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DPR – KALI RIVER (53.415KM) NW-52

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RESTRICTED

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

Subject: **DETAILED PROJECT REPORT – KALI RIVER (53.415KM) NW-52**

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

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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 52 has 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 in Jan-2017.

Traffic Survey was carried out as detailed and summarized in Annexure 4.2. Terminal Land Survey was carried out at left bank of Kali river for locating proposed terminal at Virje situated downstream of Kadra Dam.

Geotechnical Borehole was carried out at “D/s of the Kadra Dam” in June 2017 & 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

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VOLUME-IV GEO-TECHNICAL INVESTIGATION REPORT

LIST OF ABBREVIATIONS

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

#	Particulars	Details		
A	**GENERAL**			
1	***Location***			
a	Cluster	Cluster-6		
b	State(s)	Karnataka		
c	Co-ordinates & Name of Place	**Start**	**End**	
	Place	Sadashivgad bridge	Kodasalli Dam	
	Latitude	14°50'33.5786"N	14°55'8.24"N	
	Longitude	74°07'19.7098"E	74°32'6.90"E	
B	**TECHNICAL**			
1	***Waterway***			
a	National Waterway Number	NW-52		
b	Class	IV (upto Ch 29.55km)		
c	Type (Tidal/Non-Tidal)	Tidal		
	Length (Km.)	**Total**	**Tidal**	**Non-Tidal**
		53.415	29.90km	23.415km
d	Average Tidal Variation, if applicable	1.35m upto 29.55km		

#	Particulars	Details			
e	Chart Datum				
	Description/Basis	Gauge 1	Gauge 2	Gauge 3	Gauge 4
	Value (from Zero of Gauge)	0.329	0.513	0.715	2.402

#	Particulars	Details					
F	LAD Status (w.r.t. CD)						
	LAD status (Observed LAD) Survey period (03 Jan to 29 Jan 2017.)	**Stretch-1 (km)**	**Stretch-2 (km)**	**Stretch-3 (km)**	**Stretch-4 (km)**	**Stretch-5 (km)**	**Total (km)**
	Stretch (From 0.00 To 53.415)	0.00–10.00	10.00-20.00	20.00-29.90	29.90-40.00	40.00-53.415	
	Length with LAD < 1.2 m	0.000	1.000	7.350	0.300	6.800	15.450
	With LAD from 1.2-1.4 m	0.000	0.000	0.000	0.00	0.450	0.450
	With LAD from 1.5-1.7 m	1.2000	1.800	0.450	0..400	0.000	3.850
	With LAD from 1.8-2.0 m	0.450	0.450	0.000	0.00	1.400	2.300
	With LAD > 2.0 m	8.350	6.750	2.200	9.30	4.750	30.900
	Total	10.000	10.000	10.000	9.550	13.40	52.950
	LAD status (w.r.t. CD) Survey period (03 Jan to 29 Jan 2017.)	**Stretch-1 (km)**	**Stretch-2 (km)**	**Stretch-3 (km)**	**Stretch-4 (km)**	**Stretch-5 (km)**	**Total (km)**
	Stretch (From 0.00 To 53.415)	0.00 – 10.00	10.00-20.00	20.00-29.90	29.90-40.00	40.00-53.415	
	Length with LAD < 1.2 m	-	-	-	0.000	4.400	4.400
	With LAD from 1.2-1.4 m	-	-	-	0.000	0.300	0.300
	With LAD from 1.5-1.7 m	-	-	-	0.000	0.450	0.450

#	Particulars	Details					
	With LAD from 1.8-2.0 m	-	-	-	0.000	0.000	0.000
	With LAD > 2.0 m	-	-	-	9.55	8.250	17.800
					9.55	13.400	22.95
G	Target Depth of Proposed Fairway (m)	1.35m upto Ch 29.55km					
H	Conservancy Works Required						

	Type of Work	Stretch-1	Stretch-2	Stretch-3	Stretch-4	Stretch-5
		(0.00-10.00)	(10.00-20.00)	(20.00-30.00)	(30.00-40.00)	(40.00-53.415)
	Dredging Required (Cum.) A total of 604997.0 cum for class-IV (Stretch-I to Stretch-III)- D/S of Kadra Dam.	**5005.8**	**23704.6**	**603470.5**	16395.4	3113257.3
	Bandalling	Nil	Nil	Nil	Nil	Nil
	Barrages & Locks	Nil	Nil	Nil	Nil	Nil
	River Training/Bank Protection (Km.)	450 m @ 6 locations Ch. 3.19 km; Ch. 11.12 km; Ch. 14.47; Ch. 15.53 km; Ch. 24.80 km and Ch. 27.20 km.				
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.	Dam	1	--	--
	Bridges	Rail/Road	4	20.0-30.0m	2.457-8.567m
	HT/Tele-communication lines	HT line	1	380.0m	15.00m
	Pipelines, underwater cables, etc.	Nil	Nil	Nil	Nil

#	Particulars	Details	
2	***Traffic***		
a	Present IWT Operations (type of services)	No terminal exists on Kali River. Local people are using small wooden boats for across the river movement. Apart from passenger movement, no other activities are happening on the river. Fishing is done, but on very small scale and consumed locally.	
b	Major industries in the hinterland (i.e. within 25 km. on either side)	Advance Petropole Processes & Aditya Birla Chemicals are the two industries in hinterland. Rests all are located more than 25kms away from river.	
c	Connectivity of major industries with Rail/ Road network (Distances/ Nearest Railway Stations etc.)	Major roads – SH 34 & SH 6 passes parallel to Kali River. NH 66 (Panvel-Kochi Highway) crosses the mouth of river at Karwar. Major railway – Konkan railway line runs across the river at Kanasgiri.	
d	Commodities	**In-bound**	**Out-bound**
1	Molasses & Other Liquids	Haliyal	Export
E	Future Potential (MMT)		

#	Particulars	Details				
	Name of Commodity	**5 yr. (Fy-20)**	**10 yr. (Fy-25)**	**15 yr. (Fy-30)**	**20 yr. (Fy-35)**	**25 yr. (Fy-40)**
1	Molasses & Other Liquids	13,000	13,000	13,000	13,000	13,000
3	***Terminals/Jetties***					
a	Terminal/Jetty	Passenger Ferry Terminal (03 Nos.) – Sadasivgad, Katne & Virje				
	Location (Bank/city/district)	14°53'50" N & 74°21'06" E D/s of Kadra dam				
	Type/Services	Passenger / Tourism Traffic				
	Facilities	Ambulance has been provisioned				
	Approach	Road is available				
	Land Ownership					
	Area (ha.)	0.123 ha at each terminal location (both Govt. and private land)				
4	***Design Vessel***					
a	Type	Passenger Ferry Vessels				
b	No. & Size	1 Passenger Ferry Vessel; Mono Hull Steel Boat/ FRP Boat - Size (L x B x D) – 13m x 2.0m x 0.8m (30 Pax); Engine: 1 Marine Outboard Engine of 150hp (approx); Speed: 12 Knots				
c	Loaded Draft	<1.8m				
d	Capacity	30 Passengers				
5	***Navigation Aids***					
a	Type	Buoy and Light				
b	Nos.	0				
b	Communication Facilities	Through RIS/AIS				
C	**FINANCIAL**					
1	***Project Cost***					

#	Particulars	Fairway	Ferry Terminal	Vessel
a	Capital Cost	Fairway	Ferry Terminal	Vessel
	Cost (INR in Cr) - Phase I	2.100	7.440	0.00
	Cost (INR in Cr) - Phase II	17.356	6.188	0.00
	Cost (INR in Cr) - Total	19.456	13.628	0.00
2	***Financial Internal Rate of Return (%)***	Fairway	Ferry Terminal	Vessel
A	For IWAI	-	-4.2%	NA
B	Operator		-	
3	***Economic Internal Rate of Return (%)***	Fairway	Ferry Terminal	Vessel
		-	3.3%	NA

EXECUTIVE SUMMARY

Kali River is one of the waterways declared as National Waterway in March, 2016 as NW-52. The Kali river rises near Diggi, a small village in Uttar Kannada district. The total length of Kali River is about 184 km from the origin up to its draining into Arabian Sea north of Karwar Port, in Uttara Kannada district of Karnataka state. The River flows entirely through the district of Uttara Kannada. The river is under tidal effect of the Arabian Sea (backwater effect) up to Kadra dam which is located at about chainage 29.90 km. Kali River has a relatively large catchment area and its tributaries are small feeder streams and canals. The total catchment area of Kali River is 5,104 sq. km.

The stretch of the river for about 54 kms from Kodasalli Dam, Lat 14°55'08"N, Long 74°32'07"E to confluence with Arabian sea near Sadasivgad Bridge at Lat 14°50'31"N, Long 74°07'21"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 Kali River of 53.415 kms from Lat 14°50'33.5786" N, Long 74°07'19.7098" 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. Based on the Hydrographic Survey data, the initial stretch up to Kadra Dam for about 30 kms is in Tidal Zone and having a water depth of > 1.7 m (LAD) for a considerable length (of about 7.2 kms). The rest of the stretch is in the submersion of ponding upstream of Kadra Dam, up to the end of the study stretch, which is D/s of Kodasalli Dam. It has been noticed that 3 Bridges and 1 HT Line are located in the initial stretch, which can be crossed without any difficulty, by considering the single lane operation. 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. The rest of the stretch is under the submersion of Kadra dam.

At the outset, it is to place that the study stretch of "Kali River" is segregated with the Kadra Dam at Ch. approx. 29.55 km. D/s of Kadra Dam is experiencing the Tidal effect. U/s of the Dam is having sufficient LAD, however the cargo volume support and hinterland connectivity have been observed as difficult.

Karwar Port exports presently 0.26 MMTPA of Molasses from the industries located at Haliyal, Dharwad etc in its hinterland having connectivity through Kali River. Cargo, Tourist, Passengers and Ro-Ro prospect has been explored for IWT movement on Kali River. No cargo has been found. Trucks are regularly moving between Northern Karnataka and Karwar Port; however, volume is too low to divert on River Kali as Ro-Ro cargo. Also, LCA depicts shifting to IWT from existing road movement is commercially unviable due to small river distance and multiple handling. No return cargo could be established. Presently local people are using country boats, volume is too low to justify the IWT development for passengers. River Kali holds potential to handle tourist traffic as tourism in the region is likely to grow in future. Developing IWT would attract more tourist footfalls in the region.

The project is proposed to be developed about 29.55 kms traversing through a moderately clustered habitant zone in the Karwar Town area and subsequently in the rural area. The balance stretch from Kadra Dam up to Kodasalli Dam is almost under the submergence of Kadra Dam. Through navigation is not possible without the provision of lock structure at Kadra Dam. Keeping in view of the above, the most amenable class will be Class IV waterway to facilitate the Passenger Ferry type of vessels, for the mobilization of the tourists in the vicinity.

The present study stretch in the Kali River has been limited to Class IV waterway from Arabian Sea to D/s of Kadra Dam. There is a proposed phasing of the project where the waterway of 10.0kms of length from the mouth of the sea near Sadasivgad bridge to Katne is to be developed as **Phase-I**, which is under fully tidal effect of the Arabian sea (backwater effect upto Kadra Dam at 29.55kms). It is being visualized that the project will have huge economic benefits for the local people in terms of following.

(i) Act as a enabler for river tourism in the catchment area.
(ii) Attract high end tourist footfalls with other anciliarry developments.
(iii) Provide tourist and residents of the region, the oppurtunity to experience the luxurious water-based tourism activities.
(iv) Add the sceneic beauty of the river/dam.
(v) Has the potential to open up other allied/ support industries in the region such as boat/ yacht building, boat yards, marine equipment manufacturing among the others.

Phase-II of the project shall be considered in due course from Katne (10.00km approx) to downstream of Kadra dam (29.55 kms downstream of Kadra dam). The infrastructure developed in phase-I shall help to incresae significant number of tourists in the region which may attract some good investments which may be manufacturing based or recreational purposes.

Terminal Infrastructure has been considered to suit to the ferry operation for tourists with the length of the Berthing structure as 14 m and width as 4.5 m for Sadasivgad & Katne ferry terminal location in Phase I development.

Terminal Infrastructure has been considered to suit to the ferry operation with the length of the berthing structure as 30 m and width as 8.0 m for Virje ferry terminal location near Kadra dam in Phase II development. So, there are three number of ferry terminals has been proposed for development in phased manner.
IWAI Terminal requirement has been considered with 1 Ferry terminal which has been proposed, keeping in view for development of tourism traffic. Geotechnical Investigations have been completed and the test results are placed at Volume IV.

Targeted depth of River Kali (NW-52) is considered as 2 m. Any passenger ferry vessel with less than 1.8 m draught is suitable for navigating in the defined stretch. The table below lists down the sample specifications of few vessel along with pictures that could be deployed in River Kali (NW-52).

Vessel Name	Length (m)	Beam (m)	Draught (m)	Capacity (Pax.)
FRP Water Taxi Without Engine	10.5	3.8	1.4	40
Catamaran Luxury 60-80 Seater Cruise Boat	14	5	0.5	60 - 80
Aditya 50	12-15	5-6		30 - 60
Solar Electric 30 Pax Ferry	12	3.5	1.2	30
Suncruise 40	12	5	1.2	30
ODC Marine, Mono Pax	12.2	4.2	1.2	36
Wantaim 14m Fast Ferry	14	3.2	1.2	45

Source: Consultant's Analysis

Any passenger ferry with less than 1.8m draught is suitable for navigating in the defined stretch, as targeted depth of River Kali (NW-52) is 2 m. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

For Mono Hull Steel Boat

- Size (L x B x D) – 13.0m x 2.0m x 0.8m
- Capacity – 30 Passengers (Seating Capacity)
- Engine - 1 Marine Diesel Outboard Engine of 150 hp (approx.)
- Speed – 12 Knots (Max)

For FRP Boat

- Size (L x B x D) – 13.0m x 2.0m x 0.8m
- Capacity – 30 Passengers (Seating Capacity)
- Engine - 1 Marine Diesel Outboard Engine of 150 hp (approx.)
- Speed – 12 Knots (Max)

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 suggested / recommended to establish a local office manned through a JHS and one or two support staffs through nearest Kochi office covering such development in Karnataka and Kerala having office infra requirements and an admin setup housed in the terminal building.

The project has been proposed to be phased for its development. There shall be two phases while the year of 2022 shall be proposed as the commencement year and the project implementation period shall be 02 years, ending in December 2023 of Phase I of the project. In phase I of the project the ferry operation shall be developed from Sadasivgad to Katne, which is 10 kms apart catering to tourism development with a nominal cost of 9.54 Crores (2.10 Crores for fairway development and 7.44 Crores for terminal development).

Phase II shall be considered for two years which is 2030 & 2031 and this is the period for extending the ferry services from Katne to Virje (downstream of Kadra Dam). Phase II is proposed to be extended from Katne to Virje (downstream of Kadra Dam). The distance from Katne to Virje is 19.55 kms approx is proposed to be developed at an additional investment of (17.356 Crores for fairway development and 6.188 Crores for terminal development).

The revenue factor, however, is to be considered along with the development of fairway in Kali River and also the passenger ferry terminal Sadasivgad & Katne in Kali River in phase I develioment.

The FIRR and EIRR have been worked out and the details are placed.

Project Modules	FIRR	EIRR
Fairway	---	---
Ferry Terminal	-4.2%	3.3%

The project does not have cargo transportation hence this aspect is not commercially and economically viable. Study stretches of 29.55kms of Kali River has been identified for development (D/s of Kadra Dam to Sadasivgad) for tourist related movement with Class IV system of the NW standards, however this is also not generating positive returns. A phased development for passenger ferry services is recommended. In the most optimistic scenario,

Phase I development of river Kali (NW-52) from Sadasivgad to Katne (10.0kms approx.) may be considered for the tourist service.

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 5200 km 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 meagre 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 (Tamil Nadu) 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	23.56	Karnataka
7.	**Kali River**	**NW-52**	**53.415**	**Karnataka**
8.	Netravathi	NW-74	30.000	Karnataka
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 Kali River (NW-52) 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 about the Kali River (NW-52) for a distance of 53.415km from the Arabian Sea mouth at Sadashivgad Bridge to upstream upto Kodasalli Dam. The detail description of the Kali River has been compiled in below Table.

TABLE 1-3: Description of Kali River (NW-52)

Sl No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Kali River (NW-52)
2	State/ District through which river passes	The Kali River passes through Uttara Kannada district of Karnataka state.
3	Length of the river / canal	Kali River or Kalinadi drains into Arabian Sea north of Karwar Port, in Uttara Kannada district of Karnataka state. The river rises near Diggi, a small village in Uttar Kannada district. Out of the total length of 184 km of Kali River, about 54 kms of the stretch of the river from Kodasalli Dam, Lat 14°55'08"N, Long 74°32'07"E to confluence with Arabian sea near Sadasivgad Bridge at Lat 14°50'31"N, Long 74°07'21"E has been declared as new national waterway. In this, 53.415kms of the stretch of the river from confluence of Kali river with Arabian Sea near Sadashivgad bridge at Lat 14°50'33.5786"N, Long 74° 07'19.7098"E is under consideration for Stage II study.
4	Map	The index map of Kali River showing proposed waterway stretch, topographic features and road networks are shown in Figure 1.1. The study stretch of the Kali River for the Detailed Project Report (DPR) is presented in **Volume-II Drawing No. P. 010256-W-20301-A04 (Sheet–8).**
Characteristic of River		
5	River Course	The river flows entirely through the district of Uttara Kannada. The total length of the river is about 184 km before joining the sea. The river is under tidal effect of the Arabian Sea (backwater effect) up to Kadra dam which is located at about chainage 29.55 km.
6	Tributaries / Network of Rivers / Basin	Kali River has a relatively large catchment area and its tributaries are small feeder streams and canals.
7	Catchment Area	The total catchment area of Kali River is 5,104 sq. km.

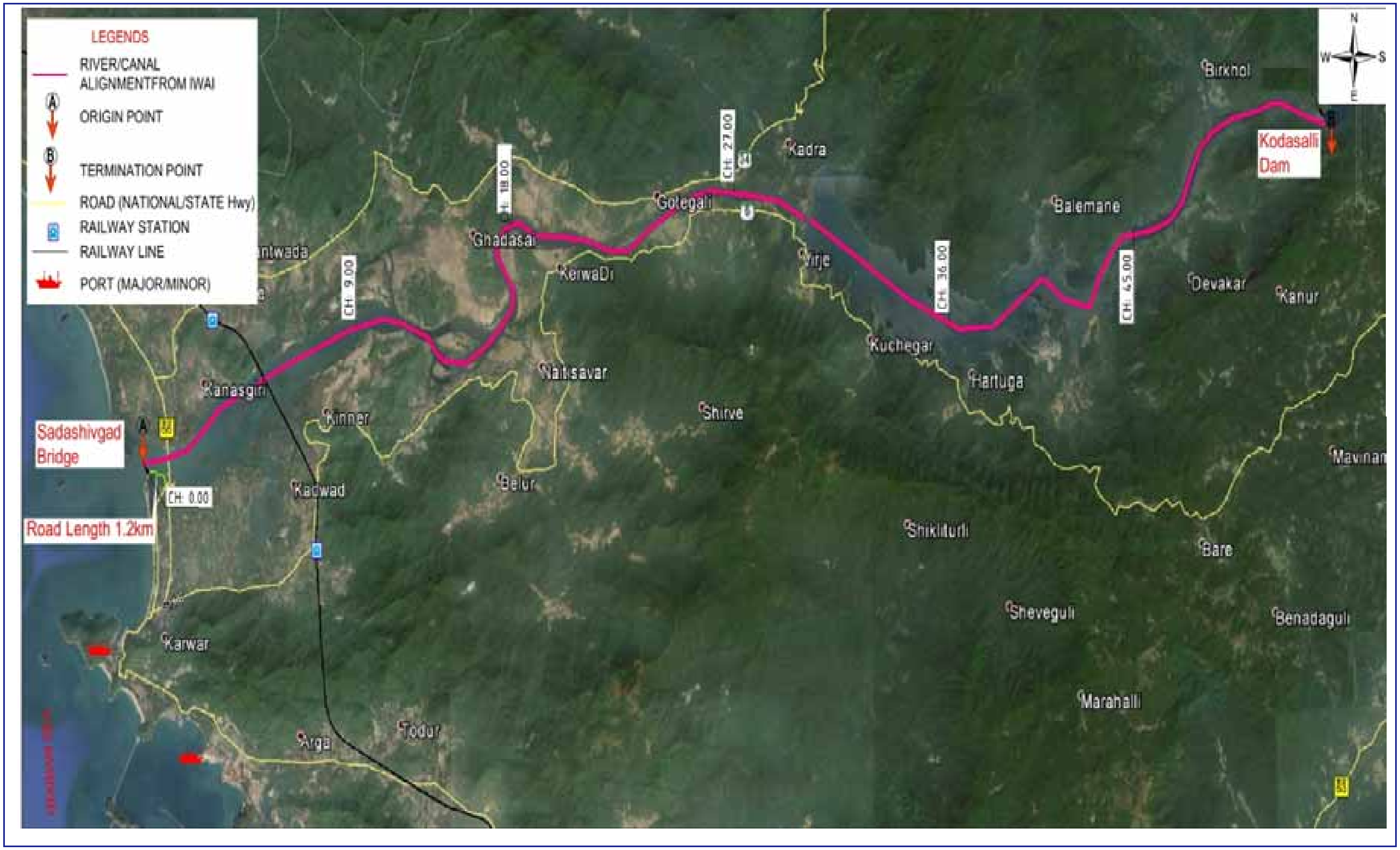


FIGURE 1-1 : INDEX MAP

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 are being carried out for one or more of the following activities like measurement of tides for sea coast works (e.g. construction of sea defence works, harbours 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

The Kali River or Kalinadi is a river that drains into Arabian Sea north of Karwar Port, in Uttara Kannada district of Karnataka state in India. The river rises near Diggi, a small village in Uttar Kannada district. The river is the lifeline to about 4 lakh people in the Uttara Kannada district and supports the livelihoods of tens of thousands of people including fishermen on the coast of Karwar. There are many dams built across this river for the generation of electricity. Kadra Dam is situated in Uttara Kannada district of Karnataka state in India. The dam is constructed across Kali River. The dam was primarily built as hydroelectric project for supply of water to turbines of electric power generating station. The full reservoir level (FRL) and Minimum Draw down Level (MDDL) of the Kadra Reservoir are 34.5m and 27m, respectively (Ref. http://india-wris.nrsc.gov.in/).

On the upstream of Kadra Dam (about 10km on the upstream of Kadra Dam), the Kaiga Atomic Power Station is located. The station utilizes Kadra reservoir water through an intake and exits upon usage through an exit channel.

Kodasalli Dam is built across the Kali River (Kalinadi) in Yellapura taluk of Uttara Kannada district of Karnataka state, India. This dam was built by Karnataka Power Corporation Limited. This electric power generating station is classified as hydroelectric power station.

The Kali River is bounded by Kalache, Birkhol, Devakar, Balemane, Hartuga and Kuchegar in the upper stretch, Virje, Kadra, Gotegali, KerwaDi, Ghadasai and Naitisavar in the middle stretch and Siddar, Halga, Hankon, Kinner, Kadwar and Kanasgiri in the lower stretch. The present study focusses on 53.415 km.

FIGURE 2-1: Catchment Area Map of Kali River (Source: Google Earth)

The catchment area of the river is about 5,104 sq. km (Ref. Ecological Status of Kali River Flood Plain; http://ces.iisc.ernet.in). The catchment area has been verified from Google Earth and has been found to be in order. The length of the longest stream of the river, inclusive of proposed NW-52 stretch, is about 184 km. The mean annual rainfall (MAR) in the Kali River Basin from 1901 to 1987 varies from upper catchment (MAR = 3187mm) to lower catchment (MAR = 848mm) (Ref. http://ces.iisc.ernet.in). The above figure indicates that significant portion of the river flows close to the coastal region and the lower stretch of river is tidal affected zone.

Hydro-morphological Characteristics

The combined study of hydrology and morphology gives a clear picture of hydro morphological 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 riverbed has been observed during the reconnaissance survey. It has observed that Gravelly Soil and Gravelly Red Soil are present in most part of the river under study stretch however rocky outcrops are visible along the river banks.

Formation of braiding pattern is popularly attributed to heavy sediment load in a river having a wide and shallow cross section. Rise in riverbed 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 riverbed 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 maximum width required, and maximum depth required has been given as 100 m and 2.75 m respectively for two-way navigation. Though the river Kali was classified as class V for the entire stretch i.e. up to Ch 53.415 km at the FSR stage, the present analysis has been relooked with the possibilities for 100 m width and 2.75 m depth.

Kali River (Ch 0.00 km - Ch 10.00 km)

The satellite image for the stretch of first 10 km for three time periods have been placed (February, 2009, December, 2013 and February, 2016).

FIGURE 2-2: River stretch from Ch 0.00km to 10.00km in February, 2009 (Source: Google Earth)

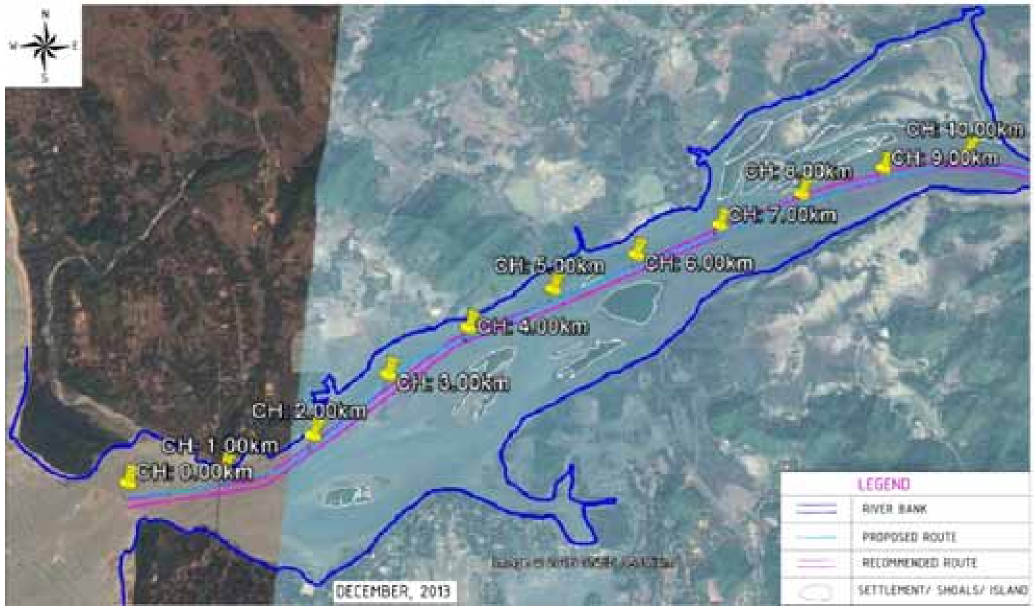


FIGURE 2-3: River stretch from Ch 0.00km to 10.00km in December, 2013 (Source: Google Earth)

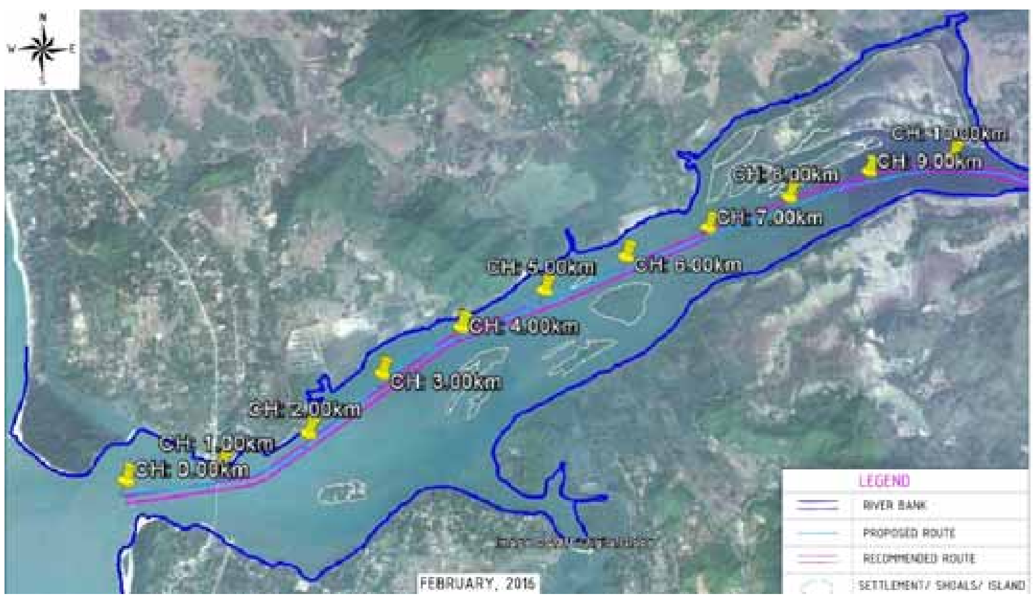


FIGURE 2-4: River stretch from Ch 0.00km to 10.00km in February, 2016 (Source: Google Earth)

The water depth is observed to be shallow throughout the stretch. In December, 2016, prominent effect of accretion is observed.

There are few smaller shoals between Ch 2.00 km and Ch 6.00 km. These shoals do not show any migration and therefore their relative positions remain same in the duration between February, 2009 and February, 2016. Some portions of these shoals are observed to be submerged as seen from the figure of December, 2013 when the water depth is shallow. Similarly some portions of the left bank are submerged which is visible with shallow depth. There is one island and two small shoals near Ch 9.00 km which show no migration during the above mentioned time period.

Kali River (Ch 11.00 km - Ch 20.00 km)

The satellite image for the stretch of next 10 km for three time periods have been placed (March, 2011, December, 2013 and February, 2016).

FIGURE 2-5: River stretch from Ch 11.00km to 20.00km in March, 2011 (Source: Google Earth)

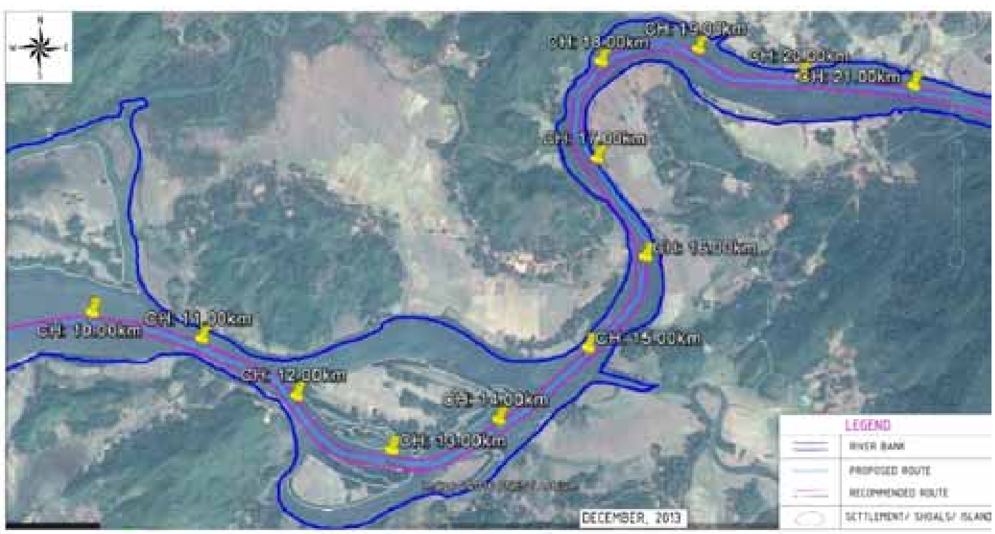


FIGURE 2-6: River stretch from Ch 11.00km to 20.00km in December, 2013 (Source: Google Earth)

FIGURE 2-7: River stretch from Ch 11.00km to 20.00km in February, 2016 (Source: Google Earth)

The water depth is observed to be shallow in some portions of the stretch in December, 2013. Minor effect of accretion is seen during this time period.

There is one big shoal and few small shoals present near Ch 13.00 km which show no migration in the above mentioned time period.

No other significant changes are observed.

Kali River (Ch 21.00 km - Ch 30.00 km)

The satellite image for the stretch of next 10 km for three time periods have been placed (December, 2013, December, 2014 and February, 2016)

FIGURE 2-8: River stretch from Ch 21.00km to 30.00km in December, 2013 (Source: Google Earth).

FIGURE 2-9: River stretch from Ch 21.00km to 30.00km in December, 2014 (Source: Google Earth).

FIGURE 2-10: River stretch from Ch 21.00km to 30.00km in February, 2016 (Source: Google Earth)

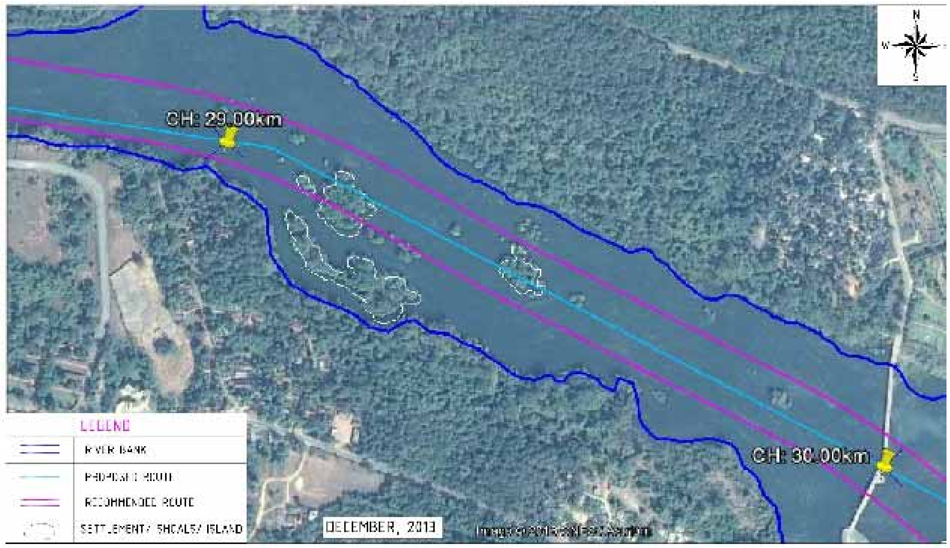


FIGURE 2-11: River stretch from Ch 29.00km to 30.00km in December, 2013 (Source: Google Earth

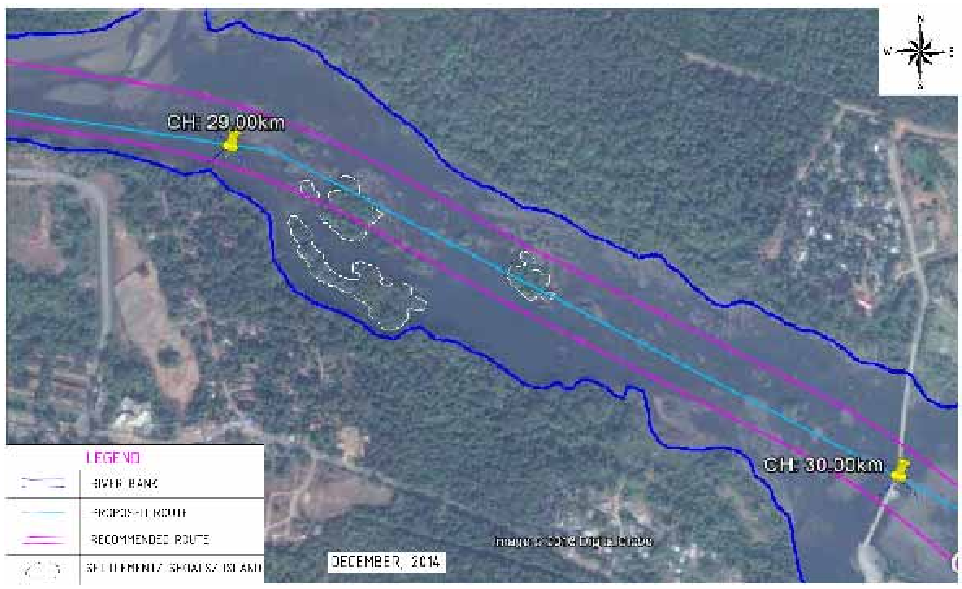


FIGURE 2-12: River stretch from Ch 29.00km to 30.00km in December, 2014 (Source: Google Earth

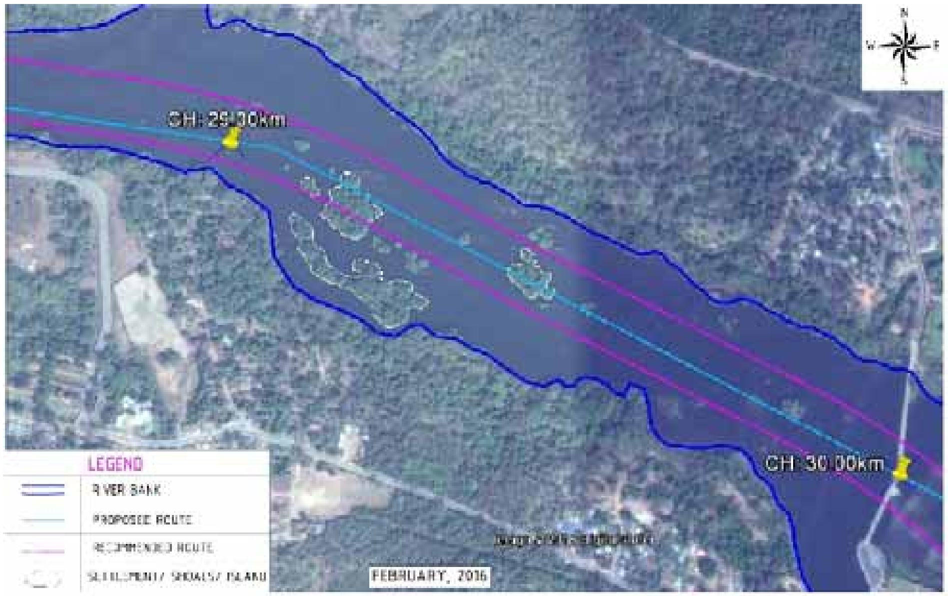


FIGURE 2-13: River stretch from Ch 29.00km to 30.00km in February, 2016 (Source: Google Earth)

There is one islet present near Ch 23.00 km. A very small shoal is present at Ch 26.00 km which shows some migration towards the right between 2013 and 2016. However with sufficient width available and the small size of shoal, no hindrance is expected in the waterway route. Smaller landmasses covered with mangroves are found between Ch 29.00 km and Ch 30.00 km. Dredging may be required for obstruction free waterway.

One tributary joins the right bank near Ch 29.00 km. Kadra Dam is present at Ch 30.00 km.

No other significant changes are observed.

Kali River (Ch 31.00 km - Ch 40.00 km)

The satellite image for the stretch of next 10 km for three time periods have been placed (February, 2009, December, 2013 and February, 2016).

FIGURE 2-14: River stretch from Ch 31.00km to 40.00km in February, 2009 (Source: Google Earth)

FIGURE 2-15: River stretch from Ch 31.00km to 40.00km in February, 2013 (Source: Google Earth)

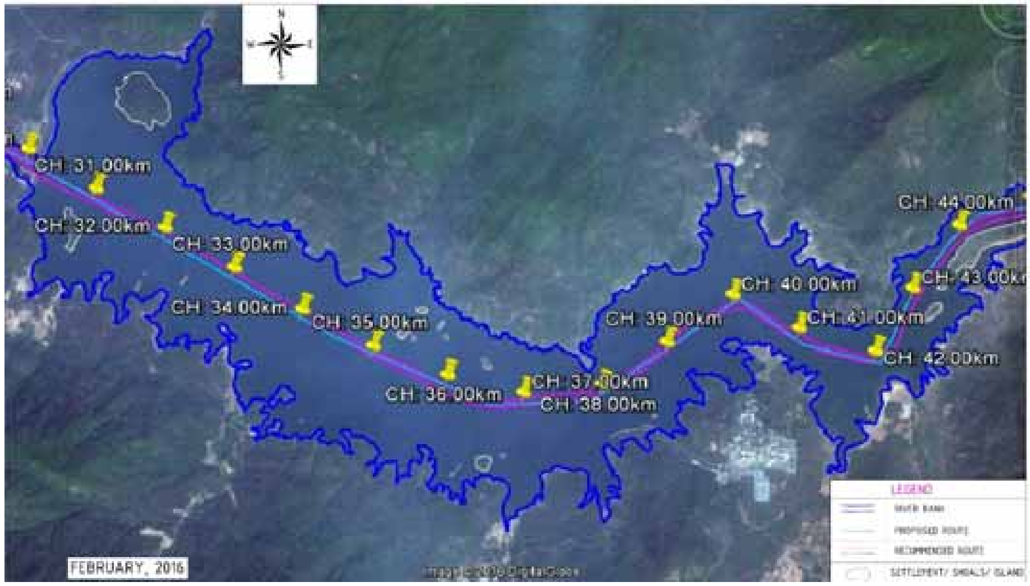


FIGURE 2-16: River stretch from Ch 31.00km to 40.00km in February, 2016 (Source: Google Earth)

With Kadra dam present at Ch 30.00 km, this stretch comes under Kadra reservoir. Therefore sufficient width and water depth is available here.

Kali River (Ch 41.00 km - Ch 53.415km)

The satellite image for the stretch of next 13.415 km for three time periods have been placed (February, 2009, December, 2013 and February, 2016).

FIGURE 2-17: River stretch from Ch 41.00km to 45.00km in February, 2009 (Source: Google Earth)

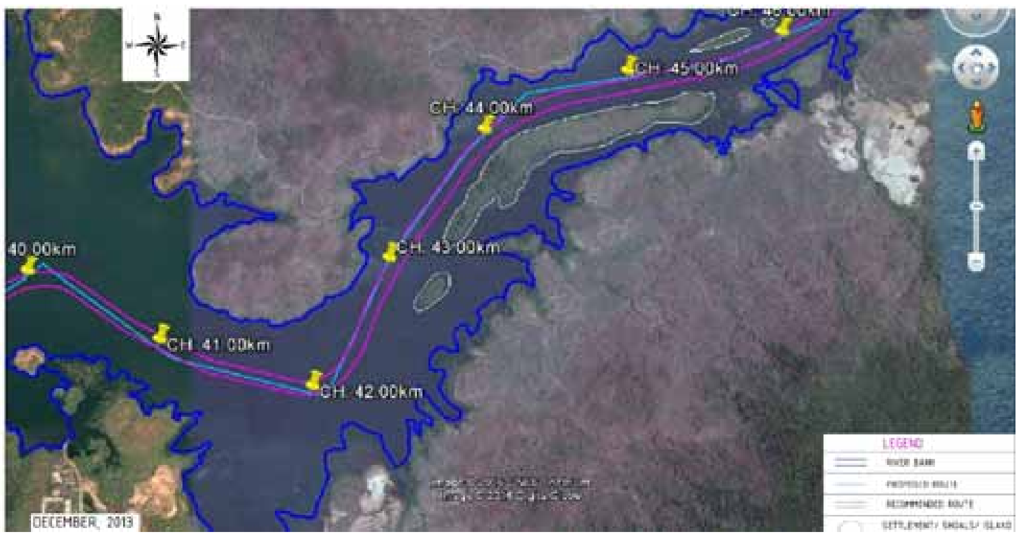


FIGURE 2-18: River stretch from Ch 41.00km to 45.00km in February, 2013 (Source: Google Earth)

FIGURE 2-19: River stretch from Ch 41.00km to 45.00km in February, 2016 (Source: Google Earth)

FIGURE 2-20: River stretch from Ch 46.00km to 50.00km in February, 2009 (Source: Google Earth

FIGURE 2-21: River stretch from Ch 46.00km to 50.00km in February, 2013 (Source: Google Earth)

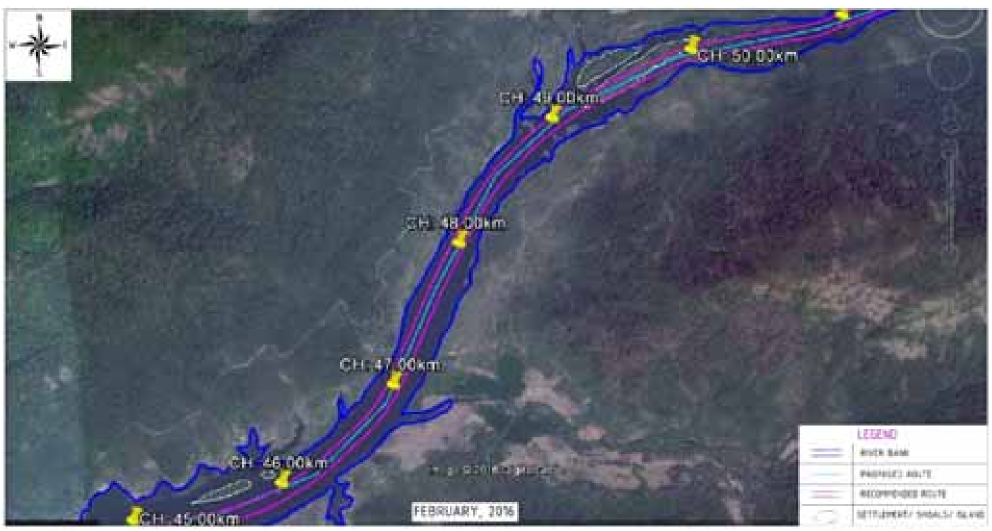


FIGURE 2-22: River stretch from Ch 46.00km to 50.00km in February, 2016 (Source: Google Earth)

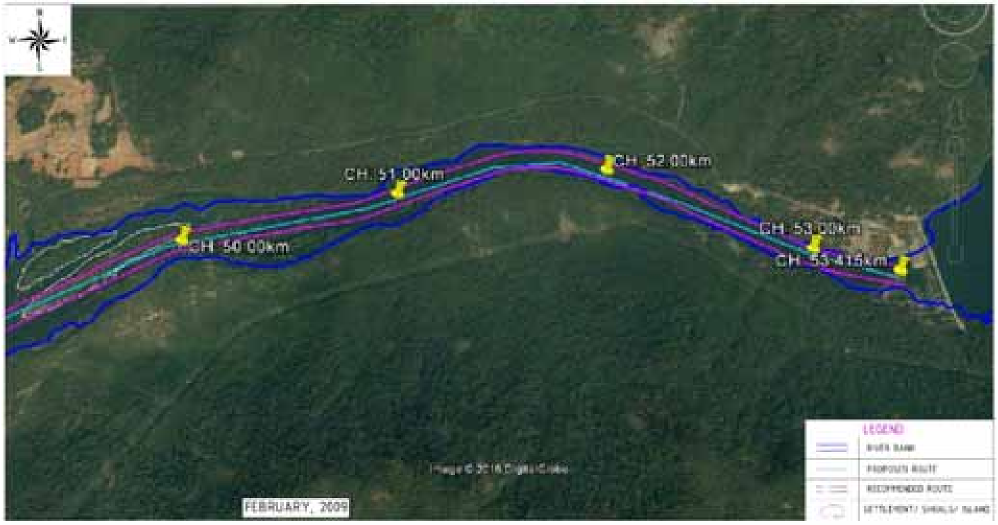


FIGURE 2-23: River stretch from Ch 50.00km to 53.415km in February, 2009 (Source: Google Earth)

FIGURE 2-24: River stretch from Ch 50.00km to 53.415km in February, 2013 (Source: Google Earth)

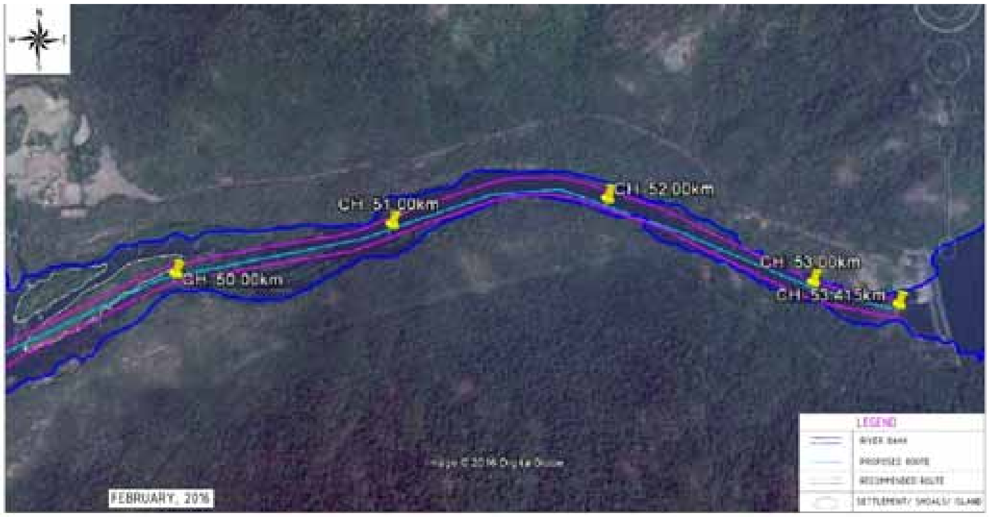


FIGURE 2-25: River stretch from Ch 50.00km to 53.415km in February, 2016

(Source: Google Earth)

There is one big shoal and few small shoals present between Ch 43.00 km and Ch 45.00 km which show no migration in the above mentioned time period. Two big settlements of soil covered with mangroves are present near Ch 50.00 km. Presence of mangroves is prominent across the river channel From Ch 49.00 km and Ch 51.00 km.

From the figures, it is observed that there is some deposition on the left bank upto Ch 44.00 km from 2009 to 2016.

2.1.2. Existing Hydrological / Topographical Reference levels

6.09m below a benchmark GTS BM cut on rock, towards SE from state office building, situated E of Karwar- Mangalore road, 15.69m from NE corner of small Maratha school of 22.93m from pakka well (This BM is 4.5m above IMSL).

TABLE 2-1Accepted BM coordinates

Bench Mark	Chainage (Km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	BM Height above MSL (m)	BM Height above CD/SD (m)
KR-1	0.97	14°50'22.46474"	74°07'50.02278"	406456.445	1640764.024	2.595	3.725
KR-2	9.43	14°52'21.42916"	74°12'07.68477"	414170.525	1644390.586	2.054	2.786
KR-3	22.2	14°53'23.93981"	74°17'15.29805"	423369.085	1646280.141	5.073	5.196
KR-4	29.55	14°53'51.07082"	74°21'06.11174"	430268.278	1647092.693	7.997	7.858
KR-5	35.2	14° 52' 56.0836"	074° 24' 8.1004"	435701.371	1645388.030	34.527	7.307
KR-6	46.3	14° 53' 58.0000"	074° 28' 55.2399"	444285.721	1647268.909	37.697	10.477

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 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											H- 533	
For Spring Tides												
Date and Time of 1st LW Observation at Established Gauge = 04.05.2018, 15.17hrs												
Sl. No.	Position of Established Gauge		Long	074° 07’ 50.1514” E			Position of Established Gauge		Long	074° 12’ 5.7266” E		
			Lat	14° 50’ 22.5471” N					Lat	14° 52’ 23.6317” N		
			Name	TP1 near KR1 BM					Name	TP2 near KR2 BM		
	At Established Gauge						At New Gauge					
	Height Above CD			Contribution for			Height Above zero of tide gauge				Contribution for	
	HW	LW	Factor	HW		LW	HW	LW	Factor		HW	LW
a		1.08	x	1		1.08		1.215	x	1		1.215
b	1.68		x	1	1.68		1.725		x	1	1.725	
c		0.34	x	3		1.02		0.507	x	3		1.521
d	1.88		x	2	3.76		1.951		x	2	3.902	
e		1.12	x	3		3.36		1.191	x	3		3.573
f	1.55		x	1	1.55		1.636		x	1	1.636	
g		0.44	x	1		0.44		0.521	x	1		0.521
	Sum of Contribution			6.99		5.9	Sum of Contribution				7.263	6.83
	Observed M. H.W.				1.75		Observed M.H.W.				1.82	
	Observed M.L.W.					0.7375	Observed M.L.W.					0.854
	Note : Observed MHW = Sum of Contribution of HW / 4											
	Observed MLW = Sum of Contribution of LW / 8											
	Observed Mean Range = R			=		1.01	Observed Mean Range = r				=	0.962
	R = M.H.W. - M.L.W.						r = M.H.W. - M.L.W.					
	Observed Mean Level = M'			=		1.2425	Observed Mean Level = m'				=	1.3348
	M' = (M.H.W +M.L.W.)/2						m' = (M.H.W.+M.L.W.)/2					
	Note : Observed Mean Range = Observed M. H.W. -Observed M.L.W.											
	Observed Mean Level = (Observed MHW + Observed MLW) /2											
	Calculation of Sounding Datum (d) at New Gauge											
	(A) Where 'True Spring M.L (M)' at						(B) Where 'True Spring M.L (M)' at					
	Established is known						Established is not known					
	From A.T.T (Table V of Part II)											
	MHWS =											
	MLWS =											
	True Spring M.L. (M) =			0.00								
	Note : True Spring M.L. (M) = (MHWS + MLWS)/2											

SD =	m' (M'-M) - M*(r/R)		SD =	m'-((M*r)/R)
SD =	0.00	m above of Zero of Gauge	SD = +0.151 m above of Zero of Gauge	

Transfer of Sounding Datum	H- 533

For Spring Tides

Date and Time of 1st LW Observation at Established Gauge = 04.05.2018, 15.17hrs

Sl. No.	Position of Established Gauge	Long	074° 07' 50.1514" E				Position of Established Gauge	Long	074° 17' 16.0176" E			
		Lat	14° 50' 22.5471" N					Lat	14° 53' 26.5493" N			
		Name	TP1 near KR1 BM					Name	TP3 near KR3 BM			
	At Established Gauge						At New Gauge					
	Height Above CD			Contribution for			Height Above zero of tide gauge				Contribution for	
	HW	LW	Factor	HW		LW	HW	LW	Factor		HW	LW
a		1.08	x	1		1.08		0.914	x	1		0.914
b	1.68		x	1	1.68		1.31		x	1	1.31	
c		0.34	x	3		1.02		0.01	x	3		0.03
d	1.88		x	2	3.76		1.556		x	2	3.112	
e		1.12	x	3		3.36		0.927	x	3		2.781
f	1.55		x	1	1.55		1.177		x	1	1.177	
g		0.44	x	1		0.44		0.01	x	1		0.01
	Sum of Contribution			6.99		5.9	Sum of Contribution				5.599	3.735
	Observed M. H.W.				1.75		Observed M.H.W.				1.4	
	Observed M.L.W.					0.7375	Observed M.L.W.					0.46687
	Note : Observed MHW = Sum of Contribution of HW / 4											
	Observed MLW = Sum of Contribution of LW / 8											
	Observed Mean Range = R			=		1.01	Observed Mean Range = r				=	0.9329
	R = M.H.W. - M.L.W.						r = M.H.W. - M.L.W.					
	Observed Mean Level = M'			=		1.2425	Observed Mean Level = m'				=	0.9333
	M' = (M.H.W +M.L.W.)/2						m' = (M.H.W.+M.L.W.)/2					
	Note : Observed Mean Range = Observed M. H.W. -Observed M.L.W.											
	Observed Mean Level = (Observed MHW + Observed MLW) /2											
	Calculation of Sounding Datum (d) at New Gauge											
	(A) Where 'True Spring M.L (M)' at Established is known						(B) Where 'True Spring M.L (M)' at Established is not known					
	From A.T.T (Table V of Part II)											
	MHWS =											
	MLWS =											
	True Spring M.L. (M) =			0.00								
	Note : True Spring M.L. (M) = (MHWS + MLWS)/2											
	SD =	m' (M'-M) - M*(r/R)					SD =	m'-((M*r)/R)				
	SD =	0.00	m above of Zero of Gauge				SD = -0.214 m below of Zero of Gauge					

For Spring Tides

Date and Time of 1st LW Observation at Established Gauge = 04.05.2018, 15.17hrs

Sl. No.	Position of Established Gauge		Long	074° 07’ 50.1514” E			Position of Established Gauge		Long	074° 17’ 16.0176” E		
			Lat	14° 50’ 22.5471” N					Lat	14° 53’ 26.5493” N		
			Name	TP1 near KR1 BM					Name	TP4 near KR4 BM		
	At Established Gauge						At New Gauge					
	Height Above CD			Contribution for			Height Above zero of tide gauge				Contribution for	
	HW	LW	Factor	HW		LW	HW	LW	Factor		HW	LW
a		1.08	x	1		1.08		0.59	x	1		0.59
b	1.68		x	1	1.68		1.149		x	1	1.149	
c		0.34	x	3		1.02		0.591	x	3		1.773
d	1.88		x	2	3.76		1.457		x	2	2.914	
e		1.12	x	3		3.36		0.62	x	3		1.86
f	1.55		x	1	1.55		1.048		x	1	1.048	
g		0.44	x	1		0.44		0.585	x	1		0.585
	Sum of Contribution			6.99		5.9	Sum of Contribution				5.111	4.808
	Observed M. H.W.				1.75		Observed M.H.W.				1.28	
	Observed M.L.W.					0.7375	Observed M.L.W.					0.601
	Note : Observed MHW = Sum of Contribution of HW / 4											
	Observed MLW = Sum of Contribution of LW / 8											
	Observed Mean Range = R			=		1.01	Observed Mean Range = r				=	0.6768
	R = M.H.W. - M.L.W.						r = M.H.W. - M.L.W.					
	Observed Mean Level = M'			=		1.2425	Observed Mean Level = m'				=	0.9394
	M' = (M.H.W +M.L.W.)/2						m' = (M.H.W.+M.L.W.)/2					
	Note : Observed Mean Range = Observed M. H.W. -Observed M.L.W.											
	Observed Mean Level = (Observed MHW + Observed MLW) /2											
	Calculation of Sounding Datum (d) at New Gauge											
	(A) Where 'True Spring M.L (M)' at						(B) Where 'True Spring M.L (M)' at					
	Established is known						Established is not known					
	From A.T.T (Table V of Part II)											
	MHWS =											
	MLWS =											
	True Spring M.L. (M) =			0.00								
	Note : True Spring M.L. (M) = (MHWS + MLWS)/2											
	SD =	m' (M'-M) - M*(r/R)					SD =	m'-((M*r)/R)				
	SD =	0.00	m above of Zero of Gauge				SD = +0.107 m above of Zero of Gauge					

2.2. Existing Waterway Structures

2.2.1. Bridges

There are three bridges present in the entire survey stretch of Kali River. The vertical clearance of the bridges before Ch 29.684km is sufficient for class IV vessels. However the vertical clearance at Ch 29.684km is not relevant as this bridge is located at just downstream toe of Kadra Dam up to which the waterway is recommended. This aspect has further been discussed in section 3.6 of this DPR.

TABLE 2-3: Details of Bridges

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 wrt MHWS/HFL	Remarks
01	Bridge (Under construction)	1.4km	U/C	Karwar	14°50'38.13"N 74°07'553.11"E	1641245.00 N 406550.59 E	U/C	U/C	U/C	U/C	U/C	--
02	Kali Bridge	1.81km	RCC	Edapally-Panvel Highway	14°50'40.7628"N 74°07'54.3698"E	406588.552E 1641325.749N	450.00	10	18	25	8.567	MHWS
03	Railway bridge	5.361km	RCC	Margaon-Mangalore Railway Bridge	14°51'51.7316"N 74°09'49.1632"E	410027.604E 1643493.252N	1200.00	6.0	40	30	7.227	MHWS
04	Kadra Dam DS road	29.684 km	RCC	Kaiga Dadra Bridge	14°53'48.4026"N 74°21'07.9058"E	430321.644 E 1647010.555 N	220.00	4.0	11	20	2.457	MHWS

MHWS (1.9 m as per Karwar port)

2.2.2. Electric Lines / Communication Lines

There is one high tension line present in the entire survey stretch of Kali 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 4.0 m to get the required clearance. Detail has been worked out in section 3.6.

TABLE 2-4: Details of HT lines

Sl. No.	Structure Name	Chainage (km)	Location	Position (Lat Long)	Position (UTM)	Horizontal Clearance (m)	Vertical clearance (m)	Remarks
01	HT LINE-1	11.0	Near Hulga Village	14°52'32.8471"N 074°12'53.8434"E	415528.772 1644578.622	380	15.0	MHWS

MHWS is + 1.90 m

2.2.3. Pipe Lines / Cables

There is no Pipe lines, under water cable present in the entire survey stretch of Kali River.

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

There are no Barrages, weirs, anicut, Locks etc. in Kali River in the entire survey stretch. However, Kadra is located at Ch 29.9km.

TABLE 2-5: Details of Dam

Sl. No.	Structure Name	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	Height w.r.t. to (MSL)	Present condition
				Left Bank	Right Bank	Left Bank	Right Bank				
1	Kadra Dam	29.9km	Kadra	14°53'34.1362"N 074°21'08.3821"E	14°54'40.4139"N 074°21'39.1762"E	5431260.562E 11646572.181N	5431260.562E 1648605.9N	2313.0	5.0	40.5	Operational

2.3. Bends

On the proposed waterway route, there are many bends in Kali River, which are given the table below. The radius of the river bends at some of locations may need smoothening. The bank protection work is proposed with the Gabions filled with rocks. The proposed Bank Protection works (each of about 75 m) length are to meet the vulnerable Bend locations at Ch. 3.19 km; Ch. 11.12 km; Ch. 14.47 km; Ch. 15.53 km; Ch. 24.80 km and Ch. 27.20 km.

TABLE 2-6: River Bend Radius in River

Sr. No.	Chainage (Km)	Radius
1	0.06	100
2	0.16	295
3	0.34	475
4	1.25	925
5	1.60	685
6.	2.09	730
7.	3.19	475
8.	4.40	1110
9.	5.11	765
10.	6.00	990
11.	8.01	845
12.	9.64	795
13.	10.45	667
14.	11.12	328
15.	12.14	605
16.	13.40	2100
17.	14.47	334
18.	14.94	600
19.	15.29	700
20.	15.41	500
21.	15.53	445
22.	16.55	685
23.	16.88	755
24.	17.14	680
25.	17.91	1060
26.	18.25	760
27.	19.47	465
28.	20.00	540
29.	21.29	1180
30.	24.80	345
31.	26.00	445
32.	27.20	290
33.	28.27	305

2.4. Velocity and Discharge Details

The details of Velocity and Discharge in the Kali River are given below in Table.

TABLE 2-7: Current meter discharge details

Stretch No.	Chainage (km)	Position		Observed Depth (m)	Velocity (m/sec)	X-sectional area	Discharge (cum/sec)
		Longitude (E) Latitude (N)	Easting (m) Northing(m)				
1	0.749	074°07'47.7076"E 14°50'25.3419"N	406387.592 1640852.697	2.0	0.3	Not aplicable due to tidal and pondage area	Discharge is total depend on high water and low water in tidal and in non-tidal stretch it is controlled by Dam Authority.
2	9.546	074°12'06.4238"E 14°52'30.5553"N	414133.846 1644671.127	1.0	0.3		
3	22.160	074°17'14.0727"E 14°53'31.9976"N	423333.262 1646527.834	2.0	0.3		
4	29.479	074°21'04.4503"E 14°53'59.6434"N	430219.404 1647356.228	0.5	0.3		
5	35.100	074°23'31.1459"E 14°52'58.9150"N	434597.373 1645478.009	3.0	0		
6	46.656	074°29'01.70"E 14°54'00.850"N	444475.588 1647356.234	2.0	0		

2.5. Waterway description

Kali River (Ch 0.00km – Ch 10.00km)

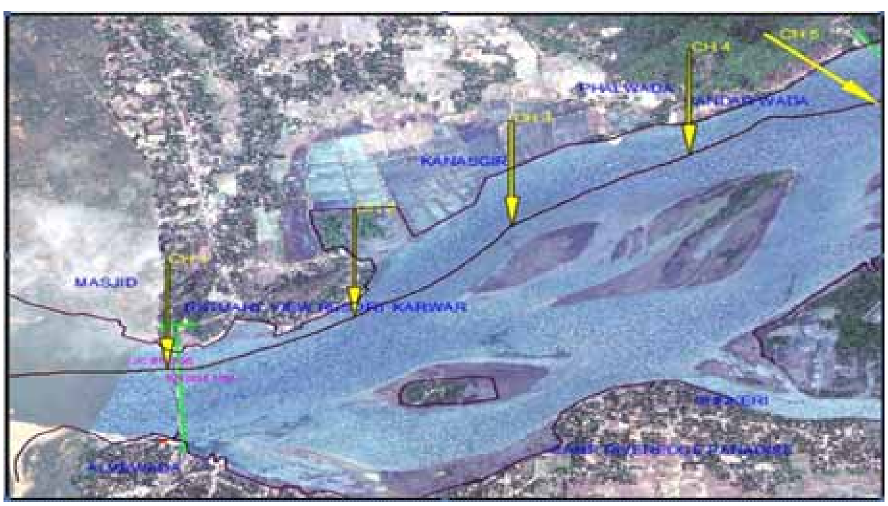


FIGURE 2-26: Kali River from Ch 0.00km to Ch 5.001km

FIGURE 2-27: Kali River from Ch 5.00km to Ch 10.00km

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

Chainage (km)		Observed					Reduced				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)
0	1	Tidal Area					2.20	6.36	0.00	0	0.00
1	2						1.63	5.94	0.15	0	0.00
2	3						1.60	4.96	0.15	22.56	22.56
3	4						1.62	3.36	0.15	4.5	27.06
4	5						1.28	2.75	0.15	913.74	940.80
5	6						0.73	3.76	0.15	7283.09	8223.89
6	7						1.80	4.80	0.00	0	8223.89
7	8						1.38	3.11	0.15	46.36	8270.25
8	9						2.19	2.82	0.00	0	8270.25
9	10						2.42	3.22	0.00	0	8270.25

The maximum and minimum LAD for the above mentioned stretch is given in the above table (as per class IV). The survey has been carried out from Arabian Sea Mouth near Karwar to Kodasalli Dam. There is one jetty on the right side of the river near Ch 1.00km. At Ch 1.04km there is a Bridge under construction and at Ch 1.81km there is an overhead road bridge. On the left of the bridge, there are Alvewada Village and Karwar. At Ch 5.30km there is a railway bridge, and at Ch 5.361km, Ch 6.50km, Ch 7.70km, and Ch 7.80km, the river exhibits divisions forming shoals in the river.

a) The banks of the River are mostly protected by the Local measure.

b) Land use on both the bank is mostly agriculture and Residential.

c) The local ferry is operated.

d) No cargo movements seen in the survey stretch

Kali River (Ch 10.00km – Ch 20.00km)

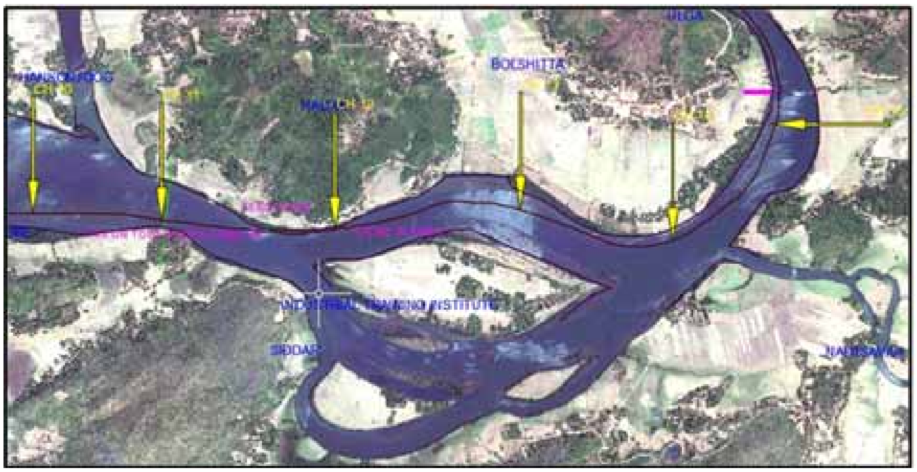


FIGURE 2-28: Kali River from Ch 10.00km to Ch 15.00km

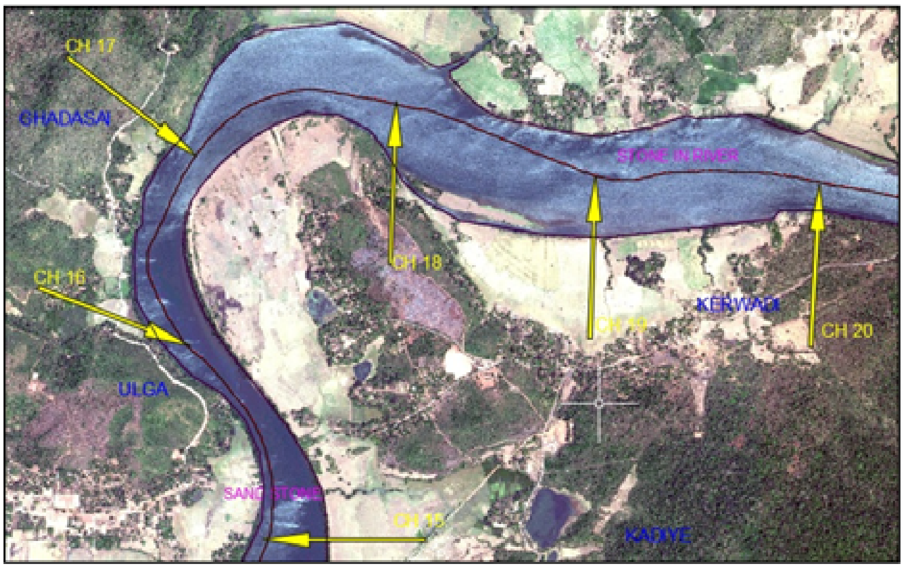


FIGURE 2-29: Kali River from Ch 15.00km to Ch 20.00km

TABLE 2-9: Reduced depth from Ch 10.00km – Ch 20.00km

Chainage (km)		Observed					Reduced				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)
10	11	Tidal Area					2.39	4.80	0.00	0	0.00
11	12						3.00	7.48	0.00	0	0.00
12	13						1.11	4.30	0.45	320.67	320.67
13	14						1.34	2.79	0.60	958.89	1279.56
14	15						1.90	13.76	0.00	0	1279.56
15	16						2.64	11.80	0.00	0	1279.56
16	17						2.00	11.36	0.15	0	1279.56
17	18						1.42	11.05	0.15	189.04	1468.60
18	19						1.49	2.96	0.45	635.67	2104.27
19	20						-0.01	2.86	1.05	20250.63	22354.90

The maximum and minimum LAD for the above mentioned stretch is given in the above table (as per class IV. At Ch 11.00km, there is an electric line on Tower with 20m vertical clearance. On the left, there is Halga Village and on the right, there is Industrial Training Institute. At Ch 11.85km, the river bifurcates due to the formation of shoal. At Ch 13.00km, there is Bolshitta Village on the right and on the left there is agriculture land area. In the river after Ch 14.50km, sand stones are present in the river. On the left Ulga, Ghadasai villages and on the right Kadiye and Kerwadi villages are existing. On the left side the area is sandy and on the right, the area is having grass on it.

The banks of the river are protected. While at the last end the bank is not protected.

a) The banks of the river are protected. While at the last end the bank is not protected.

b) Land use on both the bank is mostly agriculture and Little Residential.

c) No cargo movements seen in the survey stretch

Kali River (Ch 20.00km – Ch 29.9km)

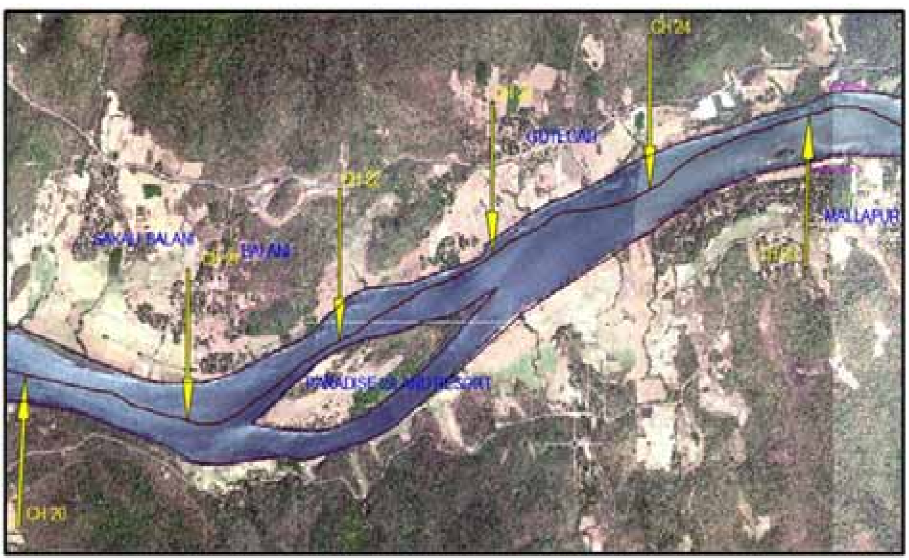


FIGURE 2-30: Kali River from Ch 20.00km to Ch 25.00km

FIGURE 2-31: Kali River from Ch 25.00km to Ch 29.9km

TABLE 2-10: Reduced depth from Ch 20.00km – Ch 29.9km

Chainage (km)		Observed					Reduced				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)
20	21	Tidal Area					0.97	3.75	0.45	13156	13156.00
21	22						0.41	4.82	0.75	13580.03	26736.03
22	23						0.28	3.20	0.75	19290.89	46026.92
23	24						0.15	3.29	1.05	11519.56	57546.48
24	25						-0.30	1.62	1.05	38394.48	95940.96
25	26						0.49	2.74	1.05	26028.32	121969.28
26	27						-0.30	3.34	1.05	36481.43	158450.71
27	28						-0.30	2.17	0.90	38369.85	196820.56
28	29						-0.30	0.95	1.05	93017.01	289837.57
29	29.9						-0.30	11.50	0.75	63659.61	353497.18

The maximum and minimum LAD for the above mentioned stretch is given in the above table (as per class III). On the right there are villages like Sakali Balani, Balani and Gotegali and on the left there is Mallapur village. The area on both sides of the river is residential and forest area. At Ch 21.40km, the river divides into two and form Paradise Island in the centre of the river. At Ch 29.9km, the Kadra dam is located which was primarily built as hydroelectric project for supply of water to turbines of electric power generating station.

On both sides of the river the area is having residential settlement as well as the forest cover. From Ch 26km to Ch 29km there are stones in the river. At Ch 28.25

there is a telephone line crosses over the river. At 29.3km one transmission line and one Bridge is there and at 29.9 there is Kadra Dam. Ch 29.7km to Ch 29.9km falls in Dam structure area. Both sides of the dam abutment area appear having forest cover.

a) The banks of the river are protected. While at the last end the bank is not protected, but firmed

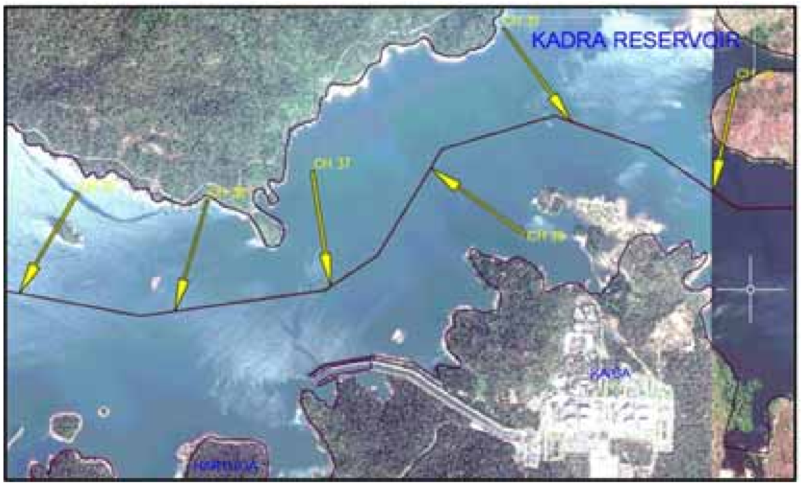


FIGURE 2-32: Kali River from Ch 29.9km to Ch 35.00km

b) Land use on both the bank is Little Residential.

Kali River (Ch 29.9km – Ch 40.00km)

FIGURE 2-33: Kali River from Ch 35.00km to Ch 40.00km

TABLE 2-11: Reduced depth from Ch 29.9km – Ch 40.00km

Chainage (km)		Observed					Reduced				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)
29.9	31	24.2	28.6	0.00	0	0	19.47	24.57	0.00	0	0.00
31	32	22.7	26	0.00	0	0	19.29	22.52	0.00	0	0.00
32	33	14.2	31.5	0.00	0	0	7.05	27.13	0.00	0	0.00
33	34	2.3	11.8	0.00	0	0	-0.30	7.09	0.15	28515.76	28515.76
34	35	13.9	22.6	0.00	0	0	5.71	18.25	0.00	0	28515.76
35	36	4.3	15.6	0.00	0	0	-0.30	11.02	0.15	3910.77	32426.53
36	37	8.1	20.8	0.00	0	0	3.39	17.02	0.00	0	32426.53
37	38	13.8	19.1	0.00	0	0	9.56	15.07	0.00	0	32426.53
38	39	12.3	17.2	0.00	0	0	6.01	12.68	0.00	0	32426.53
39	40	5.5	12.3	0.00	0	0	-0.30	5.17	1.00	51580.73	84007.26
40	41	10.6	12.6	0.00	0	0	0.50	4.55	0.45	3065.6	87072.86

The maximum and minimum LAD for the above mentioned stretch is given in the above table (as per class IV). On both sides of the river in this part the area is having forest and villages lie in this part are Virje, Kuchegar on the right. Chainage 29.7km to 29.9 km falls within the dam structure and thus survey of this portion contains the dam features. On the left side up to Kaiga area is in the forest cover. And on the right, the area is having a forest with Balemane village in it.

a) The banks of the river are protected. While at the last end the bank is not protected.

b) Land use on both the bank is Little Residential.

Kali River (Ch Ch 40.00km – Ch 53.415km)

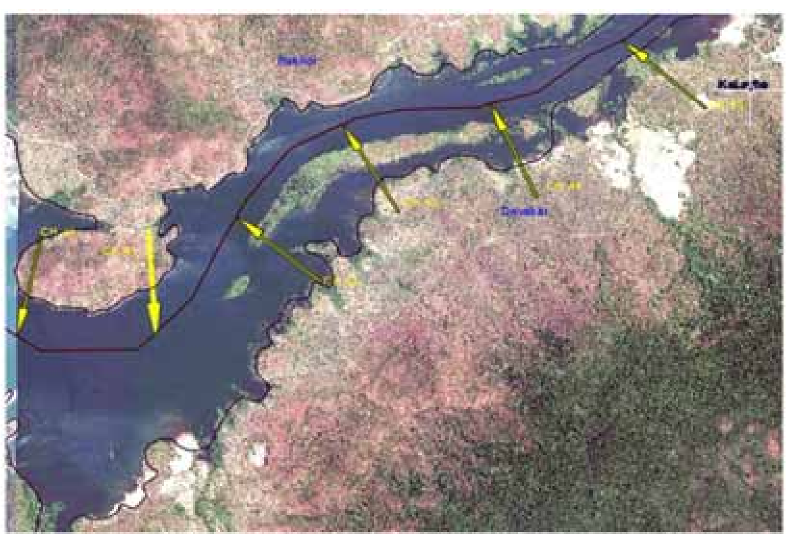


FIGURE 2-34: Kali River from Ch 40.00km to Ch 45.00km

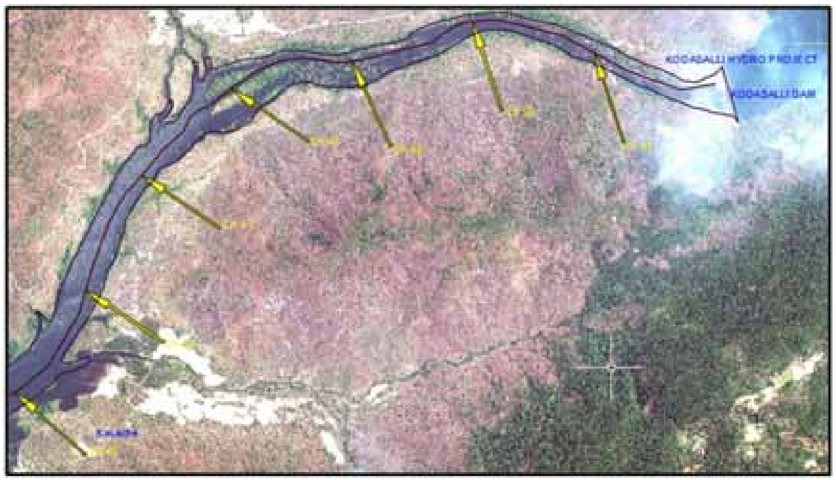


FIGURE 2-35: Kali River from Ch 45.00km to Ch 53.415km

TABLE 2-12: Reduced depth from Ch 41.00km – Ch 53.415km

Chainage (km)		Observed					Reduced				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accumulative Dredging Qty. (cu.m.)
41	42	2	9.3	0.00	0	0	-0.30	1.39	1.00	88739.79	88739.79
42	43	4.1	10	0.00	0	0	-0.30	2.39	1.00	126773.76	215513.55
43	44	3.9	9.8	0.00	0	0	-0.30	2.68	1.00	181820.27	397333.82
44	45	5.9	11.5	0.00	0	0	-0.30	4.21	1.00	92615.35	489949.17
45	46	3.2	6.8	0.00	0	0	-0.30	-0.30	1.00	242421.92	732371.09
46	47	2.7	6.6	0.00	0	0	-0.30	-0.30	1.00	309703.27	1042074.36
47	48	1.3	4.8	0.10	55.47	55.47	-0.30	-0.30	1.00	345117.67	1387192.03
48	49	1.5	4.2	0.15	7387.01	7442.48	-0.30	-0.30	1.00	380959.72	1768151.75
49	50	0	0	1.00	89265.89	96708.37	-0.30	-0.30	1.00	107403.56	1875555.31
50	51	0	0	1.00	104345.5	201053.9	-0.30	-0.30	1.00	125434.47	2000989.78
51	52	0	0	1.00	89053.82	290107.7	-0.30	-0.30	1.00	107051.45	2108041.23
52	53	0	0	1.00	104156.9	394264.5	-0.30	-0.30	1.00	125207.05	2233248.28
53	53.415	0	0	0.42	14757.37	409021.9	-0.30	-0.30	0.41	17740.03	2250988.31

The maximum and minimum LAD for the above mentioned stretch is given in the above table (as per class IV). On the right there are Baremane and Birkhol villages and on the left there is Kaiga and Devakar village. The area on both sides of the river is residential and forest area. The Kodsalli dam is located end of this stretch. On both sides of the river the area is having residential settlement as well as the forest cover.

2.6. Water and Soil Samples analysis and Results

TABLE 2-13: Water sample results

SAMPLE NO.	Chainage (km)	Latitude	Longitude	Depth (m)	WATER SAMPLES	
					Sediment concentration (ppm)	pH
1.	0.749km	14°50'25.3419"N	074°07'47.7076"E	3.0	190	7.84
2.	9.546km	14°52'30.5553"N	074°12'06.4238"E	1.0	93	7.57
3.	22.160km	14°53'31.9976"N	074°17'14.0727"E	1.4	21	7.28
4.	29.479km	14°53'59.6434"N	074°21'04.4503"E	0.25	33	7.52
5.	35.100m	14°52'58.9150"N	74°23'31.1459"E	5.0	29	7.61
6.	46.656m	14°54'05.3340"N	074°28'57.7235"E	2.0	31	7.42

The river water is slightly basic in nature with average pH being 7.54.

TABLE 2-14: Soil sample results

Sample No.	Chainage (km)	Specific Gravity	Latitude	Longitude	Grain size analysis (%)				Cu	Cc
					Mechanical Analysis		Hydrometer analysis			
					Gravel	sand	Silt	Clay		
1.	0.749km	2.68	14°50'25.3419"N	074°07'47.7076"E	4	90	1		2.88	1.307
2.	9.546km	2.67	14°52'30.5553"N	074°12'06.4238"E	6	87	7		-	-
3.	22.160km	2.65	14°53'31.9976"N	074°17'14.0727"E	8	86	6		1.025	0.975
4.	29.479km	2.66	14°53'59.6434"N	074°21'04.4503"E	5	39	38	18	-	-
5.	35.100m	2.65	14°52'58.9150"N	074°23'31.1459"E	7	48	67	12	-	-
6.	46.656m	2.66	14°54'05.3340"N	074°28'57.7235"E	7	87	6		95.6	1.28

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 Kali and Survey charts prepared have been referred. As per the data available, the 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 Ferry Service for tourist movement between Sadasivgad – Katne – Kadra Dam.

The initial stretch of about 30 kms is traversing through a moderately clustered habitant zone in the Karwar Town area and subsequently in the rural area. The balance stretch from Kadra Dam up to Kodasalli Dam is almost under the submergence of Kadra Dam. Through navigation is not possible without the provision of lock structure at Kadra Dam.

Keeping in view of the above, the most amenable class will be Class IV waterway to facilitate the Passenger Ferry type of vessels, for the mobilization of the tourists in the vicinity.

The present Study stretch in the Kali River can be limited to Class IV waterway from Arabian Sea to D/s of Kadra Dam. There is a proposed phasing of the project where the waterway of 10.0kms of length from the mouth of the sea near Sadasivgad bridge to Katne is to be developed as **Phase-I**, which is under fully tidal effect of the Arabian sea (backwater effect upto Kadra Dam at 29.55kms). The proposed project of waterways in phase-I between both the points present an oppurtunity for the tourists visiting one district to experience the serene waterways and traverse to another tourist destination. It is being visualized that the project will have huge economic benefits for the local people in term of following.

(i) Act as a enabler for river tourism in the catchment area.

(ii) Attract high end tourist footfalls with other anciliarry developments.

(iii) Provide tourist and residents of the region, the oppurtunity to experience the luxurious water-based tourism activities.

(iv) Add the sceneic beauty of the river/dam.

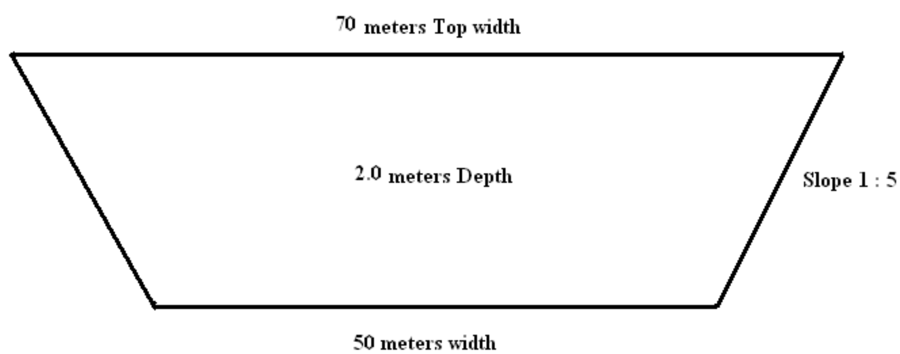
(v) Has the potential to open up other allied/ support industries in the region such as boat/ yacht building, boat yards, marineequipment manufactiring among the others.

Phase-II of the project shall be considered in due course from Katne (10.00km approx) to downstream of Kadra dam at 29.55 kms. The infrastructure developed in phase-I shall help to incresae significant number of tourists in the region which may attract some good investments which may be manufacturing based or recreational purposes.

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

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

CLASS 4



CLASS-IV

Chainage (km)		Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accum. Dredging Qty. (cu.m.)	Min. depth (m)	Max. depth (m)	Length of Shoal (km)	Dredging Qty. (cu.m.)	Accum. Dredging Qty. (cu.m.)
From	To										
0.0	10.0	Tidal Area					1.6	6.7	1.7	5005.8	5005.8
10.0	20.0						1.0	13.8	3.3	23704.6	28710.4
20.0	30.0						-7.1	5.5	7.8	603470.5	632180.9
		Total Estimated Vol. of Dredging (D/S Kadra Dam)					**-7.1**	**13.8**	**12.7**		**632180.9**
30.0	40.0	2.2	31.5	0.0	0.0	0.0	-1.1	28.9	0.3	16395.4	16395.4
40.0	50.0	0.0	12.6	1.8	117151.8	117151.8	-0.9	10.0	5.0	636936.3	653331.7
50.0	53.4	0.0	0.0	3.4	376848.3	494000.1	-11.2	2.3	3.4	2476321.5	3129653.2
Total		**0.0**	**31.5**	**5.2**		**494000.1**	**-11.2**	**28.9**	**8.6**		**3129653.2**

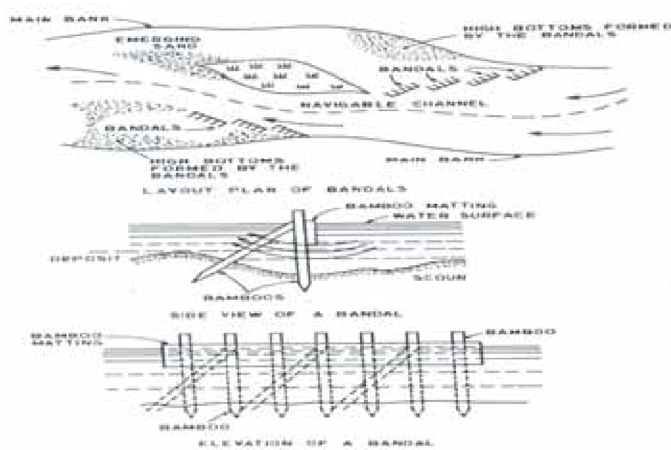
3.3. Proposed Conservancy Activities

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 submergence area.

3.3.2. Dredging

“Dredging” is the removal of sediments and debris from the bottom of lakes, rivers, harbours, 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 harbours). 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, inparticular between the Sea and Passenger Ferry Terminal (D/s of Kadra Dam @ Ch. 29.55km), dredging has been identified to maintain the channel for the mobility of Passenger Ferry vessel. The shoal length for Class IV waterway is 12,700 m with an estimated quantity of dredging as 6.32 Lakhs Cu. M. The total shoal length in full stretch of the water way (0.0 - 53.4 kms) is 21.3 kms however the proposed waterway for development is upto Kadra dam only i.e. 29.55 km only. Normally 10 % excess volume are allowed for depth variation/ fairway dimensional allowances however the excess deposited volume for time gap shall not be there as the silt deposition is generally flushed after the spillway operation of the dam the estimated quantity for dredging has been considered equivalent to the computed quantity of 6.32 Lakhs cum in section 3.2 above.

However, the quantity of dredging has been modified with respect to the actual length of waterway which is available till 29.55kms only. Also, as per dam safety norms, no dredging is normally allowed in the immediate downstream vicinity of the dam hence a length of 450m is not to be considered for dredging and a quantity of 4.3% has been reduced so the estimated dredged quantity is 6.05 Lakh cum.

In order to maintain a depth of 2.0 m, the dredging effort with respect to normal soil/ hard soil & occurance of hard rock has been examined in light of analysis of geotechnical investigation & physical features in the study stretch.

Borehole data has virtually little bearing on identification of strata for dredging which is basically deposited material (top soil). The total estimated quantity has been categorized as soft sandy soil. The area in immediate downstream vicinity of Kadra dam stretch has rock out crops however these area are in close proximity to the dam body and hence out of navigation way Hence the estimated quantity of dredged soil is segregated as follows:

Sl No.	Type of Dredged Material	Quantity (lakh Cum)
1.	Ordinary Soil	6.05
2.	Hard Soil	0.00
3.	Rock without Blasting	0.00
	Total	6.05

The dredging is proposed to be done in phases where about one sixth part may be considered in phase-I and the remaining dredging shall be required in the phase-II of the project.

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.

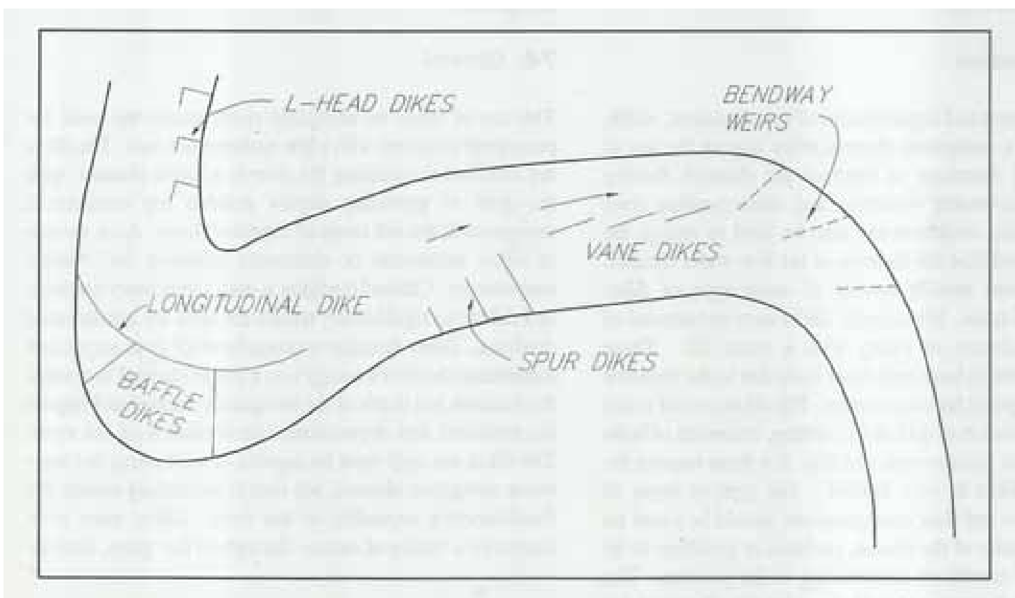


FIGURE 3-1: Types of dike structures

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.

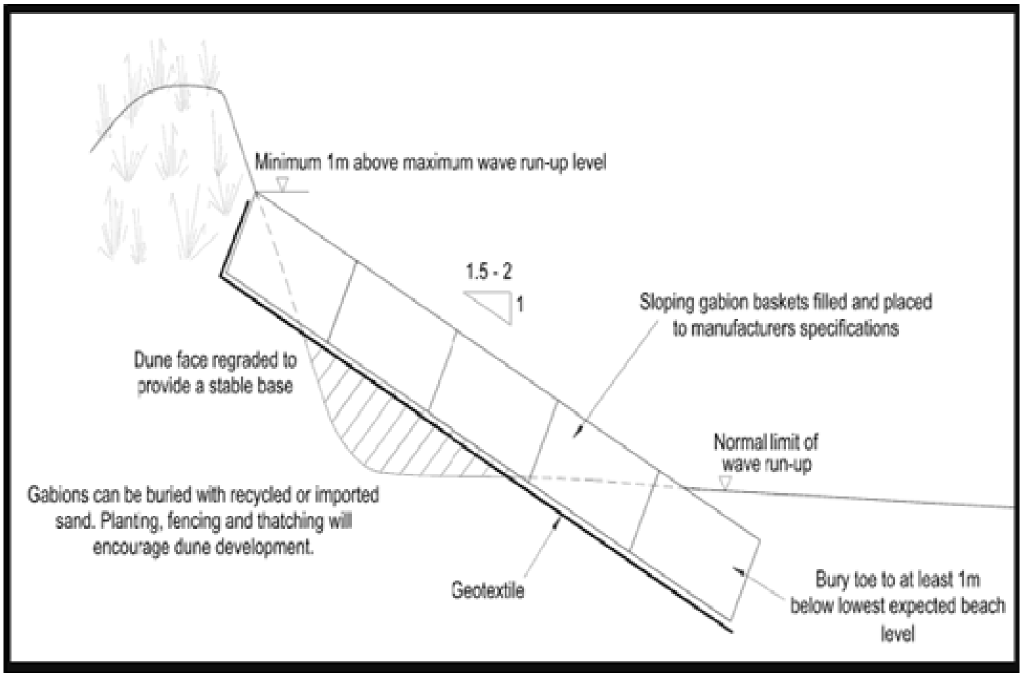
In the present study stretch, there is no need of any River Training requirements.

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, However the proposed dredging activity may have some nominal morphological disturbances, which in turn may lead to the aggravate vulnerability of bank erosion.

The proposed phasing in dredging operation shall be helpful to reduce the bank protection work and also the vulnerability of the banks shall considerably be reduced due to staggering of dredging operation in the study reach which otherwise may have negative impact on the morphological changes.

Keeping in view the above phenomenon, in the present study stretch of Kali River up to 29.55 Km a provision of 450 m (6 locations @ 75 m at each location) bank protection has been suggested. The protection work is proposed with the Gabions filled with rocks. The proposed Bank Protection works (each of about 75 m) length are to meet the vulnerable Bend locations at Ch. 3.19 km; Ch. 11.12 km; Ch. 14.47 km; Ch. 15.53 km; Ch. 24.80 km and Ch. 27.20 km. However, this Bank Protection work is suggested for execution only in Phase-II of the project development after observing the river morphological condition, bank condition at these locations and preferably after bulk of the dredging is complete. Also, Phase-II itself has been suggested after observing the traffic growth, if any.

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, the same can be considered at every 5 Kms all along the stretch in phase-I with alternative side of the River however the present waterway considered in phase I is about 10.0 kms only hence one number of this arrangement shall suffice. The location for its installation is to be finalized as per the availability of land which ideally be midway of the waterway length (approx 10.0kms) in phase-I.

The preliminary Design of Beacon & Light systems along with the specification are placed at Chapter 6, appropriately.

Regarding the Buoy & Light system, it is proposed to consider the same type of Buoy and Light deployed in NW 1, NW 2 & NW 3 with the details as sketched in the figure below. Further the Technical specifications of Buoy & Light, as available in the Market as a proprietary item are also detailed in Chapter 6.

However, this Buoy & Light system is suggested for execution only in Phase 2 after observing the requirements. Phase 2 itself is suggested after observing the traffic growth, if any.

Keeping in view the 4 nm light and considering the clear visibility range as 8000 m, the interval can be considered as 5000 m. Hence, it is proposed to work out the requirement with 5000 m interval and in Zig-zag position (i.e., 1 Left Shore Mark then 1 Right Shore Mark and 1 Left Shore Mark). Accordingly, it is estimated to provide 01 No. in the initial phase 1 stretch upto ch.10.00 kms. No such arrangement is proposed in the subsequent phase as the waterway is primarily used to cater tourist movement, hence night navigation is not needed and this cost has been removed from the cost sheet.

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

In the present study stretch, 3 Bridges are there of which the Bridge @ Ch. 1.40 km is under construction. Vertical Clearance at the other 2 Bridge locations i.e., @ Ch. 1.81 and Ch. 5.361 km is > 6 m. The Horizontal clearance may not be sufficient, however with single lane channel there will not be any constraint and hence, no such modification is suggested.

In the present study stretch, HT Line @ Ch. 11.0, can be modified by tightening the strings or as suggested by state electricity utility. 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 waterway is proposed to be developed in two phases. Phase I is to be considered for Ferry service operation from Sadasivgad to Katne for about 10.0 kms catering to tourism development with a nominal cost of 9.54 Crores (2.10 Crores for fairway development and 7.44 Crores for terminal development).and phase II of the project is extension of ferry services from Katne to Virje 19.5 kms approx at an additional investment of (17.35 Crores for fairway development and 6.188 Crores for terminal development).

Phase I is proposed to be implemented in FY: 2022-23 & Phase II is suggested to commence from 2030, with development 0eriod of 24 months from FY: 2030-31, only after critical observation/ analysis. Investment is suggested only with positive growth and confirmations. The total capital cost for the fairway has been considered for 6.05 Lakhs Cu. M of Dredging in soil costing (INR 1.73 Cr. In Phase I & 13.09 Cr. In Phase II totalling INR 14.82 Cr.); 450m of Bank Protection at 6 Locations {INR 2.57 Cr. In Phase II} and navigational aid for 16.0 Lakhs in Phase I of the project development.

Detail of 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

Kali River flows through Uttar Kannada district of Karnataka State in India. The river originates near Diggi, a small village in Uttara Kannada district and flows through Supa, Yellari and Karwar talukas before merging with the Arabian Sea.

The length of the river as given by IWAI is about 54 km, whereas navigable length is limited to the D/s of Kadra Dam at about 29.50km. Survey has been conducted in this area and it was found that the navigable length of the river does not include Kadra dam at chainage 29.55 km. Based on the deepest bathymetry single line survey carried out during the study and as per the classification of "Inland waterways" by Ministry of Shipping, Govt. of India notification, it can be classified as "Class IV" for the entire study stretch.

Below figure shows the location of Kali River in Uttara Kannada, its hinterland with talukas & road connectivity of the region.

FIGURE 4-1: Mapping of hinterland for Kali River

4.2. Influence area / Hinterland Analysis

Primary Hinterland

Hinterland of Kali River includes the areas, which are located within 25 km from the river. This would be considered as primary hinterland. Karwar, Ankola, Suppa & Yellapur talukas of Uttara Kannada and Sanguem, Canacona & Quepem talukas of South Goa come under the primary catchment area of Kali River. The cargo of this region will definitely be using Karwar Port, which is one of the biggest non-major ports in Karnataka. At present, most of the industries in this region transport their goods by road or railway from Karwar Port to destination. Target of this study is to analyze the flow of goods between industries & port and possibility to divert this movement to waterways from rail/road.

Secondary Hinterland

Apart from Uttara Kannada, Bellary District would also be analyzed under this study, because many of the industries situated here do their EXIM trade via NMPT or MPT. Bellary would be considered as secondary catchment area for Kali river. Industries transport from/to port by rail or roadways. Target of this study is to analyze the flow of goods between industries & port and look whether this movement could be diverted to waterways from rail/road or not.

FIGURE 4-2: Kali River

4.2.1. Population of Hinterland Area

- **Primary Hinterland**

Uttara Kannada, largest hinterland of Kali River is one of the biggest districts of Karnataka with plentiful of natural resources. It is located in the coastal area. Fishing related activities are carried out on large scale in this district with the support of State & Central government. Agriculture is the main occupation of rural people. Out of total population of the district, 71% population lives in rural areas. 38% of total population is involved in agriculture activities. Agriculture, Animal Husbandry, Fisheries, Sericulture, Horticulture, Beekeeping & Leather works are the traditional occupation of this district. The two major projects of the district are Hydro Electric Power Project and Nuclear Power Project. One of the important Hydro Electric Power Projects exists on Kadra Dam, which is situated on Kali River.

South Goa, a part of hinterland of Kali River is mineral rich district. In this region, there are total 94 villages, 35 in Quepem, 8 in Canacona & 51 in Sanguem. Fishing is the main occupation of people here. Out of total 39 marine villages along the coast of Goa, 23 villages are located in South Goa with 20 landing centres of fishing and 13 centres are located in North Goa. 65% of population involved in fishing activities resides in South Goa & remaining 35% population live in northern Goa. Large population, which is under poverty line, lives in South Goa. Infrastructure related to fisheries in Goa is poor. There are only 4 ice factories and one boat yard in whole Goa. Amongst the 4 ice factories, 3 are located in South Goa.

Total population of Uttara Kannada is 14.37 mn, out of which 1.44 mn are male & 0.13 mn are female. Talukas that come under the primary hinterland of Kali River contributes around 0.39 mn in total population of Uttara Kannada.

TABLE 4-1: Population & Area under catchment area of Kali River

Region	Taluka	Total Population	Area (Sq. M)	Uttar Kannada	
				GDP	District Density (People / Sq. Km)
Uttara Kannada	Karwar	155,143	55,213	6,265	140
	Supa	52,013	52,012		
	Yellapur	78,091	78,662		
	Ankola	107,428	107,332		
South Goa	Quepem	81,193	43,731		233
	Sanguem	65,147	88,660		77
	Canacona	45,172	34,736		125

Source: Census of India, 2011

6.41 mn is the total population of South Goa, out which 30% population live in Quepem, Sanguem & Canacona talukas of northern hinterland of Kali River. The northern part of South Goa is far; hence it would be considered as secondary catchment area for Kali River.

- **Secondary Hinterland**

The talukas of Uttara Kannada and Bellary which are far from Kali River could be potential market for Kali River; hence they would be studied as Secondary hinterland for Kali River. The table below shows the population of talukas which fall in the secondary catchment area.

TABLE 4-2: Population under secondary catchment area of Kali River

District	Taluka	Total Population	GDP	District Density (People/Sq. km)
Uttara Kannada	Mundgod	106,265	6,265	140
	Sirsi	187,014		
	Kumta	154,515		
	Siddapur	97,435		
	Honnavar	166,390		
	Bhatkal	161,577		
Bellary	Hadagalli	207,006	10,168	290
	Hagaribommanahalli	197,651		
	Hospet	467,885		
	Siruguppa	278,863		
	Bellary	788,472		
	Sandur	270,311		
	Kudligi	322,195		

Source: Census, 2011

As shown on the table above, the taluka with highest population in secondary catchment area is Sirsi in Uttara Kannada and Hospet in Bellary.

4.2.2. Economic profile of Hinterland

- **Primary Hinterland**

Uttara Kannada district is surrounded by Belgaum district & South Goa in the North, Dharwad in the East and Udupi & Shimoga district in the South. The district has a coastal belt of 144 km on the Western side. The talukas that fall in the hinterland of Kali River i.e. Supa, Ankola, Yellapur & Karwar consist of 303 villages and 70 Gram Panchayats. There are 6 cities in Ankola & 2 in Karwar.

Rest two takulas i.e Supa & Yellapur have 100% & 70% rural area respectively. The district is rich in forest wealth and about 80% of its geographical area is covered by forest. There is limited available area for cultivation, giving very little scope for expansion/diversification of agricultural activities. The district has significant area for fishing and contributes more than 30% of fish catch in the State. There are few large industries in Uttara Kannada because the district comes under Eco-sensitive zone. The table below shows the share of sectors in the district's economy.

TABLE 4-3: Share wise contribution of sectors in economy of Uttara Kannada

Sector	Uttara Kannada
Agricultural & allied Industries	20%
Industry	27%
Services (Tourism)	53%

Source: Uttar Kannada District Profile

South Goa, which is the northern part of the river catchment area, is rich in minerals, mainly Iron Ores & Manganese. Three talukas of Southern Goa i.e. Quepem, Sangue, & Canacona come under the hinterland of Kali River. Out of total geographical area, 26% area of Quepem, 64% of Sanguem & 53% of Canacona talukas are covered with forests.

- **Secondary Hinterland**

Bellary district is surrounded by Raichur district on north, Koppal on west, Chitradurga & Davanagere on south & Anantapur & Kurnool of AP on east. It is a land locked district with 3,261 sq. mi of total area, 8 talukas & 542 revenue villages. The table below shows the share of each sector in Bellary's economy.

TABLE 4-4: Share wise contribution of sectors in economy of Bellary

Sector	Bellary
Agricultural & allied Industries	17%
Industry	36%
Services (Tourism)	48%

Source: Bellary District Profile

4.2.2.1. PRIMARY SECTOR

- **Primary Hinterland**

Primary sector of Uttara Kannada district consists of Agriculture, Forestry, Fishing, and Animal husbandry & Mining.

Agriculture and allied industries contribute INR 1,248 CR to the district's GDP. Significant amount of population is engaged in the MSME sector, which includes fish related processing foods due to 120 km coastline in the district. People are also employed in medicinal herbs segment due to forest cover area being more than 75%. Livestock and poultry has also become a major adjunct to the agriculture occupation.

Primary sector of Goa consists of Agriculture, Forestry, Fishing and Mining. Majority of people's main occupation is fishing, agriculture, mining work etc. Ban on mining sector has pulled primary sector into negative zone. As per state government's economic survey, ban on mining and decline in growth rate of agriculture and fishing is affecting economy of Goa.

- **Secondary Hinterland**

Agriculture is the major occupation that covers more than 50% of the geographical area contributing INR 1,703 CR i.e. 17% to the district's GDP while employing more than 50% of the population comprising both rural and urban population. Paddy is the major cereal crop grown in the district whiles the major oilseed crop and commercial crop being sunflower and sugarcane respectively. Few horticulture crops also contribute significantly to the district's agricultural produce. However, increased mining and industrialization has led to decrease in the cultivable land in this district. Dairy, Poultry, Farming, Fishery and Sericulture are adjuncts to the agriculture.

Agriculture

Primary Hinterland-

In Uttara Kannada around 80% of total land is covered by forest area and only 1.2 lakh ha. of land is available for agriculture & horticulture. Major forests in Uttara Kannada are concentrated in catchment area of Kali River i.e. Supa, Yellapur, Sirsi and Ankola talukas. These four Talukas account for 57.02% of total forest area.

TABLE 4-5: Major Food Grain Production in Kali Catchment Area

Taluka	Paddy & other cereals (Major crop: paddy)		Pulses		Oil Seeds		Total	
	Area (Ha)	Production (T)	Area (Ha)	Production (T)	Area (Ha)	Production (T)	Area (Ha)	Production (T)
Karwar	2179	6541	1	14	9	12	2189	6567
Yellapur	4033	12183	89	36	0	0	4122	12219
Supa	5013	15059	7	4	0	0	5020	15063
Ankola	5523	16580	70	51	720	961	6313	17592
Total	**16748**	**50363**	**167**	**105**	**729**	**973**	**17644**	**51441**

Source: Uttar Kannada District at a Glance 2014-15

TABLE 4-6: Major Horticulture Production in Uttara Kannada District

Sl. No.	Uttar Kannada		
	Plantation (T)	**Area (Ha)**	**Production (T)**
1	Arecanut	9,363	42,000
2	Coconut	5,748	1,400
3	Cashew	1,707	7,000
4	Banana	1,196	70,000
5	Mango	1,106	30,000
6	Pine Apple	464	33,000
7	Cardamom	431	140
8	Sapota	1,230	1,000
9	Papaya	149	1,700
10	Guava	363	250
11	Lemon	329	125
12	Others	41	10
-	**Total**	**13,700**	**1,86,625**

Source: Uttar Kannada District at a Glance 2014-15

The major land use for agricultural produce is for cereals namely paddy, maize and jowar accounting to 80.42% while the commercial crops like sugarcane and groundnut take up 7.93% of the agricultural land. Fruits and spices along with some plantation crops are also cultivated in the region. Vanilla grown in the district is exported.

About 40% of population of Goa is dependent on agriculture. In recent times there has been steady decline in agriculture produce in Goa. People face problems of land constraint for agriculture to feed it's own population. For day to day agriculture needs like vegetables etc. North Goa is dependent on Maharashtra and South Goa is dependent of Karnataka. State government has come up with lot of subsidies and schemes to improve quality of agriculture produce of Goa.

TABLE 4-7: Major Sericulture Production in catchment area of Kali River

Taluka	Area (Hec)	Production	
	Mulberry	**Cocoon (T)**	**Silk (Rs. Lakh)**
Ankola	7.1	0.2	0.4
Karwar	6.6	0.5	0.9
Supa	0.5	0.2	0.2

Taluka	Area (Hec)	Production	
	Mulberry	Cocoon (T)	Silk (Rs. Lakh)
Yellapur	25.1	1.2	2.2
Total	**39.3**	**2.1**	**3.7**

Source: Perspective Industrial Development Plan 2013-17

As shown in the above table, the production of cocoon and silk is very less in the catchment area of Kali River; hence sericulture would not provide any opportunity for the proposed waterway on the river.

TABLE 4-8: Area under Food Grain Cultivation in South Goa within catchment area (Ha.)

Taluka	Paddy	Rice	Ragi
Quepem	3,257	2,171	920
Sanguem	3,529	2,353	940
Canacona	3,334	2,223	710
Total	**10,120**	**6,747**	**2,570**

Paddy (Rice) is the main crop of Goa cultivated in two seasons followed by coconut trees. Hilly and inferior soil region is used for growing cereals and pulses. The main sources of irrigation for crops are rivers and streams, tanks, wells and canals etc.

TABLE 4-9: Area under Horticulture in South Goa within catchment area (Ha.)

	Quepem	Sanguem	Canacona
Cereals, Oilseeds; Pulses	36	96	29
Sugarcane	188	509	69
Coconuts	2,187	3,050	1,779
Arecanuts	57	139	71
Cashewnuts	2,502	7,003	3,341
Vegetables	147	206	582
Garden Crops	1,173	1,560	1,365

Local production of horticulture crops is not sufficient for the population residing in Goa. From last 6-7 years most of the agriculture land was left barren because young generations prefer to go outside of Goa for education and job. Due to less agricultural production on the region, Goa has to import Agricultural products from neighboring states.

Secondary Hinterland-

In Bellary district around 11% of land is covered under forest area while 68% of land is free for agriculture. And remaining land is either barren or under some other use. The important crops grown in Bellary district are cotton, jowar, groundnut, paddy, sunflower and cereals.

TABLE 4-10: Major Food Grain Production in Kali Catchment Area

Taluka	Paddy & other cereals (Major crop: paddy)		Pulses		Oil Seeds		Total	
	Area (Ha)	Production (T)	Area (Ha)	Production (T)	Area (Ha)	Production (T)	Area (Ha)	Production (T)
Uttara Kannada	80,272	232,751	2,217	686	3,193	4,961	85,682	238,398
Bellary	120,414	575,115	65,492	32,596	143,358	49,863	329,264	657,574
Total	**200,686**	**807,866**	**67,709**	**33,282**	**146,551**	**54,824**	**414,946**	**895,972**

Source: Uttar Kannada District at a Glance 2014-15

As shown on the below table, the highest grown horticulture product of Bellary district is Banana.

TABLE 4-11: Major Horticulture Production in Bellary District

Sl. no.	Bellary		
	Plantation (T)	**Area (Ha)**	**Production (T)**
1	Banana	1532	56569
2	Brinjal	215	5369
3	Coconut	1039	7837
4	Grapes	240	3897
5	Mango	592	2518
6	Onion	3865	18635
7	Papaya	353	12784
8	Pomegranate	1433	17238
9	Sapota	1599	8456
10	Tomato	487	8671
11	Others	334	1198
12	-	-	-
-	**Total**	**11355**	**141974**

4.2.2.2. SECONDARY SECTOR

Primary Hinterland

Industries in the district contribute INR 1,267 CR i.e. 27% to its GDP. There are 8 industrial estates and 1 industrial park in the district to support the district's INR 660 CR aggregated investments in the large, medium and small scale industries. The district is also home to one of total six atomic power stations of India at Kaiga along with a hydroelectric power projects in the district. Jewellery industry has prominence in the region due to vast coastline in the district and has a cluster exclusively for it in addition to the 4 clusters for handloom.

Manufacturing industries, Electricity, Gas, Water supply providing and construction companies come under secondary sector of Goa. Secondary sector's contribution to GSDP has also declined over the years. There do not exist many major manufacturing industries, as these industries will require ample amount of land that is not possible in Goa.

Secondary Hinterland

Industries in Bellary district contribute INR 3,612 CR i.e. 35% of the district's GDP. With many steel industries setting up base in the Bellary – Hospet area, the district has the potential to be the steel hub of Southern India. The district has quarter of India's iron ore reserves. Apart from Iron Ore, Iron Ore Fines, Red Oxide and White Quartz are also available in this region.

4.2.2.3. TERTIARY SECTOR

Primary Hinterland

The service sector comprising of tourism vastly contributes INR 3,555 CR i.e. more than 50% to the district's GDP as it constitutes diverse tourist hotspots such as temples, beaches, waterfalls, forts and peaks. The coastline of the district is spread over 5 Talukas. More than 75% of the district's area is covered by dense forests of Western Ghats.

Hotels, Restaurants, Transport, storage, Banking & insurance, Public administration and other communication industries etc. comes under tertiary sector of Goa. Goa is one of the most famous tourist places of India, which has contributed in the growth of Goa's tertiary sector.

Secondary Hinterland

In Bellary district tourism sector contributes significantly and has a very vast potential in the district as it has numerous South Indian architecture temples including UNESCO Heritage site in Hampi.

Hampi is visited by many foreign tourists every year. It is also getting popularity among domestic travellers. Tourism has boosted the service sector, including hotel and restaurant segment and other related segments.

4.2.2.4. Infrastructure Analysis

Infrastructure plays major role in the development of a region. It is essential to understand various types of infra around river and new development that would become support-connecting waterway with other mode of transportation. It becomes backbone for any new development. Infrastructure in & around Kali River consists of only Ports, as there does not exist any jetty or bridge on the defined stretch of Kali River.

4.2.2.5. Connectivity Analysis

Railway, roadway and airports around the waterway help to understand various ways through which evacuation of cargo and passengers could take place. It helps to determine best multimodal route for evacuation. Following image depicts connectivity around Kali River.

a. Roadways

- **Primary Hinterland-**

Uttara Kannada has 3 National Highways passing through it namely,

- N.H. 66 connecting the west coast of India from Panvel (Navi Mumbai) to Ernakulam (Kerala) covering four states along the west coast.
- N.H. 4A connecting the capital of Goa and Karnataka.
- N.H.206A connecting Honnavar in the district to Tumakaru, an envisaged smart city 70 km from Bengaluru, the capital of Karnataka.

The district boasts of 7 State Highways with connectivity in all of its talukas along with the National Highways and connectivity to the districts of Dharwad, Ballari and Shivamogga in Karnataka.

National Highway 66 runs over Kali River connecting Mumbai to Ernakulam- Kochi, a major port city in Kerala and Kanyakumari in Tamil Nadu, the southern node of India. Two state highways S.H. 6 and S.H. 34 run parallel to Kali River on either sides of the river and both the highways are less than 1 KM away from Kali River and 30 KM from Karwar port.

TABLE 4-12: Road length in Catchment area of Kali River (KM)

Taluka	National Highway	State Highway	Major Roads	Major Bridges
Ankola	75	38	153	1
Karwar	29	107	135	5
Supa	22	223	138	4
Yellapur	64	91	170	1
Total	**190**	**459**	**595**	**11**

FIGURE 4-3: Expansion of Kadwad Bridge (Under Construction)

FIGURE 4-4: Kadwad Bridge on Kali River (Fully Functional)

FIGURE 4-5: Under Construction Bridge on Kali River

Above figure depicts the condition of Kadwad bridge that is fully functional and a part is still under construction that is shown in below figure A new bridge (Kali Bridge) is being constructed with the existing one. This bridge is a part of NH 66, which is also known as Edapally- Panvel Highway. It directly connects Navi Mumbai to Kerala.

In South Goa the National Highway 66A is the only National Highway passing through the coastal talukas of Quepem and Canacona. The state highways S.H.6, S.H.7 and S.H.8 converge at Curchorem in the Sanguem taluka connecting Borim, Dharbandora and Madgaon respectively in the state. Rest of the connectivity in the talukas is maintained by district roads, numbered 34, 36, 40, 41, 45, 46 and 47.

- **Secondary Hinterland**

Bellary district has 3 National highways passing through it namely,

- N.H. 50 connecting Bidar to Hospet in Karnataka itself,
- N.H. 67 connecting Hubbali in Karnataka to Nellore, close to the non-major Krishnapatnam port in Andhra Pradesh
- N.H. 150A connecting Bidar in North-west Karnataka to Chamrajnagar in Southern Karnataka.

The fastest route that connects Bellary to Uttara Kannada is the N.H. 67 along with N.H. 52 via Hubbali. The N.H. 52 via Gadag, Koppal and Hubbali connects Bellary to Uttara Kannada. It is also connected via N.H. 150A and N.H.48 i.e. stretch of Asian Highway A.H. 47 via Davengere.

The connectivity from Bellary to Uttara Kannada includes the curvy hilly terrain of Western Ghats.

The fastest route connectivity for Bellary to Kali River is through the stretch of N.H. 67 and N.H. 52 taking the Hospet- Gadag- Hubbali route along with S.H. 6 stretch of the Western Ghats. N.H. 150A, N.H. 48 - a partial stretch of Asian Highway 47 and S.H. 6 also connect the district to the river.

b. Railways

- **Primary Hinterland-**

With 75% of the district's area covering the UNESCO biodiversity hotspot of Western Ghats, the major railway network passes through the district is the Mumbai-Madgaon-Mangaluru-Kochi Konkan Railway & Southern Railway network. It connects the major port cities in states of Maharashtra, Goa, Karnataka and Kerala parallel to the Indian west coast. The Konkan Railway connects the beach towns along the district's coastline including Karwar and Honnavar. The Konkan railway operates the country's first of its kind and highly successful Ro-Ro Service wherein the loaded trucks are mounted on the rail wagons.

Ro-Ro service is environment friendly, cost effective, safer and easier for the concerned truck drivers, making them avoid driving on the dangerous Ghats. The truck drivers use the Ro-Ro service at Ankola to get down at Surathkal town near Mangaluru. Passenger and freight trains running on the line connecting Londa in North Karnataka to Kulem in Goa passes through the district at Castle rock. Castle rock is close to Braganza Ghats in Karnataka and Dudhsagar Falls near the Goa-Karnataka border. Both these places are famous for their scenic beauty.

The Talukas of South Goa namely, Sanguem, Quepem and Canacona boost a total of 10 Railway stations with 2 stations each in Quepem and Canacona talukas on the Mumbai – Mangaluru connecting Konkan railway and the remaining 6 stations connecting Hubbali – Goa on the South Central railway are located in Sanguem. The Konkan Railway passing through Quepem and Canacona operates Ro-Ro services wherein loaded trucks are mounted on rail wagons to transport goods on the Konkan railway route. The Ro-Ro operates 2-3 times a week with an average of 50 trucks being loaded per rake and upto 3 rakes loaded per day. But unfortunately Qupem and Canacona talukas don't have a drop on/drop off points as the RO-RO services operate between Kolad-Verna, Kolad-Surathkal and Ankola-Surathkal. Freight trains also run on the South central railway passing through the Sanguem taluka.

- **Secondary Hinterland-**

Bellary district has poor rail coverage with respect to its large area and the arid region of the district. Bellary junction is a major stop for trains on the North-South route as well as the West-South route connecting Mumbai, Bengaluru, Mysuru, Jaipur, Howrah and Delhi and the trains bound towards Andhra Pradesh.

The Tirupati-Goa passenger route connected via Hubli passes through Bellary junction. Guntakal junction in neighboring state of Andhra Pradesh is a major junction serving the needs of the district. The Guntakal-Hubbali Line connects the cities of Hospet and Bellary in the district.

4.2.2.6. Existing Infrastructure

Kadra Dam is located 30 km away from sea end of Kali River. Its objective was to start a hydroelectric project for supply of water to turbines of electric power generating station. Later this project was completed by KPCL. Going further there is Kadra Reservoir, which provides adequate water to this plant to meet the requirement. Due to this dam the navigability of river is reduced till 30 km only. Any industry, which intends to use the river, has to start or end its movement at Virje, a place just before Kadra Dam. After Kadra Dam there is no road connectivity to river till the Kodasalli Dam.

4.2.3. Existing Infrastructure of Primary Catchment Area

The objective of the study is to show the linkage of industrial areas around Kali River with New Mangalore Port, Mormugao Port and other Non Major Port of Karnataka via waterways. In this section, we shall discuss the strategic location and infrastructural advantages of the ports in brief and analyse the amalgamation of river routes with these ports.

4.2.3.1. EXISTING INDUSTRIES

- **Primary Hinterland**

The major industries located in the hinterlands are far off from the port. The industries transport their cargo via roadways to the Karwar. The objective of this section is to show the linkage of industrial areas located on the banks of Kali River with the ports via waterways. In this section, we shall discuss the strategic location and infrastructural advantages of the ports in brief and analyze the amalgamation of river routes with ports.

FIGURE 4-6: Port Connectivity of Industries via Kali River

NPCIL, a power plant industry in Kadra on Kali River is the only major plant located nearby. Apart from this plant, Small Scale industries like Metals & Jewelries are located 10- 12 km away from river in Shirwad Industrial area. People who stay near the river are majorly dependent on fishing and agriculture. Seasonal sand mining along the river is also one of the income-generating sources of the local people.

Uttara Kannada is a thick forest district; hence the number of big industries in the district is very limited. Some of the small-scale industries like Metal, Jewelry, Food Stuffs, Fisheries & Chemicals are listed below.

TABLE 4-13: Industries in Uttar Kannada District

Sr. NO	Industries	Location	Type
1	Advance Petropol Processes private limited	Nandangadda, Karwar	Structured metal products
2	Aditya Birla Chemicals	Binaga	Cement
3	Bahety Chemicals and Minerals Private Limited	Dandeli	Chemicals
4	The West Coast Paper Mills	Dandeli	Papers
5	Sayi Pores And Exports Private Limited	Kumta	Mining & Quarrying
6	Green Crown Agro Processors Private Limited	Banavasi	Food Stuffs
7	Canara Breweries	Kasarkod,Honnavar	Brewery
8	Parrys Sugar Ltd	Haliyal	Sugar

Source: Consultant's Analysis

The above marked industries come under the hinterland defined by IWAI i.e. in 25 KM. Rest all industries are located far away from river. These industries are within 10 KM from the mouth of river. Karwar port is nearer to these industries via roadways than waterways. So from 25 KM hinterland, there is no scope of shifting cargo to Kali River from existing mode of transportation. Industries would directly move to Karwar port rather than shifting to river and then coming to Karwar Port.

- Possibility of Diversion

As it can be seen in below table, distance of all the industries in hinterland of Kali River to the destined ports is nearer by Road than any other mode of transportation. Advance Petropol Processes Pvt. Ltd which is situated on the mouth of the river has no scope of using river, as it is just 3 KM away from Karwar Port. This industry will definitely move its cargo by road only to Karwar Port. Industries situated in Dandeli & Binaga are nearer to Karwar Port via waterways as compared to roadways, but volume traded is very less to shift.

Other two industries situated in Kumta & Honnavar are not considered in the distance matrix because they are situated in the hinterland of Sharavati River. Sharavati River and Karwar Port are nearer to them than Kali River, so they would not go to Kali River. Parry Sugar situated in Haliyal could generate traffic for river movement as this industry exported 0.26 MMTP molasses in FY’16 by trucks. This traffic could be shifted to proposed multimodal transportation.

TABLE 4-14: Distance Matrix between Industries & Ports – Uttar Kannada

Sr. No	Industries	To Karwar Port (Km)			Opportunity	Reasoning
		Rail	Road	Kali River		
1	Advance Petropol Processes	364	4	NA	✗	Industry is located on the mouth of river, It is just 6km away from Port. No potential exists
2	Aditya Birla Chemicals	NA	3.3	NA	✗	Industry is located on the mouth of river. It is just 5km away from Port. No potential exists
3	Bahety Chemicals and Minerals	NA	110	106	✗	Difference between distance is low, but volume is too small to divert
4	The West Coast Paper Mills	NA	108	104	✗	Difference between distances is low, but volume is too small to divert.
6	Green Crown Agro Processors	NA	150	150	✗	Though distance difference is low, but volume moving is not too small to divert.
8	Parrys Sugar	NA	244	235	✓	Exports/Imports from Karwar port by trucks, this could be shifted to waterways though difference in distance huge but cost would be low comparatively due to waterways transportation.

- **Secondary Hinterland**

All the big industries in Goa are located in northern region of the state, which could not be considered as primary catchment area. While in South Goa, there is no major or medium scale industries that could be potential market for Kali River. But many small & micro industries are located in southern region. Below table shows commodity wise no. of units in South Goa.

TABLE 4-15: Micro & Small Scale Units in South Goa

Sr. No	Micro & Small Units	No. of Units
1	Food Products	483
2	Metal Products	386
3	Rubber, Plastic, Petroleum & Coal	251
4	Paper	249
5	Non-Metallic Minerals	247
6	Beverages & Tobacco	213
7	Wood Products	198
8	Electrical Machineries	171
9	Chemicals	161
10	Basic Metal & Alloys	81
11	Textile Products & Garments	77
12	Transport Equipment	74
13	Machineries	37
14	Leather	8
15	Jute, Hemp & Mesta Textile	5
16	Others	95

Source: Ministry of MSME, GOI

Amongst all three talukas of South Goa considered as catchment area of Kali River, Canacona is the only taluka with industrial units. Below table shows type of industries located in Canacona. Rest two talukas namely Sanguem & Quepem are famous for minerals. These talukas don't have much industrial units to count on.

TABLE 4-16: Industries in Canacona Taluka

Sl no.	Type of Industries	No. of Units
1	Food Stuffs	2
2	Storage	2
3	Electrical	5
4	Machineries	2
5	Oil Extraction	2
6	Rubber	1
7	Stationery	1
8	Textile	2
9	Others	10

Source: Ministry of MSME, GOI

There is no opportunity for Kali River from catchment area of South Goa. Above listed units are too small to shift cargo to Kali river. Though Pharmaceuticals & Chemicals are the exported items of South Goa, but Pharmaceuticals & Chemical industries are located in the upper part of southern region, which is out of scope of this study. Upper part of southern region falls in the hinterland of other rivers of Goa. The cargo produced of this region would not use Kali river. They will directly go to the Major Port, i.e. Mormugao Port for export trade, rather than coming to Karwar Port, which is a non-major port.

Apart from the listed industries of Uttar Kannada, industries located in Bellary district are also studied in order to evaluate commercial viability of Kali river movement.

The JSW steel plant in Toranagallu, North Karnataka having a capacity of 12 MTPA is 380 KM away from Bengaluru. This plant is well connected to Chennai and Goa ports. Vijaynagar plant produces Slabs, Billets, HR coils, Sheets, Plates, CRCA coils and sheets, Galvanized Products, bar rods, Wire rods and Angles. It exports finished products to countries like USA, South America, Middle East and Africa. The raw material is procured from the extractable 29 million Tonnes reserves of Moitra mine in Hazirabagh district of Jharkhand and 111 million Tonnes reserves in the 5 C-category mines of North West Karnataka.

TABLE 4-17: Industries in Bellary District

Sl No.	Industries	Location	Type	Capacity (TPA)
1	JSW STEEL	Torangallu	Steel	10,000,000

Sl No.	Industries	Location	Type	Capacity (TPA)
2	SLR Metaliks	Narayanadevarake	Pig iron	200,000
3	Mahesh Extrusions Limited	Mundaragi	Unrigid PVC	180,000
4	Sudhakar Polymers Limited	Mundaragi	Pipe	18,000
5	Wadi Cement ACC	Wadi	Cements	6,090
6	Mcallus	Bangalore Bellary Road	Medical equipment	NA
7	Janaki Corp	Vishal Nagar	Steel	101,000
8	Janaki Corp	Sidiginamola	Sponge iron	180,000

Source: Consultant's Analysis

SLR Metaliks, a pig iron and steel manufacturer and seller has a steel plant capacity of 0.3 MTPA at Narayanadevarakare in Bellary district. The pig iron is sold off to other industries for steel making and the granulated slag is sold as raw material for cement industries.

Mahesh Extrusions, at Mundaragi, is a manufacturer of unrigid PVC pipes and its products include agricultural pipes, SWR pipes, UGD pipes, HDPE pipes, Ringtite pipes and Electrical conduits. It has a plant capacity of 0.18 MTPA.

Sudhakar pipes, located in Mundaragi, is a leading manufacturer in the PVC and HDPE piping and fitting sector as well as in Electrical conduits. Its product range includes electrical pipes and fittings, water pipes and fittings, SWR pipes and fittings, casing pipes, HDPE pipes, PVC and CPVC plumbing, drainage pipings and water storage tanks.

Janki Corporation Limited has its steel division in Sidiginamola, Bellary. It produces sponge iron. This has 0.18 MTPA capacities at its own integrated steel plant. It produces iron ore pellets using its pellet plant with a production capacity of 0.6 MTPA. It also produces sponge iron or reduced iron, which is used as raw material for high steel manufacturing. This plant is well connected to Mormugao port.

In the below section, distance matrix is shown to understand the distance between industries & port via various means of transportation. In the distance matrix, only industries of Uttar Kannada are considered because there exist no industry in Goa, which is in the catchment area of Kali River. According to IWAI study, only those industries would be considered which are located within 25 km from the river. However, the two industries, which are located near river, present no opportunity. Apart from these two industries, industries located far away from the river are also considered to show the possible viability of river for cargo movement. If IWAI widens its scope of hinterland than this river could be commercially viable.

Below table depicts the distance matrix between industries located in Bellary & destined port by different modes of transportation. JSW Steel Plant located in Hospet is well connected with Chennai Port & Mormugao Port, Goa. The Plant uses both the ports for importing raw materials. Every year a huge volume of cargo is transported between this plant and ports. It imports coal by using Mormugao Port rather than Karwar Port because there is a direct rail link between Mormugao port & the plant. This direct connectivity makes Mormugao Port much cheaper for JSW plant than Karwar Port. Apart from Coal, Dolomite is also used in this Plant, which is also imported due to lack of local availability. Dolomite is imported by Chennai port, which is located on the east side of JSW plant. JSW uses roadways to transport the imported cargo from Chennai Port, as Chennai Port is nearer to the port than Karwar Port. Connectivity is the big issue for Karwar Port because of the uneven land terrain. The table below shows that industries, which are located more than 250 km away from Kali river, have to face difference of 100 km if they shift cargo to Kali river from their present mode of transportation.

.TABLE 4-18: Distance Matrix between Industries & Ports – Bellary

Sr. No	Industries	To Karwar Port (Km)			Opportunity	Reasoning
		Rail	Road	Kali River		
1	JSW STEEL	620	447	623	✗	Direct Rail connectivity exists between Mormugao Port & Industry. Diversion is not viable.
2	SLR Metaliks	590	366	580	✗	Waterway movement is not viable for small volume cargo.
3	Mahesh Extrusions	605	427	512	✗	Difference in distance is too high
4	Sudhakar Polymers	605	429	644	✗	Cargo diversion is not possible in low volume
5	Wadi Cement ACC	884	656	780	✗	Difference in distance is too high
6	Mcallus	605	428	646	✗	Cargo diversion is not possible in low volume
7	Janaki Corp	605	432	646	✗	Low volume & direct connectivity with MPT exists.

4.2.4. Traffic from Major & Non Major Ports

In existing infrastructure Karwar Port comes under catchment area of Kali River. Industries located within 25 km are using this port for import/export of their raw material or finished goods. Mode of transportation preferred between industries & ports are either roadways or railways. Karwar port is further studied in detail in order to identify the potential commodities for Kali River & its diversion from road/rail to river.

4.2.4.1. Non Major Ports

- **Primary Hinterland**

a. Karwar Port-

FIGURE 4-7: Cargo handling activity at Karwar Port

Karwar port located in the vicinity of River, south of its confluence with Arabian Sea is the biggest port amongst all non-major ports of Karnataka. There is one temporary jetty along the River in the initial reach. In the year 2014-15, out of the 0.65 MMTPA cargo handled at all Non-Major Ports in Karnataka, about 0.53 MMTPA (82%) was handled at Karwar Port. The cargo traffic has increased to 0.72 MMTPA in 2015-16.

Roadways are used to move cargo between industries and Karwar port. There is also facility of pipeline, directly connected to transfer liquid cargos. The major commodities are iron ores, manganese ore, Bauxite, Sugar, Horticulture and agriculture products, Cement, Fertilizers, Liquid cargos like Molases and marine products.

The port is connected with national highway connecting Mumbai and Kochi in Kerala. NH 17 & NH 63 are connected near to Karwar port. Currently a four lane highway is been constructed. The Konkan Railway that is 8 km away connects Karwar port. The port has already proposed for a rail sliding from railways station to port. They have also proposed for Hubli – Ankola Rail.

Major mining head for Karwar Port are Bellary – Hospet area and Ilkal – Mudgal area. Presently the port can withstand one ship at a time. The port has been developed and there is expansion plan to increase it by 1,000 mts more so that the port can handle three ships simultaneously.

TABLE 4-19: Facilities at Karwar Port

Port	Draft (m)	Type	Cargo Type	No. of Berths	Traffic (mn T) Fy'16
Non-Major Ports					
Karwar	8.3	All weather sea port	Raw Sugar, Liquid Cargo, Aluminium, Maize & Iron Ore	2	0.71

Source: Karwar Port Office

TABLE 4-20: Company wise Infrastructure in Karwar Port

Sl. No.	Name of Companies	Activity of Area	Extent Capacity	Storage
1.	USTTL Baithkol, Karwar	Storage Tanks	20,230 sq m	40,000 KL
2.	Karnataka State Ware Housing Corporation, Baithkol, Karwar	Ware House	4,459 sq m	5,000 MT Food Grains/ Fertilizer
3.	Indian oil Corporation, Baithkol, Karwar	For Bunkering	4,407 sq m	5,000 KL
4.	Adity Overseas Petro Products, Gandhidhan, Gujrat	Construction of storage tanks	8,000 sq m	15,000 KL
5.	Indian Ports warehousing organization	Construction of storage tanks	8,000 sq m	
6.	Gujarat Ambuja Cements Ltd. New Delhi	Storage of cement packing industry	11,095 sq m	15,000 KL

Sl. No.	Name of Companies	Activity of Area	Extent Capacity	Storage
7.	Mysore Mercantile Corporation, Bangalore	Construction of storage tanks	8,000 sq m	15,000 KL
8.	Southern Port Terminals Ltd, Indore	Construction of storage tanks	10,625 sq m	15,000 KL
9.	S S Exports Bangalore	For construction of warehouse and storage tanks	20,000 sq m	15,000 KL

Perspective Industrial Development Plan: Uttar Kannada 2013-17

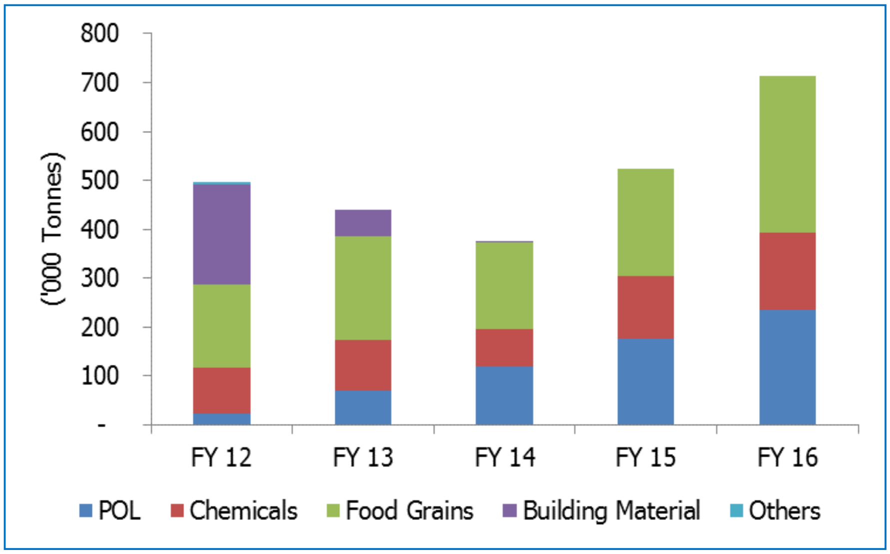


FIGURE 4-8: Cargo handled at Karwar Port (Source: Karwar Port Office)

In the year 2015-16, Karwar Port handled 0.72 MMTPA cargo, of which, the unloaded cargo was 62% mainly comprising of POL (0.23 MMTPA), Chemicals (0.15 MMTPA) and Palm oil (53,440 MTPA). About 0.27 MMTPA of Molasses was also loaded at the port. The possibility of moving the cargo through Kali River to Karwar Port is analyzed below.

TABLE 4-21: Commodity wise Imports of Karwar Port ('000 T)

Commodities		FY 12	FY 13	FY 14	FY 15	FY 16
POL	HSD	0.0	38.1	37.7	39.9	82.2
	Bitumen	23.8	28.2	77.1	136.0	153.1
	Calcined petroleum coke	0.0	0.0	6.0	0.0	0.0
Chemicals	Rock Phosphate	28.9	51.5	75.2	47.4	57.2

Commodities		FY 12	FY 13	FY 14	FY 15	FY 16
	Industrial salt	64.1	51.2	0.0	44.8	79.2
	Caustic soda lye	0.0	0.0	0.0	23.7	7.6
	Caustic soda solution	0.0	0.0	0.0	11.7	14.0
Food Grains	Palm Oil	25.7	32.3	59.6	32.9	53.4
	Raw sugar	0.0	6.8	0.0	0.0	0.0
	Crude sunflower seed oil (CSFO)	0.0	3.0	4.9	0.0	0.0
Building Material	Cement clinker	2.6	0.0	0.0	0.0	0.0
Total		**145.1**	**211.1**	**260.5**	**336.4**	**446.8**

Source: Karwar Port Office

TABLE 4-22: Commodity wise Exports of Karwar Port (‘000 T)

Commodities		FY 12	FY 13	FY 14	FY 15	FY 16
POL	Calcined petroleum coke	0.0	5.0	0.0	0.0	0.0
Food Grains	Molasses	128.1	170.8	112.7	188.6	267.6
	Maize	15.7	0.0	0.0	0.0	0.0
Building Material	Granite	202.4	54.3	3.9	0.0	0.0
Others	Dumb Barge	6.0	0.0	0.0	0.0	0.0
Total		**352.2**	**230.1**	**116.6**	**188.6**	**267.6**

Source: Karwar Port Office

- Possibility of Diversion

Following table shows the possibility of cargo diversion from Karwar Port. Commodities destined or originated towards port mostly use Roadways or Railways. From the above detailed traffic breakup, some of the commodities could be diverted if industries find this proposed multi modal route beneficial in every aspect.

TABLE 4-23: Traffic Diversification from Port

Commodities	Traffic	Diversion	Reasoning
POL	235.29	✗	Petroleum products are mostly evacuated from port using pipelines, this cannot be shifted to waterways.

Chemicals	158.04	✗	Majorly consumed by the chemical plant located near Karwar port itself.
Molasses	267.6	✓	Regular movement of trucks loaded with molasses between Industries & Ports. Trucks are moving to/from Hubli, Dharwad & sometimes Goa. This movement could create some potential for river movement.

4.2.4.2. Major Ports

- **Secondary Hinterland**

a. New Mangalore Port-

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, and Haveri, all the way up to Kannur in Kerala. Lots of cargos from these regions move to and from the port.

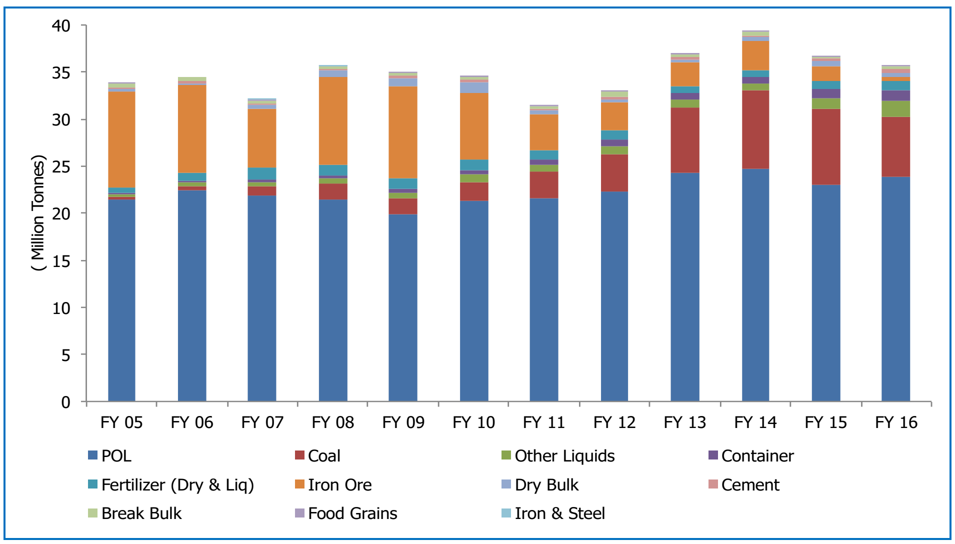


FIGURE 4-9: Commodity wise historic Traffic handled at NMPT (Source: IPA)

TABLE 4-24: Commodity wise Imports of NMPT (mn T)

Commodities	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16
POL	13.6	14.0	14.0	14.3	12.9	14.7	14.8	15.6	16.5	16.8	16.2	18.2
Other Liquids	0.3	0.4	0.3	0.4	0.5	0.7	0.6	0.7	0.7	0.6	0.7	0.8
Iron Ore	0.0	0.0	0.3	0.5	0.5	0.3	0.6	1.2	1.5	1.7	1.0	0.1

Commodities	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16
Fertilizer	0.6	0.9	1.3	1.1	1.1	1.1	1.0	1.0	0.7	0.7	0.9	1.0
Food Grains	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coal	0.3	0.5	1.0	1.7	1.7	1.9	2.8	4.0	6.9	8.3	8.1	6.3
Iron & Steel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cement	0.2	0.3	0.2	0.2	0.3	0.3	0.2	0.3	0.3	0.2	0.3	0.4
Dry Bulk	0.2	0.1	0.4	0.7	0.9	1.2	0.5	0.3	0.2	0.3	0.4	0.4
Break Bulk	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.4	0.3	0.3	0.1	0.1
Container	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6
Total	**15.4**	**16.5**	**17.9**	**19.3**	**18.3**	**20.7**	**21.1**	**23.7**	**27.3**	**29.3**	**28.3**	**28.0**

Source: IPA

TABLE 4-25: Commodity wise Exports of NMPT (mn T)

Commodities	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16
POL	7.8	8.4	7.8	7.2	7.0	6.6	6.7	6.6	7.8	7.9	6.8	5.7
Other Liquids	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.8
Iron Ore	10.3	9.3	6.0	8.7	9.3	6.7	3.1	1.9	1.1	1.5	0.5	0.4
Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Break Bulk	0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2
Container	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.5
Others	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.0
Total	18.4	17.9	14.1	16.3	16.6	13.7	10.4	9.2	9.5	9.9	8.1	7.6

The major commodities exported through the port are Iron ore Pellets, POL products (petroleum, oil and lubricants), 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. Ratio of Imports to Exports at New Mangalore Port was 3:1 in 2014-15. Total traffic handled at the port has reduced to 36.57 MTPA in 2014-15 from 39.37 MTPA in 2013-14. The major drop was reported in iron-ore traffic and also in crude oil imports.

Mormugao Port- Mormugao Port is the only Major Port situated in South Goa with four other Non-Major Ports. It is the leading iron ore exporting port of India. Loading and Unloading of major commodities at Mormugao Port is shown in the below graph. It is clearly visible that most of the commodities are getting unloaded in the past fifteen years at port compared to number of commodities loaded at the port.

Iron Ore is the only major commodity loaded at port followed by other bulk commodities.

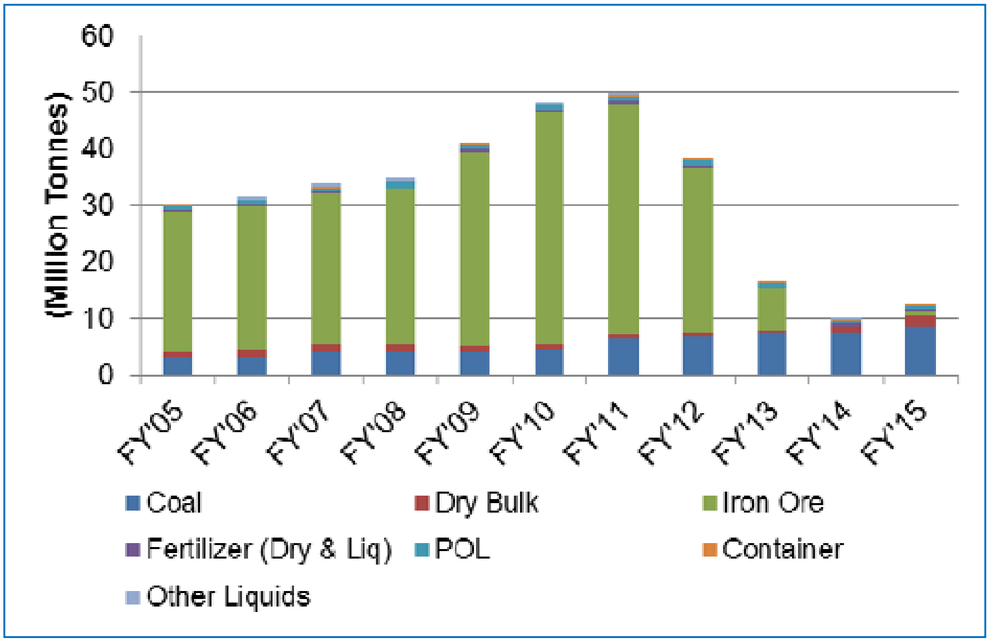


FIGURE 4-10: Commodity wise traffic handled at Momugao Port (Source: IPA)

Among unloaded commodities at port, Coal is the major commodity followed by POL and fertiliser. JSW imports coal from Mormugao Port for their Vijaynagar Plant in Ballery district of Karnataka.There exists good and direct railway connectivity from Mormugao Port to their plant. For JSW this is cheaper route as compared to New Mangalore Port for handling coal.

TABLE 4-26: Commodity wise Imports of Mormugao Port (mn T)

Commodities	**FY 05**	**FY 06**	**FY 07**	**FY 08**	**FY 09**	**FY 10**	**FY 11**	**FY 12**	**FY 13**	**FY 14**	**FY 15**	**FY 16**
POL	1.0	0.8	0.8	0.9	0.9	1.0	0.9	0.9	0.8	0.5	0.6	0.6
Other Liquids	0.0	0.5	0.6	0.5	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Iron Ore	0.0	0.0	0.1	0.0	0.0	0.3	0.3	0.2	0.0	0.0	0.2	0.4
Fertilizer	0.2	0.2	0.2	0.2	0.5	0.6	0.6	0.4	0.2	0.4	0.6	0.6
Coal	3.0	3.3	4.0	4.2	4.2	4.6	6.6	6.8	7.4	7.5	8.6	11.5
Dry Bulk	0.9	1.1	1.4	1.2	0.7	0.9	0.5	0.5	0.4	0.7	1.2	1.9
Container	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
Others	0.3	0.4	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Total	5.5	6.4	7.1	7.2	6.6	7.7	9.2	9.1	9.0	9.4	11.4	15.4

Iron Ore and other bulk commodities fall under major loaded commodities at Mormugao Port. Iron Ore has shown inconsistent growth over the years due to ban on mining activities. Due to upliftment of ban on some of the mines it is expected to increase iron ore traffic. Over the years there has been decline in number of mine owners who loaded minerals at port.

TABLE 4-27: Commodity wise Exports of Mormugao Port (mn T)

Commodities	FY 05	FY 06	FY 07	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16
Iron Ore	24.7	25.3	26.7	27.4	34.2	40.4	40.4	29.2	7.4	0.0	0.6	3.6
Iron & Steel	0.0	0.0	0.2	0.1	0.1	0.3	0.1	0.1	0.0	0.1	0.1	0.0
Dry Bulk	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.4	0.6	0.5
Break Bulk	0.1	0.1	0.1	0.2	0.1	0.1	0.3	0.5	1.0	1.6	1.9	1.2
Container	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
Others	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Total	25.0	25.6	27.2	27.9	34.7	40.9	40.8	29.9	8.6	2.3	3.3	5.4

Source: IPA

- Possibility of Diversion

TABLE 4-28: Traffic Diversification from Ports

Port	Commodities	Traffic (mn T)	Diversion	Reasoning
New Mangalore	All	35.6	No	Main hinterland of NMPT is central & Northern Karnataka. At present transportation is done by roadways & railways. Trucks moving between industries & Port cannot be shifted to waterways as direct road connectivity provides easein transportation. Hence, no scope for traffic diversion exists from NMPT for Kali River movement.
Mormugao	All	20.43	No	Commodities moving between Mormugao Port & Bellary already has direct rail connectivity. Diverting to Modal shift movement would cost them too high due to double handling & increase in distance

4.3. Commodity Composition / Categorization

4.3.1. Bulk Commodities

- **Primary Hinterland**

River transportation would be viable for movement of bulk commodities like coal and minerals. Mining operations of lime shell, sand and rough stone take place in Uttar Kannada. Kali River can be proposed as an alternate medium of transport rather than the traditional roadways. The river does not offer business potential for coastal extraction points like Ankola & Karwar. They can rather move their goods directly to the port. Mining points would prefer using port via roadways, not waterway on Kali River because of direct connectivity. However, there is no possibility of minerals for shifting from existing road route to proposed waterways.

Following map shows location of mineral belt of Uttar Kannada with respect to Kali River and the port infrastructure.

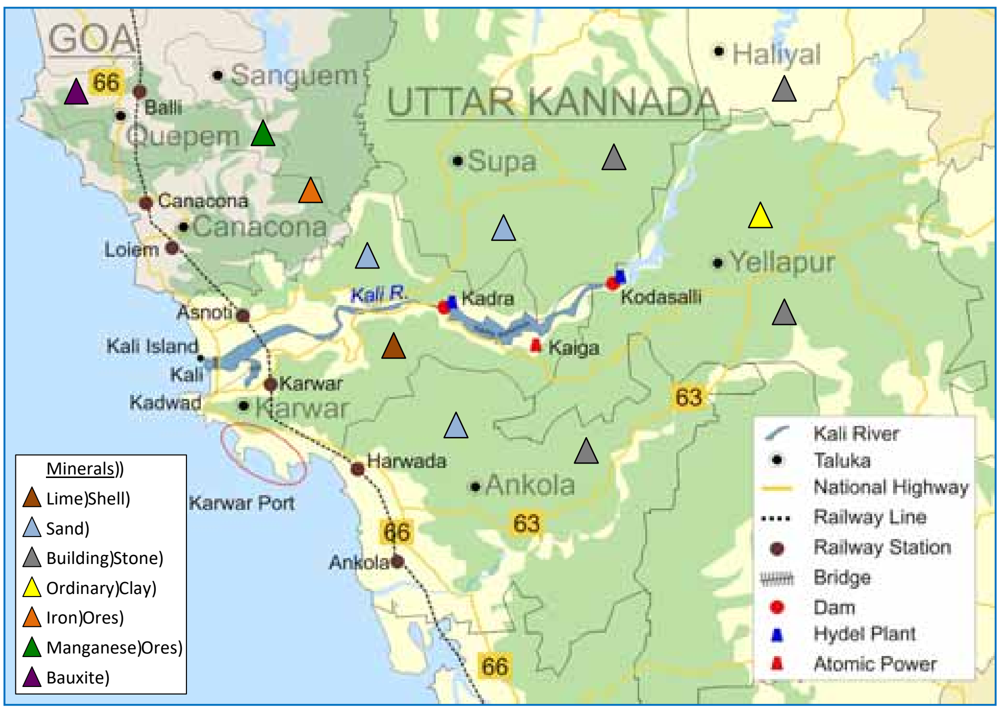


FIGURE 4-11: Minerals availability in Hinterland of Kali River

The district has large reserve of Silica sand that accounts for a production volume of more than 63,000 Tonnes. Lime Shell & Sand are the other major minerals. The Major Minerals like Silica Sand & Sand are mostly extracted from the rivers of Karwar & Ankola taluka, which come under the hinterland of Kali River.

TABLE 4-29: Mineral Ore Availability in Uttar Kannada District (FY'12)

Sl No.	Name of minerals	Production (MT)	Location
Major Minerals			
1	Lime shell	19,392	Tadri in Kumta & Sunkeri in Karwar, Ankola
2	Silica Sand	63,088	Aghanashini River in Kumta, Sharavati River in Honnavar
3	Sand	14,340	Gangavali River in Ankola, Kali River in Joida & Karwar
Minor Minerals			
1	Building stone	128,083	Supa, Haliyal, Yellapur, Mundgod, Ankola, Honnavar, Bhatkal
2	Ordinary Clay	5,990	Yellapur

Source: Ministry of MSME, GOI

Earlier sand mining was active at Kodibaug in the dockyard & Kanasgeri, but now it has been completely stopped. Sand mining has now started at Siddar village. Below figure shows the sand mining activity at Siddar. It is located 18 km away from Karwar Port and on the Coast of Kali River.

FIGURE 4-12: Sand Mining Activity at Siddar

Sand mining activity takes place in Kinnar near Siddar. At present, sand mining is not active, as it's a seasonal activity. Usually sand extracted from here is transported to north Karnataka & Goa. Transportation is done by roadways only, as Siddar has got direct connectivity to NH6.

The mining belt of Goa covers approximately 700 sq. km. The maximum area under mining comes under Sanguem Taluka followed by Bicholim, Sattari and Quepem. Only Sanguem & Quepem come under the catchment area of Kali River. Contribution of mining sector to GSDP has fallen down to 5% in FY 13 from 20% in FY 11 and almost nil FY14. State government has now pulled the ban on some of the iron ore mines but still no major growth has been witnessed in mining sector, due to limitations of exporting iron ore by government. Vedanta is one of the major iron ore players in Goa and the first to start its operations after the government has removed the ban. Mining activity has affected the landscape around mining area. The private operators who were dealing in iron ore exports have also declined and almost nil now. The table below shows the availability of Minerals in South Goa along with production and location.

TABLE 4-30: Mineral Ore Availability in South Goa (FY'12)

Sl No.	Name of minerals	Production (Lakh T)	Location
Major Minerals			
1	Iron Ores	248.5	Northern, southern and central blocks of Goa
Minor Minerals			
1	Manganese Ores	0.01	South Goa
2	Bauxite	4.63	Hilly area of southwest Quepem, south of Chauri, Betul area and Polem -Loliem-Galgibaga area

Source: Ministry of MSME, GOI

Bauxite Mines are majorly located in South Goa in 1,264 Ha with around 70 mn T. of reserves. Bauxite is used by Cement, Chemicals etc. companies. Mormugao & Betul Ports are located in the proximity of these mines. So port the companies it's easy to use nearby port that is Mormugao & Betul to export via Mandovi & Zuari River. Most of the mines are located within 15 km of these rivers loading points. Bauxite does not provide any scope in Kali river waterway.

Iron Ore deposits are mainly extended in North-West & South-East region. The main iron ore bearing zone is divided into 4 major parts, and one of them comes in the catchment area of Kali River, i.e. Sanguem-Quepem Area.

- Possibility of Diversion

The table below shows the possibility of minerals diversion on Kali River with the appropriate reasoning. As observed during the site visit, there are many mines located on the coastal region. For these mines, diversion could not be an option. Minerals found in south Goa does not create any opportunity for Kali River.

Road is considered to be the most expensive mode of transportation for those industries which are located far away from ports, with uncertainty in delivery of cargo due to congestion at Road. Hence, the potential to shift cargo from Road to Rivers would be maximum for those commodities which use roadway extensively.

TABLE 4-31: Opportunity identification for Kali River in Uttara Kannada

Minerals	Production (T)	Traffic Source	Diversion	Reasoning
Sand	14,340	Ankola, Joida	✗	Most of the mines are located on the coastal Taluka. Shifting won't be viable because ports are more nearer by roads than via waterway on Kali River. And also volume is too low too get shifted.
Lime Shell	2,030	Karwar	✗	
Iron Ore	2.5 mn T	South Goa	✗	Mormugao Port is the major iron exporter in India. Production in south Goa would not prefer coming Kali river to get exported.
Manganese	4 mn T (Reserves)	Joida-170 sq. Miles, Yellapur-20 sq. Miles & Ankola	✗	Though reserves are high but production is too low for diversion.
Limestone	NA	Yellapur & Joida	✗	Low volume not suitable for waterways

- **Secondary Hinterland**

In major mineral category, Iron Ore, Iron Ore Fines, Red Oxide & White Quartz are found in Bellary district. The district produced 410,591 tonnes of Iron Ore and 202,812 tonnes of Iron Ore Fines in FY 12. The total volume of the major minerals produced in Bellary was 720,323 Tonnes in FY 12.

TABLE 4-32: Mineral Ore Availability in Bellary District

S.No	Name of minerals	Production (MT)	Taluka Location
Major Minerals			
1	Iron Ore	410,591	Hospet, Bellary, Sandur
2	Iron Ore Fines	202,812	

S.No	Name of minerals	Production (MT)	Taluka Location
3	Red Oxide	89,398	Hospet, Sandur
4	White Quartz	17,522	Hospet, Bellary, Sandur
		Minor Minerals	
1	Building Stone	106,944	Hospet, Bellary, Sandur, Kudligi, Hadagalli
2	Ordinary Sand	150	Siruguppa
3	Pink granite	3,462 m3	-
4	Grey Granite	4,711 m3	-

Source: Ministry of MSME, GOI

- Possibility of Diversion

Table below shows the possibility of minerals diversion on Kali river with the appropriate reasoning. As understood by site visit many mines are located on the coastal region, for which diversion could not be the option.

TABLE 4-33: Diversion possibility of minerals for Kali River

District	Minerals	Production	Diversion	Reasoning
Bellary	Iron Ore, Red Oxide, Building Stone, Pink Granite, White Quartz etc	827,417 MT & 8,173 m3	X	Most of the mines are located on the coastal Taluka. Shifting to waterway won't be viable because ports are nearer by roads than via Kali River.

4.3.2. Fisheries

Hinterland of Kali River is rich in its marine resources. Fish production plays a very important role in economy of this district. Plenty of fishes like Mackerels, Sardines, Prawns & other export potential fishes are found in sea. Shrimp culture is also carried on the coastal area. Fish production from this district is exported as well as locally consumed. Government of Uttar Kannada started many schemes for development of fishing industry.

TABLE 4-34: Diversion

Taluka	Fish Market	Ice Plants	Cold Storage	Fish Catch (T)
Ankola	7	5	2	27,120
Karwar	6	9	2	15,830.5

Taluka	Fish Market	Ice Plants	Cold Storage	Fish Catch (T)
Joida	1	0	0	73
Yellapur	1	0	0	95
Total	**15**	**14**	**4**	**43,118.5**

Fishing activities around Karwar port is done in advance manner. 89,788 tonnes is the annual average fish catch; out of which 99% is coastal catch and rest is inland catch. This 1% Inland fishing is done in small villages that are located on the coast of river. Below images show fishing activities carried out in Kodibaug & Sunkeri villages. Fishing is the main occupation of these villages. Fish catch volume from these places is negligible and locally consumed.

FIGURE 4-13: Fishing Activity at Sunkeri Bank

The proposed Waterway is mostly viable for large volume commodities. To become commercially attractive, the river would have to give time & cost advantage to the industries. This would be only possible if large volume of cargo are transported through waterways. It would save time and cost of transportation. Movement of fisheries would not create opportunity for Kali river as volume generated from this region is very low.

FIGURE 4-14: Fishing Activity at Kodibaug

4.3.3. Molasses

FIGURE 4-15: Trucks loaded with Molasses near Karwar Port

Molasses is one of the major commodities handled by Karwar Port and utilized in sugar factories. Factories located in North Karnataka like Hubli, Dharwad, Dandeli etc use Karwar Port to import/export their materials. Some factories in south Goa also import Molasses from Karwar Port. Molasses are mostly transported by trucks because there is good road connectivity in whole northern Karnataka. But these industries are located more than 100 km away from river. They don't come into scope of IWAI as hinterland is restricted to 25km only. If IWAI widens their scope than these commodities could create some opportunity for river movement. Figure below shows the trucks fully loaded with molasses at Karwar Port.

4.4. Originating & Terminating commodities

At present industries in hinterland transport their cargo either by Roadways or Railways. This proposed multimodal route via Kali River is beneficial to those industries whose road distance/rail distance is more than the proposed waterway route. If this Multi Modal route gives some cost benefits with additional infrastructure benefits then companies might consider shifting their cargo to waterways. Below table shows the traffic generated in hinterland of Kali River.

TABLE 4-35: Identification of Potential Traffic for Kali River

Sr. No	Commodities	Capacity ('000 T)	Traffic Source	Opportunity	Reasoning
1	Steel	10,101	JSW Steel & Janaki Corp are the two steel manufacturing plants	No	JSW has well developed rail connectivity with Mormugao port, diverting from rail to modal shift movement by using Kali River would increase cost, time & distance.
2	Pig/Sponge Iron	380	SLR Metaliks & Janki Corp are the producers of this commodity	No	Movement of bulk commodities with small volume does not create any cost advantage
3	Molasses & other liquid cargo	267	From Sugar Factory at Haliyal to Karwar Port	Yes	At present these liquid cargos are transported by roadways in trucks, this could be shifted on river if Ro-Ro service gets started from Karwar Port till Kadra Dam.
4	Sugar	95	From Sugar Factory at Haliyal to Karwar Port	Yes	This road movement could be shifted to waterways as it gives cost advantage.
5	POL	253	Unloaded at Karwar Port & 10% is moving eastwards	No	POL products are mostly evacuated from port by pipeline. Hence this cannot be shifted on waterways
6	Chemicals	158	Unloaded at Karwar Port & largely consumed by Chemical Plant at Binaga.	No	Chemical industries are located on mouth of river, which is more nearer to port via roadways than river. This diversion cannot be viable.
7	Cement	6	ACC Wadi Cement	No	Industry is located on mouth of river
8	Minerals	NA	Largely found in Uttar Kannada	No	Though reserves are high but production is not sufficient for shifting from existing to waterways.
	Total	**11,535**			

FIGURE 4-16: Primary & Secondary Catchment Area of Kali River

4.5. Passenger Traffic

On Kali River, several ferry services are operational, but they operate in small scale. Places like Kodibaug, Kanasgeri, Kinnar & Siddar are the places where local people use these ferries for crossing river.

a. Kodibaug

Kodibaug is a village on the Coast of Kali River, just 4 km away from Karwar Port. It is located very close to Kali Bridge. The nearest railway station is Shirwad that is 10 km away. NH 66, which connects Mumbai & Edapally, passes through this place. The ease in connectivity helps tourists who travel from North & South of Uttar Kannada.

At present, Fishing & Passenger movement take place at this place. Ferries operate for fishing and crossing the river mainly for tourism purpose. Daily one return ferry movement has been seen on site. Passenger ferry operated here is usually for carrying people to Kurumgad Island & Kali Island. There also exists a private jetty at Kodibaug which is managed by Cintacor Island Report.

Earlier there was a dockyard at this place used for fishing & sand mining but later on it has been removed due to objections from local people. Now “Jungle Lodge and Resort” has constructed one more Dockyard for tourism across Kali river at this place. The main objective of this development is to utilize the river for tourism purpose. Once the dockyard will be fully functional then tourism in the area would gradually increase. But still over the years it would not be able to generate sufficient number of tourists for river movement.

FIGURE 4-17: Passenger Ferry at Kodibaug

b. Siddar

Siddar is a place located just 18 km away from Karwar Port & on the coast of Kali River. It has direct connectivity with NH6 & just 12 km from the nearest Shirwad Railway station. Major occupation of local people nearby is Agriculture & Fisheries and sand mining will be started shortly. At present, there is no existing jetty near Siddar.

Passengers use local small boats to cross the river and go to the village Ulga that is located on the other side of the river. Operators charge INR 10 for each person for Crossing River. Small wooden boats are seen plying on this river and it is mostly used by students to cross the river and go to other side for schools & collages in Ulga village. This place lacks proper infrastructure and facilities to cross the river. Population around river is very less, which ultimately makes river development unviable.

FIGURE 4-18: Passenger Jetty at Wailwada near Siddar

FIGURE 4-19: Passenger Ferry from Wailwada to Ulga

c. Kanasgeri

Kanasgeri is located beside the bank of Kali river, just opposite of Kodibag across the river. Very few people reside here and their main occupation is Agriculture & fishing. Earlier this place was allotted for sand mining but it has been immediately stopped because of some legal issue. At present, some local boats ply on the river at this place. These passenger boats are used by people to cross the river or go to Kali Island.

FIGURE 4-20: Kali Island view from Kanasgeri

4.6. Tourism Traffic

Tourism section includes only primary talukas of Uttar Kannada from catchment area of Kali River. People from Goa would not like to come at Kali River as Goa itself is a big tourist spot, and Bellary district is located more than 350 kms away from defined stretch. Hence for tourism, the consultant would not analyze Bellary and Goa, as it presents no visible opportunity for passenger's traffic in Kali River.

There are several potential tourist spots in the talukas, which come on the catchment area of Kali River. Some of these places could be connected through water transportation. The reservoir beyond Kadra and Kodasalli Dam could also be used for water sports facilities. Below are some listed tourism spots around Kali River.

TABLE 4-36: Tourism Sites Along Kali River

Sl No	Taluka	Tourist Spots
1.	Karwar	Karwar Port/Light House, Devbagh Beach, Kurmagarh Islands, Tilamathi Beach, Ravindranath Tagore Beach, chapel Warship, Aquarium, Sadashivaghada Fort.
2.	Yellapur	Magod Falls, Satodi Falls, Kavadikere, Jenukal Gudda, Gram Devi Temple
3.	Supa	Ullavi Channabasaveshwar Temple, Supa Dam, Dood Sagar, Synteri Rocks
4	Ankola	Shri Shantadurga Temple, Venkatramana Temple, Shri Arya Temple, Shri Katyayani Baneshwar, Shri Lakhminarayana Mahamaya Temple.

Source: Uttar Kannada District at a Glance, 2014-15

It is understood that Kali River is surrounded by attractive tourist spots which has potential to grow. Separate passenger terminal has not been provided however the proposed facility at Ro-Ro location can very well be availed for tourist activities on Kali River.

4.7. Ro-Ro Traffic

At present there exist no Ro-Ro traffic in catchment area of Kali River. Industries located nearby transport their cargo to/from Karwar Port in trucks by roadways. Sugar factory situated in Haliyal exports around 2.67 Lakh Tonnes of molasses by Karwar Port. Apart from molasses other liquid, like palm oil is unloaded at Karwar Port & further distributed all over by roadways. Total traffic moved between industries & port is around 0.7 mn T annually. If Ro-Ro service gets started on Kali River then weekly 250 trucks in total could be moved both side as per the current traffic.

Special customized small ships, which can carry 30-40 trucks at time could be designed after taking all the technical aspects into consideration. Companies can load their trucks in to vessel on River to reach upto Karwar Port & vice-versa. This shifting from roadways to waterways would reduce the congestion on State highway 6 on southern side of river & State highway 64 on northern side, which are moving parallel to river. However, this diversion could only take place if the proposed route shows commercial viability. Viability of proposed multimodal route is further evaluated in the following section.

4.8. Growth Trend

4.8.1. Passenger Growth for Kali River

People living along the river are less in numbers. They travel across the river for daily necessity. This movement is too less to count on for passenger traffic. Small wooden boats are plying on river that is used for going other side. Neither proper facilities nor any infrastructure are created on bank of river for passengers' movement yet. People residing here started migrating to near by towns & cities for studies & Jobs. Though requirement of development exists at this place but this would be loss making. Revenue generated from infrastructure would be collected from local people only, which would be too low as per the purchasing power of people.

4.8.2. Tourism Growth for Kali River

There are several tourist places located in the catchment area of Kali river, as discussed in section 4.6. Karnataka Tourism Policy 2015-20 have identified 319 tourism destinations in Karnataka. Karwar 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 Kali 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.

4.8.3. Cargo Growth for Kali River

Hinterland defined by IWAI i.e 25 kms does not have any Major & medium industries which ultimately creates no opportunity in Kali river for Cargo. This river cannot expect any cargo in future as well because the Industrial growth in Uttar Kannada is restricted due to many reasons, which are listed below.

- Inadequate infrastructural facilities
- Non-availability of sufficient land as 80% of land is covered under forest area.
- Educated people prefer doing job in Goa, Bangalore & Bombay that results into not many local entrepreneurs coming forward to start industries.
- Non-Availability of sufficient power
- Investors are scared of environmental laws & regulations.

Apart from industries, though district is rich in its minerals reserves but the mines are either situated in coastal talukas or do not produce/extract enough volume that could be transported. As waterway movement is viable & beneficial only for high volume cargo, so minerals do not create any opportunity for Kali River.

4.8.4. Ro-Ro Traffic Growth for Kali river

Though Kali River does not have many industries around it for cargo traffic but from the secondary hinterland i.e from North Karnataka loaded trucks are transported to Karwar Port for export purpose. This traffic could be shifted to waterways if Ro-Ro service is provided. These trucks moving on SH6 & SH34 which are passing parallel to Kali river leads to congestion and delay in delivery. As explained in above Cargo Growth Section, catchment area of Kali River restricted for industrial growth due to various reasons. It is assumed that traffic for Ro-Ro movement would be same for the next 20 years based on the today's growth scenario. Though possibility of ro-ro movement exists, but the traffic volume is very low with no growth. 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 Kali.

4.8.5. Logistic cost comparison for Ro-Ro

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 in Haliyal is indicative of their preference for moving their EXIM cargo. Proposing traffic shift to a different mode requires a very 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 **Error! Reference source not found.** illustrates time and distance difference between the current roadway movement and potential ro –ro operation using the Kali river:

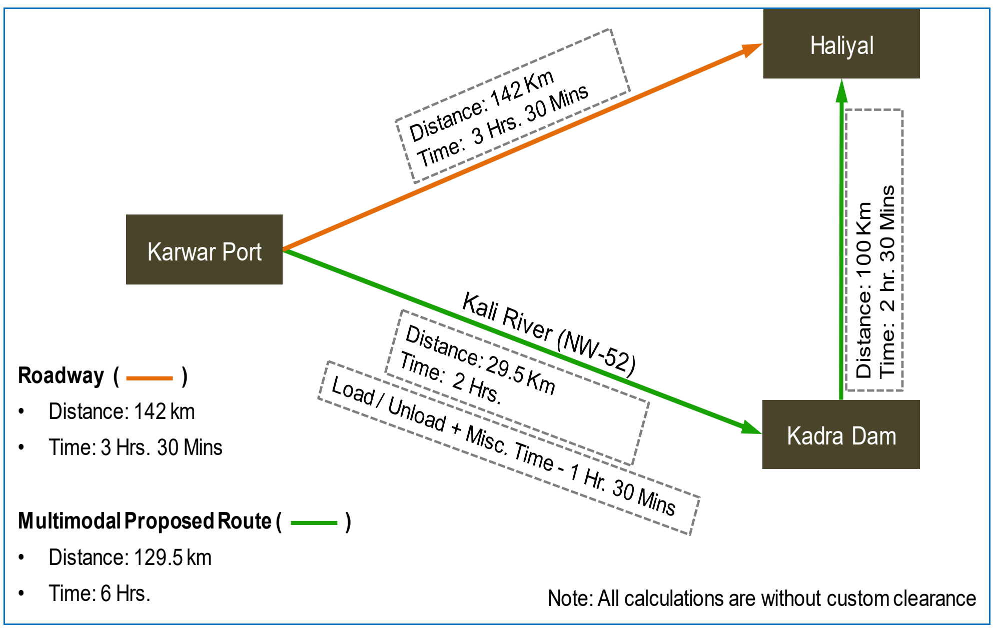


Figure 4-21 Time & Distance Comparison

It is evident from the graphical representation above that time required to cover the distance to reach Karwar Port is more in case of multimodal route (Road + IWT) than going directly by roadways. Therefore, time and cost involved in multimodal transportation will be higher compared to roadway, because the proposed IWT route involves multiple handling of trucks. This adds to the total logistic cost in transportation. An elaboration of the impact on overall logistics cost difference is depicted in the logistics cost comparison chart. The table below shows the assumptions considered while calculating logistics cost differences between roadways and proposed IWT.

TABLE 4-37:: Assumptions for Calculating Logistics Cost

Assumptions		Case I	Case II
Route	-	Haliyal – Karwar Port	
Road Distance (Haliyal - Karwar)	km	142	
Road Distance (Haliyal - Kadra)	km	100	
River Distance (Kadra - Karwar)	km	29.5	
Ro-Ro Vessel Capacity (Trucks)	Trucks	40	
Berth Hire charge	GRT / Hr	0.1008	
Port Dues	per GRT	2.03	
Fairway Usage Cost	GRT/Km	0.5	
Engine Power	bhp	2 x 200	150
Engine fuel requirement	l/hr	31	8
Ro-Ro Vessel Speed	Knots	8	6
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, vessel with a cumulative engine power of 298 kW and 15 kmph speed has been considered. In Case II, vessel with only one engine of 150 kW power and loaded speed of 10 kmph has been taken for cost comparison.

Ro-Ro/Trade Cost Dynamics

Origin	Destination
Haliyal	Karwar Port

Ro-Ro Cost Dynamics (129.5 km.)

Components	Unit	Case I	Case II
Engine	kW	200.0	150.0
Engine fuel requirement	l/hr	31.0	7.8
Ro-RoTariff	INR	2,395.3	2,304.4
Port-related charges	INR	50.3	50.3
Fairway Usage	INR	348.5	348.5
Last Mile Connectivity	INR	2,960.0	2,960.0
Total Cost	**INR/Ton**	**5,754.1**	**5,663.2**

Truck Cost Dynamics (142 km.)

Components	Unit	Cost
Fuel	INR	2,435.3
Toll Charges	INR	1,245.0
Total Cost	**INR/Ton**	**3,680.3**

Figure 4-22 Logistic Cost Comparison

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 entails 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 cost heads will never feature 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 heads in case of Ro-Ro cost dynamics. However, these costs will be nullified, as their impact on both the logistics cost dynamics will produce a similar cost escalation, leading to a similar logistics cost difference. It is assumed that IWAI will develop the entire infrastructure (Terminal & Navigation), and hand it over to the operator without looking to recover the development cost. IWAI will also be required not to take Terminal charges, Fairway usage charges, etc. in order to increase the appeal of any Ro-Ro service on Kali river.

It is evident, that total logistics cost for both the cases exceeds roadways total logistics cost by a decent margin. As per Case I, the logistics cost difference for roadway and waterway is big. Roadway movement is INR 2,074 cheaper than Case I, and INR 1,983 cheaper than Case II. Industries would opt for waterway utilization only if the total cost is cheaper than existing mode of transportation. Regardless of both the cases, logistic cost difference favours the existing roadway movement. Industries would not divert to waterways, as it will prove to be costlier than the existing mode of transportation. For promoting waterway over roadway, IWAI needs to offer the difference in cost as a subsidy per truck.

Subsidizing Ro-Ro movement is only likely to serve as initial impetus for transporters. There are other factors that need to be considered for sustaining this diversion of cargo from roadway to Kali River i.e IWAI should bear costs associated with maintenance of the Terminal and the navigation infrastructure. A combination of subsidy and incentives would be essential to induce shift of traffic from existing roadways to waterway to cater to the EXIM requirements of the industries in Haliyal.

Without the offer of aforementioned subsidy and incentives, industries would not deviate from their current logistics practice. In such a case, any Ro-Ro service on Kali River will not be a viable enterprise to pursue. Therefore, in such a scenario, it will be counterproductive and a loss making venture to develop a Ro-Ro Terminal on the River.

Also, the market doesn't show any increase in traffic volume for the industries in Haliyal, therefore the decision to set up a Ro-Ro terminal on Kali River becomes irrelevant. The cost difference between roadways and waterways is going to be same or widen even further. Even in the case where the government compensate the cost difference, the Ro-Ro terminal is unlikely to generate profits in the long run due to no growth in traffic volume. A combination of increased costs, time, and distance weighs on the overall appeal and benefits of waterway movement, deterring potential customers. Hence, it is recommended not to develop River Kali for Ro-Ro service.

4.8.6. Comparison of FSR & DPR study

Commodities considered in previous study that is Feasibility Study Report are also been analysed. Same has been shown below in table with its traffic generating source and whether it is considered in DPR or not. Potential of all commodities with reasoning is explained below.

TABLE 4-38:: Analysis of FSR

Commodity	**Source**	**Considered in DPR**	**Potential**	**Reasoning**
Molasses	Sugar Factory at Haliyal	✓	✗	Produced in Haliyal & distributed in North & South Karnataka & Goa. 1.25 to 2.75 lakh tonnes moved by factory to Port by trucks. Volume is too low to justify the IWT development. Also, commercially not viable as multimodal route is far costlier than existing mode.
Sugar	Sugar Factory at Haliyal	✓	✗	
Other Liquid	Imported by Karwar Port	✓	✗	Volume is too low to justify the IWT development. Also, commercially not viable as multimodal route is far costlier than existing mode.
POL	Imported by Karwar Port & moved towards eastwards	✓		Moved by Pipeline, diversion would not be viable.
Chemicals	Chemical Plants located near Karwar Port	✓		Plants are located on mouth of river, Port is nearer than river.
Minerals	Extracted from mines	✓	✗	Either located on coastal region or far away from river, Extraction is too less to count on traffic for Kali River
Food Grains	Produced in talukas of Uttar Kannada	✗	✗	Less production and locally consumed
Fisheries	Caught in Kali Catchment Area	✓	✗	99% is coastal fishing & only 1% is inland fishing. Locally consumed

Commodity	Source	Considered in DPR	Potential	Reasoning
Fertilizers & Chemicals	Allotment in catchment area used in agricultural production	✗	✗	Very low volume to consider. No industries exists in catchment area
Passengers	Population	✓	✗	Local People using country boats, volume is too low to justify the IWT development
Tourism	Tourist Spots	✓	✓	Tourism likely to grow in future. Development of IWT would attract more tourist footfalls in the region.

Source: Consultant's Analysis

4.8.7. Forecasting & Potential IWT Assumption

As per the study, ferry terminal could be developed at 3 locations i.e Sadasivgad, Kante and Virje near Kadra Dam. It is assumed that these are the ideal locations for handling tourist traffic on River Kali. Tourists arriving from other districts or states are the main focus for IWT attraction. River Kali has a beautiful landscape. The city of Karwar is one of the prominent tourist spot for its beaches, temples and landscape. A large number of tourists used to visit this place. The annual foot fall of tourists in the city is estimated to be more than 3.0 lakhs. River Kali meanders through lush green vegetation and beautiful rock formations. Waterway induced tourism including boating and other water related activities is traditionally most sought-after & attractive destination for tourists. This is primary reason for conceptualizing and promoting ferries by the Government, Construction of "Statue of Unity", Ferries in River Ganga in Varanasi etc are some good example to attract people for experiencing a different aspect of tourism. All the beaches and tourism locations near rivers have developed conceptualizing for river tourism. With this background, consultants have reasonably assumed at least 5% of the tourists visiting Kali River, to travel in boats and enjoy beautiful view of dams, forts, temples and forests along the river.

2020 is the considered as the base year and projection is done for next 20 years i.e till 2040. Base year tourist traffic is assumed based on the study carried out by Directorate of Ports and IWT, Government of Karnataka and projections made by them. Below table depicts the tourist traffic projections that River Kali would attract in next 20 years i.e till 2040.

TABLE 4-39:**:** Annual Tourist Traffic on River Kali

Source (in numbers)		2020	2025	2030	2035	2040
Primary	**Sadasivgad – Katne - Virje**	**15,000**	**24,712**	**40,711**	**71,747**	**126,443**

Source (in numbers)	2020	2025	2030	2035	2040
Total	15,000	24,712	40,711	71,747	126,443

Source: Consultant's Analysis

Tertiary sector of Karnataka state contributes around 66% to the total states economy. This sector has shown 10.5% CAGR in last 5 years i.e FY16 to FY21. It is assumed that the proposed IWT would grow in line with the tertiary sector of the state. Therefore, for first 10 years 10.5% growth rate is considered. Thereafter 12% growth rate is assumed once phase I gets operational. The extended ferry service till Kadra Dam in Phase-II will attract more tourists traffic due to the Dam and beautiful parks and caves located nearby.

4.8.8. Terminal wise IWT Traffic analysis

As per the above analysis, traffic for Kali river could be generated only by tourism. Three terminals are proposed to handle estimated tourist traffic in River Kali. These three terminals will be operated in two phases. 2 terminals are proposed to handle traffic in Phase-I at Sadasivgad and Katne, both on the right bank of the river.

The waterway distance between both the terminals is around 10 km. Terminal at Virje near Kadra Dam will be constructed in Phase-II, which is approx. 19.5 kms away from Katne. In Phase-I, passenger ferry service will be operated between Sadasivgad and Katne. This ferry service will be extended till Kadra Dam in Phase-II once a positive growth and conducive environment is experienced over the years. Phase-I is proposed to be completed in two years starting from January 2022 whereas the Phase-II is also proposed to be completed in two years with commencement of Phase-II in January 2030. Below figure shows the identified terminals on Kali River and its connectivity (Road & Rail)

FIGURE 4-23: Mapping of identified terminals on Kali River (Source: Google Earth)

TABLE 4-40:**:** Traffic Potential for Identified Terminal Locations

SI No.	Identified Location	Coordinates	Reasoning
1	Sadasivgad (Point A)	14°50'42.91"N 74° 07'58.80"E	**Phase-I:** Terminal identified at Sadasivgad is located just next to Edapally – Panvel Highway. The proposed ferry terminal is a greenfield site.
2	Katne (Point B)	14°52'29.14"N 74°13'4.94"E	**Phase-I:** Terminal identified at Katne is in Karwar taluka. Location is proposed for terminal development for tourism purpose. Tourist can board from this terminal to move along the river for sightseeing.
3	Near Kadra Dam (Point C)	14° 53' 50" N 74° 21' 06" E	**Phase-II:** Terminal identified is located on left bank of downstream of Kadra Dam. Proposed ferry service for tourists in Phase-I i.e. between Sadasivgad and Katne will be extended till downstream of Kadra Dam in Phase-II.

Source: Consultant's Analysis

TABLE 4-41:: Traffic Summary

Sl No.	Name of Cargo	Type of Cargo	Origin	Original Terminal on NW	Final Destination	Destination Terminal on NW	Co-ordinates	Unit p.a	Fy-20	Fy-25	Fy-30	Fy-35	Fy-40
Proposed Terminal Opportunity for IWAI													
1	**Tourist**	**-**	**Sadasivgad – Katne – Virje near Kadra Dam**				**-**	**In numbers**	15,000	24,712	40,711	71,747	126,443

Source: Consultant's Analysis

Abbreviations	Full Form
IWAI	Inland Waterway Authority of India
EXIM	Export Import
NMPT	New Mangalore Port Trust
MPT	Mormugao Port Trust
GDP	Gross Domestic Product
CR	Crore
MSME	Micro Small Medium Enterprises
Ha	Hectares
T	Tonnes
Hec	Hectares
INR	Indian Rupees
UNESCO	United Nations Educational, Scientific, and Cultural Organization
N.H.	National Highway
A.H.	Asian Highway
S.H.	State Highway
RO-RO	Roll On-Roll Off
KPCL	Karnataka Power Corporation Limited
MTPA	Metric Tonnes Per Annum
JSW	Jindal Steel Works
CRCA	Cold Rolled Close Annealed
PVC	Polyvinyl Chloride
SWR	Soil, Waste and Rain
UGD	Rigid
HDPE	Hidh Density PolyEthylene
CPVC	Chlorinated Polyvinyl Chloride
MMTPA	Million Metric Tonnes Per Annum
POL	Petroleum Oil Lubricants
FY	Financial Year
mn T	million Tonnes
GSDP	Gross State Domestic Product
MT	Metric Tonnes

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.,.

5.1. Functional Requirements for Ferry Terminal

The proposed ferry terminal has been proposed at three locations.

TABLE 5-1 : Components of Riverine Structure

Sl No.	**Terminal Location**	**Coordinates**	**General Information**
1	Sadasivgad (Point A)	14°50'42.91"N 74° 07'58.80"E	**Phase-I:** Terminal identified at Sadasivgad is located just next to Edapally – Panvel Highway. The proposed ferry terminal is a green field site.
2	Katne (Point B)	14°52'29.14"N 74°13'4.94"E	**Phase-I:** Terminal identified at Katne is in Karwar taluka. Location is proposed for terminal development for tourism purpose. Tourist can board from this terminal to move along the river for sightseeing.
3	Near Kadra Dam (Point C)	14°53'50"N 74°21'06" E	**Phase-II:** Terminal identified is located on left bank of downstream of Kadra Dam. Proposed ferry service for tourists in Phase-I i.e between Sadasivgad and Katne will be extended till downstream of Kadra Dam in Phase-II.

All three ferry ghats is proposed to cater the passengers for tourism traffic and also to cross the river. The riverine and landside infrastructure proposed for the ferry terminal are robust structures and provide floating but permanent boarding/deboarding locations for passenger. This also ensures a greater sense of safety among the passengers while ferrying through the river. The boarding/deboarding location is accessible for all passengers and shall have ample waiting areas for convenience of tourists. The terminal utilities and services are provided for ease of operation and maintenance during any water levels. The following figures show an overall site plan of the proposed terminal location at Sadasivgad, Katne & Virje (downstream of Kadra Dam).

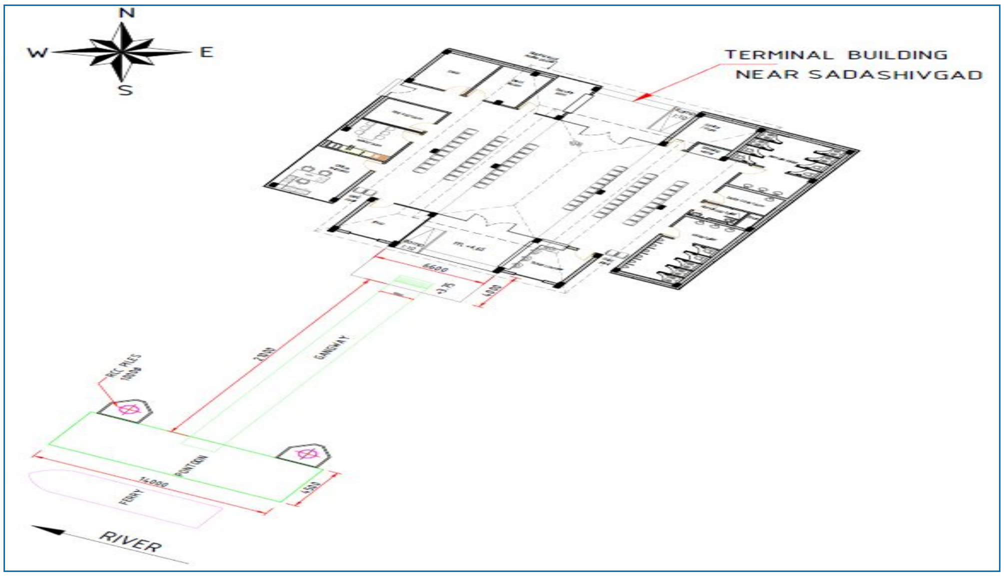


FIGURE 5-1: Overall site plan of proposed ferry terminal at Sadasivgad & Katne.

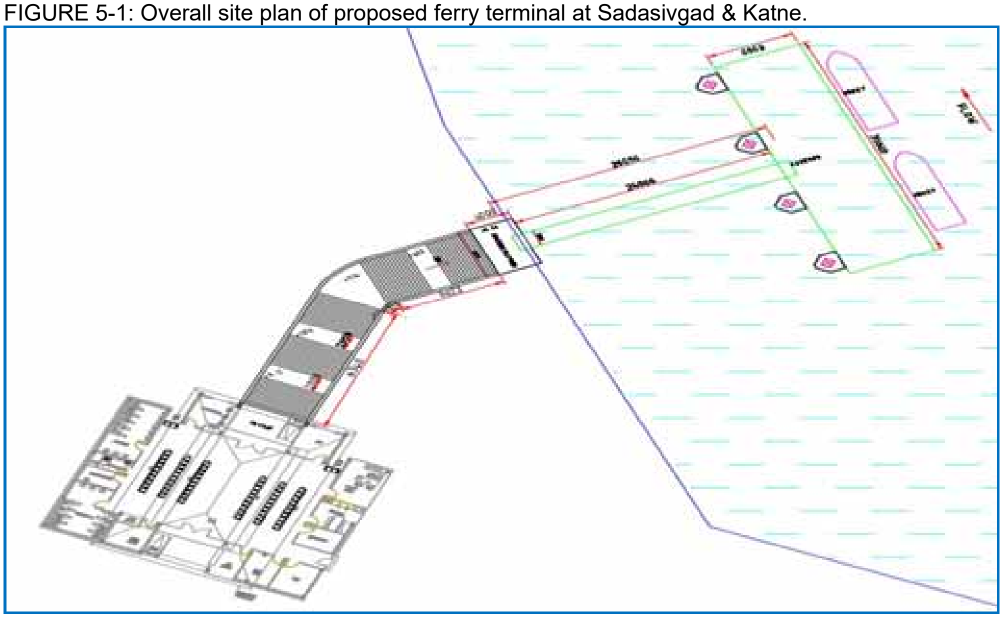


FIGURE 5-2: Overall site plan of proposed ferry terminal at Virje (D/s- Kadra Dam)

The following sections describe the basis of planning and design of terminal infrastructure (both riverine and landside).

5.2. Riverine Terminal Infrastructure

The riverine infrastructure comprises of the following components:

TABLE 5-2 : Components of Riverine Structure

Sl No.	Components of Terminal Structure
1.	Berthing pontoons (Sadasivgad & Katne) – 14x4.5m (01 each)
2.	Berthing pontoons (Virje- Downstream of Kadra Dam) – 30x8m (01 no.)
3.	Aluminum Gangway – (Sadasivgad & Katne) 23m span x 2m wide (1no.)
4.	Aluminum Gangway – (Virje- Downstream of Kadra Dam) 26m span x 2m wide (1no.)
5.	Bankseat – Concrete Raft Structure (6.6m wide and 4.0m long)

The layout and general arrangement of the components of riverine infrastructure listed above are shown in Volume-II Drawing No. **P.010256-W-20311-A06**.
The dimensions of the above-mentioned structures are based on many factors like pile spacing, rake angle which are governed by forces and proposed stiffness to resist the forces.

The detail of ferry ghat of Virje, Katne & Sadasivgad are shown in the Volume-II in Drawing No. **P.010256-W-20309-A04/A05/A06** respectively.

5.3. Planning of riverine infrastructure

The usage of the ferry terminal is greatly enhanced if the proposed location is at the same location or very near to the existing ferry terminal location. Hence the proposed ferry terminal is located at the same location where the current ferry activities are under operation. Since the proposed ferry terminal is at a fixed location, the riverine infrastructure is provided at a depth where a minimum water depth is available round the year. The low water level evaluated at Sadasivgad & Katne ghat based on the water levels recorded is found to be 1.13m RL. Considering a minimum draft of pontoon of 0.75m, keel clearance of 0.5m, a conservative allowance for sedimentation at riverbed and the required length of the gangway to cater to the difference in water levels, the proposed berthing pontoons are located to serve at minimum water level.

5.4. Berthing pontoons and pile system

The berthing pontoons are floating steel structure supporting aluminum gangways, providing safe boarding/deboarding for passengers and vehicles in the operating range of water level and possess fenders and bollards for berthing and mooring of ferries. The size of the berthing pontoons is considered based on the requirement of tourist traffic and also based on the proposed ferry sizes that are going to operate at the terminal.

Considering the above criteria, 30m (long) and 8m (wide) berthing pontoons are provided at Virje (downstream of Kadra Dam), 14.0m (long) and 4.5m (wide) berthing pontoons are provided at Sadasivgad & Katne locations. The ferry terminals are proposed with one (1) numbers of berthing pontoons at each terminal location. The following figure shows general arrangement of berthing pontoons at high water level and low water level.

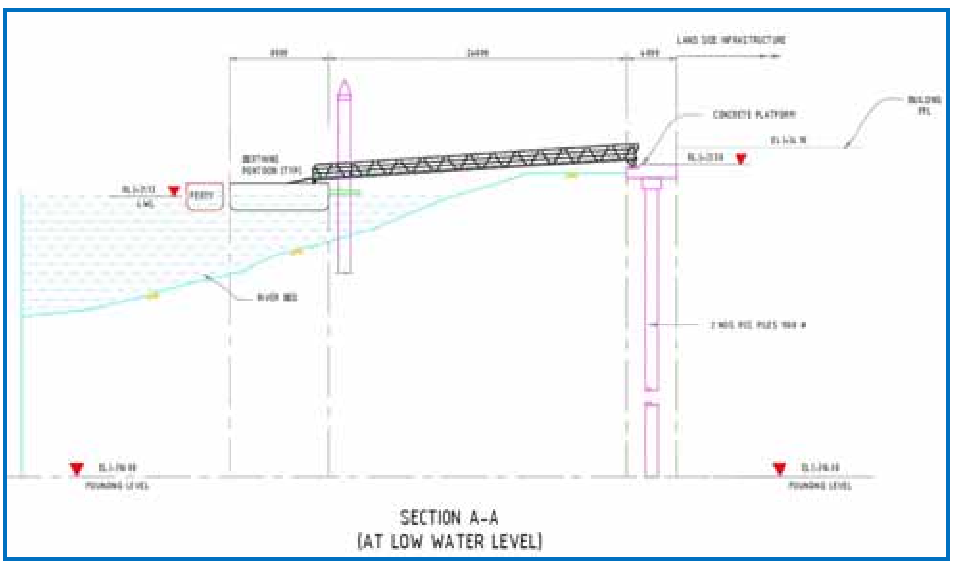


FIGURE 5-3: General arrangement of berthing pontoon at Low Water Level (Sadasivgad & Katne)

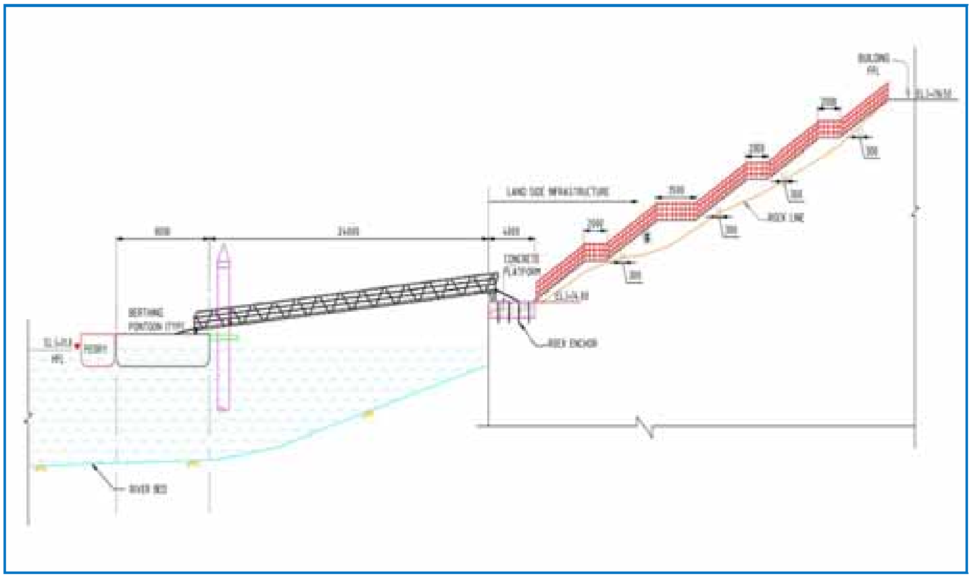


FIGURE 5-4: General arrangement of berthing pontoon at Low Water Level
(Virje- Downstream of Kadra Dam)

BERTH OCCUPANCY AND BERTHING PONTOON REQUIREMENTS:

The number of berthing pontoons to be provided is evaluated based on the berth occupancy of the vessels and traffic requirements.

The berth occupancy of the vessels and traffic are considered with respect to the vessel turnaround times and traffic requirements respectively as described below:

5.5. Vessel Turnaround 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 River Kali (NW-52), between Sadasivgad and Katne, is approx 10.0 Kms. The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel at defined 10.0 km stretch of River Kali (NW-52) carrying passengers in Phsae-I & about 19.5 kms stretch from Katne to Virje in Phase II.

TABLE 5-3 : Turn Around Time Calculation for Single Vessel

Sl No.	Parameters	Unit	Sadasivgad – Katne / Sadasivgad- Virje
1	NW-52 Stretch	Km.	29.55
2	Traffic Type Proposed	Type	Tourists
3	Terminal Proposed	Type	Passengers
4	Embark/Disembark (both side)	Mins	60
5	Total Handling Time	Mins	60
6	Sailing Speed	Knots	10
7	Sailing Time	Mins	93 mins / 1 Hr. 33 Mins
8	**Total Turn-around Time/ trip/voyage**	**Mins**	**246 mins/ 4 Hr 36 Mins**

Based on the above assumptions, a vessel loaded with passengers would take at least 4 hours 06 Mins to complete one trip reaching from one terminal to another & back. Vessel speed and operational time consumed at terminal and in transit are the primary influencing factor of turnaround time.

5.6. Traffic Requirements:

The number of vessels required to handle projected passenger and tourist traffic on the defined 10 km of NW-52. 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 vessel calls and number of vessels required to cater to the projected traffic till FY-45.

TABLE 5-4 : Assumptions for Calculating Vessel Requirement

Sl No.	Parameters	Unit	Sadasivgad – Katne / Sadasivgad- Virje
1	Operational Days	Days	300

Sl No.	Parameters	Unit	Sadasivgad – Katne / Sadasivgad- Virje
2	Daily Operational	Hours.	8
3	Carrying Capacity	No.	30
4	Vessel Speed	Nm. / km.	10/ 19.0
5	Loading and Unloading Time	Mins	60
6	Chainage (Karwar Port – Kadra Dam)	Km.	29.5
7	Turn Around Time	Mins	4 Hr 06 Mins

Based on the above assumptions, number vessels required on the River Kali (NW-52) is represented in the table below.

TABLE 5-5 : Number of Vessel Requirement

Sr. No	Unit	FY23	FY25	FY30	FY35	FY40
Tourist Traffic	No.	20,238	24,712	40,711	71,747	126,443
Annual Vessel Calls	No.	506	618	1,018	1,794	3,162
Daily Vessel Calls	No.	2	3	4	6	11
Vessels Requirement	No.	1	1	1	2	3
Additional Vessel Requirement	-	-	-	-	1	2

The above calculation concludes that 1 Passenger Ferry Vessel is adequate to handle projected traffic on River Kali (NW-52) in Phase I. Requirement for additional vessel would arise in Phase II, as traffic increases due to the extended ferry service till Kadra Dam. Additional 2 vessels will be required each in FY31 and FY37.

The above calculation concludes that 1 Passenger Ferry Vessel is adequate to handle projected traffic on River Kali (NW-52) in Phase I. Requirement for additional vessel may be needed in Phase II, as traffic increases due to the extended ferry service till Kadra Dam. Additional 01 vessel will be required each in FY31 and FY37.

As shown in the table above, proposed vessel will require to make single trip daily to cater to the projected traffic. If in future traffic increases beyond the projected, the proposed vessel can make up to 2-3 trips every day. The river is proposed to be developed for tourism, hence night navigation is not required.

5.7. Gangway

The gangway bridge the gap between the approach trestle/bank seat and the berthing pontoons. The gangway are aluminum truss elements formed with box sections and enclosed built-up sections. The terminal is provided with one gangway arrangement for access to the berthing pontoons.

The end points are hinged at one end and are provided with roller supports the other end. The roller supports allow the slope of linkspan to vary with the fluctuation of water level. The operating level mostly shall be (1.00m RL) at the water side and 3.75m RL at the bank side. the gangway has a maximum slope envisaged as 1 in 8. A pictorial view is shown in the figure below.

FIGURE 5-5: The Artistic View of Pontoon and Gangway Arrangement

5.8. Bankseat

The bankseat is a deck structure that supports the gangway at the hinged end. The proposed structure is 6.6m wide and 4.0m long. The following figure shows typical arrangement of the bankseat structure. This is a raft structure, no piles have been proposed as soft/hard rock outcrop is present in the region. The dimensions of deck structures of dolphins has been finalized.

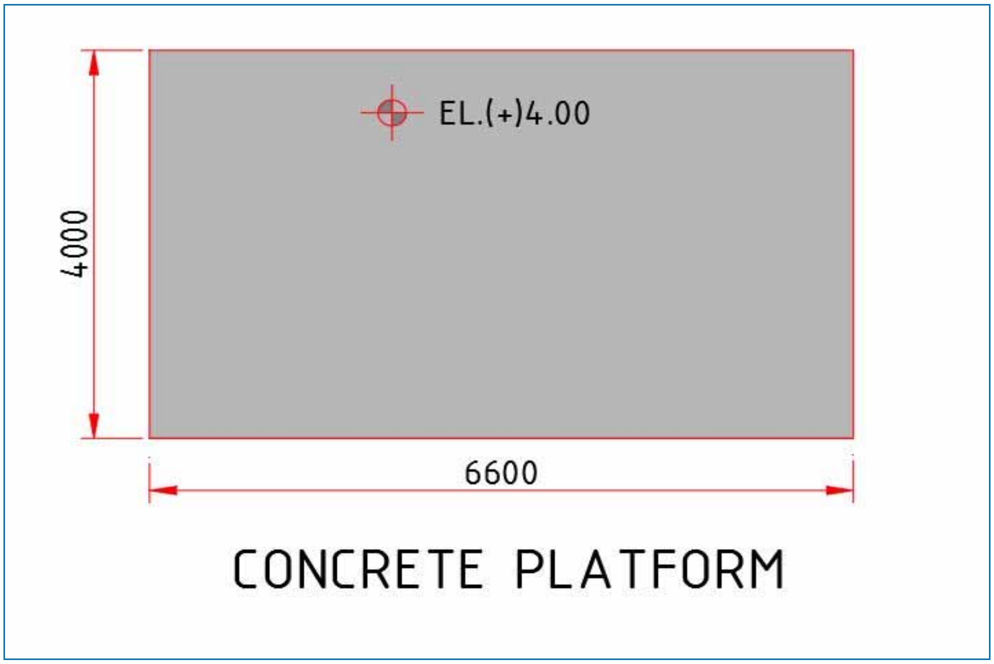


FIGURE 5-6: General arrangement of Concrete Platform at Bank (Sadasivgad/Katne)

5.9. Landside Terminal Infrastructure

Based on the traffic analysis and forecast in previous chapter, terminal building areas and infrastructure requirement will be finalised.

Typical elements/ Activities in terminal building are given below -

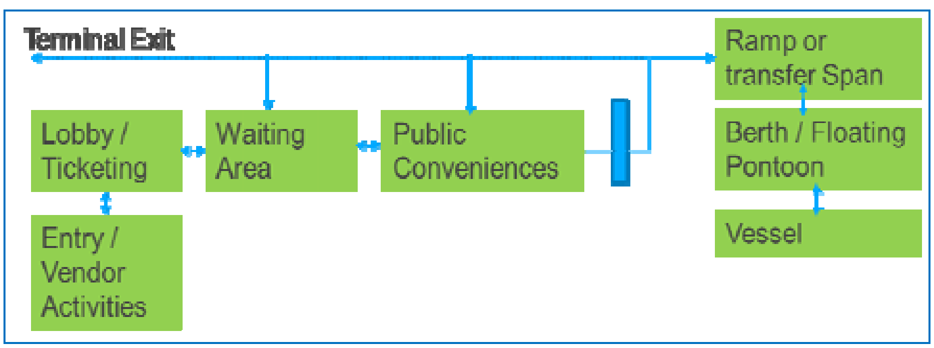


FIGURE 5-7: Typical element for terminal building

The broad components of terminal building are as under –

- Waiting areas for passengers
- Emergency service facilities
- Toilet facilities
- Security check areas
- Ticketing booths

- Parking areas
- Office and Meal Room
- Shops
- Open area
- Entry exit routes
- Access to ferry services by disabled persons
- Space for utilities / infrastructure requirements
- Control room for ferry services
- Storage Areas

Area Requirement for Pontoon Side Given Below –

TABLE 5-6 : Area requirement Pontoon Side

Terminal Land Area Requirement for the Waterway Kali (NW-52) - Virje /Sadasivgad/ Katne			
Facility	**Nos.**	**Size**	**Area**
Open Mobility Area	1	-	120
Main Terminal Building/ Administrative department/ Ticket Counter/ waiting Area/ First Aid etc.	1	25m x 20.0m	500
Security shed for watch and ward	1	4m x 3m	12
Electrical facility, Transformer etc.	1	4m x 3.5m	14
Fuel Bunkers	1	6m x 4m	24
Water Supply Room	1	3m x 4m	12
Fire and Safety support Room	1	3m x 4m	12
DGPS receiver & transmitter shed	1	4m x 3m	12
DG shed	1	5m x 5m	25
Sewerage Treatment Plant (STP)	1	15m x 15m	50
Overhead Tank	1	7.5m dia	44
Green Area	1	-	200
Land required for Road Extension external approach road	1	-	100
Area under Mangroves clearance	1	-	100
Total Area	-	-	1225.18

5.10. Planning for Terminal Building

Vision

"Rivers are a spatial system woven into the geographic fabric of the city" Cities have evolved in proximate of water bodies.

Water based transport most reliable means of Communication and transport for goods and passengers.

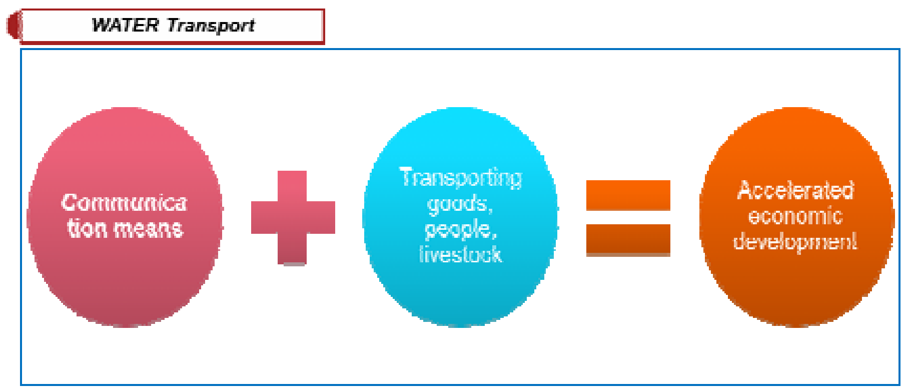


FIGURE 5-8: Water transport importance

and Ferry terminal is a building used for marine transportation of goods and people. Therefore, Vision for designing the terminal building is –

"To develop a self-sustainable building focused upon positive customer experience from embarking till last mile Connectivity".

Objective

to develop any ferry terminal building, following points should be taken care off

FIGURE 5-9: Design criteria for terminal building

For last mile connectivity The Land Side terminal building will be connected to the existing road by means of ramps for convenient entry and exit of passengers and vehicles.

5.11. Architecture Design of Terminal Building

Terminal design is driven by the following factors.

FUNCTIONALITY

The concept is an outcome of design philosophy, “Form follows function”. Landside development broadly comprises of the circulation space, parking lots, utility/substation zone and the main building with administration and waiting areas.

Spatial arrangement of various zones revolves around the main building mass which comprises of the basic amenities for all the users, pedestrians and passengers on vehicles. Customers coming by bikes and cars can park in the designated spaces and avail the public amenities in the waiting time, if they wish to. The beauty of the concept is its absence of complication combined with its clarity of functional and richness of cultural experience.

Functional zoning of the terminal building is explained below: -

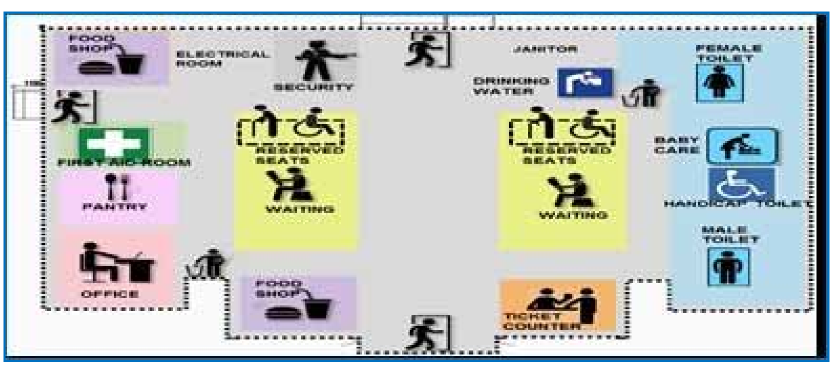


FIGURE 5-10: Terminal building: - zoning plan

The form of terminal building is a modern interpretation of the vernacular architecture of the site. It is an amalgamation of state of the art and local materials. Reference Drawings of detail layout of terminals located at Virje, Katne & Sadasivgad have been shown in the Volume-II Drawing No. **P.010256-W-20364-A04/A05/A06**.

SEGREGATION OF TRAFFIC MOVEMENT

Terminal design aims at creating separate routes for the vehicular and pedestrian movement to have least to no conflict in the two types of user movements.

SUSTAINABLE BUILDING

Parameters for sustainability adopted in terminal design are:

1. Minimum disturbance with natural scape
2. Use of local material
3. Proper shading
4. Proposal for roof top solar panels- Renewable energy
5. Waste treatment – Provision of STP to treat waste water and use the treated water for irrigation.
6. Use of Water saving equipment.

A single storied structure is proposed that respects and reflects the natural landscape of the site and does not stand out as an eye sore.

Sloping roofs on terminal building have been proposed as a climate responsive design and following the local architecture.

Use of local material for tiling of roads and sloped roofs has been adopted.

Proper shaded pathways and parking lots have been given by proving line of shade giving native trees and shrubs along the parking bays. It reduces heat island effect and provides a positive experience for the end users.

To provide for 10% of energy being consumed as renewable energy, roof top solar panels are proposed above the terminal building and over the concrete platform towards pontoon.

Particulars of Sadasivgad, Katne & Virje Ferry Terminal Ghat.

TERMINAL & INFRASTRUCTURE

The following main components are considered to form the basic infrastructure required at Ferry Terminal ghat at Sadasivgad, Katne & Virje (D/s of Kadra Dam). Similar building and the same plinth area has been proposed ath all the three locations. The only difference is in their elevation depending upon the topography of that particular terminal location. The floor FFL is 16.50m at Virje whereas it is at EL.+4.65 for bothe the terminals at Sadasivgad & Katne.

- Ticketing Office

- Administration & Security
- Passenger waiting area
- Public Amenities: Toilet Facilities, Drinking water fountain, Vending area
- Vehicle parking area
- Roads / Turning Areas
- Utilities
- Green cover

Typical elevation of terminal building & the zoning plan is shown as below: -

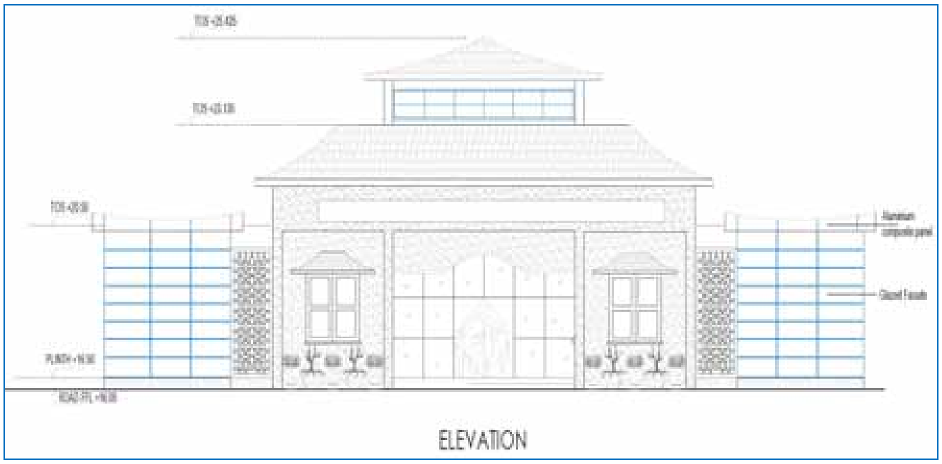


FIGURE 5-11: Terminal building: - Elevation

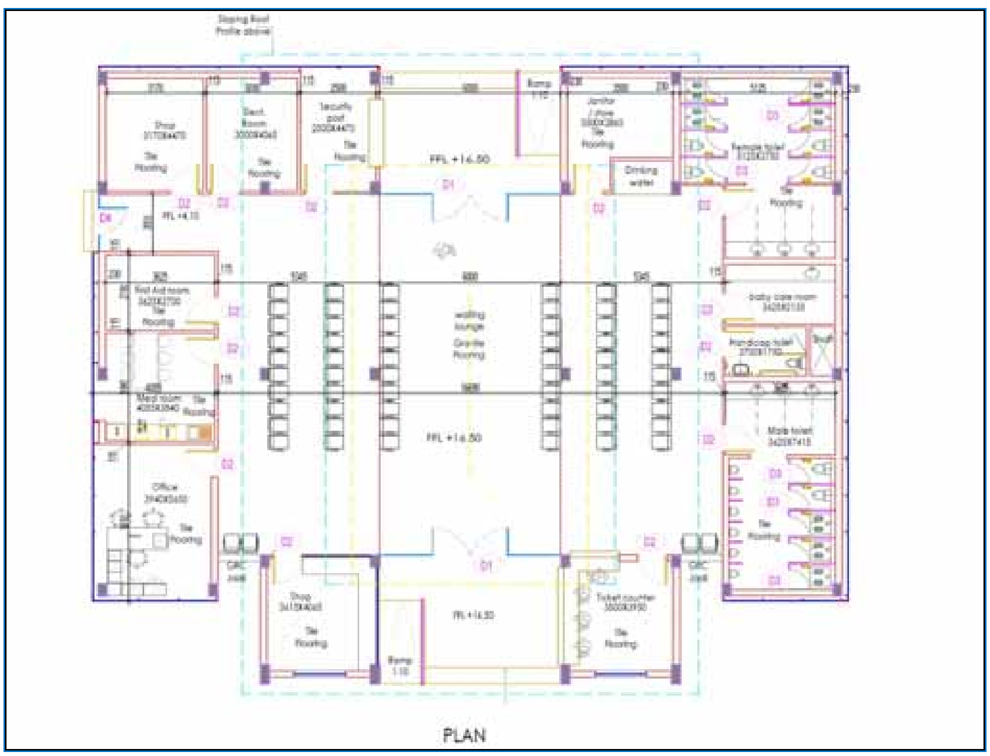


FIGURE 5-12: Terminal building: - Zoning Plan

5.12. Land Details

Apart from all the technical requirement for operation of ferry services, Land Availability is considered the main criteria for finalisation of terminal building. The connectivity to the proposed terminal location is through main road The Land area identified is as below:

TABLE 5-7: Terminal Land Details

Coordinates (UTM) N/E	**1647059.8**	**430264.84**
Coordinates (DMS) N/E	14°50'42.91"N	74° 07'58.80"E
Village	Kadra	
Taluka	Virje	
District	Uttara Kannada	
State	Karnataka	
Nearest Town	Karwar	
Distance of town (km)	40km	
Land use	Mostly forest land adjacent to dam	
Ownership	both govt and Private land	
Water Distance	on edge	
Nearest Road	Kaiga - Kadra road	
Road Distance (m)	200	
Nearest Railhead	Asnoti Rly Stn	
Railhead Distance	30km	
Nearby major Structure	Kadra Dam	
Terrain	Uneven hilly terrain with mild slopes	
Soil/Subsurface strata	Thick overburden material with boulders/cobbles etc	
Surveyed Area (Approx)	1225.18 Sq. m	

The land detail for locating the terminal at Virje downstream of Kadra Dam is described in table 5.6 which is in Phase II. Apart from this there are two more ferry terminals have been proposed at Sadasivgad (Phase I) & Katne (Phase I). The land requirements are similar for all the three terminals proposed in this document irrespective of its phase of implementation.

5.13. 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 detail al estimated up to a depth of 3.0m in bedrock. Borehole has been terminated at a depth of 10.15m below existing ground level (EGL).

5.13.1. Regional Geology

Uttar Kannada district in particular is occupied by rocks of Sargur Group, Peninsular Gneissic complex (PGC), older Granitoids and Chitradurga Group of Dharwar Supergroup of Archean age. Dolerite dykes of Palaeoproterozoic age are intruding these rocks **(Figure 5.12)**. The older metamorphics of Sargur Group are represented by amphibolite occurring as enclaves within granite. The rocks belonging to PGC are represented by granitic gneiss and granodiorite. The granite gneiss at places is migmatitic in nature. The Dharwar Supergroup of rocks and PGC-I are intruded by older granitoids referred as "Karwar Granite". The granite is massive, generally coarse grained, porphyritic found in shades of grey and pink consisting of quartz, Kfeldspars, plagioclase and biotite.

The Goa belt represented by Chitradurga Group is exposed in the area as "Barcem Formation" consisting of metabasalt (Schistose), BMQ and acid volcanics. The area is also intruded by numerous swarms of dolerite dykes. The majority of the rock sequences are lateritised that occur as extrusive cappings in the Western Ghats and in coastal plains. Their thickness ranges from a few cm to 60 m. (Chalpathi Rao, 1968; Chalpathi Rao and Kannan, 1970; Davay, 1968; Gopal Rao, 1968; Pazhamalainathan et. Al, 1982; Ramakrishna, 1967; Shafeeq Ahmed, 1990; Subramanian, 1968; Subramanian, 1969).

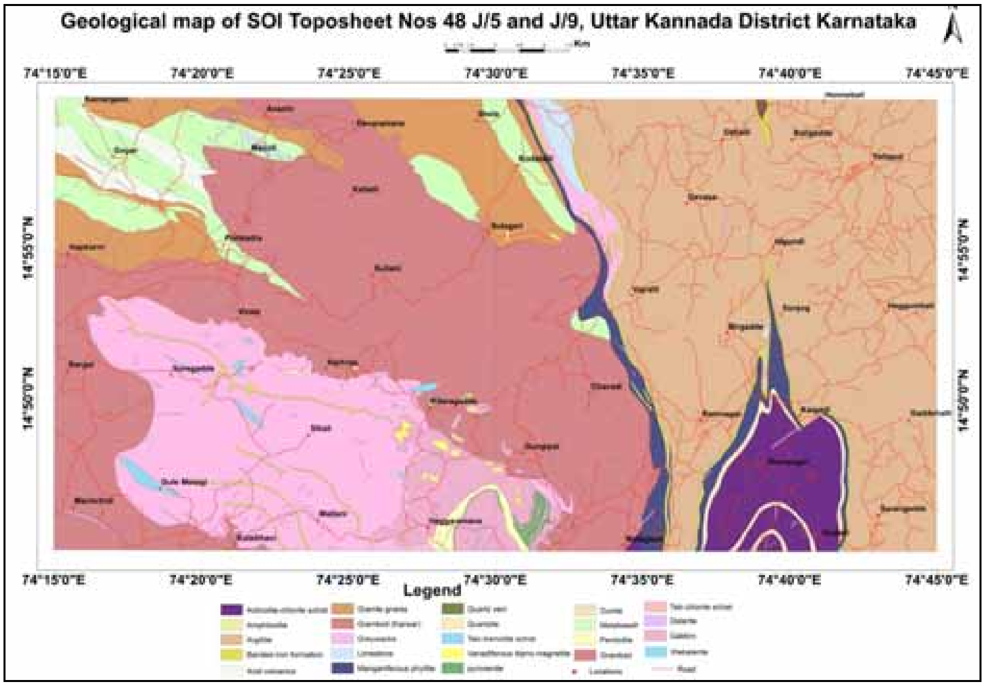


FIGURE 5-13: Geological map of parts of SOI Toposheet No. 48 J/5 & J/9.showing Project Area

(Source: Geological Survey of India, Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheet No. 48 J/5 & J/9, Uttar Kannada District, Karnataka (Code No : Lsm/Sr/K&G/2015/098) (Field Season 2015-16)

5.13.2. Physical Condition and Drainage

The study area has gentle to moderate undulating topography having elevation variation from +10 to +35m above MSL. The area has temperate climate and the forest type is semi evergreen forest. The present landscape of the study area under consideration is viewed as the manifestation of a chain of interactions between fluvial and denudational processes operating on underlying geology that has been subjected to past vertical tectonics. Field studies indicate that the geomorphology of the study area is marked mostly by alluvial plains suggesting the considerable period has elapsed during the development of the landforms. Each landform signifies the processes operated in the evolution of the landforms. However, some present topographical features seem to be introduced by construction of Kadra dam in the past which is very near to site.

Figure 5.13 shows the geomorphology map of parts of toposheets 48 J/5 and 48 J/9 with project area. As per the map, most part of the project area is covered by alluvial plain which is a level or gently sloping tract or a slightly undulating land surface produced by extensive deposition of alluvium, usually adjacent to a river that periodically overflows its banks; (NGLM Manual, 2010).

The project area/selected site forms a part of Kali river basin which constitutes the major drainage of the area. The location of the selected site on Google earth is shown as Figure 5.14 while the enlarged view of the same is shown as Figure 5.15 and the figures showing the actual condition of the site is shown as Figure 5.16.

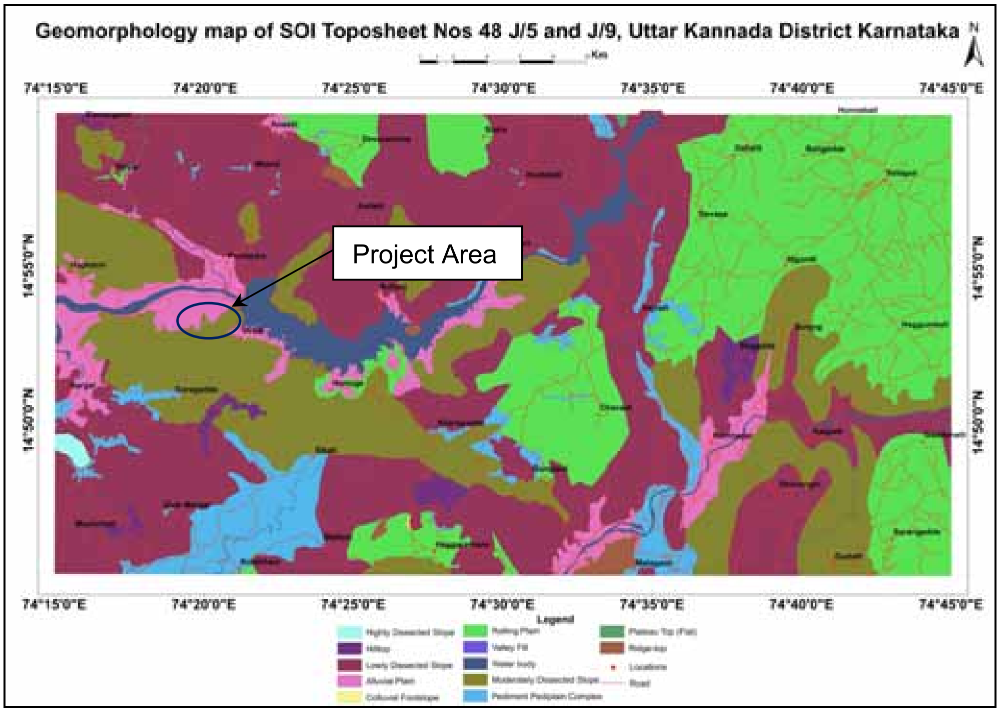


FIGURE 5-14: Geomorphology map of parts of SOI TS No. 48 J/5 & J/9 showing Project Area (Source: Geological Survey of India, Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheet No. 48 J/5 & J/9, Uttar Kannada District, Karnataka (Code No : Lsm/Sr/K&G/2015/098) (Field Season 2015-16)

Drainage:

Kalinadi forms the primary drainage way which flows from east to west and passes through the Central part of the toposheet (48J/5). A number of nalas join it forming the secondary drainage. Almost all of the nalas cross Mallapur Idgundi road and among them some are perennial. Other numerous tertiary and rilly grilly drainage ways die out at short distances in the area and flow in different directions. The drainage pattern of the area is mainly dendritic, sub-dendritic and trellis (Figure 5.3).

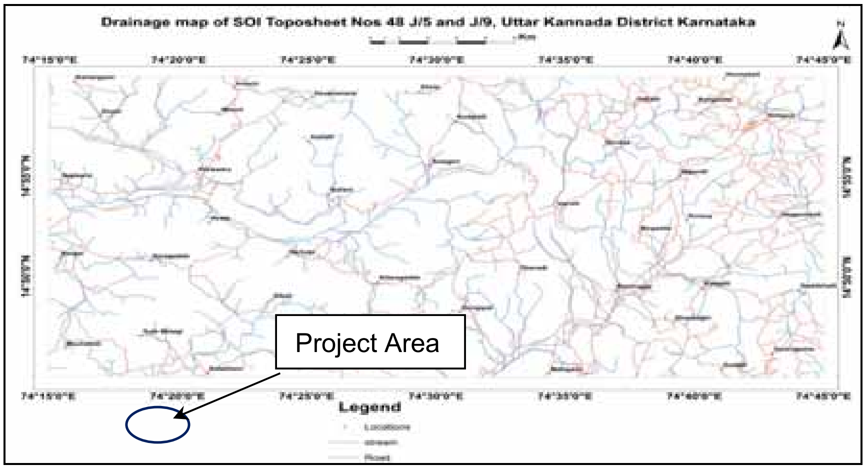


FIGURE 5-15: Drainage map of parts of SOI TS No. 48 J/5 & J/9 showing Project Area

(Source: Geological Survey of India, Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheet No. 48 J/5 & J/9, Uttar Kannada District, Karnataka (Code No : Lsm/Sr/K&G/2015/098) (Field Season 2015-16)

FIGURE 5-16: Google Earth Image Showing Project Area

FIGURE 5-17: Enlarged View of Google Earth Image Showing Project Area

FIGURE 5-18: Image Showing River Kali and Part of Selected Site (Left Bank)

5.13.3. General Geology and Stratigraphy

The project area forms a part of Western Ghats that grade into a plateau towards east. Geologically the area exposes Late Archean rocks (<3000 ma), Peninsular gneiss-I of Tonalite-Trondjhemite-Granodiorite composition, Middle Archean (>3000 ma) Sargur Group, with ultramafic-mafic intrusive complex, serpentinised komatitc and amphibolites, etc. and lower to Middle Archean (~3400 ma) older Gneisses.

As per the Geological Survey of India, Report on Macro-Scale (1:50,000) Landslide Susceptibility Mapping in parts of Toposheet No. 48 J/5 & J/9, Uttar Kannada District, Karnataka (Code No: Lsm/Sr/K&G/2015/098) (Field Season 2015-16) the project area comprises of Granitoids (Figure 5.1).

The earlier workers considered the area to be part of North Kanara schist belt. The lithounits of the area represent a part of eugeosynclinal sedimentation of Precambrian age. Though it is to be still classified, tentatively based on the lithological assemblages, it is grouped under Chitradurga group of Dharwar super group (Swaminath et al 1981).

Laterite	
Basic and ultrabasic suite	Pyroxenite/gabbro/ferro-gabbro and dolerite
Gneissic granite	Tonalite gneiss
Metavolcanics	Talc-Tremolite schist
	Chlorite phyllite/chlorite sericite schist
Metasediments	Quartz-schist/quartz-Sericite-schist (Pink phyllite)

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

Strata I: Reddish Medium Dense to Dense Silty Sand

Strata II: Greenish Grey Moderately Weathered Granite

5.13.4. Sub-surface Investigations

The selected site has been investigated by one drill hole (BK-1) which has been drilled for depth of 10.15 m. The detail of the drill hole is tabulated below in **Table 5-7**.

Table 5-8: Summary of Drill holes

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.	BK-1 (NGL – 17.75 m)	Left bank of Kali river **(14^0 53' 50'' N, 74^0 21' 06'' E)**	10.15	0	7.15	7.15	Reddish Medium Dense to Dense Silty Sand	22 - 37			
				7.15	10.15	3	Greenish Grey Moderately Weathered Granite	-	62-63	50-55	

The description of the drill hole is as given below.

BK-1: Drill hole BK-1 has been drilled at the terminal location area on the Left bank of Kali river just downstream of Kadra Dam, Uttara Kannada, Karnataka. The drill hole has been drilled vertically down to the depth of 10.15m from EL.17.75m to EL. 7.6m. The drill hole has encountered 7.15 m thick Reddish Medium Dense to Dense Silty Sand underlain by 3.0 m thick Greenish Grey Moderately Weathered Granite.

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

5.13.5. Geotechnical Results and Analysis

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 Table 5.8.

TABLE 5-9: Summary of In-Situ Test Results

Sl. No.	Strata Description	Depth		SPT 'N' Value
		From	To	Observed
1	Reddish Medium Dense to Dense Silty Sand	1.5	2.1	22
		3.0	3.6	29
		4.5	5.1	35
		6.0	6.6	37

Laboratory Test Results

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

4 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 **Table 5.9**

.

Table 5-10: Summary of Laboratory Test Results on Soil Samples

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/cm^3		%	%	%	%	%	%	%	%	%			Kg/cm^2	degree	C_C	e_0	G
BK-1	Reddish Medium Dense to Dense Silty Sand	1.50	2.10	SPT	1.700	1.504	13.00	0	77	23	---		Non - plastic			SM	UU	0.065	25			2.64
		3.00	3.60	SPT	1.745	1.524	14.50	0	79	21	---		Non - plastic			SM	UU	0.017	26			2.61
		4.50	5.10	SPT	1.815	1.613	12.50	0	66	20	14		Non - plastic			SM	UU	0.005	30			2.63
		6.00	6.60	SPT	1.843	1.631	13.00	0	72	28	---		Non - plastic			SM	UU	0.041	32			2.65

Testing on Rock Core Samples

Three 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 **Table 5.10**.

Table 5-11: 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
		From	To	Kg	Kg/cm²	Kg/cm²	Kg/cm²		%	%	gm/cm³
BK-1	Greenish Grey Moderately Weathered Granite	7.15	8.65	17600	---	783.36	5.067 E+05	0.19	0.27	0.78	2.89
		8.65	10.15	14350	---	635.36	2.435 E+05	0.19	0.33	0.94	2.87
		8.65	10.15	630	21.21	---	---	---	---	---	---

5.14. Terminal Infrastructure including equipment

The land area identified is measuring to about 25476.27 Sq. m and surveyed for puttting the terminal infrastructure and to be considered for Land acquisition as per the . The land requirement with the requirement of facilities for each terminal has been worked out to 1225.18 Sq. m, which can be accommodated within the Land proposed for Acquisition.

Considering the Class IV waterway classification, Ferry services and the required facility has been proposeds for each of the terminal locations.

5.15. Berthing Structure

The berthing structures shall be designed such that they provide safe berthing of ferry/vessels without damaging the ferry/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 tourist traffic, and water level variations.

- Deck Level

As per IS 4651_IV, the deck level of the Ferry 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 terminal is maintained in a slope of not steeper than 1:8, maintaining the deck level at the shore side at 1.0m above the MHWS /highest water level or to match with the existing ground elevations.

On the river side, the deck level is fixed maintaining under keel clearance of 0.5 m 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. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows

- Size (L x B x D) – 13m x 2m x 0.8m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Outboard Engines of 150hp (approx.)
- Speed - 12 Knots (max.)

TABLE 5-12 : Salient Features of Berthing Pontoon

Description	Length(m)	Width (m)
Berthing Pontoon (Sadasivgad/Katne)	14	4.5
Berthing Pontoon (Virje – Downsream of Kadra Dam)	30.0	8.0

The structural arrangement of the berthing pontoon including the preliminary design has been shown below in Figure 5.15.

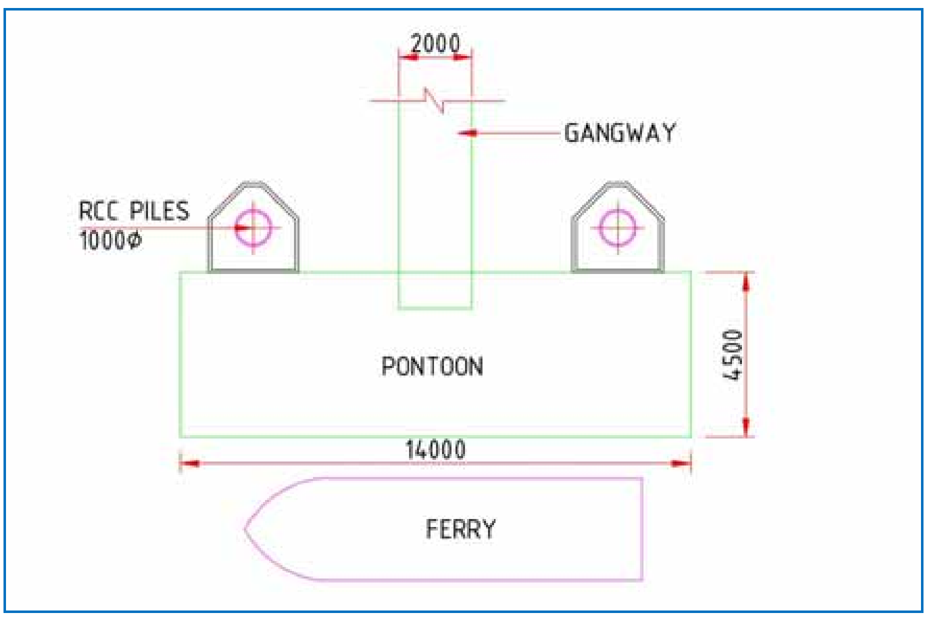


FIGURE 5-19: Structural Arrangement of Pontoon

The preliminary design has explained in the chapter 6. (Refer Volume-II Drawing No. **P.010256-W-20309-A06**)

Note: The above berthing 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.

5.16. Terminal Costing

5.16.1. Capital Cost

The Capital Cost for the fairway has been considered in Chapter 11 along with the proposed development for Ferry Terminal facilities at the defined location. The Capital Cost of terminal works out to be about 7.44 Crores in Phase I & 6.188 Crores in Phase II of the project.

5.16.2. 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 perform 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.

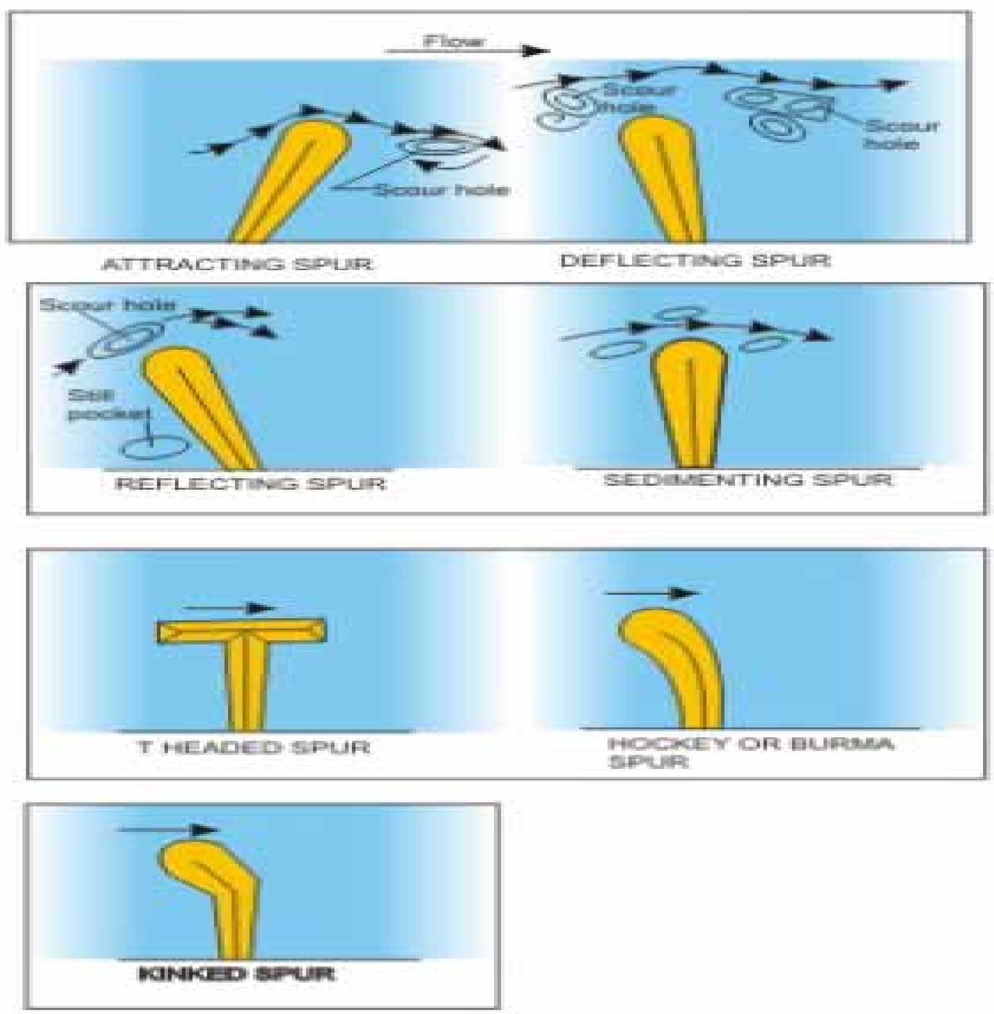


FIGURE 6-1: Different types of Spur

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.

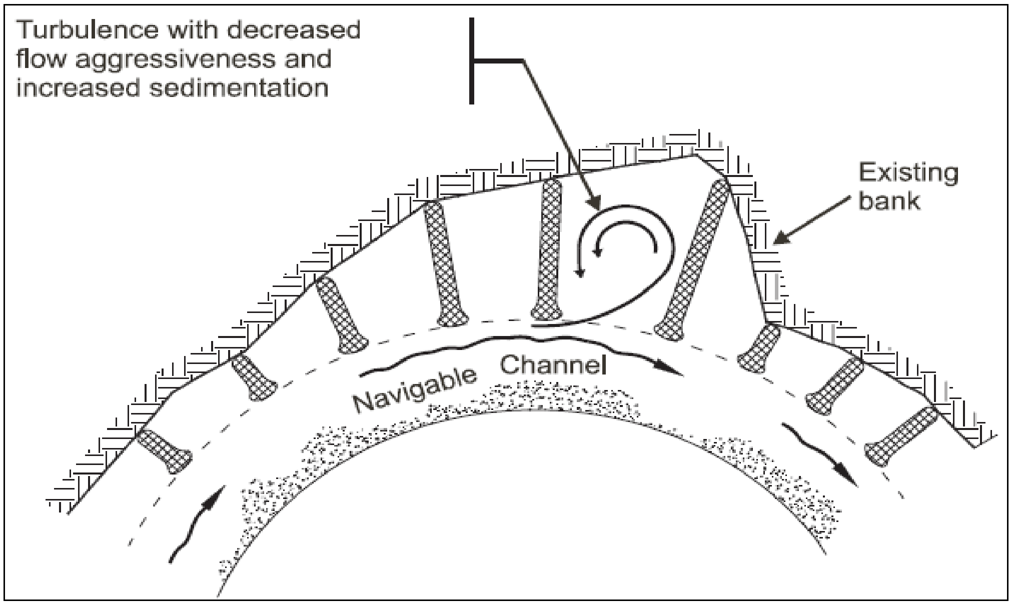


FIGURE 6-2: Plan view of system of spur-dikes constructed to control and stabilize the erosion of the outer band

Spacing

Each spurs protects only a certain length. The stability of eddies is govern by the non- dimensional spur ratio, esp., which is ratio of the head loss in the river between two spurs, U2 SSP / (C2 h) (m), to the velocity head U2 / (2g) (m) of the river.

Where,

U = depth-averaged velocity (m/s)

SSP = spacing between spur-dikes (m)

C = Chezy coefficient of the river (0.5m$^{1/2}$/s)

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

eSP = (2g SSP) / (C2 h),

eSP 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.

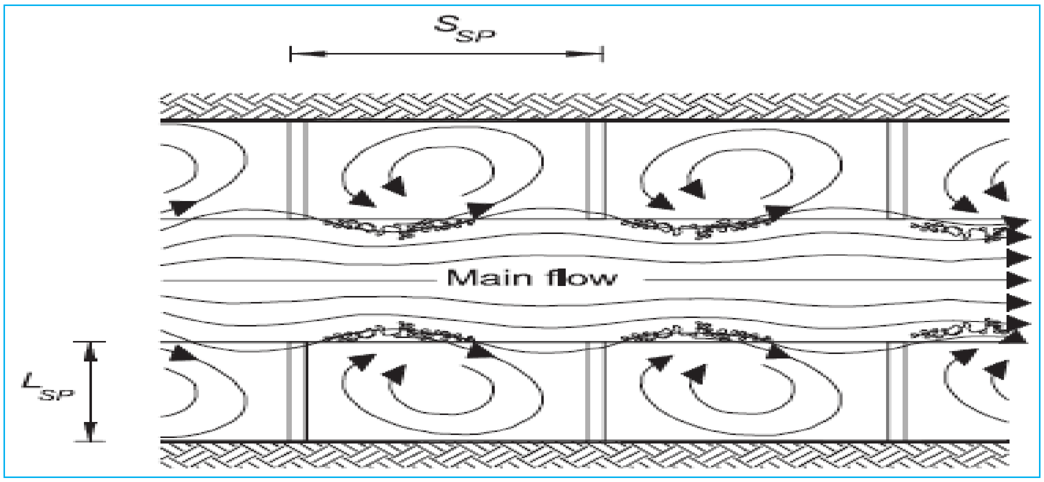


FIGURE 6-3: Diagram showing the length and spacing of the individual dikes with respect to the river width

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 Figures below.

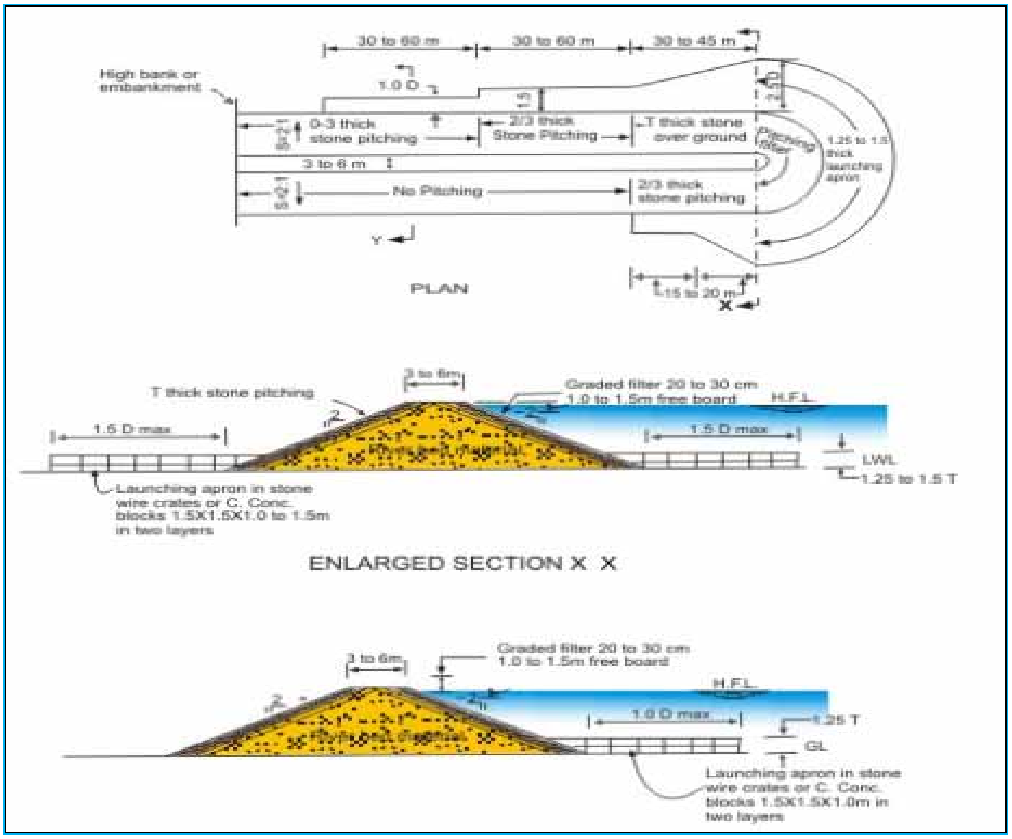


FIGURE 6-4: Typical layout and section of spur

Figure 6-5:Impermeable spurs

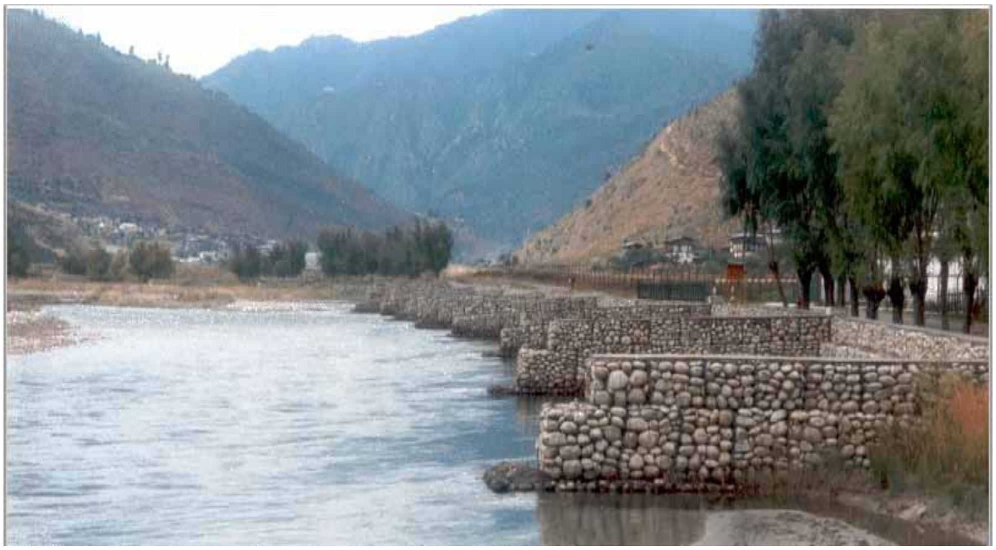


Figure 6-6:Series of spurs

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 stretch, wherein the Design and Photos are placed herewith.

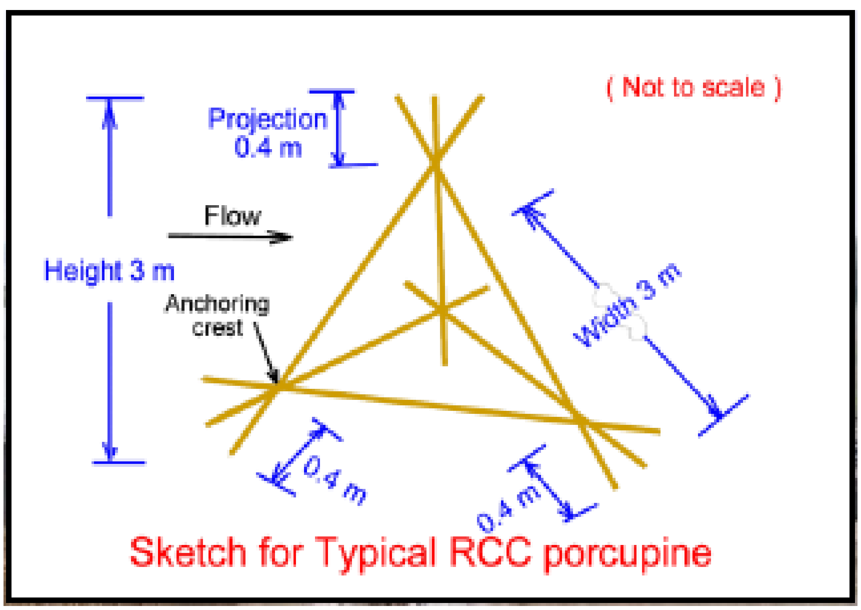


Figure 6-7: Typical sketch for RCC Porcupine

Figure 6-8:Porcupine Arrangement

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.

PIANC (2014). Harbour approach channels design guidelines. Report no. 121.

CIRIA, CUR, CETMEF (2007). The Rock Manual. The use of rock in hydraulic engineering (2nd edition). C683, CIRIA, London.

Pilarczyk, K.W. (2000). Geosynthetics and Geosystems in Hydraulic and Coastal Engineering. Taylor & Francis Group, London & New York.

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.

(Refer Volume-II Drawing No.**P.010256-W-20303-X04** for details).

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.

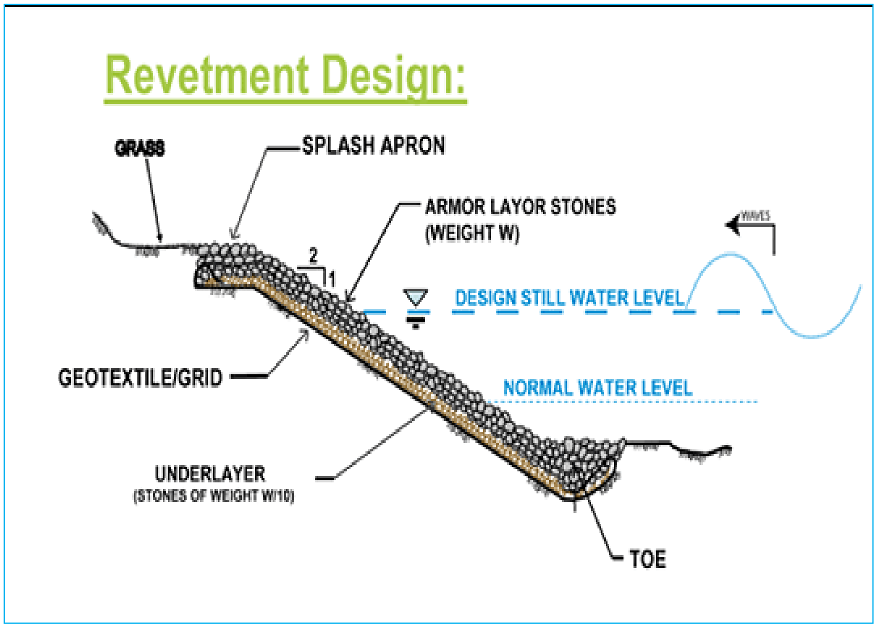


Figure 6-9: Typical section for Revetment Design

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.

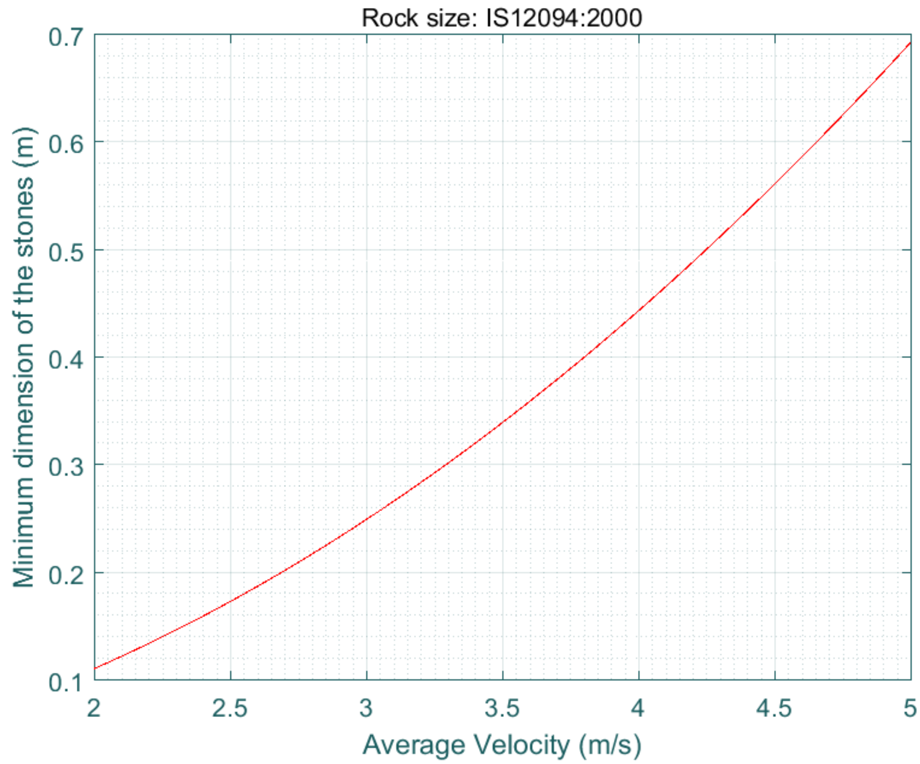


FIGURE 6-10: Minimum rock size according to the IS12094

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:

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

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:

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

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

- D50= 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)
- Ks = 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
- Kh1 = 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.

- Kh2 = factor related to the depth. For propeller jet PIANC (2016) recommends using 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.

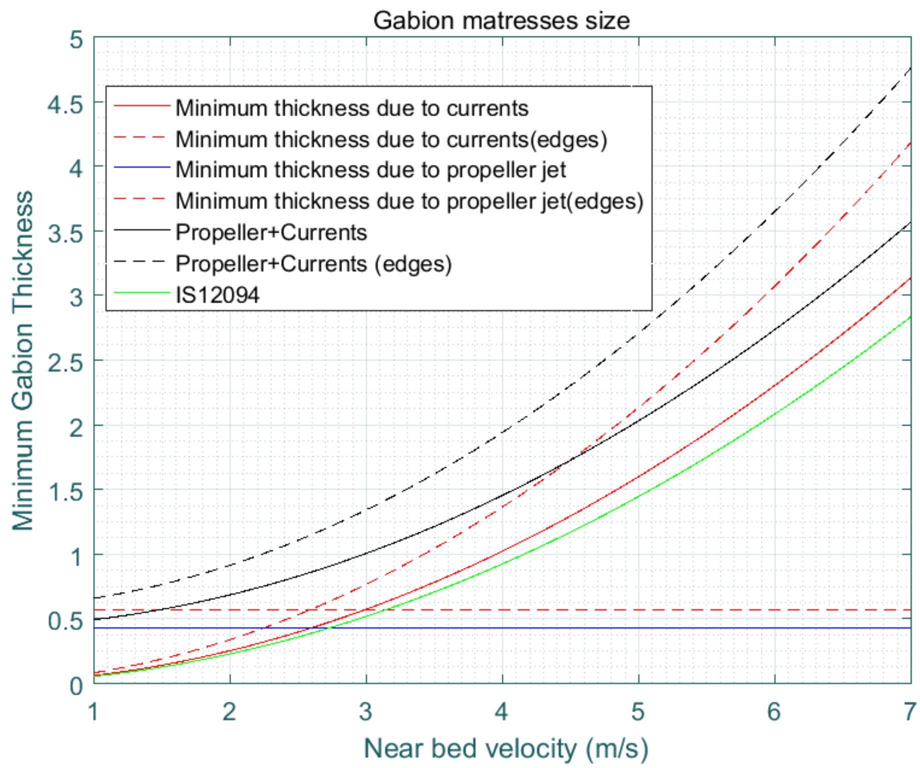


FIGURE 6-11: Minimum required thickness for revetment

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):

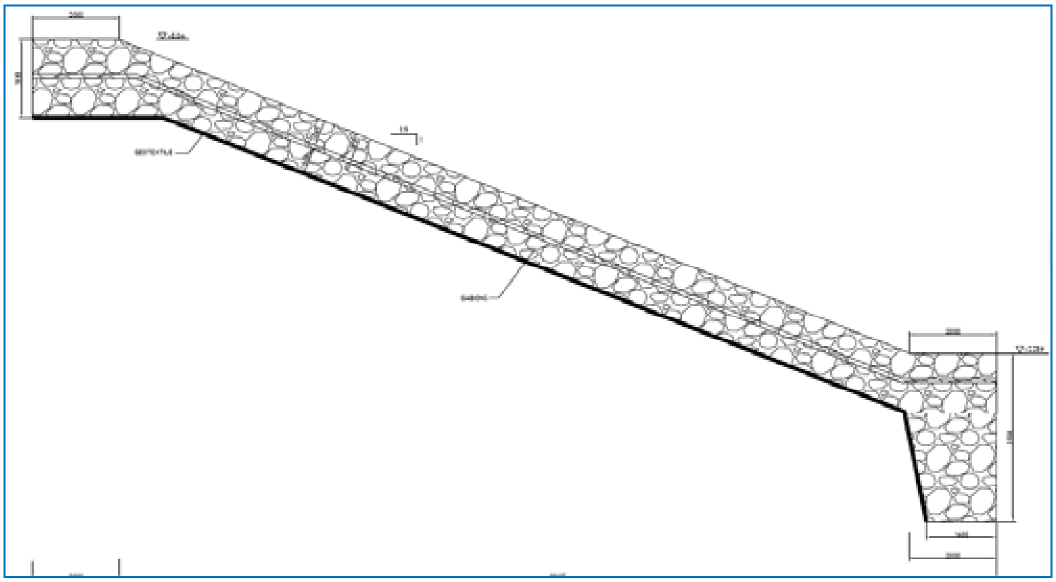
$$\frac{H_s}{\Delta D} = \frac{9\cos(\alpha)}{\xi_{op}^{2/3}}$$

- 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
- εop= Breaking parameter

$$\xi_{op} = \frac{\tan(\alpha)}{\sqrt{\frac{H_s}{1.56 T_p^2}}}$$

The proposed bank protection as derived from various design assumptios are shown in **Figure** below.



The maximum velocity during the high tide is recorded as 4.0m/s as mentioned in Table 2.5 and therefore the minimum proposed thickness of the Gabian is 1200 mm having two layers of rock each of 600mm to enhance the effectiveness overlain on a slope of 2.5H:1V. The whole arrangement is once again overlain on geotextile.

Geotextile filter layer shall prevent the underline sand & fine materials being washed out through the gabions. The minimum rock size for the gabions shall be 0.4m. Assumptions have been taken for the calculation of the velocity and turbulence factors applied for the river currents. Standard gabion baskets are of thickness 1, 1.5 and 3 feet and the length size of 6, 9 and 12 feet however these are intertwined with linking wire of the same material.

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 number 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	Dn50	D50	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 d50 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:

- Cs = Stability coefficient (= 0.1), Cv = Velocity coefficient (= 1.25), Sf = safety factor (= 1.1)
- dm = average rock diameter in gabions
- d = local flow depth at V
- V = depth average velocity (= 4 m/s)
- γs = unit weight of stone (2650 kg/m3)
- γw = unit weight of the water (1000 kg/m3)
- K1 = 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.

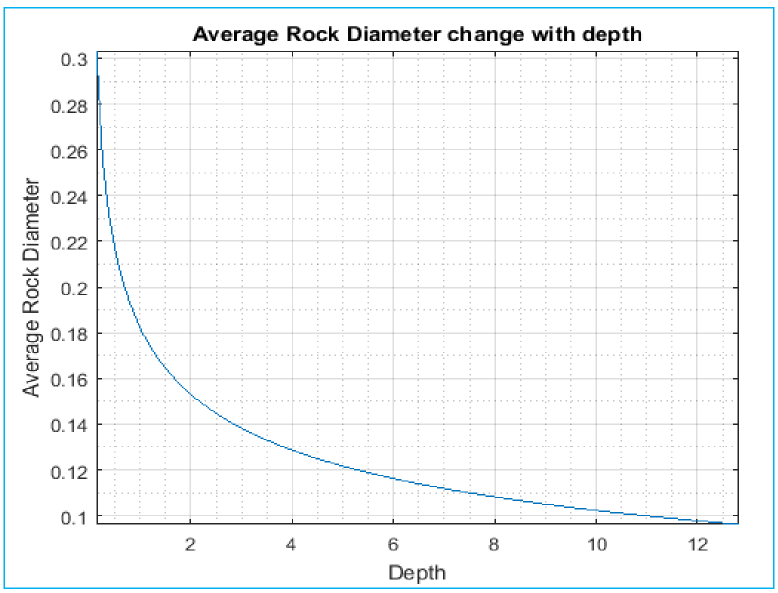


FIGURE 6-12: Minimum average rock diameter

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

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

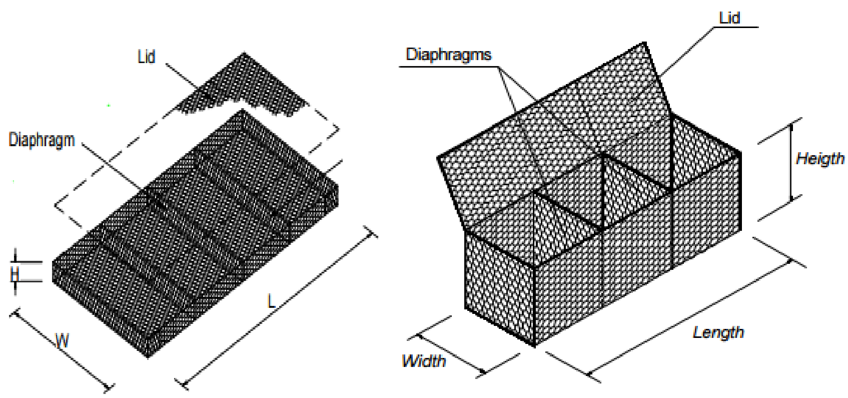


FIGURE 6-13: Example of a gabion mattress and gabion basket

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 stricter 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 are being followed in India also.

In the Shore based system, for the west flowing National 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:

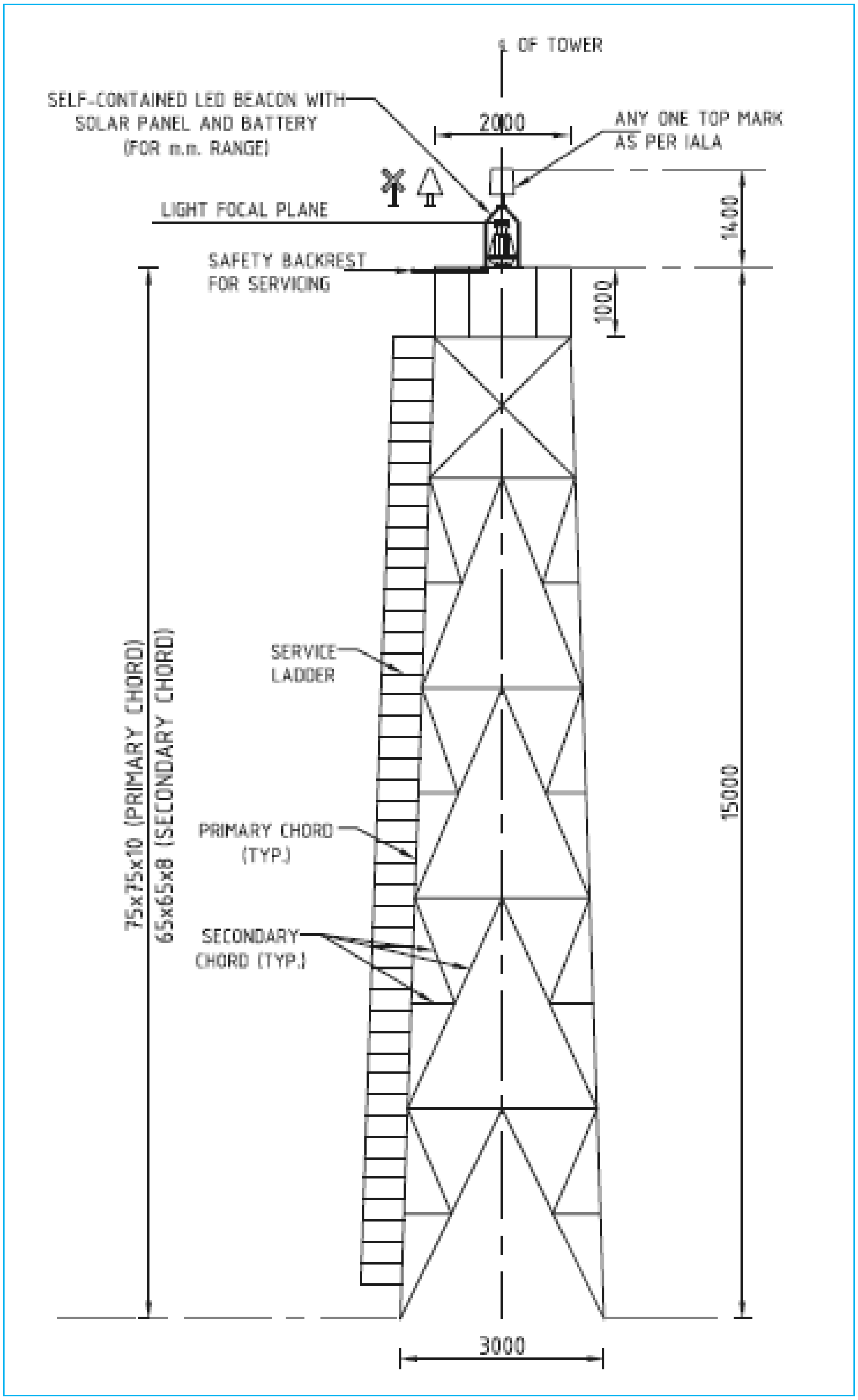


Figure 6-14: Typical detail of Navigational Tower

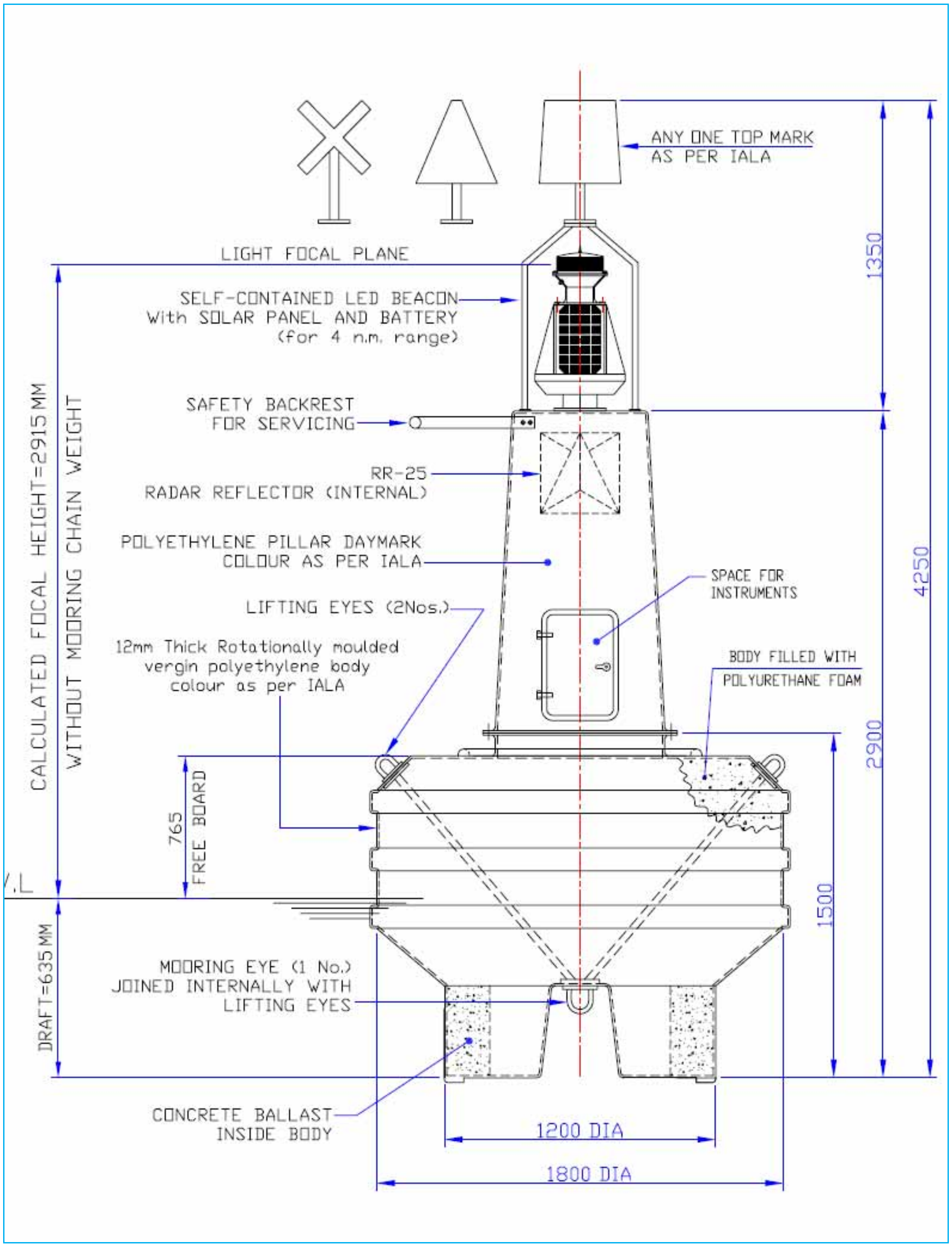


Figure 6-15 BUOY with Light System:

<u>POLYETHYLELENE CHANNEL MARKING BUOYS: (PORT HAND) 1 No. - PEB/1800 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).

1 Set - Mooring gear – Each set comprised of the following:

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 micro-processor-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 condition, 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. Loads from the River Side:

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. Loads from Deck

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. Loads from Shore

Seismic loading

Earthquake loads shall be adopted as applicable for the site as per IS 1893 – 2002. The river fall under Zone III, 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	**III**
Design horizontal seismic coefficient, Ah	Z I (Sa/g)/ (2R)
Zone Factor Z	0.16
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.

R = 0.473 (Q/f) 1/3

Where R = depth of scour below HFL

Q = discharge m3/s

f = silt factor (=1)

Max scour around piers = 2 R.

Scour length of 22 m has been considered.

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. The pile termination level is kept at -16.0m which will provide a 5.0m developmental length having socketing arrangement with surrounding rock.

6.5. Materials of Construction

6.5.1. Concrete

The reinforced concrete member sizes considered for all the components of the riverine and landside infrastructure works shall comply to minimum dimensions prescribed in Fig. 1 of IS 456-2000 for a fire resistance of 4 hours. The following grades of concrete shall be used for construction of precast / cast-in-situ concrete components:

Sr. No	Members / Components	Proposed Grade of concrete
1	Piles	M25
2	Beams & Deck slab for superstructure of approach bridge and dolphins	M25
3	Buildings	M20

Partial Safety Factor γ_m for Material Strength

- Concrete $\gamma_m = 1.50$
- Reinforcement $\gamma m = 1.15$

Reinforcement

Main reinforcement steel shall conform to [Fe 500 (IS 1786)] TMT, 500 S with low alloy steel grade. Strength parameters shall be as follows:

- Minimum yield stress (Main steel) : 500 N/mm²
- Elongation (min) : 18 %
- Secondary steel shall be HYSD : 500 N/mm2 (confirming to IS 1786)

<u>Cover to Reinforcement</u>

The nominal cover to reinforcement for all reinforced concrete members complies with Fig. 16A of IS 456-2000 for a fire resistance of 4 hours. Nominal cover to be followed are as shown below:

Riverine Structures:	Prescribed Parameter
Piles and Pile caps	75mm
Deck slab	50mm
Beams	50mm
Landside Structures:	
Superstructure	45mm
Substructure	50mm

Structural steel

The grade of structural steel considered for pontoons, linkspans and other superstructures shall conform to Grade 250 as per IS;2062 with a minimum yield strength of 250 N/mm^2. However, the structural steel shall conform to Grade E275BR as per IS: 2062 with minimum yield Strength of 275 N/mm^2 for steel tubular piles.

6.6. Design of Riverine Terminal Infrastructure

The layout and components of the riverine infrastructure have been planned and the structural design of these components follow the design basis described below with the methodology adopted for the analysis and design of each component of the riverine infrastructure based on the Preliminary Designs, as advised. Before taking up the work in the site, Detailed Engineering / Design are to be considered.

RCC bored piles with sacrificial MS liners installed vertically.

6.6.1. Berthing pontoons

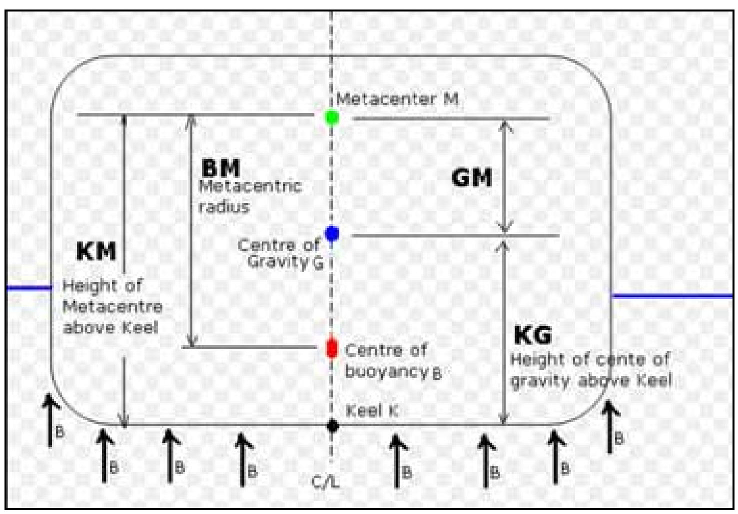
Three berthing pontoon has been proposed, each located at three given location described as Sadasivgad, Katne and Virje having floating arrangement, shall be of structural steel with the following minimum requirements.

- 30m x 8m in plan at Virje.
- 14.0m x 4.5m in plan at Sadasivgad.
- 14.0m x 4.5m in plan at Katne.
- Deck stiffened for uniformly distributed load of 5kN/m^2.
- Deck of high yield steel plate of at least 10mm thickness.
- Pontoon to be divided into buoyancy chambers, all with sealed access hatches.
- Gangway to be placed to approach the Pontoon having vessel ramps to accommodate angle variations.
- As a result of current forces, Guide frames with piles to hold the pontoon
- Lifesaving equipment, safety ladders and fire control for small fire

• 1 No. Potable water hydrants.
• Water jet system to be installed beneath pontoon to prevent silt build up.
• 15year protective paint system to all steel-work.
• Fitted with sacrificial anodes (near low water mark) with 10 yrs life
• 20lux lighting mast illumination
• The walking/bike lane surface preparation on top of gangway shall comprise of anti-skid high
• grade abrasion resistant polyurethane resin based designed to give strength, flexibility and long-life durability of minimum 5 years duly approved by engineer in charge.
• Safety restraints to IRC guidelines
• Fresh water hydrants for Ferry and also for washing the pontoons.

The floating stability of the pontoon has been checked for 8m (width) and 30 m (length) of the pontoon. The loads including self-weight and live loads of 5 kN/m^2 have been considered in two load cases, with live loads on half the cross section (load case 1) and live loads fully loaded (load case 2). The metacentric height (> 0), the max angle of heel (10°) and minimum freeboard (>0.3 m) of the pontoon have been checked to be within the permissible limits.

The Metacentric height is a measure of the vessel's stability under small heeling also called the initial stability. The higher the value of GM, the better the vessel's initial stability. Thus, harder it is to get the vessel to heel.



Floatation Stability Calculations

A 3-D model of guiding pile for Berthing pontoon is prepared in STAAD-Pro software and linear elastic analysis is carried outfor the following loads:

- Dead load
- Live load
- Wind load
- Current load (on the structure and on the berthing pontoon)

- Seismic load
- Berthing reaction onto the pontoon

. Logical combinations of the above loads in line with the IS 4651 Part IV are used to obtain the results of the analysis.

The following figure shows the 3D analysis model prepared in STAAD-Pro.

Figure 6-16: STAAD-Pro analysis model of pile for berthing pontoons

Reinforced concrete member sizing and design are carried out by Limit State approach as laid down in IS 456.

6.6.2. Gangway

The gangway bridges the gap between the two structures i.e. bankseat & berthing pontoon. The gangway shall be aluminum structure and shall cater for the differential level between the bankseat and berthing pontoon during high and low water levels, by adjusting in a slope not steeper than 1 in 8. Only one gangway spanning 23.0m is proposed for this riverine infrastructure development with detail as below.:

TABLE 6-5:SALIENT FEATURES OF GANGWAY

Sl No.	Location	Span	Width
1	Gangway	23 m	2.0m

The gangway shall be of aluminum structure with the following minimum requirements.

- Aluminum gangway bridge having built up sections.
- Deck stiffened for a uniformly distributed load of 5 kN/m^2.

- The ends of gangway should be equipped with hinge and roller support at either ends to ensure that gangway bridge adjusts to a slope in case of lowering of berthing pontoon.
- The walking/bike lane surface preparation on top of gangway shall comprise of anti-skid high grade abrasion resistant polyurethane resin based designed to give strength, flexibility and long-life durability of minimum 5 years duly approved by engineer in charge.
- Service lines to run down link-span for potable water, electrical supply and communications.
- Safety restraints to IRC guidelines

The gangway bridge design allows for the movement of berthing pontoon and subsequent transfer of vertical, horizontal and rotational loads into the bridge through a pinned hinge with the others free to slide horizontally and pivot through the vertical. Based on the preliminary design specification the fabricated aluminium gangway will be supplied by the vendor.

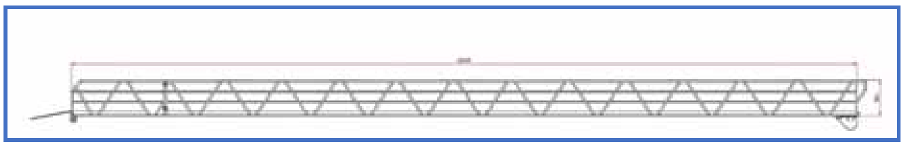


Figure 6-17: Elevation of Aluminium Gangway Span of 26.0m

The member section properties will be consider for fabrication of of the aluminium gangway is shown in thefigurebelow:

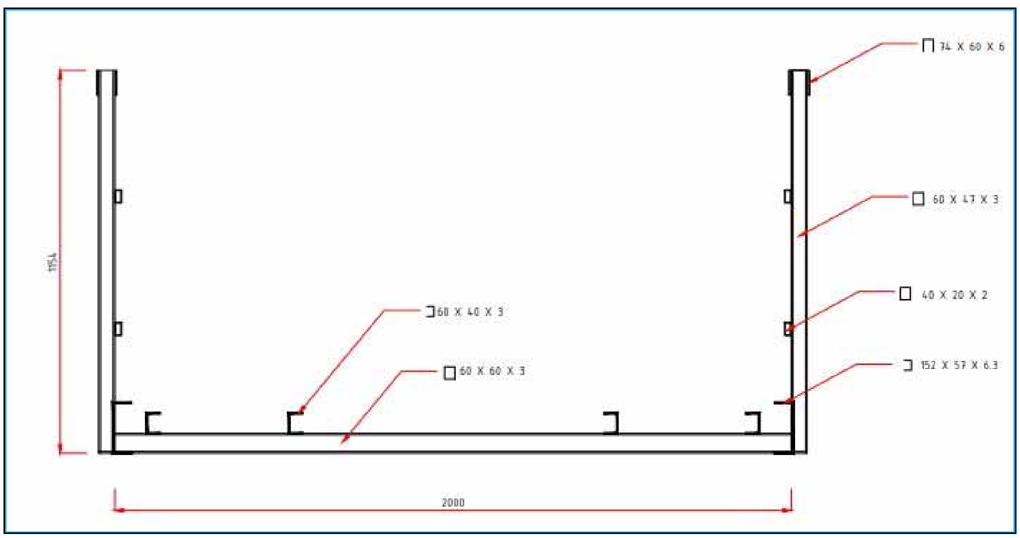


Figure 6-18: Section properties of member components of Aluminium Gangway

TABLE 6-6:Section properties of member components of aluminium gangway

Sl No.	Type of Section	Section Property(mm)
1	Channel	60x40x3
2	Box	60x60x3
3	channel	152x57x6.3
4	Box	40x20x2
5	Box	60x47x3
6	Channel	74x60x6

6.7. Construction Schedule

Construction schedules of different components 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 Kali (NW-52) is proposed to develop for ferry services along river for tourism purpose. No opportunity exists for bulk cargo movement due to unavailability of industrial development in the region however development of Kali river may be considered for tourist activities. Residents are currently using small wooden boat ferry service for river crossing. There exist small ferry services at few locations for river crossing. Local residents would continue to use existing infrastructure, additional infrastructure development is not required for across the river movement. A well-developed road runs parallel to entire stretch of river.

The taluka Karwar is identified as one of the 41 tourist destinations on immediate development basis. This development would lead to increase in tourist footfalls in the region and creates opportunity for IWT movement. 3 Terminals are proposed to develop on River Kali (NW-52) to handle projected tourist traffic in 2 phases. Sadasivgad and Katne would be developed in Phase 1 and start operating ferry service in 10km of stretch. In Phase 2, the ferry service is proposed to extend till Kadra dam and a terminal will be constructed nearby at Virje. Entire stretch of 29.5km from mouth of river to Kadra Dam would get operational in Phase 2. Tourists would use IWT service for along the river movement i.e. between Sadasivgad - Katne - Virje near Kadra Dam. River Kali (NW-52) attracts tourists for its scenic beauty. The entire river stretch is surrounded by green hills and valleys covered with thick forests. Tourists would use proposed IWT service for touring around and grab an opportunity to have a closer look at beauty of nature by sightseeing.

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 Kali (NW-52) has 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, Road Transport and Highways (Inland Waterways Authority of India) has classified the Inland waterways into seven categories for rivers and canals for safe plying of self-propelled vessels up to 2000 tonne Dead Weight Tonnage (DWT) and tug-barge formation in Push Tug + 4 barges units of carrying capacity up to 8000 tonne (Ref: IWAI, Gazette Notification 2006).

The classification criteria of waterways are mentioned in **Table 7.1** for Rivers and in **Table 7.2** for canals.

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

TABLE 7-2: Classification of Inland Waterways for Canals

Class of Waterways	Canals				
	Minimum Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance (m)
I	1.5	20	300	4	20
II	1.8	30	500	5	30
III	2.2	40	700	7	40
IV	2.5	50	800	10	50
V	-	-	-	-	-
VI	3.5	60	900	10	60
VII	-	-	-	-	-

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:

i) Low voltage transmission lines including telephone lines -16.5 metres

ii) High voltage transmission lines, not exceeding 110 kilo volt-19.0 metres

iii) High voltage transmission line, exceeding 110 kilovolt- 19.0 metres+1centimetres 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 traffic; Terminal facilities etc. The study stretch of River Kali (NW-52) has been considered as Class IV. Class IV waterways can operate passenger ferry. It has been suggested and recommended to have 3 Terminals in River Kali (NW-52) each at Sadasivgad, Katne and Virje near Kadra Dam area.

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 Kali (NW-52) due to its small stretch and limited commercial opportunity cannot have exclusive vessels for maintenance of waterway. All the vessels required for maintenance of waterways have been clubbed together for cluster 6 waterways and it has been discussed in the "Institutional Requirement".

7.4. Proposed Vessel Size and Specifications

Targeted depth of River Kali (NW-52) is considered as 2 m. Any passenger ferry vessel with less than 1.8 m draught is suitable for navigating in the defined stretch. The table below lists down the sample specifications of few vessel along with pictures that could be deployed in River Kali (NW-52).

TABLE 7-3: Specification of Vessels – Sample

Vessel Name	Length (m)	Beam (m)	Draught (m)	Capacity (Pax.)
FRP Water Taxi Without Engine	10.5	3.8	1.4	40
Catamaran Luxury 60-80 Seater Cruise Boat	14	5	0.5	60 - 80
Aditya 50	12-15	5-6		30 - 60
Solar Electric 30 Pax Ferry	12	3.5	1.2	30
Suncruise 40	12	5	1.2	30
ODC Marine, Mono Pax	12.2	4.2	1.2	36
Wantaim 14m Fast Ferry	14	3.2	1.2	45

Source: Consultant's Analysis

Figure 7-1: Aditya 50 – 30-60 Pax

Figure 7-2: Catamaran Luxury 60-80 Seater Cruise Boat

Figure 7-3: FRP Water Taxi Without Engine – 40 Pax

Figure 7-4: SunCruise 40 – 30 Pax

Any passenger ferry with less than 1.8m draught is suitable for navigating in the defined stretch, as targeted depth of River Kali (NW-52) is 2 m. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

(For Mono Hull Steel Boat)

- Size (L x B x D) – 13m x 2m x 0.8m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Outboard Engines of 150hp (approx.)
- Speed - 12 Knots (max.)

(For FRP Boat)

- Size (L x B x D) – 13m x 2m x 0.8m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Outboard Engines of 150hp (approx.)
- Speed - 12 Knots (max.)

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 River Kali (NW-52), between Sadasivgad and Katne is approx. 10km and Katne to Virje near Kadra Dam is 18km i.e total 29.5km. The table below shows the calculation and assumptions considered to arrive at Turn Around time for single vessel at defined 29.5 km stretch of River Kali (NW-52).

TABLE 7-4: Turn Around Time Calculation for Single Vessel

Sl No.	Parameters	Unit	Sadasivgad – Katne / Sadasivgad- Virje
1	NW-52 Stretch	Km.	29.5
2	Traffic Type Proposed	Type	Tourists
3	Terminal Proposed	Type	Passengers
4	Embark/Disembark (both side)	Mins	60
5	Total Handling Time	Mins	60
6	Average Sailing Speed	Knots	10

Sl No.	Parameters	Unit	Sadasivgad – Katne / Sadasivgad- Virje
7	Sailing Time	Hrs.	93 mins / 1 Hr. 33 Mins
8	**Total Turn-around Time/trip/voyage**	**Mins**	**4 Hr 06 Mins / 246 Mins**

Based on the above assumptions, a loaded vessel would take at least 4 Hr 6 Mins to complete one trip reach from one terminal to another. 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 defined 29.55 km of River Kali (NW-52). 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 vessel calls and number of vessels required to cater to the projected traffic till FY-45.

TABLE 7-5: Assumptions for Calculating Vessel Requirement

Sl No.	Parameters	Unit	Sadasivgad – Katne / Sadasivgad- Virje
1	Operational Days	Days	300
2	Daily Operational	Hours.	8
3	Carrying Capacity	No.	30
4	Vessel Speed	Nm. / km.	10 / 19
5	Loading and Unloading Time	Mins	60
6	Chainage (Karwar Port – Kadra Dam)	Km.	29.5
7	Turn Around Time	Mins	4 Hr 6 Mins / 246 Mins

Based on the above assumptions, number vessels required on the River Kali (NW-52) is represented in the table below.

TABLE 7-6: Number of Vessel Requirement

Sr. No	Unit	FY23	FY25	FY30	FY35	FY40
Tourist Traffic	No.	20,238	24,712	40,711	71,747	126,443
Annual Vessel Calls	No.	506	618	1,018	1,794	3,162
Daily Vessel Calls	No.	2	3	4	6	11
Vessels Requirement	No.	1	1	1	2	3
Additional Vessel Requirement		-	-	-	1	2

The above calculation concludes that 1 Passenger Ferry Vessel is adequate to handle projected traffic on River Kali (NW-52) in Phase 1. Requirement for additional vessel would arise in Phase 2, as traffic increases due to the extended ferry service till Kadra Dam. Additional 2 vessels will be required each in FY31 and FY37.

7.7. Vessel Costing

7.7.1. Capital Cost

The deployment 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. The indicative ferry acquisition cost, as ascertained from the Market, is being furnished herewith. The recommended specification of Passenger Ferry vessel that can be deployed in River Kali (NW-52) for passenger movement is as follows.

- ✓ Market Price for steel boat – Approx. INR 95 Lakhs
- ✓ Size (L x B x D) – 13m x 2m x 0.8m, 30pax
- ✓ Engine - 1 Marine Outboard Engines of 150 hp each.
- ✓ Market Price for FRP boat – Approx. INR 75 Lakhs
- ✓ Size (L x B x D) – 13m x 2m x 0.8m, 30pax
- ✓ Engine - 1 Marine Outboard Engines of 150 hp each.

7.7.2. 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; Crew Cost; Repair Cost; Depreciation Cost; Insurance factor and Interest Factor. The vessel mobility is under consideration of 1 passenger vessel, for which working the O & M Costs will not have any bearing at this point of time. The following cost factors are only indicative.

1 Ferry Vessel (For 1 Year)

- 1 Passenger vessel Running cost for 300 days operation with 4 Hrs mobility in a cycle and having 2 cyclic maximum operations in a day, cost per annum will be as detailed.
- 6 00 cycles x 4 Hrs x {0.16 Litre per hour x 1 Engines x 150 Bhp} x INR 94 per Litre = INR 54.14 Lakhs Per Annum.
- 2 Nos. Crew on 1 Passenger vessel @ INR 0.50 Lakhs per month.
- Crew cost for 12 months will be 12 x 2 x 0.5 = INR 12 Lakhs Per Annum per Unit.
- Repair Cost for **steel boat** is @ 2 % P. A of CAPEX i.e., 0.02 {1 x 95} = **INR 1.9 Lakhs Per Annum**
- Repair Cost for **FRP boat** is @ 1% P. A of CAPEX i.e., 0.01 {1 x 75} = **INR 0.75 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.

CHAPTER 8: NAVIGATION AND COMMUNICATION SYSTEM

8.1. General Requirements

A foolproof 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 have 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.

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 on-board 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.

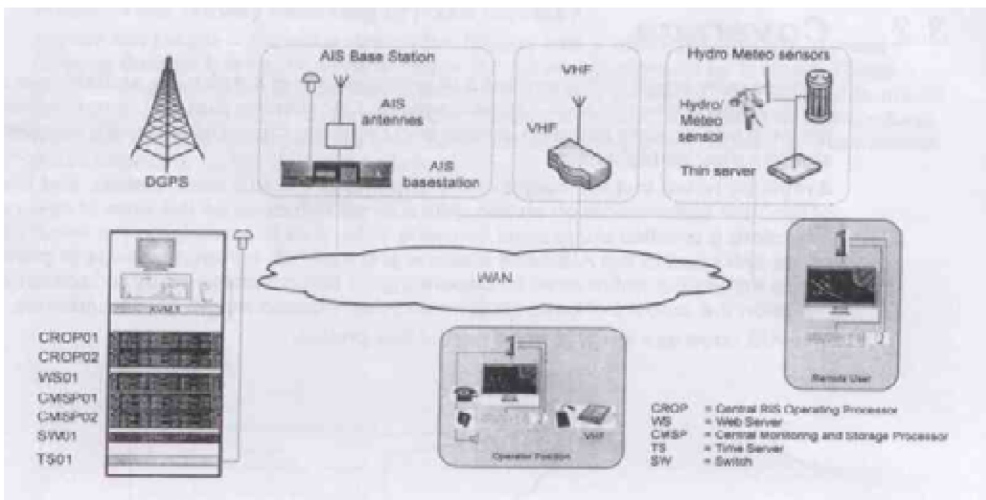
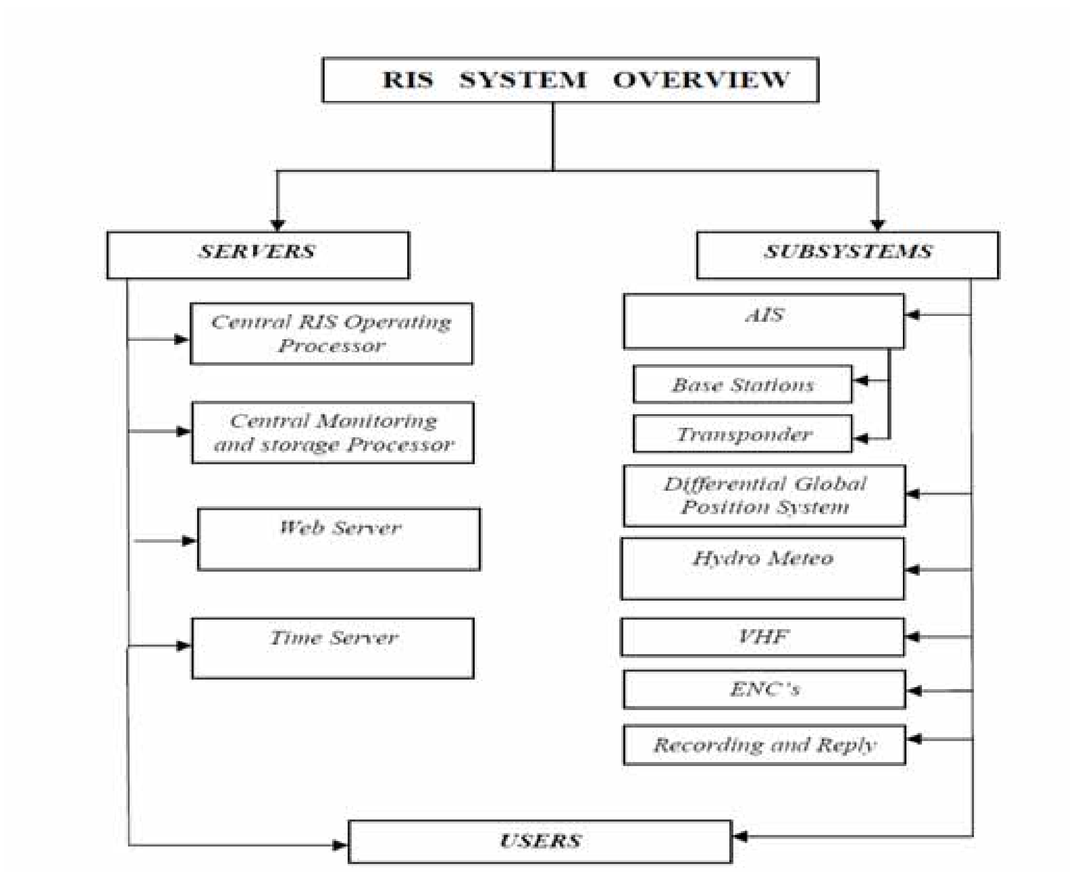


Figure 8-1: Main components of the RIS system are given below in flowchart:



Servers

The system consists of several central servers (or processors). For availability reasons these server 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 other Terminal;
- Logistic supply chain manager at other 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 on-board 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.

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

8.1.4. 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 more costly than the RIS system and has not been discussed.

Subsequent to the discussions with the stakeholders' viz., Maharashtra Maritime Board and Mumbai Port Trust, 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

8.4.1. Capital Cost

No development is suggested, at this point of time however a nominal amount of Rs.16.00 Lakhs has been proposed for Beacon & light system as per requirement during the implementation of the project..

8.4.2. O&M Cost

No development is suggested, at this point of time.

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 project is designated as national waterway no. 52 under the National Waterways Act 2016 and is located on Kali River in the Uttara Kannada district of Karnataka State. Out of the total length, 53.415 km length of the river from the confluence of Kali river with Arabian Sea near Sadashivgad Bridge at Lat 14°50'31"N, Long 74°07'21"E to Kodasalli Dam at Lat 14°55'08"N, Long 74°32'07"E has been declared as new national waterway.

The total catchment area of Kali is 5104 Sq. Km.

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 the following four physiographic landforms:

1. Northern Karnataka Plateau
2. Central Karnataka Plateau
3. Southern Karnataka Plateau and

4. 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.

Uttara Kannada district is one of the three districts of the State located in the coastal region. The district is located in the mid-western part of the state. It lies between 13°.551 and 15°.311 north latitudes and 74°.91 and 75°.101 east longitudes. The total geographical area of Uttar Kannada district is 10,291 sq. kms, which is about 5.37% of the total area of the state.

The district is hilly and most of its part is covered by thick forest. Somewhat broken and irregular Sahyadri range of central hills divide the district into two parts; a) the uplands or the regions above the ghat with an area of about 7898 sq km comprising 77% of the total area of the district which is 600-700 meters above the sea level, and b) the low lands covering around 3370 sq. km.

Uttar Kannada district has three main distinctive regions:

(a) The coastal region

(b) Malnad region (Western Ghat)

(c) Semi-Malnad region.

(a) The coastal region:

The coastal area is well-developed and densely populated. It serves as a link between Goa, Mumbai and Mangalore. The coastal belt begins in the north from the village called Majali that lies on Goa border and continues in the south up to Dakshina- Kannada boundary. In this region, the taluks of Karwar, Ankola, Kumta, Honnavar and Bhatkal are situated.

(b) The Malnad region (Western Ghat):

The Malnad region consists of four taluks namely Joida, Yellapur, Sirsi and Siddapur. This region is mostly forested forming the valleys and the roads passing through the ghats have resulted in some kind of activities of economic significance. The western boundary of the region is represented by the edges of ghat, while eastern boundary roughly coincides with the limits of forested area, as well as agricultural land. It is the central belt of the district that consists of hills, valleys and eastern table land. About 75% of the area of the district consists of hills and valleys.

(b) Semi-Malnad region:

To the east of the Malnad is the semi-malnad of undulating plateau, where rainfall is moderate. The eastern belt consists of a narrow transitional zone of undulating lands and vast stretches of plains as one moves further eastwards. This is a transitional tract between the "Malnad" and the "maidan". Mundgod and Haliyal taluks fall in the upghat section. Geographical area of Mungod taluk is 668 sq. km and Haliyal 847 sq. km.

River System:

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

There are four prominent rivers flowing in the Uttara Kannada district from the high range of mountains to the Arabian Sea, they are as follows:

a) **Kali River:** originates near the village called Diggi in the earlier Supa taluk that has been shifted to a newly formed Joida taluk, consequent upon the sub merger of the taluk. It has a total length of 184 km. After taking South-east course of about 64 km it takes sharp turn to the south-west and after a course of about 66 km till Kadra, a small village where a Power generation unit is commissioned by KPC Ltd., it flows towards east-west and falls into Arabian Sea at about 3 km north of Karwar. Konkan railway-bridge is constructed over the river at this point.

b) **Aghanasini River:** also called Tadri river rises at Manjaguni near Sirsi and after winding westerly course of about 70 km falls into the sea about 10 km south of the river. This river passes through Kumta taluk.

c) **Gangavali River:** is formed by the confluence of two streams namely, Shaimala and Bedti originating in Dharwad district flows through eight kms South-east to the border of Uttar Kannada at Magod, covering a length of 96 km.

d) **Sharavati River:** also called Gerusoppa River has its origin at Ambutirtha in Tirthalli taluk of Shimoga district. After a northerly course of about 64 km from Nagar, it forms the south-east boundary of Uttar Kannada for about 13 km and then passes about 32 km west to join the sea at Honnavar. Sharavati River which forms the famous jog falls, flows through Honnavar. **(Source:** https://www.karnataka.com/profile/physiography/)

9.2.2. Geology and Seismicity

The geology of Karnataka is largely confined to the two oldest eras; the Archean and the Proterozoic. 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 oldest rocks in the State are from Gorur area, Hassan district, Karnataka dating 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 3300 to 3000 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. age 2600 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.

(Source: Karnataka: National Disaster Risk Reduction Portal, National Institute of Disaster Management)

Geologically, the region of Uttara Kannada consists of rock of the Earth's crust. Archaeozoic rocks occur over the whole of the district. A system of ridges and plateau characterises the region with the plateau on the West descending rapidly creating between itself and the Arabian Sea a narrow strip of low land covered by alluvium. The low land is regarded as a creation of later period (of glacial and interglacial age) than the up-ghat regions. Formerly the sea had submerged the land up to an elevation of 200 rats. The Archaean formation comprises the earlier metamorphosed Dharwar system and later peninsular gneisses overlain by laterite cap. The ridge of hills in the western part of this district, sometimes rising to a height of 700 mts, nearly runs parallel to the coastline and consists of varied assemblage of granites and schists. These ridges separate the Sahyadris consisting of Deccan traps in the north from the Western Ghats consisting of Dharwar schists in the south. The eastern part of this district, being entirely hilly, consists of Dharwar and the peninsular gneisses, the latter being found in low ground areas.

(Source: http://shodhganga.inflibnet.ac.in/bitstream/10603/104998/8/08_chapter%202.pdf)

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: Karnataka: National Disaster Risk Reduction Portal, National Institute of Disaster Management)

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.

(Source: https://www.karnataka.com/profile/physiography/)

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. Winter stays in Karnataka during the months of January and February. (Source: https://www.karnataka.com/profile/physiography/)

Karnataka is divided into three meteorological zones, as under:

Coastal Karnataka — This zone comprises the districts of Uttara Kannada, Udupi and Dakshina Kannada. It is a region of heavy rainfall and receives an average rainfall of 3638 mm per annum.

North interior Karnataka — This zone occupies the districts of Bidar, Belgaum, Bijapur, Bagalkot, Haveri, Gadag, Dharwad, Gulbarga, Koppal, Bellary and Raichur districts. This is an arid zone receiving only about 711 mm of average rainfall per annum.

South interior Karnataka — The rest of the districts of Karnataka falls into this zone. This zone receives about 1,064 mm of average rainfall per annum.

(Source: State of Environment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

The climatic conditions of the different parts of the Uttara Kannada district vary greatly, normally humid, hot along the coast, cool in the ghat region and warm in the eastern ghat region. Average rainfall in the district is 2835 mm.

The coastal region receives annual rainfall varying between 2540 mm - 3556 mm in the southern part and between 1016 mm to 1524 mm in the northern transitional belt. The temperature of the district varies between 15°C in the winter to 34°C in the summer. Average climate is 33° Centigrade during the summer and 20°C during the winter at the sea level.

(Source: http://shodhganga.inflibnet.ac.in/bitstream/10603/95312/12/12_chapter%203.pdf)

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

(Source: https://www.karnataka.com/profile/physiography/)

Six major types of soil are found in Karnataka in addition to 75 associations of subgroups. The major soil types include red soils covering 37.2% of the geographical area followed by black cotton soil with 27.8%. Other major types are alluvial soils with 15.7% followed by lateritic soil with 11.6%. (Source: State of Environment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

The soils of Uttara Kannada district are divided into two distinct zones based on topography; the coastal alluvial soil and the upghat lateritic and granitic soils.

Along the coast the costal alluvial soil is occurring on western most parts of the district. The most rugged hilly parts of the district are covered by hilly type soil and surrounded by the areas covered by lateritic soil having less rugged features. On eastern parts, the lateritic soils change to red loamy soils. Some parts on eastern most parts of Mundgod taluk are covered by semi-black cotton soils.

(Source:http://cgwb.gov.in/District_Profile/karnataka/UTTARA_KANNADA_BROCHURE. pdf)

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. Uncultivable waste land, barren and fallow land are unused lands.

TABLE 9-1:**:** Land Use Pattern in Karnataka

KARNATAKA STATE
CLASSIFICATION OF TOTAL GEOGRAPHICAL AREA IN KARNATAKA
Unit: Area in lakh hectares.

Sl. No.	Classification	Year						
		1960-61	**1970-71**	**1980-81**	**1990-91**	**2000-01**	**2010-11**	**2011-12**
	Total Geographical Area	187.80	189.43	190.50	190.50	190.50	190.50	190.50
1	**Forest**	27.09	28.90	30.33	30.74	30.68	30.72	30.72
	Not available for							
2	**a) Land put to non-**	8.12	9.37	10.66	11.89	13.12	14.30	14.33

3	b) Barren & uncultivable land	9.22	8.39	8.44	7.99	7.94	7.87	7.87
4	Cultivable waste	6.56	6.15	5.02	4.46	4.27	4.14	4.13
	Uncultivated land excluding fallow land:							
5	a) Permanent pastures & other grazing land	17.39	16.19	13.46	10.98	9.59	9.12	9.08
6	b) Misc. Tree crops,	3.66	3.11	3.42	3.16	3.03	2.86	2.85
	Fallow Land							
7	a) Current fallow	8.35	8.11	14.59	12.90	13.67	11.99	16.72
8	b) Other fallow land	5.13	6.72	5.58	4.57	4.08	4.26	5.39
9	Net Area Sown	102.28	102.48	98.99	103.81	104.10	105.23	99.41
	Total Cropped Area	105.88	108.87	106.60	117.59	122.84	130.62	120.59
	Area sown more than once	3.60	6.39	7.61	13.78	18.74	25.40	21.18
	Cropping Intensity - %	**103.52**	**106.24**	**107.69**	**113.27**	**118.00**	**124.13**	**121.30**
Source: Annual Season & Crop Reports of DE&S, Bangalore.								

Source: http://raitamitra.kar.nic.in/ENG/statistics.asp

TABLE 9-2:**:** District-Wise Land Use Pattern in Karnataka

CLASSIFICATION OF TOTAL GEOGRAPHICAL AREA IN KARNATAKA - 2011-12

(Area in Hectares)

S. No.	District	Total Geo-graphical area	Classification of area: Forest	Not available for cultivation: Land put to non-agri. uses	Not available for cultivation: Barren & uncultivable land	Cultivable waste	Uncultivated land excluding fallow land: Pmt.pastures & other grazing land	Uncultivated land excluding fallow land: Mics.tree crops, groves	Fallow land: Current fallows	Fallow land: Other Fallow land	Net Area Sown	Total Cropped Area	Area Sown more than once
1	Bagalkote	658877	81126	28832	24810	2035	3429	274	30819	9971	477581	616301	138720
2	Bangalore (Urban)	217410	5055	115806	4911	3844	5674	7517	17779	5391	51433	53591	2158
3	Bangalore (Rural)	229519	11322	39978	11124	3898	3879	12498	9653	11397	125770	130615	4845
4	Belgaum	1344382	190424	69795	44342	11465	24807	3046	226952	6971	766580	1011264	244684
5	Bellary	813196	97017	110291	53477	24839	5472	3606	91048	13374	414072	532016	117944
6	Bidar	541765	27707	22006	19127	19382	13964	10915	37597	40275	350792	415695	64903
7	Bijapur	1053471	1977	36068	29059	5502	9575	1316	215485	5685	748804	844202	95398
8	Chamarajanagar	569901	275610	24611	21434	7637	22750	4741	15745	12977	184396	222404	38008
9	Chikkaballapur	404501	49704	31933	34302	4743	55550	6482	9939	6381	205467	215484	10017
10	Chikkamagalur	722075	200485	43190	28322	19412	88585	21257	23044	4792	292988	323635	30647
11	Chitradurga	770702	73719	51243	25403	21612	88740	11317	89767	21801	387100	453484	66384
12	Dakshina Kannada	477149	128476	65509	58780	30554	19027	31652	6288	5417	131446	157683	26237
13	Davanagere	597597	89918	39079	20533	8525	19538	4955	20620	5419	389010	486680	97670
14	Dharwad	427329	35235	22982	3985	2669	3571	202	63426	6617	288642	477025	188383
15	Gadag	465715	32614	10481	11628	1010	2592	273	49348	5145	352624	494617	141993
16	Gulbarga	1094120	35316	38420	35113	9417	25855	1131	38648	14394	895826	972506	76680

17	**Hassan**	662602	58775	79405	30365	14142	32943	6963	50127	30690	359192	449236	90044
18	**Haveri**	485156	47454	33096	5793	2989	12209	2290	12114	6004	363207	411129	47922
19	**Kodagu**	410775	134597	24215	31010	9076	13884	20219	4231	3621	169922	185882	15960
20	**Kolar**	374966	20620	45677	28870	6397	39418	7009	33449	10312	183214	194233	11019
21	**Koppal**	552495	29451	39003	16627	2568	14675	210	19659	80104	350198	433195	82997
22	**Mandya**	498244	24765	60906	21519	41955	32049	3428	34867	46351	232404	272524	40120
23	**Mysore**	676382	62851	75946	45018	21407	46808	5871	39116	34457	344908	536323	191415
24	**Raichur**	835843	18167	20563	20084	10712	19816	13684	227704	47051	458062	541135	83073
25	**Ramanagar**	355912	69946	26225	24339	1178	24662	3950	20435	20875	164302	168997	4695
26	**Shimoga**	847784	276855	88708	13312	16311	163463	26868	8811	25491	227965	267814	39849
27	**Tumkur**	1064755	45177	84956	67539	62642	76453	21033	167729	29684	509542	575961	66419
28	**Udupi**	356446	100102	39876	11595	38528	10625	46763	269	8560	100128	117884	17756
29	**Uttara Kannada**	1024679	813595	34547	16234	6450	16625	4806	5906	14214	112302	123533	11231
30	**Yadgir**	516088	33773	29609	27966	2385	11755	737	101212	5129	303522	374319	70797
	Karnataka State:	19049836	3071833	1432956	786621	413284	908393	285013	1671787	538550	9941399	12059367	2117968
	Area in Lakh Hects.	**190.50**	**30.72**	**14.33**	**7.87**	**4.13**	**9.08**	**2.85**	**16.72**	**5.39**	**99.41**	**120.59**	**21.18**

Source: Annual Season & Crop Report 2011-12, DE&S, Bangalore.

Source: http://raitamitra.kar.nic.in/ENG/statistics.asp

The Uttara Kannada district has 813695 ha. of forest which constitutes 79 % of the total geographical area of the district. The land not available for cultivation is 50600 ha. i.e.; 5 % of the total area. The fallow land in the district is around 16951 ha. The other uncultivated lands are 30156 ha.

The study stretch of river Kali is not having continuity due to the presence of Kadra Dam at approx. ch 30km. The upper stretch of Kadra Dam is under Foreshore submersion.

The Kali River is bounded by Kalache, Birkhol, Devakar, Balemane, Hartuga and Kuchegar in the upper stretch, Virje, Kadra, Gotegali, KerwaDi, Ghadasai and Naitisavar in the middle stretch and Siddar, Halga, Hankon, Kinner, Kadwar and Kanasgiri in the lower stretch.

Mixed land use is found on both sides of the waterway stretch comprising mangroves, agricultural land, forests and village settlements. Mangroves are observed on the right bank in the initial stretch of the river (between Ch 0.00km to Ch 10.00 km). The river channel under consideration is characterized by presence of shoals and islands. A major bifurcation has been observed at ch 13 km.

9.2.6. Ambient Air and Noise Quality

The Air (Prevention & Control of Pollution) Act, 1981 of India describes air pollutants as *'Any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may or tend to be injurious to human beings or other living creatures or plants or property or environment'*. The condition of air quality in the surroundings is the ambient air quality.

In India the Central Pollution Control Board (CPCB) coordinates the air quality monitoring regime through its nationwide programme known as National Air Quality Monitoring Programme (NAMP). CPCB has been monitoring ambient air quality through 363 stations in 139 cities across the country as of November, 2009.

The Karnataka State Pollution Control Board (KSPCB) is monitoring ambient air quality under NAMP in 14 monitoring stations at Bangalore and other six major towns in the state. Six of them are in industrial areas, six in residential, rural and other areas and two in sensitive areas.

National Ambient Air Quality Standards (NAAQS) set limits for air pollutants with an adequate margin of safety to protect public health, vegetation and property. There were seven parameters, namely, Sulphur dioxide (SO2), oxides of nitrogen (NOX), ozone (O3), particulate matter (PM), lead (Pb), carbon monoxide (CO) and ammonia (NH3) notified under the Air Act, 1981 and the Environment (Protection) Act, 1986. These are known as air quality criterion pollutants. Under NAMP, CPCB and KSPCB regularly monitor only four viz., Sulphur dioxide (SO2), oxides of nitrogen (NOX), suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM) which are less than 10 µg in weight, commonly called PM10.

(Source: State of Environment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

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 is to be collected as part of the EIA study for the project to be carried out separately by IWAI.

9.2.7. Ambient Water Quality

Water quality samples have been collected and tested for four sample locations along the NW-52 stretch as part of the hydrographic survey carried out for preparation of the present DPR. The pH value of the six samples is found to be over 7, which indicates that water in the project area is alkaline in nature.

As per the State of Environment Report, Karnataka, 2011, surface and groundwater of the state is under increasing pressure with rising contamination levels of biological, toxic, organic and inorganic pollutants. The main sources are industrial and domestic effluent (so-called point sources) and non-point sources such as agricultural run-off carrying agro-chemicals, municipal waste and human faeces from open defecation.

Surface water bodies particularly rivers and lakes are highly polluted with increasing pollution loads from agricultural discharge, industrial effluents and sewage. Karnataka State Pollution Control Board (KSPCB) assessed water quality, sediment and biological samples in the Tunga, Bhadra and Tungabhadra rivers in 2006-07. The analysis reveals that in the Tunga river, one of three sample locations is 'moderately polluted' and two 'slightly'. In the Bhadra river, two of the four sampling stations are 'moderately polluted' and another two 'slightly'. In the Tunganhadra river, seven of the nine monitoring stations were classified as 'moderately polluted' and one as 'slightly'. It is inferred that these rivers have become outlets for untreated or insufficiently treated wastewater from industries and households.

Between 2009 and 2010 highly polluting (or Red category) establishments in Karnataka regulated by KSPCB were investigated by Environmental Management & Policy Research Institute (EMPRI). The study identified 13,125 operating Red establishments, including 2,881 industries, 6,391 heath care establishments, 293 mines, 1,616 stone crushers and 1,944 local bodies.

(Source: State of Environment Report, Karnataka, 2011; Website: www.karnataka.gov.in/empri)

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.

<u>Criteria for Priority III</u>

Monitoring locations having BOD between 10-20 mg/l.

<u>Criteria for Priority IV</u>

Monitoring locations having BOD between 6-10 mg/l.

<u>Criteria for Priority V</u>

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 is 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.

The details of the polluted river stretches in Karnataka are provided in Table 9-3.

TABLE 9-3:**:** Details of Polluted River Stretches in Karnataka

Sl No.	River Name	Stretch Identified	Towns Identified	Approx. Length of the Stretch (in Km)	BOD Range / Max. Value	Priority Class
1.	**Arkavathi**	Halli Reservoir to Kanakapura Town	Bengaluru, Bhadravathi	35	5.0-8.0	IV
2.	**Bhadra**	Holehunnur to Bhadravathi	Chikkodi, Kopa	10	6.0	V
3.	**Bhima**	Ghanapur to Yadgir	Jevargi	80	3.8-5.0	V
4.	**Cauvery**	Ranganathittu to Sathyamangalam Bridge	Sriranga Patna	50	4.0	V
5.	**Ghatprabha**	Gokak To Chigadolli	Gokak	5	4.0	V
6.	**Kabini**	Nanjanagud to Hejjige	Basavanapura, Chikkaiahnachatra	5	5.0	V
7.	**Kagina**	Shahabad to Hongunta	Bhankoor	10	3.1-3.2	V
8.	**Kali**	Hasan Maad (West Coast Paper Mill) to Bommanahalli Reservoir	Dandeli	10	4.3	V
9.	**Krishna**	Yadurwadi to Tintini Bridge	Ugarkhurd, Chikkodi, Narayanpura	200	3.2-4.8	V
10.	**Lakshman Tirtha**	Kattemalavadi to Hunsur	Undavadi	10	4.0-5.0	V
11.	**Malprbha**	Khanapur to Dharwad	M.K Hubli, Kadrolli	80	3.4-4.6	V
12.	**Manjira**	Bidar to Hussain Nagar	Nittur, Chambol, Bidar	10	3.5	V
13.	**Shimsha**	Yediyar to Halagur	Thattekere, Mallur	80	4.5	V
14.	**Tungabhadra**	Harihar to Korlahalli	Ullanur, Harihar	60	3.5-9.3	IV
15.	**Tungha**	Shivamoga to Kudli	Shivamoga	10	6.7	IV

Source: River Stretches for Restoration of Water Quality, CPCB, 2015 (Monitoring of Indian National Aquatic Resources Series: MINARS/37 /2014-15).

As can be noted from the data provided in Table 1-3 above, with a maximum BOD value of 4.3, the river stretch under consideration is amongst the least polluted river stretches and falls under Priority Class V.

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 km 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 in the Arabian Sea. The floods are quite common in the districts namely Belgaum, Bijapur, Bagalkote, Raichur, Gulbarga, Shimaoga, Chikkamagalur, Udupi, Coorg, Bellary, Dakshina Kannada, Dharwad, Davanagere, Gadag, Hassan, Uttara Kannada, Koppal, Bidar, Bangalore (R), Bangalore(U), Kolar, Mandya, Mysore, Chamarajanagar. In the North Karnataka region covering the Krishna and Godavari Basins, even when the state was suffers under drought like conditions, heavy discharges from Maharashtra cause floods.

Hilly regions of Western Ghats spread in the districts of Kodagu, Chikmagalur, Hassan, Shimoga, Daksina Kannada and Uttara Kannada record a very high rainfall of 2000mm to 4000mm. Landslides are common in these districts. During the rainy periods these hilly regions regularly experience displacement of rocks and soils causing widespread damage to property, infrastructure such as rails, roads and loss of human life.

Karnataka stands Second only to Rajasthan in terms of drought affected areas. The state is highly vulnerable to drought as compared to its neighboring states. About 152.1 lakhs ha (80%) out of 190.238 lakh ha is affected by drought in Karnataka.

(Source: National Disaster Risk Reduction Portal (Karnataka), National Institute of Disaster Management; Website: http://nidm.gov.in/pdf/dp/Karnataka.pdf)

9.2.9. Estuary and Coastal Zone

Karnataka has a coastline of over 300 km and there is gradual transition between the Konkan coast in the north and Kerala coast in the south. The coastal region is further divided into two parts, the plains and the Western Ghats. The coastal plains are partly formed by marine denudation, but the level character of the land is severely restricted directly by the Western Ghats and transverse intrution. Esturine plains of Kali, Gangavali and the Tadri (Bedti) and the Sharavati rivers, separated by two east-west Sahydri off shoots, boarders the coastline. To the east of the coastal plains, the general elevation is higher and increase occurs abruptly resulting in Western Ghats sections. The Western Ghats run NNW to SSE for about 320 km.

(Source: National Wetland Atlas: Karnataka, sponsored by Ministry of Environment and Forests, Government of India as a part of the project on National Wetland Inventory and Assessment (NWIA), Space Applications Centre (ISRO), Ahmedabad and Karnataka State Remote Sensing Applications Centre, (KSRSAC), Bangalore, August 2010)

The stretch of NW-52 up to Kadra Dam 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 stretch of NW-52 project area up to Kadra Dam will fall in CRZ – I. Accordingly, the proposed project will require clearance under the CRZ Notification 2011.

9.2.10. Archaeological and Heritage Locations

No structures of archaeological, cultural or historical importance will be impacted due to the proposed project.

As per the information available on the website of Archaeological Survey of India, Karnataka has a total of 747 Protected Monuments. 48 of these protected monuments are located in Uttara Kannada District. None of these protected monuments are located close to Kali River stretch falling under NW-52. Accordingly, no activities relating to the project will be carried out inside the prohibited or regulated areas of these protected monuments. Therefore, no clearance requirement is envisaged with respect to these structures.

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 meters 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 meters in all directions shall be regulated area in respect of every ancient monument and archeological site and remains.

A list of the protected monuments located in Uttara Kannada District along the banks of Kali river, along with their distance from the proposed waterway as measured on Google Map, is provided in Table 9-4 below.

TABLE 9-4:**:** Protected Monuments Located along Kali river in Uttara Kannada District, Karnataka

Sl.No	MONUMENTS	District	RIVER BANK (KALI)	SHORTEST DISTANCE FROM NW- 52 (km) As Measured on Google Map
	Fort Rudrasvera Temple	Uttara Kannada	left	291.95
	Lakshmidevi Temple	Uttara Kannada	right	52.68
	Carved Stones	Uttara Kannada	left	75.92
	Mahadeva temple with 4 inscribed tablets	Uttara Kannada	left	1.60
	Temple of Mahabaleshwar several shrines and ponds	Uttara Kannada	right	0.30
	Rameshvar Temple	Uttara Kannada	right	6.33
	Loose stone sculptures near Jaina Temple	Uttara Kannada	left	80.70
	Forty ponds, temple of Kallamma	Uttara Kannada	left	23.80
	Narasimha Temple	Uttara Kannada	left	23.66
	Temple of Markiamma	Uttara Kannada	left	47.01

Sl.No	MONUMENTS	District	RIVER BANK (KALI)	SHORTEST DISTANCE FROM NW- 52 (km) As Measured on Google Map
	Temple of Naganath	Uttara Kannada	left	1.06
	Fort (Sadasivgad)	Uttara Kannada	right	0.34
	Basavesvar Idol at Shirve Hill	Uttara Kannada	left	3.85
	Ramaling Temple	Uttara Kannada	left	55.46

(Source: http://asi.nic.in/asi_monu_alphalist_karnataka_bangalore.asp)

9.2.11. Flora and Fauna

Karnataka has a rich diversity of flora and fauna. The state has a recorded forest cover of 39,369 km^2 which constitutes 20.5% of the total geographical area of the state. These forests support 25% of the elephant and 18% of the tiger population of India. The Western Ghats, a biodiversity hotspot, includes the western region of Karnataka. The abundant diversity of the Western Ghats includes hundreds of medicinal plants of high value.

The Western Ghats region, which extends well beyond Karnataka, is recognised as one of the 25 biodiversity hotspots of the world and accounts for 4,000 known species of flowering plants.

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.

A study of Bawa K.S. et al. (2007) funded by the Critical Ecosystem Partnership Fund made an exhaustive analysis of biodiversity of the Western Ghats. It concludes that 50% of its biodiversity is present in Karnataka. It further found that 332 globally threatened species occur in the Western Ghats, comprising of 229 plant species, 31 mammals, 15 bird species, 52 amphibians, four reptiles and one fish species. 55 of these are critically endangered, 148 endangered and 129 are vulnerable.

(Source: State of Environment Report: Karnataka, 2011)

Flora

Based on Champion and Seth's system of classification (1968) the following major types of forests are recognised 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 leaf hill forests;
- Littoral and swamp forest.

Outside forests, Karnataka's tree cover is estimated to be 5,733 sq km. This accounts for 3.0% of the state's geographical area and consists of tree plantations of rubber (*Haevia braziliensis*), silver oak (*Grevillea arobusta*), dadap (*Erythrina indica*), mango (*Mangifera indica*), coconut (*Cocos nucifera*), cashewnut (*Anacardium occidentale*), eucalyptus, casurina (*Casuarina equisetifolia*) and other cash crops. The growing stock of woody biomass for major forest types has been estimated to be 417 million cu m. This estimate considers both the forest inventory and trees outside forests.

Nair and Daniel (1986) estimated that there are 4,000 species of flowering plants in the Western Ghats of which about 1,500 are endemic. Approximately 63% of India's woody evergreen taxa are endemic to the Western Ghats according to Johnsingh (2001). Daniels (2001) states that 352 of the 650 tree species found in the Western Ghats are endemic. Tree genera endemic to the Western Ghats include *Blepharistemma, Erinocarpus, Meteromyrtus, Otenophelium, Poeciloneuron, and Pseudoglochidion. Other plant genera endemic to the Western Ghats include Adenoon, Griffithella, Willisia, Meineckia, Baeolepis, Nanothamnus, Wagatea, Campbellia, and Calacanthus* (Nair, 1991). The grass family *Gramineae (Poaceae)* has the highest number of endemic genera and the genus Nilgirianthus has 20 endemic species across all genera in this family (Nair, 1991). (Source: State of Environment Report: Karnataka, 2011)

Fauna

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).

Insects

Butterflies in the Western Ghats belong to five families, 166 genera, and 330 species, of which 37 species are endemic (Gaonkar, 1996). The southern Western Ghats extending from Agasthyamalai to the Palghat Gap holds the highest diversity of butterfly species with the most number of endemics (Gaonkar, 1996). Goa and Uttara Kannada are other regions within the Western Ghats with high butterfly diversity.

According to a recent study, there are at least 200 species of spiders in the Western Ghats. The dominant families are *Argyopidae, Salticidae, Thomisidae, Oxyopidae, Lyniphidae, and Hersilidae* (Rajashekhar and Raghavendra, 2001 cited by Daniels, 2001). Studies have indicated that there has been a decline in the diversity of aquatic insects in some areas of the Western Ghats due to anthropogenic interference leading to habitat loss and pollution (Daniels, 2001).

Fishes

Daniels (2001) reports 218 species of fishes from primary and secondary freshwaters in the Western Ghats, of which 116 (53% representing 51 genera) are endemic to the region. Streams and rivers in the southern parts tend to support greater diversity than those in the north and east-flowing streams and rivers have richer fish faunas than west-flowing ones. High levels of endemism are also associated with the ichthyofauna of the southern Western Ghats, which includes several endemic genera (*Brachydanio, Lepidopygopsis, Bhavania, Travancoria, Horabagrus, Horaglanis, Horaichthys*). The highest diversity of freshwater fishes is in deep, slow-moving waters. The species composition of many freshwater fish assemblages has been extensively modified by the introduction of invasive alien species, which are now naturalised. The distribution of many species is also adversely affected by the construction of dams to create artificial lakes and reservoirs.

Amphibians

Approximately 126 species of amphibians from 24 genera are known from the region, with new species being frequently added to the list (Daniels, 2001). The Western Ghats has the highest levels of amphibian endemicity in India. The largest family is *Ranidae* (49 species) followed by *Rhacophoridae* (30 species). The Western Ghats also harbour a remarkable number of caecilians (families *Ichthyophidae* and *Caeciliidae*) – 16 species, all of them endemic to the region. Distribution within the region varies from extremely widespread e.g. black-spined toad (*Bufo melanostictus*), skittering frog (*Euphlyctis cyanophlyctis*), Indian bullfrog (*Hoplobatrachus tigerinus*) to highly restricted e.g. Malabar torrent toad (*Ansonia ornata*), *Indirana gundia* and *Micrixalus kottigeharensis* (Nair, 1991 and Daniels, 1992).

Reptiles

Approximately 157 species of reptiles are reported from the Western Ghats, representing 36 genera: Two genera of turtles/tortoises, 14 genera of lizards, and 20 genera of snakes (Ishwar, unpublished information). Of these, nearly 50% are endemic.

Among the different habitats of the Western Ghats, the evergreen forests alone are known to support approximately 130 species of reptiles. Certain groups of reptiles have a very high proportion of endemics; for example, about 70% of the uropeltid snakes are endemic to the Western Ghats. Endemism is also high among lizards (65%). Many of the rare and endemic reptiles are known only from single locality records. A major challenge to conservation efforts in this region is the lack of a complete understanding of the distributional patterns, habitat requirements, and conservation status of reptiles in the Western Ghats.

Birds

The status and distributions of bird species in the Western Ghats is relatively well known. A total of 508 species have been recorded in the region, including 324 resident species (64%). This figure also includes 144 (28%) species of aquatic birds, many of them from the western coastline. The central parts of the region (especially Uttara Kannada district) harbour the highest diversity of bird species. Due to the interspersion and juxtaposition of different habitat types in secondary and disturbed evergreen and moist deciduous forests, these forests have the highest number of bird species including many habitat generalists and migrants in addition to resident and endemic species. 16 species are endemic to the Western Ghats region (Daniels, 2001), most of them occurring in the areas southwards of Goa. Many of the endemics are obligates of evergreen forests and shola-grassland systems.

Mammals

Of the 137 species of mammals recorded in the Western Ghats, the largest representation is from the orders Chiroptera (41 species), Rodentia (27 species) and Insectivora (11 species). Of the 127 species, 14 are endemic (Daniels, 2001) and three are listed as critically endangered. One of the critically endangered species, Wroughton's free-tailed bat (*Otomops wroughtonii*), is restricted to a single cave within the Western Ghats and has been recently discovered in Cambodia and north-eastern India (Walston and Bates, 2001 and Thabah and Bates, 2002).

A total of seven species of mammals are endemic to the southern Western Ghats and Sri Lanka as a unit: The mountain shrew (*Suncus montanus*), slender loris (*Loris tardigradus*), stripe-necked mongoose (*Herpestes vitticollis*), Sri Lankan giant squirrel or grizzled giant squirrel (*Ratufa macroura*), Layard's striped squirrel (*Funambulus layardi)*, dusky striped squirrel (*Funambulus sublineatus*), and the Travancore flying squirrel (*Petinomys fuscocapillus*).

(Source: State of Environment Report: Karnataka, 2011)

Threatened and Endangered Species

Critically endangered flora in Karnataka includes evergreen trees such as *Dipterocarpus bourdilloni, Hopea erosa and Hopea jacobi, Croton lawianus* (a small tree) and *Pinnatella limbata* (a moss). Other endangered trees include *Isonandra stocksii, Kingiodendron pinnatum, Maesa velutina, Myristica magnifica, Rapanea striata* and *Xylosma latifolium*.

Endangered fauna in Karnataka includes the tiger, the Indian elephant, the lion tailed macaque, the turtle and the Indian wild dog dhole (*Cuon alpinus*). It also includes amphibians (*Indirana brachytarsus, Microhyla sholigari, Minervarya sahyadris, Nyctibatrachus aliciae, Nyctibatrachus hussaini, Nyctibatrachus sanctipalustris, Philautus charius, Philautus wynaadensis, Ramanella mormorata* and *Rhacophorus lateralis*), a toad (*Bufo beddomii*) the Kolar leafnosed bat (*Hipposideros hypophyllus*) and a mollusc (*Pseudomulleria dalyi*).

(Source: State of Environment Report: Karnataka, 2011)

9.2.12. National Parks, Forests, Wildlife Sanctuaries and Reserves

The geographical area of the state is 191,791 sq km of which 43,356 sq km (22.6%) is forest area. Notified forests measure 33,238 sq km (17.3%) and include reserved, protected, village and private forests. (Source: State of Environment Report: Karnataka, 2011)

The Uttara Kannada district is rich in forest resources. Forest resources constitute one of the sources of revenue to the state government. 80% of the district is under forest. The total forest area is 8,14,455 hectares. The types of forests found in the district consists of 1) evergreen (2) semi-evergreen (3) moist deciduous (4) scrub and thorny and (5) unwooded forests.

The general species in moist deciduous are Teak, Sissum (Rosewood), Nandi, Kindal, Jamba, Matti, Holedasal, Toon and Burga. The teak of Dandeli area is said to be the finest in the world. Medicinal plants are available in the vast thick forest.

As per State of Forest Report 2015, Forest Survey of India, Karnataka has 36,421 sq km of recorded forest area which is 18.99 per cent of its geographical area (1,91,791 sq km). The Western Ghats which includes Nilgiri Biosphere Reserve adds up to 84 per cent of forest cover of the State.

In 2012, the UNESCO inscribed Western Ghats on the World Heritage list. The property recognised as a ‘World Heritage Property’ has 39 sites spread across four States, of which 10 are in Karnataka. The sites in Karnataka include five Protected Areas i.e., Pushpagiri Wildlife Sanctuary (WLS), Brahmagiri WLS, Talacauvery WLS, Someshwara WLS and Kudremukh National Park (NP). Interspersed along with this is the "Nilgiri Biosphere Reserve" (NBR), which covers an area of about 5,520 sq km in the states of Karnataka, Tamil Nadu and Kerala. Nilgiri Biosphere Reserve is the first and the largest biosphere reserve in the country and was recognised as one of the Heritage sites by UNSECO in 1986. In Karnataka, the Western Ghats pass through 11 districts which contribute a forest cover of 30,573 sq km out of the geographical area of 62,795 sq km covered by these districts. Against the total area of 9,576.88 sq km covered by the 35 National Parks and Wildlife Sanctuaries in the State, 16 are located in the Western Ghats-Nilgiri Biosphere Reserve region covering an area of 8,485 sq km and constituting 88 per cent of area under Protected Areas in the State.

There are five National Parks, 30 Wildlife Sanctuaries, 13 Conservation Reserves and one Community Reserve in the State spread across an area of 10,222.19 sq km, out of which, five NPs / WLSs have been declared as Tiger Reserves namely Bandipur NP, Bhadra WLS, Biligiri Ranganathaswamy Temple WLS, Dandeli-Anshi and Rajiv Gandhi (Nagarahole) NP.

(Source: http://admin.indiaenvironmentportal.org.in/files/file/Administration_of_National_Parks_and_Wildlife_Sanctuaries_Government_of_Karnataka.pdf).

The list of National parks and Wildlife sanctuaries in the State has been provided in Table 9-5 and Table 9-6 below.

TABLE 9-5:: National Parks in Karnataka

Name of the National Parks	Year of Establishment	Area (sq km)	Nearest Dist. HQ
Anshi National Park	1987	417.34	Karwar 60 Bengaluru 580
Bandipur National Park	1974	872.24	Chamarajnagar 52 Bengaluru 218
Bannerghatta National Park	1974	260.51	Bengaluru 22
Kudremukh National Park	1987	600.57	Udupi 90 Bengaluru 263
Nagarahole (Rajiv Gandhi) National Park	1988	643.39	Mysuru 120 Bengaluru 240

Source: Website of Karnataka Forest Department - http://www.aranya.gov.in/Static%20Pages/NationalParks.aspx

TABLE 9-6:: Wildlife Sanctuaries in Karnantka

Sl No	Name of the Wildlife Sanctuaries	Area (sq km) Notified under Section of WLP Act, 1972	Date/Year	Area (sq km)
1	Adichunchanagiri Peacock Sanctuary, Mandya Dist	Section 26 (A) (1)	No.FEE-56-FWL-96, dated: 01-09-1998	0.840
2	Arbithittu Wildlife Sanctuary, Mysore Dist.	Section 18	No. AHFFD 3 FWL 85 30-04-1985	13.500
3	Attiveri Bird Sanctuary, Uttara Kannada & Dharwad Dist.	Section 26 A (1) (a)	No.FEE-17-FWL-99, dated: 17-08-2000	2.230
4	Bhadra Wildlife Sanctuary, Chikmagalur Dist.	Section 26 (A) (b) Section 26 (A) (b)	No.FEE-58-FWL-96, dated: 09-03-1998 No.FEE-177-FWL-2008(1) to 2008(6), dated: 28-04-2010	500.160
5	Bramhagiri Wildlife Sanctuary, Kodagu Dist.	Section 26 A (1) (b)	No.FEE-29-FWL-2013, dated: 29-07-2013	181.290
6	BRT Wildlife Sanctuary, Chamarajanagar Dist.	Section 26 (A) (b)	No.FEE-57-FWL-94, dated: 13-06-1994	539.520
7	Cauvery Wildlife Sanctuary, Ramanagar & Chamrajanagar Dist.	Section 26 (A)	No.FEE-166-FWL-94, dated: '03-08-1994 No.FEE-302-FWL-2011-(IV), dated: 27-12-2011	
8	Dandeli Wildlife Sanctuary, Uttara Kannada Dist.	Section 26 (A) (3) Section 26 (A)	No.FEE-58-FWL-96, dated: '09-03-1998 No.FEE-302-FWL-2011-(I), dated: 27-12-2011	886.410
9	Daroji Bear Sanctuary, Bellary Dist.	Section 26 A (b)/Section 26 A (b)	No.Apaji-139-FWL-91, dated: 17-10-1994 No.FEE-119-FWL-2008, dated: 03-10-2008	82.720
10	Ghataprabha Bird Sanctuary, Belgaum Dist.	Section 26 A (1) (a)	No.FEE-58-FWL-96, dated: 08-07-1999	29.780
11	Gudavi Bird Sanctuary, Shimoga Dist	Section 26 A (1) (a)	No.FEE-220-FWL-99, dated: 04-09-2000	0.730
12	Melkote Wildlife Sanctuary, Mandya Dist	Section 26 (A) (b)	No.FEE-58-FWL-96, dated: 09-03-1998	49.820

13	Mookambika Wildlife Sanctuary, Shimoga & Udupi Dist.	Section 18 /Section 26 (A)	No.KFD-48-FWL-74, dated: 22-05-1978/No.FEE-302-FWL-2011-(III), dated: 27-12-2011	370.370
14	Nugu Wildlife Sanctuary, Mysore Dist.	Section 26 (A) (b)	No.FEE-58-FWL-96, dated: 09-03-1998	30.320
15	Pushpagiri Wildlife Sanctuary, Kodagu Dist.	Section 26 A (b)	No.FEE-57-FWL-94, dated: 13-06-1994	102.920
16	Ranebennur Black Buck Sanctuary, Haveri Dist.	Section 18	No.AFD-58-FWL-74, dated: 12-06-1975	119.000
17	Ranganathittu Bird Sanctuary, Mandya Dist.	Section 26 A (1) (a)	No.FEE-58-FWL-96, dated: 01-09-1998	0.670
18	Sharavathi Wildlife Sanctuary,Shimoga Dist	Section 18	No.AFD-22-FWL-74, dated: 28-06-1978	431.230
19	Shettihalli Wildlife Sanctuary, Shimoga Dist	Section 18	No.AFD-47-FWL-74, dated: 25-01-1977	395.600
20	Someswara Wildlife Sanctuary, Udupi & Shimoga Dist.	Section 18/Section 26 A (b)	No.AFD-51-FWL-76, dated: 12-10-1979/No.FEE-302-FWL-2011-(V), dated: 27-12-2011	314.250
21	Talacauvery Wildlife Sanctuary, Kodagu Dist.	Section 26 A (b)	No.FEE-57-FWL-94, dated: 13-06-1994	105.590
22	Bhimgad Wildlife Sanctuary, Belgaum Dist.	Section 26 A (b)	No.FEE-10-FWL-2009, dated: 28-11-2011	190.420
23	Rangayyanadurga Four horned Antelope Sanctuary, Davangere Dist	Section 26 A (b)	No.FEE-240-FWL-2010, dated: 10-01-2011	77.230
24	Chincholi Wildlife Sanctuary, Kalburgi Dist.	Section 26 A (b)	No.FEE-224-FWL-2011, dated: 28-11-2011	134.880
25	Ramadevara Betta Vulture Sanctuary, Ramanagara Dist.	Section 26 A (b)	No.FEE-234-FWL-2008, dated: 30-01-2012	3.460
26	Malai Mahadeshwara Wildlife Sanctuary, Chamrajanagar Dist.	Section 26 A (1) (b)	FEE 90 FWL 2013 Dt.07-05-2013	906.187
27	Gudekote Sloth Bear Sanctuary, Bellary Dist.	Section 26 A (b)	FEE 72 FWL 2013 Dt.11-11-2013	47.610
28	Jogimatti Wildlife Sanctuary, Chitradurga Dist.	Section 26 A (b)	FEE 77 FWL 2015 Dt.23-12-2015	100.480
29	Yadahalli Chinkara Wildlife Sanctuary, Bagalkote Dist.	Section 26 A (b)	FEE 204 FWL 2015 Dt.23-12-2015	96.360
30	Thimlapura Wildlife Sanctuary, Tumkur Dist.	Section 26 A (b)	FEE 301 FWL 2015-1 Dt.16-01-2016	50.860

Source: Website of Karnataka Forest Department -

http://www.aranya.gov.in/Static%20Pages/Sanctuary.aspx

Tiger Reserves in Karnataka

Karnataka has been declared as No.1 State in tiger population in the country. At present, the tiger population is estimated around 300 as per India Tiger estimate 2010 conducted by the Ministry of Environment and Forests, Govt. of India. The State has 5 Tiger Reserves namely, Bandipur, Bhadra, Nagarahole, Dandeli-Anshi and BRT Tiger Reserves.

A list of Tiger Reserve in Karnataka has been provided in Table 9-7 below.

TABLE 9-7:: Tiger Reserves in Karnataka

Name of the Tiger Reserve	Area (sq. kms)	Year of Establishment
Bandipur	872.24	1973
Bhadra	500.16	1998
Nagarahole	643.39	2000
Dandeli-Anshi	475.00	2006
BRT	539.52	2011

Source: http://www.aranya.gov.in/Static%20Pages/TigerReserves.aspx

Proximity of the Project to Protected Areas

The project is located close to Anshi national Park. The project is located within a distance of 10 km from the Anshi National Park. The nearest distance of the project from the boundary of the Anshi national Park is 0.87 km. Anshi National Park has been granted the status of Project Tiger sanctuaries in January 2007. The project will, therefore require clearance under Wildlife Protection Act, 1972.

9.2.13. Socio-economic Profile

Uttara Kannada is one of the northernmost coastal districts of the state of Karnataka, bounded by the Arabian Sea to its west. It has a geographical area of 10291 sq km which is about 5.36 % of the geographical area of the state.

Uttara Kannada is bordered by the state of Goa to the North West, Belgavi District to the north, Dharwad and Haveri Districts to the east, and, Shivamogga and Udupi Districts to the south. The district falls in the Western Ghat region. The city of Karwar is the administrative headquarters of the district.

According to Census 2011, the district has a total population of 14.37 lakh, which is about 2.35 % of the state population. Kannada and Konkani (also Tulu to a limited extent) are the major regional languages spoken in Uttara Kannada district. With regards to Sex-ratio in Uttara Kannada, it stood at 979 females per 1000 males (2011).

As per Census 2011, 29.15 percent of the total population of Uttara Kannada lived in urban areas and 70.85 percent lived in rural areas of the district. Sirsi, Kumta, Karwar, Bhatkal, Honnavar, Haliyal taluks are the bigger taluks as compared to the remaining taluks, in terms of population size. Density of population in the district is 140 persons per sq km.

As per Census 2011, the Uttara Kannada district (Karnataka state) recorded an overall literacy rate of 84.06 (75.4) %. The literacy rate for male and female population in Uttara Kannada (Karnataka) was 89.63 (82.5) % and 78.39 (68.1) %, respectively.

DISTRICT HIGHLIGHTS – 2011 CENSUS

- Uttara Kannada with a total population of 1,437,169 holds the 20th position in terms of total population in the State.
- The district holds the 19th rank in terms of rural population and 16th in terms of urban population.
- Uttara Kannada district accounts for 2.4 percent of the total population of the State.
- With the decadal growth rate of 6.2 percent, it ranks 22nd in the State in terms of decadal growth rate.
- The district with a Sex ratio of 979 holds 18th rank in the State.
- The district with a Sex ratio of 955 among the child population in the age-group 0-6 holds the rank of 12th in the State.
- The proportion of child population, (0-6 age-group) is 10.5

percent in the district and ranks 19th in the State.

- The district has a literacy rate of 84.1 percent and is placed at 4th rank in the State.
- The male literacy rate in the district is 89.6 percent and the female literacy rate is 78.4 percent.
- The male – female literacy gap in the district is 11.2 percentage points, which is less than the male – female literacy gap registered by the State (14.39 percentage points).
- The Scheduled Caste population contributes 8.1 percent to the total population of the district and the Scheduled Tribe population contributes 2.4 percent.
- The district has registered a work participation of 42.3 percent and stands at 28th rank in the State.
- The work participation rates for Male and Female population are 59.3 and 25.0 respectively in the district.
- Among the total workers in the district 81.9 percent are Main workers and 18.1 percent are Marginal workers.
- Major work force of 61.0 percent is engaged in other workers category and the district holds 5th rank in the State.
- Agricultural sector constitute 37.4 percent of the total workers i.e., Cultivators (18.3 percent) and Agricultural Labourers (19.1 percent) and 1.6 percent of the total workers are engaged in Household Industry. About 57.7 percent of the total population in the district is Nonworkers.
- Uttara Kannada district with area figure of 10277 Sq.Km stands at 5th Position in the State in terms of area.
- The population density for this district is 140 and it is the third least dense district in the State.
- There are 1289 villages, 11 Statutory Towns and 7 Census Towns in the district.

Agricultural sector continues to play a prominent role in the development of the economy of Uttara Kannada district. Paddy is the principal agricultural crop in the district and grown in all the taluks. Haliyal, Mundgod and Sirsi are predominantly cultivating paddy. The other important crops grown in the district are sugarcane, ragi, jowar, maize and groundnut.

The number of marginal holdings below one hectare and small holdings of size one to two hectares constitute 89.49% of the total holdings. Only 0.15% holder own land more than ten hectares.

Uttara Kannada district has a coastal line of 144 km. endowed with rich marine resources. The fish are landed through purse-seiners, trawlers and other mechanised boats. The fish production plays a very important role in the district economy. There are 16 fish landing centres, 4 fishing harbours and 13 estuaries (with an area 4188.5 hectares) in the district. The marine fish production for the district is 33,132.5 metric tonnes. There are 55 ice plants, 9 cold storages and 5 freezing plants in the district. Also the district is having one canning plant and one fish meal plant. There are about 45 fishermen cooperative Societies and 28 fish markets in Uttara Kannada district. The fish are marketed both inside and outside district. About 10 percent are utilized for manure purposes, for coconut and other crops.

Traditionally, Uttara Kannada is known for sandal wood carving and cane work. Kumta and Karwar are the principal centres of woodcrafts and both have continued to maintain their reputation. The industries of district may be classified into 4 categories, 1) Agro-based 2) Marinebased 3) Forest-based and 4) Mineral based. There are numerous Rice mills and Khandasari manufacturing units all over the district. There are a few fruit processing factories and coir industrial units.

The marine based industries are concentrated in the coastal zone and consist of boat building, production of fish oil and fish manure, ice plant and freezing plants. Forest industries include the numerous saw mills, the plywood factory, veneers manufacturing unit and the paper mill. Ferromanganese and silicon-manganese unit as well as the caustic soda factory are the major mineral based industries.

There are totally 82 factories in the district providing employment to 9,767 persons.

(Source: District Census Handbook: Uttara Kannada, Series 30, Part XII-A, Census of India, 2011

Only 11 % of geographical area is under agricultural crops in Uttara Kannada district. The main agricultural crops produced in the district are: paddy, sugarcane, maize, cotton and groundnut. An additional 3 % of district area is under horticulture. The main horticulture crops are: betel leaves, areca nut, coconut, mango, banana, pepper, coriander, etc.

Proportion of SC and ST population in the total population of Karnataka is about 17.15 and 6.95 %, respectively. As against it, Uttara Kannada district has the lower proportion of both SC and ST population 8.1 % and 2.4 %, respectively. This is true for even for all taluks of Uttara Kannada, except for Yellapur, where the proportion of ST population is marginally higher than that for the State as a whole. The highest proportion of SC population is in Mundgod and lowest in Honnavar and Karwar. The lowest proportions of ST population are in Kumta, Honnavar and Siddapur.

(Source: District Human Development Report 2014,

http://www.zpkarwar.kar.nic.in/publication/docs/English/EnglishPart2.pdf)

9.3. Potential Environmental and Social Impacts of the Project

As per the traffic study undertaken as part of the present DPR study, there is no market demand that necessitates the development of the proposed waterway at this juncture. Accordingly, the DPR recommends development of the proposed NW-52 only if demand for the same arises in future.

Development of NW-52, which shall be for a stretch of 29.55 km, which is upto Kadra Dam, shall involve dredging of 5.47 lakh cu m of river material, construction of one terminal buildings near village Kadra and bank protection works at six (06) locations covering a total stretch of about 3.0 km.

Thus, the development of NW-52 in future envisages the following major construction activities:

- Construction of terminal buildings
- Bank protection works
- Dredging of the river for development of fairway
- Construction of access roads

These activities will involve mobilization of manpower and equipment at site, movement of vehicles, use of existing water 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.

As has been mentioned above, the project envisages construction of one terminal. The identified terminal site is located at the toe of Kadra Dam in Village Kadra which falls under Virje taluka of the Uttara Kannada district. The land area required for construction of terminal is estimated to be 20758 sq m. Land identified for terminal construction is mostly forest land. Part of this land is also private land.

Since limited land is required for construction of terminals and access roads, no significant adverse impact on account of land use change is anticipated due to the project.

The project involves dredging for creation of a navigable channel maintaining a depth of 2.07 m. It is estimated that a total quantity of 6.05 lakh cum of ordinary soil for dredging. All the dredged material is proposed to be disposed of within the flood banks of the river. As such there is no impact on the land environment due to disposal of dredged material.

The project also envisages river training and bank protection works. The impacts on aquatic ecology due to dredging, river training and bank protection works envisaged for the project shall have to be confirmed as part of the EIA study.

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 positive impacts on the project will include improved waterway facilities and other allied infrastructure facilities for 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
- Wildlife Protection Act, 1972

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 project shall require obtaining clearance under the CRZ Notification 2011. The stretch of Kali River (NW-52) up to Kadra Dam falls in the coastal zone. Based on the categorization provided in CRZ Notification, 2011, this stretch of NW-52 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 mean 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 50meters 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

Part of the land identified terminal location is forest land. Forest Clearance from the MoEF shall be required for diversion of this forest land.

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. However, the Notification, as amended in 2009, includes ‘Dredging’ as an activity for which prior environmental clearance is required. As such, the project will need to obtain Environmental Clearance from the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India.

The process of obtaining environmental clearance requires carrying out an Environmental Impact Assessment study in accordance with the Terms of Reference (ToR) approved by the MoEF. The Environmental Clearance is awarded upon approval of the EIA study report by the Expert Appraisal Committee of the MoEF.

9.5.2. Other Major Clearances / Approvals / Permits Applicable to the Project

The project is located within a distance of 10 km from the Anshi National Park. The nearest distance of the project from the boundary of the Anshi national Park is 0.87 km. The project will, therefore require clearance under Wildlife Protection Act, 1972.

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.

No other major clearances / approvals / permits relating to environmental and social aspects are applicable to the project.

TABLE 9-8:**:** Major Clearances / Approvals / Permits and their Applicability to the Project

Sl. No.	Clearance / Approval	Applicability to the Project	Applicable Legislation	Remarks
1.	Environmental Clearance	Yes	EIA Notification 2006	Development of the project involves dredging.
2.	Forest Clearance	Required for construction of Terminal which is mostly forest land. May be required for terminal 2 and approach road construction.	Forest Conservation Act, 1980	
3.	Wildlife Clearance	Yes	Wildlife Protection Act, 1972	The project falls within 10 km from the boundary of Anshi National Park.
4.	CRZ Clearance	Yes		The proposed stretch for development upto 29.55 km,

Sl. No.	Clearance / Approval	Applicability to the Project	Applicable Legislation	Remarks
				i.e. upto Kadra Dam, falls in tidal zone.

9.6. Cost Implications

A lump sum provision of 5% of the project cost has been made for environmental management and monitoring activities relating to the project. This does not involve the cost of land acquisition, land development cost or cost of diversion of forest land.

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 there at;

(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 Out Sourcing the work along with supervision to different contractual agencies (Out Sourcing 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 proposed as a support requirement to operate the project.

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.

There are many accessories equipment required for functioning & maintenance of waterway viz., Dredgers; Tugs; Survey vessels; Navigational Equipment maintenance vessels; Patrol Boats; Pilot Boats; Inspection Vessels etc. Since the waterway shall cater to tourist activities, hence night navigation is not needed.

Kali river due to its small stretch and no commercial opportunity at this stage doesnot need an exclusive vessel for maintenance of waterway.

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 basically located in the terminal building, 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: Manpower financial implication per month

Sl No.	Name of the Post	Nos. of the Post	Basic Pay (INR)	Implication per month @ 95 % extra (INR)	Remarks
1	Director	0	78800	0	25 % extra for statutory allowances and 20 % extra for perks have been taken into consideration.
2	Asst. Director Civil / Mechanical	0	56100	0	
3	Asst. Hy. Surveyor	0	56100	0	
4	Junior Hy. Surveyor	1	47600	92,820	
5	Junior Accounts Officer	1	47600	92,820	
6	Supervisor	0	35400	0	
7	Steno / P. A	0	35400	0	
8	Upper Divisional Clerk	0	25500	0	
9	Data Entry Operator	0	21700	0	
10	Driver	0	21700	0	
11	Attendant	1	21700	42,315	
	Total	**3**		**2,27,955**	

TABLE 10-2: Financial implication – Capital and Maintenance

Sl No.	Name of the Item	Capital Cost (INR)	Financial Implication per month (INR)	Remarks
1	Office premises	*	0	*Housed in Terminal Building
2	Furniture etc.,	20,00,000	0	One Time
3	Pay and Allowances for 4 Nos.	--	2,27,955	Refer Table 10.1
5	Computer Systems including UPS etc.,1Nos. @ 1 lakh each	1,00,000	10,000	---
6	Printers 1 Nos. @ 0.25 lakhs each	25,000	10,000	---
7	Alternate Uninterrupted Power Supply with D. G set 1 No @ 10 Lakhs per no.	2,50,000	50000	---
8	Other General Office maintenance including stationery, electricity bill, consumables etc.,	--	1,50,000	---
	Total	**23,75,000**	**4,47,955**	

+ 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.

+ No cost apportionment has been considered in conjunction with 6 National Waterways this is considered as standalone development and the maintenance cost per month will be INR 4.47 Lakhs per month.

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 working out the cost and Return on capital. 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 concerned region / state. 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 Kali River is having tourist mobility near the early stretches in the mouth of the River meting the sea, as on date and according to the estimation and forecast based on detail study, there is non-availability of cargo and the possibility of operation does not appear feasible at this stage which may be reviewed with the passage of time only, till positive growth development, with its hinterland extending to Eastern Karnataka with its originating traffic at Karwar Port area.

In view of the above, the costing has been considered as a nominal fairway development for ferry services and development of ferry terminal facility in one of the proposed IWAI Terminal location.

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 Kali River Ferry Terminal Development (Phase I & II)

Sl No.	Item Description	Amount (in Lakh Rs.)	Schedule	
			Phase 1	**Phase 2**
A	**Terminals**			
(i)	Land			
	Terminal Location Downstream of Kadra Dam	17.52	0.00	17.52
	Terminal Location at Sadasivgad	17.52	17.52	0.00
	Terminal Location at Katne	17.52	17.52	0.00
	Sub-total (A)	**52.56**	**35.04**	**17.52**
B	Riverine Components			
a	Floating Pontoon with Link Span - Downstream of Kadra Dam	305.89	0.00	305.89
b	Floating Jetty - Sadashivgad	116.32	116.32	0.00
c	Floating Jetty - Katne	116.32	116.32	0.00
(i)	Infrastructure Components/ Terminal Building including internal roads at D/s of Kadra Dam	185.49	0.00	185.49
(ii)	Infrastructure Components/ Terminal Building including internal roads at Shadasivgad	185.49	185.49	0.00
(iii)	Infrastructure Components/ Terminal Building including internal roads at Katne	185.49	185.49	0.00
(iv)	Approach Road (External) Cost	0.83	0.83	0.00
(v)	Bank Protection Works for terminal	38.27	7.65	30.62
	Sub-total (B)	**1134.09**	**612.10**	**521.99**
C	**Institutional Requirement**			
(i)	Office Development Cost	23.75	23.75	0.00

Sl No.	Item Description	Amount (in Lakh Rs.)	Schedule	
			Phase 1	Phase 2
	Sub-total (C)	**23.75**	**23.75**	**0.00**
	Sub-total (A)+(B)+(C)	**1210.40**	**670.89**	**539.51**
D	**Vessels**			
(i)	Vessel Size	0.00	0.00	0.00
(ii)	Vessel Capacity	0.00	0.00	0.00
	Sub-total (B)	**0.00**	**0.00**	**0.00**
E	**Equipments for Both Terminals**			0.00
(i)	Ambulance - 1 no.	18	0.00	18.00
(ii)	Dumper Trucks 16 T Capacity - 1 no.	0	0.00	0.00
(iii)	Cranes with 50 T Capacity - 1 no.	0	0.00	0.00
(iv)	Fork lift trucks 20 T Capacity - 1 no.	0	0.00	0.00
	Sub-total (C)	**18.00**	**0.00**	**18.00**
	Sub-total (A)+(B)+(C)+(D)+(E)	**1228.40**	**670.89**	**557.51**
D	Enviornmental Management Plan Cost @ 5% of Prime cost as per Chapter 9 of DPR	61.42	33.54	27.88
E	Project Management & consultancy Charges @3% of Prime cost	36.85	20.13	16.73
F	Contingencies and Unforseen Items of Works @ 3% of Prime cost	36.85	20.13	16.73
	Project total Hard Cost	**1363.53**	**744.69**	**618.84**
	Breakup of Terminal Development Cost (Phase-I) - FY: 22-23			
	Terminal Development	**486.46**	**Lakhs**	
	Floating Jetties	**258.23**	**Lakhs**	

TABLE 11-2: Abstract of Cost for Kali Fairway Development – Fairway (Phase 1 & II)

Sl No.	Item Description	Amount (in Lakh Rs.)	Schedule	
			Phase 1	Phase 2
A	**Fairway**			
1	Dredging			
(i)	General Soil	1482.24	173.19	1309.05
(ii)	Hard Soil	0.00		0.00

Sl No.	Item Description	Amount (in Lakh Rs.)	Schedule	
			Phase 1	Phase 2
(iii)	Hard Rock	0.00		0.00
2	Low Cost River Structures			
(i)	Bandaling	0.00		0.00
(ii)	Bottom Paneling	0.00		0.00
3	River Training Works			
(i)	Spurs			
(ii)	Bank Protection Works for river	254.57	0.00	254.57
(iii)	Porcupine			
4	Night Navigation			
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	0.00	0.00	0.00
(ii)	Shore Marking with Latiice Bridge & Lighting Equipments	16.00	16.00	0.00
5	Land Acquisition			
	Sub-total (A)	**1752.80**	**189.19**	**1563.61**
B	**Modification of Structures**			
(i)	Bridges	0.00		0.00
(ii)	Cables	0.00		0.00
(iii)	Dams	0.00		0.00
(iv)	Barrages	0.00		0.00
(v)	Locks	0.00		0.00
	Sub-total (B)	**0.00**		0.00
C	**Communication System**			
(i)	RIS Centre	0.00	0.00	0.00
(ii)	AIS Base Station	0.00	0.00	0.00
(iii)	Vessels - Survey vessel & Other Vessel	0.00	0.00	0.00
	Sub-total (C)	**0.00**	**0.00**	**0.00**
	Sub-total (A)+(B)+(C)	**1752.80**	**189.19**	**1563.61**
E	Enviornmental Management Plan Cost@5% of Prime cost as per Ch 9 of the DPR.	87.64	9.46	78.18
F	Project Management & consultancy Charges @3% of Prime cost	52.58	5.68	46.91
G	Contingencies and Unforseen Items of Works @3% of Prime cost	52.58	5.68	46.91
	Project total Hard Cost	**1945.61**	**210.00**	**1735.61**

Sl No.	Item Description	Amount (in Lakh Rs.)	Schedule	
			Phase 1	Phase 2
	Breakup of Fairway Development (Phase-II) - FY: 30-31			
	Dredging	**194.00**	**Lakhs**	
	Navigational Aids	**16.00**	**Lakhs**	

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

As explained above, the project has been proposed to be phased for its development. There shall be two phases while the year of 2022 shall be proposed as the commencement year and the project implementation period shall be 02 years, ending in December 2023 of Phase I of the project. In phase I of the project the ferry operation shall be developed from Sadasivgad to Katne, which is 10 kms apart catering to tourism development with a nominal cost of 9.54 Crores (2.10 Crores for fairway development and 7.44 Crores for terminal development). The detail of capital expenditure in phase I is shown in the table below:

TABLE 11-2: Capital Expenditure in Phase I (FY: 2022-2023)

Particulars	Item Description	Cost in Cr.
Fairway Development		
	Dredging	1.94
	Navigational Aids	0.16
Sub Total -I		**2.10**
Terminal Development		
	Terminal development at two locations	4.86
Berthing Facility		
	Concrete Floating	1.95

Particulars	Item Description	Cost in Cr.
	Jetties Large (Sadashivgad)	
	Concrete Floating Jetties Large (Katne)	0.63
Sub Total -II		**7.44**
Grand Total		**9.54**

Phase II shall be cnsidered for two years which is 2030 & 2031 and this is the period for extending the ferry services from Katne to Virje (downstream of Kadra Dam). Phase II is proposed to be extended from Katne to Virje (downstream of Kadra Dam).The distance from Katne to Virje is 19.5 kms approx is proposed to be developed at an additional investment of (17.356 Crores for fairway development and 6.188 Crores for terminal development). The detail of capital expenditure in phase II is shown in the table below:

TABLE 11-2: Capital Expenditure in Phase II (FY: 2030-2031)

Particulars	Item Description	Cost in Cr.
Fairway Development		
	Dredging	13.090
	Bank Protection for River	2.545
	EIA/EMP/PMC/Contingencies	1.720
	Navigational Aids	0.000
Sub Total - I		**17.356**
Terminal Development		
	Land Terminal Building	0.175
	Flooting Pontoon/ Jetty	3.058
	Terminal Building & Infrastructure.	1.854
	Bank Protection at Termunal Location.	0.306
	Institutional Requirement.	0.00
	Equipments.	0.180
Sub Total -II		**6.188**
Grand Total I + II		**23.545**

The financial modules have been developed with detail discussion on this aspect in chapter 13.

CHAPTER 12: IMPLEMENTATION SCHEDULE

12.1. Time Frame

The development of river Kali is proposed with cautious approach due to the identified cargo with same volumes without any estimated increase. Further, the possibility of diversion to Inland Water Transport (IWT) is yet to be confirmed.

Accordingly, it is proposed to develop the waterway for ferry vessel from Sadasivgad to Katne in Phase I of the project to be implemented in FY 22-23 and thereafter extension of ferry services till virje which is in the downstream of Kadra dam.

It is suggested for a nominal investment of INR 7.44 Crores for ferry terminal development at two locations and fairway development from Sadasivgad to Katne at a cost of 2.10 Crores in Phase-I of the project proposed to be implemented in 2022-23.

Subsequent to this, after having meticulous analysis, based on the observed growth of mobility, the investment decision may have to be taken which shall be Phase II of the project proposed to be implemented in 2030-31 at a total cost of 23.545 Crores. The distribution shall be 17.35 Crores for Fairway development & 6.18 Crores at one additional terminal development at Virje during the Phase-II.

In order to facilitate the passenger traffic for tourism activity and loca / confirmed traffic, the investment on Fairway development consisting of the activities of Dredging; Bank protection; Day / Night Navigation facilities & aids (Buoy & Light) 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 for initial development and Annexure 12.2 for subsequent Phase.

12.2. Phasing

The Phase 1 / initial development is with effect for considering the promotional mobility from 2022.

The next Phase development, if to be considered, after experiencing a positive growth in the 8-9 years and shall be taken up in two years in FY: 2030-31. The passenger ferry vessel deployment, however, 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

Kali River (NW 52) development has been distinguished across two development modules. This is depicted in the following Table 13-1.

TABLE 13-1 NW 52 Development

Sub-sector	FY22	FY23	FY25	FY30	FY31	FY35	FY40
Fairway	Development - Phase 1			Development - Phase 2			
		Operational (10 km)			Operational (Entire 29.5 km)		
Terminal	Construction - Phase 2			Construction - Phase 2			
		Operational (Sadasibgad & Katne)			Operational (All 3 Terminals)		

Source: Tractebel; Consultant

NW 52 has been proposed with prospects for handling tourist traffic on stretch of 29.55km in two phases. The State Government of Karnataka has plans of developing River Tourism along River Kali. There are small boats owned by locals plying across the river. The scenic beauty of the location could attract substantial footfall of tourists. Hence, development has been proposed keeping in mind the request of Karnataka Government during meeting with IWAI. The terminals on NW 52 have been proposed at 3 locations i.e Sadasivgad, Katne and Virje near Kadra Dam. Entire Development will be done in two phases. In Phase I (FY:22-23) terminals Sadasivgad and Katne are proposed for its development along with 10km of fairway between them. Apart from fairway development and terminal construction, cost for Office Development, shore marking with lattice bridge and for lighting equipment will be done in Phase I only. Phase II (FY:30-31) factors in cost for dredging activity, bank protection works along with construction of terminal at Virje with all supporting infrastructure facilities to enable water transportation on the extended fairway of 19.55km. After completion of Phase II entire stretch of 29.55km will get operational for tourists movement.

In the beginning stage, ferry service may be started with Public- Private Partnership (PPP) methodology while the institutional support in terms of infrastructure, safety, licensing to operate shall be provided by the implementing organization. The state govt. has a very proactive role to play in such kind of development. IWAI would develop fairway for class IV waterways and terminals infrastructure. The recovery of investment for fairway development, maintenance of fairway and terminals would be from royalty generated from tourism operations.

Construction period for Phase 1 is considered for 2 years (FY22 & FY23) and IWT service will get operationalized from end of construction phase i.e FY23 onwards. Development period considered in Phase 2 is FY30 and DY31. FY31 onwards the extended stretch of fairway will get operational. IWAI prescribed tariffs (notified in 2011) has been assumed for vessel berthing and fairway usage. The table below shows the revenue generating sources considered in this financial study.

TABLE 13-2 Revenue Sources for IWAI

Sr. No	Source	Tariff	Description
1	Royalty from Tour Operators		
	Boat Ride	INR 100 / Pax	20% of ticket fee charged by Operator (INR 500 per tourist)
2	Vessel Berthing	INR 1,000 / Day	By IWAI
3	Fairway Usage	NIL	By IWAI
4	Real Estate Leasing	INR 500 / Day	04 Shops

Source: IWAI and Consultant

Royalty from tour operators would be the primary revenue source for IWAI. The boat operators carrying tourists for along the river ride would pay IWAI a Royalty of 20% from the boat tariffs. The selection of operators could be made using tendering process whereas 20% royalty sharing to be made as reserve price. Any operator bidding higher/highest revenue sharing to be awarded tourism project. There could be one or multiple operators based on the interest from tourism industry.

IWAI would generate additional revenue from Vessels berthing, license fee and leasing of real estate space on the terminals.

13.1. Input Sheet

The following table lists all the assumptions and input values used in the financial modeling of Kali River. This includes financial analysis for the navigation infrastructure (fairways), and terminal operations:

TABLE 13-3 Input Sheet for NW 52

Description	Unit	Fairway	Terminal
Loan Tenure	**Years**	**10**	**10**
Moratorium Period (Years Construction)	**Years**	**2**	**2**
Rate of Interest	**Annual**	**11%**	**11%**
Corporate Tax	**Annual**	**25%**	**25%**

Revenue Escalation	**Annual**	**6%**	**6%**
Administrative Cost	**of Revenue**	**3%**	**2%**
Manpower Cost Escalation	**Annual**	**5%**	**5%**
Dredging Costs Escalation	**Annual**	**5%**	
Other Costs Escalation	**Annual**		**6%**
Fairway Chainage	**km**	**29.5**	
Chainage (mouth of the river to Terminal)	**Km**		**29.5**
Operation & Maintenance			
Description	Unit	Fairway	Terminal
Civil Infrastructure	**Cost**		**1%**
Dredging		**10%**	
Machinery Infrastructure			**5%**
Insurance Cost	**Capex**	**2%**	**2%**

Assumptions for EIRR

Parameters	Unit	Value
Distance		
Road	**Km**	**35**
IWT	**Km**	**29.5**
Capacity		
Road	**Pax. Per Bus**	**60**
IWT	**Pax. Per Vessel**	**40**
Accidental Loss		
Road	**Rs Lakhs/KM**	**7.6**
IWT	**Rs Lakhs/KM**	**0.15**
Fuel price	**Rs/Litre**	**94.0**
Operating Cost (OC)		
Road	**Rs/Pax.-km**	**1**
IWT	**Rs/Pax.-km**	**2.5**
Emission		
Road	**Rs/Trip**	**650**
IWT	**Rs/Trip**	**105.5**

Source: Consultant, Market standards

All the necessary assumptions for financial modeling are either market driven or provided by IWAI. Fairway and terminal tariff have been taken from IWAI. The chainage of 29.5 km is between both the proposed terminals.

13.1.1. Revenue

Revenue for the cumulative stretch of Kali River will be generated from the core i.e operation at the passenger terminal only. Secondary revenues sources, labeled “Ancillary Revenue”, will be generated from sources like land leasing for commercial operations (tea-stall, coffee shops, inn, etc.). The revenue break-up and total revenue for IWAI on Kali River are presented in the table below:

TABLE 13-4 Revenue for NW 52 (INR Lakhs)

Description	FY22	FY23	FY25	FY30	FY35	FY40
Fairway	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Terminal	**6.0**	**33.2**	**43.9**	**90.7**	**204.1**	**468.3**

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 belived 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 finanicals 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 of fairway and maintaince of fairway without any revenue.

13.2. Cost

This section presents the total project cost in phased manner. 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 river navigable. The following table shows these cost-heads for all the three core business operations:

TABLE 13-5 Project Cost (INR Lakhs)

Description	Total		Phase 1		Phase 2	
	Phase 1	Phase 2	FY22	FY23	FY30	FY31
Fairway						
Fairway	173.2	1,563.6	86.6	86.6	781.8	781.8
Communication System	16.0	0.0	8.0	8.0	0.0	0.0
Environmental Management Plan Cost as per chapter-9 of the DPR	9.5	78.2	4.7	4.7	39.1	39.1
Project Management & consultancy Charges @ 3% of Prime cost	5.7	46.9	2.8	2.8	23.5	23.5
Contingencies and Unforeseen Items of Works@ 3% of Prime cost	5.7	46.9	2.8	2.8	23.5	23.5
Total Project Cost	210.0	1,735.6	105.0	105.0	867.8	867.8

Description	Total		Phase 1		Phase 2	
	Phase 1	Phase 2	FY22	FY23	FY30	FY31
Terminal						
Terminal	647.1	539.5	323.6	323.6	269.8	269.8
Equipment	0.0	18.0	0.0	0.0	18.0	0.0
Institutional Requirement	23.8	0.0	11.9	11.9	0.0	0.0
Environmental Management Plan Cost as per chapter-9 of the DPR	33.5	27.9	16.8	16.8	13.9	13.9
Project Management & consultancy Charges @ 3% of Prime cost	20.1	16.7	10.1	10.1	8.4	8.4
Contingencies and Unforeseen Items of Works @ 3% of Prime cost	20.1	16.7	10.1	10.1	8.4	8.4
Total Project Cost	744.7	618.8	372.3	372.3	318.4	300.4

For operations, 3 passenger vessels may be required till FY40 to cater to the estimated tourist traffic on the river. The onus of vessel acquisitions lie with the private operator and not IWAI. Hence, these costs will not be factored in to develop model for the Terminal.

13.3. Financial Analysis / FIRR

The financial indicators dictating FIRR for 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 tables, respectively:

TABLE 13-6 Employment schedule and salary expenditure (INR Lakh)

Parameter	No.	CTC p.a. / person	FY22	FY23	FY25	FY30	FY35	FY40
Manpower Expenditure								
Junior Accounts Officer	**1**	**11.1**	-	**11.7**	**12.9**	**16.5**	**21.0**	**26.8**
Junior Hy. Surveyor	**1**	**11.1**	-	**11.7**	**12.9**	**16.5**	**21.0**	**26.8**
Attendant	**1**	**5.1**	-	**5.3**	**5.9**	**7.5**	**9.6**	**12.2**
Total Salary (INR Lakh)	**3**	**-**	-	**28.7**	**31.7**	**40.4**	**51.6**	**65.8**

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 terminal 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 13-7 Depreciation (Using SLM Method) (INR Lakh)

Depreciation & Amortization	FY22	FY23	FY25	FY30	FY35	FY40
Terminal						
Gross Block	372.3	744.7	744.7	1,063.1	1,363.5	1,363.5
Depreciation & Amortization	-	58.0	58.0	82.0	76.0	76.0
Cumulative Depreciation & Amortization	-	58.0	173.9	458.4	884.4	1,264.2
Net Block	372.3	686.7	570.7	604.7	479.2	99.3

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 13-8 P&L Statement (INR Lakh)

Parameter	FY22	FY23	FY25	FY30	FY35	FY40
Terminals						
Revenue	**6.0**	**33.2**	**43.9**	**90.7**	**204.1**	**468.3**
O&M Cost	**3.4**	**62.6**	**69.9**	**98.2**	**136.3**	**183.0**
PBDIT	**2.6**	**-29.5**	**-26.0**	**-7.6**	**67.8**	**285.3**
Depreciation	**0.0**	**58.0**	**58.0**	**82.0**	**76.0**	**76.0**
Interest	**26.6**	**53.2**	**40.7**	**25.3**	**15.4**	**0.0**
PBT	**-24.0**	**-140.7**	**-124.6**	**-114.9**	**-23.6**	**209.3**
Tax	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**52.3**
PAT	**-24.0**	**-140.7**	**-124.6**	**-114.9**	**-23.6**	**157.0**

Source: Consultant

Terminal starts generating profit in last 5 years i.e FY36 onwards. The following table is the ultimate assessment of the viability of the individual sector under the development of the Kali River:

TABLE 13-9 FIRR for NW 52 (INR Lakh)

Parameter	FY22	FY23	FY25	FY30	FY35	FY40
Terminal						
Project Cashflow (Pre-tax)	**-369.7**	**-401.8**	**-26.0**	**-326.0**	**67.8**	**285.3**
Project IRR (Pre-tax)	**-3.1%**					
Project Cashflow (Post-tax)	**-369.7**	**-401.8**	**-26.0**	**-326.0**	**67.8**	**233.0**
Project IRR (Post-tax)	**-4.2%**					

Source: Consultant

In contrast to the above project component-wise FIRR, the following table provides FIRR for the project as a whole. The project as whole generates no IRR.

TABLE 13-10 FIRR for NW 52 – Whole Project (INR Lakh)

Parameter	FY22	FY23	FY25	FY30	FY35	FY40
Whole Project						
Project Cashflow (Pre-tax)	**-483.5**	**-525.2**	**-46.3**	**-1,335.2**	**-260.1**	**-133.3**
Project IRR (Pre-tax)	**Non-existent**					
Project Cashflow (Post-tax)	**-483.5**	**-525.2**	**-46.3**	**-1,335.2**	**-260.1**	**-133.3**
Project IRR (Post-tax)	**Non-existent**					

Source: Consultant

Revenue prospect for both the sectors generates no rate of returns. It's because of low traffic and high cost of project. Based on the EIRR, Viability Gap Funding (VGF) can be sought.

13.4. 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	FY22	FY23	FY25	FY30	FY35	FY40
			Terminal			
Economic Cash Outflow	-3.8	-4.5	-0.8	-4.4	-2.7	-4.1
Net Cash Flow to Project	-2.2	-2.2	0.1	-1.5	0.7	2.5
Project EIRR	3.3%					

Source: Consultant

Terminal operation shows positive economic returns. Developing IWT on Kali River generates economic benefits to the society. Similar to calculating EIRR of the whole project, the following table shows the EIRR of the whole project:

TABLE 13-12 Project EIRR – Whole Project (INR Crores)

Parameters	FY22	FY23	FY25	FY30	FY35	FY40
			Whole Project			
Economic Cash Outflow	-4.9	-5.7	-1.0	-14.5	-5.9	-8.3
Net Cash Flow to Project	-2.9	-2.9	0.0	-7.3	-0.7	0.8
Project EIRR	Non-existent					

Source: Consultant

The whole project produces no EIRR.

13.5. 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	FY22	FY25	FY30	FY35	FY40
		Terminals			
Revenue	6.0	47.6	98.8	223.2	513.4
PAT	-27.0	-131.7	-119.3	-16.7	181.7
Project IRR (Pre tax)	-2.2%				
Project IRR (Post tax)	-3.3%				

Source: Consultant

TABLE 13-14 Sensitivity Analysis (+10% Revenue, -10% Project Cost)

Revenue Source	FY22	FY25	FY30	FY35	FY40
Terminals					
Revenue	6.0	47.6	98.8	223.2	513.4
PAT	-21.0	-110.4	-94.6	5.3	198.6
Project IRR (Pre tax)	-0.1%				
Project IRR (Post tax)	-1.4%				

Source: Consultant

TABLE 13-15 Sensitivity Analysis (-10% Revenue, +10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Terminals					
Revenue	6.0	40.3	82.6	185.0	423.2
PAT	-27.0	-138.9	-135.2	-54.2	115.4
Project IRR (Pre tax)	-6.2%				
Project IRR (Post tax)	-7.2%				

Source: Consultant

TABLE 13-16 Sensitivity Analysis (-10% Revenue, -10% Project Cost)

Revenue Source	FY23	FY25	FY30	FY35	FY40
Terminals					
Revenue	6.0	40.3	82.6	185.0	423.2
PAT	-21.0	-117.6	-110.5	-30.4	132.3
Project IRR (Pre tax)	-4.2%				
Project IRR (Post tax)	-5.3%				

Source: Consultant

Under no scenario terminal generates positive FIRR and this primarily because of 20% of royalty 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.

13.6. Risk Factors & Mitigation

Risk is a function of the probability of an event's occurrence and the impact it can have on the project. The major risk associated with the Project is the unwillingness of tourists to shift from existing mode of transportation i.e. roadways to proposed waterway. Opting for waterway for touring the local tourist spots by first using waterways and then roadways will be unreasonable to expect. The River is surrounded mostly by hills and valleys, covered with thick forests. Some tourist places are beyond the River's primary catchment area, which are better accessible by roads. Other risks typically impressing upon such a project are political, technical, environmental, and financial in nature.

13.7. 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. 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.

Terminal is commercially unviable while it comes economically viable. The table below shows the outcome of return under 20% and 40% grant.

TABLE 13-17 Probable impact of VGF on project returns

Reduction in Project Cost	Terminal	
	-20%	-40%
Project IRR (Pre Tax)	-0.9%	1.9%
Project IRR (Post Tax)	-2.2%	0.3%

Source: Consultant

At 40% of financial support from Government, terminal shows positive return of 0.3%. With financial support from government development on Kali River could be done for tourism movement.

13.8. Conclusion

The following table gives a snapshot of the project cost and viability indicators for all the sub-sector developments for NW 52 under different scenarios:

TABLE 13-18 Critical Indicators for the NW 52

Sl. No	Factors	Section	Unit	Outcome
1	Project Cost	Fairway	Cr.	19.46
		Terminals	Cr.	13.64

Sl. No	Factors	Section	Unit	Outcome
2	Tariff	Vessel Berthing	INR Vessel/Day	1,000
		Royalty	INR / Pax.	100 (20% of Ticket Fare)
		Fairway Usage	INR GRT-Km	0.00
2	Traffic	Tourists	In numbers (FY40)	126,443
3	Revenue	Fairway (FY40)	Cr.	0.00
		Terminals (FY40)	Cr.	4.68
4	FIRR	Fairway	-	-
		Terminals	-	-4.2%
		Whole	-	Non-existent
5	EIRR	Fairway	-	-
		Terminals	-	3.3%
		Whole	-	Non-existent

Source: Consultant

As shown in the table above, development of 3 terminals give positive EIRR. The isolated returns from fairway is negative. Development of tourism around Kali River i.e Karwar district is in the plans of Karnataka Government. This would increase the tourist's arrival in the region, which could be attracted by Kali River for boat riding and related activities.

CHAPTER 14: CONCLUSIONS AND RECOMMENDATIONS

The study of Second Stage Detailed Project Report (DPR) for Development of Kali River (NW 52) in the stretch of 53.415 Kms from Lat 14°50'33.5786" N, Long 74°07'19.7098" 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 study stretch of “Kali River” is segregated with the Kadra Dam at Ch. approx. 29.55 km. D/s of Kadra Dam is experiencing the Tidal effect. U/s of the Dam is having sufficient LAD, however the cargo volume support and hinterland connectivity have been observed as difficult.
- 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, in 29.55kms stretch from Sadasivgad to Virje (Downstream of Kadra Dam), along with the dredging to achieve a LAD of 2.0 m as the waterway depth (dredging of 6.05 Lakhs Cu. M of ordinary soil).
- Since the waterway is proposed to be developed for passeneger ferry services. Day / Night Navigation (Buoy / Light) are not recommended for now since the fairway is proposed to be developed for passenger ferry vessel. Bank Protection (6 Nos locations @ 75 m at each location totaling to 450 m) have been considered. No need of Modification of structures, since there is no structure obstructing the IWT mobility. The project is segregated into two phases for its implementation.
- **Phase I** is proposed to be developed commencing in year 2022 from Sadasivgad bridge to Katne about 10.0 kms at the mouth of the sea and to be implemented in two years period. The coordinate of Sadasivgad (Point A) is 14°50'42.91"N & 74°07'58.80"E. Similarly, the coordinate of Katne (Point B) is 14°52'29.14"N & 74°13'4.94"E. It is assumed that these are the idle locations for handling tourist traffic on River Kali.

- **Phase-II** of the project shall be considered in due course from Katne (10.00km approx) to Virje downstream of Kadra dam near 29.55 kms. The infrastructure developed in phase-I shall help to increase significant number of tourists in the region which may attract some good investments which may be manufacturing based or recreational purposes. Terminal identified is located on left bank of downstream of Kadra Dam. Proposed ferry service for tourists in Phase-I i.e between Sadasivgad and Katne will be extended till downstream of Kadra Dam in Phase-II.
- The coordinate of Virje (Point C) is 14°53'50"N 74°21'06" E. This location is having good accessibility to the road and the tentative Land requirement has been arrived at with 1225.18 Sq. M in the Kadra Village; Virje Taluka; Uttara Kannada District of Karnataka state.
- Karwar Port exports presently 0.26 MMTPA of Molasses from the industries located at Haliyal, Dharwad etc in its hinterland having connectivity through Kali River.
- Terminal Infrastructure has been considered to suit to the passenger ferry operation with the length of the Berthing structure as 14 m and width as 4.5 m for Sadasivgad & Katne ferry terminal location in Phase I development.
- Terminal Infrastructure has been considered to suit to the passenger ferry operation with the length of the berthing structure as 30 m and width as 8.0 m for Virje ferry terminal location near Kadra dam in Phase II development.
- Any passenger ferry with less than 1.8m draught is suitable for navigating in the defined stretch, as targeted depth of River Kali (NW-52) is 2 m. The sample vessel specification proposed for tourist mobility considered at the initial stage is as follows.

(For Mono Hull Steel Boat)

- Size (L x B x D) – 13m x 2m x 0.8m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Outboard Engines of 150hp (approx.)
- Speed - 12 Knots (max.)

(For FRP Boat)

- Size (L x B x D) – 13m x 2m x 0.8m
- Capacity – 30 Passengers (seating capacity)
- Engine - 1 Marine Outboard Engines of 150hp (approx.)
- Speed - 12 Knots (max.)

The project has been proposed to be phased for its development. There shall be two phases while the year of 2022 shall be proposed as the commencement year and the project implementation period shall be 02 years, ending in December 2023 of Phase I of the project. In phase I of the project the ferry operation shall be developed from Sadasivgad to Katne, which is 10 kms apart catering to tourism development with a nominal cost of 9.54 Crores (2.10 Crores for fairway development and 7.44 Crores for terminal development).

- Phase II shall be cnsidered for two years which is 2030 & 2031 and this is the period for extending the ferry services from Katne to Virje (downstream of Kadra Dam). Phase II is proposed to be extended from Katne to Virje (downstream of Kadra Dam). The distance from Katne to Virje is 19.55 kms approx is proposed to be developed at an additional investment of (17.356 Crores for fairway development and 6.188 Crores for terminal development).
- The revenue factor, however, is to be considered along with the development of Fairway in Kali River and also the passenger ferry terminal Sadasivgad & Katne in Kali River in phase I develioment.

The FIRR and EIRR have been worked out and the details are placed.

Project Modules	FIRR	EIRR
Fairway	---	---
Ferry Terminal	-4.2%	3.3%

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	✓		The project is located at a distance of approximately 1 km from the Anshi National Park.
b) Wildlife/ Bird Sanctuary		✓	
c) Tiger or Elephant Reserve		✓	Anshi National Park has been granted the status of a Tiger Reserve in January 2007.
d) Biosphere Reserve		✓	
e) Reserved / Protected Forest	✓		The land identified for terminal location is mostly forest land.
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	✓		Anshi National Park is located close to the project.
k) World Heritage Sites		✓	
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?	✓		EIA Notification 2006 CRZ Notification 2011 Water Act, 1974 Air Act 1981 Wildlife Protection Act, 1972
5. Is the project involved clearance of	✓		Only for construction of terminal buildings

Screening Question	Yes	No	Details / Remarks
existing land, vegetation and 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 stretch of the project up to Kadri Dam falls under CRZ – I.
9. Is the project involved any demolition of existing structure?		✓	
10. Is the project activity require acquisition of private land?	✓		Part of the land identified for terminal construction is private land.
11. Is the proposed project activity result in loss of direct livelihood / employment?		✓	
12. Is the proposed project activity affect schedule tribe/ caste communities?		✓	

Sl. No	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	Yes
5.	Wildlife Clearance is required	Yes
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	No

15.2. Traffic Template

15.2.1. Catchment Baseline

- Local economic geography – Originates near Diggi, a small village in Uttara Kannada district and flows through Supa, Yellari and Karwartalukas before merging with the Arabian sea.

- Catchment area – Karwar, Ankola, Suppa & Yellapur talukas of Uttara Kannada and Sanguem, Canacona & Quepemtalukas of South Goa
- Population – As per census 2011, total population residing in Karwar-155,143, Supa-52,013, Yellapur-78,091 and Ankola-107,428 in Uttar Kannada & Quepem – 81,193, Sanguem-65,147, Canacona-45,172 talukas of South Goa.
- Economic activities – Big portion of hinterland is covered under forest area. Uttar Kannada district is rich in forest wealth & South Goa in Minerals. Fishing, Agriculture & Sand Mining are the major income generating sources.
- Industrial Cluster - Advance Petropole Processes & Aditya Birla Chemicals are the two industries in hinterland. Rest all are located more than 25kms away from river.
- Connectivity
  - ✓ Major roads – SH 34 & SH 6 passes parallel to Kali River. NH 66 (Panvel-Kochi Highway) crosses the mouth of river at Karwar.
  - ✓ Major railway – Konkan railway line runs across the river at Kanasgiri.
- Specific Developments
  - ✓ Not available
- Catchment area Map

15.2.2. Navigation Baseline

✓ Existing Waterway Usage

At present no terminal exists on Kali River. Local people are using small wooden boats to cross the river on daily basis. Apart from passenger movement, no other activities are happening on the river. Fishing is done, but on very small scale and consumed locally.

15.2.3. Market Baseline

- Potential Market

✓

Commodity	Source	Reasoning
Molasses & Sugar	From Sugar Factory at Haliyal to Karwar Port	Produced in Haliyal & distributed in North & South Karnataka & Goa. 1.25 to 2.75 lakh tonnes moved by factory to Port by trucks. Volume is too low to justify the IWT development. Also, commercially not viable as multimodal route is far costlier than existing mode.
Other Liquid	Imported by Karwar Port	Volume is too low to justify the IWT development. Also, commercially not viable as multimodal route is far costlier than existing mode.
POL	Imported by Karwar Port & moved towards eastwards	Moved by Pipeline, diversion would not be viable.
Chemicals	Chemical Plants located near Karwar Port	Plants are located on mouth of river, Port is nearer than river.
Minerals	Extracted from mines	Either located on coastal region or far away from river, Extraction is too less to count on traffic for Kali River
Food Grains	Produced in talukas of Uttar Kannada	Less production and locally consumed
Fisheries	Caught in Kali Catchment Area	99% is coastal fishing & only 1% is inland fishing. Locally consumed

Commodity	Source	Reasoning
Fertilizers & Chemicals	Allotment in catchment area used in agricultural production	Very low volume to consider. No industries exists in catchment area
Passengers	Population	Local People using country boats, volume is too low to justify the IWT development
Tourism	Tourist Spots	Tourism likely to grow in future. Development of IWT would attract more tourist footfalls in the region.

15.2.4. Forecasting Years

Sl No.	Name of Cargo	Type of Cargo	Origin	Original Terminal on NW	Final Destination	Destination Terminal on NW	Co-ordinates	Unit p.a	Fy-20	Fy-25	Fy-30	Fy-35	Fy-40
Proposed Terminal Opportunity for IWAI													
1	Tourist	-	Sadasivgad – Katne – Virje near Kadra Dam				-	In numbers	15,000	24,712	40,711	71,747	126,443

15.2.5. Market Success Factors

There are several tourist places located in the catchment area of Kali river, as discussed in section 4.6 of Chapter 4. Karnataka Tourism Policy 2015-20 have identified 319 tourism destinations in Karnataka. Karwar 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 Kali 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.

15.2.6. Forecasting Methodology

No industry exists in primary catchment of Kali River. Users of Karwar Port are few sugar industries located in North Karnataka. Regular trucks movement has been seen between industries & Karwar port. These trucks moving on SH6 & SH34, which are passing parallel to Kali River creates congestion and delay issues. Diverting traffic to Kali river movement may be a solution for this hindrance. Shifting of this traffic to waterways using Ro-Ro service was evaluated and discarded based on Logistics Cost Analysis and lower volume. IWAI does not have provision for providing direct subsidy on recurring basis to make Ro-Ro service cheaper compared to existing mode of transportation. Hence, it was discarded.

Tourists arriving from other districts or states are the main focus for IWT attraction. 2020 is the considered as the base year and projection is done for next 20 years i.e till 2040. Base year tourist traffic is assumed based on the study carried out by Directorate of Ports and IWT, Government of Karnataka and projections made by them. As per the study, terminal could be developed at 3 locations i.e Kodibaug, Kante and Virje near Kadra Dam. It is assumed that these are the idle locations for handling tourist traffic on River Kali.

Tertiary sector (inclusive of Tourism) of Karnataka state contributes around 66% to the total states economy. This sector has shown 10.5% CAGR in last 5 years i.e FY16 to FY21. It is assumed that the proposed IWT would grow in line with the tertiary sector of the state. Therefore, for first 10 years 10.5% growth rate is considered. Thereafter 12% growth rate is assumed once phase 2 gets operational. The extended ferry service till Kadra Dam in Phase 2 will attract more tourists traffic due to the Dam and beautiful parks and caves located nearby.

Tourism related passenger mobility has been considered as emerging possibility for its development through creating infrastructure facility involving fairway development as well as creation of passenger terminal facility.

- ✓ As per the study on Development, a total of 20238 tourists have been projected for visiting the tourist spots near Kali River in 2023.
- ✓ It could be estimated that around 1,26,443 tourists shall visit the catchment area in 2040.
- ✓ An expected positive growth trend is visible.

15.3. Project Costing Template

Cost type	**Cost categories**	**Components to be itemized**	
Capital costs	Waterway Infrastructure	☐ Land, compensation and resettlement: No ☐ Capital dredging: 6.05 lakhs cu.m Ordinary soil– 14.82cr ☐ River training/bank protection: 450m for 6 locations -2.545 cr. ☐ Locks: No ☐ Barrages: No ☐ Channel marker : No ☐ Other: Communication system – No	
Terminal Infrastructure		Ferry facility ☐ Fixed infrastructure: berths, moorings, hard-standing etc. (itemized) ☐ Loading/uploading and other equipment (itemized) - None ☐ 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: One vessel of 40 Pax carrying capacity.	☐ Crew ☐ Fuel ☐ Maintenance ☐ Registration & insurance	Considered as per standard

Cost type	Cost categories	Components to be itemized
		□ Fees and charges □ Vessel capital amortization (or leasing cost equivalent) □ Total costs □ (Cost/Pax for use in evaluation)
Recurrent costs		Periodic major capital costs that may occur over life of assets: Considered as per standard
Price levels		All costs to be expressed at 2021 price levels. Costs derived from other years to be indexed to 2021price 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) fairway – INR 19.46 crore (b) Terminal - INR 32.12 crore □ **O & M costs:** (a) Terminal - INR 0.669 crore Savings in transport resource costs between IWT and rail and/or road transport **Saving on Fuel:** (a) Terminal - INR 2.3 crore **Saving on Vehicle Operating Cost (FY40):** (a) Terminal - INR 0.66 crore □ **Savings in road/rail accident costs (FY40):** (a) Terminal - INR 0.03 crore □ **Saving in carbon emissions (FY40):** (a) Terminal - INR 0.10 crore

Standard values	To ensure consistency between evaluations of different waterways the following has been used: Vehicle operating Cost Road : INR 1.0 Person-km IWT: INR 2.5 Person-km Road accident Loss: INR 7.6 Lakhs/km IWT accident Loss: INR 0.15 Lakhs/km
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	River Kali is proposed to develop in 2 phases - Phase 1 : FY22 – FY23 (Development – 2 Terminals and 10km Fairway) and FY23 – FY29 (Operational) Phase 2 : FY30 – FY31 (Development of additional 1 terminal and extended 19.5 km fairway) and FY31 – FY40 (Operational all 3 terminals and entire 29.5km fairway)
EIRR	Development of Kali as an alternate mode for transportation for tourism 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 Kali is also likely to generate overall benefits to the project. Economic IRR of Terminal during FY22-FY40 comes at 3.3%.
Checking and Replicability	Systematic checks of spreadsheets and logic trail have been done keeping in mind the input data, assumptions and calculations.

15.5. 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 Kali 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 consisting of the two sub-sectors: (a) navigation infrastructure; (b) terminal operations **Returns for Fairway are:** Total Revenue: INR 0.00cr. in FY40 Project Capital Cost (with escalation): INR 19.46 cr. **Returns for Terminal are:** Total Revenue: INR 4.68 cr. in FY40 O&M Cost: INR 0.669 cr. in FY40 Tax: 0.52 (@ 30% on EBITDA) EBIDA: INR 2.85 cr.in FY40 Project Capital Cost (with escalation): INR 13.64 cr.

	Net Cash Flow: INR 2.33 cr. In FY40
Disaggregation	**Returns for Fairway are:** Total Revenue: INR 0.00cr. in FY40 Project Capital Cost (with escalation): INR 19.46 cr. **Returns for Terminal are:** Total Revenue: INR 4.68 cr. in FY40 O&M Cost: INR 0.669 cr. in FY40 Tax: 0.52 (@ 30% on EBITDA) EBIDA: INR 2.85 cr.in FY40 Project Capital Cost (with escalation): INR 13.64 cr. Net Cash Flow: INR 2.33 cr. In FY40.
Evaluation period	River Kali is proposed to develop in 2 phases - Phase I : FY22 – FY23 (Development – 2 Terminals and 10km Fairway) and FY23 – FY29 (Operational) Phase II : FY30 – FY31 (Development of additional 1 terminal and extended 19.5 km fairway) and FY31 – FY40 (Operational all 3 terminals and entire 29.5km fairway)
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: Financial rate of returns does not exists for Fairway and comes negative for terminal i.e -4.2%. Factors influencing healthy this dismal financial indicators are: • High Project Cost • Low traffic
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.: Sadasivgad to Kadra Dam would attract only those tourists that are coming from coastal region. People from central region have direct road connectivity to Kadra Dam to access nearby tourist spots. Therefore, good road connectivity restricts the utilization of River stretch. Tourist moving along the river would find no strong reason to divert to waterways, mainly because waterways tend to be more time consuming than road mode.

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 <u>CURRENT VELOCITY AND DISCHARGE MEASUREMENT</u>

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 <u>Minimum Qualification of Key Professionals</u>

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.

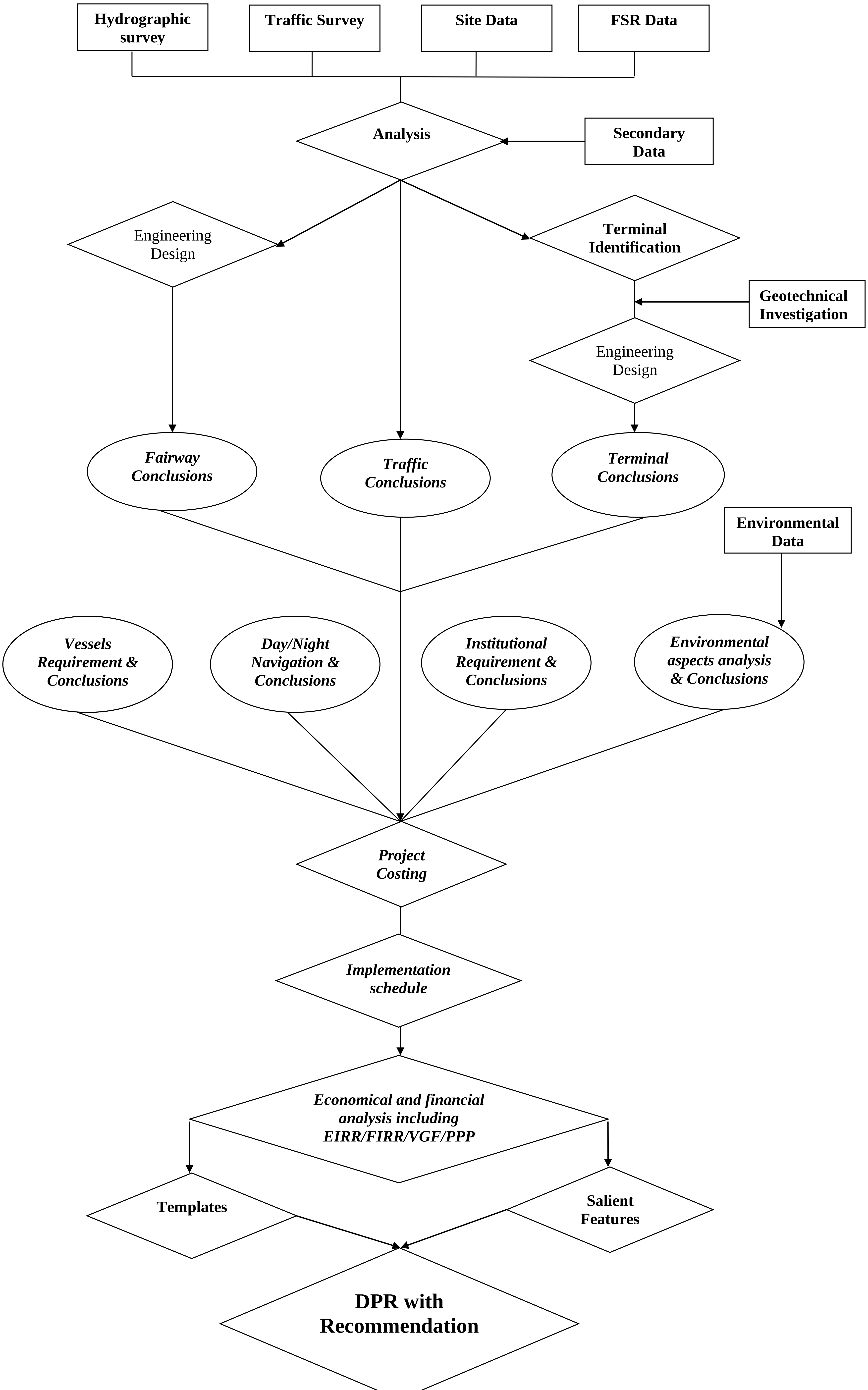
Note 4:- Since two clusters only will be awarded to one bidder, the same CVs cannot be proposed for at least two clusters. The same CV's can be proposed if the bidder is bidding for more than two Clusters.

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.

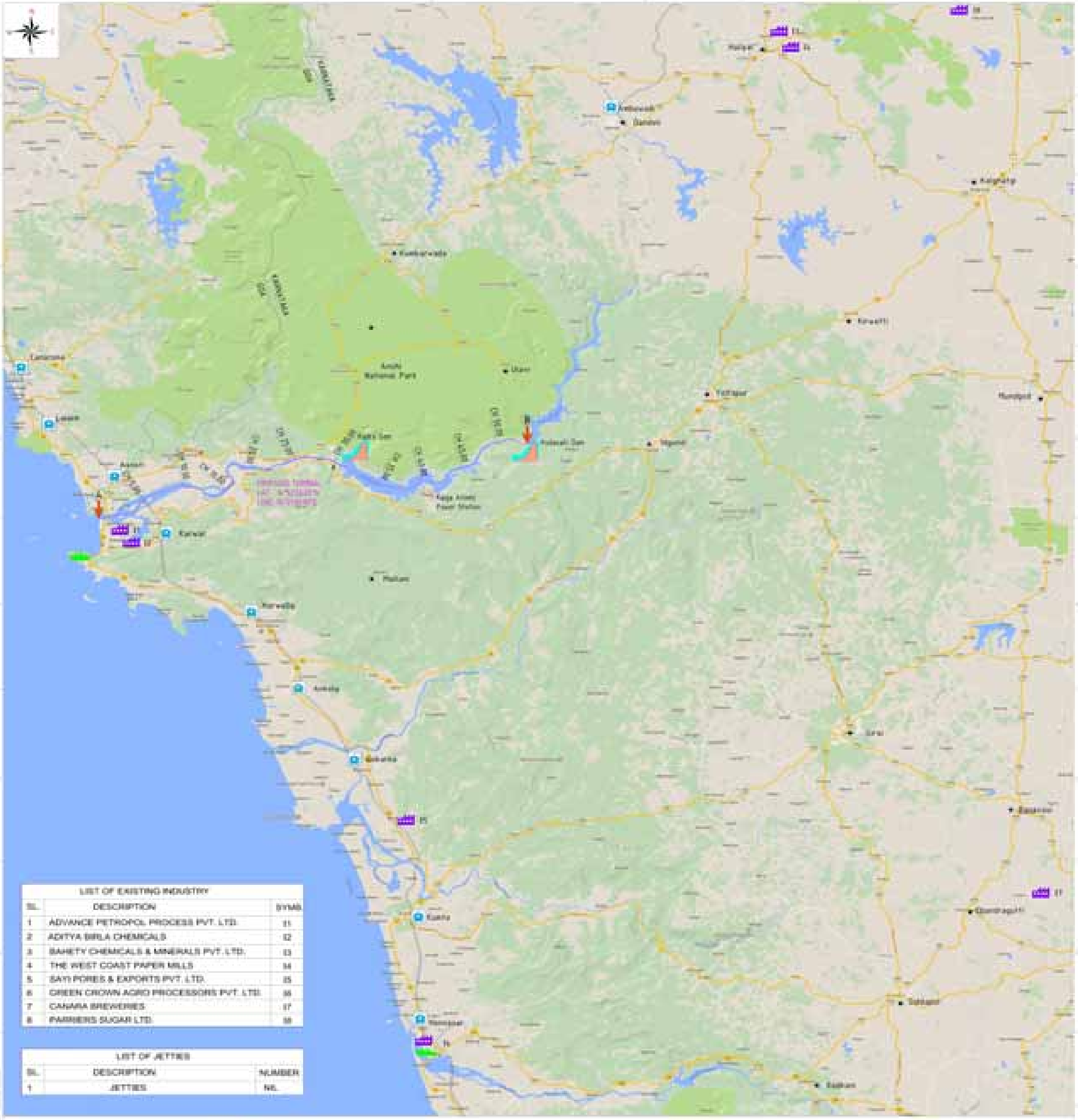
ANNEXURE 1.2 – SEQUENTIAL APPROACH TO THE PROJECT IN SCHEMATIC FORM

ANNEXURE 1.2

SEQUENTIAL APPROACH TO THE PROJECT IN SCHEMATIC FORM



ANNEXURE 4.1 – LAYOUT MAP SHOWING EXISTING JETTIES AND INDUSTRIES IN THE VICINITY OF KALI RIVER



LIST OF EXISTING INDUSTRY

SL.	DESCRIPTION	SYMB.
1	ADVANCE PETROPOL PROCESS PVT. LTD.	I1
2	ADITYA BIRLA CHEMICALS	I2
3	BAHETY CHEMICALS & MINERALS PVT. LTD.	I3
4	THE WEST COAST PAPER MILLS	I4
5	SAYI PORES & EXPORTS PVT. LTD.	I5
6	GREEN CROWN AGRO PROCESSORS PVT. LTD.	I6
7	CANARA BREWERIES	I7
8	PARRIERS SUGAR LTD.	I8

LIST OF JETTIES

SL.	DESCRIPTION	NUMBER
1	JETTIES	NIL

LEGEND

ATOMIC POWER STATION
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

A
START AT CONFLUENCE OF KALI RIVER WITH ARABIAN NEAR SADASHIVGAD BRIDGE
LAT. 14°50'33.5786" N
LONG. 74°07'19.7098" E

B
END POINT AT KODASALLI DAM
LAT. 14°55'09.37" N
LONG. 74°32'02.06" E

TOTAL WATERWAY LENGTH FROM POINT 'A' TO POINT 'B' 53.415Km

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF KALI RIVER NW-52 (KARNATAKA)

INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

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

P.010256

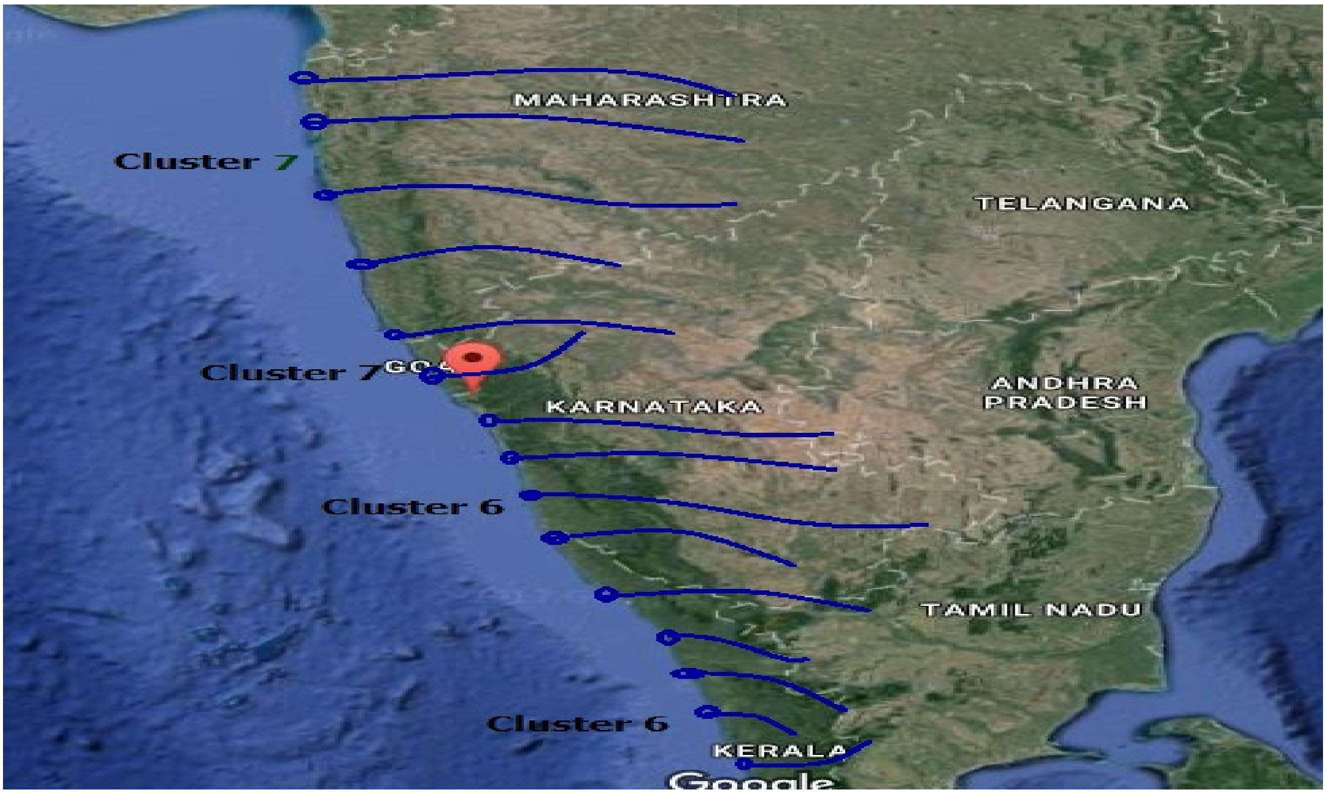
TRACTEBEL

ANNEXURE - 4.1

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

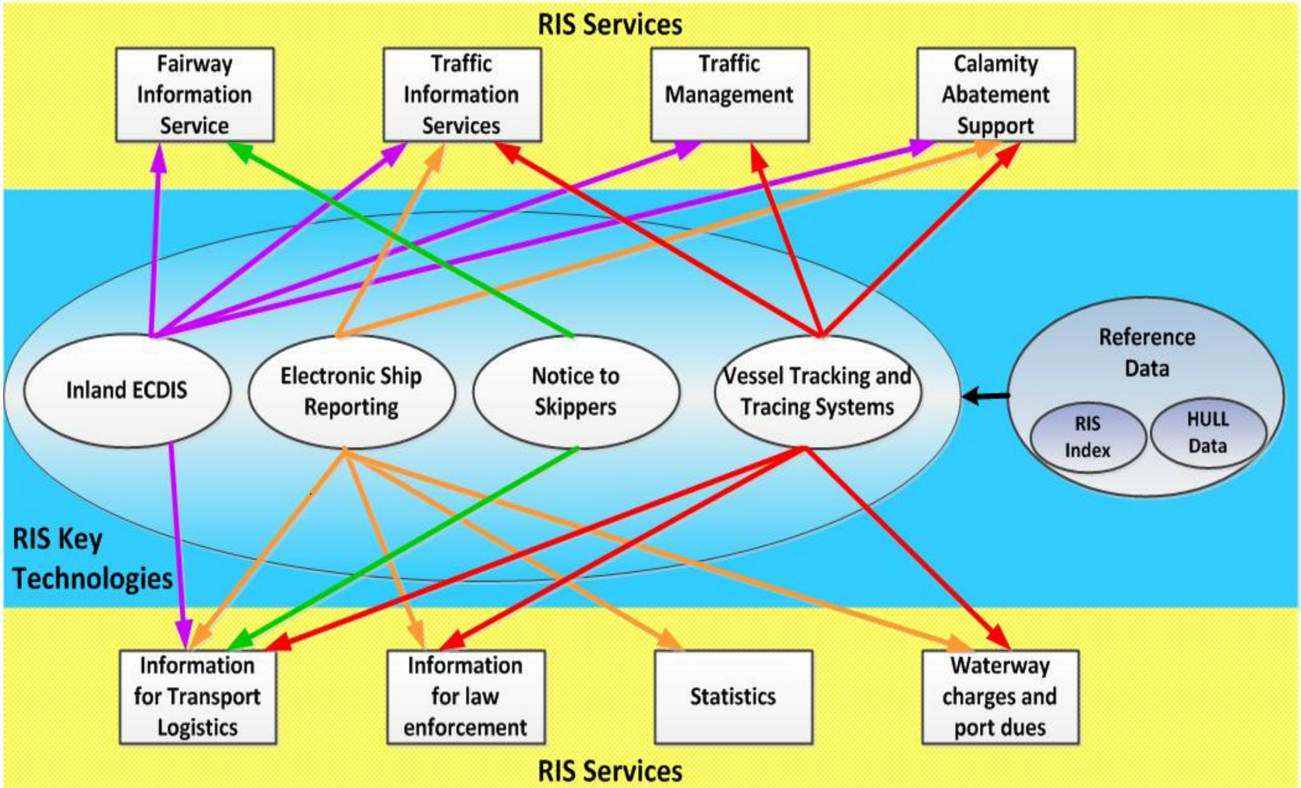
- Electronic Navigational Charts / Inland ECDIS
- Information on nautical conditions (fairway, obstructions, water level, etc.)
- Real time traffic information
- Electronic reporting of cargo and voyage
- Electronic pre-announcement at locks and harbours

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

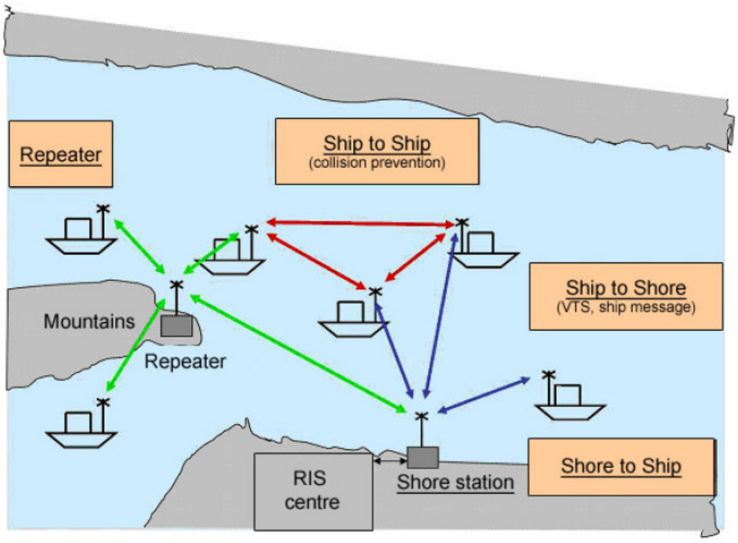


The key technologies of RIS are

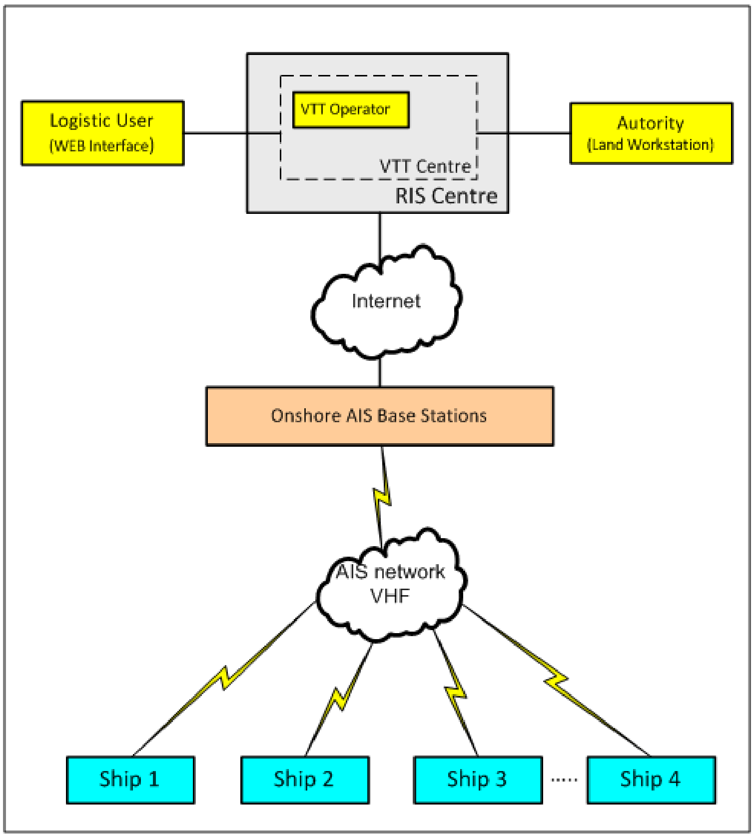
- VTT (Vessels Tracking and Tracing)
- ECDIS (Electronic Charts)
- NtS (Notice To Skippers)
- ERI (Electronic Reporting International)
- HULL Database
- LMS (Lock Management System)

Some technologies needs to be adapted to the local laws and operating procedures.

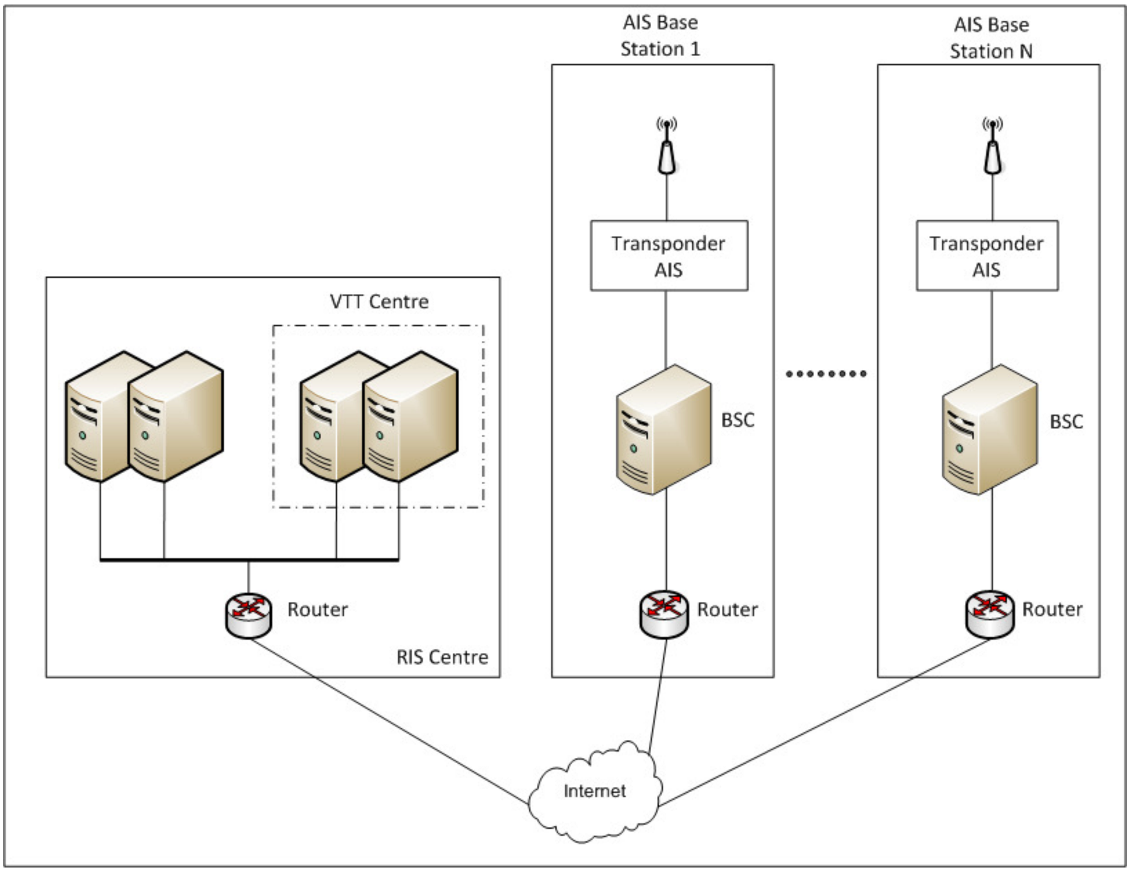
System to get a Strategic and Tactical Traffic Image using AIS technology with INLAND extension



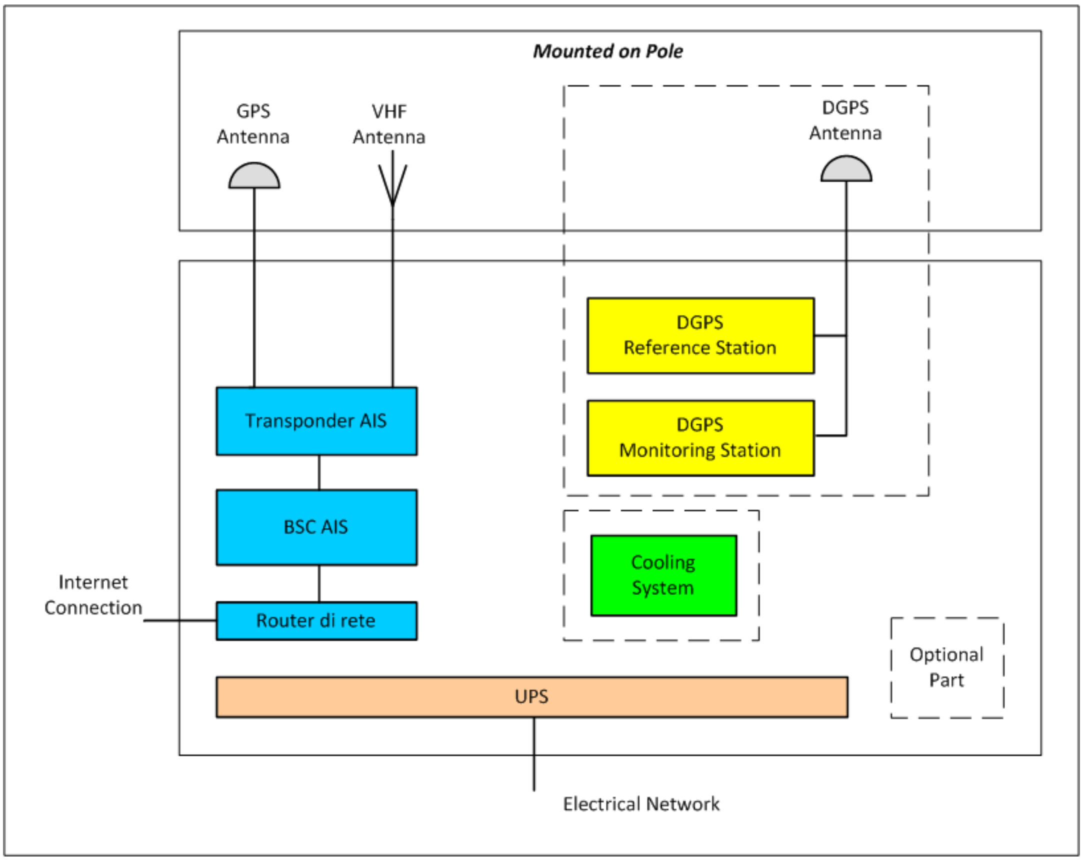
Onboard AIS devices transmit the identity of the vessel, its position and other data at regular intervals. By receiving these transmissions, AIS shore stations or ships fitted with AIS can automatically recognize, identify and track vessels equipped with AIS on a suitable screen, such as an inland ECDIS 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

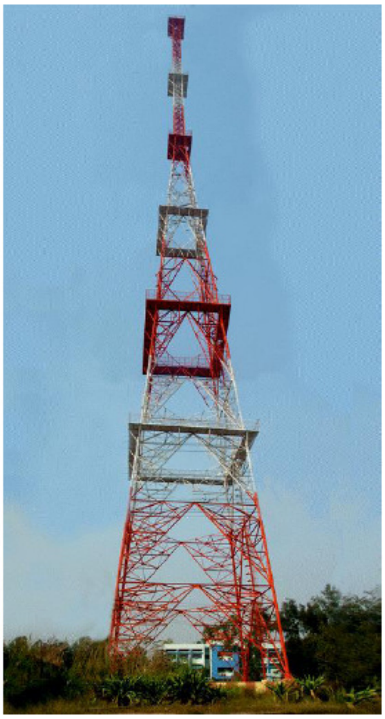


AIS BASE STATION



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

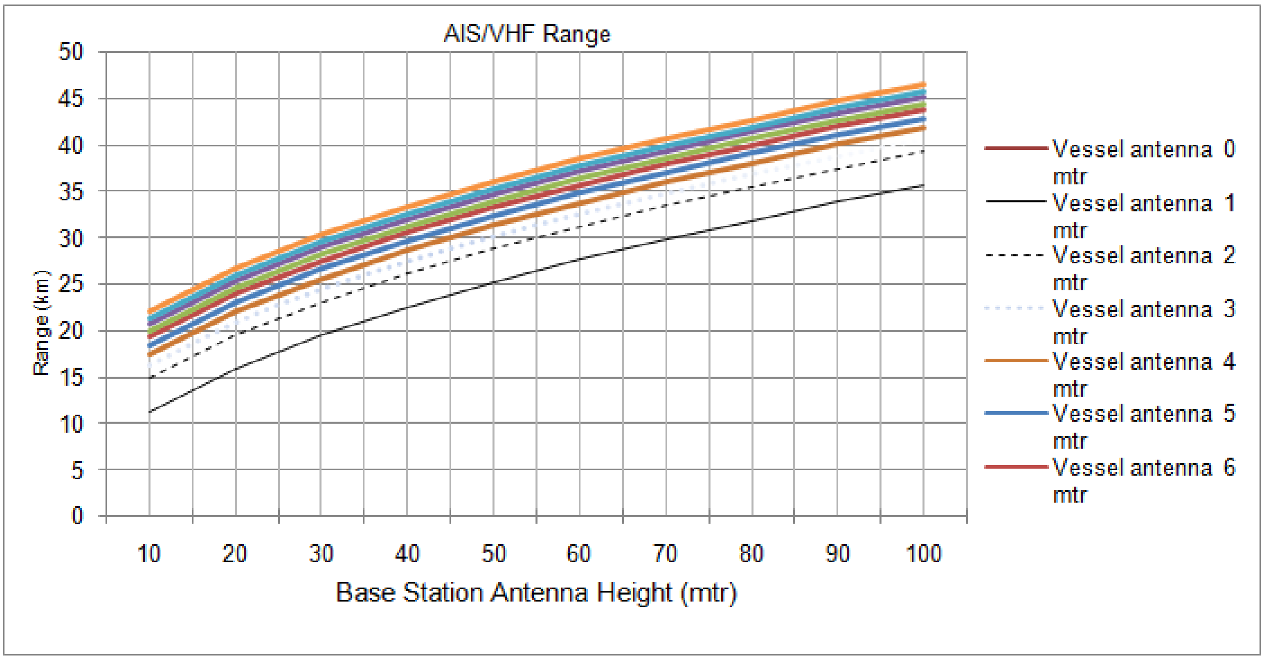


AIS STATION VHF RANGE

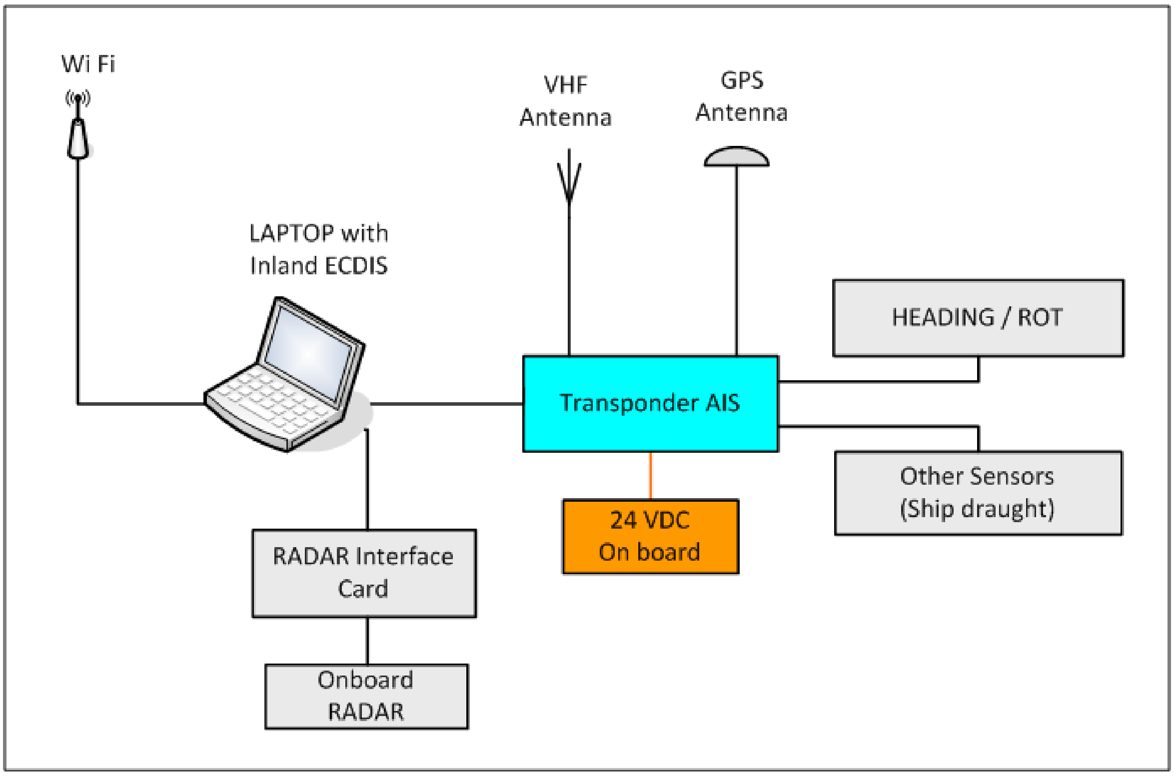
AIS/VHF Range

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

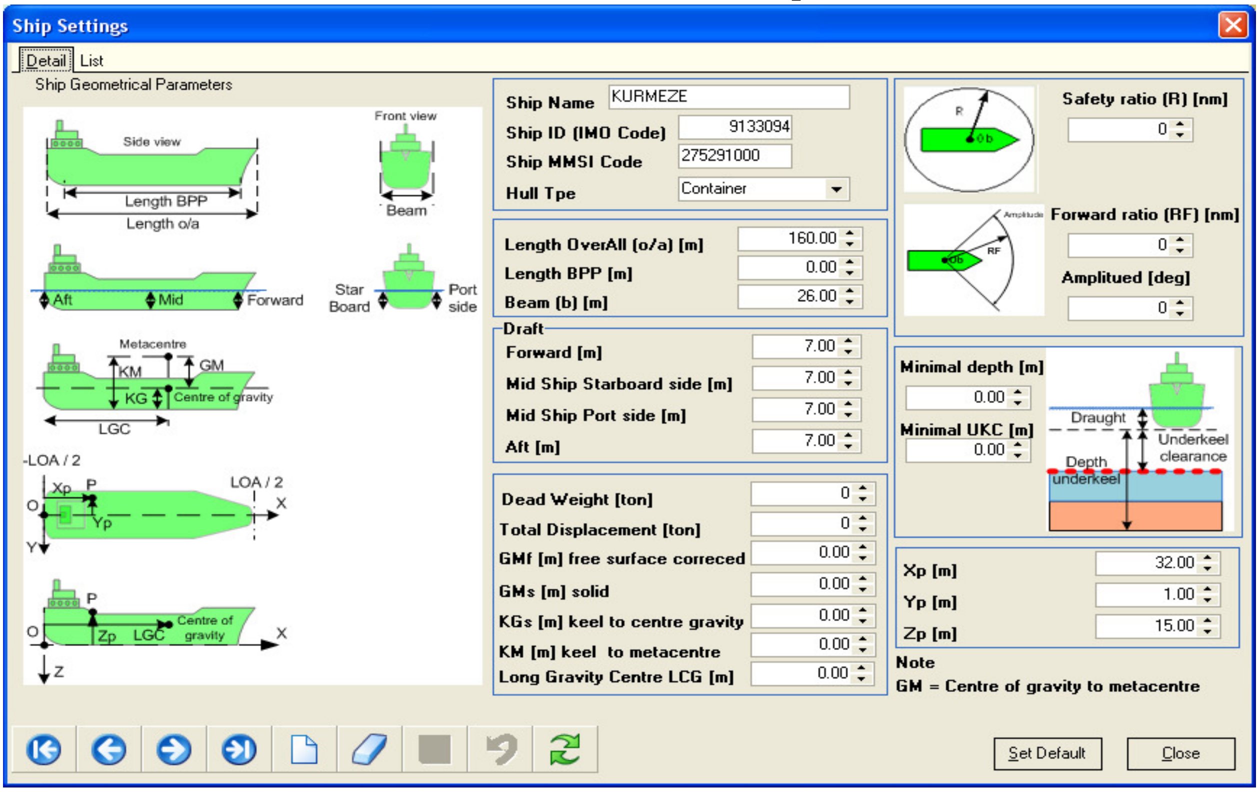


AIS ON BOARD DEVICE



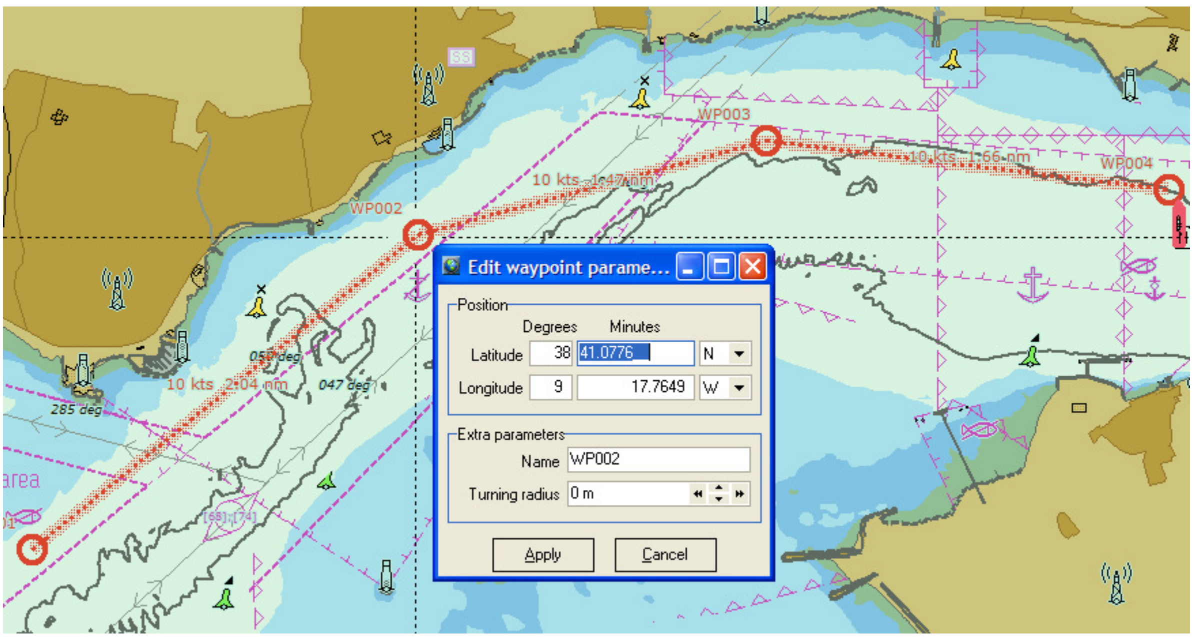
ONBOARD ECDIS INTERFACE

Interface to insert ship data

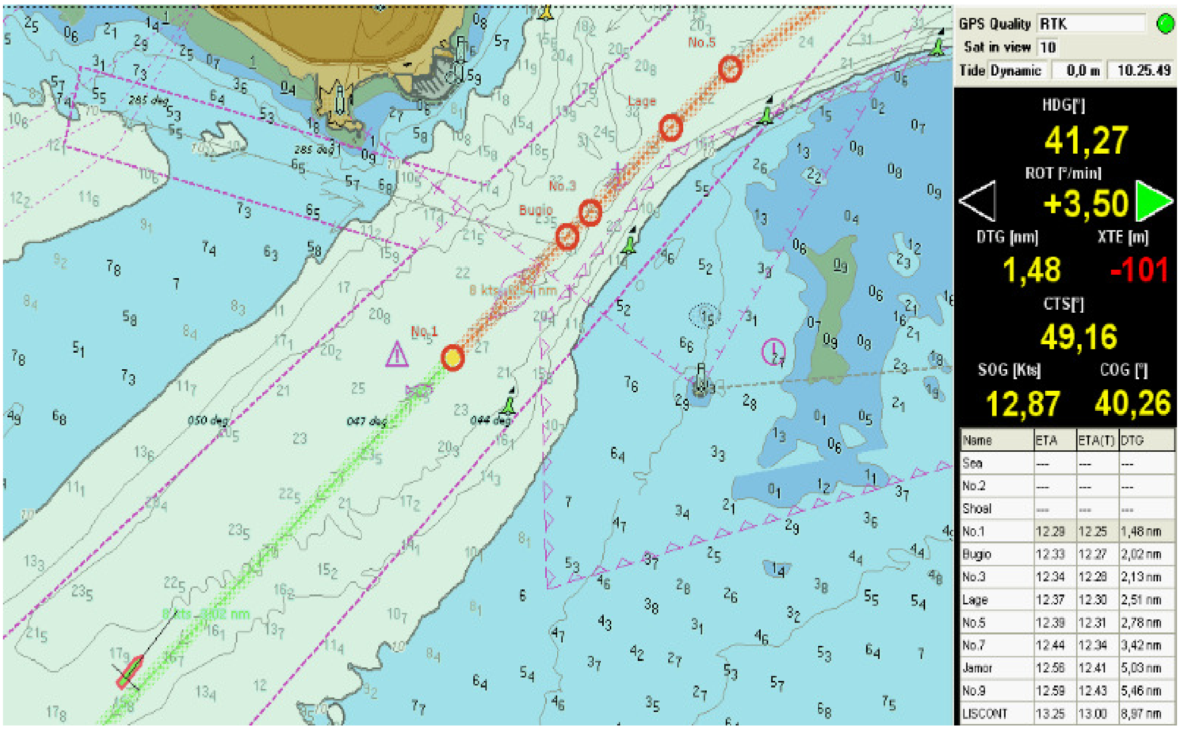


ONBOARD INTERFACE

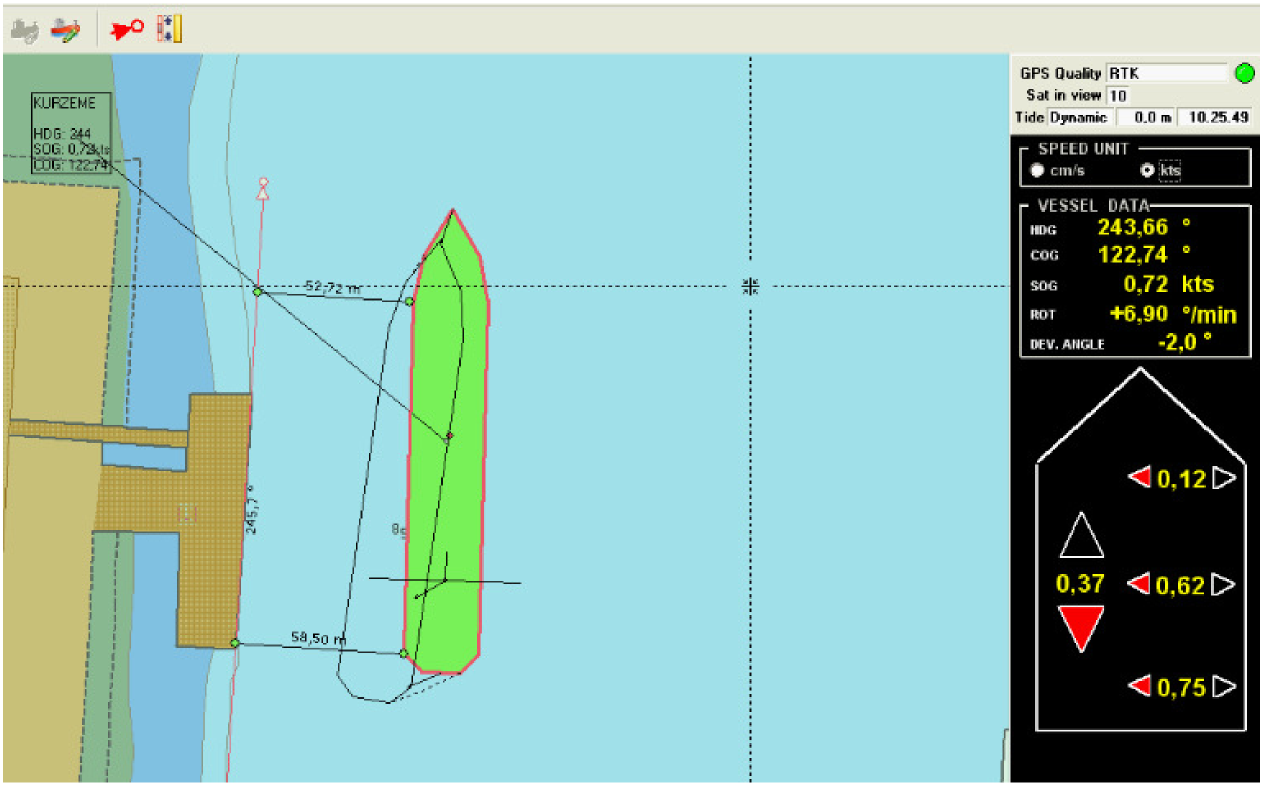
Interface to for voyage planning



Interface in navigation mode

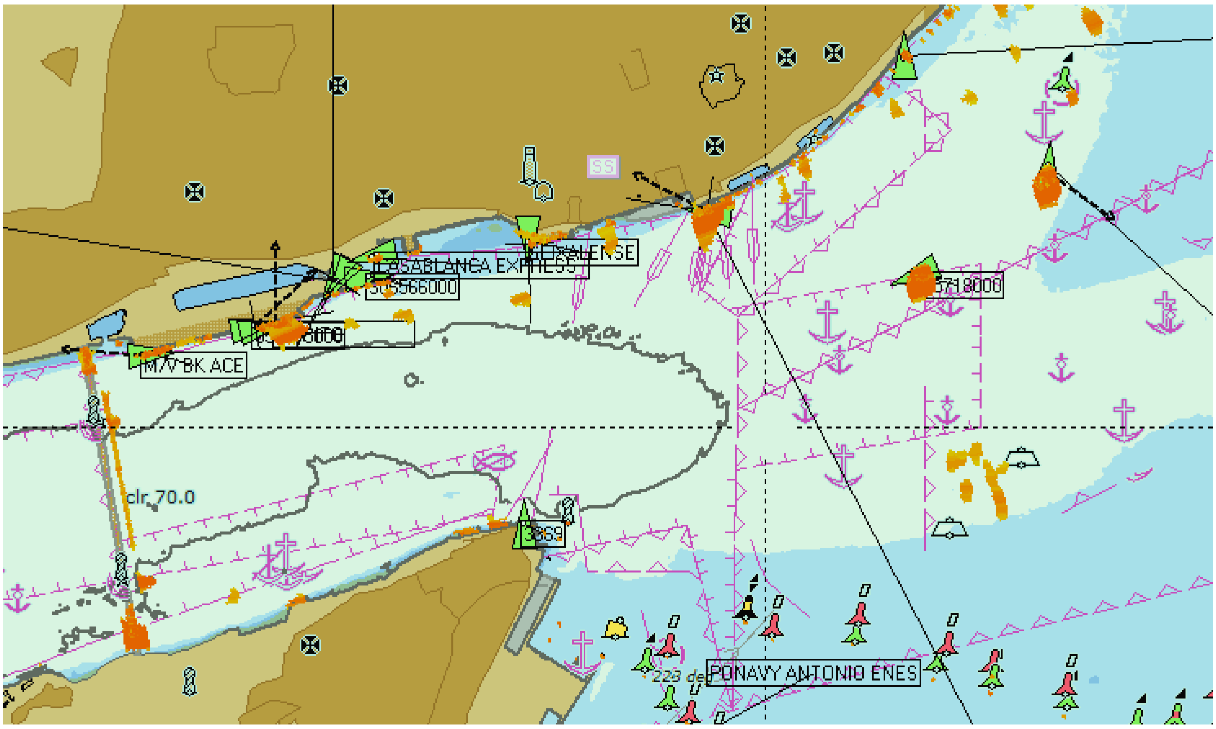


Interface for docking

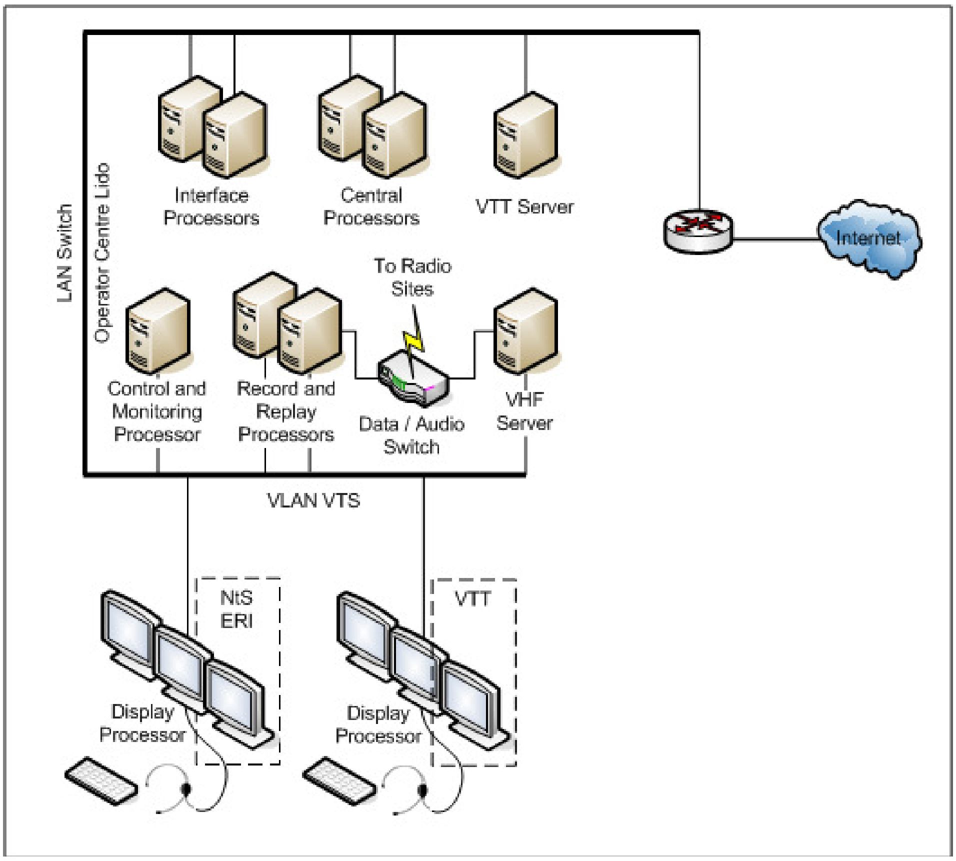


ONBOARD INTERFACE

Tactical Traffic Image + RADAR

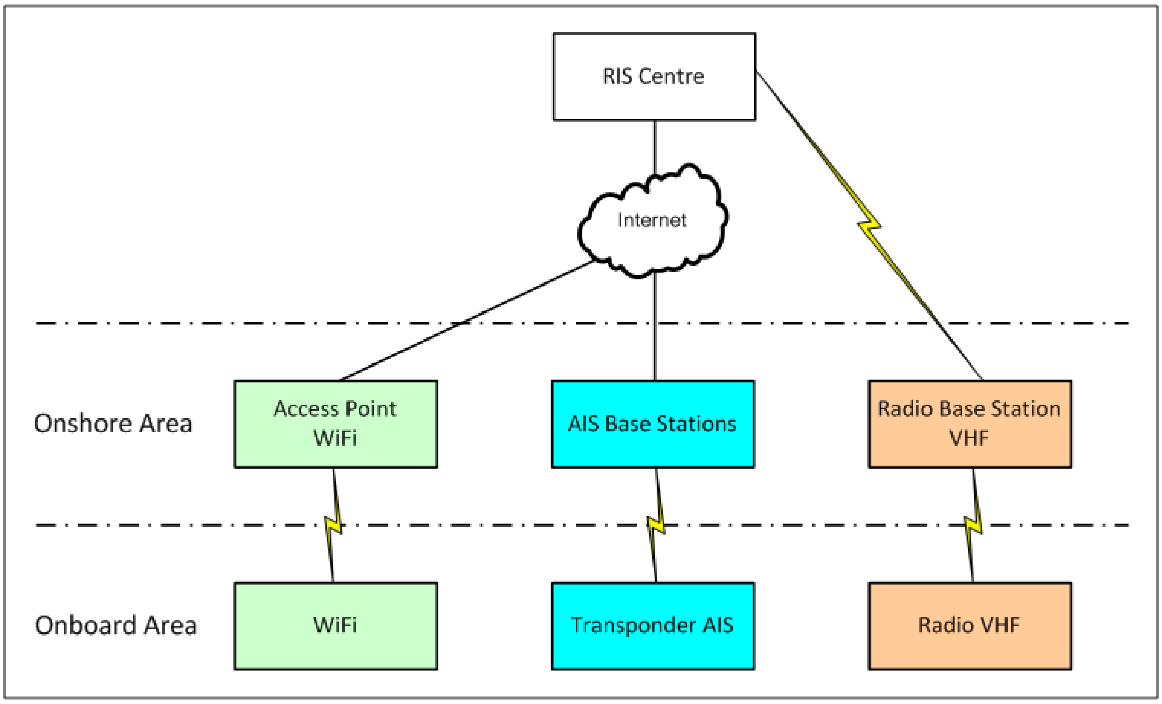


RIS CENTRE



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

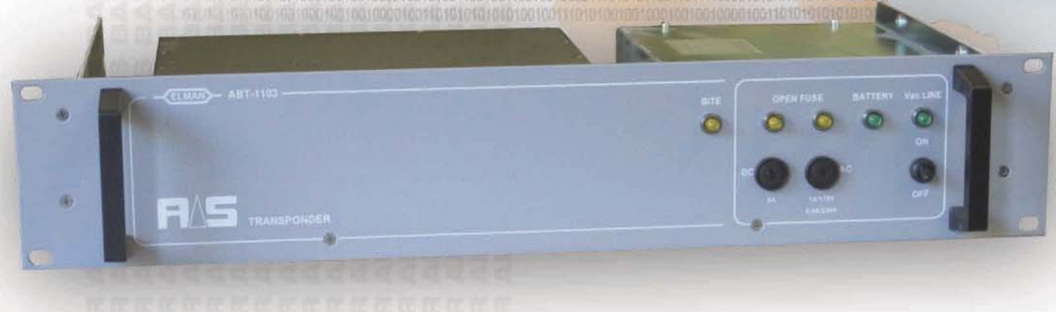
- AIS Base Stations + Controller + radio base VHF (voice)

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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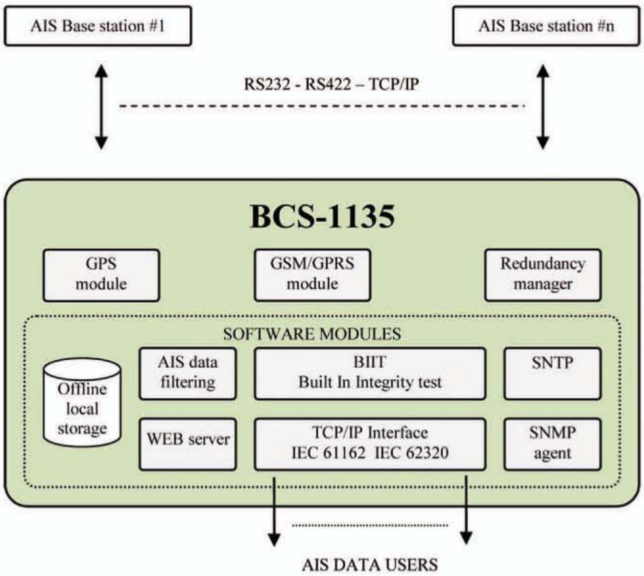
AIS EMBEDDED SERVER
Mod. BCS-1135, BCD-1135

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.

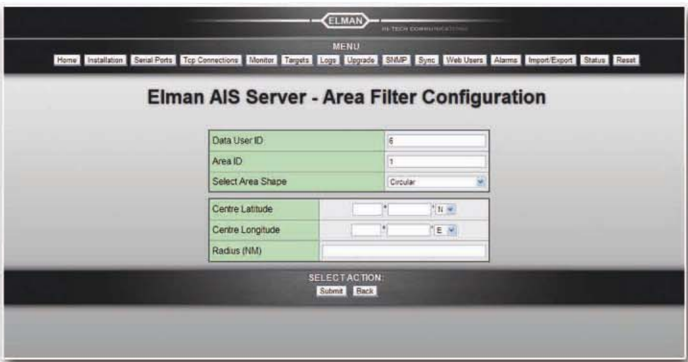


USER INTERFACE

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.

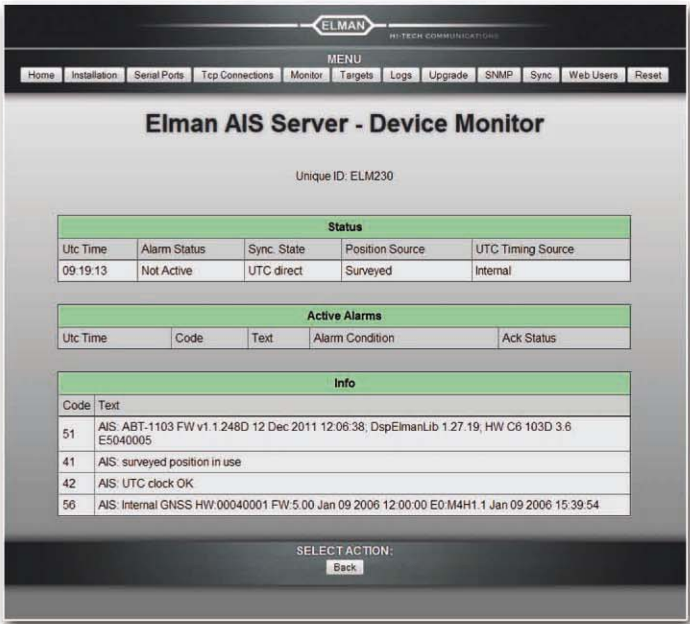
AIS DATA MANAGEMENT

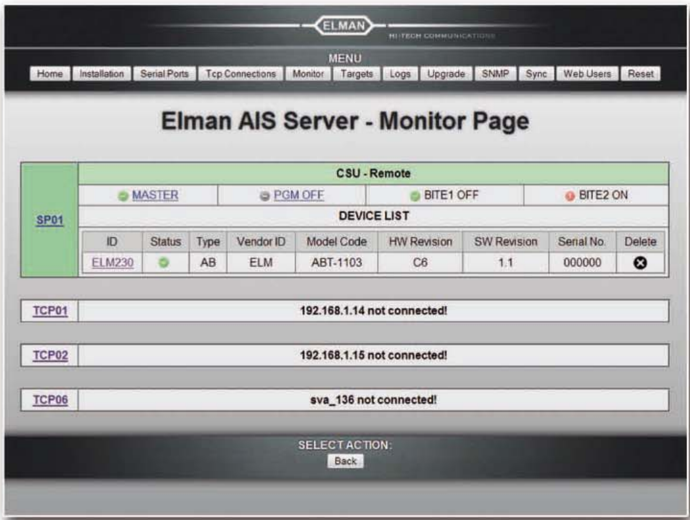
The BCS-1135 can acquire AIS data from the serial ports and from TCP connections according to the specified configuration. In the same way the collected AIS data are made available to serial ports and TCP connections. Moreover, it is possible to configure the data forwarding for each port (serial and/or 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

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ANNEXURE 8.4– COST OF RIS CENTRE, AIR BASE STATION & SURVEY VESSELS

Since the waterway shall cater to tourist activities, hence night navigation is not needed at this stage and this cost has been removed from the cost sheet.

ANNEXURE 10.1– INSTITUTIONAL REQUIREMENT HEAD OFFICE COMPONENTS

Sl No.	Name of the Post	Nos. of the Post	Basic Pay (INR)	Implication per month @ 95 % extra (INR)
1	Director	0	78800	0
2	Asst. Director Civil / Mechanical	0	56100	0
3	Asst. Hy. Surveyor	0	56100	0
4	Junior Hy. Surveyor	1	47600	92,820
5	Junior Accounts Officer	1	47600	92,820
6	Supervisor	0	35400	0
7	Steno / P. A	0	35400	0
8	Upper Divisional Clerk	0	25500	0
9	Data Entry Operator	0	21700	0
10	Driver	0	21700	0
11	Attendant	1	21700	42,315
	Total	**3**		**2,27,955**

ANNEXURE 10.2– INSTITUTIONAL REQUIREMENT IN KARNATAKA

Sl No.	Name of the Item	Capital Cost (INR)	Financial Implication per month (INR)	Remarks
1	Office premises	*	0	*Housed in Terminal Building
2	Furniture etc.,	20,00,000	0	One Time
3	Pay and Allowances for 4 Nos.	--	2,27,955	Refer Table 10.1
5	Computer Systems including UPS etc.,1Nos. @ 1 lakh each	1,00,000	10,000	---
6	Printers 1 Nos. @ 0.25 lakhs each	25,000	10,000	---
7	Alternate Uninterrupted Power Supply with D. G set 1 No @ 10 Lakhs per no.	2,50,000	50000	---
8	Other General Office maintenance including stationery, electricity bill, consumables etc.,	--	1,50,000	---
Total		**23,75,000**	**4,47,955**	

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%

OTHER ASSUMPTIONS

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%

Final IRR Reporting:

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 –ABSTRACT OF COST FOR FAIRWAY DEVELOPMENT OF RIVER KALI (NW 52)

Abstract of Cost for Kali River (NW-52) Fairway Development				
Sl No.	**Item Description**	**Amount (in Lakh Rs.)**	**Schedule**	
A	**Fairway**		**Phase 1**	**Phase 2**
1	Dredging			
(i)	General Soil	1482.24	173.19	1309.05
(ii)	Hard Soil	0.00		0.00
(iii)	Hard Rock	0.00		0.00
2	Low Cost River Structures			
(i)	Bandaling	0.00		0.00
(ii)	Bottom Paneling	0.00		0.00
3	River Training Works			
(i)	Spurs			
(ii)	Bank Protection Works for river	254.57	0.00	254.57
(iii)	Porcupine			
4	Night Navigation			
(i)	Channel Marking Buoy, Mooring Gear & Lighting Equipments	0.00	0.00	0.00
(ii)	Shore Marking with Latiice Bridge & Lighting Equipments	16.00	16.00	0.00
5	Land Acquisition			
	Sub-total (A)	**1752.80**	**189.19**	**1563.61**
B	**Modification of Structures**			
(i)	Bridges	0.00		0.00
(ii)	Cables	0.00		0.00
(iii)	Dams	0.00		0.00
(iv)	Barrages	0.00		0.00
(v)	Locks	0.00		0.00
	Sub-total (B)	**0.00**		0.00
C	**Communication System**			
(i)	RIS Centre	0.00	0.00	0.00
(ii)	AIS Base Station	0.00	0.00	0.00
(iii)	Vessels - Survey vessel & Other Vessel	0.00	0.00	0.00
	Sub-total (C)	**0.00**	**0.00**	**0.00**
	Sub-total (A)+(B)+(C)	**1752.80**	**189.19**	**1563.61**
E	Enviornmental Management Plan Cost@5% of Prime cost as per Ch 9 of the DPR.	87.64	9.46	78.18
F	Project Management & consultancy Charges @3% of Prime cost	52.58	5.68	46.91
G	Contingencies and Unforseen Items of Works @3% of Prime cost	52.58	5.68	46.91
	Project total Hard Cost	**1945.61**	**210.00**	**1735.61**
	Breakup of Fairway Development		**(Phase-I) - FY: 22-23 (In Lakhs)**	**(Phase-II) - FY: 30-31 (In Lakhs)**
	Dredging		173.19	1309.05
	Navigational Aids		16.00	0.00
	Bank Protection Works for river		0.00	254.57
	EIA/EMP/PMC/Contingencies		20.81	172.00
	Total		**210.00**	**1735.616**

ANNEXURE 11.3 –COST OF DREDGING

Cost of Dredging (Kali River NW-52)					
Sl No.	**Item Description**	**Unit**	**Estimated Quantity**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
1	Dredging in General Soil	Cum	604997	245	1482.24
2	Dredging in Hard Soil	Cum	0	963	0.00
3	Dredging/ Excavation of Hard Rock without Blasting Excavation in hard rock of all toughness including boulders above 0.6 m diameter (0.113 cum) for pipe line trenches / foundation of anchor blocks / saddles and other similar structures by approved controlled blasting methods including control of vibration by use of delay detonators and control of fly-rock by muffling arrangements and adopting only jack hammers for drilling holes and adopting any one or combination of line drilling / pre-splitting / smooth blasting techniques to minimise damage to rock beyond excavation line and placing the excavated rock neatly as directed including cost of all materials, materials, machinery, labour, barricading the area, providing danger lights and other safety measures etc., complete with lead upto 1 km and all lifts.	Cum	0	839	0.00
	Total Cost of Dredging				**1482.24**

ANNEXURE 11.4 –COST OF BANK PROTECTION WORKS

Cost of Bank Protection Works at River (Kali River NW-52)					
Sl No.	**Item Description**	**Unit**	**Estimated Quantity**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	7035	3759.57	264.49
2	Providing and laying geotextile as per technical specifications	Sqm	11380	135.42	15.41
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	558.89	0.12
4	Boundary wall 250 mm thk brick masonary (1:6)	Cum	100	2830.50	2.83
	Cost of Bank Protection Works for 500 m				282.85
	Cost of Bank Protection Works for 1 m				0.57
	Cost of Bank Protection Works for 75.0m at each location i.e. 450 m for 6 locations				**254.57**

ANNEXURE 11.5 –COST OF NIGHT NAVIGATION WORKS

Sl No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
	Cost of Night Navigation Works (Beacon & Lights) (Kali River NW-52)- (Phase I)				
1	Land Area Cost	Sq.m	32	1,243	0.40
2	Lattice bridge structure	No.	1	9,51,500	9.52
3	Lattice bridge structure Foundation)				
3-a	RCC (Cement) 3.5 m x 3.5 m x 2.5 m	Cu. M	15	8,744	1.34
3-b	RCC (Steel) @ 3.3 Kg / Cu. M	Kg	51	8,635	4.36
4	Lighting equipment	No.	1	39,050	0.39
	Cost of of Night Navigation Aid				16.00

Cost of Night Navigation Works (Buoy & Lights) (Phase II)

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.	0	3,73,238	0.00
	Cost of of Night Navigation Works including GST				**0.00**
	Since the waterway shall cater to tourist activities, hence night navigation is not needed at this stage and this cost has been removed from the cost sheet.				

ANNEXURE 11.6 – WHOLESALE PRICE INDEX

			Computation for Applicable WPI (Jan-2019 to June-2021)									
Year -2019												
WPI Index Value												
Month/ Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Avg**
2019	**119.2**	**119.5**	**119.9**	**121.1**	**121.6**	**121.5**	**121.3**	**121.5**	**121.3**	**122.0**	**122.3**	**123**	**121.2**
WPI in Jan - 2019			119.2										
WPI in Dec - 2019			123										
Increase			+ve				Multiplying Factor			(1 + 3.19/100) =		1.032	
% Increase - 2019 = (123-119.2)/119.2					**3.190**	%							

Year -2020													
WPI Index Value													
Month/ Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Avg**
2020	**123.4**	**122.2**	**120.4**	**119.2**	**117.5**	**119.3**	**121**	**122**	**122.9**	**123.6**	**125.1**	**125.4**	**121.8**
WPI in Jan - 2020			123.4										
WPI in Dec - 2020			125.4										
Increase			+ve				Multiplying Factor =			(1 1.62/100) =		1.016	
% Increase - 2020 = (125.4-123.4)/123.4					**1.620**	%							

Year -2021													
WPI Index Value													
Month/ Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**							
2021	**126.5**	128.1	129.9	132	132.7	**133.7**							
WPI in Jan - 2021			126.5										
WPI in June - 2021			133.7										
Increase			+ve				Multiplying Factor =			(1 5.69/100) =		1.057	
% Increase - 2020 = (133.7-126.5)/126.5					**5.690**	%							
Combined Effect (Jan-2019 to June-2021)							1.0319 X 1.0162 X 1.0569			1.11	%		

ANNEXURE 11.7 – ABSTRACT OF COST FOR KALI (NW-52) PASSENGER TERMINAL FACILITY

Abstract of Cost for Kali (NW-52) Terminal Development - Passenger Ferry Facility

Sl No.	Item Description	Amount (in Lakh Rs.)	Schedule	
A	**Terminals**		**Phase 1**	**Phase 2**
(i)	Land			
	Terminal Location Downstream of Kadra Dam	17.52	0.00	17.52
	Terminal Location at Sadasivgad	17.52	17.52	0.00
	Terminal Location at Katne	17.52	17.52	0.00
	Sub-total (A)	**52.56**	**35.04**	**17.52**
B	Riverine Components			
a	Floating Pontoon with Link Span - Downstream of Kadra Dam	305.89	0.00	305.89
b	Floating Jetty - Sadashivgad	116.32	116.32	0.00
c	Floating Jetty - Katne	116.32	116.32	0.00
(i)	Infrastructure Components/ Terminal Building including internal roads at D/s of Kadra Dam	185.49	0.00	185.49
(ii)	Infrastructure Components/ Terminal Building including internal roads at Shadasivgad	185.49	185.49	0.00
(iii)	Infrastructure Components/ Terminal Building including internal roads at Katne	185.49	185.49	0.00
(iv)	Approach Road (External) Cost	0.83	0.83	0.00
(v)	Bank Protection Works for terminal	38.27	7.65	30.62
	Sub-total (B)	**1134.09**	**612.10**	**521.99**
C	**Institutional Requirement**			
(i)	Office Development Cost	23.75	23.75	0.00
	Sub-total (C)	**23.75**	**23.75**	**0.00**
	Sub-total (A)+(B)+(C)	**1210.40**	**670.89**	**539.51**
D	**Vessels**			
(i)	Vessel Size	0.00	0.00	0.00
(ii)	Vessel Capacity	0.00	0.00	0.00
	Sub-total (B)	**0.00**	**0.00**	**0.00**
E	**Equipments for Both Terminals**			0.00
(i)	Ambulance - 1 no.	18	0.00	18.00
(ii)	Dumper Trucks 16 T Capacity - 1 no.	0	0.00	0.00
(iii)	Cranes with 50 T Capacity - 1 no.	0	0.00	0.00
(iv)	Fork lift trucks 20 T Capacity - 1 no.	0	0.00	0.00
	Sub-total (C)	**18.00**	**0.00**	**18.00**
	Sub-total (A)+(B)+(C)+(D)+(E)	**1228.40**	**670.89**	**557.51**
D	Enviornmental Management Plan Cost @ 5% of Prime cost as per Chapter 9 of DPR	61.42	33.54	27.88
E	Project Management & consultancy Charges @3% of Prime cost	36.85	20.13	16.73
F	Contingencies and Unforseen Items of Works @ 3% of Prime cost	36.85	20.13	16.73
	Project total Hard Cost	**1363.53**	**744.69**	**618.84**
	Breakup of Terminal Development		**(Phase-I) - FY: 22-23 (In Lakhs)**	**(Phase-II) - FY: 30-31 (In Lakhs)**
	Land Terminal Building		35.04	17.52
	Flooting Pontoon/ Jetty		232.64	305.89
	Terminal Building & Infrastructure		371.81	185.49
	Bank Protection at Termunal Location		7.65	30.62
	Institutional Requirement		23.75	0.00
	Equipments		0.00	18.00
	EIA/EMP/PMC/Contingencies		73.80	61.33
	Total		**744.69**	**618.84**

ANNEXURE 11.8 –COST OF LAND

Cost of Land (Kali NW-52)					
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	1225.18	1180.55	14.46
(ii)	Land required for Road Extension or construction of external approach road	m^2	0.00	1180.55	0.00
(iii)	Area under Mangrooves clearance	m^2	0.00	1180.55	0.00
3	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 (WPI-11% added)	m^3	2502.92	122.10	3.06
	Total Cost of Land at Virje & its Development at D/s of Kadra Dam				**17.52**
	Total Cost of Land & its Development At Sadasibgad				**17.52**
	Total Cost of Land & its Development at Katne				**17.52**

ANNEXURE 11.9A –COST OF RIVERINE STRUCTURES AT KALI PASSENGER FACILITY AT TERMINAL (SADASIVGAD)

Kali (NW-52) FERRY GHAT FERRY TERMINAL (Sadasivgad)

BOQ - LINKSPAN & PONTOONS

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Total Amount (incl. CESS & GST)
1	**Piling Works**						
1.1	Shifting and setting up of piling plant and equipment using jackup rig, tripods, winch / rile driving rig, rotary drilling rig, bailers, chisellers etc (as per the methodology of work) at each pile location for pontoon piles for providing of 1000mm vertical MS steel liner for boring work and for concreting the piles including fabrication and erection of pile driving plant, staging with various steel plates, girders, angles, channels etc., including cost of steel items, welding charges, strutting and fixing in position at each location, cost of mobilization and demobilization of all equipment, transportation charges of all materials to worksite, all labour charges and tools etc. complete.						
a	Pontoon Piles in River		No	4	12,500	50,000	50,000
b	Bankseat - Land piles		No	2	8,000	16,000	16,000
1.2	Providing, Fabricating and delivering of 8mm thick MS liner with 8 mm thick stiffeners at bottom of liners, as per drawing, for 1000mm dia vertical cast-in-situ RCC pile for each pile in Pontoon guide piles and bankseat piles including cost of supply of steel plates confirming to IS: 2062, Grade E250, cost of all other materials, transportation charges of structural steel plate to Work Site, all labour charges, hire charges, tools, rolling, cutting, welding etc., complete.						
a	Pontoon Piles in River	5.8 Karnataka SOR	MT	12	1,01,400	11,92,679	13,35,801
b	Bankseat - Land piles		MT	6	1,01,400	5,96,340	6,67,900
1.3	Boring / drilling through all types of soil and including soil removal for vertical piles from the existing river bed level/Ground Level to founding level (firm stratum) including cost of winch / Pile driving rig, rotary drilling machine						
a	Pontoon Piles in River	Karnataka SOR-4.35	M	40	21,008	8,40,320	8,40,320
b	Bankseat - Land piles	Karnataka SOR-4.35	M	20	21,008	4,20,160	4,20,160
1.4	Providing and laying design mix concrete of RCC M40 grade in accordance with IS 456 (Latest Edition) using coarse aggregate, sand and 53 grade Ordinary Portland cement confirming to IS 455 for RCC piles by using tremie with hopper arrangements, excluding cost of fabrication, fixing of reinforcement, which will be paid separately but including cost of cement, stone chips, sand, cost of all labour charges, centering and shuttering, mixing, conveying, placing, consolidation, screening and washing of coarse aggregate and sand, transportation charges of all materials to the Work Site, hire charges and running charges of batching plant, vibrator, consumables and all other equipment, cost of tools etc. complete. (The design mix shall be provided by the contractor from the approved laboratory of Govt. of India/ IITs/ NITs/ NABL Accredited Labs).						
a	Pontoon Piles in River	DSR-20.5.6	CUM	44	12,537	5,53,888	5,53,888
b	Bankseat - Land piles	DSR-20.5.6	CUM	138	12,537	17,28,129	17,28,129
c	Bankseat - Pile cap platform	DSR-20.5.6	CUM	24	12,537	3,00,899	3,00,899
1.5	Supply, deliver and transportation of reinforcement steel with a minimum yield strength of 500 N/mm2 and minimum elongation of 16% or equivalent confirming to IS 1786 with corrosion resistant element for Fabrication and fixing of reinforcement cages as per drawing for cast-in-situ piles including cost of fabrication, fixing dowels, shear ties, cutting, bending, tying, lapping and welding in position wherever necessary with black 18 SWG annealed binding wire, all labour charges, transportation charges of all materials to Work Site, cost of binding wires, all other items required for the work and tools etc. complete.						
a	Pontoon Piles in River	Karnataka-WRD-2.13	MT	9	70,225	6,20,489	6,20,489
b	Bankseat - Land piles		MT	21	70,225	14,51,944	14,51,944
2	**PONTOON**						
	Procure, supply , fabricate ,install & commissioning of Pontoon with structural steel work (structural steel Fy 250MPa) welded in built up sections, framed work including cutting, hoisting and fixing in positions and applying priming coat of red-lead paint including drilling holes, supplying, fitting and fixing with bolts and nuts or welding, if necessary as directed	Karnataka 18.2.3					
3	**Gangway**						
a	Procure, supply, install and commission of the Aluminium Gangway as per the length and width shown in drawings including the hinge and roller support accessories.		SQM	28	52,500	14,70,000	14,70,000
							1,16,31,862

ANNEXURE 11.9B –COST OF RIVERINE STRUCTURES AT KALI PASSENGER FACILITY AT TERMINAL (KATNE)

Kali (NW-52) FERRY GHAT FERRY TERMINAL (Katne)

BOQ - LINKSPAN & PONTOONS

Sl no.	Description of work	SOR Ref	Units	Total Qty.	Rate (INR)	Amount	Total Amount (incl. CESS & GST)
1	**Piling Works**						
1.1	Shifting and setting up of piling plant and equipment using jackup rig, tripods, winch / rile driving rig, rotary drilling rig, bailers, chisellers etc (as per the methodology of work) at each pile location for pontoon piles for providing of 1000mm vertical MS steel liner for boring work and for concreting the piles including fabrication and erection of pile driving plant, staging with various steel plates, girders, angles, channels etc., including cost of steel items, welding charges, strutting and fixing in position at each location, cost of mobilization and demobilization of all equipment, transportation charges of all materials to worksite, all labour charges and tools etc. complete.						
a	Pontoon Piles in River		No	4	12,500	50,000	50,000
b	Bankseat - Land piles		No	2	8,000	16,000	16,000
1.2	Providing, Fabricating and delivering of 8mm thick MS liner with 8 mm thick stiffeners at bottom of liners, as per drawing, for 1000mm dia vertical cast-in-situ RCC pile for each pile in Pontoon guide piles and bankseat piles including cost of supply of steel plates confirming to IS: 2062, Grade E250, cost of all other materials, transportation charges of structural steel plate to Work Site, all labour charges, hire charges, tools, rolling, cutting, welding etc., complete.						
a	Pontoon Piles in River	5.8 Karnataka SOR	MT	12	1,01,400	11,92,679	13,35,801
b	Bankseat - Land piles		MT	6	1,01,400	5,96,340	6,67,900
1.3	Boring / drilling through all types of soil and including soil removal for vertical piles from the existing river bed level/Ground Level to founding level (firm stratum) including cost of winch / Pile driving rig, rotary drilling machine						
a	Pontoon Piles in River	Karnataka SOR-4.35	M	40	21,008	8,40,320	8,40,320
b	Bankseat - Land piles	Karnataka SOR-4.35	M	20	21,008	4,20,160	4,20,160
1.4	Providing and laying design mix concrete of RCC M40 grade in accordance with IS 456 (Latest Edition) using coarse aggregate, sand and 53 grade Ordinary Portland cement confirming to IS 455 for RCC piles by using tremie with hopper arrangements, excluding cost of fabrication, fixing of reinforcement, which will be paid separately but including cost of cement, stone chips, sand, cost of all labour charges, centering and shuttering, mixing, conveying, placing, consolidation, screening and washing of coarse aggregate and sand, transportation charges of all materials to the Work Site, hire charges and running charges of batching plant, vibrator, consumables and all other equipment, cost of tools etc. complete. (The design mix shall be provided by the contractor from the approved laboratory of Govt. of India/ IITs/ NITs/ NABL Accredited Labs.)						
a	Pontoon Piles in River	DSR-20.5.6	CUM	44	12,537	5,53,888	5,53,888
b	Bankseat - Land piles	DSR-20.5.6	CUM	138	12,537	17,28,129	17,28,129
c	Bankseat - Pile cap platform	DSR-20.5.6	CUM	24	12,537	3,00,899	3,00,899
1.5	Supply, deliver and transportation of reinforcement steel with a minimum yield strength of 500 N/mm2 and minimum elongation of 16% or equivalent confirming to IS 1786 with corrosion resistant element for Fabrication and fixing of reinforcement cages as per drawing for cast-in-situ piles including cost of fabrication, fixing dowels, shear ties, cutting, bending, tying, lapping and welding in position wherever necessary with black 18 SWG annealed binding wire, all labour charges, transportation charges of all materials to Work Site, cost of binding wires, all other items required for the work and tools etc. complete.						
a	Pontoon Piles in River	Karnataka-WRD-2.13	MT	9	70,225	6,20,489	6,20,489
b	Bankseat - Land piles		MT	21	70,225	14,51,944	14,51,944
c	Bankseat - Pile cap platform		MT	3	70,225	2,44,383	2,44,383
2	**PONTOON**						
	Procure, supply , fabricate ,install & commissioning of Pontoon with structural steel work (structural steel Fy 250MPa) welded in built up sections, framed work including cutting, hoisting and fixing in positions and applying priming coat of red-lead paint including drilling holes, supplying, fitting and fixing with bolts and nuts or welding, if necessary as directed	Karnataka 18.2.3					
	Berthing Pontoon size - 14 m X 4 m	Karnataka 6.12	KG	19,938	97	19,31,949	19,31,949
3	**Gangway**						
a	Procure, supply, install and commission of the Aluminium Gangway as per the length and width shown in drawings including the hinge and roller support accessories.		SQM	28	52,500	14,70,000	14,70,000
							1,16,31,862

ANNEXURE 11.9C –COST OF RIVERINE STRUCTURES AT KALI PASSENGER FACILITY AT TERMINAL (VIRJE)

	Kali (NW-52) FERRY GHAT FERRY TERMINAL (Downstream of Kadra Dam)						
	BOQ - LINKSPAN & PONTOONS						
Sl no.	**Description of work**	**SOR Ref**	**Units**	**Total Qty.**	**Rate (INR)**	**Amount**	**Total Amount (incl. CESS & GST)**
1	**Piling Works**						
1.1	Shifting and setting up of piling plant and equipment using jackup rig, tripods, winch / rile driving rig, rotary drilling rig, bailers, chisellers etc (as per the methodology of work) at each pile location for pontoon piles for providing of 1000mm vertical MS steel liner for boring work and for concreting the piles including fabrication and erection of pile driving plant, staging with various steel plates, girders, angles, channels etc., including cost of steel items, welding charges, strutting and fixing in position at each location, cost of mobilization and demobilization of all equipment, transportation charges of all materials to worksite, all labour charges and tools etc. complete.						
a	Pontoon Piles in River		No	4	12,500	50,000	50,000
b	Bankseat - Land piles		No	2	8,000	16,000	16,000
1.2	Providing, Fabricating and delivering of 8mm thick MS liner with 8 mm thick stiffeners at bottom of liners, as per drawing, for 1000mm dia vertical cast-in-situ RCC pile for each pile in Pontoon guide piles and bankseat piles including cost of supply of steel plates confirming to IS: 2062, Grade E250, cost of all other materials, transportation charges of structural steel plate to Work Site, all labour charges, hire charges, tools, rolling, cutting, welding etc., complete.						
a	Pontoon Piles in River	5.8 Karnataka SOR	MT	12	#######	11,92,679	11,92,679
b	Bankseat - Land piles		MT	6	#######	5,96,340	5,96,340
1.3	Boring / drilling through all types of soil and including soil removal for vertical piles from the existing river bed level/Ground Level to founding level (firm stratum) including cost of winch / Pile driving rig, rotary drilling machine						
a	Pontoon Piles in River	Karnataka SOR-4.35	M	100	21,008	21,00,800	21,00,800
b	Bankseat - Land piles	Karnataka SOR-4.35	M	60	21,008	12,60,480	12,60,480
1.4	Providing and laying design mix concrete of RCC M40 grade in accordance with IS 456 (Latest Edition) using coarse aggregate, sand and 53 grade Ordinary Portland cement confirming to IS 455 for RCC piles by using tremie with hopper arrangements, excluding cost of fabrication, fixing of reinforcement, which will be paid separately but including cost of cement, stone chips, sand, cost of all labour charges, centering and shuttering, mixing, conveying, placing, consolidation, screening and washing of coarse aggregate and sand, transportation charges of all materials to the Work Site, hire charges and running charges of batching plant, vibrator, consumables and all other equipment, cost of tools etc. complete. (The design mix shall be provided by the contractor from the approved laboratory of Govt. of India/ IITs/ NITs/ NABL Accredited Labs).						
a	Pontoon Piles in River	DSR-20.5.6	CUM	94	12,537	11,81,627	11,81,627
b	Bankseat - Land piles	DSR-20.5.6	CUM	47	12,537	5,90,813	5,90,813
c	Bankseat - Pile cap platform	DSR-20.5.6	CUM	36	12,537	4,51,348	4,51,348
1.5	Supply, deliver and transportation of reinforcement steel with a minimum yield strength of 500 N/mm2 and minimum elongation of 16% or equivalent confirming to IS 1786 with corrosion resistant element for Fabrication and fixing of reinforcement cages as per drawing for cast-in-situ piles including cost of fabrication, fixing dowels, shear ties, cutting, bending, tying, lapping and welding in position wherever necessary with black 18 SWG annealed binding wire, all labour charges, transportation charges of all materials to Work Site, cost of binding wires, all other items required for the work and tools etc. complete.						
a	Pontoon Piles in River	Karnataka-WRD-2.13	MT	19	70,225	13,23,710	13,23,710
b	Bankseat - Land piles		MT	7	70,225	4,96,391	4,96,391
c	Bankseat - Pile cap platform		MT	5	70,225	3,79,215	3,79,215
2	**PONTOON**						
	Procure, supply , fabricate ,install & commissioning of Pontoon with structural steel work (structural steel Fy 250MPa) welded in built up sections, framed work including cutting, hoisting and fixing in positions and applying priming coat of red-lead paint including drilling holes, supplying, fitting and fixing with bolts and nuts or welding, if necessary as directed	Karnataka 18.2.3					
	Berthing Pontoon size - 30 m X 8 m	Karnataka 6.12	KG	1,70,893	97	1,65,59,564	1,65,59,564
3	**Gangway**						
a	Procure, supply, install and commission of the Aluminium Gangway as per the length and width shown in drawings including the hinge and roller support accessories.		SQM	68	52,500	35,70,000	35,70,000
4	**Guide Pile - Brackets, Rollers**						
a	Procure, supply, install and commission of the pontoon guide pile steel bracket, rollers and fixtures.		LS	4	80,000	3,20,000	3,20,000
5	**Pontoon Fixtures**						
a	Procure, supply, install and commission of the pontoon fixtures Fenders, Bollards, Life saving Equipment and Handrails		LS	1	#######	5,00,000	5,00,000
							3,05,88,968

ANNEXURE 11.10 –COST OF STRUCTURES AT TERMINAL

Cost of other Structures at Terminals proposed on River Kali (NW-52) for Tourist movement (Sadasivgad / Katne and Virje – Downstream of Kadra Dam)

Sl no.	Facility	Nos.	Size	Area (in m^2)	Rate (in Rs.)	Amount (in Lakh Rs.)
1	Open Mobility Area	1	-	120	8,754	10.50
2	Main Terminal Building/ Administrative department/ Ticket Counter/ waiting Area/ First Aid etc.	1	25m x 20.0m	500	27,157	135.78
3	Security shed for watch and ward	1	4m x 3m	12	9,435	1.13
4	Electrical facility, Transformer etc.	1	4m x 3.5m	14	30,525	4.27
5	Fuel Bunkers	1	6m x 4m	24	6,167	1.48
6	Water Supply Room	1	3m x 4m	12	30,618	3.67
7	Fire and Safety support Room	1	3m x 4m	12	35,243	4.23
8	DGPS receiver & transmitter shed	1	4m x 3m	12	19,225	2.31
9	DG shed	1	5m x 5m	25	14,819	3.70
10	Sewerage Treatment Plant (STP)	1	15m x 15m	50	28,694	14.35
11	Overhead Tank	1	7.5m dia	44	2,135	0.94
12	Green Area	1	-	200	888	1.78
13	Land required for Road Extension external approach road	1	-	100	666	0.67
14	Area under Mangroves clearance	1	-	100	666	0.67
	Total Area			**1225.18**	**Sq-m**	
	Total cost of Other Components inclusive of GST					**185.49**

ANNEXURE 11.11 –COST OF APPROACH (EXTERNAL) ROADS

Cost of Approach Roads to proposed Terminals in River Kali (NW-52)

S.No.	Item Description	Unit	Estimated Quantity	Rate (in Rs.)	Amount (in Lakh Rs.)
A	**Terminal (T)**				
1	External Roads				
(i)	Pucca Road (3.5m wide road)	m	10.00	8325	0.83
	Sub-total 1				**0.83**
	Total Cost of Approach Roads				**0.83**

ANNEXURE 11.12 –COST OF BANK PROTECTION WORKS AT TERMINAL

Cost of Bank Protection Works (NW-52)					
Sl No.	**Item Description**	**Unit**	**Estimated Quantity**	**Rate (in Rs.)**	**Amount (in Lakh Rs.)**
A	**Terminal (T)**				
1	Providing and laying gabion for erosion control, river training works and protection works as per technical specifications	Cum	720	3978.74	28.65
2	Providing and laying geotextile as per technical specifications	Sqm	1075	135.42	1.46
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	11	555	0.06
4	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 Ferry terminal side. as per 5.22 of SOR, Karnataka	m^3	67.50	6825.39	4.61
5	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	459	365.19	1.68
6	Carriage of Material @ 5% of the cost				1.82
	Sub-total 1				**38.27**
	Cost of Bank Protection Works inclusive of GST				**38.27**

ANNEXURE 12.1 –IMPLEMENTATION SCHEDULE - FERRY SERVICES

KALI RIVER

Sl.No.	Items	Initial Phase (12 Months Commencing on immediate basis for observation up to 2020)																																			
		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 -Nil-																																				
	1.b) Dredging																																				
	Hard Soils																																				
	2. Low Cost Riverine Structures (NIL)																																				
	3. River Training Works/ Bank Protection (NIL)																																				
	4. Night Navigation																																				
	Beacon / Lights (Approval & Tendering)																																				
	Beacon / Lights (12 Nos)																																				
	5. Land Acquisition (No land acquisition for fairway)																																				
B	**Modification of Structures (NIL)**																																				
C	**Communication System (NIL)**																																				
D	**Institutional Requirement (Along with CI 6 development)**																																				
	Office / Manpower (Establishment & Recruittment)																																				
	Office / Manpower (Deployment)																																				
	Vessels (Approvals & Tendering)																																				
	Vessels (Procurement & Deployment of 2 SLs; 2 Tugs; 2 IBs)																																				
E	**Environmental Management Plan**																																				
		Subsequent Phase (36 months Commencing 2021 and ending 2023)																																			
A	**Fairway**																																				
	1.a) Dredging																																				
	Ordinary Soils / Hard Soils (Approvals & Tendering)																																				
	Ordinary Soils (10.5 Lakhs Cu. M)																																				
	1.b) Dredging																																				
	Hard Soils (1.5 Lakhs Cu. M)																																				
	2. Low Cost Riverine Structures (NIL)																																				
	3. River Training Works/ Bank Protection (Approval & Tendering)																																				
	River Training Works/ Bank Protection (6 Locations 3000 m)																																				
	4. Night Navigation																																				
	Buoy/ Lights (Approval & Tendering)																																				
	Buoy / Lights (70 Nos)																																				

*** Fairway Development (along with 1 No. Ro-Ro Terminal) is to be taken up after having the confirmation of Traffic Volumes. Implementation will be in 36 months ending 2023. As such recommended for implementation after observations with positive growth.**

ANNEXURE 12.2 –IMPLEMENTATION SCHEDULE - FERRY SERVICES

KALI RIVER

Sl.No.	Items	Subsequent Phase (36 months Commencing 2021 and ending 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	**Ro - Ro Terminal - 1 No. ***																																				
	Land Acuisition																																				
	Riverine Components																																				
	Infrastructure Components internal roads (Approvals & Tendering)																																				
	Infrastructure Components internal roads (Execution)																																				
	Approach Road Cost																																				
	Bank Protection Works for terminal (Approvals & Tendering)																																				
	Bank Protection Works for terminal (Execution)																																				
	Cargo Handling Equipments																																				
	1 No. Ambulance																																				
	2 Nos. Cranes with 125 T Capacity																																				
	2 Nos. Fork lift trucks 20 T Capacity																																				
	Environmental Management Plan																																				
	Vessels																																				
B	**Lo - Lo Terminal**																																				
	Land Acuisition (Should be completed by 2030)																																				
	Riverine Components																																				
	Infrastructure Components internal roads (Approvals & Tendering)																																				
	Infrastructure Components internal roads (Execution)																																				
	Approach Road																																				
	Bank Protection Works for terminal (Approvals & Tendering)																																				
	Bank Protection Works for terminal (Execution)																																				
	Cargo Handling Equipments																																				
	Ambulance - 0 no.																																				
	Cranes with 125 T Capacity - 0 no.																																				
	Fork lift trucks 20 T Capacity - 0 no.																																				
	Environmental Management Plan																																				
	Vessels																																				

*** Ro-Ro Terminal Development (along with Fairway) is to be taken up after having the confirmation of Traffic Volumes. Implementation will be in 36 months ending 2023. As such recommended for implementation after observations with positive growth.**

LIST OF DRAWINGS

Sl.No	DRAWING NAME	DRAWING NUMBER
1.	LAYOUT PLAN OF KALI RIVER (8 SHEETS)	P.010256-W-20301-A04
2.	KALI RIVER LOCATION OF BORE HOLE (1 SHEET)	P.010256-W-20351-X04
3.	TERMINAL LAYOUT PLAN OF KALI RIVER FERRY GHAT - VIRJE (1 SHEET)	P.010256-W-20311-A04
4.	TERMINAL LAYOUT PLAN OF KALI RIVER FERRY GHAT- KATNE (1 SHEET)	P.010256-W-20311-A05
5.	TERMINAL LAYOUT PLAN OF KALI RIVER FERRY GHAT- SADASHIVGAD (1 SHEET)	P.010256-W-20311-A06
6.	KALI RIVER FEERY GHAT DETAILS-VIRJE (5 SHEETS)	P.010256-W-20309-A04
7.	KALI RIVER FEERY GHAT DETAILS-KATNE (5vSHEETS)	P.010256-W-20309-A05
8.	KALI RIVER FEERY GHAT DETAILS-SADASHIVGAD (5 SHEETS)	P.010256-W-20309-A06
9.	KALI RIVER TERMINAL BUILDING DETAILS - VIRJE (2 SHEETS)	P.010256-W-20364-A04
10.	KALI RIVER TERMINAL BUILDING DETAILS -KATNE (2 SHEETS)	P.010256-W-20364-A05
11.	KALI RIVER TERMINAL BUILDING DETAILS -SADASHIVGAD (2 SHEETS)	P.010256-W-20364-A06
12.	BANK PROTECTION TYPICAL SECTION (1 SHEET)	P.010256-W-20303-X04

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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