Creek from Lat 19°18'53.50"N to Lon 72°47'30.18"E to Kasheli at Lat 19°13'22.84"N, Lon 73° 0'21.44"E
7	RAJPURI CREEK	31 km length of the river from Arabian Sea at Rajpuri Lat 18°18'3.15"N, Lon 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Lon 73° 6'45.35"E
8	REVADANDA CREEK / KUNDALIKA RIVER	31 km length of the river from Arabian Sea at Revadanda Lat 18°32'19.85"N, Lon 72°55'32.80"E to bridge on Roha-Astami Road near Roha Nagar Lat 18°26'31.50"N, Lon 73° 7'10.74"E
9	SAVITRI RIVER (BANKOT CREEK)	44 kms length of the river from Bridge near Sape at Lat 18° 5'54.11"N, Long 73°20'8.81"E to Arabian Sea at Harihareswar Lat 17°58'47.10"N, Long 73° 2'15.01"E
10	SHASTRI RIVER / JAIGAD CREEK	52 kms length of the river from Sangmeshwar at Lat 17°11'15.83"N, Long 73°33'2.57"E to confluence with Arabian Sea at Jaigad Lat 17°19'11.92"N, Long 73°12'39.30"E

CLUSTER-8		
1	MAHI RIVER:	248 kms length of the river from Kadana Dam at Lat 23°18'22.35"N, Long 73°49'37.45"E to confluence with Gulf of Khambhat near Kavi railway station at Lat 22°10'34.71"N, Long 72°30'36.31"E
2	NARMADA RIVER	227 km length of the river from Pandhariya at Lat 21°57'10.37"N, Lon 74° 8'27.46"E to confluence of Narmada with Arabian Sea at Gulf of Khambhat Lat 21°38'26.81"N, Lon 72°33'28.24"E
3	SABARMATI RIVER:	212 kms length of the river from Barrage near Sadoliya at Lat 23°26'49.66"N, Long 72°48'34.85"E to confluence with Gulf of Khambhat near Khambhat at Lat 22° 9'17.99"N, Long 72°27'27.81"E
4	TAPI RIVER:	436 kms length of the river from Hatnur Dam near Mangalwadi at Lat 21° 4'21.99"N, Long 75°56'44.88"E to confluence with Gulf of Khambhat (Arabian Sea) at Lat 21° 2'15.51"N, Long 72°39'29.63"E

#	River/Canal	State	Length (km)	Spacing (m)	Ave. width (m)
CLUSTER-2					
1	Dhansiri / Chathe	Assam	110	150	150
2	Lohit	Assam & Arunachal Pradesh	100	200	1000
3	Subansiri	Assam	111	200	1000
4	Tizu and Zungki	Nagaland	42	50	100
			363		
CLUSTER-3					
1	BIDYA RIVER	West Bengal	55	200	1500
2	CHHOTA KALAGACHI (CHHOTO KALERGACHI) RIVER	West Bengal	15	200	500
3	DVC CANAL	West Bengal	130	100	100
4	GOMAR RIVER	West Bengal	7	200	400
5	HARIBHANGA RIVER	West Bengal	16	200	2000
6	HOGLA (HOGAL)-PATHANKHALI RIVER	West Bengal	37	200	300
7	KALINDI (KALANDI) RIVER	West Bengal	8	200	500
8	KATAKHALI RIVER	West Bengal	23	200	200
9	MATLA RIVER	West Bengal	98	200	2000
10	MURI GANGA (BARATALA) RIVER	West Bengal	27	200	3000
11	RAIMANGAL RIVER	West Bengal	52	200	800
12	SAHIBKHALI (SAHEBKHALI) RIVER	West Bengal	14	200	300
13	SAPTAMUKHI RIVER	West Bengal	37	200	700
14	THAKURRAN RIVER	West Bengal	64	200	1000
			583		
CLUSTER-4					
1	Baitarni	Odisha	49	100	100
2	Birupa / Badi Genguti / Brahmani	Odisha	156	100	200
3	Budha Balanga	Odisha	56	100	100
4	Mahanadi	Odisha	425	200	500
			686		

		CLUSTER-5			
1	Pennar	Andhra Pradesh	29	100	400
2	Kaveri / Kollidam	Tamil Nadu	364	200	400
3	Palar	Tamil Nadu	141	200	500
4	Pazhyar	Tamil Nadu	20	50	100
5	PONNIYAR	Tamil Nadu	125	200	300
6	Tamaraparani	Tamil Nadu	64	150	300
			743		
		CLUSTER-6			
1	West Coast Canal	Kerala	160	50	100
2	ALAPPUZHA- CHANGANASSERY CANAL	Kerala	28	50	100
3	ALAPPUZHA- KOTTAYAM – ATHIRAMPUZHA CANAL	Kerala	38	50	100
4	KOTTAYAM-VAIKOM CANAL	Kerala	28	50	100
5	GURUPUR RIVER	Karnataka	10	100	400
6	KABINI RIVER	Karnataka	23	200	500
7	Kali	Karnataka	54	150	450
8	Netravathi	Karnataka	78	100	300
9	PANCHAGANGAVALI (PANCHAGANGOLI) RIVER	Karnataka	23	150	600
10	SHARAVATI RIVER	Karnataka	29	150	400
11	UDAYAVARA RIVER	Karnataka	16	100	250
			487		
		CLUSTER-7			
1	CHAPORA RIVER	Goa	33	100	250
2	MAPUSA / MOIDE RIVER	Goa	27	50	100
3	SAL RIVER	Goa	14	50	100
4	AMBA RIVER	Maharashtra	45	150	300
5	DABHOL CREEK/VASHISHTI RIVER	Maharashtra	45	150	400
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	Maharashtra	145	150	350
7	RAJPURI CREEK	Maharashtra	31	150	1000
8	REVADANDA CREEK / KUNDALIKA RIVER	Maharashtra	31	150	400
9	SAVITRI RIVER (BANKOT CREEK)	Maharashtra	46	150	400
10	SHASTRI RIVER / JAIGAD CREEK	Maharashtra	52	150	300
			469		
		CLUSTER-8			
1	MAHI RIVER	Gujarat	248	200	400
2	NARMADA RIVER	Maharashtra & Gujarat	227	200	500
3	SABARMATI RIVER	Gujarat	212	200	150
4	TAPI RIVER	Maharashtra & Gujarat	436	200	350
			1123		

Note:- Bathymetric and Topographical survey of specified Waterways is to be conducted for average width specified in above table. Average width of the Waterways is the average of narrow and wider portions of the river. For reservoir / ponding areas, only bathymetric survey of maximum 500m width in the deepest channel is to be carried out. Minimum 100m wide corridor is to be surveyed (only for rivers / canals having less than

60m water width). 100m wide corridor includes width of proposed Waterways. Bathymetric and topographic survey is to be carried out for 50m width on both side from the centre line of the channel.

a. Bathymetric and Topographical survey of proposed Inland Waterways is to be conducted for width specified in above table. Minimum 100m wide corridor is to be surveyed to assess the extent of land acquisition required for 100m wide corridor (100m wide corridor includes width of proposed Inland Waterways).
b. Cross-section sounding lines / leveling are to be run from bank to bank at spacing specified in above table, to identify the navigable channel.
c. Continuous soundings are to be taken by running the sounding boat at constant speed on the cross-section so as to get smooth contours. Intermediate line is to be run at bends, if the line spacing is more than the specified above.
d. For cross-sectional bathymetric survey more than 60m in proposed Inland Waterways, spot levels at line spacing x 20m length grid, on both banks should be taken. If Island or sandchur exist in the middle of the waterway, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
e. If bathymetry cross-section is limited up to 60 mts width in waterway, then Consultant has to cover 100m corridor including spot levels in line spacing x 20m length grid on both banks.
f. If bathymetry cross-sectional is limited up to 20 mts width in waterway, then Consultant has to run three (03) nos. longitudinal lines. One in centre and one each at equal interval (near the edges of water).
g. If bathymetry cross-sectional is limited up to 10 mts width in waterway, then Consultant has to run one (01) no. longitudinal line at centre only.
h. If Island or sandchur exist in the middle of the river, spot levels on the same spacing should also be taken and indicated in the charts along the same cross-section line.
i. Surveys in non-approachable areas are to be informed by the Consultant and joint inspection (Consultant's representative & Engineer-In-Charge or his representative) will be held to confirm the non-approachable areas.
j. The survey area may consist of canal sections, rivers, sea openings of different dimensions. Hence, Consultant has to inspect the area to be surveyed and satisfy themselves with respect to site conditions before submission of bid. However, variation in quantity will be considered only for length of the river/canal (longitudinal length).
k. The soundings are to be reduced to the chart datum/ sounding datum established at every gauge stations.

1.2.1.4 CURRENT VELOCITY AND DISCHARGE MEASUREMENT

a. The current velocity and discharge at every 10 km interval shall be observed once in a day during the survey period. Current velocity and discharge at every 10 km interval are to be measured only once at different depths while carrying out survey in that region.
b. Current meter measurement should be taken at 1m below water surface or 0.5d (if depth is less than 1m), where d is measured depth of water & values indicated in the report along with position.
c. Measurements at different depths may be taken by single equipment over three different time spans.
d. Measurement of current velocity at different depth is to be measured for at least 15

minutes or as per listed calibration period of the equipment, under use for this project.

e. Current velocity and discharge can also be measured with the help of ADCP during survey, at every 10km interval. Discharge can be measured either by ADCP or standard formulas.

1.2.1.5 WATER AND BOTTOM SAMPLES

a. Water and bottom samples are to be collected from the deepest route at every 10 km interval and are to be tested and the results/characteristics of the soil and the water are to be incorporated in the report. Soil sample can be collected by a grab and water sample at 0.5d (d-measured depth of water) by any approved systems. The following tests are to be carried out for Bottom samples:-

i) Grain size distribution
ii) Specific gravity,
iii) PH value
iv) Cu, Cc
v) Clay silt%
and Sediment concentration for Water Samples.

1.2.1.5 COLLECTION OF TOPOGRAPHICAL FEATURES

a. Photographs of the prominent features are to be taken and included in the report along with its position.
b. Permanent structures located within this corridor are also required to be indicated on the report & charts.
c. All prominent shore features (locks, bridges, aqueducts, survey pillars if available etc) and other conspicuous objects are to be fixed and indicated on the chart and included in the report.
d. Identify cross structures which are obstructing navigation.
e. Details (horizontal and vertical clearances above High Flood Level in non-tidal area and High Tide Level in tidal area) of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route are to be collected and indicated on the chart and also included in the report along with their co-ordinates and location.
f. Details of water intake/ structures are to be collected and shown on the charts and include in the report.
g. Availability of berthing place, existing jetty, ferry ghats, approach roads etc. are to be indicated on the charts and include in the report.
h. During the survey, conditions of the banks are also required to be collected. It is to be noted that banks are pitched (protected) or not protected. Estimate the length of bank protection, where banks erosion is taking place.
i. Positions and levels of corners of permanent structures within the corridor are to be physically surveyed and marked on survey charts.
j. Approachable roads / rails / places outside the corridor may be incorporated from Toposheets/Google Map/Google Earth.

1.2.1.6 SURVEY CHART PREPARATION

a. The survey chart is to be prepared on a scale of 1:1,000 for Waterways width less than 100m. On a scale of 1:2,000 for Waterways width between 100m to 300m. On a scale of 1:5,000 for Waterways width between 300m to 500m and On a scale of 1:10,000 for Waterways width more than 500m.

b. Contours of 0m, 1m, 2m, 3 m, 5m and 10 m are to be indicated on the charts with respect to Chart Datum / Sounding Datum.

c. Reduced spot levels w.r.to MSL to be indicted on the charts. Spot level values are to be given w.r.t. Mean Sea Level (MSL) & Soundings w.r.t. Chart Datum / Sounding Datum. A separate file (xyz) (soft copy only) is also to be created for spot levels w.r.t. Chart Datum / Sounding Datum for dredging calculation purpose.

d. On completion of the cross-sections, dredge channel is to be identified/ established by linking deepest soundings on the cross-sections. Dredging quantity is to be estimated for developing a navigational channel of

   i. dimension of 32m x 1.8m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is less than or equal to 100m).

   ii. dimension of 45m x 2.0m, with side slope of 1:5, w.r.t. chart datum/sounding datum (if channel width is more than 100m).

e. Dredging quantity is to be indicated in the report for per km length of the waterway.

f. Minimum & maximum reduced depth and length of shoal for per km length of the waterway is also to be indicated in the report.

g. Current meter measurement values shall be indicated in the report along with position.

h. The results/characteristics of the soil and the water are to be incorporated in the report.

i. Shallow patches /shoal and submerged sand-chur having less than 1.0 m depth, rocky outcrops, rapids and other navigational impediments are to be indicated on the charts.

j. A brief write up on condition of the locks, Sluice gates, Barrages, Dams etc. (if available) are also to be included in the report. Brief write up based on visual observation, photographs and information from State Irrigation Deptt. and local sources.

k. The chart shall also be suitably updated with prominent land features from the Topo-sheets/site. Available Survey of India (SOI) Topographic sheet will be shared with successful Consultant on receipt of Undertaking. Satellite imageries are not available with IWAI for the designated area. Route map and survey plan will be provided by IWAI to the successful Consultant.

l. All raw data and processed data of Automatic Hydrographic Survey System are required to be submitted. Standard procedure is to be adopted for data processing. All RAW, EDIT, SORT and field data are required to be submitted by the Contractor.

m. All surveyed field data including leveling data (csv file) are required to be submitted.

n. All position data of ground features, waterway structures are to be submitted in both hard copies and soft copies.

1.2.2 TRAFFIC SURVEY & TECHNO ECONOMIC FEASIBILITY

This is a detailed study to make a forecast of the traffic prospects to facilitate the projection of the most promising route for waterway transport and to assess the quantum of traffic of vessels/cargo on that route. This survey is to be under-taken in conjunction with Reconnaissance and Hydrographic surveys so that the Techno Economic feasibility and costs of the alternative proposals can be taken into account while formulating the recommendations.

Modality of conducting traffic survey shall be based on industrial surveys and a traffic projection for a horizon period (say 5, 10, 15 and 20 years) has to be forecasted based on standard methods. Divertible traffic to IWT is also to be assessed.

1.2.3 DETAILED PROJECT REPORT

The scope of works is as follows:

a. Assessment of the morphological, hydrological, hydrographical conditions, and operation and maintenance requirements of the proposed waterways to identify works in sufficient details that are required in respect of:
   - River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation.
   - Navigational aids and communication facilities.
   - Improvements with reference to horizontal and vertical clearances required on the existing or proposed cross structures such as bridges, power cables, locks etc.

b. Geo-tech investigation will be carried out by the consultant as per standard guidelines of Geological Survey of India, Government of India.

c. To conduct necessary investigations for the preliminary design, to ensure a coordinated development to cover waterways engineering works and structures, waterway crossing, navigational structures, riverine ports and terminals, land and rail access.

d. Prepare preliminary engineering designs, drawings and estimates for the optimum structure of river training and bank protection measures and navigational aids to develop and maintain a navigable channel for the waterway system in an EPC mode.

e. For preliminary engineering designs, the data about soil characteristics shall be collected from the local sources based on the structures constructed nearby. In case of critical structures, consultant can suggest that detailed soil investigation including borehole tests etc.

f. River training/bank protection works particularly for those stretches where either the channel is narrow and needs to be widened by dredging or where it is anticipated that the bank can erode due to continuous movement of barges.

g. Identify the location and carry out preliminary designs of cargo terminals and river ports to handle the anticipated cargo as duly updated.

h. Prepare a realistic construction schedule for the whole project indicating the priority of different components of the project. The phasing of expenditure is also to be worked. Also suggest phased programs of construction including riverine terminals and ports which shall be fully integrated with the existing and planned irrigation and hydropower facilities.

i. Prepare cost estimate for various possible alternatives for the entire proposed infrastructure, handling, and other allied facilities. While comparing the different alternatives, the cost and economy factors shall also be evaluated. The most suitable alternative recommended shall have detailed costing for all the components of the project. The Consultant is to propose the River conservancy including river training, bank protection, dredging etc. needed for shipping and navigation. Alternate possible methods for water augmentation are also to be suggested in detail. FIRR, EIRR, NPV and SWOT analysis are also to be carried out by the Consultant.

j. Assess the environmental impacts due to these development works and suggest suitable environmental management plan (EMP) to mitigate the adverse impacts, if any, including its cost. Flood Plain specialist will be responsible to assess the Environmental Impact and preparation of EMP. Consultant has to identify the Authorities who will give the clearances for EIA/EMP. Consultant will not be required to take clearances from these identified Authorities.

k. Suggest horizontal and vertical clearances to be provided on cross structure such as bridges, power cables, locks etc. for commercial viable navigation in present as well as in future. For this, IWAI guidelines Section-IV, may also be referred to.

2.0 PERIOD OF SERVICES

Consultant may associate with sub Consultant(s) to enhance their expertise. The applicant shall submit a Memorandum of Understanding (MOU) with the Sub Consultant regarding the role and responsibilities of the Associate Company along with the proposal.

2.1 TIME SCHEDULE/SUBMISSION OF REPORTS:

(a) The time of completion of various sub-stages of the assignment will be as given below:

			Cluster -2	Cluster -3	Cluster -4	Cluster -5	Cluster -6	Cluster -7	Cluster -8
	Sl. No	**Activity**	**Time in weeks****						
Stage-I	a)	Mobilization of the Team and submission of Inception Report (2 copies)	6	9	10	11	8	8	15
	b)	Submission of Draft Feasibility Report (3 copies)	9	12	13	14	11	11	18
	c)	Comments from IWAI	11	14	15	16	13	13	20
	d)	Presentation and Submission of Final Pre-feasibility Report (3 copies)	13	16	17	18	15	15	22
Stage-II	a)	Acceptance of Stage-I report and go ahead for Stage-II by IWAI	15	18	19	20	17	17	24
	b)	Submission of Hydrographic Survey Charts and report (3 copies)	23	30	29	31	24	26	38
	c)	Submission of Draft Detailed Project Report (3 copies)	31	38	37	39	32	34	46
	d)	Receipt of comments of IWAI on Draft DPR.	33	40	39	41	34	36	48
	e)	Submission of Final Detailed Project Report (10 copies) after incorporating final comments of IWAI.	39	46	45	47	40	42	54
reckoned from the date of signing of Contract or 15 days from the date of issuance of work order, whichever is earlier.									

NOTE: - The consultants are required to submit the following outputs in Stage-II for all the clusters in the enclosed standard templates:-

vi) Traffic Template: at Annex-IV
vii) Project Costing Template: at Annex-V
viii) Financial Evaluation Template: at Annex-VI
ix) Economic Evaluation Template: at Annex-VII
x) Environmental & Social Screening Template: at Annex-VIII

3.0 Minimum Qualification of Key Professionals

Sl. No	Key Professionals	Qualification Criteria
1.	**Waterway Expert (Team Leader)**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Higher professional qualification in Port and Harbor Engineering/Structural Engineering/Geo-technical Engineering will be preferred. **Professional Qualification:** • Minimum 15 years' experience in planning, design, construction, preparing Feasibility Report/Detailed Project Report for various waterway/port/river front development/river training works, terminals, trade facilitations and other infrastructures in different natural and operational conditions with at least 5 years in a reputed firm of consultants.
2.	**Port planning & Infrastructure Specialist**	**Educational Qualification:** • Should be Graduate in Civil Engineering. Postgraduate training/ studies in Port & Harbor Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in Port planning, Port infrastructure Planning and development of physical facilities for port operations. Should be well conversant with different types of port structures and other physical facilities required for the provision of various port services efficiently. Should preferably have experience/ exposure of constructing several modern ports.
3.	**Remote Sensing/GIS Expert**	**Educational Qualification:** • Should be Graduate in Engineering/Geology. Higher professional qualification in Remote Sensing/ Geoinformatics will be preferred. **Professional Qualification:** • Minimum 10 years' experience in waterway/port/river mapping and a demonstrated proficiency in using the GIS software. Working knowledge of spatial data formats and related metadata issues. Working knowledge of web mapping applications, such as Google Earth/Bhuvan.
4.	**Floodplain Specialist**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher professional qualification in Floodplain Management/ Hydrology/Water Resource Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in Floodplain Management. Working

Sl. No	Key Professionals	Qualification Criteria
		knowledge of water and/or wastewater modeling is desirable.
5.	**Hydrographic Expert**	**Educational Qualification:** • Should be ITI in Survey/Diploma in Civil Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 8 years' experience in conducting hydrographic surveys, investigations and measurements, bathymetric surveys/Topographic Survey in a variety of geographical locations and natural.
6.	**Soil Engineer/ Foundation Engineer**	**Educational Qualification:** • Should be Graduate in Civil/Environmental Engineering. Higher qualification in Marine Structure/Geotechnical Engineering will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of the soil investigation, reclamation work, soil improvement and will be associated in foundation design. He will also be responsible for preparation of cost estimates/BOQ.
7.	**Traffic Surveyor**	**Educational Qualification:** • Should be Graduate in Engineering. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of traffic survey of waterways/river/canal or similar facilities.
8.	**Transport Economist**	**Educational Qualification:** • Should be Graduate in transport planning management, transport economics, transport/road/rail/Civil engineering/MBA or equivalent qualifications. Higher qualification in relevant field will be preferred. **Professional Qualification:** • Minimum 10 years' experience in related field. He should have experience of estimating transport investments and implementing transport programs.

NOTE 1:- If the Key Personnel proposed in the CV does not fulfill the minimum academic qualification, the overall score of his CV will be evaluated as zero. All such Key Personnel (whose CV scores less than 75% or who does not fulfill the minimum qualification) will have to be replaced by the firm. H-1 firm will be intimated for replacement of such personnel and work will be awarded after receipt of CV's fulfilling the tender criteria.

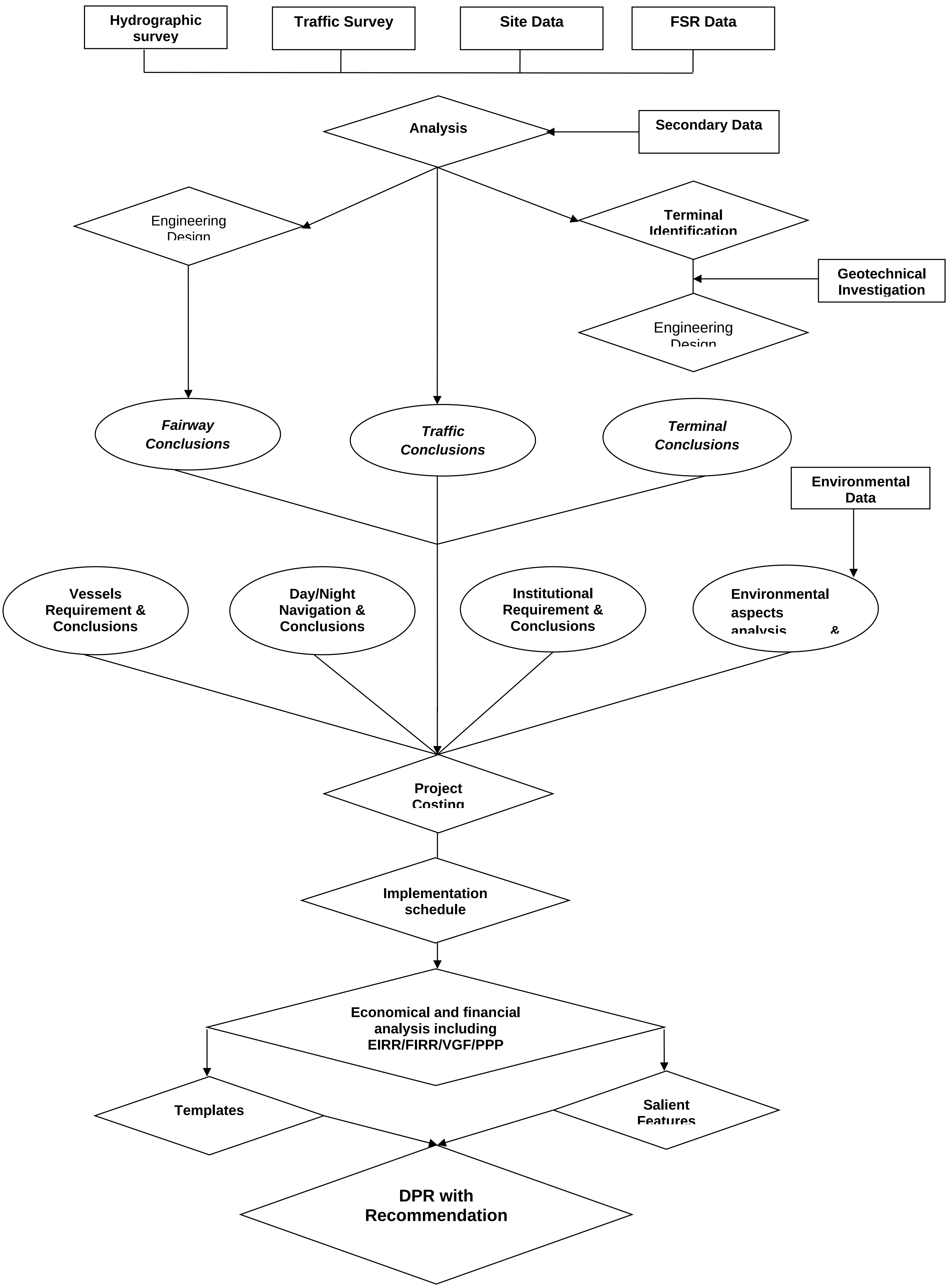
Note 2:- IWAI may call each key personnel of the preferred Consultant at the time of award of work, at the cost of Consultant.

Note 3: - In case during interaction with the key personnel, it is found that the key personnel proposed is un-suitable for the assignment position, his replacement by equivalent or better shall be provided by the consultant. The key personnel with such un-suitable CV shall not be considered in any future bids for that position for two years. No deduction for such replacement, who are not found suitable during interaction shall be made.

Note 4:- Since two clusters only will be awarded to one bidder, the same CVs cannot be proposed for at least two clusters. The same CV's can be proposed if the bidder is bidding for more than two Clusters.

Note 5:- Role and responsibilities of the Key Professional shall be as per the requirement of the project and Terms of Reference of the tender document and the same has to be access by prospective bidder.

ANNEXURE 1.2 – SEQUENTIAL APPROACH TO THE PROJECT IN SCHEMATIC FORM



ANNEXURE 3.1 – MOM DATED 07.01.2022 - CARGO TRAFFIC ESTIMATION DATA BY DIRECTOR OF PORTS & IWT, BAITHKOL KARWAR

भारतीय अन्तर्देशीय जलमार्ग प्राधिकरण
(पोत परिवहन मंत्रालय, भारत सरकार)
मुख्यालय : ए–13, सैक्टर–1, नौएडा–201 301, (उ० प्र०)
INLAND WATERWAYS AUTHORITY OF INDIA
(Ministry of Shipping, Govt. of India)
Head Office : A-13, Sector-1, Noida-201 301 (U.P.)
Website : www.iwai.gov.in | www.iwai.nic.in
Tel. : +91-120-2544036, 2543972, 2527667, 2448101 Fax : +91-120-2544009, 2544041, 2543973, 2521764

No. IWAI/NNW/GoKN/01/2020-21 Dated 31.01.2022

To,
M/s Tractebel Engineering Pvt. Ltd.
2nd Floor, Building no. 10C,
DLF Cyber City
Gurgaon - 122 002 (Haryana)

Sub: Updation of DPR for river Gurupur (NW-43) and river Netravathi (NW-74) based on the inputs received from Director of Ports & IWT Baithkol, Kanwar – reg.

Ref.: Consultancy services for preparation of 2nd stage Detailed Project Report of Cluster - 6 of NWs Gurupur river (NW-43) & Netravathi river (NW-74).

Sir,

Reference to the subject matter, it is to inform that M/s Tractebel Engineering Pvt. Ltd. have prepared the DPR for river Gurupur (NW-43) and river Netravathi (NW-74) & submitted to IWAI and the same is under finalization. It is for information that the Govt. of Karnataka has indicated that more cargo potential exists in the river Gurupur (NW-43) & river Netravathi (NW-74) and hence the Competent Authority has directed to revise the DPR on above rivers taking the inputs of Director of Ports & IWT, Kanwar. A copy of the minutes of meeting held on 07.01.2022 by Secretary, MoPS&W and a copy of the letter dated 12.01.2022 received from the Director of Ports & IWT, Karwar are enclosed herewith for ready reference and record.

In this regard, I am directed to request you to examine the DPR study conducted on river Gurupur (NW-43) and river Netravathi (NW-74) and update / revise the same incorporating the cargo inputs of the Director of Ports & IWT, Kanwar and submit to IWAI at an early date.

This issues with the approval of Member (Tech.) vide Note#9 of e-office file no. IWAI/NNW/GoKN/01/2020-21.

Yours faithfully,

(S.V. K Reddy)
Chief Engineer (Technical)
Email.: ce.iwai@nic.in

Encl.: As above.
Copy to:
1. The Hydrographic Chief, IWAI, Noida.
2. The Director, IWAI, Kochi – for information and further Co-ordination.

Copy also for information to:
1. PPS to Chairman, IWAI, Noida.
2. PS to Vice Chairman, IWAI, Noida.
3. PA to Member (Tech.), IWAI, Noida.
4. PA to Member (Fin.), IWAI, Noida.

Email

Ashutosh Gautam

Fwd: Minutes of the Meeting held on 07 January 2022 through VC Mode under Chairmanship of Secretary, Ministry of Ports, Shipping and Waterways on Proposal of Government of Karnataka for development on Gurupur and Netravati Rivers-Reg.

From : Sanjay Bandopadhyaya <chairman.iwai@nic.in> — Mon, Jan 17, 2022 05:14 PM

Subject : Fwd: Minutes of the Meeting held on 07 January 2022 through VC Mode under Chairmanship of Secretary, Ministry of Ports, Shipping and Waterways on Proposal of Government of Karnataka for development on Gurupur and Netravati Rivers-Reg. — 2 attachments

To : Jayant Singh <vc.iwai@nic.in>, Ashutosh Gautam <mt.iwai@nic.in>

Cc : S.V.K. Reddy, Chief Engineer, IWAI, Noida <ce.iwai@nic.in>

Sanjay Bandopadhyaya, IAS
Chairman,
Inland Waterways Authority of India,

A-13, Sector-01 Noida-201301 (U.P.)
Ph:0120-2543972
Fax:0120-2543973

Mail: chairman.iwai@nic.in
sanjay.bando@gov.in

CE(T)

TA(T) For y' pleas. 21/1/2022 DD (Tech) AG 18/1

As per x of the minutes, we may ask our consultants for preparation of DPR for Gurpur & Netravati rivers to update the DPR. Draft please. 20/1 CE(Tech)

Begin forwarded message:

From: Sagarmala Cell <sagar.mala@gov.in>
Subject: Minutes of the Meeting held on 07 January 2022 through VC Mode under Chairmanship of Secretary, Ministry of Ports, Shipping and Waterways on Proposal of Government of Karnataka for development on Gurupur and Netravati Rivers-Reg.
Date: 17 January 2022 at 17:01:03 IST
To: "R Karikal Valaven I A S" <prlsecy_ii@ap.gov.in>,"Sanjay Bandopadhyaya" <chairman.iwai@nic.in>,ceokmb2019@gmail.com
Cc: "Office of Secretary Ports Shipping and Waterways" <secyship@nic.in>,"Bhushan Kumar" <bhushan.k@gov.in>,"Bhushan Kumar" <jssm-ship@gov.in>,"VINAY PRAJAPATI" <vinay.prajapati@gov.in>,"H Verma" <h.verma@nic.in>,"SANJAY Kumar" <sanjay.kumar38@nic.in>,"Himanshu Johri" <himanshu.johri@gov.in>,sagarmalapmt@gmail.com

Sir,

Please find enclosed OM dated 17-01-2022 on the subject mentioned above for further necessary action.

Regards,

450/m(T) 18/1/2022

for Director
Ministry of Ports, Shipping & Waterways
Sagarmala
Tel/Fax-23718390

747/CE(T) 2/1/22

P2-25021/31/2021-SM(e349104)
Government of India
Ministry of Ports, Shipping & Waterways
(Sagarmala Cell)

3rd Floor, PTI Building,
Parliament Street,
New Delhi – 110001
Dated the 17th January, 2022

OFFICE MEMORANDUM

Sub:- Minutes of the Meeting held on 07 January 2022 through VC Mode under Chairmanship of Secretary, Ministry of Ports, Shipping and Waterways on Proposal of Government of Karnataka for development on Gurupur and Netravati Rivers-Reg.

The undersigned is directed to forward herewith approved Minutes of the Meeting held on 07 January 2022 through VC Mode underChairmanship of Secretary, Ministry of Ports, Shipping and Waterways on Proposal of Government of Karnataka for development on Gurupur and Netravati Rivers for information and necessary action.

17/01/2022

(Sanjay Kumar)
Under Secretary to the Govt. of India
Tele: 011-23714715
email: sanjay.kumar38@nic.in

To,
1. Additional Chief Secretary, IDD Dept., Govt. of Karnataka
2. Chairman, IWAI
3. CEO, Karnataka Maritime Board

Copy to:-
1. PPS to Secretary (PSW)
2. PPS to Joint Secretary (SM)
3. PS to Dir(SM)/ DS(SM)
4. Sagarmala PMT.

Minutes of the Meeting held on 07 January 2022 through VC Mode under Chairmanship of Secretary, Ministry of Ports, Shipping and Waterways on Proposal of Government of Karnataka for development on Gurupur and Netravati Rivers.

List of Participants is at Annexure.

1. The Secretary (PSW) welcomed all the participants present during the meeting and informed that the proposals received from the Government of Karnataka (GoK) are under active consideration in the Ministry but there is a need to create synergies between the individual projects. Further it was stressed that expenditure on projects should given measurable outcomes and adherence to timelines.

2. Additional Chief Secretary (ACS) to Government of Karnataka gave a presentation covering the landscape of area and details of the 7 (seven) projects proposed for development on Gurupur and Netravati Rivers. The following points were discussed during the presentation:

i. Chairman, IWAI informed that studies were conducted for Gurupur and Netravati River and they were not found feasible for cargo and tourism. As the study has become outdated, further studies may be carried out to determine the feasibility as on date. IWAI will update these studies. Government of Karnataka may share the relevant data with IWAI.

X

ii. In response to query on outcome of the projects, ACS, Ports Department, Govt. of Karnataka informed that Development of Waterway on Gurupur River (10 km, Project No. 2) and Enhancement of Road Connectivity to Old Mangalore Port (Project No. 4) will lead to decongestion of Mangalore City by rerouting the cargo which normally comes through city, through waterway and enhanced road. He further informed that there are two (2) ongoing projects (dredging and berthing facilities) on the south side of Gurupur river and the above-mentioned projects will add to the outcome of these projects.

iii. ACS further explained that development of dedicated jetty for Lakshadweep (Project No. 3) would enhance cargo and passenger movement from Lakshadweep which is currently being done from Old Mangalore Port. He further informed that this project may have multiple stakeholder involvement including administration of UT of Lakshadweep.

iv. The projects including island development (Project No. 1), installation of floating jetty for seaplanes (Project No. 6), development of Marina (Project No. 5), development of ancillary infrastructure (Project No. 7) would aid in coastal community development through enhanced tourism and associated employment opportunities.

v. Chairman, IWAI suggested that prioritization of projects may be done in the following sequence i.e. cargo, passenger and then tourism.

vi. The Chair emphasized that there was a need to integrate projects which are currently under implementation with the new proposals, so that measurable impact is observed on completion of the projects. He suggested that project proposals may be consolidated in categories according to outcomes. Project number 2, 4 and 7 may be clubbed in one category for decongestion of the city roads. Further, projects 1,3,5 and 6 may be clubbed for promotion of Tourism. The consolidated projects proposal should provide a clear common outcome with timeline after agreement of stakeholders.

3. After detailed discussions, it was decided that GoK may examine the suggestions provided in the meeting and send revised proposal where projects are clubbed into categories. Out of the 93 projects, revised proposal for the projects for development on Gurupur and Netravati rivers may be given preference. The Ministry would examine the proposals and approve the projects in groups. The appraisal may include taking inputs/comments/ suggestions from Development wing and IWAI may be considered by a committee (similar to SFC) where suggestions from all stakeholders are duly considered in the approval process.

4. The meeting ended with vote of thanks to the Chair.

*****

ANNEXURE

List of Participants

1. Dr. Sanjeev Ranjan, Secretary, MoPSW
2. Shri Bhushan Kumar, Joint Secretary, Sagarmala, MoPSW
3. Shri Sanjay Bandopadhyay, Chairman, Inland Waterways Authority of India (IWAI)
4. Shri B. H Anil Kumar, Additional Chief Secretary to Government of Karnataka
5. Shri Kapil Mohan, Chief Executive Officer, Karnataka Maritime Board
6. Captain C. Swamy, Director of Ports, Government of Karnataka
7. Shri S.V.K Reddy, Chief Engineer, IWAI
8. Shri Hemant Verma, Deputy Secretary (Sagarmala), MoPSW
9. Shri Sanjay Kumar, Under Secretary (Sagarmala), MoPSW
10. Sagarmala PMT

ENCLOSURE-2:

Email

Ashutosh Gautam

Re: Development of waterways in Karnataka – Request to furnish clarifications / details of cargo / passenger traffic on other NWs for development – reg.

From : directoratep@karnataka.gov.in

Wed, Jan 12, 2022 06:50 PM

1 attachment

Subject : Re: Development of waterways in Karnataka – Request to furnish clarifications / details of cargo / passenger traffic on other NWs for development – reg.

To : Ashutosh Gautam <mt@iwai.gov.in>

Cc : S.V.K. Reddy, Chief Engineer, IWAI, Noida <ce.iwai@nic.in>, V Murugesan <vmurgeshan@iwai.gov.in>, Satish kumar <satish.kr24@gov.in>, swamyc112@gmail.com, piwtdev wks <piwtdev.wks@gmail.com>, sameep@blackbrix.com, vasudeva@blackbrix.com, tarkesh phayde <tarkesh.phayde@gmail.com>, idd gok <idd.gok@gmail.com>

Dear Sir,

Please find attached Letter No.PIWT-36/DEV-I/2020 dated 12.01.22 regarding the traffic projections and other relevant data requested by your kind office as part of the discussion held on 05.01.22 at Inland Waterways Authority of India, Noida for the project: **Development of Waterways on Gurupur (NW-43) & Netravathi River (NW-74), Karnataka.**

We request you to expedite the process of approval and funding of the Projects submitted to IWAI by Government of Karnataka.

Warm Regards,
Director of Ports,
Infrastructure Development Ports & Inland Water Transport
Government of Karnataka

From: Director
Sent: 29 November 2021 12:39:36
To: Ashutosh Gautam
Cc: S.V.K. Reddy, Chief Engineer, IWAI, Noida; V Murugesan; Satish kumar; swamyc112@gmail.com; piwtdev.wks@gmail.com; sameep@blackbrix.com; vasudeva@blackbrix.com; tarkesh.phayde@gmail.com; idd.gok@gmail.com
Subject: Re: Development of waterways in Karnataka – Request to furnish clarifications / details of cargo / passenger traffic on other NWs for development – reg.

Respected Sir,

This mail is with regards to the trailing mail sent by IWAI dated 08.11.2021.
The response to the Request for furnishing clarifications/ details of cargo/ passenger traffic is attached with Annexure is attached herewith.

This email may kindly be acknowledged.

Warm Regards,
Director of Ports,
Infrastructure Development Ports & Inland Water Transport, Karwar
Government of Karnataka

4(c-7)/ddt 23/1

TA(T) pl. put up. 27/11/2021

25/1

DD (Tech)

As per annexure given by chairman T sec (shipping), update DPR to be updated on the above 2 R project

Copy of the letter sent to IWAI consultant for updation of DPR

796/CE(T) 23/11/22

TA(T) DD(T) 27/11/2022

CE (Tech)

Dir (T&L)

From: V Murugesan <vmurgeshan@iwai.gov.in>
Sent: 08 November 2021 16:28
To: Director; Satish kumar
Cc: Ashutosh Gautam; S.V.K. Reddy, Chief Engineer, IWAI, Noida
Subject: Development of waterways in Karnataka – Request to furnish clarifications / details of cargo / passenger traffic on other NWs for development – reg.

Sir,
Reference above, I am directed to forward the scanned copy of the letter for kind perusal.

Yours faithfully,

(V Murugesan)
Deputy Director (NW.3)
Inland Waterways Authority of India
(Ministry of Shipping, Govt. of India)
A-13, Sector-1, Noida - 201 301 (U.P.)
Mobile: +91 94460 49765
Off Tel: +91 120 2521704

Azadi Ka Amrit Mahotsav

Letter to IWAI 12012022 - Traffic Projection and other relevant Requested by IWAI on 05.01.22.pdf
2 MB

GOVERNMENT OF KARNATAKA
[Infrastructure Development, Ports & Inland Water Transport Department]

No.PIWT-36/DEV-I/2020

Office of the
Director of Ports & IWT
Baithkol, Karwar-581302
Dated: 12.01.2021

To,
Chairperson,
Inland Waterway Authority of India (IWAI),
Ministry of Ports, Shipping & Waterways (MoPSW),
Government of India

Greetings,

Sub: Traffic Projection and other relevant Data Requested by IWAI on 05.01.22

*****

Further to the discussion held on 05.01.22 in your kind office at the Inland Waterways Authority of India, Noida, please find the details with respect to the project **Development of Waterways on Gurupur (NW-43) & Netravathi River (NW-74), Karnataka**, as requested by you:

NO source of date is indicated.

Cargo Traffic Estimation *From the Year of Operation

Year	Gurupur (MT)	Netravati (MT)	Total (MT)	Potential Daily Traffic (MT)
	Cargo Traffic Estimation			
2019	70,000	-	70,000	192
2020	71,918		71,918	197
2025	82,326	-	82,326	226
2030	2,68,128	5,40,397	8,08,524	2,215
2035	3,06,930	6,18,601	9,25,531	2,536
2040	3,51,348	7,08,122	10,59,470	2,903

27/1/2022
DD(T)

..2...

Tele No 08382-221035/221494
Website www.karnatakaports.org
Fax : 08382-221035/228918
E-mail: piwtdev.wks@gmail.com / directoratep@Karnataka.gov.in

Passenger Traffic Estimation for Gurupur & Netravati Rivers

Year	Potential Traffic
2011	33,65,378
2020	38,34,389
2025	41,22,638
2030	44,32,557
2035	47,65,774
2040	51,24,040

The following broad details are attached in the Detailed Project Report for easy perusal of your kind self:

1) **Cargo Traffic -**
The Traffic Study for the catchment of Gurupur and Netravathi River is detailed in the Chapter-4 of the DPR submitted from the **Page No: 55 – 62.**
Further the Cargo Traffic Estimation for both the river is summarised in the Table at **Page No: 62.**

2) **Passenger Traffic -**
The Passenger Traffic Study for the catchment of Gurupur and Netravathi River is detailed in the Chapter-4 of the DPR submitted from the **Page No: 63 – 65.** The Passenger Traffic Estimation for both the river is summarised in the Table at **Page No: 65.**
In addition, three Ferry Lines are operational currently in the Gurupur Stretch and 5 Ferry Lines are operational along Netravati River, details are in the Detailed Project Report from **Page No: 48-49**

3) **Synergy with Mangalore Smart City -**
The Department of Ports & IWT is in active talks with the Mangalore's Smart City for Integration of Development of Jetty with Water Taxi Project envisaged by the Smart City

4) **Capital Expenditure** -
The Capex Expenditure for the Project is summarized in the **Page No: 114** with the Detailed Breakup of Capex at **Page No:118.**

5) **Terminal Design –**
The Terminal Design is detailed out in the Chapter 6.2 from **Page No: 86-91.**

...3...

Fax : 08382 -221035/228918
Tele No. : 08382-221035/221494
Website : www.karnatakaports.org
E-mail: piwtdev.wks@gmail.com / directoratep@Karnataka.gov.in

6) **General Information Summary** –
The Table in Chapter 10 at **Page No: 123-125** summarizes the information of Infrastructure along the River Length, Cargo Traffic, Passenger Traffic, Operational Ferry Service and other Technical Observation and Inferences.

We request you to expedite the process of approval and funding of the Projects submitted to IWAI by Government of Karnataka.

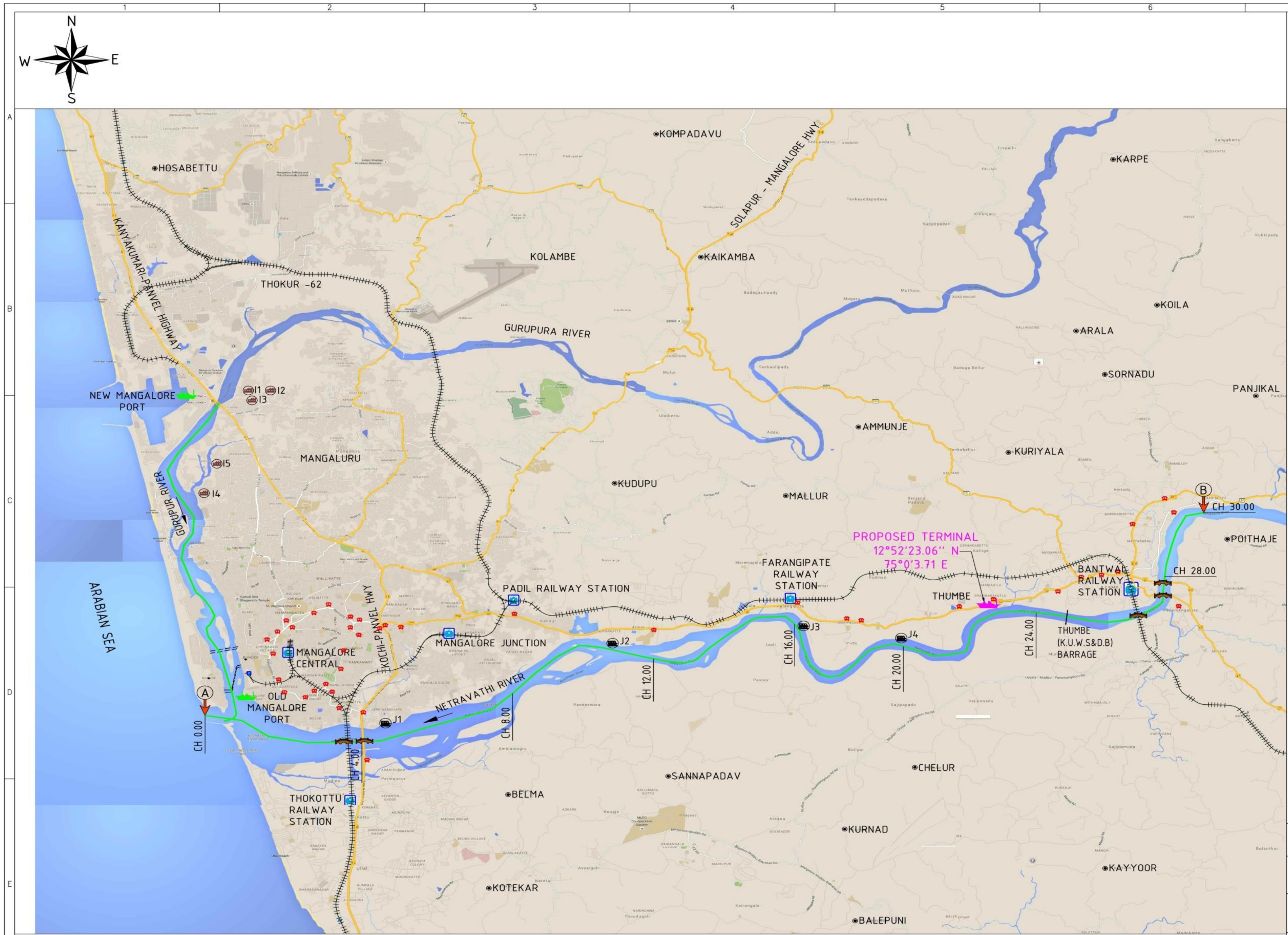
Warm Regards,

12/1/22

Director of Ports,
Infrastructure Development,
Ports & IWT Department,
Government of Karnataka

Tele No. : 08382-221035/221494
Website : www.karnatakaports.org
Fax : 08382 -221035/228918
E-mail: piwtdev.wks@gmail.com / directoratep@Karnataka.gov.in

ANNEXURE 4.1 – LAYOUT MAP SHOWING EXISTING JETTIES AND INDUSTRIES IN THE VICINITY OF NETRAVATHI RIVER



LEGEND

	BARRAGE
	PROPOSED TERMINAL
	PORT
	BRIDGE
	INDUSTRY
	PLACE NAME
	JETTY
	RAILWAY STATION
	BUS STOP
	NATIONAL/STATE HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	STUDY STRETCH
	RAILWAY LINE

NETRAVATHI RIVER DETAILS

A	START POINT FROM ARABIAN SEA MOUTH AT BENGRE LAT. 12°50'44.6904" N LONG. 74°49'33.3734" E
B	END POINT NEAR BANTWAL LAT. 12°53'53.50" N LONG. 75°2'57.30" E

TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'B' 30.00 Km

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

SCALE 0 2.0 5.0KM

LIST OF NETRAVATHI JETTIES

SL.	DESCRIPTION	SYMB.
1	JEPPINAMOGARU JETTY	J1
2	ADYAR - PAVOOR JETTY	J2
3	FARANGIPETE JETTY	J3
4	THUMBE JETTY	J4

EXISTING INDUSTRY OF NETRAVATHI RIVER

SL.	DESCRIPTION	SYMB.
1	BASF INDIA LIMITED	I1
2	M/S MANGALORE REFINERY & PETROCHEMICALS LTD.	I2
3	BAIKAMPADY	I3
4	MANGALORE CHEMICALS & FERTILIZERS	I4
5	KUDREMUKH IRON ORE PROJECTS	I5

TITLE: LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF NETRAVATHI RIVER

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT: CONSULTANCY SERVICES FOR PREPARATION OF SECOND STAGE DPR OF CLUSTER -6 OF NATIONAL WATERWAYS

PROJECT NO. P.0010256

TRACTEBEL ENGIE

ANNEXURE - 4.1

ANNEXURE 4.2 – SUMMARY OF INTERVIEWS

Industry/Port	Contact Person	Designation
NMPT	Y.R. Belagal/ J.S. Manjunatha	Traffic Manager/ Asst. Traffic Manager
OMPT	Gouse Ali	Port Conservator
Aspinwall & Co. Ltd.	Shekhar Pujari	General Manager
MCF	K. Prabhakar Rao	Director, Works
KIOCL	Govind Raju Bhatt	Joint General Manager
HPCL	Rajeev Hagargi/ Rakesh Agrawal	Chief Installation Manager/ Joint Director (MO)
BASF	Fredrick Lobo	Manager- P&A, Transportation

Gurupur River

- The ferry owners at Bengre Ferry Line provided the information about the ferry facilities at Gurupur river. There is a Motorboat facility for passenegers to cross the river.
- Ferry charge is INR 5 per passenger.
- Ferry operator at Bengre Ferry Line provided the information that approx. 1,000-person travel by ferries everyday.

New Mangalore Port

Name: Mr. Y. R. Belagal/ J.S. Manjunatha

Designation: Taffic Manager/ Asst. Traffic Manager

- Mr. Belagal provided information that the proposed waterway may not interest nearby industries because it is commercially not viable.
- Mr. Belagal gave the information that there is sudden gradient in Netravathi river, which would make it difficult for cargo movement. Ghat near Mangalore has an elevation of 850 m, which makes it difficult for vehicles to move; however, industries would not be interested to use waterways.
- Cargoes from NMPT generally moves towards northern side.
- HPCL uses pipeline for transporting liquid cargo from Mangalore to Bangalore. Their cargo moves majorly in two routes- Mangalore to Hassan and Mysore to Bangalore.
- Coal is transported towards North Karnataka. Automobiles, Food and Machinery also are transported to the same destination.
- There exist 2 cement plants for local distribution, Ambuja Cement and Ultratech cement.

- Container traffic mostly originates from Hassan, Mysore, Chikamangalur, Shimogga and Davanagere. Coffee traffic comes from Hassan and Mysore. Cashewnut traffic originates from Africa and processed in Karnataka.

Old Mangalore Port

Name: Mr. Gouse Ali

Designation: Port Conservator of Old Mangalore Port

- Mr. Gouse Ali, Port Conservator of Old Mangalore Port, provided information that cargo & passengers move from OMPT to Lakshadweep.
- Mr. Ali shared the cargo traffic data of OMPT.

Industries

Aspinall & Co. Ltd. (Logistics)

Name: Mr. Shekhar Pujari

Designation: General Manager

- Mr. Pujari who is also president of the Association of New Mangalore Port Stevedores, gave information about container handling at NMPT. According to him, container cargo mainly comes from Hassan by road and destined for Tuiticorin.
- In 2015, total container (fully loaded) handling at NMPT was 54,936 TEU, out of which 33,000 TEU containers were exported.
- In Fy 16, total Import container volume was 38,098 and export volume was 37,611 TEU (Total- 75,709 TEU). However, the actual container volume in the same financial year was 30,983 TEU import and 21,953 TEU export (Total- 52,936 TEU). The actual volume varies from Fy 16 total import- export container volume because the actual volume excludes empty containers.
- According to him, in Fy 15, coffee production in Mangalore region was 340,000 tonnes, out of which 100,000 tonnes is consumed locally. 240,000 tonnes coffee is exported from NMPT.
- Mr. Pujari also shared information about an upcoming PTA (Purified Terephthalic Acid) plant of JBF Petrochemicals Ltd. in Mangalore SEZ. This plant is under construction and would have a 1.25 MMT p.a capacity, which will be amongst the largest plants in India. Once this plant is operational, it would export 300,000 to 350,000 tonnes of Propylene. 70% of this cargo would be in container form and 30% would be in break bulk form. JBF's plant would provide opportunity for NMPT, however it is unlikely that this plant would provide any opportunity for the propsed waterway.
- Gypsum import at NMPT is used by ACC and Kudremukh Iron Ore Company Ltd. (KIOCL).

MCF

Name: K. Prabhakar Rao

Designation: Director, Works

- MCF uses NMPT for EXIM trade. It is the largest importer of Fertilizer and raw materials through NMPT. About 60% of the company's products are sold in different parts of the state of Karnataka.
- The plant has capacity to manufacture 2,17,800 MT of ammonia and 380,000 MT of urea annually.
- MCF plant imports phosphoric acid, liquid ammonia and naphtha as feedstock through NMPT. From NMPT, the imported fertilizer is moved to MCF plant. The finished products imported by MCF is directly bagged in the plant and distributed in the hinterland using railways.
- Fertilizer is subsidized by the Government and Ministry gives money to railway for fertilizer transportation. Railway has monopoly on fertilizer transportation and hence MCF's cargo is evacuated by trains. This arrangement restricts any potential for the prooposed waterway from MCF or other fertilizer plants.

KIOCL

Name: Govind Raju Bhatt

Designation: Joint General Manager

- The pellet plant of KIOCL's capacity is 3.5 mn tonnes per anuum. In Fy 16, the production was 1.3 mn tonnes.
- KIOCL has a captive berth, Berth 18 at NMPT to handle Iron ore. The capacity of the berth is 7.5 MTPA for importing iron ore and exporting pellets. KIOCL produces and exports concentrates and pellets. KIOCL handles Cargo in its own captive berth.
- KIOCL Ltd. is in process to lay its own lines inside the marshalling yard of NMPT and it would use rail to unload ore at the port; hence KIOCL would not provide any opportunity for the waterway in Netravathi river.
- KIOCL pellets have been used in blast furnaces of steel mills in different countries, like Australia, China, Japan, Taiwan, and Turkey.
- KIOCL procures limestone from North Karnataka where there is abundance of limestone mines. In Fy 16, the volume of procured limestone was 30,000 tonnes. The plant's maximum requirement of limestone is 100,000 tonnes.
- KIOCL imports limestone in small quantity at NMPT. Kudremukh could get maximum 100,000 tons/annually. At present, KIOCL's limestone import is handled in general berth.

- KIOCL’s blast furnace would start in Fy 18. The plant capacity of this plant would be 0.2 mn tonnes per anuum. KIOCL’s blast furnace unit sources high quality Iron ore lumps and with high quality coke.
- Pig iron of this plant would be transported to North Karnataka and Tamil Nadu. The rate of pig iron transporttaion to Belgaum is INR 900-1000/tonne.
- Panamax vessels are used for import. These vessels come to NMPT. Iron is procured from Chattishgarh via Vizag. Transportation cost is USD 9-10 per tonne. Transportation cost for Capesize vessel is USD 3-4 per tonne.

HPCL

Name: Rajeev Hagargi/ Rakesh Agrawal

Designation: Chief Installation Manager/ Joint Director (MO)

- At present HPCL, Mangalore moves its cargo through pipeline. HPCL has comissioned a new pipeline, as a result HPCL would not provide any opportunity to the proposed waterway.
- LPG/ POL products are mostly distributed in Bangalore, Mysore, Palghat, Andhra Pradesh, Hyderabad, Coimbatore and other southern districts through pipeline. Around 90% cargo is moved through pipeline. As the river navigability stretch would not help company to save time and cost of transportation; hence they are not interested at present.

BASF

Name: Mr. Fredrick Lobo

Designation: Manager- P&A, Transportation

- Mr. Fredrick Lobo, Manager- P&A, Transportation, provided information that BASF is located near NMPT and it would not provide opportunity for the proposed waterway.
- BASF produces chemicals, which is hazardous cargo. BASF handles these chemicals with great safety as these hazardous cargoes are flammable. BASF is not willing to take risk to transport their cargo with other commodities.
- According to Mr. Lobo, previously Mangalore plant was the base plant, from where chemicals used to be distrbuted in different parts of the country. However, at present BASF has other plants in different states, including Andhra Pradesh and Gujarat. These plants are used for distribution in their particular region. Mangalore plant only distrbutes in Karnataka state.

ANNEXURE 5.1 – PILE CAPACITY CALCULATION

Working Pile - Vertical Capacity in Soil (Both Friction and End Bearing as per IS 2911-1-2 : 2010) i.e. Bored Cast in situ Pile of NW -43 **NW-43**

Dia of Pile (D) =	1.20 m		0 to 12 m	12 to 25.6m	
Average Ground Level =	5.50 m	Saturated Unit Weight (kN/m³) =	17.74	18.42	
Pile Cutoff Level =	2.15 m				
Maximum Scour Level	-1.5 m	Overburden Pressure Correction Factor CN = 0.77*log10(2000/σ0)			
FoS (Bearing and Friction)	2.5	Ultimate Shaft Resistance = S ((Ks*Pdi*tanδ)*Asi + a*C(As))			
Effective Length of Pile = 15D =	18 m	Ki = Earth Pressure Coefficient	**Value**	**ϕ (Degree)**	**Factor**
Length of Pile below NSL =	20.10 m		1	30	
Unit Weight of Reinforced Concrete	25 kN/m³		1.5	40	0.05

Depth below NSL (m)	EL (m)	Friction angle (ϕ) as per Fig-1 (IS 6403)	Cohesion (C) kN/m²	Wall Friction Angle δ (Degree)	Earth Pressure Coefficient (Ki)	Adhesion Factor (α)	Overburden Pressure at bottom of the	Circumferential Area of Pile Shaft (Asi) (m²)	Ultimate Shaft Friction (kN)
0	5.50	0	0	0	0	0	0	0	0
3	2.50	27	0.00	27	1.00	0.00	53.22	11.31	0.0
6	-0.5	30	0.00	30	1.00	0.00	106.44	11.31	0.0
7	-1.5	30	0.00	30	1.00	0.00	124.18	3.77	0.0
9	-3.5	30	0.00	30	1.00	0.00	161.02	7.54	620.8
12	-6.5	31	0.00	31	1.05	0.00	214.24	11.31	1338.8
15	-9.5	31	0.00	31	1.05	0.00	271.54	11.31	1733.1
16.5	-11	31	0.00	31	1.05	0.00	299.17	5.65	1018.1
19.5	-14	32	0.00	32	1.10	0.00	354.43	11.31	2540.5
22.5	-17	32	0.00	32	1.10	0.00	409.69	11.31	2970.1
25.6	-20.10	34	0.00	34	1.20	0.00	466.792	11.69	4145.5

Total Ultimate Skin Friction Resistance, Qst (kN) = 14366.75
Total Allowable Skin Friction Resistance, Qst (kN) = 5746.70

Note : Effective Length of Pile = 15D. Effective Overburden pressure will not increase after effective length of Pile.

End Bearing (T) = Ap*(Nc*Cp+0.5*D*γ*Nγ+Pd*Nq)		
Cohesion (C) =	0.00	kN/m²
Depth of Pile Tip (Pile Bottom) from Ground Level =	25.6	m
Effective Overburden Pressure at Pile Tip =	466.79	kN/m²
Angle of Internal Friction at Pile Tip (ϕ) =	34	degree
Bearing Capacity Factor (Nc)	0	
Bearing Capacity Factor (Nq)	45.000	(As per IS 2911Part-1 Sec-2 -2010)
Bearing Capacity Factor (Nγ)	42.904	(As per IS 6403 -1981)
End Bearing (T) =	24293.10	kN
Allowable End Bearing Capacity of Pile =	**9717.24**	**kN**
Self Weight of Pile =	629.10	kN
Net Bearing Capacity of Pile =	**14835.0**	**kN**

Uplift Capacity of Pile

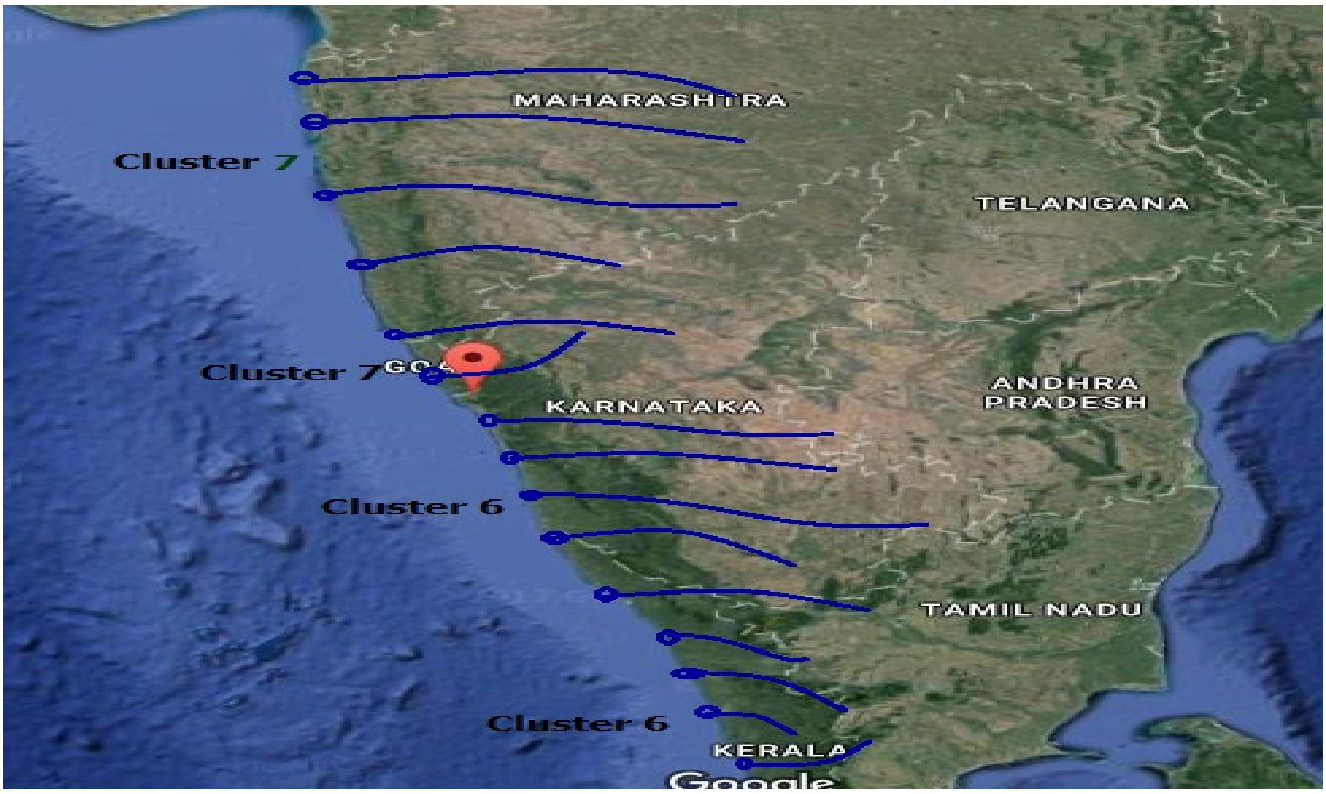
Safe Uplift Capacity of Pile = 2/3*Frictional Resistance = 3831.13

Safe Uplift Capacity (Including Weight of Pile)= 4460.0 kN

ANNEXURE 8.1– RIS / AIS

RIVER VESSEL TRACKING INFORMATION SYSTEM

- RIS Objective
- Proposed AIS Base Station
- RIS Key Technologies
  - (a) Vessel Tracking & Tracking
  - (b) Onshore Facilities
- AIS Base Station Set up
- AIS Station Tower Design
- AIS Station VHF Range
- AIS Onboard Device
- Onboard ECDIS Interface
- RIS Centre
- Communication Segments
- Bill of Material



Services for skippers

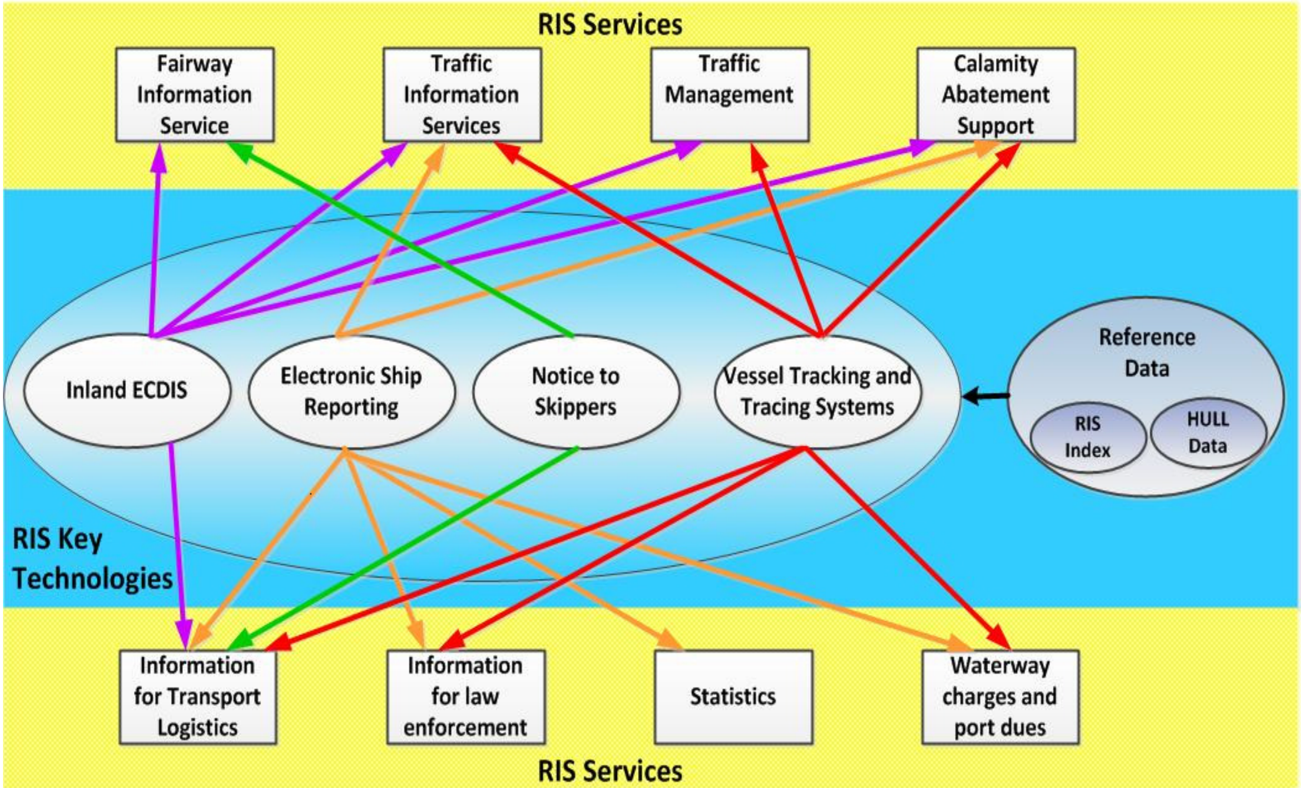
- Electronic Navigational Charts / Inland ECDIS
- Information on nautical conditions (fairway, obstructions, water level, etc.)
- Real time traffic information
- Electronic reporting of cargo and voyage
- Electronic pre-announcement at locks and harbours

Services for authorities

- Real time traffic monitoring (tracking and tracing)
- Analysis of accidents
- Exchange of safety related messages
- Electronic vessel register
- Electronic lock management
- Reception of electronic cargo reports
- Border surveillance

Services for logistic users

- Electronic cargo documents
- Data for fleet management
- Data for voyage planning
- Fairway conditions
- Water level forecast
- Availability of locks
- Calculations of arrival times

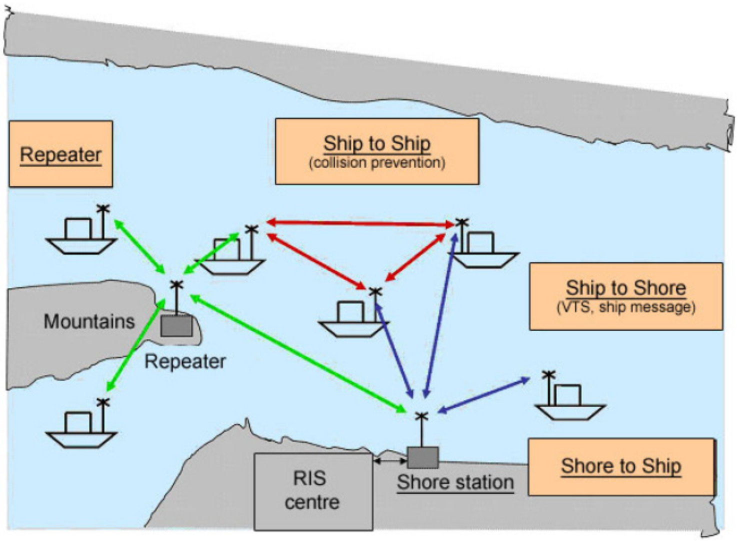


The key technologies of RIS are

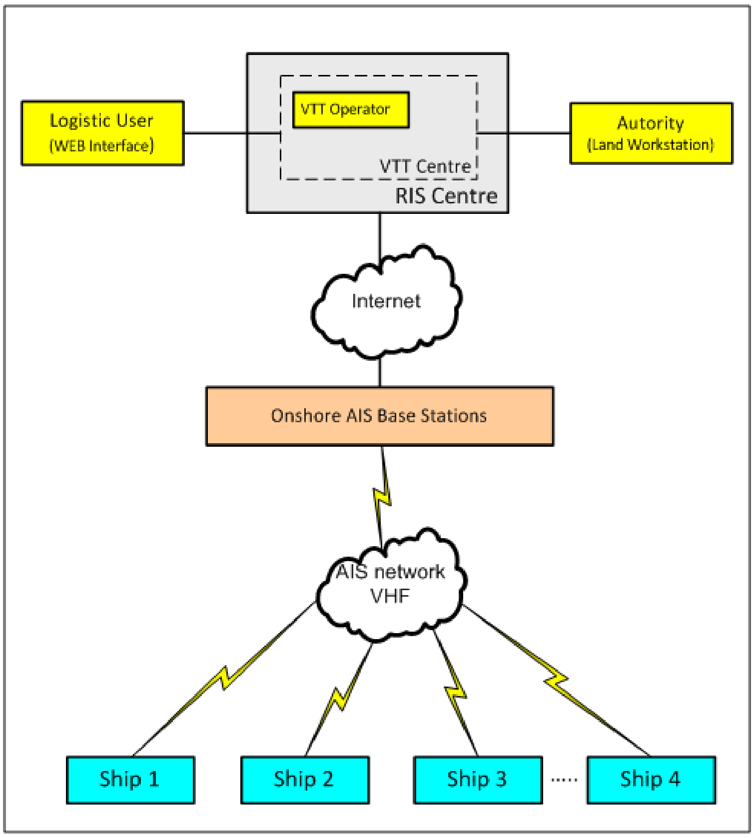
- VTT (Vessels Tracking and Tracing)
- ECDIS (Electronic Charts)
- NtS (Notice To Skippers)
- ERI (Electronic Reporting International)
- HULL Database
- LMS (Lock Management System)

Some technologies needs to be adapted to the local laws and operating procedures.

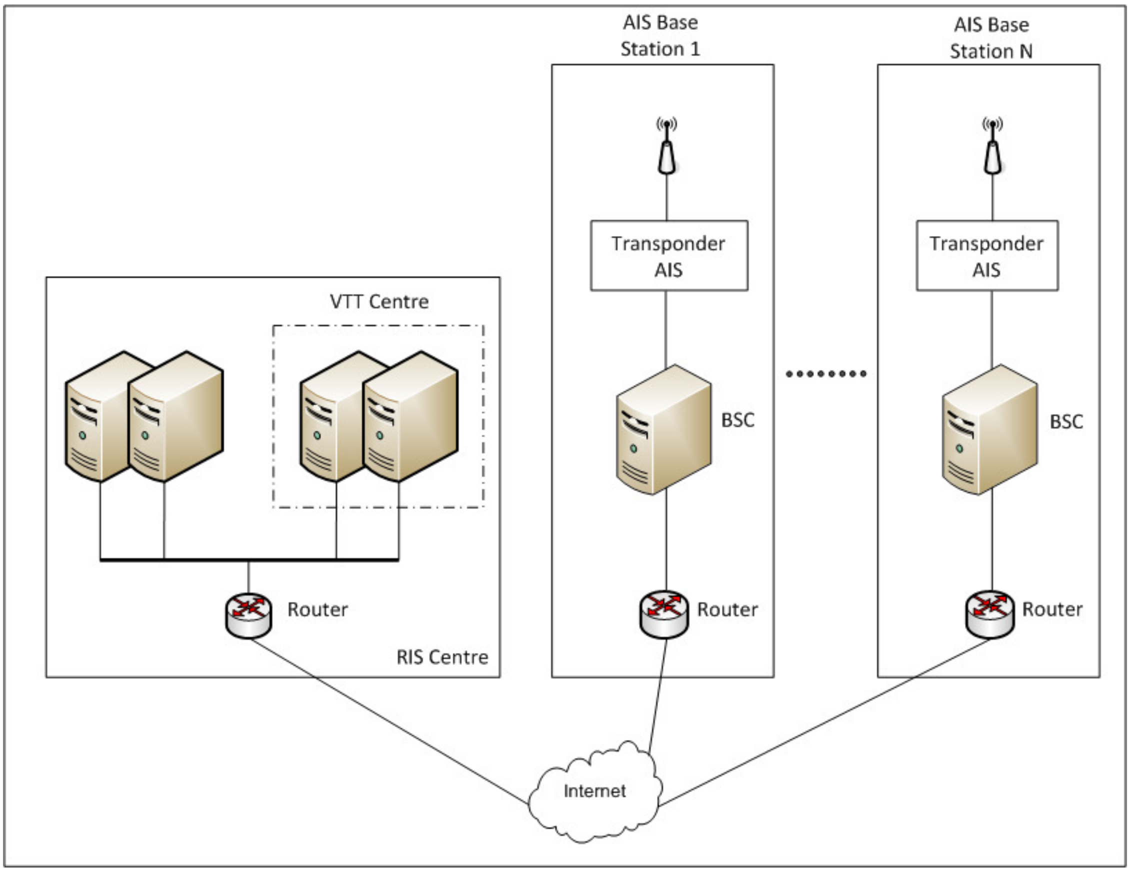
System to get a Strategic and Tactical Traffic Image using AIS technology with INLAND extension



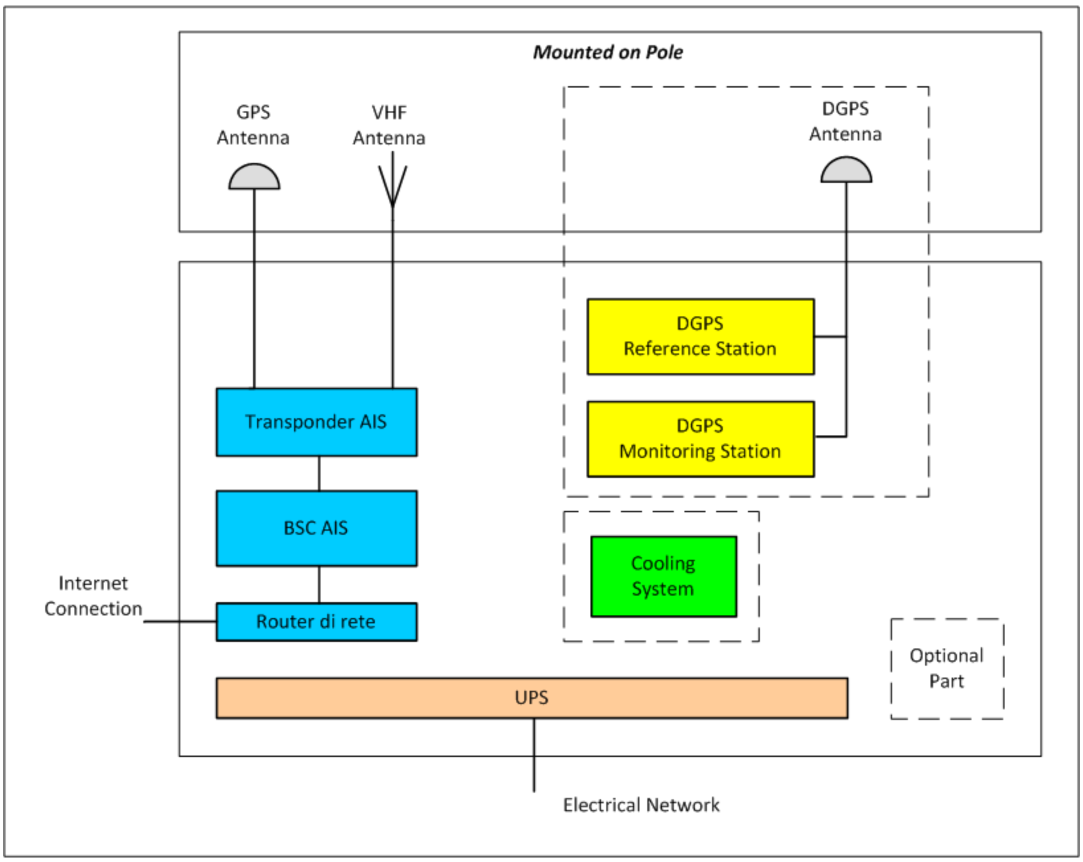
Onboard AIS devices transmit the identity of the vessel, its position and other data at regular intervals. By receiving these transmissions, AIS shore stations or ships fitted with AIS can automatically recognize, identify and track vessels equipped with AIS on a suitable screen, such as an inland ECDIS display. AIS systems are meant to boost the safety of navigation by use from vessel-to-vessel alongside onshore Vessel Traffic Services (VTS) to trace and track vessels and to assist in calamity abatement.



AIS BASE STATION & RIS CENTRE ONSHORE FACILITIES

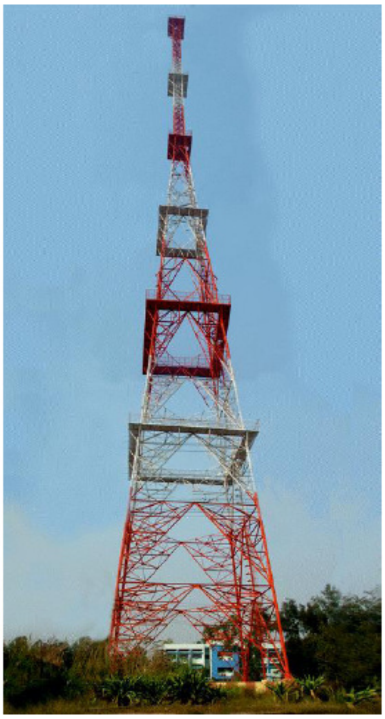


AIS BASE STATION



AIS STATION TOWER DESIGN

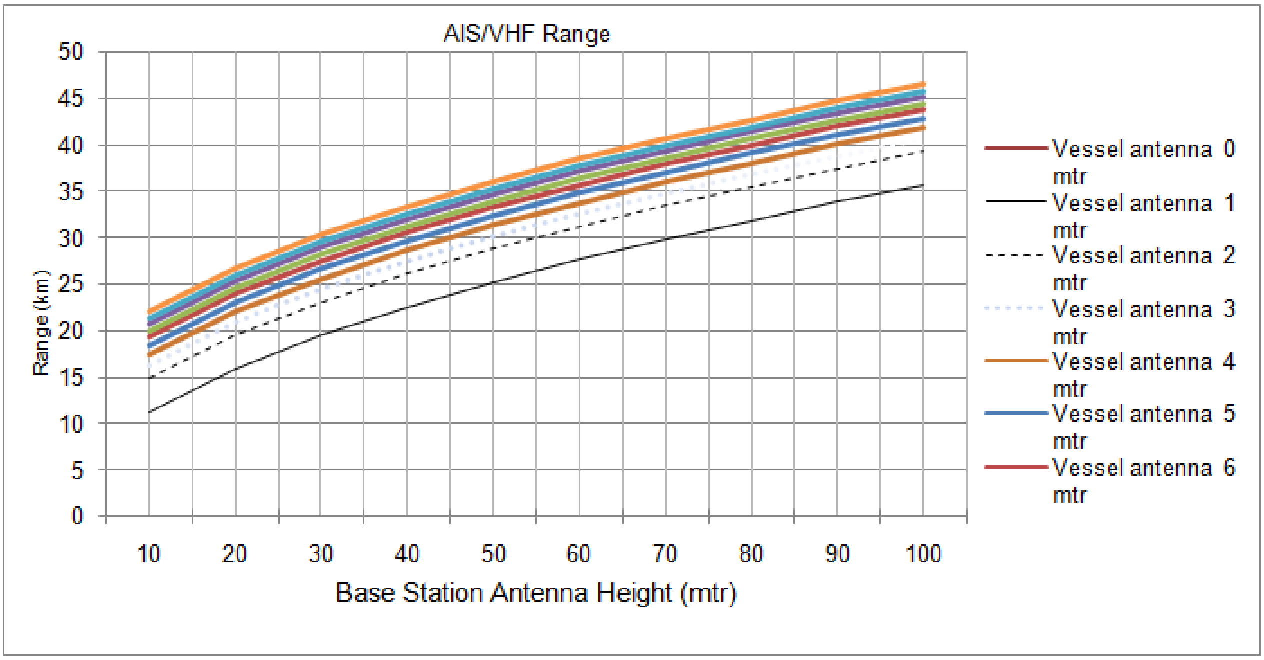
The type of tower depends upon the environment & also capable to carry Radar. Some of the examples are shown in the pictures



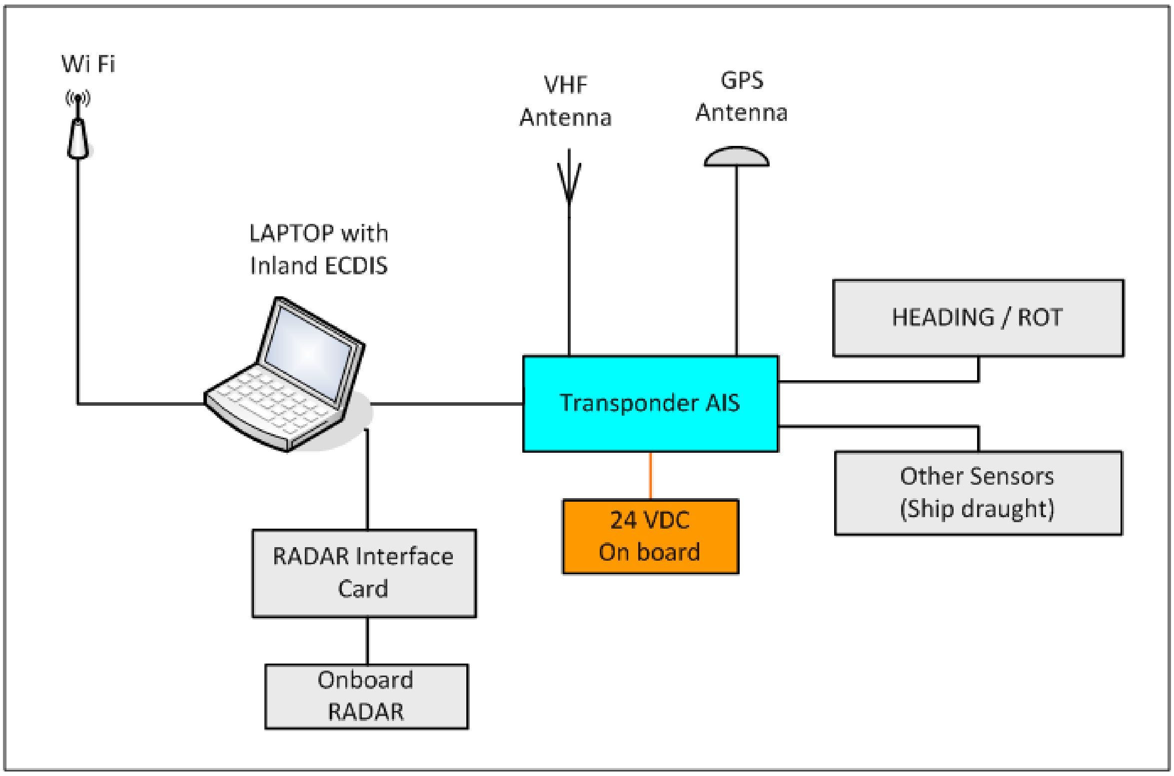
AIS STATION VHF RANGE

AIS/VHF Range												
Base Station antenna Height (mtr.)	Vessel Antenna Height	0	1	2	3	4	5	6	7	8	9	10
10		11.3	14.9	16.3	17.5	18.4	19.3	20	20.7	21.4	22	22.6
20		16	19.5	21	22.1	23.1	23.9	24.7	25.4	26.1	26.7	27.3
30		19.6	23.1	24.6	25.7	26.7	27.5	28.3	29	29.7	30.3	30.8
40		22.6	26.1	27.6	28.8	29.7	30.6	31.3	32	32.7	33.3	33.9
50	Range (km)	25.2	28.8	30.3	31.4	32.4	33.2	34	34.7	35.3	36	36.5
60		27.7	31.2	32.7	33.8	34.8	35.6	36.4	37.1	37.8	38.4	38.9
70		29.9	33.4	34.9	36.1	37	37.9	38.6	39.3	40	40.6	41.2
80		31.9	35.5	37	38.1	39.1	39.9	40.7	41.4	42	42.6	43.2
90		33.9	37.4	38.9	40.1	41	41.9	42.6	43.3	44	44.6	45.2
100		35.7	39.3	40.8	41.9	42.8	43.7	44.4	45.1	45.8	46.4	47

AIS STATION VHF RANGE

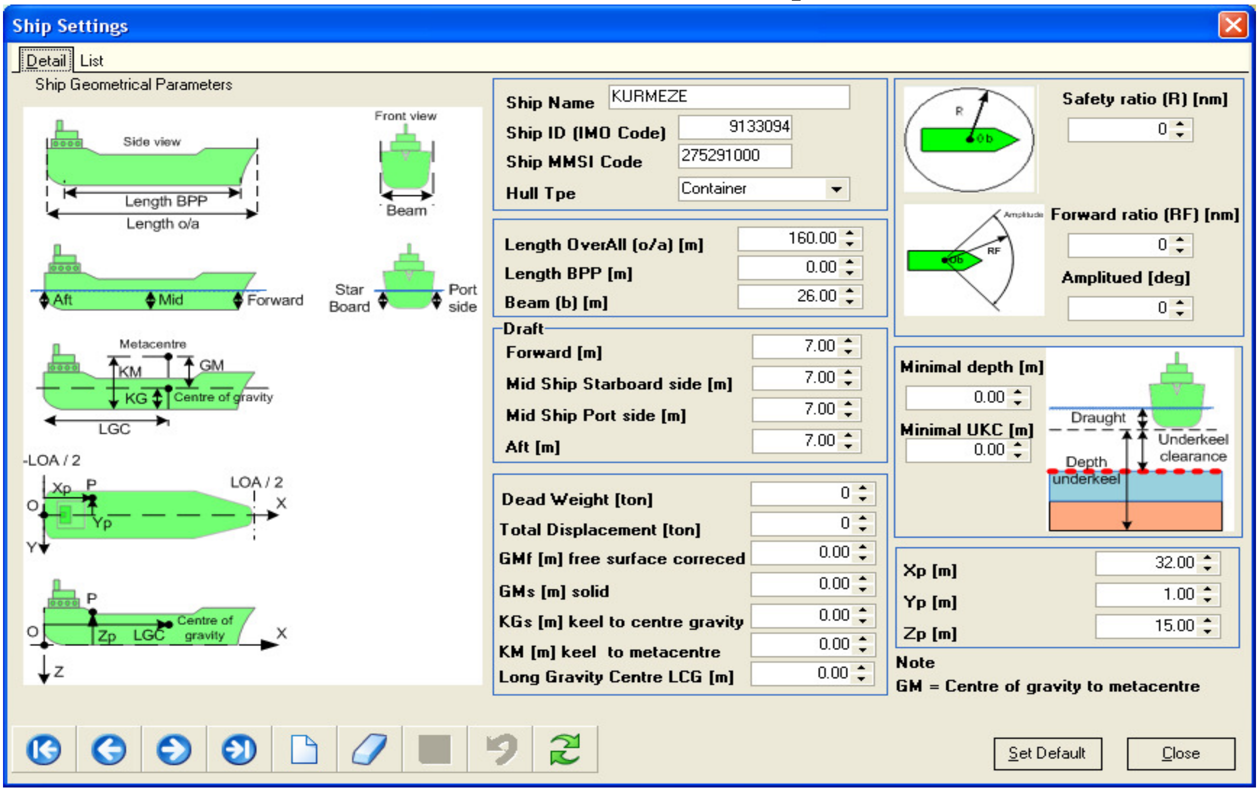


AIS ON BOARD DEVICE



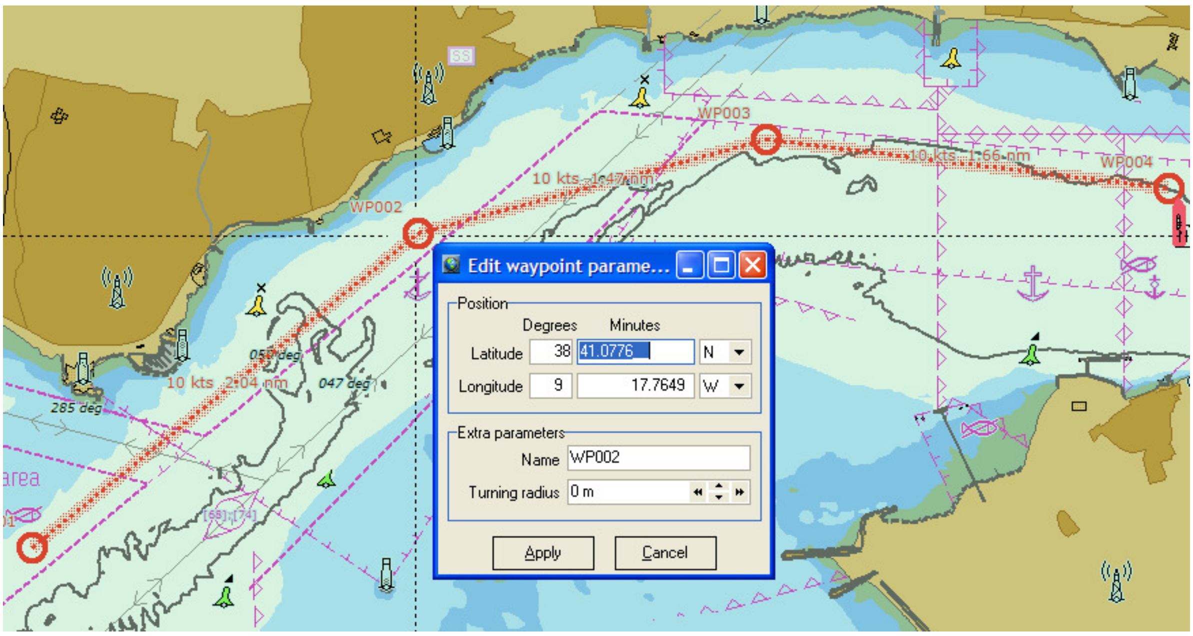
ONBOARD ECDIS INTERFACE

Interface to insert ship data



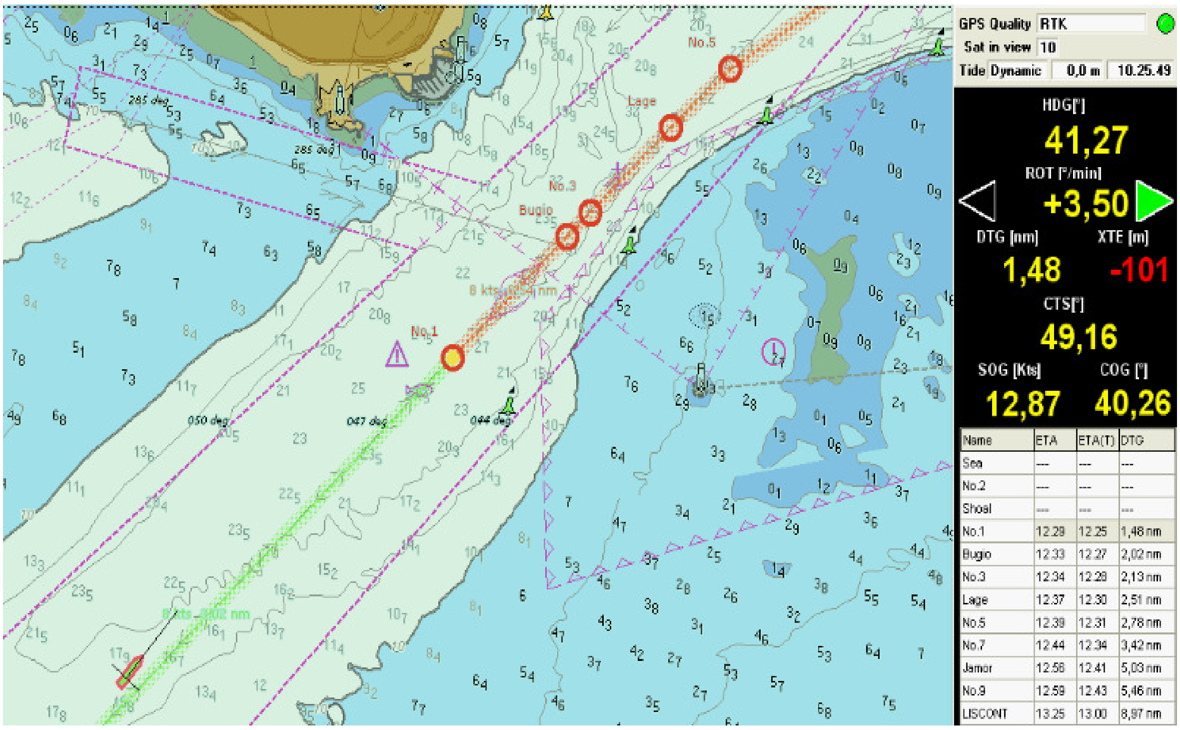
ONBOARD INTERFACE

Interface to for voyage planning



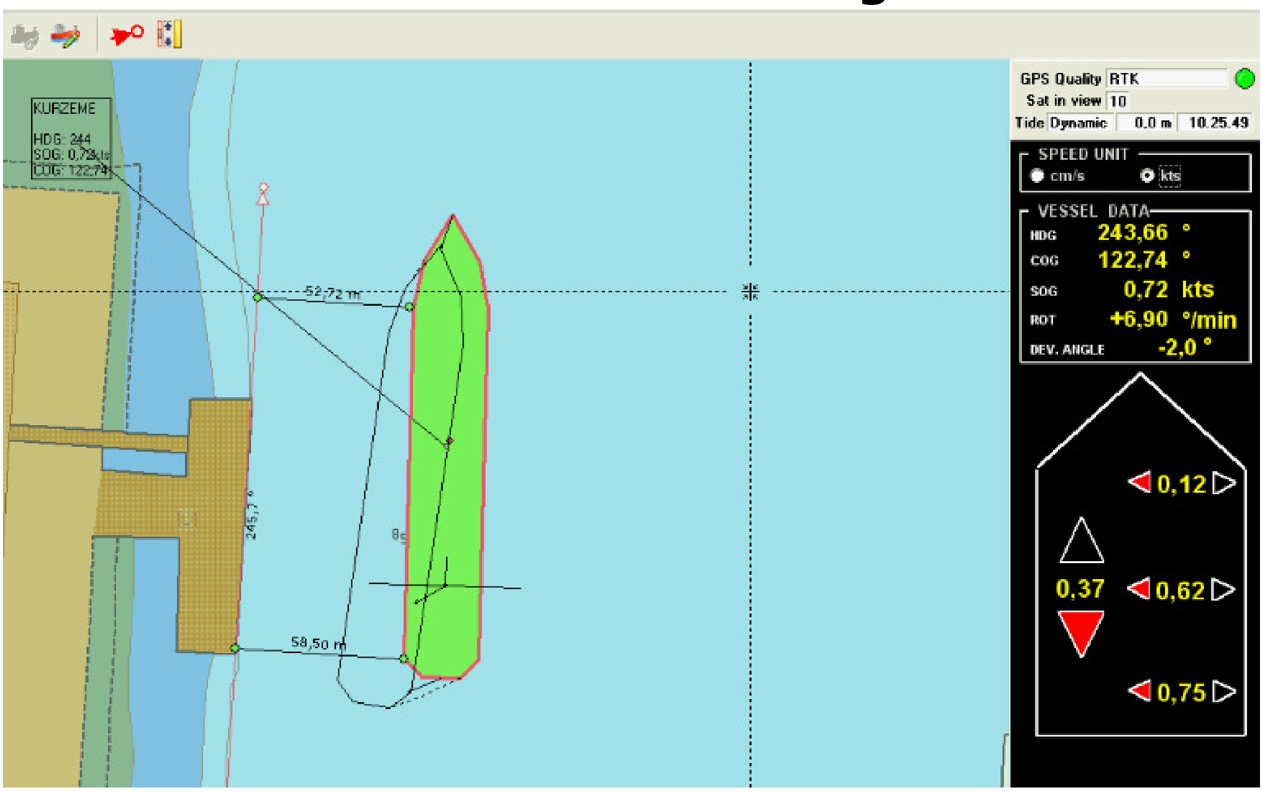
ONBOARD INTERFACE

Interface in navigation mode



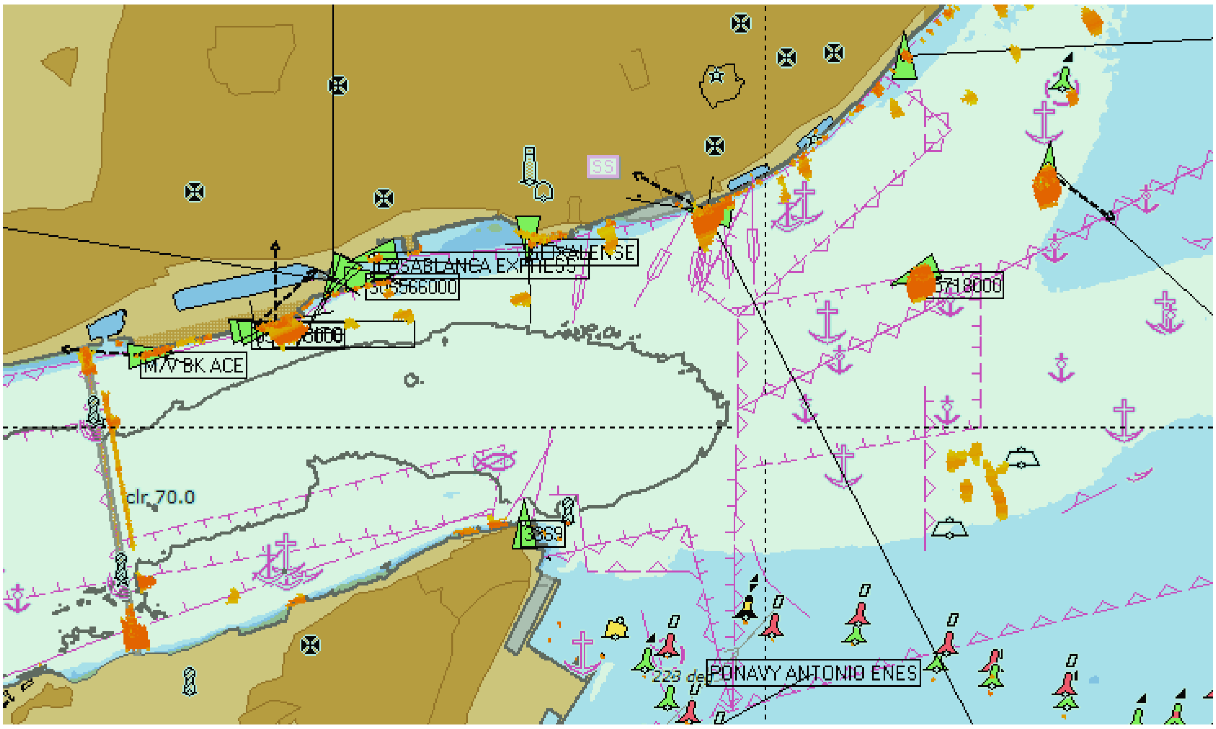
ONBOARD INTERFACE

Interface for docking

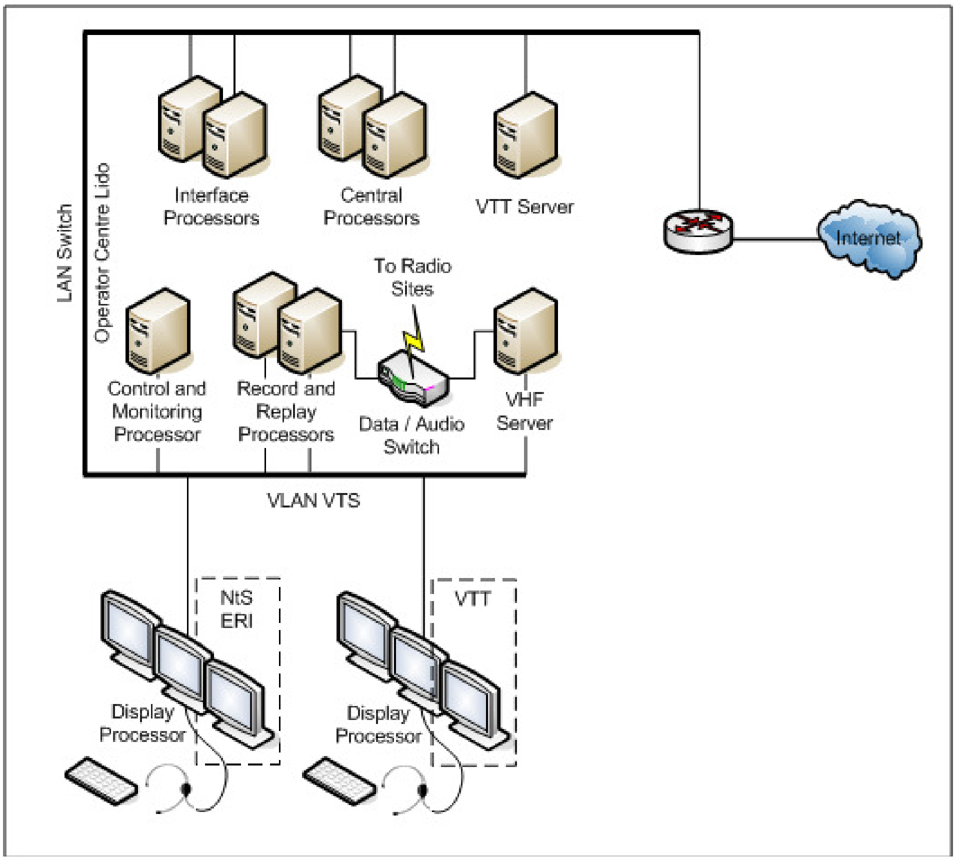


ONBOARD INTERFACE

Tactical Traffic Image + RADAR

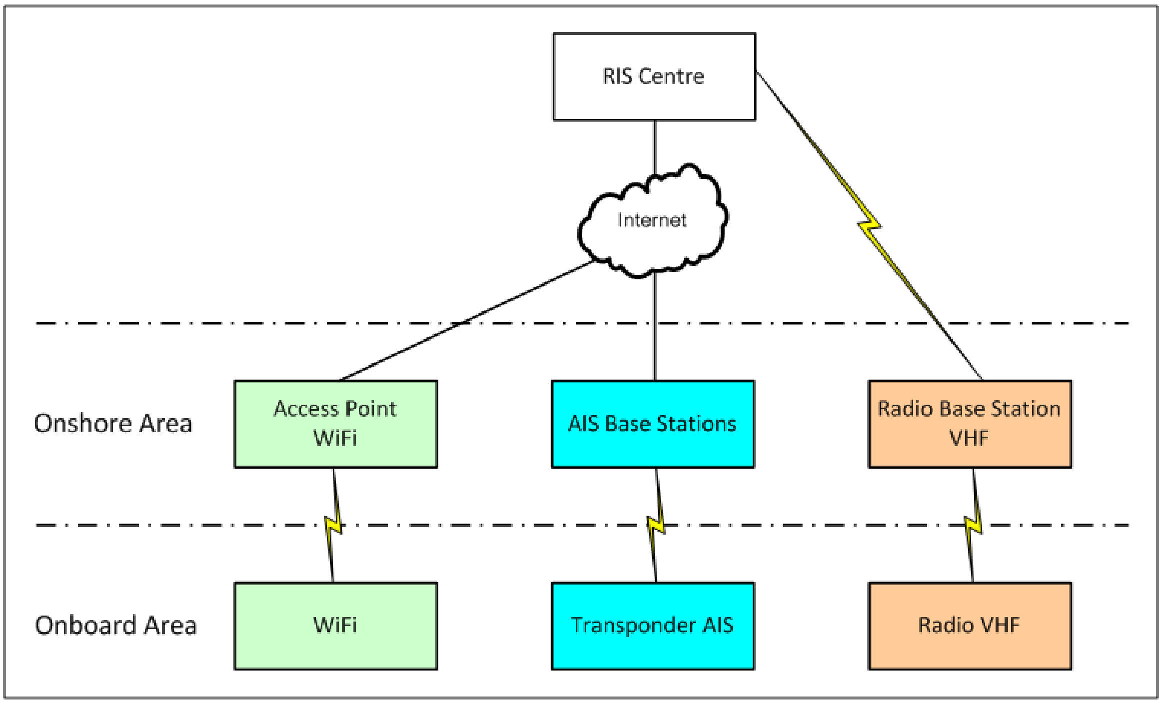


RIS CENTRE



COMMUNICATION SEGMENTS

- **Voice**
- **AIS**
- **WiFi for Charts Update and WEB Interface**



MAIN ACTIVITIES

- VHF/WiFi Coverage Study of the Inland Area
- Identification of Location for WiFi Access Point
- Identification of Location of VHF voice base stations
- Detailed definition of Main VTT Functionalities
- Notice To Skipper for River Levels
- Instrumentation with Inland AIS class A of each ship
- Creation of Inland ECDIS-S57 Chart
- DGPG integration in AIS Base Stations for 10cm precision in ships location (RTCM via AIS Msg. 17)
- Integration with Local Level and Meteo Monitoring Systems ?
- Lock/Bridge/Terminal Management ?

BILL OF MATERIAL

Onboard Vessel composed of
- AIS Transponder+ VHF

Onshore Area composed of
- AIS Base Stations + Controller + radio base VHF (voice)

1 RIS Centre Composed of
- Workstations with Data management software

ANNEXURE 8.2– AIS BASE STATION SPECIFICATIONS

AIS BASE STATION TRANSPONDER ABT-1103

AIS mod. ABT-1103
BASE STATION TRANSPONDER

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AIS BASE STATION TRANSPONDER
mod. ABT-1103

According to IMO recommendations, the AIS system is employed by Authorities to improve monitoring of maritime traffic and VTS (Vessel Traffic Services) operations. This technology, based on the use of GPS (Global Positioning System) receivers, enables transmission of position information in an automated, safe, and accurate fashion. Moreover, the AIS integrates position information with static and dynamic data enabling full identification of vessels.

The ABT-1103 has been designed to implement an independent AIS base station according to the relevant international regulations (ITU-R M.1371 and IEC 62320-1), and compliance with these standards has been certified by BSH.

The ABT-1103 can be easily integrated in a regional monitoring system according to the IALA Recommendation A-124. The exchange of data between the base station and the monitoring system is carried out through the embedded Presentation Interface (PI) ports (RS232 or RS422), or via TCP communications using a PCU (Physical shore station Control Unit) like the BCS-1135, or BCD-1135. The operating mode of the transponder can be configured through the same PI ports, using the embedded web server of the Elman PCU, or by means of a dedicated management software.

The ABT-1103 includes an internal GPS receiver used to acquire position and time information; this information can be forwarded in order to synchronize other units. Alternatively, the ABT-1103 can accept time and position information from external devices. Furthermore, the ABT-1103 features a dedicated RTCM port to input DGNSS messages to the unit, enabling corrections to be forwarded to the internal GPS and/or transmitted to remote stations.

The ABT-1103 can also be equipped, upon request, with additional functionalities that can be adapted, and specifically developed to the customer's needs. The Secure mode functions, for example, can be used to stop the standard broadcasting of AIS messages and/or enable encrypted communications with selected AIS stations (e.g. WAIS equipped vessels).

GENERAL CHARACTERISTICS

- 2 or 3 VHF receivers and 1 VHF transmitter
- Transmission/reception of text messages
- User Interface (ECDIS, ECS)
- Internal DGPS receiver
- Standard 19" form factor
- Internal BIIT (Built In Integrated Test)
- Optional Secure mode functions (WAIS)

ORDERING GUIDE

Model	Description
ABT-1103	Base Station unit compliant to IEC 62320-1 standard, 2 receivers installed
ABT-1103-W	Base Station unit compliant to IEC 62320-1 standard, 2 receivers installed , WAIS support
ABT-1103-WR3	Base Station unit compliant to IEC 62320-1 standard, 3 receivers installed , WAIS support, dedicated channel for WAIS transmissions

TECHNICAL SPECIFICATIONS

Physical characteristics

Dimensions	482 x 220 x 88 mm
Weight	5 kg

Environmental specifications

Operating temperature	-20 ÷ +55 °C
Storage temperature	-40 ÷ +70 °C
Relative humidity	95% @ +25° ÷ +55° C
Vibration	Compliant with NAV-30-A002 regulations
Shock	Compliant with NAV-30-A001, level B, class II regulations

Power

Input	115/220 VAC 24 V DC
Power consumption	20 W (50 W peak)

VHF transponder

Frequency Band	156.025 ÷ 162.025 MHz
Channel width	25 kHz
RF Power output	2 or 12.5 W (nominal)
Modulation	GMSK/FM
Bit rate	9600 bps
Sensitivity	-112 dBm @ 20% PER

GPS receiver

Receiver	Differential, 16 channel
Accuracy (2D)	5 m (95%) - GPS 1.5 m (95%) - DGPS

Interfaces

Input	3 x IEC 61162-1 / 2 1 x ITU 823-2 1 x PPS input pin 1 x TX INHIBIT input pin
Bidirectional	4 x IEC 61162-2 1 x RS232
Output	1 x ITU 823-2 / IEC 61162-1 / 2 1 x NC/NO Contact 1 x PPS output pin 1 x BIIT output pin
RF	1 x BNC for VHF antenna 1 x TNC for GPS antenna

Position and time sources

External synchronization supported	Yes
Fallback algorithms for time synchronization	Yes
External position sensor supported	Yes
Fallback algorithms for position sensor	Yes
GPS output port DGNSS corrections output port	Yes
DGNSS corrections dedicated input port	Yes

Operation modes

Dependent mode	Yes
Independent mode	Yes
RATDMA	Yes

Processing capacity

FATDMA message memory	Up to 100 messages at the same time
RATDMA message memory	Up to 100 messages at the same time
AIS internal directory	Up to 2048 remote stations

Optional message transmission

Station name (Message 24A) Yes

Standards

IMO MSC.74(69) Annex 3	ITU-R M.1371-4,
ITU-R M.1084-4,	EN 301 489-1, V 1.8.1,
EN 55022:2006 + A1,	EN 60950-1,
EN 55022:2006 + A1,	EN 61000-3-2,
EN 61000-3-3 + A1 + A2,	EN 61000-4-2,
EN 61000-4-3,	EN 61000-4-4,
EN 61000-4-5,	EN 61000-4-6,
EN 61000-4-11,	IEC 61162-1 / 2,
IEC 61108-1,	IEC 62320-1

Type approvals

Statement of Conformity nr. BSH/46162/4321801/11

R&TTE Directive 1999/5

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ANNEXURE 8.3– AIS EMBEDDED SERVER SPECIFICATIONS

AIS EMBEDDED SERVER

FOR PHYSICAL SHORE STATIONS

Mod. BCS-1135, BCD-1135

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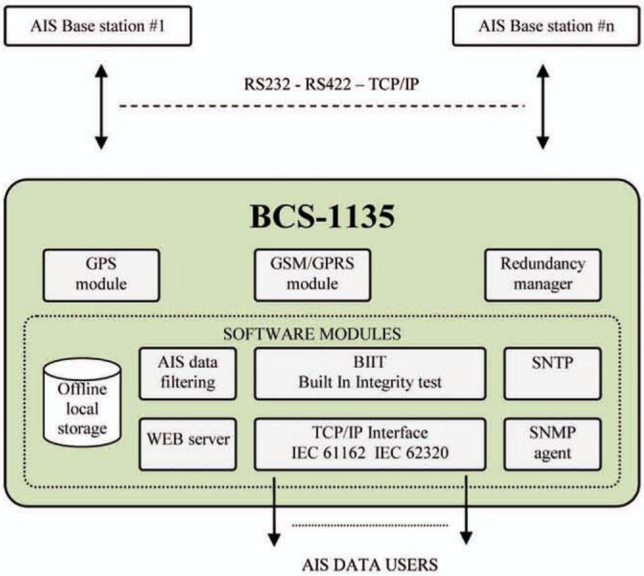
AIS EMBEDDED SERVER
Mod. BCS-1135, BCD-1135

The BCS-1135 AIS Embedded Server is designed to interface multiple AIS Physical Shore Stations (PSS) and to allow their management from shore systems. The BCS-1135 can be easily integrated in an AIS network acting as a PSS Controlling Unit (PCU) according to the IALA Recommendation A-124.
The BCS-1135 is designed to withstand harsh environments including industrial range components and solutions normally employed in military products like solid state technology, fanless approach etc.

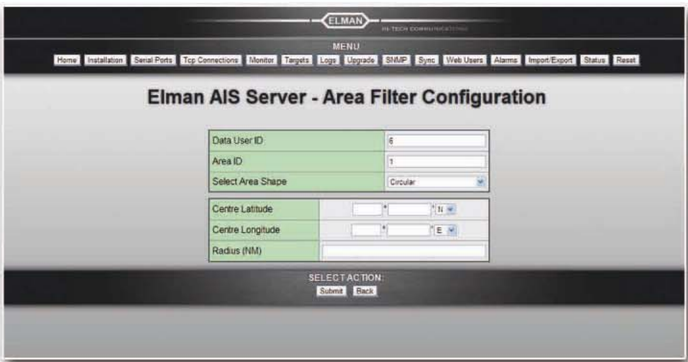


USER INTERFACE

The BCS-1135 features an embedded web server which allows configuring and monitoring both the BCS-1135 and the connected AIS Base Stations, through a Web User Interface (WUI) removing the need of additional software. Authorized operators can log-in the web interface to configure and monitor every aspect of the BCS-1135, its ports and connections and the linked devices and users. A TFTP client allows easy firmware upgrades.

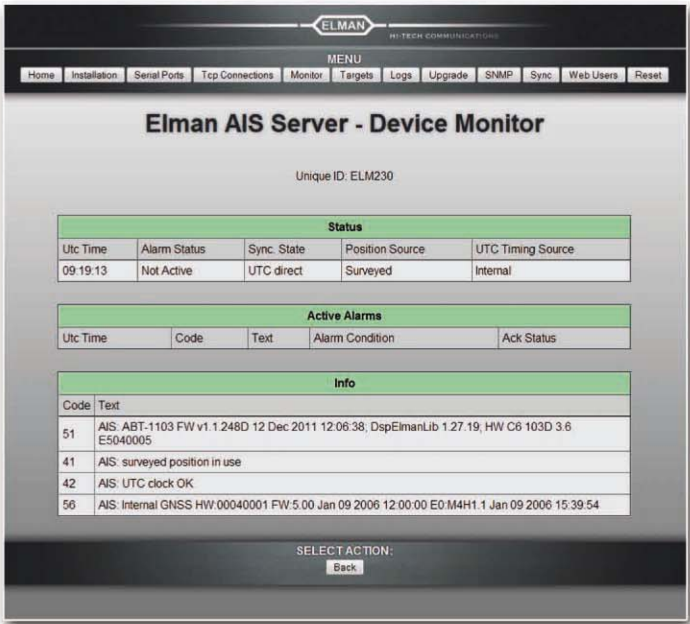
AIS DATA MANAGEMENT

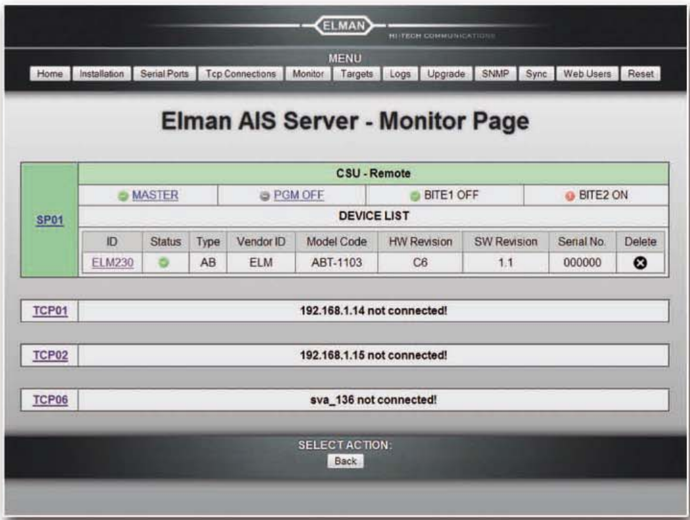
The BCS-1135 can acquire AIS data from the serial ports and from TCP connections according to the specified configuration. In the same way the collected AIS data are made available to serial ports and TCP connections. Moreover, it is possible to configure the data forwarding for each port (serial and/or TCP) applying filters on the AIS data like duplicate removal, down-sampling, area filters and type of ITU messages.
Received AIS targets can be displayed on the BCS-1135 WUI or exported using the included Kml Service.
Optionally, the BCS-1135 includes a memory card which provides persistent local AIS data storage, thus avoiding loss of data when the link to a data centre is temporarily broken.



ALARM AND STATUS MONITORING

The BCS-1135 includes modules dedicated to monitor the status and detect alarms generated from internal circuitry and the connected Base Stations. Alarm and status information can be displayed and managed using WEB interface. Moreover the featured SNMP agent allows for remote centralized monitoring.





BASE STATION MANAGEMENT

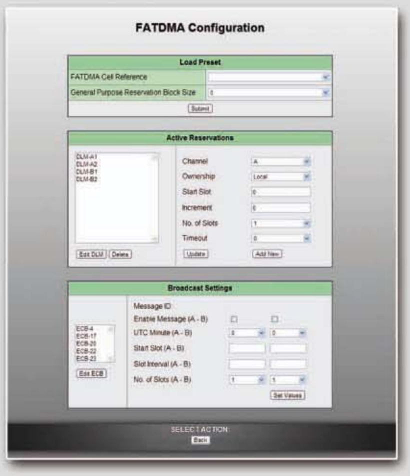
The BCS-1135 is also capable of addressing the connected AIS Base Stations, allowing the remote configuration and monitoring. The standard IEC 61162 protocol is used for all the real time data communications; the comment block extension as per IEC 62320-1 is also supported, providing a standard and convenient way to address data users and devices and to attach a timestamp to the AIS data. All the Base Stations compliant with the IEC 62320-1 standard should work seamlessly with the BCS-1135; however the BCS-1135 also supports Elman proprietary sentences to manage the advanced functionalities of the ABT-1103, such as Warship-AIS configuration.

OPTIONAL MODULES

The BCS-1135 can be optionally equipped with an internal GPS receiver which can be used as position and time source both for the BCS-1135 itself and for the connected AIS Base Stations, simplifying the installation where more than one Base Station is required. Time synchronization can also be achieved through the embedded SNTP client.
An optional internal GSM/GPRS module can be installed and used as primary connection to an external AIS data user, fallback connection or service link to monitor the status of the BCS-1135 and connected devices.
Moreover, the BCS-1135 can also be used as a switching unit for Base Stations in redundant installations in active/passive configuration; VHF antenna switch can be used to feed the active Base Station only, thus reducing the number of required antennas.

BCD-1135

The BCD-1135 is the dual version of the BCS-1135; it includes all the functionalities featured by the BCS-1135. In addition, the BCD-1135 features two separate processing modules and Ethernet interfaces supporting internal redundancy or the simultaneous interface to two different TCP networks (Serial Router).



GENERAL CHARACTERISTICS

- Serial to IP conversion
- Up to 5 serial ports for direct interface to AIS Base Stations
- User configurable up to 10 TCP/IP connections
- Collected data available on serial and TCP/IP ports
- User customizable message filters
- Configuration and monitoring via WEB interface
- Multiple AIS base station configuration and monitoring via WEB interface
- Support for secure mode functions (Warship-AIS)
- Internal BIIT (Built In Integrated Test)
- KML Service to display AIS targets on external application like Google Earth
- Embedded SNMP agent
- Time synchronization via SNTP
- Automatic firmware upgrade via TFTP
- Optional internal DGPS receiver
- Optional GSM/GPRS module
- Optional VHF antenna switch
- Dual processing module and Ethernet interface (BCD-1135 only)
- PoE (Power over Ethernet) support
- Standard 19” form factor

TECHNICAL SPECIFICATIONS

Physical characteristics

Dimensions	482 x 230 x 44 mm
Weight	3 kg

Environmental specifications

Operating temperature	-20 ÷ +55 °C
Storage temperature	-40 ÷ +70 °C
Relative humidity	95% @ +25° ÷ +55° C°

Power

Input	115/220 VAC 18÷48 VDC
Power consumption	5 W (BCS-1135) 10 W (BCD-1135)

GPS receiver

Receiver	Differential, 50 channel
Accuracy (2D)	5 m (95%) - GPS 1.5 m (95%) - DGPS

Interfaces

Ethernet	2 x RJ45 (BCS-1135) 4 x RJ45 (BCD-1135)
Serial ports	Up to 5 x DB9 connectors Each port is configurable as: • RS232 DTE (DB9 male) • RS422 (DB9 female) • ABT-1103 PI (DB9 female)
Maintenance ports	1 x RJ12 (BCS-1135) 2 x RJ12 (BCD-1135)
RF	1 x N-Female for VHF antenna in 2 x BNC-Female for VHF antenna out 1 x TNC-Female for GPS antenna 1 x GSM/GPRS antenna

Standards

IALA Rec. A-124,
ITU-R M.1371-4,
IEC 61162-1 / 2,
IEC 62320-1,
IEC 61108-1

Measures							
Name	Nominal	Min	Max	Value	Unit	Utc Time	Status
12VI	12.00	10.80	13.20	11.83	V	-	OK
7V	7.00	6.30	7.70	7.07	V	-	OK
5V	5.00	4.75	5.25	4.96	V	-	OK
5VT	4.70	4.23	5.17	4.67	V	11:46:44	OK
3V3RF	3.30	3.14	3.46	3.29	V	-	OK
GPS_VANT	-	3.14	5.25	4.92	V	-	OK
WDIR	-	-	-	1.96	W	11:46:44	OK
WRIF	-	-	-	0.14	W	11:46:44	OK
VSWR	-	-	5.00	1.73	-	11:46:44	OK
SGN0	-	-	-	-128	dBm	-	OK
SGN1	-	-	-	-130	dBm	-	OK
SGN2	-	-	-	-126	dBm	-	OK

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ANNEXURE 9.1– MoEFCC LETTER_EXEMPTION FROM EC

No. F.No.14-9/2016-IA-III
Government of India
Ministry of Environment, Forest and Climate Change
(Impact Assessment Division)

Indira Paryavaran Bhawan
Jor Bagh Road, Aliganj
New Delhi-110003

Dated: 21st December, 2017.

OFFICE MEMORANDUM

Subject: Non-requirement of environment clearance for maintenance dredging in rivers for the purpose of navigation - regarding.

This has reference to your Office Memorandum IWT-11011/89/2016-IWT-(Vol.II) dated 7th December 2017 on the above mentioned subject.

2. The minutes of the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping and Water Resources, River Development & Ganga Rejuvenation held on 24.10.2017 concluded that as per the extant legal position, no prior EC is required for maintenance dredging for navigational channel for Inland Waterways.

3. In view of the above the Ministry of Shipping may like to go ahead with the decision taken during the meeting held under chairmanship of Hon'ble Minister, Road Transport & Highways, Shipping held on 24.10.2017 subject to the implementation of the environmental safety measures as enclosed as annexure.

4. This issues with the approval of the competent authority.

21/12/17

Sharath Kumar Pallerla
Director

To

The Secretary,
Ministry of Shipping,
Parivahan Bhavan, 1, Parliament Street,
New Delhi - 110 001

ANNEXURE

Environmental safety measures to be implemented

i. 'Consent to Establish' and 'Consent to Operate' shall be obtained from State Pollution Control Board under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.

ii. The project authority shall ensure that no rivers or tributaries are blocked due to any activities at the project site and free flow of water is maintained.

iii. Shoreline shall not be disturbed due to dumping. Periodical study on shore line changes shall be conducted and mitigation carried out, if necessary.

iv. Dredging shall not be carried out during the fish/turtle breeding seasons.

v. All vessels used in the river will be fitted with noise control and animal exclusion devices so that aquatic life is not unduly disturbed.

vi. Spillage of fuel / engine oil and lubricants from the construction site are a source of organic pollution which impacts aquatic life, particularly benthos. This shall be prevented by suitable precautions and also by providing necessary mechanisms to trap the spillage.

vii. Construction waste including debris shall be disposed safely in the designated areas and in no case shall be disposed in the aquatic environment.

viii. Vessels shall not discharge oil or oily water such as oily bilge water containing more than 15 ppm of oil

ix. The project authority shall ensure that water traffic does not impact the aquatic wildlife sanctuaries that fall along the stretch of the river.

x. All vessels will also have to comply with 'zero discharge' standards to prevent solid or liquid waste from flowing into the river and affecting its biodiversity.

xi. The dredging shall be carried by integrated and systematic planning by selective grid method by allowing migratory movement of Benthic fauna.

xii. All required Noise and vibration control measures are to be adopted in Dredgers. Cutter section Dredgers should be avoided as much as possible which produces more noise and vibration. No Drilling and Blasting is to be carried out.

xiii. Pre geo-tectonic studies has to be completed and the strata to be dredged is predetermined with complete data pertaining to hardness, compressive and tensile strengths.

xiv. Dredger type and other strata loosening methods shall be preconceived.

xv. Staggered dredging shall be carried based on turbidity monitoring to minimise the impact of turbidity.

xvi. Threshold level of turbidity, which has a minimal effect on fauna, has to be predetermined and Dredging planned accordingly.

xvii. Further silt screens needs to be used for minimising the spread of Turbidity.

xviii. Disposal places of Dredged sediments needs to be predetermined, along the shore by assessment of suitability, which will not affect the shoreline (erosion) and also causing impacts during monsoon and flooding.

xix. As much as possible, it shall not be disposed off in the river itself, and the site should be such that the dispersion is quicker by undertaking modelling studies.

xx. Ballast water control and management measures shall be implemented.

xxi. Waste and waste water reception facilities in Jetty shall be implemented.

xxii. The Risk and Disaster management plan has been prepared in consonance with the manual of terminals and harbours issued by the Ministry of Environment and Forests dated 5th May 2010.

xxiii. Standard Operating Procedures (SOP) and Emergency Response Plan (ERP) for onsite and offsite emergencies shall be prepared and implemented based on Hazard Identification and Risk Assessment to handle, process, store and transport of hazardous substances.

xxiv. Oil spill contingency plan shall be prepared and part of DMP to tackle emergencies. The equipment and recovery of oil from a spill shall be assessed. Guidelines given in MARPOL and Shipping Acts for oil spill management shall be followed.

xxv. No diversion of the natural course of the river shall be made without prior permission from the Ministry of Water resources.

xxvi. All the erosion control measures shall be taken at water front facilities.

xxvii. Necessary Air Pollution Control measures shall be taken during loading, unloading, handling, transport of the material at the berthing and water front facilities.

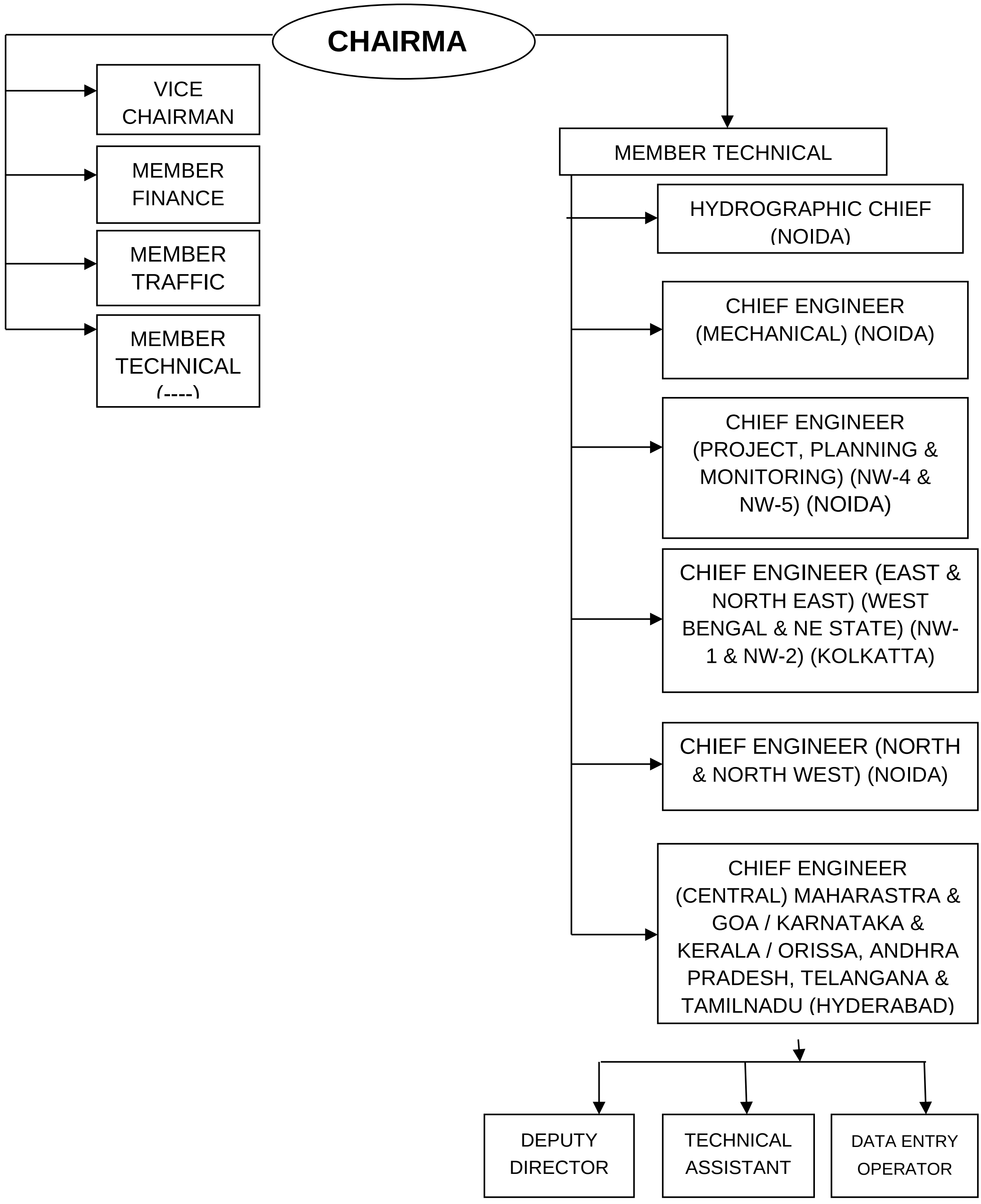
xxviii. The Vessels shall comply the emission norms prescribed from time to time.

xxix. All safety measures are to be implemented in coordination with the respective state government departments such as State Forest Department, Public Works Department, State Pollution Control Board etc.

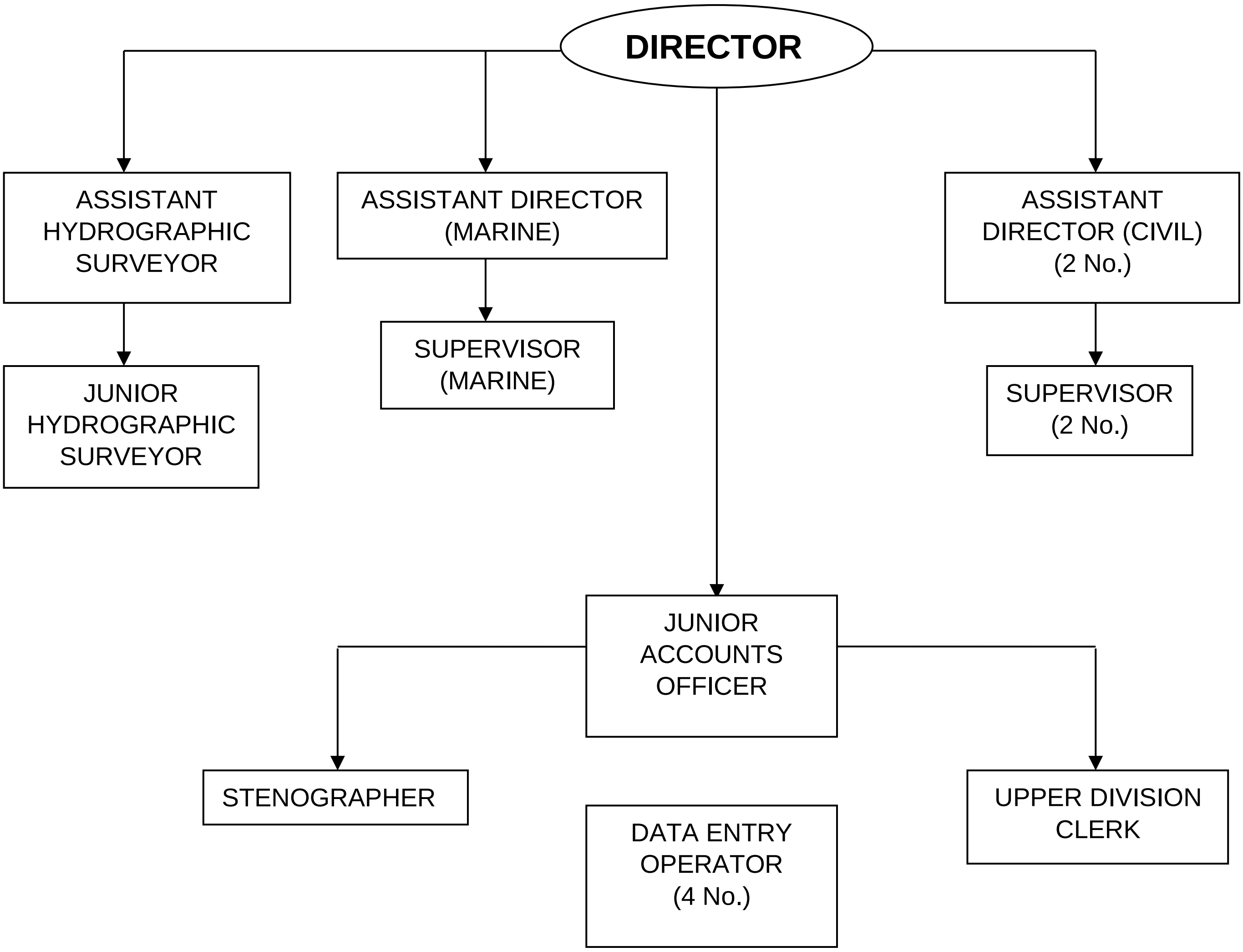
21/12/17

Sharath Kumar Pallerla
Director

ANNEXURE 10.1– INSTITUTIONAL REQUIREMENT HEAD OFFICE COMPONENTS



ANNEXURE 10.2– INSTITUTIONAL REQUIREMENT IN KARNATAKA AND KERALA (excluding the existing NW-3 & NW-8/9/59)



Note: *The present organizational system at IWAI Kochi will look after the existing NW-3 and NW-8/9/59 with due modifications at the time of implementations of proposed Cluster-6 activities.*

ANNEXURE 11.1 – COSTING/FINANCIAL ASSUMPTIONS

FINANCIAL ANALYSIS

Broad Assumptions

Based on Financial Analysis as per DPR of NW5

Abstract

Broadly identified assumptions in order to facilitate financial analysis of Category II shortlisted waterways development

Inland Waterways Authority of India

FINANCIAL ANALYSIS BROAD ASSUMPTIONS[1]:

Capital Expenditure:

Elements to be covered (based on planned infrastructure requirement for respective rivers)

Suitable assumptions with relevant justification shall be made for any missing items.

CAPEX HEAD	TOTAL COST (INR CRORE)
Land Acquisition	Cost initially to be considered for acquisition of land for land side development of floating jetty
Dredging	**Normal Condition** Standard dredging rate of Rs. 200/cum to be considered. Suitable adjustments shall be made (with proper justification) for change in quality of dredge material/any special requirement for disposal of dredge material
Barrages with Navigational Locks	Based on requirement standard charges as per Planned Infrastructure of respective rivers.
Raising Banks	
Protection Measures	
Environmental Monitoring	
Navigational Aids	
Bridges	
Cross Drainage Works	
Facilities to Local People	
Terminals	Initially while calculating CAPEX terminal cost shall include cost for development of required numbers of floating jetty along respective waterways, cost of equipment, manpower required for terminal operation
Total Capital Expenditure	**Sum of all parameters mentioned above**
DC, PMC, IE Services, Loan Fees	10% of Total CAPEX
Overall Contingency	3% of Total CAPEX
Escalation	1.5% of Total CAPEX
Total Hard Capex	
Interest During Construction	
Total Project Cost	

Operations & Maintenance Expenditure:

(Pick up the cost items relevant to your study and planned infrastructure components)

Suitable assumptions with relevant justification shall be made for any missing items.

Annual Escalation shall be assumed @ 5.0%.

[1] These assumptions are to facilitate consultants in giving a sense of direction in which they shall move to make the reporting of final outcome consistent. Any missing information shall be assumed suitably (with valid justification) by the consultants in order to provide desired end result.

Cost Items	% of CAPEX
Dredging	5%
Cross Drainage	2%
Locks	2%
Bridges	1%
Terminals	2%
Navigation Aids	2%
Protection Measures	2%
Raising Banks	2%
Facility to Local People for Ferry Services	2%
Environmental Monitoring	2%
Cost of Barrages with Navigation Locks	2%
Total Waterway O&M Costs	

Revenue Estimation:

For estimating the revenue, the tariff structure proposed by IWAI (Levy & Collection of fees and charges) Regulations, 2011 shall be used as a reference.

Existing Tariff Structure & Charges by IWAI (Shall be verified from the latest published Tariffs)

Suitable assumptions with relevant justification shall be made for any missing items.

Tariff Heads	Charge unit	Charges (INR)
(A) Usage Charges		
Movement of Vessels	GRT/km	0.02
(B) Vessel related charges		
Berthing charges	Vessel	1000.00
Towage	Vessel/hour	600.00
Pilotage	Day	750.00
(C) Cargo related charges		
(i) Terminal Charges		
Dry Cargo	Ton (or part thereof)	1.00
Liquid Cargo	Ton (or part thereof)	1.00
Containerised Cargo	TEU	50.00
(ii) Transit shed charges		
First 3 days	MT per day	
First 7 days	MT per day	
7-21 days	MT per day	5.00
22-35 days	MT per day	10.00
After 35 days	MT per day	40.00
(iii) Open storage charges		
Hard Stand		
First 3 days	MT per day	
First 7 days	MT per day	0.00
7-21 days	MT per day	2.00
22-35 days	MT per day	4.00
After 35 days	MT per day	16.00
On Open Area		
First 3 days	MT per day	

Tariff Heads	Charge unit	Charges (INR)
First 7 days	MT per day	0.00
7-21 days	MT per day	1.00
22-35 days	MT per day	2.00
After 35 days	MT per day	8.00
(D) Composite Charges		
Movement of Over Dimensional Cargo	Per MT per km	1.50
Customs clearance convenience charges	Per MT	40.00
(E) Miscellaneous charges		
Crane, fork lift, bunkering of fuel, water supply, etc.	Of total revenue	
Crane (including Pontoon crane)		
5 MT capacity Crane	Per shift of 8 hrs	800.00
20 MT capacity Crane	Per shift of 8 hrs	2000.00
>20 MT capacity Crane	Per shift of 8 hrs	2500.00
Container Crane	Per hr	1100.00
Fork Lift (3MT capacity)	Per shift of 8 hrs	600.00
Electricity supply to Vessels		As per Electricity Board
Bunkering of fuel/ Petroleum Oil Lubricants		As per Market Rates
Water Supply	Per km	300.00
Sewage Disposal	Per km	100.00
Weighing scale	Per MT	5.00

In order to estimate the effective charge that the end users are expected to face, it is assumed that the margin charged by barge operators is Rs. 1.20 per MT per km.

FINANCING

The financing parameters considered for the study are as follows:

Suitable assumptions with relevant justification shall be made for any missing items.

Item	Unit	Value
Leverage Ratio	% Debt	70%
Moratorium	Quarters	2
Door-to-door Tenor	Years	15
Interest Rate	%	8%
Debt Drawal Start Quarter	No.	1
Debt Repayment Start Quarter	No.	22
Debt Repayment End Quarter	No.	60
Discount Rate (For NPV calculations)	%	16%

<u>OTHER ASSUMPTIONS</u>

Suitable assumptions with relevant justification shall be made for any missing items.

Tax Rate Assumptions

Type of Tax	Rate
Corporate Income Tax Rate	34.61%
Minimum Alternate Tax Rate	21.34%

<u>Final IRR Reporting:</u>

The consultant shall report the Project FIRR & EIRR considering different scenarios. Broadly the sensitivity shall include (but not limited to) following parameters as variable:

- Traffic (15-20% ± of projected divertible cargo, as at this stage the divertible cargo potential)
- Development Cost (15-20% ± of planned cost)
- Leverage Ratio (70:30 in base case, 10-15% ± in optimistic & pessimistic scenarios)

ANNEXURE 11.2 –COST OF DREDGING

Cost of Dredging (Gurupur River NW-43)

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Dredging in General Soil	Cum	430964	245	1055.86
2	Dredging in Hard Soil	Cum	0	963	0.00
	Total Cost of Dredging				**1055.86**

Cost of Dredging (Netravati River NW-74)

1	Dredging in General Soil	Cum	813683	245	1993.52
2	Dredging in Hard Soil	Cum	0	963	0.00
	Total Cost of Dredging				**1993.52**

ANNEXURE 11.3 –COST OF BANK PROTECTION WORKS ON RIVER

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks
1	Providing & making Gabion structure with Mechanically Woven Double Twisted Hexagonal Shaped Wire mesh Gabion Boxes as per IS 16014:2012,MORTH Clause 2500, of required size, Mesh Type 10x12 (D=100 mm with tolerance of ± 2%) Zinc coated, Mesh wire diameter 3.0 mm, mechanically edged/selvedged with partitions at every 1m interval and shall have minimum 10 numbers of openings per meter of mesh perpendicular to twist, tying with lacing wire of diameter 2.2mm, supplied @ 3% by weight of Gabion boxes, filled with boulders with least dimension of 200 mm, as per drawing, all complete	Cum	17400	3727.1	648.52	DSR 2021, Cl.no.16.94 Vo. II
2	Providing and laying geotextile 200 gsm as per technical specifications	Sqm	11380	225	25.61	WRD- SoR-Karnataka- Item No.58
3	Providing and fixing in position of perforated PVC pipe /filter of dia 100 mm including materials and labour etc. complete @ 100 m c/c	m	22	341	0.08	WRD- SoR-Karnataka- Item No.3.69
	Cost of Bank Protection Works for 500 m				674.20	
	Cost of Bank Protection Works for 1 m				1.35	
	Cost of Bank Protection Works for 100 m for 2 locations (Gurupur)				**134.84**	
Sl No.	**Item Description**	**Unit**	**Estimated Quantity**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**	**Remarks**
1	Providing & making Gabion structure with Mechanically Woven Double Twisted Hexagonal Shaped Wire mesh Gabion Boxes as per IS 16014:2012,MORTH Clause 2500, of required size, Mesh Type 10x12 (D=100 mm with tolerance of ± 2%) Zinc coated, Mesh wire diameter 3.0 mm, mechanically edged/selvedged with partitions at every 1m interval and shall have minimum 10 numbers of openings per meter of mesh perpendicular to twist, tying with lacing wire of diameter 2.2mm, supplied @ 3% by weight of Gabion boxes, filled with boulders with least dimension of 200 mm, as per drawing, all complete	Cum	17400	3727.1	648.52	DSR 2021, Cl.no.16.94 Vo. II
2	Providing and laying geotextile 200 gsm as per technical specifications	Sqm	11380	225	25.61	WRD- SoR-Karnataka- Item No.58
3	Providing and fixing in position of perforated PVC pipe /filter of dia 100 mm including materials and labour etc. complete @ 100 m c/c	m	22	341	0.08	WRD- SoR-Karnataka- Item No.3.69
	Cost of Bank Protection Works for 500 m				674.20	
	Cost of Bank Protection Works for 1 m				1.35	
	Cost of Bank Protection Works for 125 m for 2 locations i.e.250.0m (Netravati)				**337.10**	

ANNEXURE 11.4 –COST OF NIGHT NAVIGATION WORKS

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	RIS Centre				
1	Land Cost		1	1,50,000	1.50
2	Equipments		1	10,20,700	10.21
3	Tower & installation		1	7,50,000	7.50
4	Other Incidentals		1	8,50,000	8.50
	Total RIS Centre				**27.71**
B	AIS Base Station (One Number)				
1	Land Cost		1	10,00,000	10.00
2	Equipments		1	10,20,700	10.21
3	Tower & installation		1	7,50,000	7.50
4	Other Incidentals		1	8,50,000	8.50
	Total AIS Base Station				**36.21**
	Cost with GST & the Cost to be divided equally in Gurupur & Netravati				

Cost of Navigation Aid Works (Buoy & Lights) (Gurupur - NW-43

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Providing and laying 1.8 m dia. Polythene Buoy, Mooring Gear & fixing Lighting Equipments	No.	42	3,59,788	151.11
	Cost of of Night Navigation Works including GST				**151.11**
	The waterway shall cater to movement of Ro-Ro Vessel for Cargo , provision for Polythene buoys and accessories has been provisioned in the cost sheet.				

Cost of Night Navigation Works (Buoy & Lights) (Netravati - NW-74)

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Providing and laying 1.8 m dia. Polythene Buoy, Mooring Gear & fixing Lighting Equipments	No.	102	3,59,788	366.98
	Cost of of Night Navigation Works including GST				**366.98**

ANNEXURE 11.5 –COST OF LAND FOR Ro-Ro

A. GURUPUR

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Terminal (T)**				
1	Land Area Cost				
(i)	Land inside the terminal area	m^2	13643.00	1180.55	161.06
(ii)	Land required for Road Extension or construction of external approach road	m^2	2812.50	1180.55	33.20
2	Brick masonry wall in CM 1: 4 proportion . by volume for walls using burnt bricks from approved source including cost of all materials, machinery, labour, scaffolding, ramps, cleaning, batching and mixing mortar, packing mortar into joints, finishing, curing etc., complete with lead upto 50 m and lift upto 1.5 m. & additional lift beyond 1.5 m add Boundary wall 250 mm thk brick masonary surrounding the entire terminal on 3 sides except Ro-Ro terminal side. as per 5.22 of SOR, Karnataka	m^3	375.94	7255.82	27.28
3	Providing 12 mm thick cement mortar plastering in CM 1:3 proportion . by volume including cost of all materials, machinery, labour, scaffolding, cleaning joints, smooth finishing, curing etc., complete with initial lead upto 50 m and all lifts. & Providing and applying two coats of water proof cement paint of as per item 5.29.1 of SOR approved quality and colour including cost of all materials, labour, scraping and cleaning surface, scaffolding, curing etc., complete with all leads and lifts. as per item 5.27 of SOR, Karnataka -2018	m^2	1503.75	388.22	5.84
4	Carraiage of Material for item 2 & 3 @ 5% of the total cost of these items	%	---	5.00	1.66
5	Land Cutting/Excavation for 2.0 m depth Excavation for foundation in soft rock with-out blasting including 2.2. boulders upto 0.6 m diameter (0.113 cum) for dam, spillway, intake structure, surface power house and other appurtenant works and placing the excavated material neatly in specified dump area or disposing off the same as directed including cost of all materials, machinert, labour etc., complete with lead upto 1 km and all lifts. SOR Karnataka Item no.2.2 page 34 SOR 2018-19	m^3	27286.00	129.80	35.42
	Total Cost of Land & its Development				**264.45**

B. NETRAVATI

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Terminal (T)**				
1	Land Area Cost				
(i)	Land inside the terminal area	m^2	33065.00	1180.55	390.35
(ii)	Land required for Road Extension or construction of external approach road	m^2	375.00	1180.55	4.43
(iii)	Area under Mangrooves clearance	m^2	0.00	1180.55	0.00
2	Brick masonry wall in CM 1 : 4 proportion . by volume for walls using burnt bricks from approved source including cost of all materials, machinery, labour, scaffolding, ramps, cleaning, batching and mixing mortar, packing mortar into joints, finishing, curing etc., complete with lead upto 50 m and lift upto 1.5 m. & additional lift beyond 1.5 m add Boundary wall 250 mm thk brick masonary surrounding the entire terminal on 3 sides except Ro-Ro terminal side. as per 5.22 of SOR, Karnataka	m^3	375.94	7255.82	27.28
3	Providing 12 mm thick cement mortar plastering in CM 1:3 proportion . by volume including cost of all materials, machinery, labour, scaffolding, cleaning joints, smooth finishing, curing etc., complete with initial lead upto 50 m and all lifts. & Providing and applying two coats of water proof cement paint of as per item 5.29.1 of SOR approved quality and colour including cost of all materials, labour, scraping and cleaning surface, scaffolding, curing etc., complete with all leads and lifts. as per item 5.27 of SOR, Karnataka -2018	m^2	1503.75	388.22	5.84
4	Carraiage of Material for item 2 & 3 @ 5% of the total cost of these items	%	---	5.00	1.66
5	Land Cutting/Excavation for 2.0 m depth Excavation for foundation in soft rock with-out blasting including 2.2. boulders upto 0.6 m diameter (0.113 cum) for dam, spillway, intake structure, surface power house and other appurtenant works and placing the excavated material neatly in specified dump area or disposing off the same as directed including cost of all materials, machinert, labour etc., complete with lead upto 1 km and all lifts. SOR Karnataka Item no.2.2 page 34 SOR 2018-19	m^3	66130.00	129.80	85.84
	Total Cost of Land & its Development				**515.38**

ANNEXURE 11.6 –COST OF RIVERRINE STRUCTURES AT TERMINAL GURUPUR & NETRAVATI

A. GURUPUR

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ References
1.0	**RCC Concrete Works (M40 grade concrete)**					
	CONCRETE - Reinforced Cement Concrete of specified Grade M40 in different structural members above pile cut-off level.					
1.1	Providing and laying Vertical M40 Grade Concrete Piles of 1.4 m diameter					
	Vertical Piles					
	Grid A	No	7			
	Grid B	No	7			
	Grid C	No	7			
	Total Piles	cu.m	499			
1.2	Pile Caps (1800x1800x600)	cu.m	42.87			
1.3	Longitudinal Beams (1000x1250)					
	Grid A	cu.m	94.50			
	Grid A1	cu.m	94.50			
	Grid B	cu.m	94.50			
	Grid B1	cu.m	94.50			
	Grid C	cu.m	94.50			
1.4	Cross Beams (1800x1500)					
	grid 1 to 7	cu.m	327.44			
1.5	Deck Slab	Cu.m	415.80			
	Total Concrete	Cu.m	1757.37	9683.67	170.18	DSR 2018, Cl.no. 5.33.1 & 5.34.3. Rate updated with Wpi till Dec-2021.
2.0	**Steel Reinforcement**					
	REINFORCEMENT - High yield strength deformed bars Reinforcement Grade Fe500 in reinforcing cage including ring bars as detailed on the drawings					
2.1	Vertical Piles 1.2m dia	MT	74.81			
2.2	Pile Caps (1800x1800x600)	MT	5.14			
2.3	Longitudinal Beams (1000x1250)					
	Grid A	MT	17.01			
	Grid A1	MT	17.01			
	Grid B	MT	17.01			
	Grid B1	MT	17.01			
	Grid C	MT	17.01			
2.4	Cross Beams (1800x1500)					
	grid 1 to 8	MT	58.94			

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ References
2.5	Deck Slab	MT	49.90			
	Total Reinforcement	**MT**	**274**	103456.50	283.31	DSR 2018, Cl.no.5.22.4. Rate updated with Wpi till Dec-2021.
3.0	**Structural Steel works**					
3.1	Structural Steel hand rail with steel grade Fy=240 Mpa	MT	120	120065.0	144.08	DSR 2018, Cl.no.10.2 - Rate updated with Wpi till Dec-2021.
4.0	**Bollards**					
	Supply and fix in position cast steel bollards of working loads capacity of 40 ton, twin horn type of approved make, including galvanized holding down bolts, nuts, washers (80microns zinc coating) and painting as per specification and drawings complete.	MT	4	98309.70	3.93	As per Market rate. 7% escalation per annum
5.0	**Fenders**					
	Supply and fix in position fender system in the rear side of jetty structure from an approved manufacturer meeting the berthing energy absorption and reaction forces requirements given in technical specification and drawings for the following type of fenders. The rate include design, supply, installation, testing and commissioning of fenders and necessary fixtures such as chains, U bolts, fasteners etc., complete.	LS			35.00	
4	Carraige of construction Material for item 2 & 3 / Shuttering Materials/ Staging for shuttering, other miscellaneous @ 7% of the total cost of these items	%	---	---	44.55	
	Total cost of Riverrine Structures at RORO Terminal				**681.05**	

NETRAVATI

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ References
1.0	**RCC Concrete Works (M40 grade concrete)**					
	CONCRETE - Reinforced Cement Concrete of specified Grade M40 in different structural members above pile cut-off level.					
1.1	Providing and laying Vertical M40 Grade Concrete Piles of 1.4 m diameter					
	Vertical Piles					
	Grid A	No	11			
	Grid B	No	11			
	Grid C	No	11			
	Total Piles	cu.m	1,494			
1.2	Pile Caps (2000x1800x600)	cu.m	74.84			
1.3	Longitudinal Beams (1000x1250)					
	Grid A	cu.m	157.50			
	Grid A1	cu.m	157.50			
	Grid B	cu.m	157.50			
	Grid B1	cu.m	157.50			
	Grid C	cu.m	157.50			
1.4	Cross Beams (2000x1500)					
	grid 1 to 11	cu.m	523.91			
1.5	Deck Slab	Cu.m	740.88			
	Total Concrete	Cu.m	3620.64	9683.67	350.61	DSR 2018, Cl.no. 5.33.1 & 5.34.3. Rate updated with Wpi till Dec-2021.
2.0	**Steel Reinforcement**					
	REINFORCEMENT - High yield strength deformed bars Reinforcement Grade Fe500 in reinforcing cage including ring bars as detailed on the drawings					
2.1	Vertical Piles 1.2m dia	MT	235.23			
2.2	Pile Caps (1800x1800x600)	MT	9.43			
2.3	Longitudinal Beams (1000x1250)					
	Grid A	MT	29.77			
	Grid A1	MT	29.77			
	Grid B	MT	29.77			
	Grid B1	MT	29.77			
	Grid C	MT	29.77			

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ References
2.4	Cross Beams (1800x1500)					
	grid 1 to 8	MT	99.02			
2.5	Deck Slab	MT	93.35			
	Total Reinforcement	**MT**	**586**	103456.5	606.12	DSR 2018, Cl.no.5.22.4. Rate updated with Wpi till Dec-2021.
3.0	**Structural Steel works**					
3.1	Structural Steel hand rail with steel grade Fy=240 Mpa	MT	120	120065.0	144.08	DSR 2018, Cl.no.10.2 - Rate updated with Wpi till Dec-2021.
4.0	**Bollards**					
	Supply and fix in position cast steel bollards of working loads capacity of 40 ton, twin horn type of approved make, including galvanized holding down bolts, nuts, washers (80microns zinc coating) and painting as per specification and drawings complete.	MT	4	98309.70	3.93	As per Market rate. 7% escalation per annum
5.0	**Fenders**					
	Supply and fix in position fender system in the rear side of jetty structure from an approved manufacturer meeting the berthing energy absorption and reaction forces requirements given in technical specification and drawings for the following type of fenders. The rate include design, supply, installation, testing and commissioning of fenders and necessary fixtures such as chains, U bolts, fasteners etc., complete.	LS			35.00	
4	Carraige of construction Material for item 2 & 3 / Shuttering Materials/ Staging for shuttering, other miscellaneous @ 7% of the total cost of these items	%	---	7.00	79.78	
	Total cost of Riverrine Structures at RORO Terminal				**1,219.52**	

ANNEXURE 11.7 –COST OF STRUCTURES AT GURUPUR & NETRAVATI TERMINAL

Cost of Other Structures at Gurupur Ro-Ro Terminal						
S.No.	**Facility**	**Nos.**	**Size**	**Area (in Sq-m)**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
1	Open Mobility Area	1	60 m x 40 m	2400	7,002	168.04
2	Covered Storage Godown (Nominal)	1	40m x 20m	800	21,006	168.04
3	Vehicles Parking	1	15m x 10m	150	1,573	2.36
4	40' Container Stack Yard	1	40m x 20m	800	10,503	84.02
5	Parking for Handling equipments		15m x 10m	150	1,573	2.36
6	Main Parking Area	1	30m x 30m	900	1,191	10.72
7	Public Utility	1	6m x 4m	24	34,741	8.34
8	Weigh bridge	1	8m x 3m	24	2,95,000	70.80
9	Utility Room (Near Weigh Bridge)	1	3m X3m	9	34,741	3.13
10	Area under internal & external Roads	1	600m x 7.5m	4500	2,360	106.20
11	Administration building	1	12 m x 15 m	180	44,675	80.42
12	Staff Parking Area-4 wheelers	1	13.5m x 6m	81	1,573	1.27
13	Staff Parking Area-2 wheelers	1	8m x 2m	16	1,707	0.27
14	Security shed for watch and ward	2	4m x 4m	32	4,754	1.52
15	Electrical facility	1	5m x 5m	25	16,623	4.16
16	Fuel Bunkers	1	10m x 5m	50	6,556	3.28
17	Water Supply Room	1	3m x 4m	12	16,721	2.01
18	Fire and Safety Room	1	3m x 4m	12	21,638	2.60
19	DGPS receiver & transmitter shed	1	8m x 4m	32	7,839	2.51
20	DG shed	1	5m x 5m	25	7,839	8.00
21	Canteen with Store	1	12m x 8m	96	16,083	15.44
22	Sewerage Treatment Plant (STP)	1	15m x 15m	225	14,676	33.02
23	Overhead Tank	1	10m dia	100	2,269	2.27
24	Green Area	1		1000	944	9.44
25	Future Requirement	1		2000	708	14.16
	Total Area			**13643**		
	Total cost of Other Components					**804.37**

Cost of Other Structures at Netravati RORO Terminal						
S.No.	**Facility**	**Nos.**	**Size**	**Area (in Sq-m)**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
1	Open Mobility Area	1	75 m x 40 m	3000	7,002	210.06
2	Covered Storage Godown (Nominal)	1	40m x 20m	800	21,006	168.04
3	Vehicles Parking	1	15m x 10m	150	1,573	2.36
4	40' Container Stack Yard	1	40m x 20m	800	10,503	84.02
5	Parking for Handling equipments		15m x 10m	150	1,573	2.36
6	Main Parking Area	1	30m x 30m	900	1,191	10.72
7	Public Utility	1	6m x 4m	24	34,741	8.34
8	Weigh bridge	1	8m x 3m	24	2,95,000	70.80
9	Utility Room (Near Weigh Bridge)	1	3m X3m	9	34,741	3.13
10	Area under internal & external Roads	1	600m x 7.5m	4500	2,360	106.20
11	Administration building	1	12 m x 15 m	180	44,675	80.42
12	Staff Parking Area-4 wheelers	1	13.5m x 6m	81	1,573	1.27
13	Staff Parking Area-2 wheelers	1	8m x 2m	16	1,707	0.27
14	Security shed for watch and ward	2	4m x 4m	32	4,754	1.52
15	Electrical facility	1	5m x 5m	25	16,623	4.16
16	Fuel Bunkers	1	10m x 5m	50	6,556	3.28
17	Water Supply Room	1	3m x 4m	12	16,721	2.01
18	Fire and Safety Room	1	3m x 4m	12	21,638	2.60
19	DGPS receiver & transmitter shed	1	8m x 4m	32	7,839	2.51
20	DG shed	1	5m x 5m	25	7,839	1.96
21	Canteen with Store	1	12m x 8m	96	16,083	15.44
22	Sewerage Treatment Plant (STP)	1	15m x 15m	225	14,676	33.02
23	Overhead Tank	1	10m dia	100	2,269	2.27
24	Green Area	1		1000	944	9.44
25	Future Requirement	1		2000	708	14.16
	Total Area			**14243**		
	Total cost of Other Components					**840.35**

ANNEXURE 11.8 –COST OF APPROACH (EXTERNAL) ROADS

A. GURUPUR

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Terminal (T)**				
1	External Roads				
(i)	Pacca Road (7.5m wide road)	m	60.00	15000	9.00
2	Pipe Culvert on External Road			LS	3.50
	Sub-total 1				**12.50**
	Total Cost of Approach Roads				**12.50**

B. NETRAVATI

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Terminal (T)**				
1	External Roads				
(i)	Pacca Road (7.5m wide road)	m	50.00	15000	7.50
2	Pipe Culvert on External Road			LS	3.50
	Sub-total 1				**11.00**
	Total Cost of Approach Roads				**11.00**

ANNEXURE 11.9 – COST OF BANK PROTECTION WORKS AT TERMINAL

A. GURUPUR

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ reference
A	**Terminal (T)**					
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	10414.14	3727.10	388.15	DSR 2021, Cl.no.16.94 Vo. II
2	Providing and laying geotextile 200 gsm as per technical specifications	Sqm	6763.04	225.00	15.22	WRD- SoR- Karnataka- Item No.58
3	Providing and fixing in position of perforated PVC pipe /filter of dia 100 mm including materials and labour etc. complete @ 100 m c/c	m	22	341	0.08	WRD- SoR- Karnataka- Item No.3.69
4	Boundary wall 250 mm thk brick masonary (1:4)	Cum	370	7160.24	26.49	WRD- SoR- Karnataka- Item No.5.22
5	Carriage of Material @ 5% of the cost				21.50	
	Sub-total 1				**451.43**	
	Cost of Bank Protection Works				**451.43**	

B. NETRAVATI

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)	Remarks/ reference
A	**Terminal (T)**					
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	10414.14	3727.10	388.15	DSR 2021, Cl.no.16.94 Vo. II
2	Providing and laying geotextile 200 gsm as per technical specifications	Sqm	6763.04	225.00	15.22	WRD- SoR- Karnataka- Item No.58
3	Providing and fixing in position of perforated PVC pipe /filter of dia 100 mm including materials and labour etc. complete @ 100 m c/c	m	22	341	0.08	WRD- SoR- Karnataka- Item No.3.69
4	Boundary wall 250 mm thk brick masonary (1:4)	Cum	430	7160.24	30.79	WRD- SoR- Karnataka- Item No.5.22
5	Carriage of Material @ 5% of the cost				21.71	
	Sub-total 1				**455.94**	
	Cost of Bank Protection Works				**455.94**	

ANNEXURE 12.1 –IMPLEMENTATION SCHEDULE FAIRWAY

		Fairway Development - Gurupur River (NW - 43) & Netravati Rive (NW-74)																																			
Sl.No.	Items	(36 Months Commencing from 2023)																																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A	Fairway																																				
	1.a) Dredging																																				
	Ordinary Soils / Hard Soils (Approval & Tendering)																																				
	Ordinary Soils (4.31 Lakhs Cu. M)																																				
	1.b) Dredging																																				
	Hard Soils																																				
	2. Low Cost Riverine Structures (NIL)																																				
	3. River Training Works/ Bank Protection (350 m)																																				
	4. Night Navigation																																				
	Buoy / Lights (Approval & Tendering)																																				
	Buoy / Lights (144 Nos)																																				
B	Modification of Structures (01 HT Line)																																				
C	Communication System (NIL)																																				
D	Institutional Requirement																																				
	Office / Manpower (Establishment & Recruittment)																																				
	Office / Manpower (Deployment)																																				
	Vessels (Approvals & Tendering)																																				
	Vessels (Procurement & Deployment of Survey Vessel																																				
E	Environmental Management Plan																																				

ANNEXURE 12.2 –IMPLEMENTATION SCHEDULE RO-RO

Ro-Ro Terminal Development -02 Nos. - Gurupur River (NW - 43) & Netravati Rive (NW-74)

(36 Months Commencing from 2023)

Sl No.	Items	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
A	**Ro-Ro Terminal - 2 Nos. ***																																				
	Land Acuisition																																				
	Riverine Components (Jetty Structure)																																				
	Infrastructure Components																																				
	Infrastructure Components internal roads (Execution)																																				
	Approach Road Construction																																				
	Bank Protection Works for terminal (Approvals & Tendering)																																				
	Bank Protection Works for terminal (Execution)																																				
	Cargo Handling Equipments																																				
	Ambulance - 1 no.																																				
	Fork lift trucks 20 T Capacity - 3 nos.																																				
	Environmental Management Plan																																				
	Vessels																																				

LIST OF DRAWINGS

Gurupur:

Sl. No	DRAWING NAME	DRAWING NUMBER
1.	LAYOUT PLAN OF GURUPUR RIVER (01 SHEET)	P.010256-W-20301-A02
2.	TERMINAL LOCATION MAP OF GURUPUR RIVER (01 SHEET)	P.010256-W-20351-X02
3.	TERMINAL LAYOUT PLAN (WITH PROPOSED INFRASTRUCTURE FACILITY (01 SHEET)	P.010256-W-20311-A02
4.	RO-RO TERMINAL SECTION (01 SHEET)	P.010256-W-20341-E05
5.	BANK PROTECTION TYPICAL SECTION (01 SHEET)	P.010256-W-20303-X02

Netravati:

Sl.No	DRAWING NAME	DRAWING NUMBER
6.	LAYOUT PLAN OF NETRAVATI RIVER (5 SHEETS)	P.010256-W-20301-A05
7.	TERMINAL LOCATION MAP OF NETRAVATI RIVER (01 SHEET)	P.010256-W-20351-X05
8.	TERMINAL LAYOUT PLAN (WITH PROPOSED INFRASTRUCTURE FACILITY (01 SHEET)	P.010256-W-20311-A05
9.	RO-RO TERMINAL SECTION (5 SHEETS)	P.010256-W-20341-E05
10.	BANK PROTECTION TYPICAL SECTION (01 SHEET)	P.010256-W-20303-X05

LIST OF VOLUMES

Tractebel is a global engineering company delivering game-changing solutions for a carbon-neutral future. Insights gathered during our more than 150 years of experience in energy, urban, nuclear and water projects combined with local expertise allow us to tackle complex future-oriented projects. By connecting strategy, design, engineering and project management, our community of 5,000 imaginative experts helps companies and public authorities create positive impact towards a sustainable world, where people, planet and profit collectively thrive. With offices in Europe, Africa, Asia, the Middle East and Latin America, the company registered a turnover of 581 million Euros in 2020. Tractebel is part of the ENGIE Group, a global reference in low-carbon energy and services.

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