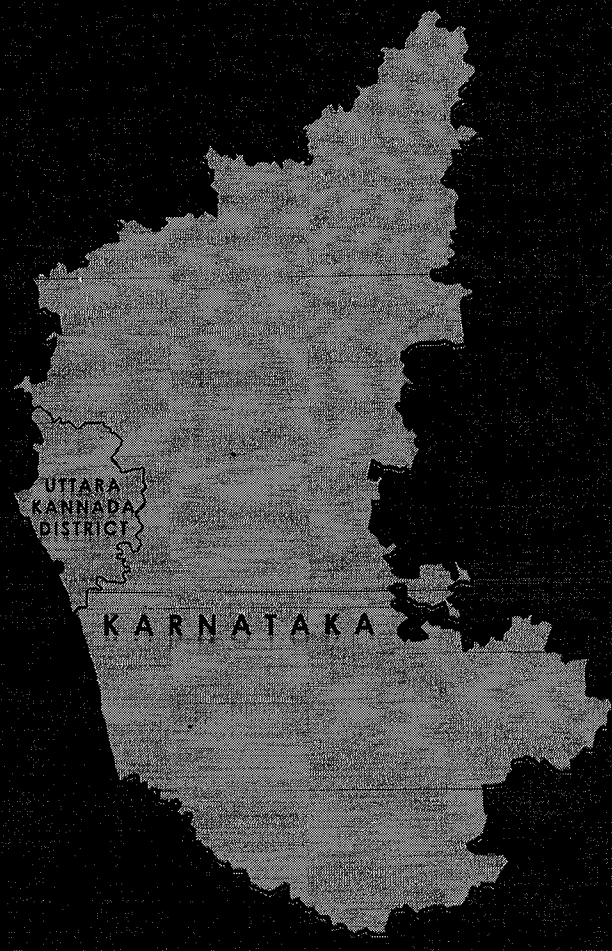
EIA FOR HONNAVAR BARGE/VESSEL LOADING FACILITY

UTTARA KANNADA DISTRICT
KARNATAKA



FINAL EIA REPORT

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Client: **Honnavar Port Private Limited**

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Appendix H: Primary Water Quality Standards
Appendix I: Implementation schedule
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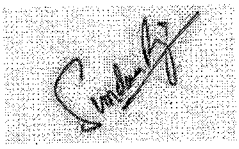
Declaration by Experts contributing to the EIA for Honnavar Barge/Vessel Loading Facility

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

EIA Coordinator:

Name: C.V. Sundara Rajan

Signature & Date:  27.02.2012

Period of involvement: August 2011 – February 2012

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Functional Area Experts:

S. No.	Functional Areas	Name of the expert/s	Involvement (Period & Task**)	Signature & Date
1.	AP	Susruta Amirapu	Provided the required input for specific functional areas of expertise (August 2011 – March 2012)	27.02.2012
2.	WP	C. V. Sundara Rajan B. Ratheesh		27.02.2012
3.	SHW	P. Balachander		27.02.2012
4.	HG	C. V. Sundara Rajan		27.02.2012

S. No.	Functional Areas	Name of the expert/s	Involvement (Period & Task**)	Signature & Date
5.	AQ	B. Ratheesh	Provided the required input for specific functional areas of expertise (August 2011 – November 2011	27.02.2012
6.	NV	P. Balachander		27.02.2012
7.	LU	Y. Rama Mohan		Dr. Y. RAMAMOHAN Ph.D. 27.02.2012
8.	SE	Dr. Latha Bhaskar		27.02.2012
9.	RH	Susruta Amirapu		27.02.2012

Declaration by the Head of the Accredited Consultant Organization

I, C.V. Sundara Rajan, hereby, confirm that the above mentioned experts prepared the EIA for Honnavar Barge/Vessel Loading Facility. I also confirm that I shall be fully accountable for any mis-leading information mentioned in this statement.

Signature: 27.02.2012

Name: C.V. Sundara Rajan

Designation: City Office Manager & Head of Environment

Name of the EIA Consultant Organization: L&T RAMBØLL Consulting Engineers Limited
NABET Certificate No. & Issue Date: Provisional Accreditation as per QCI-NABET Letter Dated April 18, 2011

S. No.	Functional Area Code	Complete Name of the Functional Areas
1.	AP	Air Pollution Prevention, Monitoring & Control
2.	WP	Water Pollution Monitoring, Prevention & Control
3.	SHW	Solid & Hazardous Waste Management
4.	SE	Socio- Economic Aspects
5.	EB	Ecology and Biodiversity
6.	HG	Hydrology, Ground Water & Water Conservation
7.	GS	Geology & Soil
8.	AQ	Meteorology, Air Quality Modeling & Prediction
9.	NV	Noise &Vibration
10.	LU	Land Use
11.	RH	Risk & Hazards Management

Chapter 1
Introduction

1 Introduction

1.0 Background

The state of Karnataka is the eighth largest state in the country covering an area of 1,92,000 sq km with a population of 52.73 million in 2001. Karnataka owns a maritime coastline of 155 nautical miles studded by ten minor ports between Karwar in the North and Mangalore in the south, flanked by Uttara Kannada, Udupi and Dakshina Kannada districts. The ten minor ports of the coast are Karwar, Belekeri, Tadri, Honnavar, Bhatkal, Kundapur, Hangarkatta, Malpe, Padubidri and Old Mangalore. Among these ten ports, Karwar is the only all weather port while the other nine are riverine anchorage ports. The entire coastal belt as well as the adjacent districts are rich with mineral and natural resources and hence offer very good scope for industrial investment. This belt is well connected by National Highway and the Konkan Railway (broad gauge line) both running parallel to the coastline.

Karnataka has always been at the forefront of industrial growth in India. With its inherent capabilities coupled with its enterprising citizens, Karnataka provides the ideal choice for investment opportunities. While the national Gross Domestic Product (GDP) grew at 8.7% between 2005 and 2010, the combined growth rate of the four southern states was merely 7.85%, with Karnataka leading at 8.7%, Kerala 8.1%, Andhra Pradesh and Tamil Nadu at 7.4% each (according to a McKinsey survey report, commissioned by the Confederation of Indian Industry in March 2011).

In order to enhance the industrial growth of Karnataka, State Government has introduced Industrial Policy 2006-11 with an aim to increase the growth of GDP, strengthen manufacturing industries, increase share of exports from Karnataka, to generate additional employment of at least 10 lakh persons in the manufacturing and service sectors, reduce regional imbalance and ultimately aim at overall socioeconomic development of the State.

At present, in Karnataka there is only one Major Port viz., The New Mangalore Port. This is located at the southern end of the coastline and hence is predominantly being utilized by the southern districts of the State.

In view of the fact that ships of large sizes are used in transportation for economies of scale in the internationals trade, port would be developed with the required drafts, berthing facilities and efficient mechanical handling facilities so as to reduce waiting period of ships and saving in the Cargo handling expenses. Major aim of port development in Karnataka is to promote regional development. Port based industrial estates would be encouraged along the coast line to facilitate import of raw material and export of finished goods. As more number of Mega projects are coming up in the State, Industrial development shall be synchronized with the port development and the infrastructure development.

The investment in the port sector would demand an equal investment in the infrastructure facilities such as roads and railways for faster and efficient handling of the cargo movement. Along the coastline National Highway-17 and Konkan Railway broad gauge line are available. The Hassan – Mangalore broad gauge line would connect the ports in the Southern coast to the adjacent hinterland and similarly the proposed railway linkage from

Hubli to Karwar / Ankola would connect all the ports on the Northern coast to the rest of the state.

Maritime related industries would be given priority to be located along Karnataka Coast, in the field of ship building, ship repairing, dredging, eco-friendly ship breaking and other flotilla units like tugs, barges, launches and support crafts.

Considering the future endeavours, Government of Karnataka (GoK) willing to develop the Honnavar minor port in to all weather facility.

With this background, the Directorate of Ports and Inland Water Transport Department, GoK signed a lease agreement with Honnavar Ports Private Limited (HPPL), a consortium formed by North Canara Seaports Private. Limited (NCS) and GVPR Engineers Limited (GVPR) to develop Honnavar port located near mouth of Sharavati River in Uttara Kannada district of Karnataka. The consortium also signed a lease agreement for the use of Portland to develop port related activities at Honnavar.

GVPR Engineers Limited is an ISO 9001:2008 certified company that has extensive experience in Infrastructure project, designing, construction, operation and maintenance management. The organisation is involved in constructing world class infrastructure projects in Irrigation, transportation, power, buildings and ports. The company has joint venture and consortium tie up with reputed national and international companies to tender large scale projects.

With this Background, HPPL has appointed L&T-RAMBØLL Consulting Engineers Limited (L&T-RAMBØLL) for Consultancy Services for Development of Barge/vessel Loading Facility at Honnavar, Karnataka.

1.1 Details of Project Proponent

The information for the authorised contact person at HPPL is given below:

Contact Details:

Mr. Shiva Shankar
Director
Honnavar Ports Private Limited
Postal Address: #103, Lalehzar Apartments, 45/1-2,
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Bangalore – 560 001, Karnataka, India
Phone No: +91-80 2235 3670, 4149 4960
E-Mail: info@honnavarport.com

1.2 Applicable Legal and Policy Framework

The proposed Barge/ Vessel loading facility at Honnavar attract the provisions of Environmental Impact Assessment (EIA) notification, 2006 (as amended) and Coastal Regulation Zone (CRZ) Notification, 2011.

The proposed project is categorised as: ***Ports, Harbours included as Item 7(e) in the Schedule of the EIA Notification. Based on the cargo handling capacity planned at the Port (4.9 MTPA),*** proposed Barge/ Vessel loading facility at Honnavar ***is classified as Category "B"***. The applicable environmental regulations for the project are listed in Table 1-1.

Table 1-1: Applicable Environmental Regulation

APPLICABLE GoI POLICIES & REGULATIONS	YEAR	OBJECTIVE	REASON FOR APPLICABILITY
Environmental (Protection) Act	1986	To protect and improve overall environment	Environment in general
Environmental Impact Assessment Notification (as amended)	2006	Re-engineered EIA notification for a more effective Environmental clearance process	Direct
Coastal Regulation Zone Notification	2011	To protect the Coastal ecological resources and to prevent coastal pollution	Direct
Air (prevention and control of pollution) Act	1981	To control air pollution by controlling emission and air pollutants according to prescribed standards	Air pollution
Noise Pollution (Regulation and Control) rules 2000 Noise Pollution (Regulation and Control) (Amendment) Rules 2010	2001 & 2010	Noise pollution regulation and controls	Control of Noise pollution
Water (Prevention and Control of Pollution) Act and Cess Act of 1977	1974	To control water pollution by controlling emission & Water pollutants as per the prescribed standards	Water pollution

In order to obtain prior environmental clearance from statutory authorities, Environmental Impact Assessment (EIA) Study has been carried out as per approved Terms of Reference (ToR) by State Expert Appraisal Committee (SEAC), State Environment Impact Assessment Authority (SEIAA), Karnataka.

1.3 Project Site

The proposed site for development of Barge/ Vessel loading facility is located near mouth of Sharavati River in Honnavar Taluk of Uttara Kannada district in Karnataka. It is at a distance of about 90 km from Karwar, the district headquarter and about 400 km from Bangalore.

The location map showing the project site is given as **Figure FD0101**.

The location of the proposed Barge/Vessel loading site in Google is presented in Figure 1-1.

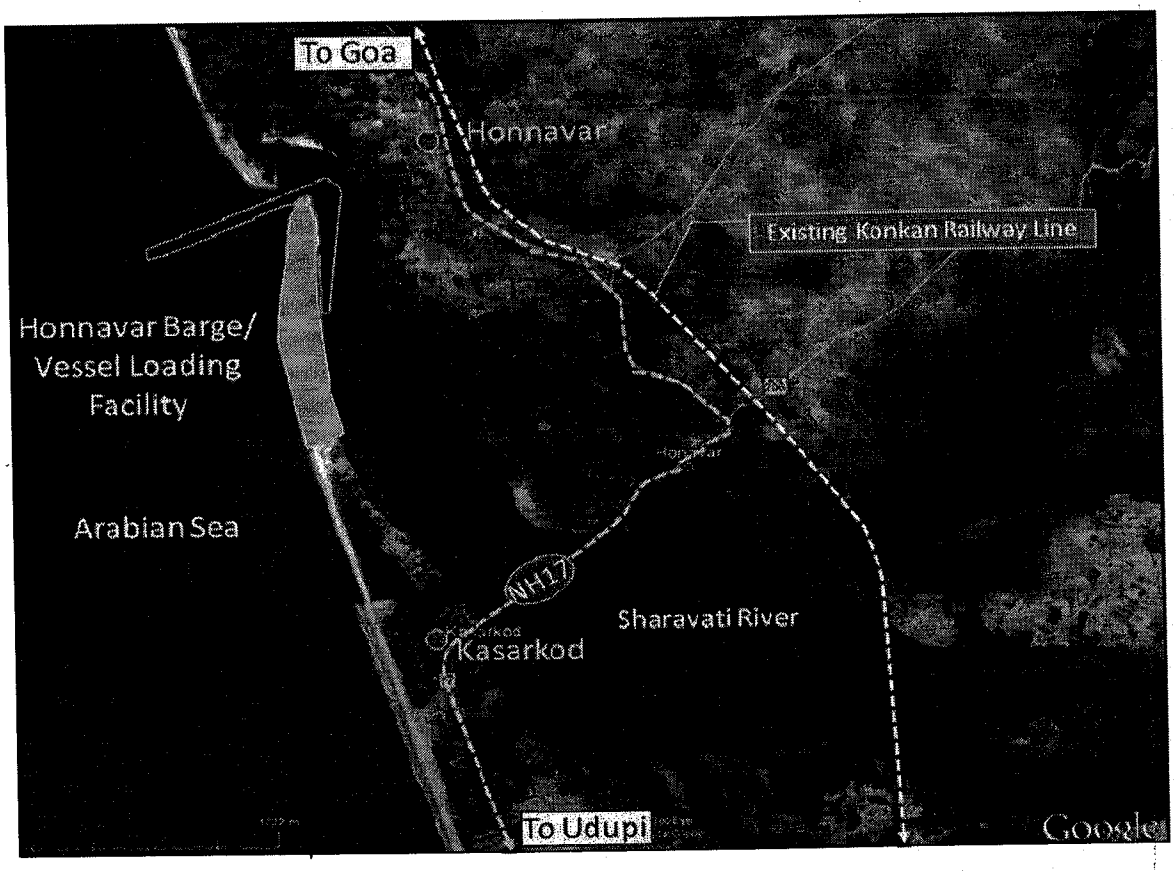


Figure 1-1: Google Imagery of the Site

1.3.1 Features of Project Site and its Surroundings

The Honnavar Taluk has a total land area of about 770 sq km. The land available along both sides of river (Pavinkurve and Kasarkod) Sharavati offers good potential for developing the barge/vessel loading facility. The land identified for development of Barge / Vessel loading facility is about 44 ha (mostly un-surveyed coastal sand) within the port limits issued by Government of Karnataka at Kasarkod. Government of Karnataka has allotted the land for the proposed development.

The eastern side of river Sharavati viz. Honnavar side has a commercial wharf which is being used by fishing vessels and few ferry boats. The area north of the wharf is densely populated. The bank of the river along Honnavar side is protected with sea wall and a black topped road that leads to a creek located further north. The area just west along the road is an intertidal region which becomes exposed during the low tide.

The western side of the river viz. Kasarkod side also has a wharf and associated facilities to handle fishing vessels. The sedimentation caused by a dam at Gersoppa being located across Sharavati River has resulted in the formation of a sand spit in the area.

Pavinkurve, the northern side of Sharavati River extends nearly up to the site. The bank of the river mouth has few dwellings and some sand dunes. Badgani River runs along the eastern side of Pavinkurve, which joins Sharavati River at confluence of Arabian Sea. This area has little vegetation with coconut trees. There are also shoals near the mouth of the

river. A 6 km long road connects Pavinkurve to NH 17 near Haldipur. There is a hanging bridge over Badgani River in the vicinity of Pavinkurve set apart for pedestrian purposes.

The area, Topalgere on opposite Bank of Kasarkod, just north of the Honnavar Port office adjoining NH 17 is densely populated and the road connecting to the port office and NH 17 which was used for approach road for barge/vessel operations in earlier days is also congested. The road passes through a densely populated area called Udhyam Nagar.

1.3.2 Connectivity

The site has good road connectivity. NH 17 passes through Honnavar towards East of project site at a distance of about 1 km. The site is connected to Bellary through NH 63 and NH 17. NH 17 meets NH 63 near Ankola at about 45 km from the site. Presently the site can be approached from a single lane black topped road that runs in continuation to NH 17 and then lies parallel to shoreline.

The site can be easily accessed through Konkan railway (Connecting Kerala with Mumbai). The barge/vessel loading facility proposed at Honnavar is at a distance of 5.0 km from Honnavar railway station and 14 km from Manki railway station.

The nearest Airports are at Mangalore and Goa which is about 155 km and 140 km respectively and the nearest seaport is at Karwar which is about 60 km from the project site.

1.4 Need for Development of Honnavar Barge/ Vessel Loading Facility

Liberalization of the Indian economy has led to significant growth and India is fast emerging as one of the largest economies of the world. This growth will provide a major thrust to trade. About 95% by volume and 70% by value of Indian exports are channelled through maritime Route. Foreign Trade Policy envisages doubling of Indian share in the global market. Hence, there is an immediate necessity to augment the Indian infrastructure by expanding or creating new Ports. Since, existing ports are saturated or congested and have limited scope for expansion there is a great need for development of green-field ports along East and West coasts.

Based on the growing demand/export potential in the state, the Government of Karnataka also has estimated that Karnataka coast would need more seaports/barge/vessel loading facility along Coast. Bellary district in Karnataka is blessed with many industrial projects that makes it second fastest growing city in the state .Out of the ports of the state, NMPT, the major port currently caters to the cargo requirements in the southern districts of the state and is operating at 89% capacity (in 2008 – 2009). Cargos such as granite, fertilizer, molasses, iron ore, wood logs, coal with other agro products and steel products also has the potential to grow in demand and supply which will increase the traffic. The capacity at the port is not adequate to cater to the demand of this region. This will increase the traffic across the proposed Barge/ Vessel loading facility.

About 27% of the power demand of Karnataka is met by that generated from coal based power plants. JSW Energy Limited (JSWEL) has commissioned coal based thermal power plant in Karnataka. JSWEL is also proposing to develop another unit of 600 MW in Bellary. Two coastal coal based thermal power plants are also proposed to be set up with capacities

of 1015 MW and 4000 MW in Tadri and Mangalore respectively. The demand supply gap of coal is expected to increase in the coming years. The development of Barge/ Vessel loading facility will meet the capacity requirements of the region and Karnataka State and in turn is expected to boost the economy of State.

1.5 Project Development Plan

The proposed barge /vessel loading facility is located at the mouth of River Sharavati towards North west of Kasarkod Tonka village in Uttara Kanada district in Karnataka..

The barge/vessel loading facility is proposed for handling of 4.9 MTPA of cargo to handle dry bulk cargo (3.7 MTPA), general cargo (1.2 MTPA) and development of navigation and back up facilities. Proposed handling capacity is listed in Table 1-2

Table 1-2: Proposed Handling Capacity

S.No	Commodity	Traffic (MTPA)
1.	Coal	2.7
2.	Iron Ore	1.0
	General Cargo	
3.	Granite	0.16
4.	Fertilizer	0.2
5.	Molasses with Agro Products	0.15
6.	Steel Products	0.40
7.	Sugar	0.29
8.	**Total**	**4.9**

The detailed project development plan is discussed in **Chapter 2.**

1.6 Environmental Impact Assessment

The EIA study for the proposed Honnavar Barge/Vessel Loading Facility covers both terrestrial and marine environmental assessment.

HPPL submitted the proposal (Form-1, Draft Terms of Reference (ToR) and Prefeasibility Report) for consideration by the State Level Expert Appraisal Committee (SEAC), Karnataka in its meeting held on August 20, 2011 at Bangalore to determine the Terms of Reference (ToR) for undertaking EIA study for obtaining environmental clearance in accordance with the provisions of the EIA Notification, 2006 (as amended) and CRZ notification, 2011.

The committee approved the ToR vide letter No: SEIAA 22 IND 2011, dated September 13, 2011. A copy of the letter is enclosed as **Appendix A** for reference.

The EIA study has been carried out based on the approved ToR covering both terrestrial and marine environments.

1.7 Approach and Methodology

1.7.1 Project Influenced Area (PIA)/Study Area

An area within 10 km radius with project site as boundary has been earmarked for the study as the general study area. The core study area is the proposed project site. The map showing the study area is given as **Figure FD0102.**

1.7.2 Study Period

The baseline terrestrial and marine environmental surveys were carried out during March to May 2011. Site specific hourly meteorological data was generated during the study period. Ambient air quality monitoring at the identified monitoring locations in the study area was carried out during the study period with twice a week frequency. Hourly noise levels were recorded at identified monitoring locations once during the study period. Inland water quality (surface and groundwater) and soil quality sampling was carried once during the study period at the identified sampling locations in the study area.

The baseline marine environmental surveys were carried out by Centre for Advanced Studies in Marine Biology (CASMB), Annamalai University. Marine water quality, sediment quality and marine biology (plankton, benthos) were carried out once during the period at the identified sampling locations within the project area.

1.7.3 Methodology

The EIA study for the proposed barge/vessel loading facility has been carried out covering both construction as well as operational phases. In each phase, the anticipated impacts due to the proposed project on both terrestrial, marine environmental and social components have been addressed. The methodology adopted for the study is discussed in the following sections.

1.7.3.1 Analysis of Alternatives

To ensure sustainable development under the given conditions, the analysis of alternatives considered for layout selection has been discussed in detail and presented in the **Chapter 3**.

1.7.3.2 Baseline Environmental Conditions

The baseline environmental status of the study area was established by carrying out the field surveys covering both the marine and terrestrial environmental components. In addition, authenticated secondary data was also collected, reviewed and presented.

Terrestrial Environment: The baseline environmental data for terrestrial environment was collected within the study area for following attributes.

- Meteorology
- Ambient Air Quality (PM10, PM2.5, SO2, NOX, CO, HC, Hg and Ozone)
- Noise
- Water Quality
- Soil
- Ecology (Flora and Fauna)
- Land use and Land Cover Mapping

The baseline terrestrial environmental conditions are described in **Chapter 4**.

Marine Environment: Centre for Advanced Studies in Marine Biology (CASMB), Annamalai University, a reputed academic and research institute, has been engaged to monitor the marine environmental attributes near proposed barge/vessel loading facility. The marine environment was monitored in terms of:

- Seawater quality
- Sediment quality
- Marine biology (plankton and benthos)

HTL/LTL and CRZ Demarcation Survey

The physical demarcation of HTL and LTL was carried out by the Centre for Earth Science Studies, Thiruvananthapuram, and an authorised agency by MoEF. Based on the survey, the CRZ set back lines were demarcated.

Socio-Economic Aspects

Data on population, literacy, occupation, amenities, and medical facilities was collected from was collected from District Statistical Handbook of Uttara Kannada District and Primary Census Abstract (Census of India), 2001.

1.7.3.3 Anticipated Environmental Impacts and Mitigation Measures

The environmental and social impacts which are likely to arise due to the proposed Honnavar barge/vessel loading facility during the construction as well as operational phases have been studied in detail with respect to the facilities being proposed. Further, the impacts have been assessed taking into consideration the existing baseline status of the terrestrial and marine environments. The mitigation measures proposed to minimise each of the likely impacts are presented in **Chapter 5**.

1.7.3.4 Environmental Monitoring Programme

Post project environmental monitoring programme has been formulated for the barge/vessel loading facility and presented in the **Chapter 6** of this report. The environmental monitoring programme covers the technical and network design of monitoring, as well as the effectiveness of mitigation measures (including measurement methodologies, frequency, location, etc., and detailed budget).

1.7.3.5 Additional Studies

Preliminary Risk Analysis and Disaster Management Plan: Preliminary Risk analysis covering the hazard identification is carried out. . Based on which, preventive measures and Disaster Management Plan were prepared outlining various measures to combat accidents and natural disasters. Also measures to safeguard against fire hazards have been provided in **Chapter 7**.

Social Impact Assessment (SIA): The likely social impacts associated with the construction and operational phases of the Honnavar barge/vessel loading facility are detailed out in **Chapter 7**.

Public Hearing: The Public Hearing was conducted on January 27, 2012 at the proposed project site and the issues raised by the public and the responses of the project proponent for the same are provided in **Chapter 7**.

1.7.3.6 Project Benefits

The project benefits in terms of improvements in the physical infrastructures and social infrastructure, employment potential and other tangible benefits are presented in **Chapter 8.**

1.7.3.7 Environmental Cost Benefit Analysis

The applicability of the proposed project to incorporate the Environmental Cost Benefit Analysis in the EIA Study is briefly explained in **Chapter 9.**

1.7.3.8 Environmental Management Plan (EMP)

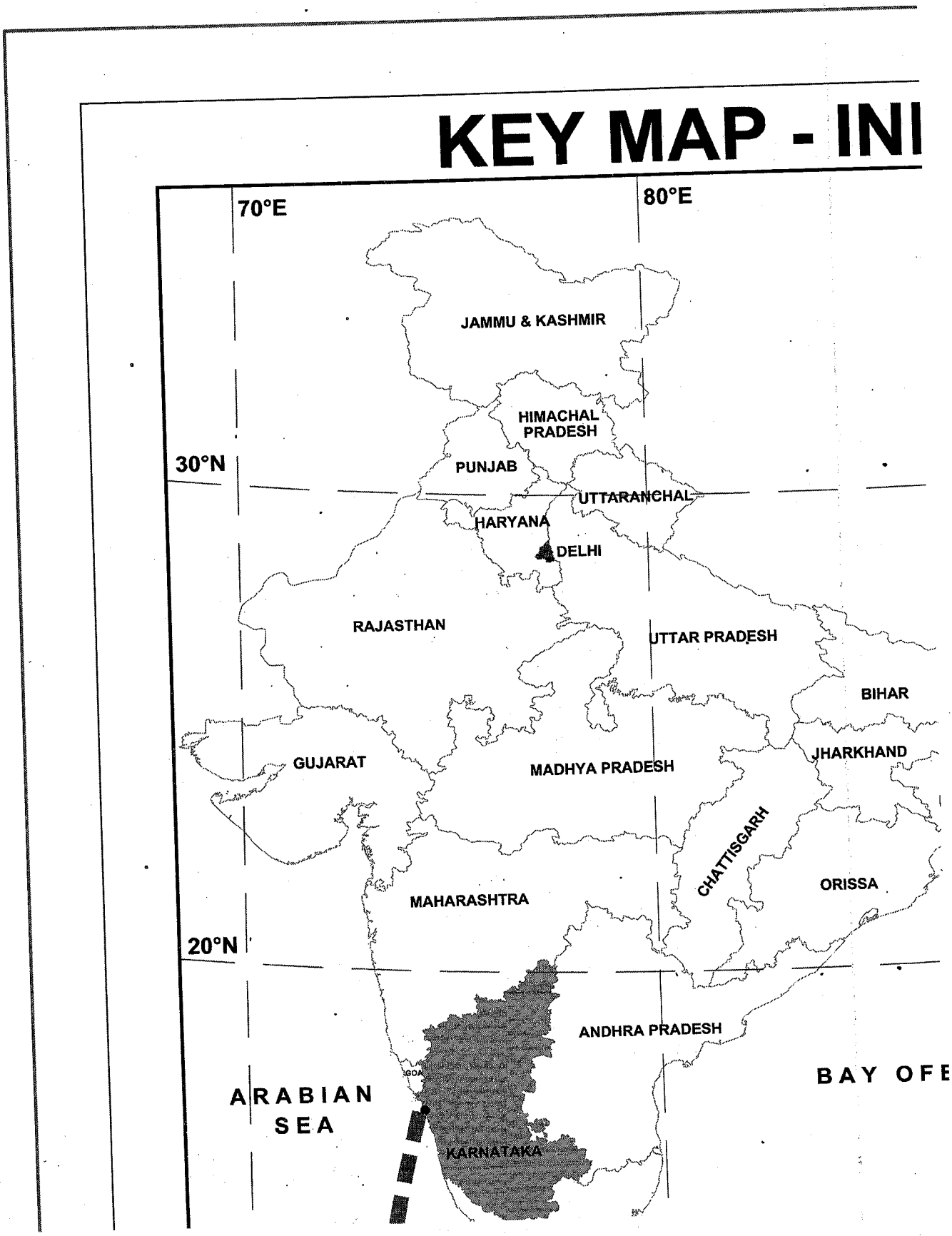
An Environmental Management Plan (EMP) was prepared based on the mitigation measures for the impacts during construction and operation phases and environmental monitoring programme proposed. The mitigation measures have been discussed in **Chapter 5** under the respective sections. The Environmental Monitoring Programme has been discussed in **Chapter 6**. The institutional mechanism responsible for the implementation of the mitigation measures and Green Belt development plan is presented in **Chapter 10.**

1.8 Structure of EIA Report

The report is structured as per Appendix III of EIA Notification, 2006 and also EIA Guidance Manual for Ports and Harbours, 2010 released by MoEF.

- Chapter 1: Introduction
- Chapter 2: Project Description
- Chapter 3: Analysis of Alternatives
- Chapter 4: Description of Environment
- Chapter 5: Anticipated Environmental Impact and Mitigation Measures
- Chapter 6: Environmental Monitoring Programme
- Chapter 7: Additional Studies
- Chapter 8: Project Benefits
- Chapter 9: Environmental Cost Benefit Analysis
- Chapter 10: Environmental Management Plan
- Chapter 11: Summary & Conclusions
- Chapter 12: Disclosure of Consultants Engaged

FIGURES


KEY MAP - INI
70°E
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20°N
JAMMU & KASHMIR
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PUNJAB
UTTARANCHAL
HARYANA
DELHI
RAJASTHAN
UTTAR PRADESH
BIHAR
JHARKHAND
GUJARAT
MADHYA PRADESH
CHATTISGARH
ORISSA
MAHARASHTRA
ANDHRA PRADESH
GOA
KARNATAKA
ARABIAN SEA
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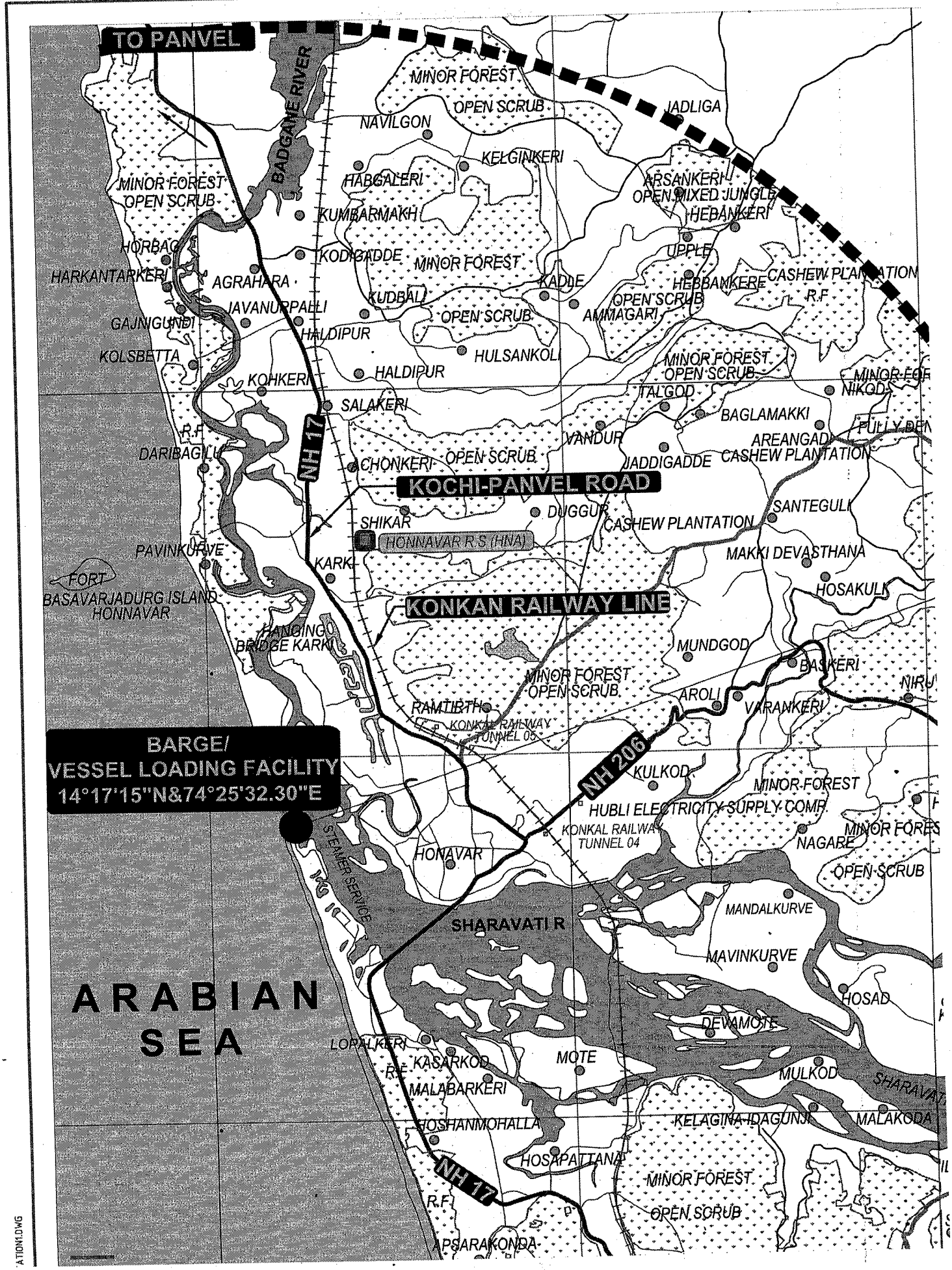

TO PANVEL
BADGANE RIVER
MINOR FOREST
OPEN SCRUB
NAVILGON
JADLIGA
KELGINKERI
HABGALERI
ARSANKERI
OPEN MIXED JUNGLE
HEBANKERI
KUMBARMAKH
HORBAG
KODIGADDE
MINOR FOREST
UPPLE
HARKANTARKERI
AGRAHARA
KADDE
HEBBANKERE
CASHEW PLANTATION
R.F
KUDBALI
OPEN SCRUB
AMMAGARI
JAVANURPALLI
GAJNIGUNDI
HALDIPUR
HULSANKOLI
KOLSBETTA
MINOR FOREST
OPEN SCRUB
KOHKERI
HALDIPUR
TALGOD
NIKOD
SALAKERI
BAGLAMAKKI
R.F
VANDUR
AREANGADI
DARIBAGILU
NH 17
CHONKERI
OPEN SCRUB
JADDIGADDE
CASHEW PLANTATION
KOCHI-PANVEL ROAD
DUGGUR
SANTEGULI
SHIKAR
CASHEW PLANTATION
HONNAVAR R S (HNA)
PAVINKURVE
MAKKI DEVASTHANA
KARKI
FORT
BASAVARJADURG ISLAND
HONNAVAR
HOSAKULI
KONKAN RAILWAY LINE
HANGING
BRIDGE KARKI
MUNDGOD
BASKERI
MINOR FOREST
OPEN SCRUB
AROLI
RAMTIRTH
VARANKERI
KONKAN RAILWAY
TUNNEL 05
BARGE/
VESSEL LOADING FACILITY
14°17'15"N&74°25'32.30"E
NH 206
KULKOD
MINOR FOREST
HUBLI ELECTRICITY SUPPLY COMP.
KONKAL RAILWAY
TUNNEL 04
NAGARE
MINOR FOREST
STEAMER SERVICE
HONAVAR
OPEN SCRUB
MG
SHARAVATI R
MANDALKURVE
MAVINKURVE
HOSAD
ARABIAN
SEA
DEVAMOTE
LOPALKERI
MOTE
KASARKOD
R.F
MULKOD
MALABARKERI
HOSHANMOHALLA
KELAGINA-DAGUNJI
MALAKODA
HOSAPATTANA
NH 17
MINOR FOREST
R.F
OPEN SCRUB
APSARAKONDA

CHAPTER 2
PROJECT DESCRIPTION

2 Project Description

2.0 General

In this chapter, Development Plan for all weather Barge/ Vessel Loading Facility at Honnavar is presented summarising the following details.

- Location
- Land Availability
- Existing Facilities
- Traffic Studies
- Field Surveys and Modelling Studies
- Dredging and Reclamation
- Material Quantities and Resources
- Utilities and Services
- Environmental Protection Measures
- Coastal Regulation Zone Compatibility
- Project Development Schedule
- Project Cost

2.1 Location

The proposed barge/ vessel loading facility site is located near Sharavati River mouth in Honnavar town, Uttar Kannada district of Karnataka State. The identified shoreline for the development will be within the notified port limits. The location map showing the project site is given as **Figure FD0101**.Existing drainage pattern of the project influence area of the proposed barge/ vessel loading facility is shown in the figure 2-1

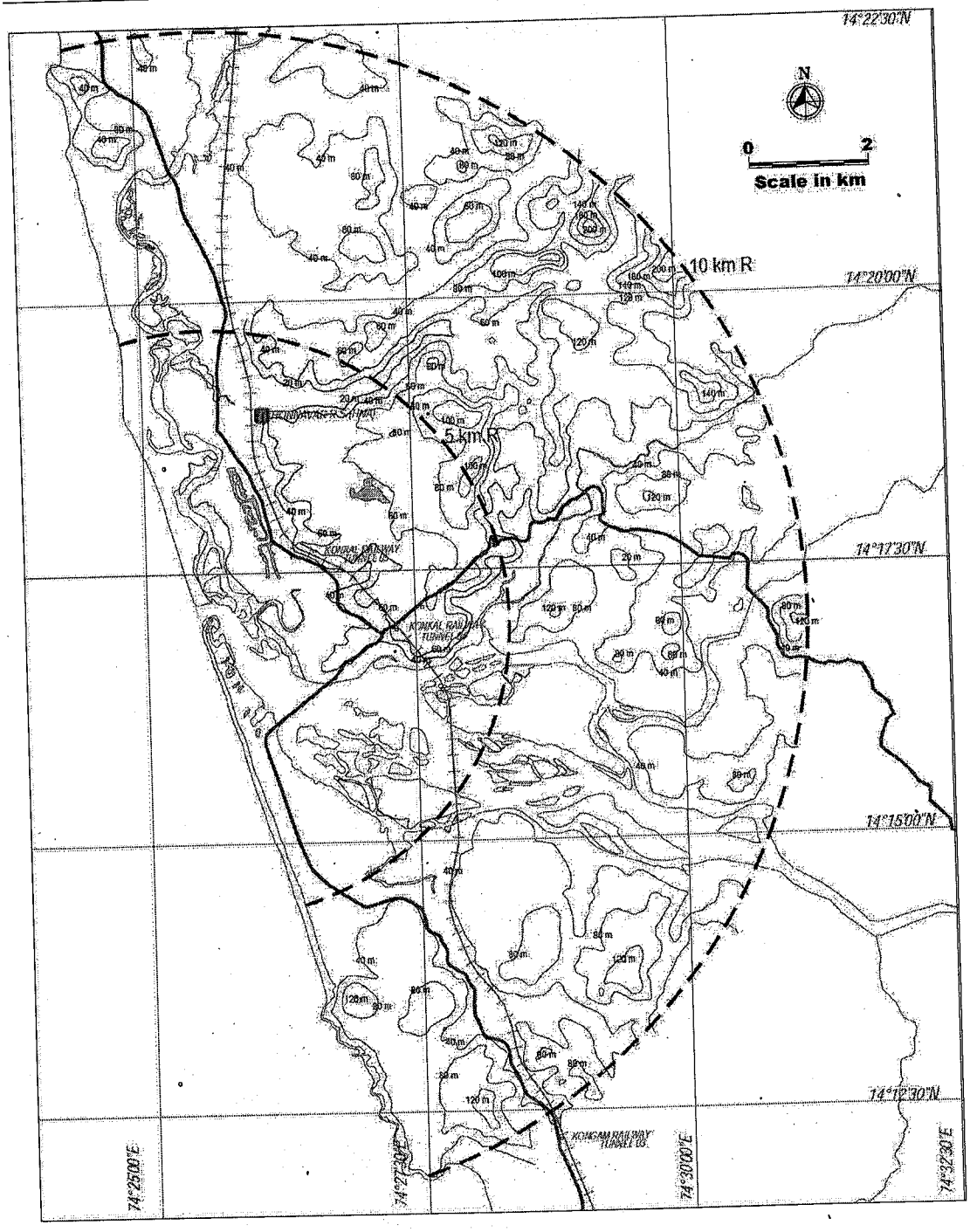


Figure 2-1: Drainage pattern of the project influence area

2.2 Land Availability

The land available along both sides of river (Pavinkurve and Kasarkod) Sharavati offers a good potential for developing the barge/ vessel jetty. The land identified for development of Barge / Vessel loading facility is about 44 ha within the port limits issued by Government of Karnataka at Kasarkod.

Government of Karnataka has allotted the land for the proposed development. The land proposed for Rail / Road Corridor is about 30 Ha, which includes Government / few patches private land and no families are present in the land proposed to be acquired. Hence, No R&R is envisaged due to the proposed development. .

The proposed land use plan/land break up details of Honnavar Barge/Vessel loading facility is given in the Table 2-1.

Table 2-1: Barge / vessel loading facility Land Use Breakup

S.No	Description	Area (Ha)
1.	Coal Stockyard	7.00
2.	Iron Ore Stockyard	1.80
3.	General Cargo Storage (Open)	4.00
4.	General Cargo Storage (Closed)	2.00
5.	Liquid cargo storage	0.10
6.	Roads and Circulation Area	8.15
7.	Operation Building	0.05
8.	Canteen	0.02
9.	Vehicle Parking	0.09
10.	Substation	0.02
11.	Gate House/Security/Weigh Bridge	1.50
12.	Truck Parking	5.40
13.	Fuel Station	0.02
14.	Control Tower	0.01
15.	Green Belt	3.10
	Sub total	33.26
16.	Area available for other Operations and area earmarked for future expansion	6.72
17	Rock armour area(approx)	4.00
	Total	**44.00**

2.3 Barge /Vessel Loading - Traffic

2.3.1 Coal

Coal is the one of most important fossil fuel in India. The majority of energy requirement in India are met through coal, largely mined in the eastern and central regions of the country. Coal accounts for approximately 53 percent of the country's energy need. India is the third largest producer of coal in the world and has the fourth largest reserves of coal in the world. The primary demand of coal is from the power sector though steel and cement plants also require coal for their production.

Though, India is the third-largest producer of coal, the demand for coal in India for its power and steel plants is higher than the supply. Therefore, India is a net importer of coal and its import has been rising over the past 10 years. Total imports have increased from 29 MT in 2004-05 to 59 MT in 2008-09, at a CAGR of 19.5 percent to meet the demand-supply mismatch. The import growth has been primarily driven by increased import of non-coking (thermal) coal, which has grown at 33.3 percent per annum, in response to the growing thermal power plants in India. The main sources for imported coal in India are from Australia, China, Indonesia and South Africa. Export of coal from India has not been significant in the past due to the high domestic demand.

The state of Karnataka is endowed with a number of steel production units and cement plants whose coal requirement is increasing proportionally to their production. JSW steel, Bellary is the largest producer of steel in the hinterland. About 27% of the power demand of Karnataka is met from coal based power plants. In addition numbers of steel and power plants are also coming which will further increase the demand for coal in Karnataka. Majority of the power plants and steel production plants import coal from the eastern part of India via coastal movement. The new SEZ planned by GVPRL in the vicinity of Honnavar Barge/ Vessel loading facility will also have a thermal power plant which will again add to the coal demand of the state.

Considering all these, it is understood that Honnavar, will attract Thermal coal traffic of 2.7 MTPA annually.

2.3.2 Iron Ore

India is ranked fifth in the world in terms of iron ore reserves, with approximately 6 percent of the total iron ore reserves. Brazil, Russia, China, and Australia are the top four countries. Indian iron ore industry is fragmented with around 270 mines spread across country. India is one among the leading exporters of iron ore in the world and competes with Australia and Brazil. Jharkhand, Orissa, Chhattisgarh, Karnataka, Goa & Maharashtra are key major states with iron ore deposits in India.

Karnataka state is endowed with rich deposits of iron ore with about 9 billion tones or about 41% of India's total haematite and magnetite resources. Numerous iron ore mines present in Bellary district account for almost 75% of the iron ore exported from the state. The quantity of iron ore mined from Hospet and Bellary had touched 20 MT and 50 MT respectively. About 80% of this iron ore is being exported and the rest is consumed domestically.

Honnavar has a very good prospective in exporting iron ore being located in close proximity to Bellary Hospet belt. Taking into account all the above said factors, the facility being developed in Honnavar is expected to handle around 1.0 MTPA of iron ore annually. However, considering the recent ban on iron ore, HPPL is committed to the national regulations and therefore Iron ore will be handled as and when the handling is legally permitted.

2.3.3 General and Other Cargos

The General cargoes proposed for the barge/vessel loading facility includes steel products, molasses, edible oil, granite, sugar and fertiliser.

2.3.3.1 Steel Products

Karnataka's annual output of iron ore is around 45 MT with around 70-75% of it being exported. Based on this the average annual output of steel from Karnataka is around 27 MT. But due to the ban in the iron ore mining in Bellary by the Supreme Court, the steel industry for which iron ore is the basic raw material got affected. This threatened the production output of the steel. In September 2011, India's Supreme Court allowed state-owned NMDC Ltd to mine 1 MT of iron per month in Karnataka's Bellary district to meet domestic steel maker's needs. This has helped steel industry to recover to an extent. As per expert's

opinions, it is expected that the amount of iron ore supply to the steel industry will be further increased and the ban on the iron ore mining will be partially or fully recovered sooner or later. Keeping in view of the prevailing situation, Honnavar barge/vessel loading facility will handle 0.4 MTPA of steel products.

2.3.3.2 Fertiliser

Chemical fertilizers play a key role in the agricultural productivity growth of India. However, the demand-supply gap of fertilizers in India has increased in recent times, thereby leading to increased dependency on imports. Indian imports, which were about 2 MT in early part of 2000, increased to 10.2 MT in 2008-09. India is the second largest consumer of fertilizers in the world after China, consuming about 26.5 MT in 2009 - 10.

Fertilizer consumption in Karnataka state is increasing while the production is less which necessitates the import of fertilizers. Considering, the potential for fertilizer, Honnavar barge/vessel loading facility plans to attract 0.2 MTPA.

2.3.3.3 Granite

Karnataka produces 25% of India's total granite production followed by Jharkhand (24%), Rajasthan (23%), Andhra Pradesh (6%), Madhya Pradesh (5%) and Orissa (5%) which altogether accounts for 88% of the resources. The quarries in Karnataka are located in Chamarajnagar sector, Kollegal sector, Kanakapura sector, Hassan sector, Mandya sector, Mysore sector and Ilkal sector. Considering the potential for granite, Honnavar barge/vessel loading facility plans to export 0.16 MTPA.

2.3.3.4 Sugar

India is the second largest producer of sugar next to Brazil. With a hold of 13.5% of country's sugar production, Karnataka ranks fourth in the country in terms of sugarcane production and third in the country in terms of production of sugar. Increase in the sugar projection was owing to the availability of large quantity of sugarcane in the state. Considering the potential for sugar, Honnavar plans to export 0.29 MTPA.

2.3.3.5 Molasses

Molasses is produced by sugar factories during the sugar manufacturing process. Godavari Sugar Mills located in Bagalkot is the largest producer of molasses in the hinterland. Demand for ethanol in the petroleum sector and potable alcohol industry is the driving forces for high molasses consumption.

Brazil, the world's largest exporter has banned molasses exports in order to produce ethanol to be used as a bio fuel; hence India could cater to the international demand for molasses. Growing demand for ethanol which is blended with petroleum will be the major factor that will fuel molasses exports in future.

In order to cater to international demands, sugar factories in the hinterland supply to local distilleries as well as export a part of their volumes. Considering the potential for molasses, Honnavar plans to export 0.08 MTPA.

2.3.3.6 Edible Oil

Indian vegetable oil economy is the fourth largest in the world, accounting for about 14.5% of the world's oilseeds area and 6.65% of the production next to U.S.A, China and Brazil. The per capita consumption of edible oil is about 11.5 kg which is very low compared to world average of 20 kgs. With steady growth in population and personal income, Indian per capita consumption of edible oil has been growing steadily. However, oilseeds output and in turn, vegetable oil production have been trailing consumption growth, necessitating imports to meet supply shortfall. Hence India being deficient imports 40% of its consumption requirements, making it the world's third-largest importer of edible oil. The country buys soya oil from Argentina & Brazil and palm oil from Malaysia & Indonesia. Exemption on import duty on edible oils (since 2008) has resulted in a huge rise in imports and has also boosted the per capita consumption of oil in the country.

In Karnataka Edible Oil is imported from Argentina, Indonesia, Brazil, Malaysia, etc through New Mangalore Port. The edible oil imported at the Port is despatched to various destinations like Karwar in Karnataka State and to Ruchi Oil refineries in Mumbai and in some parts of Kerala State. The crude Palm oil imported is processed locally and sent to various destinations in the hinterland. Considering the potential for edible oil, Honnavar barge/vessel loading facility plans to export 0.07 MTPA.

The total general cargo handled will be 1.2 MTPA.

2.3.4 Traffic for Honnavar

Based on the hinterland potential analysis, the overall traffic figures for proposed barge/ vessel loading facility are provided in the Table 2-2.

Table 2-2: Cargo Throughput for Honnavar Barge/Vessel Loading Facility

S. No.	Commodity	Traffic (MTPA)
1.	Coal	2.70
2.	Iron Ore	1.00
	General Cargo	
3.	Granite	0.16
4.	Fertilizer	0.20
5.	Molasses with Agro Products	0.15
6.	Steel Products	0.40
7.	Sugar	0.29
8.	**Total**	**4.90**

2.4 Field Surveys and Investigations

Comprehensive field surveys and investigations were carried out covering oceanographic measurements, marine geotechnical investigations and topography at the location of project site. Detailed investigations that included seabed surveys (viz. bathymetry), Oceanographic measurements (tide measurements, current meter observations) and seabed sediment sampling were carried so that the results were used for the planning of the proposed facilities at Honnavar Barge/vessel Loading facility. These surveys were carried out by M/s. Indomer Coastal Hydraulics (P) Ltd., Chennai and M/s. Fugro Geo-Tech Pvt. Limited.

2.4.1 Bathymetry

The bathymetric survey was carried out for 3.5 km along the shoreline and 3.5 km into the sea. From the analysis of the survey data it is observed that the contours run parallel to each other in the project area. Bathymetry of the study area exhibits a gentle bed slope of 1:180 up to 5 m contours beyond which it flattens to 1:350. The 10 m water depth occurs at a distance of approximately 3350 m from the coast.

The bathymetry survey carried out on the river side of the project site illustrates that the river bed is shallow and there are few deeper portions depending on the current. A maximum river depth of 3-4 m is observed, otherwise the whole of the bed seems to be very shallow and few islands in the river course. Mouth/estuary of the river also seems very shallow with maximum water depth of 2-3 m in the river mouth. Large area of shallow depth of 0.7 m is observed on either side of the river mouth which is mainly due to the deposition of the sediments brought by the river.

The bathymetric chart surveyed by Indomer is presented in Figure 2-2.

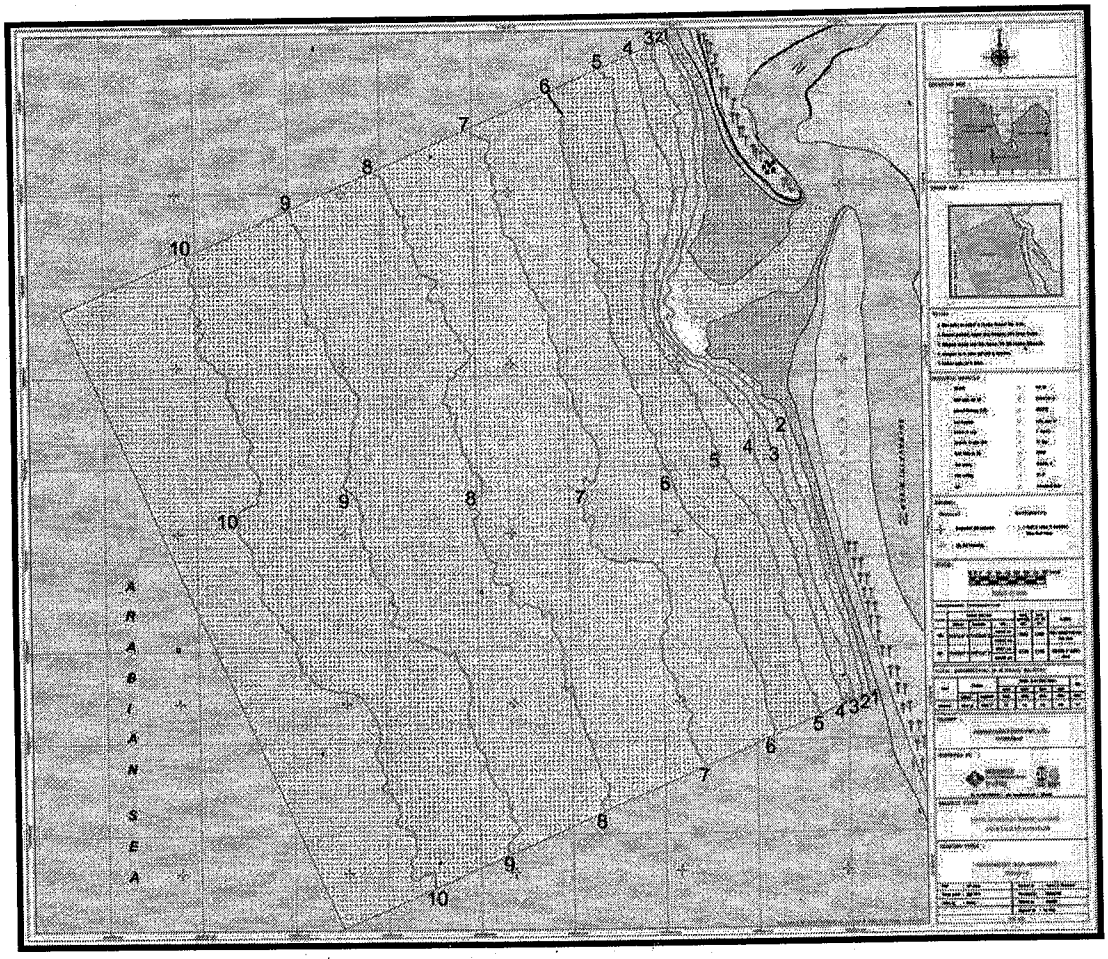


Figure 2-2: Bathymetry

The National Hydro graphic Office chart showing the depth contours of the Project region is given in Figure 2-3.

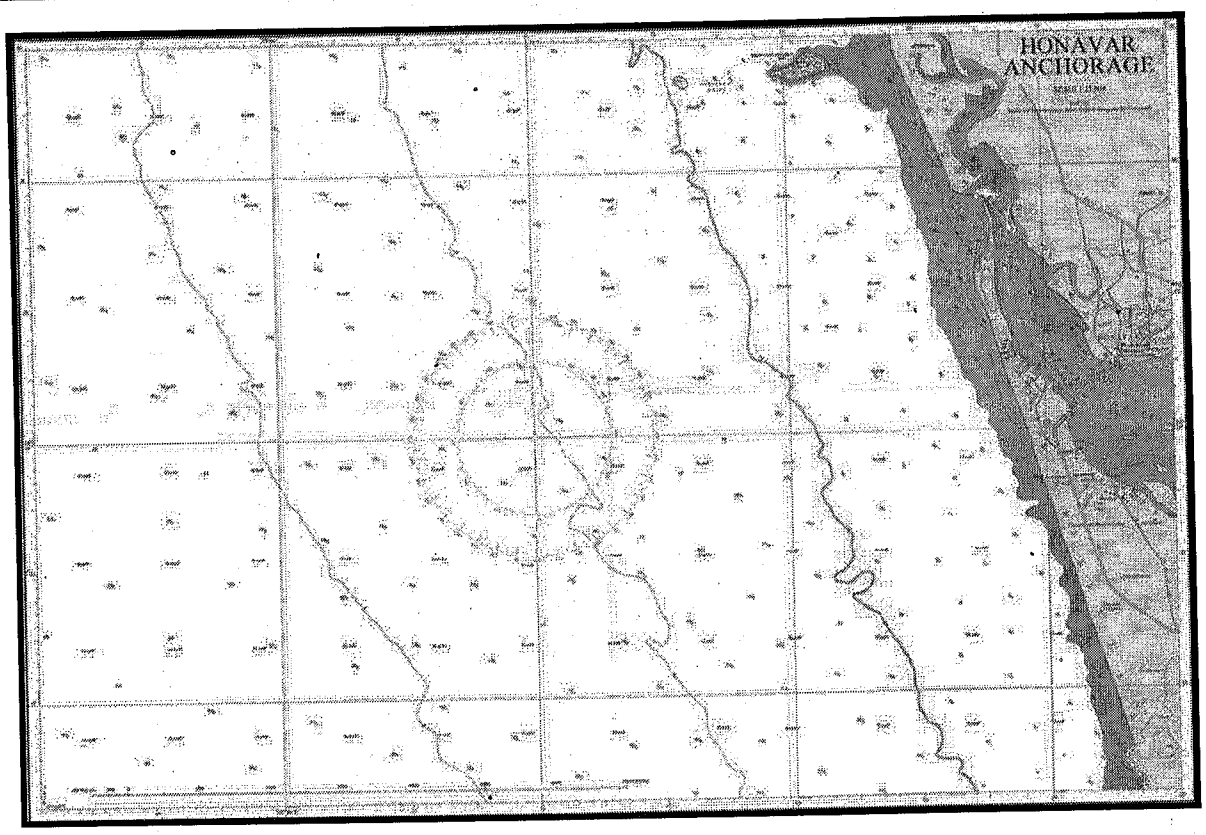


Figure 2-3: NHO Chart

2.4.2 Geotechnical Investigation

Geotechnical investigations were carried out to determine various soils/rock parameters at the proposed project location by M/s Fugro Geo-tech Pvt. Ltd. 4 land boreholes and 11 marine boreholes were explored to assess the geotechnical parameters.

The soil profile of the four land boreholes reveals that medium dense to dense yellowish brown fine to coarse sand up to 13.5 m, stiff dark grey clay from 13.5 to 16.5 m, dense yellowish brown coarse sand from 16.5 to 18 m, very dense whitish grey gravels with some sand from 18 to 22.5 m, hard reddish clay with few gravels from 22.5 to 28.5 m, highly reinforced greenish weak chloride schist from 28.5 to 31.5 m and moderately weathered greenish weak to moderately weak chloride schist from 31.5 to 35 m.

The soil profile of the eleven marine boreholes reveals that loose to dense yellowish brown fine to coarse sand up to 4.5 m, soft to firm dark grey clay from 4.5 to 6.0 m, loose to dense yellowish grey sandy clayey gravels from 6.0 to 9.0 m, medium dense whitish greyish sand with gravels from 9.0 to 12.0 m, stiff to very stiff whitish grey clay from 12.0 to 19.5 m, hard whitish grey clay with minor silt from 19.5 to 27.0 m, hard greenish clay from 27.0 to 30.15 m and moderately weathered greenish moderately weak to weak chloride schist from 30.15 to 35.0 m. Weathered rock is encountered in all boreholes at varying depths. The observed bedrock is moderately weathered at surface and rapidly grades into sound rock as depth increases.

2.4.3 Oceanic Investigation

The oceanographic conditions such as tide, wave, current, bathymetry etc, and meteorological conditions such as climate, temperature, relative humidity, rain fall, wind, visibility, cyclone etc are discussed in detail in **Chapter 4.**

2.5 Mathematical Model Studies

2.5.1 Wind-wave Model and Nearshore Wave Transformation and Wave Tranquillity

The wave transformation model has been run for deep-water waves approaching from six directions (S, SSW, SW, WSW, W and WNW). However, due to the typical orientation of the coastline and the nearshore bathymetric pattern, the waves undergo refraction and approach the coast predominantly with a westward component (WSW, W and WNW). To examine the effect of the proposed breakwaters and other structures on the waves and other parameters in the study area, models were run for the existing conditions without breakwaters (case-I) and for the future conditions incorporating the proposed breakwaters (case-II).

For case-I (without breakwaters), during monsoon season, when the deep water wave directions are S, SSW, and SW the wave heights along the coast are between 1.0 to 1.5 m up to a distance of about 1 km offshore. For WSW waves, wave heights greater than 1.75 m are noticed in the region. However, in the neighbourhood of the inlet channel (river mouth), on the seaward side the wave heights are less than 1.0 m and this is due to wave divergence in the region. On the riverside of the entrance channel good, tranquility conditions with wave heights less than 0.5 m are noticed.

For case-II (with breakwaters), the wave conditions along the coast outside the port area are almost same as in case I. But near the mouth adjoining the breakwaters somewhat rough conditions with wave heights ranging from 1 to 1.5 m are noticed. This could be due to the diffraction and reflection of the waves by the breakwaters.

The wave transmission factor is important for the study of wave tranquility. Higher transmission factor indicates low tranquility and vice versa. During the non-monsoon season when W and WNW waves prevail, the transmission coefficients are quite low (0.15) and the tranquility conditions are quite good. During monsoon months when WSW and SW waves prevail the transmission coefficients are significantly higher (>0.3) near the entrance channel; but the values rapidly decrease on the riverside of the channel.

For case-II, with breakwaters, the transmission coefficients are generally less than 0.15 indicating good tranquility conditions for non-monsoon months. But during monsoon months when S and SSW waves prevail, the inlet channel adjoining the breakwaters show higher transmission coefficients (>0.75) and the tranquility conditions are not so good.

However, the tranquility conditions on the riverside of the channel are quite good during all seasons. The model studies show that the tranquility conditions have improved on the riverside where barge/ vessel loading facilities are located, when the breakwaters are incorporated in the model.

2.5.2 Hydrodynamic Model Studies

The changes in the current patterns near the inlet and inside the river up to the point of the proposed barge/ vessel loading facilities were studied by using hydrodynamic models. The model results show that the ebb currents are strong during wet season when the river discharge is very high. The current strengths increase further during spring tide periods compared to neap tide.

For case-I (without breakwaters), during wet season with peak river discharge (300 m^3/s) strong currents of about 1.0 to 1.2 m/s are observed inside the channel as well as on the seaward side of the channel. Inside the river also up to 5 km upstream, the ebb currents are strong (0.4 to 0.6 m/s). During flood period, also the currents continue to be in the ebb direction and no reversal is found. However, there is slight reversal outside the channel to the south. The currents in the river also show no reversal with tide; they continue to be in the ebb direction even during flood period. This is due to the overwhelming effect of the river discharge, which totally controls the circulation. Similar variations of currents are observed during neap tides also.

For case-I during wet season, the impoundment of water within the river and the inlet area is observed. During ebb period, the water levels in the river are at about 0.6 to 0.75 m while on the seaside the water levels are around 0.3 to 0.45 m. However, during the flood period the water levels in the river and in the sea remain almost same at around 0.9 m. During dry season the magnitude of currents has generally decreased to about 0.2 m/s and a clear reversal in tidal currents is noticed.

For case-II (With Breakwater) in the wet season strong currents directed seaward are observed near the inlet during ebb period. The ebb current strength in the river is found to be stronger compared to case-I. With the inclusion of breakwaters, the effective cross sectional area at the entrance has decreased resulting in the increase of current strength. The water levels during the flood period remain almost same as case-I and so it may be inferred that the construction of breakwaters will have negligible effect on the water level changes in the Barge / vessel loading facility.

The increase in current strengths prevents any increase in water levels and no flooding is expected. Since, the currents show higher values only during ebb period, the riverine sediments could be carried offshore by such currents and sedimentation problem within the proposed facility is expected to be lesser. For case-II during dry season reversal of currents in the river are observed from ebb to flood periods. The water levels also do not show any variations compared to case-I.

2.5.3 Cohesive/Mud transport (MT) Model

Cohesive or mud transport studies are essential for coastal regions where river or tidal inlets are present. The Flow model (HD and MT) has been simulated for different wave directions obtained from wave radiation stresses output from NSW fine-resolution model simulations. The model setup is divided into two parts one with low discharge conditions (dry monsoon) and the other with high discharge conditions (wet monsoon). For dry monsoon season, the Sharavathi river discharge is very less (50 m^3/s) and for the wet monsoon season, it varies from 200-500 m^3/s during peak discharge periods.

For case-I (without breakwaters) in the wet season, on the 5th day of the model run higher Suspended Sediment Concentration (SSC) values are noticed both inside the river and near the inlet entrance, which gradually decreased and by 10th day became negligible except on the southern end of the river. By 15th day the SSC is completely flushed out and higher SSC values are noticed only far away on the sea side of the channel. For dry season the SSC values continue to be less throughout the model run up to 15 days. The model run for bed level changes shows negligible bed level changes up to 5th day throughout the entire area; but by 10th day slight deposition is noticed on the right bank of the river to the north of the channel entrance and by 15th day the deposition seems to have increased further. For dry season however the bed level changes are negligible for the entire area.

For case-II (with breakwaters) during wet season slightly higher values of SSC are noticed inside the region of breakwaters and also inside the river. But by 10th day the SSC is flushed out and by 15th day the entire area is free of any SSC. During dry season the SSC is negligible throughout the study area. The bed level changes during wet season indicate the sedimentation is negligible up to 10th day; but by 15th day slight deposition appears on the right bank of the river facing the channel inlet. But this siltation is not severe and it shall be concluded that the construction of breakwaters will not have any significant effect on siltation in the proposed project area.

2.5.4 Non- Cohesive Sediment transport

The littoral sand transport studies conducted through MIKE 21 (ST) model gave information on sand transport rates along the coastal stretch and near the tidal inlet.

For case-I (without breakwater) the rates of sediment transport for deep water waves from S and SSW are much less (<200 m^3/yr/m) along the entire coastal stretch. However slightly higher values (about 400) are noticed on the seaward side of the entrance where shoals are present. The bed level changes indicate deposition at the mouth and to the south of the inlet. For SW and SSW waves during monsoon season high values of sand transport (>2000) are noticed along the entire coastal stretch due to high and steep waves during this season. The bed level changes indicate significant deposition (0.005 m/day) both to the south and north of the entrance channel. During non-monsoon season, when W and WNW waves prevail the sediment transport as well as the bed level changes are not significant.

For case-II (with breakwaters) during monsoon season when SW and WSW waves prevail the sediment transport is significant (>2000) to the north as well as to the south of breakwater. Bed level changes indicate deposition to the northern and southern coastline in general; but there is also erosion just to the north of northern breakwater, some deposition is observed inside the breakwaters zone just at the mouth of the entrance channel, which must be cleared periodically in maintenance dredging.

Model studies indicate an annual deposition of about 10,300 m^3/yr in the dredged channel. Again, during non-monsoon months there is no significant deposition. On the whole the sand transport model studies indicate depositional trend near the mouth of the channel as well as to the north of the channel for case-I. But for case-II, the depositional trend in the channel has somewhat decreased due to breakwaters while some erosional trend is noticed towards the northern shores.

The predominant direction of alongshore sediment transport is towards north due to S, SSW and SW waves and the net transport of sediment is around $0.6x10^6$ m^3 directed towards north.

2.5.5 Shoreline Changes Study

The coastline evolution with the breakwaters and other interventions can be well modelled with state of art LITPACK model in the MIKE 21 software. The model has been simulated for two cases: (1) with breakwaters and without shore protection on the northern side of inlet and (2) with breakwaters and with sea wall on the northern side of inlet.

Case (I):

It is observed that severe erosion may occur towards the northern side of the north-breakwater with shoreline recession of around 20-30 m for 10 years (2-3 m/yr). Whereas, on the southern side, deposition occurs with a shoreline advancement of 50-60 m.

Case (II):

When a shore protection strategy like sea wall is constructed on the northern side of the barge/ Vessel loading facility, it is observed that the coast is almost stable and no net change in shoreline is observed. Whereas, on the southern side, slight deposition occurs with a shoreline advancement of 30-40 m.

2.5.6 Dredge Disposal study

Mathematical model study has been carried out to assess the fate of dredged spoil during dredging and dumping and its impact on the project area and near-shore regions. The dredging quantity during the proposed development is estimated to be 3.9 million m^3. Around 1.0 million cum of dredging quantity will be used for reclaiming purpose and the remaining quantity will be disposed in sea. MIKE 21 hydrodynamic model (with mud transport) has been used to simulate the suspended sediment concentration (SSC) and bed level changes when the dredged material is discharged in to the sea.

As the sediment transport and littoral drift studies revealed that the net transport along this coast is towards north, an appropriate disposal site towards north of the northern breakwater were chosen such that the disposed material does not come back towards the port entrance and at the same time it could be helpful in nourishing the eroding beaches in the area. After examining several locations along the northern coast, the most suitable site for dredge disposal is recommended at a distance of about 2 km to the north of port entrance channel located at latitude 14.308^0N and longitude 74.415^0E. It is observed that during wet season, the suspended sediment concentration (SSC) is relatively high for a few days after dredge disposal but later it spreads along the coast towards north without any impact to the port entrance area and the nearby environment. However, during dry season with WNW waves, the discharged sediment (SSC) spreads along the coast towards south, but it does not extend up to the entrance channel. It is evident from the rate of bed level changes that during wet season, there is very little increase in bed level in the nearshore regions at the disposal site. During dry season, the supplied sediment is carried towards south supplying sediment to the northern part of the north breakwater. This positive feedback from the natural nearshore current system is quite helpful for nourishing the northern beaches.

During periods of strong near shore currents (during peak wet season), it is suggested to dispose the sediment offshore at greater depths (>30 m). Based on the studies it is concluded that the dredge disposal at the recommended site will not cause any natural imbalance to the nearby shoreline and will not affect the coastal eco-system in any way. The details of the dredge spoil study such as Deposition pattern, Average suspended sediment concentration at dumping areas are discussed in Section 5.4.2.1 of Chapter 5.

2.6 Honnavar Barge/Vessel Loading Facility Development Plan

The following attributes have been considered during the planning of barge/vessel loading facility layouts:

- Bathymetry
- Type of seabed at the proposed site
- Wind and current condition at the site as well as in its vicinity
- Wave incidence
- Required tranquillity in harbour areas
- Littoral drift and sediment transport at the project site
- Traffic volume
- Availability of backup land for the terminal
- Expansion in stages
- Environmental and Social aspects

Based on the data collected on planning parameters and analysis of alternative layouts, development plan layout has been prepared for the proposed facilities at Honnavar. The barge/ vessel loading facilities is proposed near the mouth of Sharavati River. The facilities will be located at the northern end of the Kasarkod Sand spit. The berth is proposed parallel to the coastline. The berth is oriented in North south direction. The facilities proposed are as follows:

- Breakwater
- Turning circle, Approach channel
- Berthing area
- Stockyard

2.6.1 Barge/Vessel Loading Facility Layout

The salient features of barge/ vessel loading facility Layout are presented in Table 2-3

Table 2-3: Salient Features of Barge/ Vessel Loading Facility

S. No	Parameter	Description
1.	Land Area	44 Ha (108 acres)
2.	Cargo handling capacity	**Handling Capacity: 4.9 MTPA** • Coal - 2.7 MTPA • Iron Ore – 1.0 MTPA • General cargo – 1.2 MTPA • Granite – 0.16 MTPA • Fertilizer – 0.2 MTPA • Molasses with Agro Products – 0.15 MTPA • Steel Products – 0.4 MTPA • Sugar – 0.29 MTPA

S. No	Parameter	Description
3.	Cargo Storage	• Iron Ore – 1.8 Ha • Coal – 7.0 Ha • Other General Cargo – 6.10 Ha
4.	Cargo handling equipment	Barge/Vessel loader, mobile harbor cranes, pay loaders
5.	Berthing facilities	Berth of length 440 m and width 30 m
6.	Length of Northern Breakwater	820 m
7.	Length of Southern Breakwater	865 m
8.	Navigation Facilities	Approach Channel (Inner/ Outer): Length: 1395/2280 m; Width: 100/100 m; Depth:(-) 10/10 m Turning Circle: Diameter: 250 m; depth: (-)10.0 m
9.	Dredging and Reclamation	• Capital dredge material: 3.9 MCM • Reclamation: 1 MCM of dredged material will be used • Remaining dredge material will be disposed at the identified disposal location, recommended through mathematical modelling studies at a distance of about 2.0 km to the north of port entrance channel. During periods of strong near shore currents (during peak wet season), it is suggested to dispose the sediment offshore at greater depths (>30 m).
10.	Navigational Aids	• Channel marker buoys; Fairway marker Buoy; Breakwater marker lights; Berth Corner Lights
11.	Connectivity	• Proposed Rail Corridor Connecting project site to Manki Railway station of about 15 km • Road Corridor connecting project site to NH17

A layout showing the planned barge/vessel loading facilities is given as **Figures FD0201.**

2.6.2 Cargo Handling Capacity

The cargo planned to be handled at Barge/ Vessel Loading Facility is provided in Table 2-4.

Table 2-4: Cargo Handling Capacity

S. No.	Commodity	Traffic (MTPA)
1.	Coal	2.70
2.	Iron Ore	1.00
	General Cargo	
3.	Granite	0.16
4.	Fertilizer	0.20
5.	Molasses with Agro Products	0.15
6.	Steel Products	0.40
7.	Sugar	0.29
8.	**Total**	**4.90**

2.6.3 Design Vessel Size and Dimension

Detailed vessel (Barge) size analysis covering lighterage operations being carried out in various Indian ports such as Mormugao (Goa) Port, Hazira Port, Gopalpur Port, Redi Port and Belekeri port was carried out to estimate the vessel size, which is an important factor in planning of barge/ vessel loading facility at Honnavar. The design vessel size considered for planning of facilities is given in the Table 2-5.

Table 2-5: Design Barge/Vessel Size and Dimension

Type of Vessel/Barge	Design Vessel Size (T)	LOA (m)	Beam(m)	Draft (m)
Vessel	10,000 DWT	156	21	8.8
Barges	10,000	110	26	6.7

2.6.4 Berthing Facilities

The requirements for berths are worked out taking into consideration of throughput, parcel size, cargo handling rates, vessel size/parcel size, operational downtime, effective working hours per day and number of barges. Proposed barge/ vessel loading facility involves the development of Two (2) berths to handle various types of cargo.

- Each berth with length 440 m will be provided with a width of 30 m.
- Each Berth will accommodate 2 vessel or 4 barges of 10000 DWT Size
- The dredged depth at the berthing area will be (-) 10.0 m CD.

2.6.5 Operation Downtime and Effective Working Hours

The effective working days are considered as 260 days considering the weather downtime including monsoon and public holidays. The cargo handling and barge servicing will be carried out 16 hours a day in two shifts. The productive cargo handling hours on an average in a day when a barge is at berth has been taken as 15 hours to account for shift changes and for any unplanned stoppages.

2.6.6 Breakwaters

To protect the approach channel from siltation and to maintain tranquillity in the harbour basin, two (2) breakwaters are proposed for Honnavar barge/vessel loading facility. The southern breakwater of length 865 m starts from shore and extends upto (-) 5 m contour. It is aligned in North West direction. The top level of breakwater is maintained at (+) 6 m CD at head portion and tapered to (+) 4.3 m towards HTL. The northern breakwater of length 820 m is aligned in South West direction. The top level of breakwater is maintained at (+) 6 m CD head portion and tapered to (+) 4.3 m towards HTL. Siltation pattern near the mouth of the harbour will be observed for 1 to 2 years and will be extended to (-6) m contour if required.

Quantity of quarry stones required is about 4.5 Million Tonnes, which will be transported by road from Bhatkal which is about 60 km from the site.

2.6.7 Approach Channel and Turning Circle

The channel alignment is oriented considering the following aspects:

- To avoid cross winds and currents on the barges.
- In a straight line as far as possible.
- To reach the deep-water contours in shortest possible distance (this is to optimise the quantity of dredging).

The dimensions of the navigation channel to barge loading terminal are dependent on vessel size, the behaviour of vessel when sailing through the channel, maritime environmental conditions (winds, currents and waves) and channel bottom conditions. Channel design primarily involves the determination of the safe channel width and depth for the dimensions of design vessel.

The estimated width and depth of the channel is presented in the Table 2-6.

Table 2-6: Width & Depth of Channel for Honnavar Barge/ Vessel Loading Facility

Description	Width in meters	Depth in meters	Length in meters
Outer Channel	100	10	1395
Inner Channel	100	10	2280

The diameter and depth of turning circle for safe manoeuvring of design vessel for the proposed barge loading facility is presented in Table 2-7.

Table 2-7: Diameter & Depth of Turning Circle for Honnavar Barge / Vessel Loading Facility

Description	Diameter in meters	Depth in meters
Turning Circle	250	(-) 10.0

2.6.8 Dredging and Disposal

2.6.8.1 Capital Dredging and Disposal

For a safe manoeuvring of the vessels through navigational channel, harbour basin and berths, dredging depths is required. The capital dredging quantity for development is estimated at 3.9 MCM. It is observed from the geotechnical investigations that the sea-bed soil profile varies from medium sand to clay, a major portion of which can be used for reclamation.

The entire landside facilities (viz., stockyard, operation buildings, etc.) will be developed in an area of 44 Ha. The entire area selected for the port back-up area is a low-lying land which will require reclamation upto (+) 4.30 m CD. It is proposed to use the 1.0 MCM of material (dredge spoil) for reclaiming the backup area and remaining material will be dumped at the identified disposal location, recommended through mathematical modelling studies at a distance of about 2.0 km to the north of port entrance channel. During periods of strong near shore currents (during peak wet season), it is suggested to dispose the sediment offshore at greater depths (>30 m).The dumping.location or the disposal area is selected on the basis of the following parameters:

- Less adverse effect on the environment particularly on marine life
- Seabed levels (within the disposal area) should not get reduced, affecting thereby the depth requirements for safe navigation at all times.
- The material should not flow back to the channel and the dumping area should be along the direction of the most prevailing littoral current
- The lead distance should be the minimum possible to save on cost of disposal
- Least / minimum disturbance to the natural hydraulic regime/equilibrium

2.6.8.2 Maintenance Dredging and Disposal

The total maintenance dredging quantity is estimated to be around 10,300 m^3/year. The material collected will be dumped in the identified disposal ground. The details are discussed in Chapter 5.

2.6.9 Cargo Handling

The major commodities to be handled at Honnavar barge/vessel loading facility are iron ore, coal and other general cargo. The barge-shore cargo handling rate is generally selected on cost optimisation analysis, which takes into consideration reasonable barge time at berth, parcel size, the derived berth occupancy factor, relative cost of installing equipment of different rated capacity and barge time costs.

2.6.9.1 Cargo Handling Equipment

Selection of the equipment essentially depends on the through put. The iron ore will be transferred to barges from berth through barge loaders. The barge to shore transfer of coal will be using grab type mobile harbour crane. The type, capacity and number of equipments required for unloading and loading coal and iron ore are presented in Table 2-8.

Table 2-8: Summary of Cargo Handling Equipment

S.No.	Type	Cargo to be handled	Capacity	No. of equipments
At Mid sea				
1.	Barge unloader	Iron ore export	1200 TPH rated capacity	2
		Granite and Molasses export Fertiliser import	960 TPH rated capacity	2
		Sugar and Steel export	600 TPH rated capacity	2
2.	Barge Loader	Coal import	1200 TPH rated capacity	
At Berth				
3.	Mobile Harbour Crane	Coal import	1200 TPH	1
		Granite	960 TPH	1
		Molasses (Pipeline)	600 TPH	1
		Fertilizer	960 TPH	1
		Steel and sugar	960 TPH	1
4.	Loader	Iron ore export	1440 TPH	1
	Payloaders	Iron ore/coal		8

2.6.9.2 Cargo Transfer System

The iron ore will be brought from Bellary-Hospet region through trucks which will directly dump on the feeder of the barge loaders which will be transferred to barges. The additional iron ore will be stocked in the stockyard just behind the berth. Whenever the ore from the stockyard is to be loaded to barges, trucks can be used to transfer the iron ore to the berth. The coal brought by the barges is proposed to be unloaded on the jetty by mobile harbour crane. The conveying of coal from the platform to the stockyard will be done by trucks. Other cargo will also be handled in a similar way. The general cargoes will be stored in the space allotted for their storage.

2.6.10 Cargo Storage Area

The size of the storage areas have been worked out based on the criteria like the annual throughputs, design barge sizes, stowage factor, angle of repose, maximum and average stacking height, aisle space, reserve capacity factor, peaking factor, etc. Suitable space has been allocated in the backup areas in the form of open and covered storage facilities. The storage area requirements for various cargos are given in Table 2-9.

Table 2-9: Cargo Storage Area Requirements

S. No.	Cargo	Storage Area (in hectares)
1	Coal	7.0
2	Iron Ore	1.8
3	Other General Cargo	6.10
	Total	**14.9**

2.6.11 Shore Protection Works

The stockyard which will be developed by reclaiming the portion of the sand spit on the Kasakod side. Since the area is directly exposed to sea, the interface of sea land has to be protected by appropriate protection works.

As all port facilities are planned inside the river, area near the river mouth need to be protected from erosion. It is proposed provide shore protection work on both side of the river mouth and sea side of the storage area.

It is proposed to use geo-textile and rock boulders in gabions for protection of shore. The length of protection worked out as 1750 m. A typical cross-section of the protection work is presented in Figure 2-4.

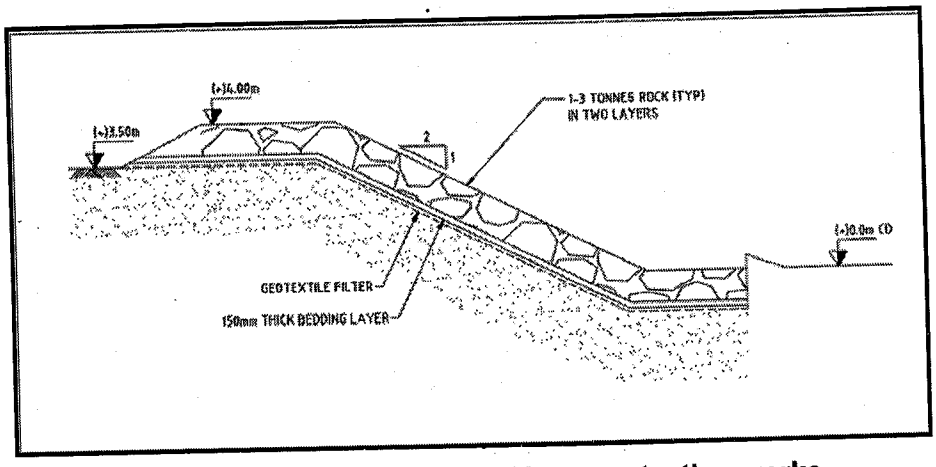


Figure 2-4: Typical Cross-section of Shore protection works

2.6.12 Fendering and Mooring Systems

Fenders are provided to absorb the berthing energy, which arise from the berthing of barge to avoid damage either to the structure or the vessel. Adequate numbers of fenders at adequate spacing has to be provided to avoid excessive load on the structure. Selection of fender will depend on the following parameters:

- Vessel size
- Berthing velocity
- Absorption capacity of fender
- Reaction force and deflection of fender
- Disposition of fender

2.6.13 Navigational Aids

The proposed development involves creating an approach channel, turning circle and manoeuvring area. Approach channels must be delineated by appropriate navigational aids. Navigational aids proposed for Honnavar barge/ vessel loading facility are Channel Marking Buoys, Star board size (2 Nos.), Port-hand side buoys (4 Nos.), Fairway marker Buoy, Breakwater marker lights and Berth Corner Lights.

2.6.14 Port Crafts

To handle the proposed vessel sizes in the short-term development, two tugs of about 20 T bollard pull capacity with fire-fighting arrangements are proposed. Also, the tug would have pollution control equipment on board. It is also proposed to provide the one pilot launch for the Honnavar barge/vessel loading facility.

2.6.15 Existing Hinterland Connections and Road/Rail Network

Good road and rail connectivity is an essential requirement for the efficient functioning of any barge/ vessel loading facility. As far as Honnavar barge/ vessel loading facility is concerned, the main commodities proposed to be handled are iron ore and coal. The iron ore handled at Honnavar is expected to come mainly from Hospet-Bellary belt of Karnataka state. At present, 30% of the iron ore exported from this belt is taken to the respective port by means

of road and the rest 70% via rail. Similarly, the coal being imported at Honnavar is taken to the respective destinations, mostly power plants, through road and rail.

2.6.15.1 Road Connectivity

The site has good road connectivity. NH 17 passes through Honnavar towards East of project site at a distance of about 1 km. The site is connected to Bellary through NH 63 and NH 17. NH 17 meets NH 63 near Ankola at about 45 km from the site.

Presently the site can be approached from a single lane black topped road that runs in continuation to NH 17 and then lies parallel to shoreline.

2.6.15.2 Rail Connectivity

The site can be easily accessed through Konkan railway (Connecting Kerala with Mumbai). The barge/vessel loading facility proposed at Honnavar is at a distance of 5.0 km from Honnavar railway station and 14 km from Manki railway station.

2.6.15.3 Airport & Seaport-Harbour

The nearest Airports are at Mangalore and Goa which is about 150 km and 220 km respectively and the nearest seaport is at Karwar which is about 60 km from the project site.

2.6.16 Proposed Dedicated Rail/Road Corridor

Proposed road connectivity to the barge/vessel loading facility is discussed below and shown in Figure 2-5. All these options will have to be laid afresh.

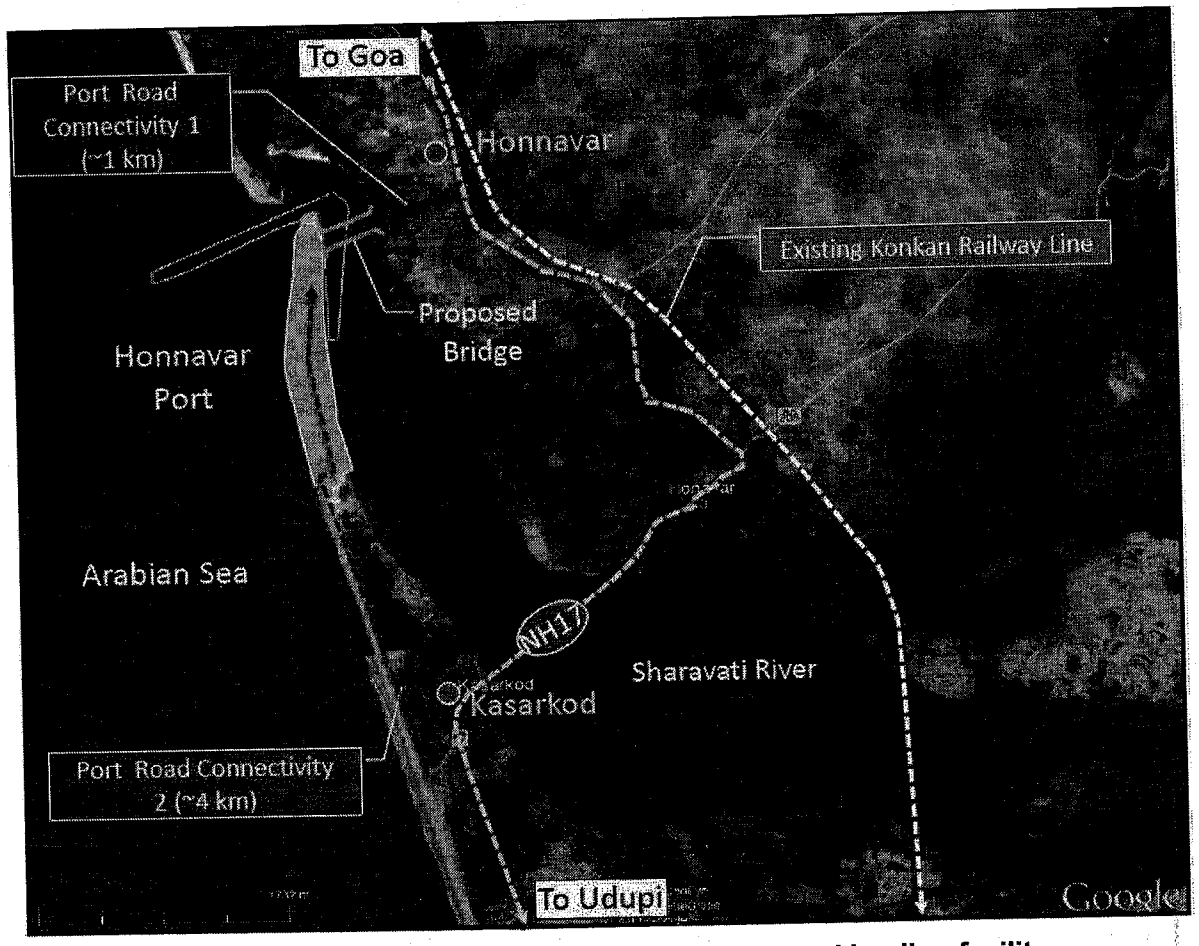


Figure 2-5: Proposed Road Connectivity to the Barge/ vessel loading facility

2.6.16.1 Road Connectivity Option: I

The road in this option takes off from NH 17 at Topalgaere and then traverses southeast a distance of around 0.90 km. A proposed bridge passing over River Bagdani will connect the road to the project site. Thus the overall length of this connectivity option will be around 1 km with a width of 25 m with a provision of double lane road.

2.6.16.2 Road Connectivity Option: II

In this option the proposed road starts from NH 17 at Kasarkod. This road will then run south east for some distance and then aligns parallel to the shoreline till it reaches the proposed project site. This option will be parallel to the existing single lane road at an offset distance of 100 m. The total length of this road from NH 17 to the proposed site is 4 km. This road connectivity will have a width of 25 m.

2.6.16.3 Conclusion

As the barge/ vessel loading facility is proposed in the Kasarkod side, Connectivity option II i.e. road from NH 17 to Kasarkod side is found to be best suited for this facility.

Proposed rail connectivity to the project site is discussed below and shown in Figure 2-6

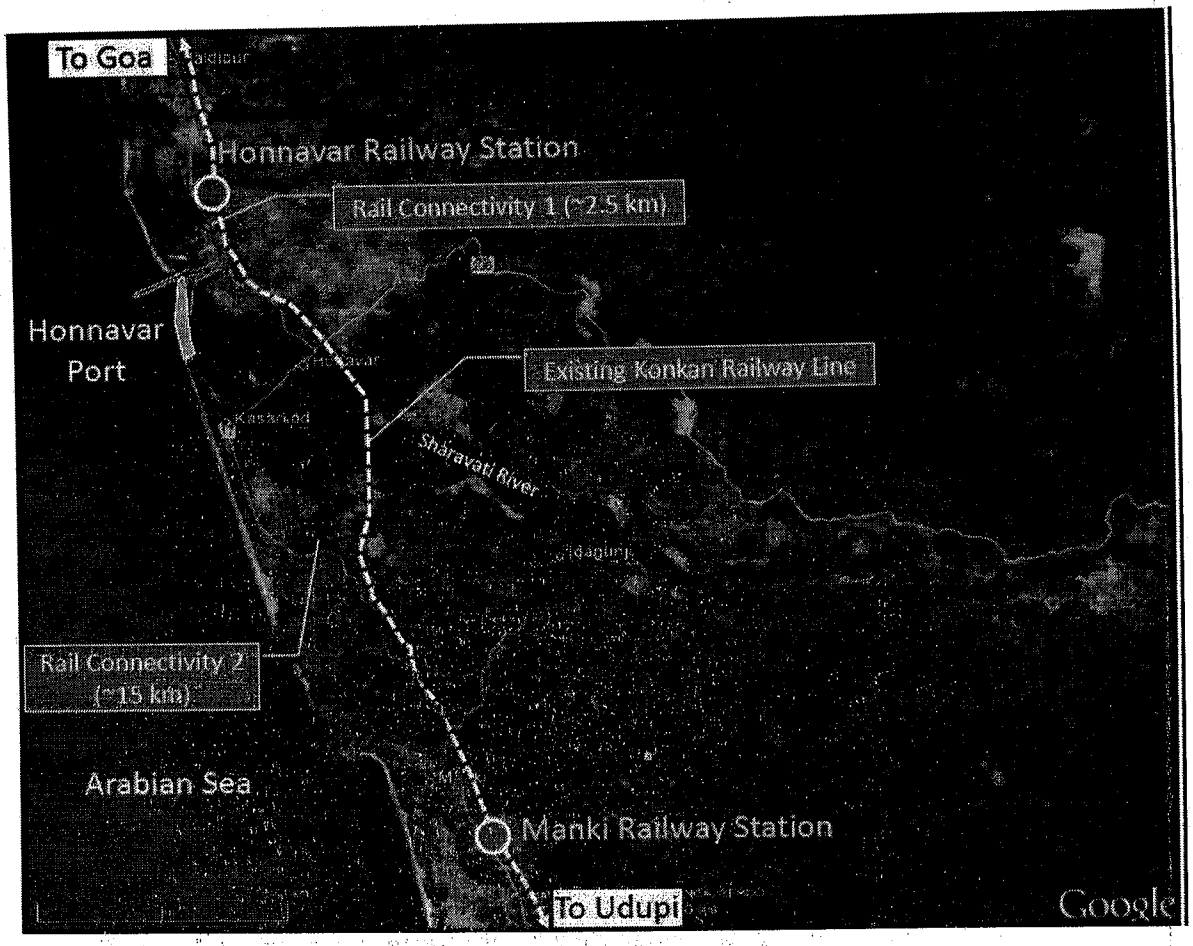


Figure 2-6: Proposed Rail Connectivity to the barge/vessel loading facility

2.6.16.4 Rail Connectivity Option: I

In this option, the connectivity will be provided to the proposed site from Topalgere side. Proposed railway siding will takes off from Honnavar railway station and will run parallel to the existing line for a length of about 1.6 km and then will turn south west towards the proposed site. Total length of the proposed railway line to be laid through this option is about 2.8 km. River Bagdani crossing is envisaged due to proposed alignment (connectivity option I) which in turn requires building a new bridge across the river.

2.6.16.5 Rail Connectivity Option: II

In this connectivity option, railway line will take off from the existing railway station at Manki. The new railway line will have to be laid for a distance of 14.6 km from Manki railway station to the proposed project site. Proposed railway line will run parallel to existing railway line for a length of about 8 km and then will take a turn towards sea coast which will then run parallel to the sea coast till the proposed project site for the remaining 6.6 km.

2.6.16.6 Conclusion

As the proposed barge/ vessel loading facility is coming up in the Kasarkod side, rail Connectivity Option II i.e. rail connectivity from Manki to Karsarkod side is found to be best suited for this facility.

2.6.17 Utilities and Services

2.6.17.1 Water Supply

Water is required at the Honnavar barge/vessel loading facility for the following activities:

- Supply to barges
- Supply to facility staff
- Miscellaneous purposes
- Dust Suppression and fire fighting purposes
- Green Belt Development

Water requirement during the construction is expected to be around 15m^3/day. Water demand during operational phase of barge/ vessel loading facility is estimated as 7m^3/day.

The break-up of the demand for each of the activity is presented in Table 2-10.

Table 2-10: Break-up of Water Requirement

S. No.	Activity	Water Requirement (m^3/day)
1.	Supply to barges	3
2.	Supply to barge loading facility staff and users	2
3.	Miscellaneous	2
	Total	**7**

The water requirement will be met from Karnataka Rural water supply and sanitation agency which includes supply to Barge/vessels, staff and users. In addition to that water required for dust suppression system and fire fighting will be sourced from Sharavati River.

2.6.17.2 Power Supply

The power supply is required for the following barge/vessel loading facility operations

- Lighting of the berth and storage yard
- Fire Fighting Equipments
- Operation Building
- Substation Lighting
- Miscellaneous

Power requirement during construction phase is expected to be around 1 MVA. The power demand is estimated at 1 MVA during operation. Construction phase power requirement will be met from DG sets and operation phase power will be drawn from Substation located at Honnavar (~2 km).

2.6.17.3 Buildings

Various buildings envisaged in the proposed barrage/vessel loading facility are as follows:

- Administrative buildings including the administrative office and officer's amenities, operational buildings / offices and the office space for major facility users.
- Maintenance buildings comprising a workshop, functional work stations and fire station.
- Substations to provide distribution of power.
- Navigational control centre, plant operational buildings, customs and security buildings, traffic offices, medical centre and amenity buildings / conveniences.

2.6.17.4 Fire-Fighting Facilities

Fire fighting system will be provided to both control and extinguish fires. It is proposed to install Fire Hydrant System, which will be designed to give adequate fire protection for the facility based on Indian Standards or equivalent and will conform to provisions of Tariff Advisory Committee's Fire Protection Manual. Fire hydrant system is provided for the following areas in the barge/ vessel loading facility:

- Berth areas
- Coal Stockpile area
- Main substation
- Control room
- Fuel depot area
- Generator power house
- Main administration office
- Workshop Areas
- Operation building

The fire hydrant system is designed to ensure that adequate quantity of water is available at all times, at all areas of the facility where a potential fire hazard exists. The hydrant service shall consist of two or more interconnected ring mains to cover the facility, each with its individual pump, located in a common pump house. Adequate arrangement with jockey pumps, pressure switches, etc., shall be provided to maintain the required pressure in the hydrant system.

Commonly used fire-fighting agents are water, foam, carbon dioxide and powder. In most of the cases when water is used as the fire-fighting agent, the intake mains should be below water at any point of time and protected from damages. A fire station will be provided for attending to all calls which will house required mobile fire tenders. One fire tender will be provided with snorkel attachment.

2.6.18 Pollution Control Aspects

2.6.18.1 Dust Suppression System

Dust suppression equipment will be provided for efficient control of dust pollution on environment during storage and handling of coking Coal and Iron ore at berth and stockyard. An efficient dust suppression system will contain dust particles before it is airborne.

A common system consisting of suitable pump, storage tank, nozzles have been proposed for efficient dust control system. Dust control is envisaged at following locations:

- barge/ vessel loading /unloading area

- Stockyards

Water sprinkling system at high pressure with swivelling type nozzles will be installed to cover entire stockpile. Nozzles will be installed on pipes at different levels from ground. Nozzles will be installed along stockpile at regular intervals to cover stockpile height and width.

2.6.18.2 Wastewater Management

The wastewater and sewage generated during construction at site and at labour camp will be collected in holding tank and periodically transferred to nearby Treatment Plant. During operation, the sewerage system will be provided to collect the sewage from Barge/ vessel loading facility administration building, canteen and operation buildings and it will be collected in septic tank followed by soak pits. The cargo storage area will be provided with an extensive drainage and treatment system so that the contaminated water from the stockyard area does not flow directly into the natural water bodies or into the groundwater system. Drainage pits will be provided in the workshop areas, which will be connected to an oily wastewater tank. Oily wastewater if any will be collected and will be treated (if required) to meet the discharge standards.

2.6.18.3 Rainwater Harvesting System

Rain water collected from roof of buildings will be channelized through rain water down comers and routed to garland drain around the buildings. These garland drains are connected to the plant storm water drainage network system all around the proposed barge/ vessel loading facility area. Recharge wells will be located at strategic locations within the site and will be interconnected to the storm water drain network system.

2.6.18.4 Solid Waste Management System

Solid waste from the utilities such as canteen shall be segregated as biodegradable and non-biodegradable waste and collected separately by providing bins at respective places. The collected biodegradable waste shall be subjected to composting and the compost will be used as manure for the development of green belt within the facility. The non-biodegradable waste like plastic shall be disposed off to approved vendors of KSPCB/CPCB in a scientific manner.

2.7 Coastal Regulation Zone Compatibility

Physical demarcation of HTL, LTL and delineation of CRZ setbacks for the project site were carried out by Centre for Earth Science Studies (CESS). Based on the perusal of the CRZ Notification, 2011 and the HTL/LTL survey outcome, following are the inferences:

- Proposed site falls on the sandy beach near the river mouth.
- CRZ Setback lines indicate that the proposed barge/ vessel loading site mostly falls within the CRZ I (B) (i.e. Area between LTL and HTL) , CRZ (III) undeveloped rural area and CRZ IV(near shore waters and backwaters).
- Proposed location does not contain environmentally sensitive areas such as National parks / marine parks, sanctuaries, wildlife habitats, corals / coral reefs. It also does

not include breeding and spawning grounds of fish and other marine life, area of outstanding natural beauty / historically / heritage area, area rich in genetic diversity.

Based on perusal of Coastal Regulation Zone (CRZ) Notification, 2011 and Karnataka Coastal Zone Management Plan (CZMP), Proposed Honnavar barge/vessel loading is a permissible activity in CRZ as it requires waterfront and foreshore facilities.

The project layout superimposed on HTL, LTL and CRZ setbacks is given as **Figure FD0202**.

2.8 Green areas and Greenbelt Development

An area of about ~3.10 Ha is proposed to be developed as greenbelt. Greenbelt will be developed at stockyards, administration building and along the road areas. The tree species to be used for the green belt development will be in line with the local ecology (indigenous species).

2.9 Project Cost

The capital cost estimate for development proposed barge / vessel loading facility is estimated at **513.00 Crores**.

2.10 Project Implementation Schedule

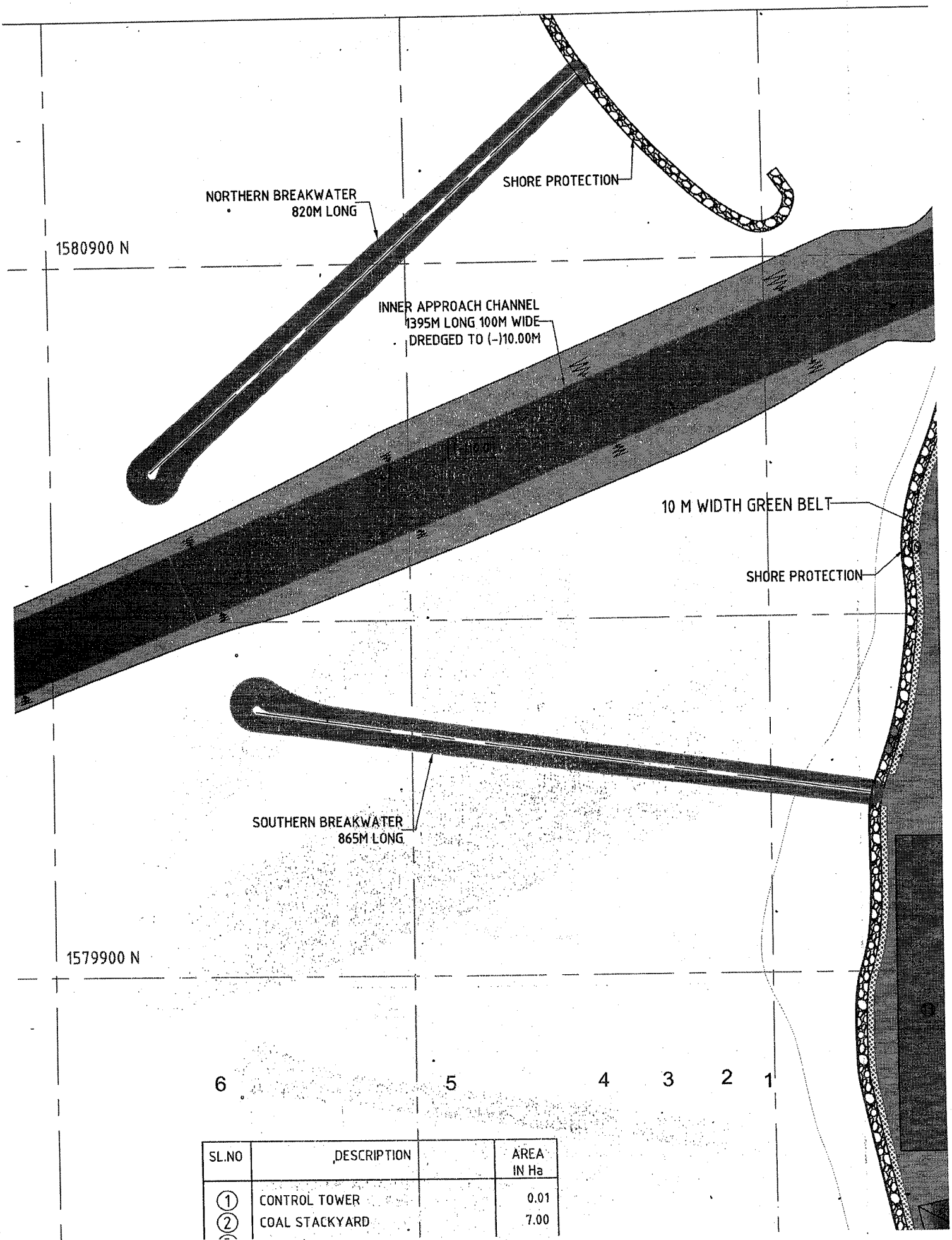
It is aimed at to achieve commissioning of the Barge/ vessel loading facility with in a period of 24 months from construction start / Financial Closure. The project implementation schedule is given as **Appendix I**.

2.11 Corporate Social Responsibility

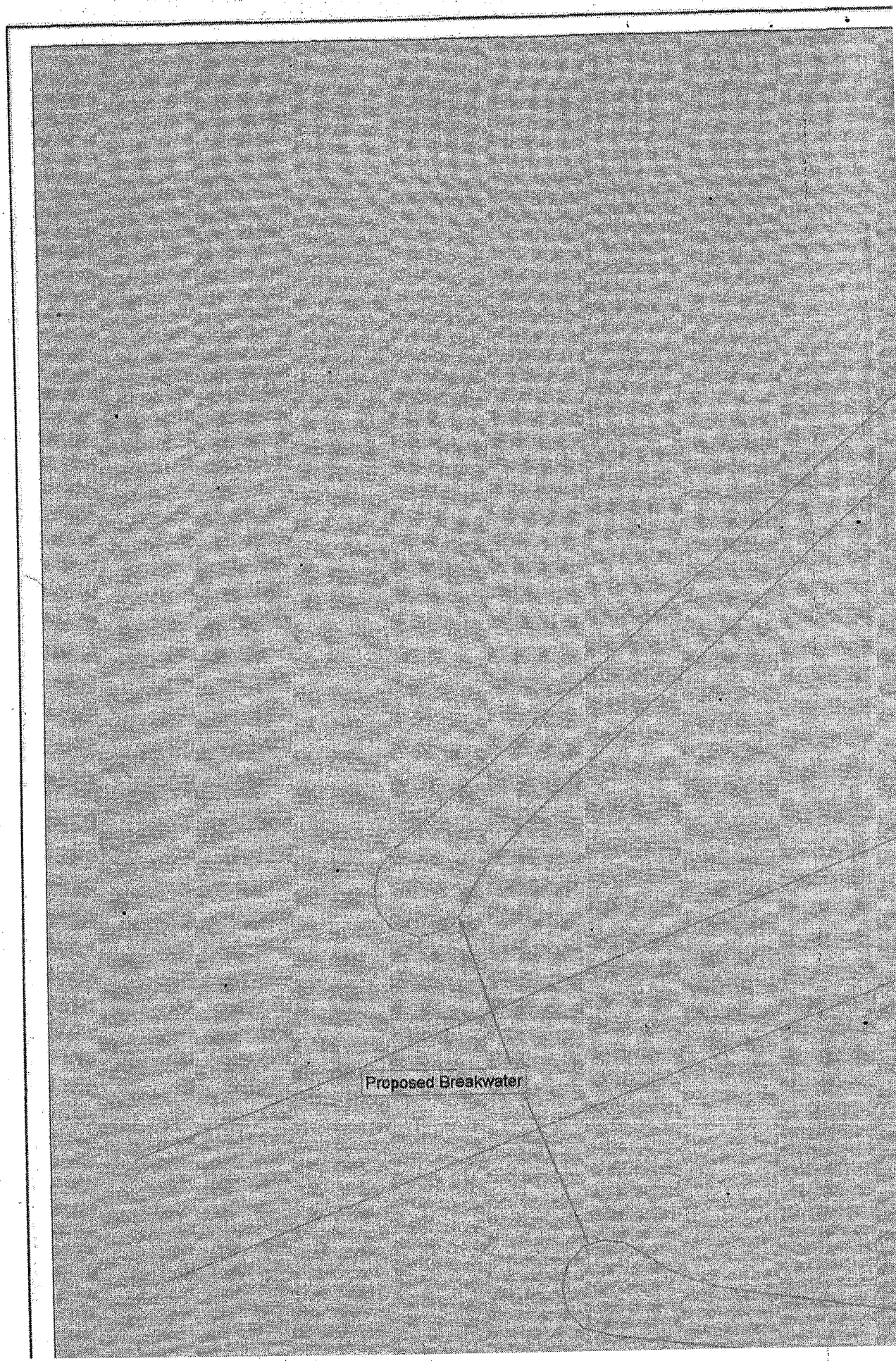
As a part of Corporate Social Responsibility (CSR), HPPL proposed to take up following activities for improving the way of living of people of Kasarkod Tonka, Apsarkonda and other nearby villages.

- Providing better health services
- Providing better educational facilities for children of employees
- Creating job opportunities
- Facilitate self-employment through training and credit linkage
- Outsourcing opportunities to Self Help Groups (SHG)
- Providing protected water supply system to Kasarkod Tonka and Apsarkonda villages.
- Strengthening area Government hospitals by assisting them in procurement of essential medical equipments.
- Providing quality health care through regular medical camps.

FIGURES



SL.NO	DESCRIPTION	AREA IN Ha
1	CONTROL TOWER	0.01
2	COAL STACKYARD	7.00


Proposed Breakwater

Chapter 3
Analysis of Alternatives

3 Analysis of Alternatives

3.0 General

Environmental sustainability, Social, Engineering aspects and Economic viability are the criteria considered to study the various possible options of Barge/ vessel loading facility development and their advantages and disadvantages. Accordingly various possible layouts have been prepared utilising the results of traffic study, environmental aspects in the area, field surveys, model studies, and economic viability which enabled to short list the most promising alternatives.

3.1 Alternate Options

This section outlines the various alternatives considered for construction of the proposed facility. To study the possible options for development of Barge/ vessel loading facilities, various alternative layouts were prepared and reviewed. The following alternatives were analysed and evaluated.

- Alternative 1: Straight Channel with berth and Stockyard on Kasarkod side
- Alternative 2: Channel along the present river mouth, berth and Stockyard on Kasarkod side
- Alternative 3: Channel made after cutting open the Kasarkod spit with berth and Backup area on the Kasarkod side
- Alternative 4: Channel made after cutting open the Kasarkod spit with berth and Backup area on the Honnavar side

The features common to all alternatives are described here under:

All alternatives are planned to handle 2 vessel or 4 barges of 10000 DWT simultaneously. The total length of the berth is planned to be 440 m with a width 30 m. The approach channel is planned for a width of 100 m and dredged depth of (-) 10 m CD. The turning circle is planned for a diameter of 250 m and dredged depth of (-) 10 m CD.

The details of the alternative layouts are presented in following subsections:

3.1.1 Alternative 1: Straight Channel with berth and Stockyard on Kasarkod side

In this alternative the channel is aligned straight and is made by cutting open the Northern end of Kasarkod sand spit 75 m south of the present opening to provide better navigation in the turning circle. The berth is proposed south of the turning circle with the stockyard immediately behind the berth. Breakwater is proposed to prevent siltation in the channel. Southern breakwater of length 895 m and a Northern breakwater of length 580 m are proposed. Land area of about 3 Ha will be isolated due to cutting open the spit. The stockyard can be connected to the NH 17 by developing the road along the sand spit behind the fishery harbour. Alternative-1 Layout is presented in **FD0301**

3.1.2 Alternative 2: Channel along the present river mouth and berth and Stockyard on Kasarkod side

In this alternative the approach channel is aligned along the present channel which is being used by the fishing vessels. The channel is made by dredging the northernmost tip of Kasarkod sand spit. The berth is proposed south of the turning circle with the stockyard immediately behind the berth. Breakwater is proposed to prevent siltation in the channel. A Northern breakwater of length 820 m and a Southern Breakwater of length 865 m are proposed. The stockyard can be connected to the NH 17 by developing the road for about 4 km along the sand spit behind the fishery harbour. Alternative 2-Layout is presented in **FD0302.**

3.1.3 Alternative 3: Channel made after cut opening the Kasarkod spit with the berth and backup area on Kasarkod side

In this alternative the channel is made by cutting the Kasarkod spit just north of the proposed extended fishery wharf. The berth is proposed north of the turning circle with stockyard immediately behind the berth. Breakwater is proposed to prevent siltation in the channel. A northern breakwater of length 250 m and Southern breakwater of length 225 m is proposed. The stockyard can be connected to the NH 17 by developing a bridge connecting the Kasarkod and Honnavar road joining the NH 17 at Topoalgere. A road of about 1 km has to be developed after the bridge. Alternative-3 Layout is presented in **FD0303.**

3.1.4 Alternative 4: Channel made after cut opening the Kasarkod spit with berth and backup area on Honnavar side

In this alternative the channel is made by cutting open the Kasarkod spit just north of the proposed extended fishery wharf. The berth is proposed on the Honnavar Side of Sharavati River with the stockyard developed by reclaiming the area behind the berth. The stockyard can be connected to the NH 17 by developing road of about 2 km along the present commercial wharf in front of the port office and joining the NH 17 just before the Sharavati Bridge. Alternative-4 Layout is presented in **FD0304.**

A northern breakwater of length 250 m and Southern breakwater of length 225 m is proposed in this option.

3.2 Comparison of Layouts

Various alternatives discussed above are compared below:

Table 3-1 presents the comparison between the above presented layouts.

Table 3-1: Comparison of Layouts

S.No.	Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1.	Location	Berth is located on the northern side of the Kasarkod spit	Berth is located on the northern side of the Kasarkod spit	Berth is located on the central part of the Kasarkod spit	Berth is located on Honnavar side

S.No.	Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
2.	Approach Channel	Channel is aligned East - West by cutting the Kasarkod Spit on the northern end. The Channel Length: 3740 m	Channel is aligned in the South West Direction. The Channel Length: 3675 m	Channel is aligned in the East - West Direction. Channel Length: 3550 m	Channel aligned in the West North West Direction. Channel Length: 3565 m
3.	Dredging	3.0M cum	3.9 M cum	3.5 M cum	2.8 M cum
4.	Breakwater	Northern: 580 m Southern: 895 m	Northern: 820 m Southern: 865 m	Northern: 250 m Southern: 225 m	Northern: 250 m Southern: 225 m
5.	Navigability	Straight Channel; Turning is comparatively easy	Channel connecting the turning circle is aligned and turning is comparatively easy	Straight Channel; Turning is comparatively easy	Straight Channel; Turning is comparatively easy
6.	Connectivity to NH 17	Road can be developed along the Sand spit behind the fishery wharf	Road can be developed along the Sand spit behind the fishery wharf	A connecting bridge has to be constructed to connect the Kasarkod and Honnavar side	Road can be developed along the commercial wharf on the Honnavar side in front of the port office
7.	Availability of Backup area	Good storage area of 44 Ha is available	Good storage area of 44 Ha is available	Good storage area of 44 Ha is available	Area needed for storage has to be reclaimed
8.	Additional cost	Nil	Nil	Total cost of the project is more as it needs a bridge and land acquisition for the road	Total cost of the project is more as it requires reclaiming of the stockyard and land acquisition for the road
9.	Social	Nil	Nil	Proposed Road alignment will pass through densely populated area	Area earmarked for development is in front of a densely populated area
10	Approx Civil cost* (` Crores)	303	450	285◊	276
11.	Future Development	Good potential for development into a major port	Good potential for development into a major port	It will continue as a lighterage port	It will continue as a lighterage port
12.	Ranking	II	I	IV	III

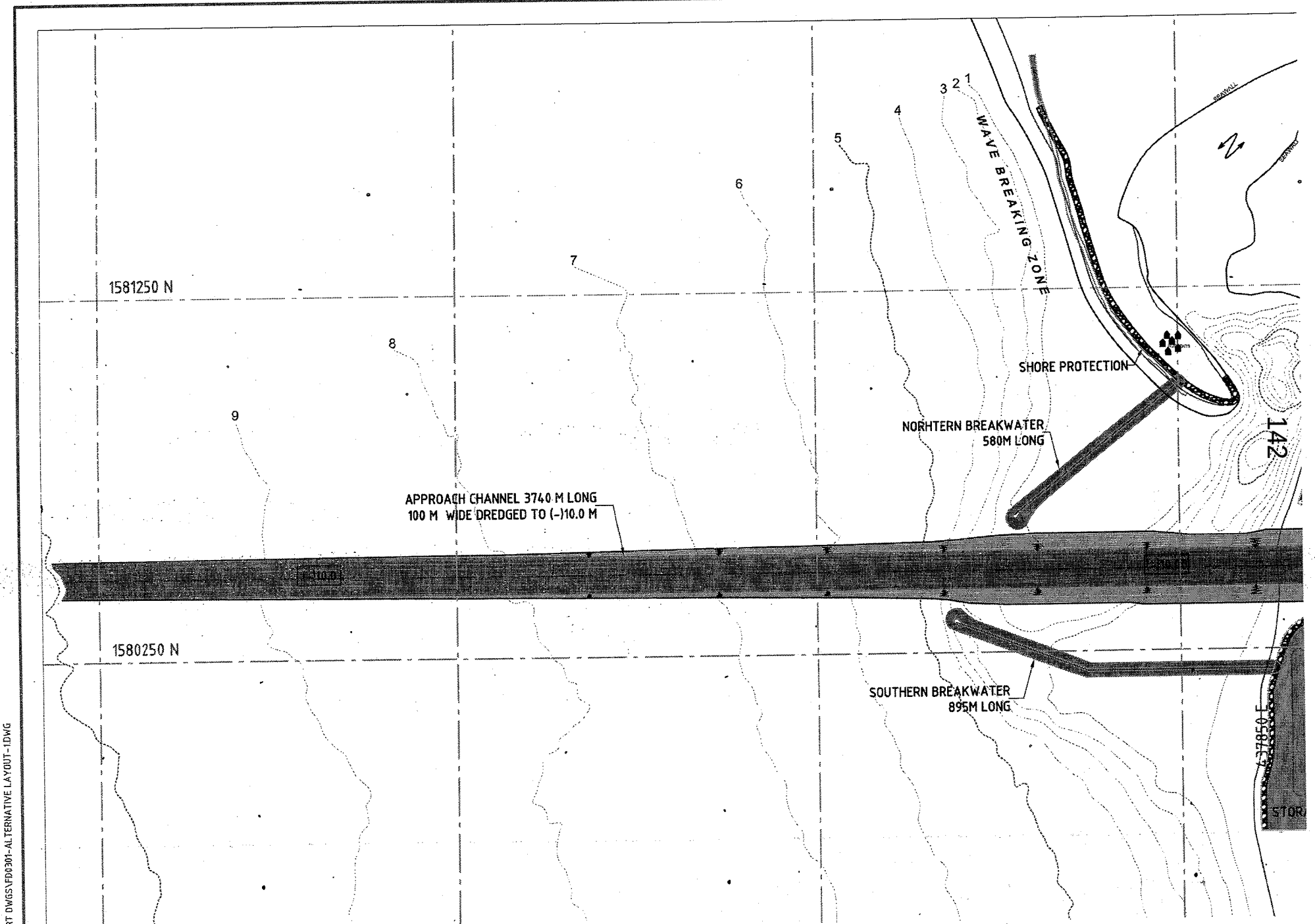
*) Cost of road way is not considered.

◊) Includes Cost of bridge connecting Kasarkod and Honnavar.

3.3 Selection of Best Layout

From the above comparison, Alternative 2 has been considered for further development as this alternative facilitates better connectivity easy operation and also good potential for future development.

FIGURES



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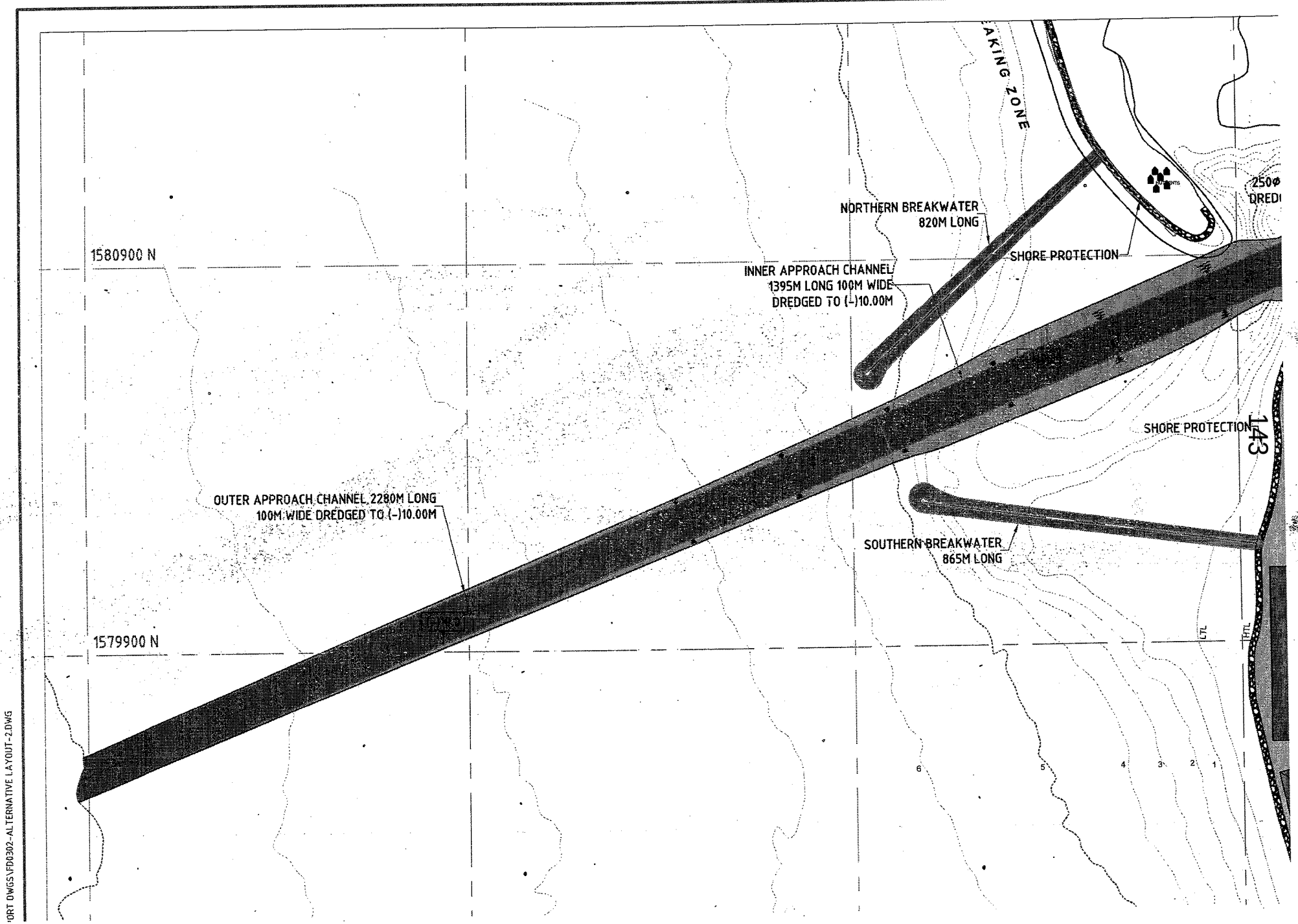

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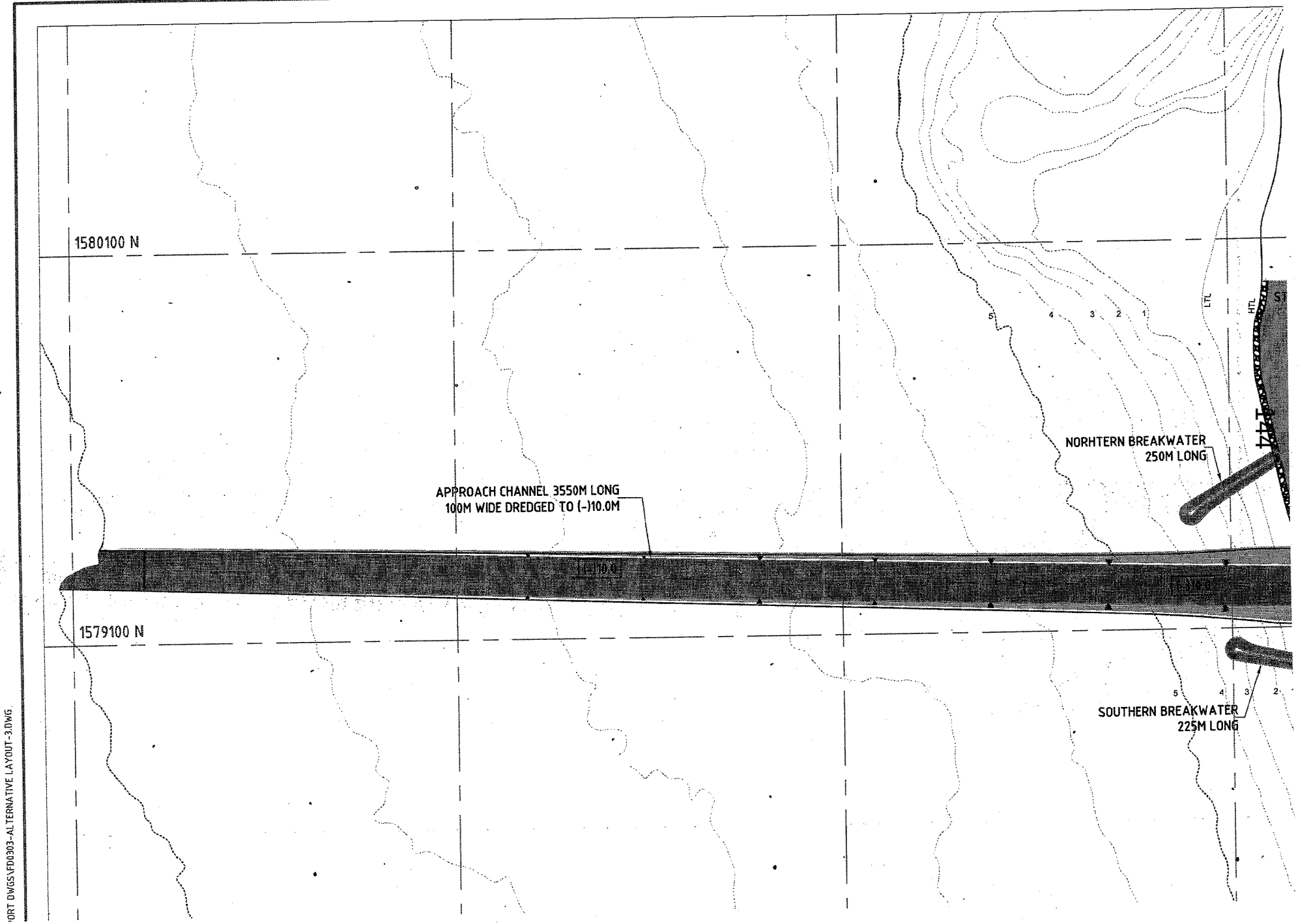

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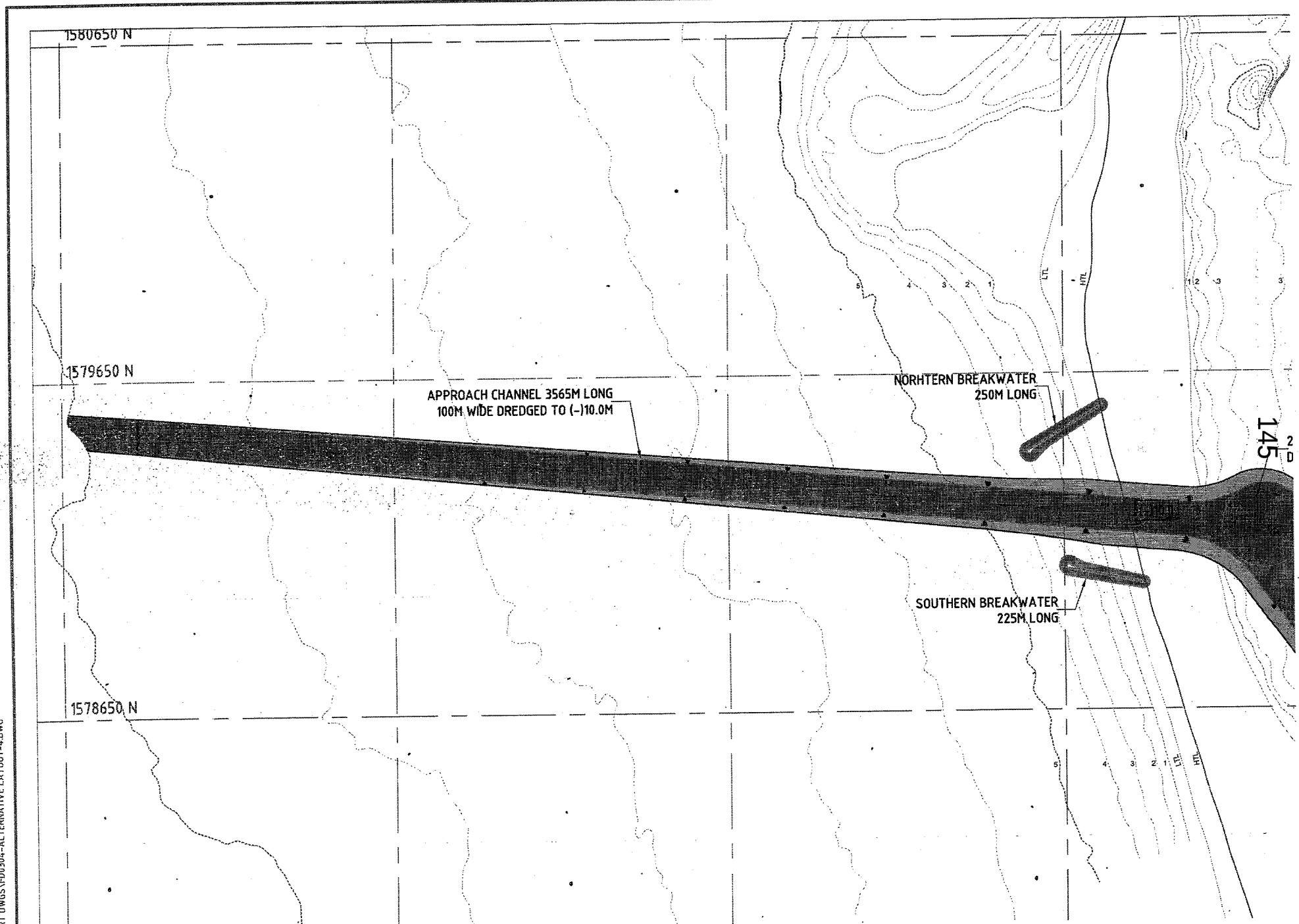

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CHAPTER 4
DESCRIPTION OF ENVIRONMENT

4 Description of Environment

4.0 General

The baseline/existing environmental conditions in the study area/Project Influence Area (PIA) are established based on field surveys, investigations and review of data collected from various secondary sources. The baseline environmental studies have been conducted for one season (non monsoon season) covering the following terrestrial and marine environmental attributes.

Terrestrial Environmental Components	Marine Environmental Components
• Meteorology – Temperature – Humidity – Rainfall – Wind Speed & Direction – Secondary Data	• Marine Water Quality – Physico-Chemical Parameters
• Ambient Air Quality – PM_{10} – $PM_{2.5}$ – Sulphur Dioxide (SO_2) – Nitrogen Dioxide (NO_2) – Carbon Monoxide (CO) – Hydro carbons (HC) – Mercury (Hg) – Ozone (O_3)	• Sediment Quality – Physical Parameters – Chemical Parameters
• Ambient Noise Levels – Day equivalent noise levels – Night equivalent noise levels	• Biological Parameters – Plankton – Macrobenthos – Meiobenthos
• Inland Water Quality – Groundwater Quality – Surface Water Quality	•
• Soil Quality	
• Flora & Fauna (Ecology)	

4.1 Study Area

Project Influence Area/Study Area: As described in **Chapter 1**, an area within 10 km radius, with the barge/vessel loading facility site as boundary has been earmarked for the study as the PIA/**study area**. The **core area** is the project site. The study area is of 10 km radius for primary data generation.

Description of Project Influence Area: The proposed Honnavar Barge/vessel loading facility is located near the mouth of Sharavati River in Kasarkod Tonka Village, Uttara Kannada District, Karnataka. The land proposed to be developed for Barge/vessel loading facility is mostly between Low tide Line (LTL) and High tide Line (HTL) and partly beyond HTL and meets the Coastal Regulation Zone (CRZ) I (b), CRZ III & CRZ IV Classification.

Study Period: The baseline environmental data was generated for one season (12 Weeks).i.e., Summer Season 2011.

4.2 Land Environment

4.2.1 Land

Availability of required land for the Barge/ vessel loading activity: The proposed site of 98.84 acres (~44Ha) of land completely coastal sand. The rail/road corridor is proposed to be developed to connect the Konkan Railway network and NH 17 respectively.

4.2.2 Land Use – Land Cover Study Methodology

Methodology: The land use/land cover for the study area is prepared in the form of a map prepared by using satellite imageries of IRS – P6 LISS IV MX (RABI Season) procured from ***National Remote Sensing Centre (NRSC), Hyderabad***. The satellite imagery showing the 15 km radius PIA is shown as **Figure FD0401**. The satellite data is processed using ERDAS Imagine software supported with ground checks and ground truth verification. Area and distance calculations have been carried out using Geographical Information System (GIS) software after geo-referencing the interpreted data with the help of Survey of India (SoI) Toposheet (scale 1:25,000). Land use and Land Cover for the study area is given as **Figure FD0402**.

4.2.2.1 Land use Pattern in Project Site

The land use in the project site is presented in Table 4-1.land use pattern of the project influence area is presented in Table 4-2.

Table 4-1: Land Use in Project Site

S. No.	Land Use	Area (Ha)	%
1	Coastal sand	44	100
	TOTAL	**44**	**100**

The proposed land use of the project site is given in the below **Figure 4-1**.

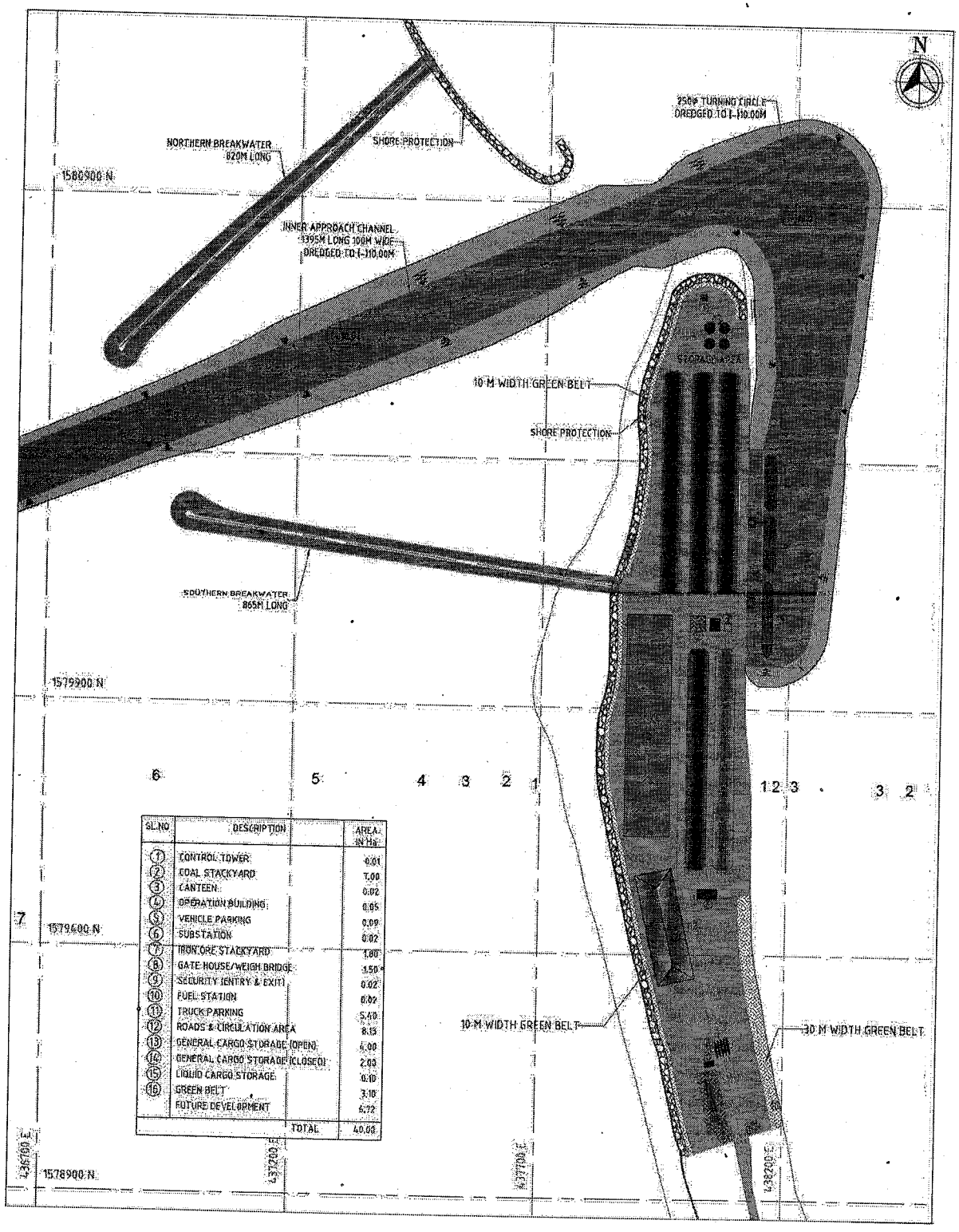

Figure 4-1: Proposed Land Use Pattern Map of Honnavar Barge/Vessel Loading Facility

4.2.2.2 Land use Pattern in and around Project Site

Table 4-2: Land Use Pattern in the Project Influence Area

S. No.	Land Use		Sq. km	Area (%)
	Description	Details		
1.	Built Up	Settlements	7.777	1.10
2.	Water bodies	Tank/River/etc.	43.127	6.10
		Sea	361.277	51.10
3	Forest	Dense forest	78.477	11.10
		Scrub forest	61.367	8.68
		Mangroves	10.605	1.50
4	Crop Land	Single crop	16.261	2.30
		Double crop	14.847	2.10
		Plantations	36.057	5.10
5	Waste Lands/Others	Land with scrub	18.382	2.60
		Land without scrub	14.847	2.10
		Costal sand	13.433	1.90
		Aquaculture	2.121	0.30
		Mud plat	1.414	0.20
		Others	24.038	3.40
		Total	**707.000**	**100.00**

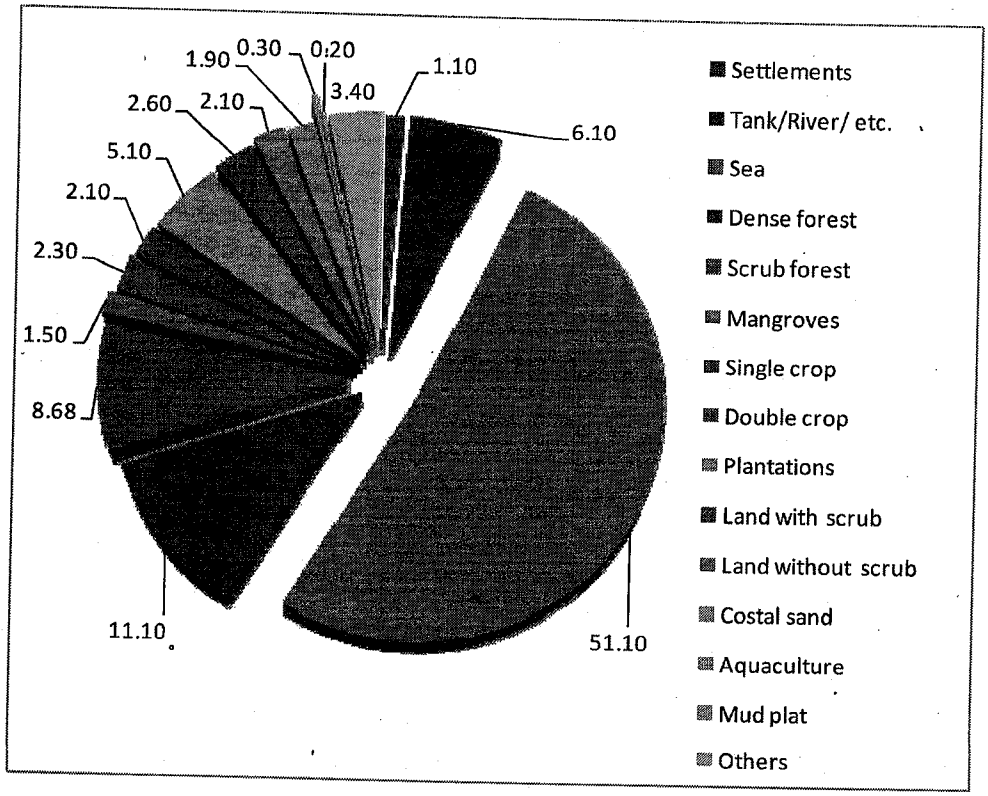

Figure 4-2: Land use Pattern in Project Influence Area

4.2.2.3 Environmentally/Ecologically Sensitive Areas

The environmental sensitive areas covering an aerial distance of 15 km from proposed barge/vessel loading facility boundary along with aerial distance from the boundary is given in Table 4-3.

Table 4-3: Environmentally Sensitive Areas within 15 km from Site Boundary

S. No.	Areas	Name/Identity	Aerial distance (within 15 km)
1	Areas protected under international conventions, national or local legislation for their ecological, landscape, cultural or other related value	Mangroves in Sharavati river	2.5 km, E
2	Areas which are important or sensitive for ecological reasons - Wetlands, watercourses or other water bodies, coastal zone, biospheres, mountains, forests	**River** Sharavati River	Proposed Barge/vessel loading facility near Sharavati river mouth
		Badgani River	~ 300 m, N
		Reserve Forest Reserve forest near Hebbankere	~ 14 km, NE
		Minor Forest There are minor forests with in the 15 km aerial distance.	~ 10 km, S
		Ecology Mangroves	~ 2.5 km, SE
3	Areas used by protected, important or sensitive species of flora or fauna for breeding, nesting, foraging, resting, over wintering, migration	**Reserve Forest** There is reserve forest near Hebbankere	~ 10 km , NE
4	Inland, coastal, marine or underground waters	Arabian sea	Adjoining West.
		Sharavati River	Proposed Project is near River mouth of Sharavati.
		Badgani river	~ 300 m, N
5	State, National boundaries	No	-
6	Routes or facilities used by the public for access to recreation or other tourist/pilgrim areas	NH 17	1 km, E
		NH 206	3.5 km, E
		Konkan railway line connecting Kerala and Maharashtra	1.5 km, E

S. No.	Areas	Name/Identity	Aerial distance (within 15 km)
7	Defence Installations	Nil	Nil
8	Densely populated or built-up area	Honnavar	1.5 km, E
		Karki	3.0 km, N
		Apsarkonda	5.0 km, S
		Manki	15.0 km, S
		Aroli	10. 0 km, E
		Arangandi	12.0 km, NE
		Navilgon	15.0 km, N
		Haldipur	7.0 km, N
9	Areas occupied by sensitive man-made land uses (hospitals, schools, places of worship, community facilities)	**Hospitals**	
		St. Ignatius Hospital, Honnavar	~ 1.5 km, E
		Sridevi Maternity Centre, Honnavar	
		Government Hospital, Honnavar	
		Sharada Nursing Home, Honnavar	
		Suvidha Hospital, Honnavar	
		Balkur Clinic, Honnavar	
		Educational Institutions	
		S.D.M. College of Management Studies, Honnavar	~ 1.5 km, E
		S.D.M. Arts, Science and Commerce College, Honnavar	
		St. Ignatius School of Nursing, Honnavar	
		St. Anthony's College for Physical Education, Honnavar	
		Government Industrial Training Institute, Honnavar	
		The New English School, Honnavar	
		St. Thomas School, Honnavar	
		Holy Rosary Convent School, Honnavar	
		Higher Elementary School (Brother School), Honnavar	
		St. Marathoma School, Honnavar	
		Government Kasba Primary School, Honnavar	
		NMS Higher Primary School, Honnavar	

S. No.	Areas	Name/Identity	Aerial distance (within 15 km)
10	Areas containing important, high quality or scarce resources, (ground water resources, surface resources, forestry, agriculture, fisheries, tourism, minerals)	Reserve forest	~ 14 km, NE
11	Areas already subjected to pollution or environmental damage. *(those where existing legal environmental standards are exceeded)*	Nil	Nil
12	Areas susceptible to natural hazard which could cause the project to present environmental problems, (*earthquakes, subsidence, landslides, erosion or extreme or adverse climatic conditions*)	The project falls in Seismic Zone III (Moderate risk). During the design stage the effects due to this natural disaster will be considered as per IS:1893 (part III) such as Zone factor 0.16 factor of safety will be considered.	-

4.2.3 Topography

The land proposed to be developed for Honnavar Barge/vessel Loading Facility is mostly between LTL and HTL. The project area is a typical coastal plain. The site exhibits flat terrain features with a gentle slope towards -west. The seashore in general is flat in this region.

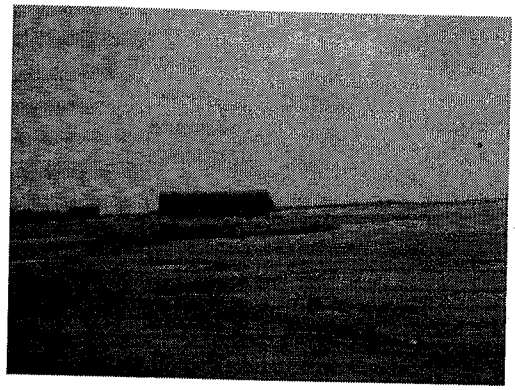
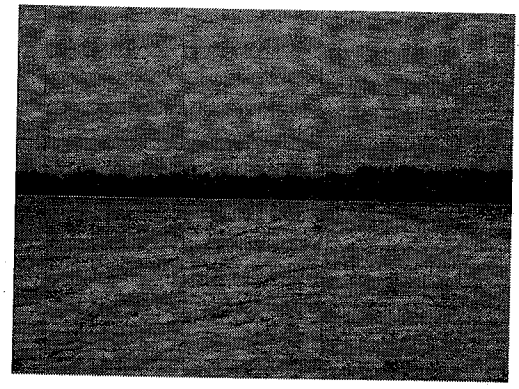
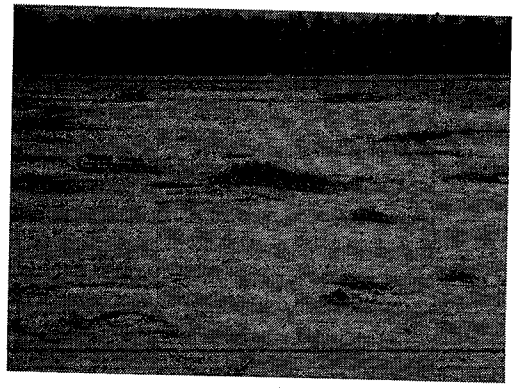

Plate 4-1: Landscape of the Project Site

4.2.4 Geology

Geologically, the study area is underlain by potash rich granodiorite & granite soils are dominant in the study area. Near the mouth of the Honnavar Barge/vessel loading Facility River, saline soils are present.

The Geological map of Uttar Kannada district is provided in Figure 4-3.

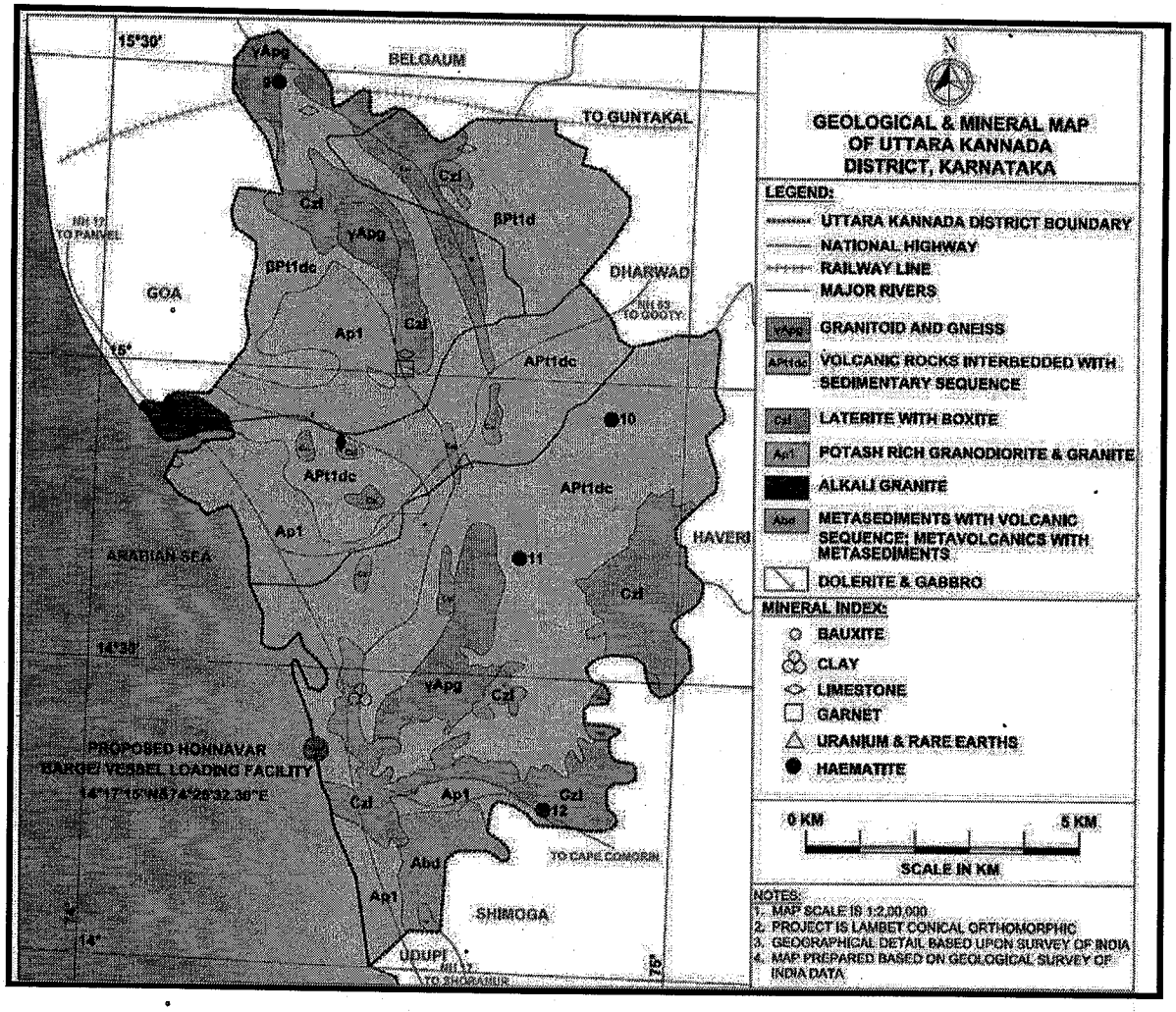

Figure 4-3: Geological Map of Honnavar Barge/vessel loading facility Region *(Source: District Planning Series Map)*

4.2.4.1 Hydrogeology

Uttara Kannada district consists of rock formations of Archaean complex characterised by a system of ridges and a plateau on the west. Laterites occur overlying the schist and granites, and alluvium along the rivers and lagoons of the coast.

Main aquifers in the study area are the weaker, weathered and fractured zones of metavolcanics, metasedimentaries, granites and gneisses, laterites, along with the alluvial patches found along the major stream courses.

Since, the hard rocks in the area do not posses the primary porosity, the secondary structures like joints, fissures and faults present in these formation acts as a porous media. It is generally çonstitute a 3% of volume of formation to facilitate to house the ground water. The ground water under atmospheric influence is the phreatic zone, which generally occurs with in the depth range of 3.00 to 30.00 mbgl .The fracture zones occur at various depth zones within the depth of 185.00mbgl are expected to be saturated with ground water. It is found that the water bearing characteristics of schistose rocks are more or less similar to that of gneisses and granites. But the weathered zones of schists may not yield as granites and gneisses, because of their compact and finegrained nature.

Alluvium occurs along the river banks in few to 14.00 metres thickness, holds the bank storage. and occurs as narrowstrip along the sea coast and the creeks occurs up to a depth of 50m. Ground water in the above aquifer material generally occurs under unconfined to semi-confined and confined conditions, in the shallower zones under phreatic condition and under semi-confined and confined condition in the deeper zones. The ground water is being exploited from within the depth range of 3.00 to 31.00mbgl through dugwells and 30.00 to 200.00mbgl through dugcum- bore wells and Bore wells. The hydrogeological map depicting all hydrogeological details of the area is presented as Figure-4-4.

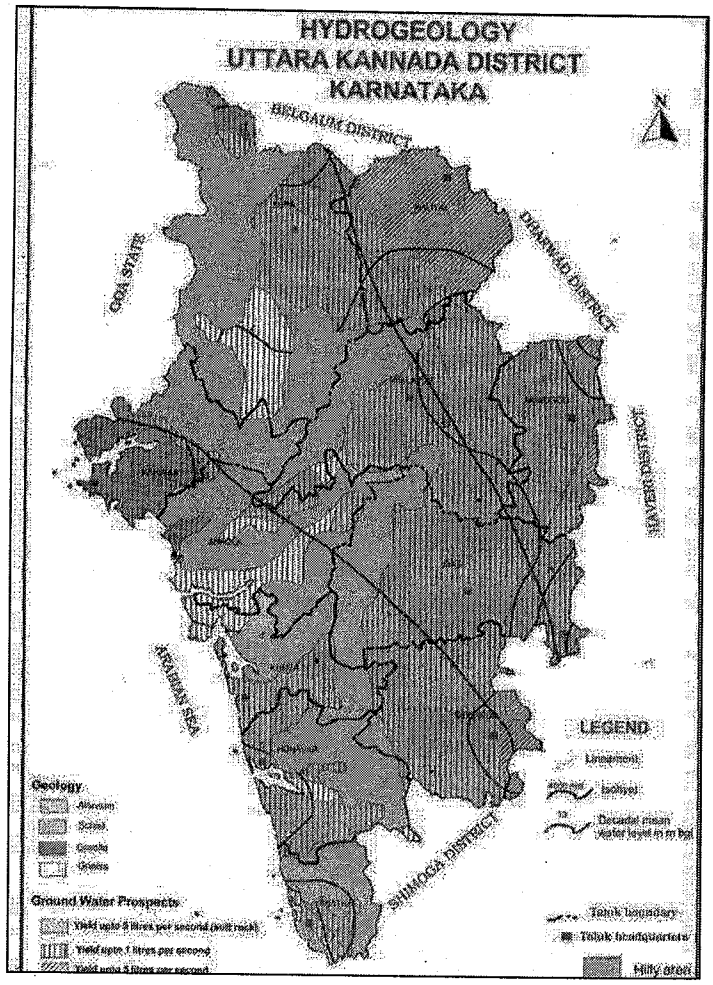

Figure 4-4: Hydrogeology Map of Uttara Kannada District

4.2.4.2 Seismicity

As per the IS: 1893 (Part 1) 2002 of Bureau of Indian Standards (BIS), the project area and study area fall in Zone III which is a moderate to low risk zone. The seismic zoning map of Karnataka region is shown in Figure 4-5.

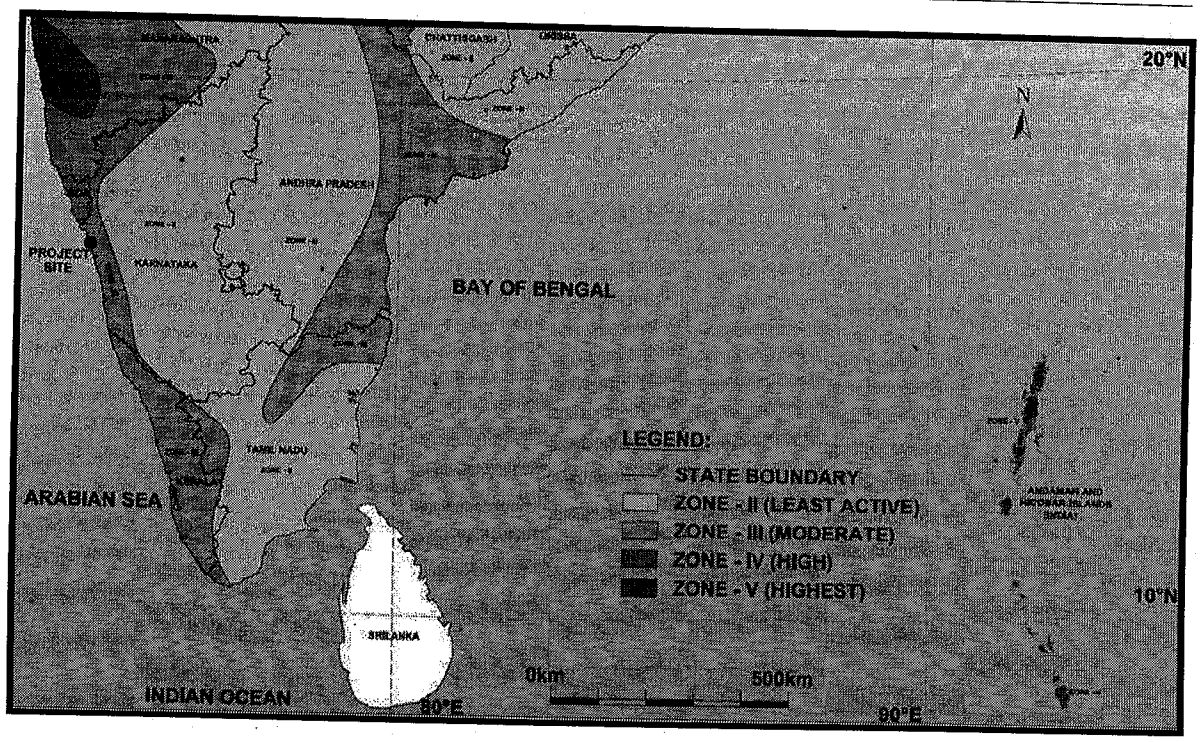

Figure 4-5: Seismic Zoning Map of Karnataka

4.2.5 Soil

Soil monitoring was carried out at Five (5) locations. Sampling locations within 10 km radius from the site are shown in **Figure FD0403**. The details of soil sampling locations are given in Table 4-4.

Table 4-4: Soil Sampling Locations

Station No.	Location	Distance (km) from Centre of Project Area	Azimuth Directions	Environmental Setting
S1	Proposed Site	--	--	--
S2	Honnavar	2.4	SE	Agriculture
S3	Kasarkod	2.5	S	Agriculture
S4	Karki	2.9	N	Agriculture
S5	Apsarkonda	6.2	S	Agriculture

4.2.5.1 Results and Discussion

Soil analysis was carried as per IS: 2720 and results are given in **Appendix B**. Inferences on soil quality are provided.

- Soil types are sandy (S1, S3, S4 and S5) and sandy clay (S2)
- pH of soils ranged between 6.62 (S4) and 7.86 (S2) indicating slightly acidic to alkaline in nature
- Electrical Conductivity varied between 88 µmhos/cm (S3) and 112 µmhos/cm (S2)
- Phosphorus as P varied between 12 mg/100 gm (S4) and 26 mg/100 gm (S2)
- Potassium (K) varied between 32 mg/100 gm (S4) and 92 mg/100 gm (S2)
- Sodium Absorption Ratio varied between 1.82 (S3) and 2.12 (S1)

- Infiltration Rate ranged between 52mm/hr (S2 & S5) and 58mm/hr (S1 & S4)
- Water Holding Capacity varied between 6.1 % (S4) and 9.3 % (S2)
- Porosity varied between 32 v/v % (S2) and 38 % v/v (S4)
- Zinc (Zn) varied between 0.49 mg/kg (S4) and 0.92 mg/kg (S2)
- Iron (Fe) varied between 0.36 mg/kg (S1) and 0.84 mg/kg (S2)
- Lead (Pb) is less than 0.02 mg/kg at all locations
- Nickel (Ni) is less than 0.02 mg/kg at all locations.

4.3 Water Environment

The baseline status of water quality has been assessed through identification of water resources and appropriate sampling locations for surface and groundwater in the study area. The samples were collected once during study period. Water samples collected were analysed for physical, chemical and bacteriological parameters. Standard methods prescribed for sampling and analysis were adopted. Inland water quality results are presented in **Appendix C** and inferences are provided.

4.3.1 Groundwater

Total *three (3)* groundwater monitoring locations were identified for assessment in different villages around the project site based on the usage of groundwater by the settlements/ villages in the study area.

Water sample analysis with respect to physico-chemical, nutrient, demand and bacteriological parameters having relevance to public health and aesthetic significance are selected to assess the water quality status with special attention. Standard methods prescribed for groundwater sampling and analysis were adopted.

Descriptions of sampling locations are given in Table 4-5. Sampling locations within 10 km radius from the proposed site are shown in **Figure FD0404.**

Table 4-5: Description of Groundwater Sampling Locations

Station No.	Location	Distance (km) from Centre of Project Area	Azimuth Directions	Source	Environmental Setting
GW1	Honnavar	2.4	N	Bore Well Water	Drinking, Bathing & Toilets
GW2	Kasarkod	2.5	S	Bore Well Water	Drinking, Bathing& Toilets
GW3	Karki	2.9	N	Bore Well Water	Drinking, Bathing& Toilets

Results and Discussion on Groundwater Quality

- pH is slightly acidic in nature and ranged between 6.68 (GW1) & 6.84 (GW3)
- Electrical Conductivity (EC) varied between 118 µS/cm (GW2) & 146 µS/cm (GW3)
- Total dissolved solids ranged between 74 mg/l (GW2) & 92 mg/l (GW3)
- Total alkalinity (as $CaCO_3$) varied between 30 mg/l (GW1) & 40 mg/l (GW2 & GW3)
- Total hardness (as $CaCO_3$) ranged between 40 mg/l (GW1 & GW2) & 48 mg/l (GW3)

- Calcium (Ca)is 12.8 mg/l at all locations
- Chlorides (as Cl^-) ranged between 7.1 mg/l (GW1) and 14.2 mg/l (GW2 & GW3)
- Fluorides as (F^-) at all locations is 0.1 mg/l
- Sulphates as (SO_4) ranged between 6.7 mg/l (GW2) & 10.6 mg/l (GW1)
- Nitrates as (NO_3) value ranged between 1.3 mg/l (GW1 & GW2) & 1.9 mg/l (GW3)
- Zinc as (Zn) is less than 0.02 mg/l at all locations
- Cadmium as (Cd) is less than 0.01 mg/l at all locations
- Arsenic as (As) is less than 0.001 mg/l at all locations
- Cyanides as (CN) and chromium as (Cr^{+6}) is <0.05 mg/l at all locations
- Mercury as (Hg) is <0.002 mg/l at all locations
- Total Coliforms and Faecal Coliforms were absent in all the monitored locations.

4.3.2 Surface Water

Total *three (3)* surface water monitoring locations were identified for assessment in different villages around the project site based on the usage of surface water by the settlements/villages in the study area.

Water sample analysis with respect to physico-chemical, nutrient, demand and bacteriological parameters having relevance to public health and aesthetic significance are selected to assess the water quality status with special attention. Standard methods prescribed for surface sampling and analysis were adopted.

Descriptions of sampling locations are given in Table 4-6. Sampling locations within the PIA of 10 km radius from the site are shown in **Figure FD0404.**

Table 4-6: Description of Surface Water Sampling Locations within the PIA

Station No.	Location	Distance from Centre of Project Area	Azimuth Direction
SW1	Sharavati River at Honnavar	2.4	SE
SW2	Badgani River at Pavinkurve	4.0	N
SW3	Sharavati River at Nagare	6.0	SE

Results and Discussion on Surface Water Quality

- pH is slightly alkaline in nature and ranged between 6.96 (SW3) & 7.64 (SW2)
- Electrical Conductivity (EC) varied between 48 µS/cm (SW3) & 8668 µS/cm (SW2)
- Total dissolved solids ranged between 26mg/l (SW3) & 5456 mg/l (SW2
- Total alkalinity (as $CaCO_3$) varied between 10 mg/l (SW3) & 50 mg/l (SW2)
- Total hardness (as $CaCO_3$) ranged between 12mg/l (SW3) & 1040 mg/l (SW2)
- Calcium (Ca) ranged between 3.2 mg/l (SW3) & 312 mg/l (SW2)
- Chlorides (as Cl^-) ranged between 7.1 mg/l (SW3) & 2982 mg/l (SW2)
- Fluorides as (F^-) at all locations is <0.1 mg/l (SW3) & 1.60 (SW2)
- Nitrates value ranged between 0.04 mg/l (SW3) & 15.2 mg/l (SW2)
- Zinc as (Zn) is less than 0.012 mg/l (SW1) & 0.22 (SW2)
- Cadmium as (Cd) is less than 0.01 mg/l at all locations
- Selenium as (Se) is less than 0.01 mg/l at all locations
- Arsenic as (As) is less than 0.001 mg/l at all locations
- Cyanides as (CN) is less than 0.02 mg/l at all locations
- Chromium as (Cr^{+6}) ranged between less than 0.01 mg/l (SW3) & 0.03 mg/l (SW2)

- Mercury as (Hg) is less than 0.0002 mg/l at SW1 & SW3 & 0.0004 mg/l (SW2)
- Total Coli forms ranged between 1 MPN/100 (SW3) & 32 MPN/100 (SW2)
- Faecal Coliforms were absent in SW3 & 12 MPN/100 (SW2)

4.3.2.1 Observation

It is inferred that all the parameters for groundwater are within the limits specified as per Drinking Water Quality Standards (IS:10500, 1991) as per Guidelines for Water Quality Management – CPCB 2008.

4.4 Marine Environment

4.4.1 Coastal Hydrology/ Geomorphology

4.4.1.1 Tides

Tide measurements were carried at two locations namely stations (stns) T1 and T2. At stn. T1, the measurement was carried out using Aanderaa Wave and Tide recorder (WTR 9) for a period of 16 days from 02.04.11 to 17.04.11 at 30 min interval. At stn. T2, the tide measurement was carried out manually with tide staff fixed on the jetty for a period of 16 days from 02.04.11 to 17.04.11 at 15 minute interval. The various design tide levels with respect to Chart Datum for Honnavar barge/loading as presented in Naval Hydrographic Chart (No. 216) are given below:

Mean High water Spring	:	1.8 m
Mean High Water Neap	:	1.5 m
Mean Sea Level	:	1.2 m
Mean Low Water Neap	:	1.0 m
Mean Low Water Spring	:	0.4 m

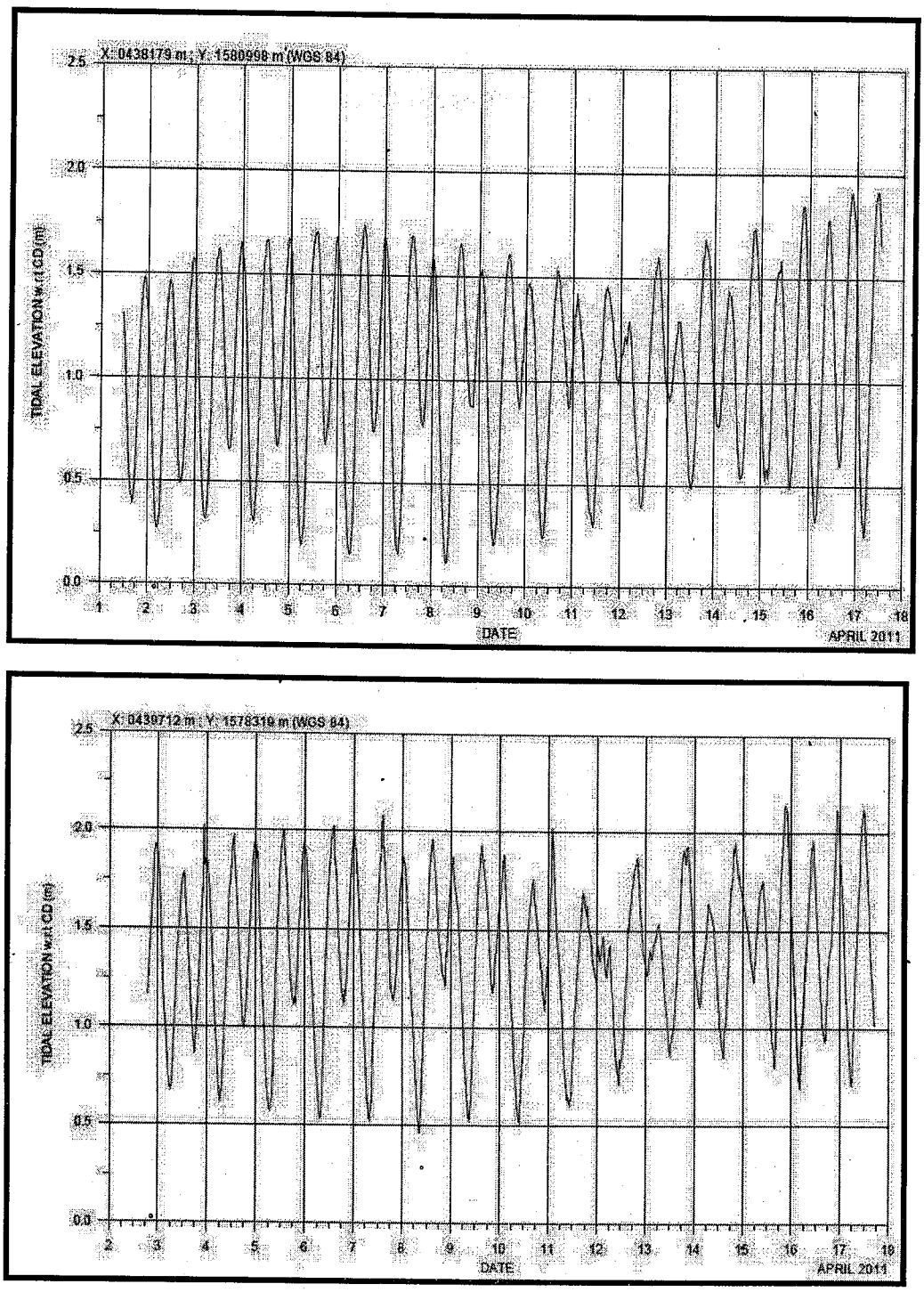

Figure 4-6: Tidal Variation in the Honnavar Barge/vessel Loading Facility

4.4.1.2 Waves

Wave measurements were carried using a Datawell Wave Rider Buoy DWRG4 for a period of 16 days at one location. The wave measurement was recorded at 30 min interval.

The variation of significant wave height, maximum wave height, zero crossing period and predominant wave direction is shown in Figs. 4-7 to 4-10. During the measurement period the significant wave height varied between 0.32 m to 1.02 m. The maximum wave height recorded was 1.67 m. The zero crossing wave periods varied between 3 to 10 seconds. The predominant wave direction during the measurement period mostly remained around 230°.

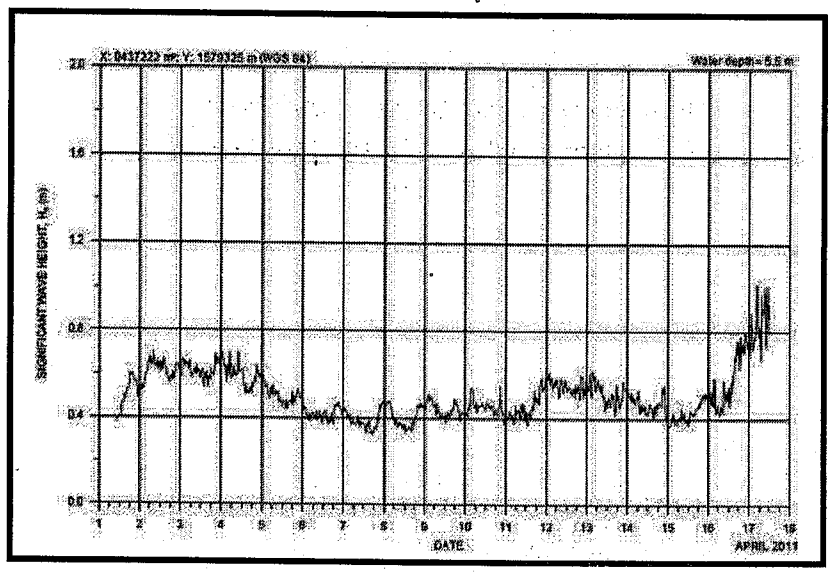

Figure 4-7: Variation of Significant Wave Height

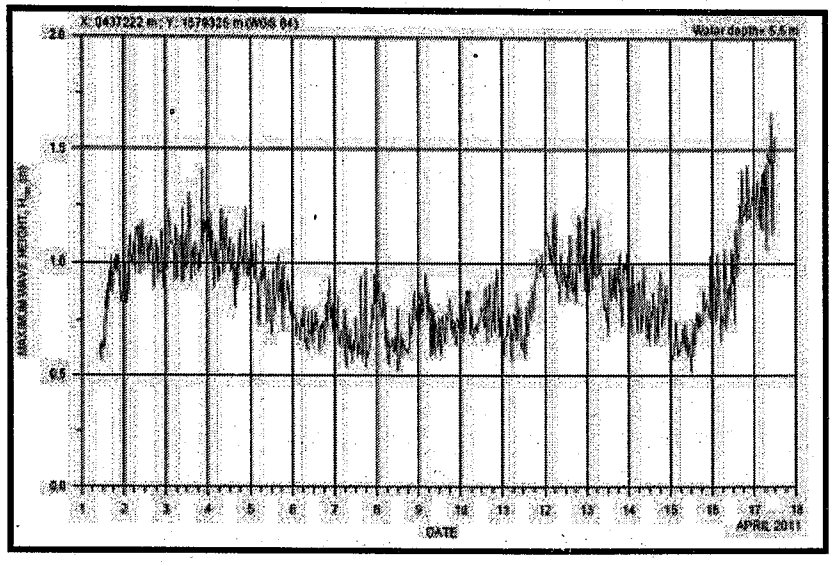

Figure 4-8: Variation of Maximum Wave height

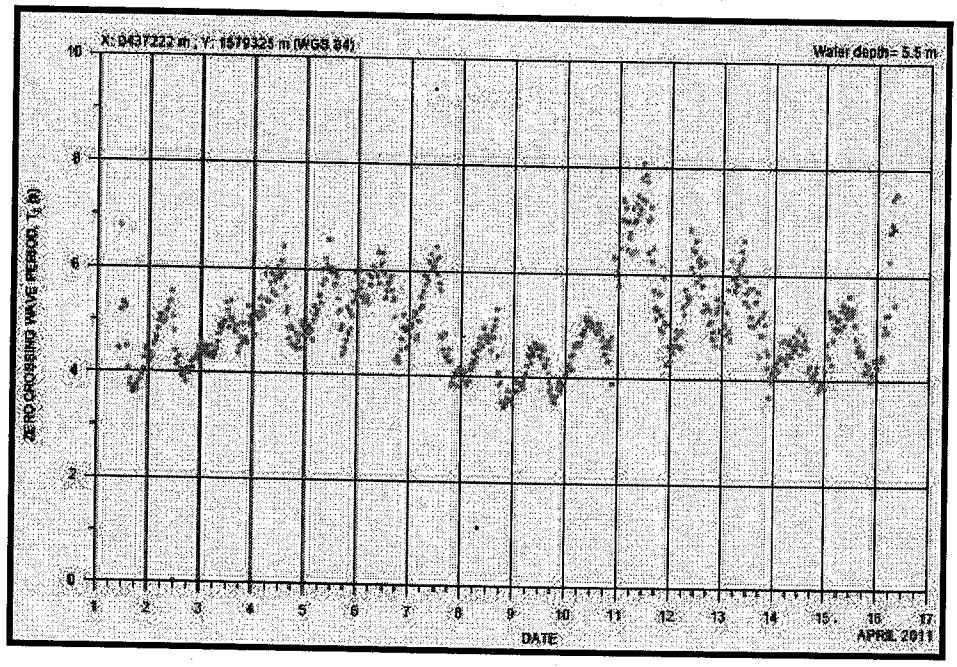

Figure 4-9: Variation of Zero Crossing Wave Height

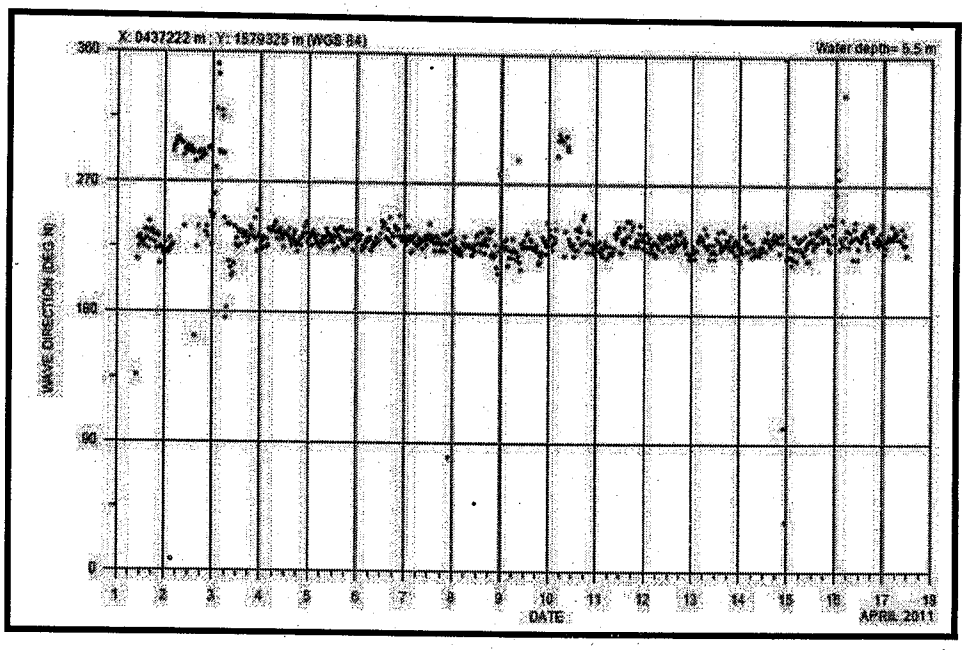

Figure 4-10: Variation of Wave Direction

4.4.1.3 Littoral Drift

The littoral drift along the West Coast of India takes place in South–North direction in general and the net drift direction is directed towards South. The direction of sediment transport varies depending on the local shoreline orientation. The configuration of shoreline between the coastal stretch of Sharavati River and Badgani River is aligned along WSW; further the coastline aligns itself in North South direction to the Honnavar Barge/vessel loading facility at

river mouth. The coastline north of river Sharavati is aligned in ENE direction which gradually orients itself southward.

The result of the shoreline change studies carried out by Department of Meteorology and Oceanography, Andhra University, Vishakhapatnam indicates the direction of sediment is towards north.

The littoral sand transport studies conducted through MIKE 21 (ST) model gave information on sand transport rates along the coastal stretch and near the tidal inlet.

For case-I (without breakwater) the rates of sediment transport for deep water waves from S and SSW are much less (< 200 m^3/yr/m) along the entire coastal stretch. However slightly higher values (about 400 m^3/yr/m) are noticed on the seaward side of the entrance where shoals are present. The bed level changes indicate deposition at the mouth and to the south of the inlet. For SW and SSW waves during monsoon season high values of sand transport (> 2000 m^3/yr/m) are noticed along the entire coastal stretch due to high and steep waves during this season. The bed level changes indicate significant deposition (0.005 m/day) both to the south and north of the entrance channel. During non-monsoon season, when W and WNW waves prevail the sediment transport as well as the bed level changes are not significant.

For case-II (with breakwaters) during monsoon season when SW and WSW waves prevail the sediment transport is significant (>2000) to the north as well as to the south of breakwater. Bed level changes indicate deposition to the northern and southern coastline in general; but there is also erosion just to the north of northern breakwater, some deposition is observed inside the breakwaters zone just at the mouth of the entrance channel, which must be cleared periodically in maintenance dredging.

Model studies indicate an annual deposition of about 10,300 m^3/yr in the dredged channel. Again, during non-monsoon months there is no significant deposition. On the whole the sand transport model studies indicate depositional trend near the mouth of the channel as well as to the north of the channel for case I. But for case II, the depositional trend in the channel has somewhat decreased due to breakwaters while some erosional trend is noticed towards the northern shores.

The predominant direction of alongshore sediment transport is towards north due to S, SSW and SW waves and the net transport of sediment is around 0.6×10^6 m^3 directed towards north.

4.4.1.4 Currents

Variations of current speed and direction were measured at three locations using Aanderaa RCM 9 self recording current meter for a period of 16 days at 20 minute interval.

The variations of current speed and direction at stns. C1, C2 and C3 are shown in Figs. 4-11 4-12 and 4-13 respectively.

Stn. C1 (Open Sea): The maximum current speed at surface reached upto 0.34 m/s. The current direction was inconsistent but predominantly showed towards south.

Stn. C2 (River-south): The maximum current speed at surface reached upto 1.23 m/s. The current direction was towards south during flood tide and towards north during ebb tide. The current direction varied between 350° and 10° during ebb tide and 170° and 190° during flood tide.

Stn. C3 (River-north): The current speed reached up to 0.81 m/s. The current direction showed a formation of gyre showing almost a unidirectional flow towards 240°.

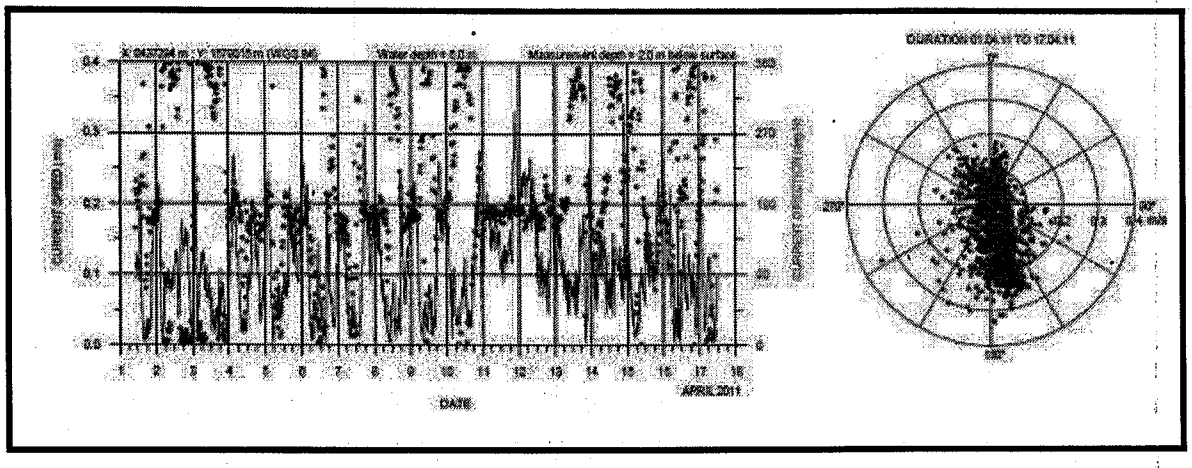

Figure 4-11: Variation of Current Speed and Direction at Stn. C1 (Open Sea)

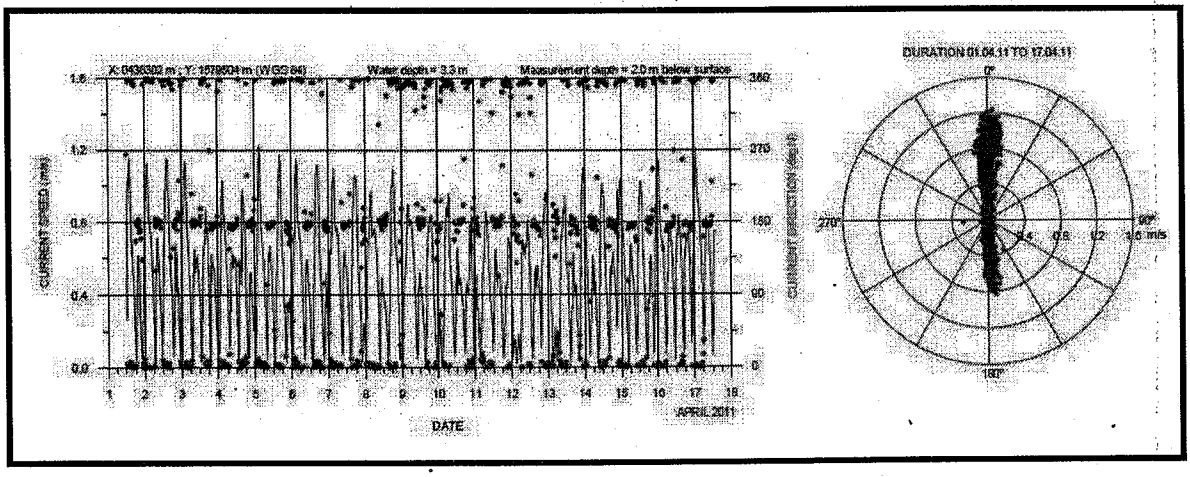

Figure 4-12: Variation of Current Speed and Direction at Stn. C2 (River South)

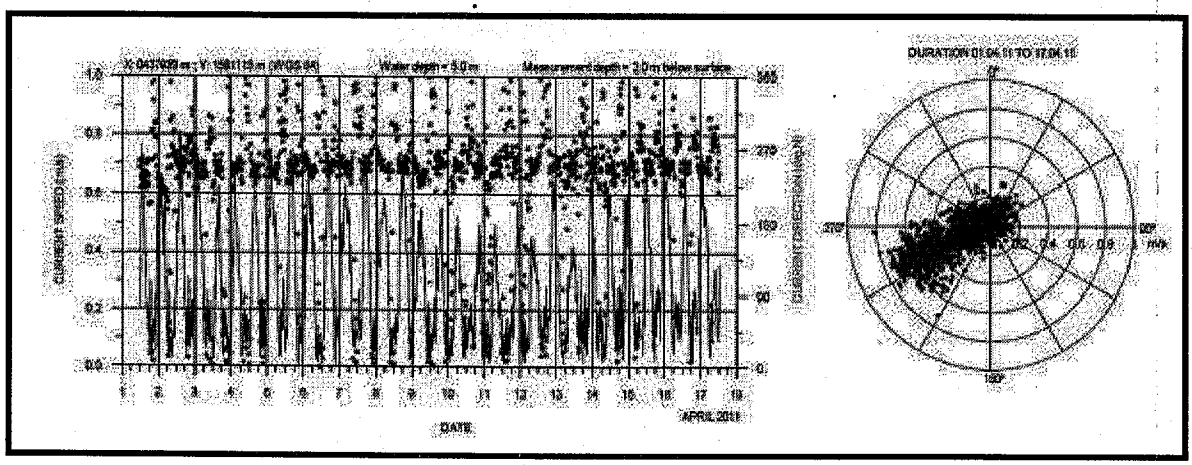

Figure 4-13: Variation of Current Speed and Direction at Stn. C3 (River North)

4.4.1.5 Seabed Bathymetry

The bathymetric survey was carried out for 3.5 km along the shoreline and 3.5 km into the sea. From the analysis of the survey data it is observed that the contours run parallel to each other in the project area. Bathymetry of the study area exhibits a gentle bed slope of 1:180 up to 5 m contours beyond which it flattens to 1:350. The 10 m water depth occurs at a distance of approximately 3350 m from the coast.

The bathymetry survey carried out on the river side of the project site illustrates that the river bed is shallow and there are few deeper portions depending on the current. A maximum river depth of 3-4 m is observed, otherwise the whole of the bed seems to be very shallow and few islands in the river course. Mouth/estuary of the river also seems very shallow with maximum water depth of 2-3 m in the river mouth. Large area of shallow depth of 0.7 m is observed on either side of the river mouth which is mainly due to the deposition of the sediments brought by the river.

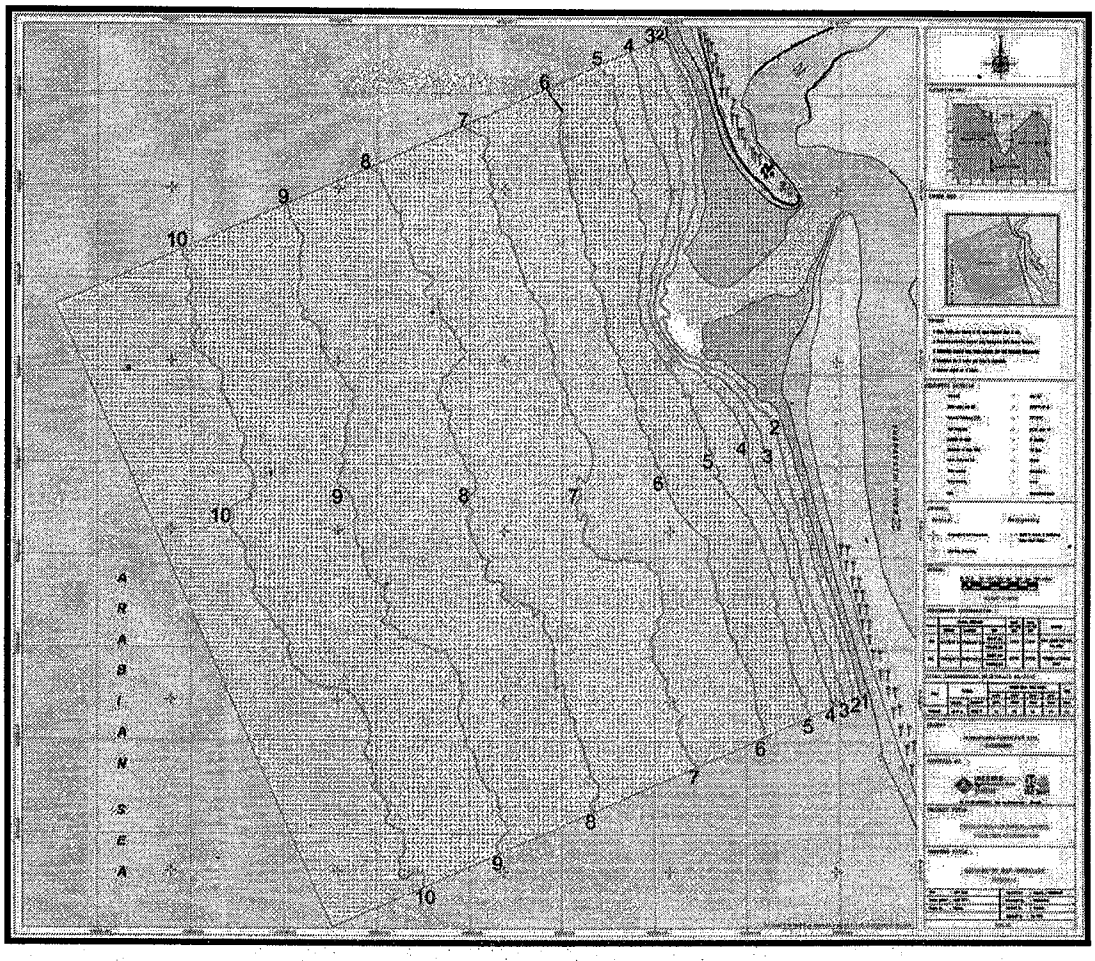

Figure 4-14: Combined Chart Open Sea and River Mouth

4.4.2 Bed Sediment Contamination/Bed Sediment Quality

Sediment samples were collected from nine locations. There are four sampling locations (HMSL-1, 2, 4, and 6) selected at <5 m depth; four sampling locations (HMSL-3, 5, 7, 8) between 5 m and 9 m depth HMSL-9 is located at a depth of 15 m. A map showing the marine sampling locations is given in **Figure FD0405**. The Coordinates of the sampling locations are given in the Table 4-7.

Table 4-7: Marine Sampling Locations

S. No.	Location Code	Latitude	Longitude
1.	HMSL-1	14°17'42.28" N	74°25'34.63" E
2.	HMSL-2	14°17'49.89" N	74°25'12.81" E
3.	HMSL-3	14°17'34.84" N	74°24'40.74" E
4.	HMSL-4	14°16'54.45" N	74°25'21.96" E
5.	HMSL-5	14°17'01.82" N	74°24'35.91" E
6.	HMSL-6	14°18'19.84" N	74°24'54.74" E
7.	HMSL-7	14°17'56.50" N	74°24'10.28" E
8.	HMSL-8	14°18'38.77" N	74°24'02.81" E

S. No.	Location Code	Latitude	Longitude
9.	HMSL-9	14°16'35.01" N	74°21'59.75" E

Among the stations, HMSL-1 is located in the river mouth, HMSL-2, 4, 6 were situated near the shore, HMSL-3, 5, 7, 8 were situated away from shore and HMSL-9 in open sea.

4.4.2.1 Physical Parameters

The sediment composition is from sandy to silty in nature. The percentage of sand ranged between 98.29% at HMSL-1 during low tide and 19.52% at HMSL-2 during low tide. The silt content varied between 46.06% at HMSL-7 during low tide and 1.27% at HMSL-1 during low tide. The percentage of clay ranged between 54.66% at HMSL-2 during low tide and 0.42% at HMSL-1 during high tide. The variations in sediment quality are given in Table 4-8.

Oil and grease levels ranged from 9 µg/g at HMSL-8 during low tide & HMSL-9 during high tide to 831 µg/g at HMSL-1 during high tide. The details of the sediment composition and Oil and Grease are given in Table 4-8 and Figure 4-15.

Table 4-8: Sediment Composition

Location Code	Sand (%)	Silt (%)	Clay (%)	Oil and Grease (µg/g)
HMSL-1-HT	98.22	1.35	0.42	831
HMSL-1-LT	98.29	1.27	0.44	137
HMSL-2-HT	19.63	26.26	54.12	29
HMSL-2-LT	19.52	25.81	54.66	49
HMSL-3-HT	21.14	27.83	51.02	27
HMSL-3-LT	22.11	26.22	51.68	19
HMSL-4-HT	71.30	26.32	2.38	79
HMSL-4-LT	75.15	23.48	1.37	35
HMSL-5-HT	24.79	22.63	52.58	21
HMSL-5-LT	23.75	24.18	52.07	53
HMSL-6-HT	29.58	31.78	38.64	27
HMSL-6-LT	29.30	31.09	39.61	11
HMSL-7-HT	41.26	45.23	13.51	17
HMSL-7-LT	41.79	46.06	12.15	13
HMSL-8-HT	76.05	21.52	2.42	23
HMSL-8-LT	78.50	19.65	1.85	9
HMSL-9-HT	28.28	31.15	40.57	9
HMSL-9-LT	30.26	28.58	41.16	13

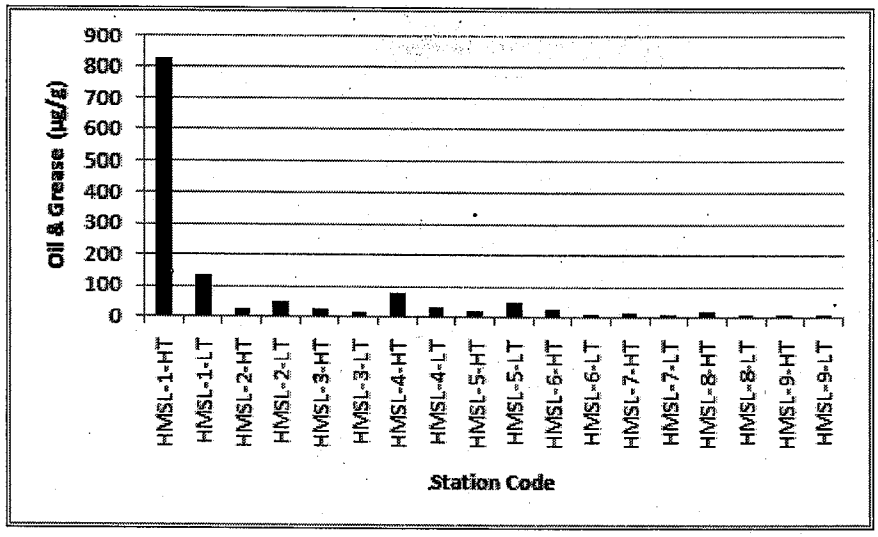

Figure 4-15: Variations in Oil and Grease Levels (Sediment)

4.4.2.2 Chemical Parameters: Heavy Metal Concentration & Total Organic Carbon

The concentrations of cadmium in sediment ranged between 1.38 µg/g at HMSL-8 during low tide and 0.40 µg/g at HMSL-6 during high tide. The Copper varied between 61.04 µg/g at HMSL-5 during low tide and 0.80 µg/g at HMSL-6 during high tide. The concentrations of Lead varied between 22.84 µg/g at HMSL-5 during low tide and 10.88 µg/g at HMSL-2 during high tide. Iron varied between 22860 µg/g at HMSL5- during high tide and 1132.28 µg/g at HMSL-6 during high tide and the zinc concentration varied between 66.40 µg/g at HMSL-5 during high tide and 12.92 µg/g at HMSL-8 during low tide. The concentration of mercury varied between 0.006 and 0.028 µg/g. The total organic carbon in all the sampling locations varied between 7.611 mg/g at HMSL-5 during low tide and 1.125 mg/g at HMSL-1 during high tide. The concentrations of heavy metals and Total Organic Carbon are given in Table 4-9.

Table 4-9: Heavy Metals & Total Organic Carbon Levels In Sediment

Location Code	Parameters (µg/g)						
	Cd	Cu	Fe	Pb	Zn	Hg	Total Organic Carbon (mg/g)
HMSL-1-HT	1.08	12.00	1459.2	14.48	17.92	0.024	1.125
HMSL-1-LT	0.84	8.04	1978.0	13.48	13.08	0.028	1.815
HMSL-2-HT	0.79	27.28	15880.0	10.88	35.76	0.016	5.196
HMSL-2-LT	0.76	35.20	17500.0	13.80	44.64	0.015	3.747
HMSL-3-HT	0.85	36.16	18664.0	15.64	48.88	0.012	6.576
HMSL-3-LT	0.92	32.96	19436.0	16.68	44.24	0.006	6.507
HMSL-4-HT	0.80	32.16	18400.0	15.00	40.48	0.012	7.197
HMSL-4-LT	1.04	25.32	5576.0	17.96	13.04	0.008	1.746
HMSL-5-HT	1.12	56.52	22860.0	22.48	66.40	0.014	7.266
HMSL-5-LT	1.10	61.04	22368.0	22.84	65.72	0.011	7.611
HMSL-6-HT	0.40	0.80	1132.28	14.48	42.35	0.013	2.919
HMSL-6-LT	1.04	31.28	16396.0	12.88	39.36	0.012	6.783
HMSL-7-HT	0.75	21.04	9480.0	17.68	18.64	0.010	2.367
HMSL-7-LT	0.81	11.96	2068.0	14.60	16.28	0.014	1.539

Location Code	Parameters (ug/g)						
	Cd	Cu	Fe	Pb	Zn	Hg	Total Organic Carbon (mg/g)
HMSL-8-HT	1.12	7.16	1828.8	13.88	15.96	0.012	1.746
HMSL-8-LT	1.38	16.24	2986.4	16.00	12.92	0.016	2.367
HMSL-9-HT	1.15	47.04	18628.0	19.08	52.20	0.018	7.611
HMSL-9-LT	0.95	42.60	18216.0	17.60	58.04	0.014	6.645

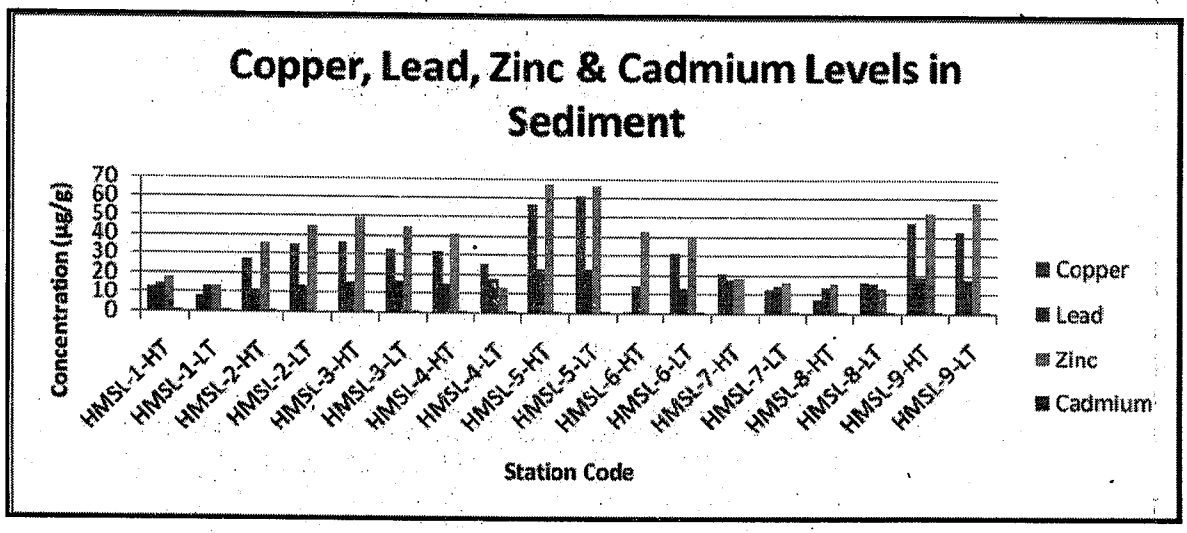

Figure 4-16: Variation of Copper, Cadmium Zinc & Lead in Sediment

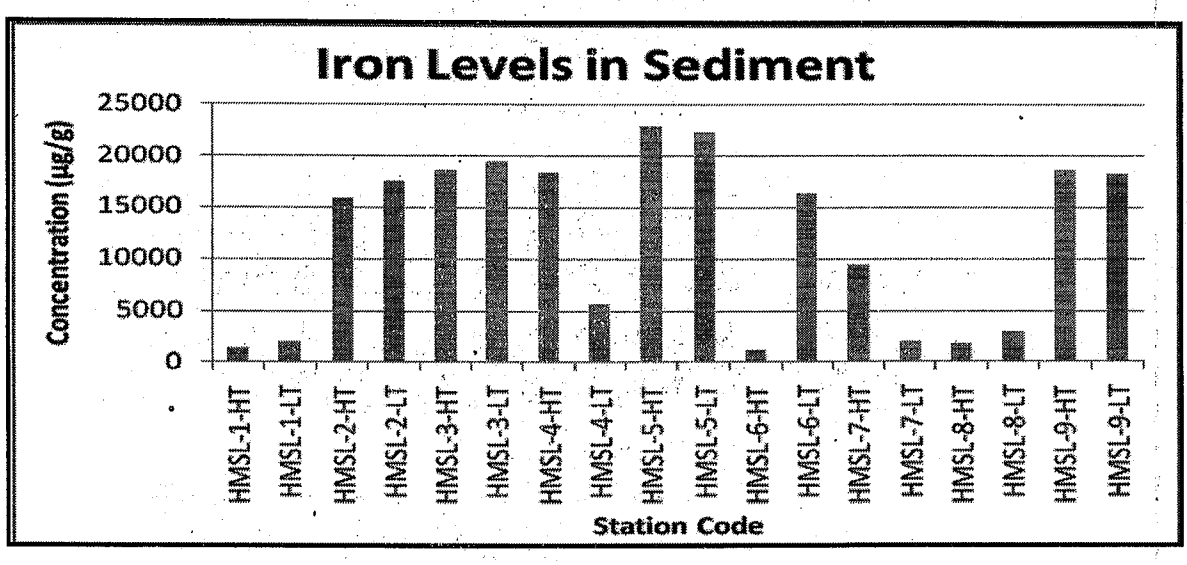

Figure 4-17: Variation of Iron concentration in Sediment

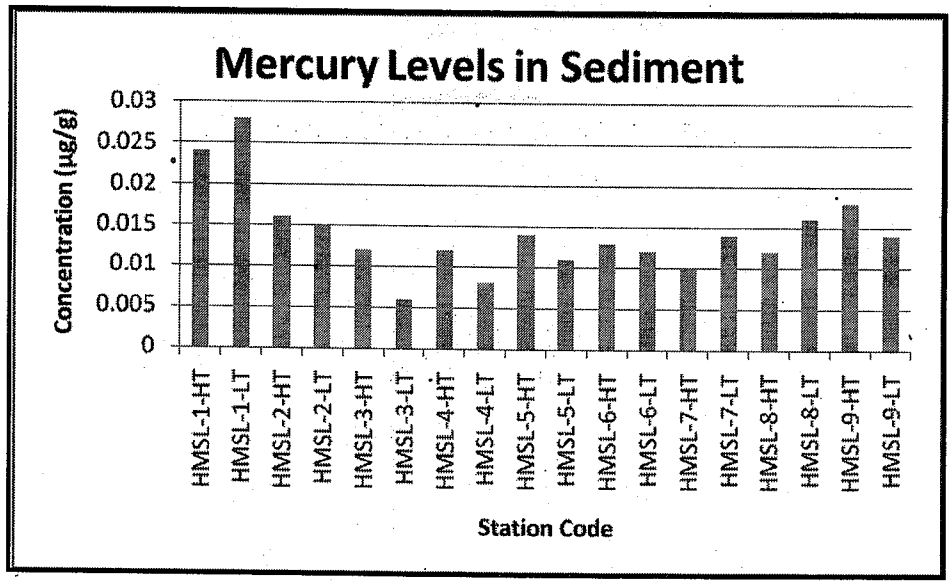

Figure 4-18: Variation of Mercury concentration in Sediment

4.4.2.3 Microbial Population

The indicator and pathogenic bacteria isolated from sediment samples collected from the marine monitoring locations are described below.

Escherichia.Coli (EC)

The *E.coli* population varied between $28x10^2$ CFU/mg at HMSL-2 during high tide and 10 x 10^2 CFU/mg at HMSL-7 during high tide and HMSL-9 during low tide.

Faecal Coliform (FC)

The Faecal Coliform population ranged between 36 x 10^2 CFU/mg at HMSL-1 during high tide and $20x10^2$ CFU/mg at HMSL-4 during low tide.

Pseudomonas Aeurginosa (PA)

The *Pseudomonas aeurginosa* population ranged between 24 x 10^3 CFU/mg at HMSL-5 during high tide and 10 x 10^2 CFU/mg at HMSL-9 during high tide.

Proteus-Klebsiella (PK)

The *Proteus Klebsiella* population ranged between 24 x 10^2 CFU/mg at HMSL-3 during high tide and 10 x 10^2 CFU/mg at HMSL-1, HMSL-5 & HMSL-7 during low tide.

Streptococcus Faecalis (SF)

The *Streptococcus Faecalis* population ranged between 25 x 10^1 CFU/mg at HMSL-1 during low tide and 10 CFU/ml at HMSL-5 during low tide.

Shigella (SH)

The *Shigella* population observed ranged between 24 x 10^2 CFU/mg and 10 x 10^2 CFU/mg. The minimum concentration was observed at HMSL-2 and HMSL-7 during low tide. The maximum concentration was observed at HMSL-4 & HMSL-6 during high tide.

Salmonella (S)

The Salmonella population ranged between 17 x 10^3 CFU at HMSL-6 during high tide and 80 CFU/mg at HMSL-9 during low tide.

Total Coliform (TC)

The Total Coliform population ranged between 19 x 10^4 CFU/mg at HMSL-2 during high tide and 10 x 10^4 CFU/mg at HMSL-1 and HMSL-3 during high tide and also at HMSL-9 during low tide.

Total Viable Count -Total Heterotrophic Bacteria (TVC)

Total Viable Count ranged between 34 x 10^5 CFU/mg at HMSL-2 during high tide and 12 x 10^5 CFU/mg at HMSL-7 during low tide.

Vibrio Cholera (VC)

The *Vibrio Cholera* population ranged between 25 x 10^2 CFU/mg at HMSL-4 during high tide and 23 CFU/mg at HMSL-9 during low tide.

Vibrio Parahaemolyticus (VP)

The *Vibrio Parahaemolyticus* population observed in sediment samples ranged between 28 x 10^2 CFU/mg at HMSL-4 during high tide and 18 CFU/mg at HMSL-9 during low tide.

The details of microbial population at each location are given in the **Appendix D**.

4.4.2.4 Benthos

Macrobenthos:

Overall macrobenthos was, represented by taxonomic groups' viz., Polychaetes, Bivalves, Amphipods, Gastropods, and Isopods. Around 44 species of macrobenthos was recorded. Minimum Density (625 Nos/m^2) was observed at HMSL-2 during high tide. Maximum density (875 Nos./m^2) was observed at HMSL-5 during high tide. The summary of macrobenthos population is given in the Table 4-10 and the variation in macrobenthos population is graphically shown in Figure 4-19. The details of macrobenthos population are given in the **Appendix D**.

Table 4-10: Summary of Macrobenthos Population

Location Code	Macro Benthos (Nos./m^2)
HMSL-1-HT	650
HMSL-1-LT	775
HMSL-2-HT	625
HMSL-2-LT	825
HMSL-3-HT	725
HMSL-3-LT	800
HMSL-4-HT	725
HMSL-4-LT	800
HMSL-5-HT	875
HMSL-5-LT	500
HMSL-6-HT	825
HMSL-6-LT	650
HMSL-7-HT	675
HMSL-7-LT	750
HMSL-8-HT	650
HMSL-8-LT	850
HMSL-9-HT	675
HMSL-9-LT	700

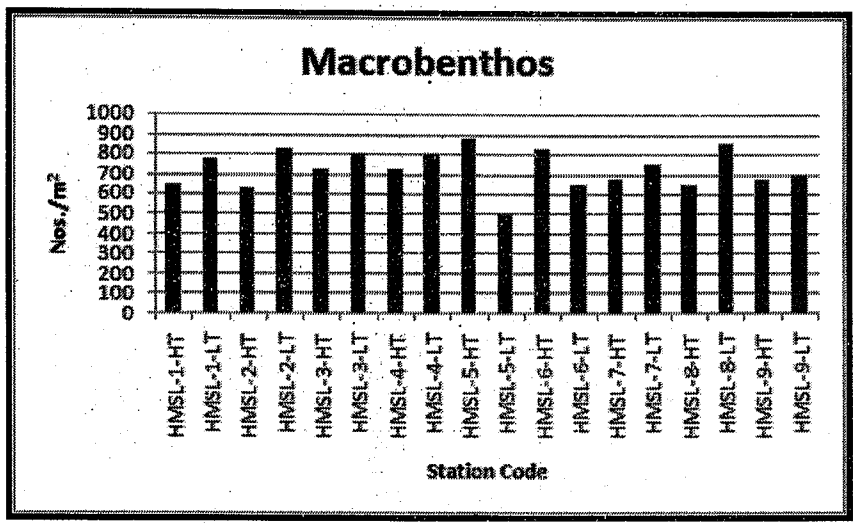

Figure 4-19: Variations in Population Density of Macrobenthos

Meiobenthos:

Overall meiobenthos was, represented by taxonomic group's viz., Nematodes, Foraminiferans, Gastrotricha, Cumacea, Oligochates, Harpacticoids, Ostrocodes, Archiannelid, Tanaidacea and Rotifera were encountered during the study. Around 81

species were recorded. The meiobenthos density was ranged between 416 nos/10cm^2 at HMSL-6 during low tide and 256 nos/10cm^2 at HMSL-1 during high tide. The Summary of meiobenthos population is given in the Table 4-11 and the variation in meiobenthos population is graphically shown in Figure 4-20. The details of meiobenthos population are given in the **Appendix D**.

Table 4-11: Summary of Meiobenthos Population

Location Code	Meio Benthos (Nos/10cm^2)
HMSL-1-HT	256
HMSL-1-LT	347
HMSL-2-HT	283
HMSL-2-LT	386
HMSL-3-HT	299
HMSL-3-LT	387
HMSL-4-HT	325
HMSL-4-LT	411
HMSL-5-HT	281
HMSL-5-LT	373
HMSL-6-HT	303
HMSL-6-LT	416
HMSL-7-HT	298
HMSL-7-LT	392
HMSL-8-HT	278
HMSL-8-LT	357
HMSL-9-HT	260
HMSL-9-LT	369

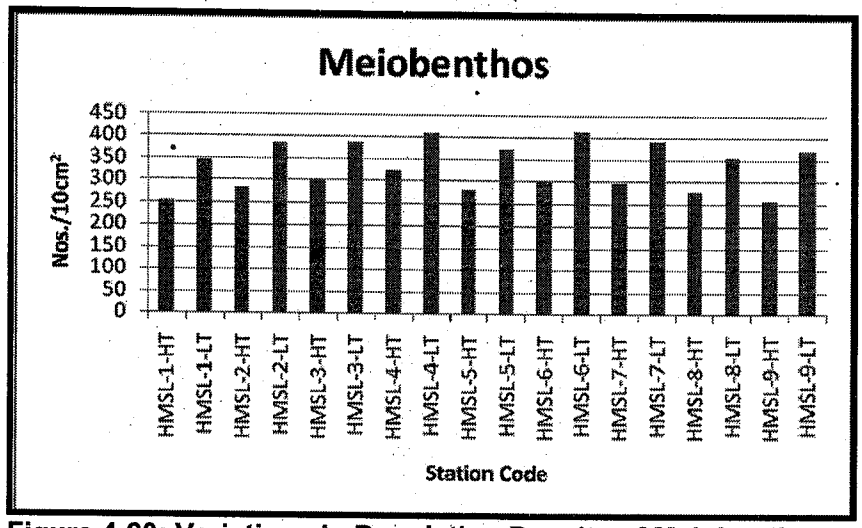

Figure 4-20: Variations in Population Density of Meiobenthos

4.4.3 Sea/Harbour Water Quality

The primary objective of this investigation was to establish baseline data on seawater quality, sediment quality and marine ecology prior to the development of Honnavar barge/ vessel loading facility. Methodologies used for the study are therefore clearly aimed at obtaining

information on the environmental conditions according to EIA governed protocols defined in standard manuals and reference material (e.g. UNESCO, 1978; Parsons et al., 1984; Standard Methods of the American Public Health Association APHA, 1989, 1998; Grasshoff et al., 1999).

Temperatures, Salinity, Transparency, DO, BOD, Nitrate, Nitrite, Ammonia, Total Nitrogen, Total Phosphorous and Inorganic Phosphate were monitored. All parameters were estimated by using following standard methods. Biological variables have also been studied and this includes planktons (both Phyto and Zooplankton), productivity and benthos (macro & meio). Sediment samples were also collected and analyzed for various parameters including heavy metals.

The following sections present the sampling locations and results for the above mentioned parameters monitored.

4.4.3.1 Physico-Chemical Parameters

The details regarding physical parameters for all monitoring locations are given in Table 4-12.

Table 4-12: Physical Parameters

Location Code	Temp. (°C)	Salinity (‰)	pH	TSS (mg/l)	Turbidity (NTU)	DO (mg/l)	BOD (mg/l)
HMSL-1-HT	29.0	26	7.4	28.0	10	5.658	0.464
HMSL-1-LT	30.5	21	7.2	33.6	12	5.222	0.960
HMSL-2-HT	29.0	32	8.2	29.0	8	5.947	1.216
HMSL-2-LT	30.0	34	8.1	24.0	9	5.593	0.960
HMSL-3-HT	29.0	31	8.1	65.0	7	5.189	1.104
HMSL-3-LT	31.0	30	8.0	81.4	7	5.462	1.168
HMSL-4-HT	30.0	32	8.0	68.6	9	5.801	0.400
HMSL-4-LT	31.0	31	8.0	51.0	8	5.004	0.544
HMSL-5-HT	31.0	33	8.2	62.6	4	5.642	1.472
HMSL-5-LT	30.0	33	8.2	75.4	5	5.220	1.200
HMSL-6-HT	29.0	33	8.2	72.2	3	5.852	1.072
HMSL-6-LT	30.0	30	8.0	86.0	3	5.769	0.928
HMSL-7-HT	29.0	31	8.1	54.4	5	5.820	1.264
HMSL-7-LT	30.0	30	8.0	44.2	6	5.092	1.376
HMSL-8-HT	29.0	25	7.5	32.4	8	6.205	1.040
HMSL-8-LT	30.0	24	7.3	45.6	8	6.624	1.168
HMSL-9-HT	31.0	28	7.7	44.2	7	6.866	0.720
HMSL-9-LT	31.0	28	7.7	32.2	9	6.545	1.216

Temperature (°C): The water temperature ranged from 29.0°C to 31.0°C. The variation of temperature at all the monitoring locations is shown in Figure 4-21.

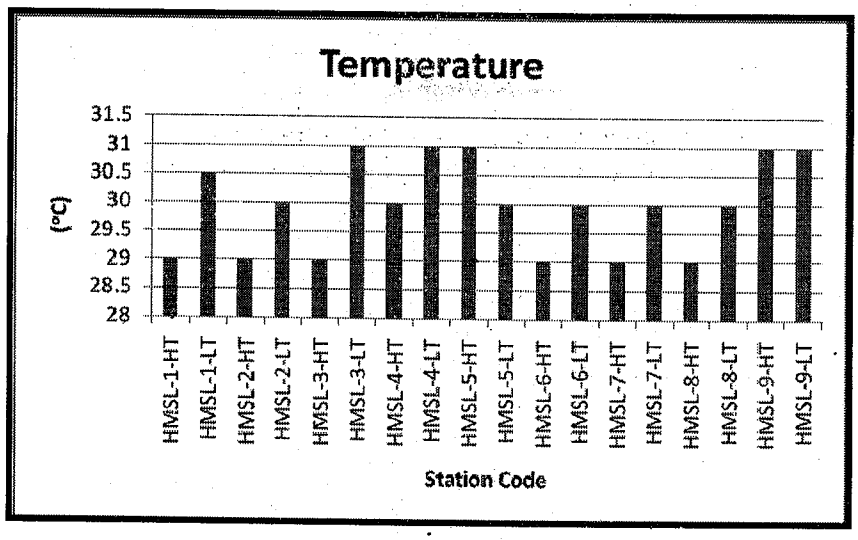

Figure 4-21: Variations in Temperature

Salinity (ppt): The major variable in the coastal environment is salinity. Usually there is a continuous gradient between shore line area and deep waters, the minimum and maximum salinity observed were 21 and 34 (ppt) respectively. The variation of salinity at all the monitoring locations is shown in Figure 4-22.

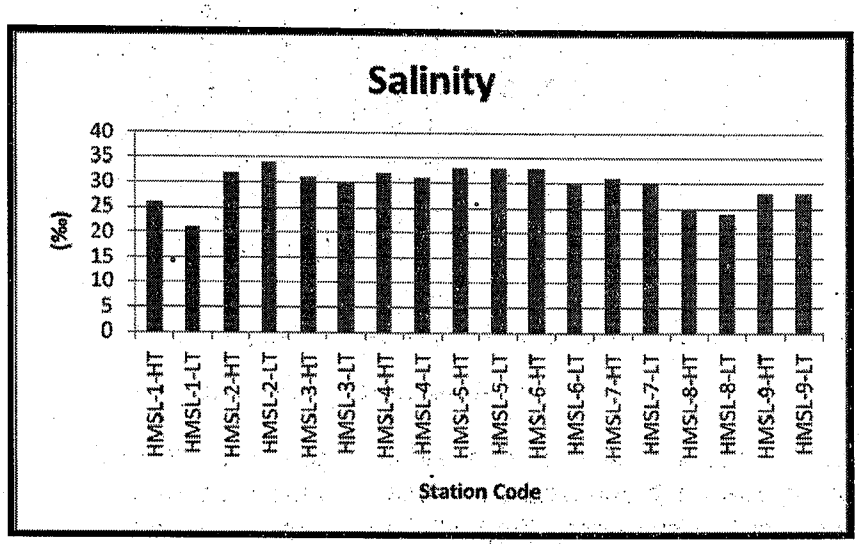

Figure 4-22: Variations in Salinity

pH: The pH value of water in the present study remained alkaline at all stations. It ranged between 7.2 and 8.2. The variation of pH at all the monitoring locations is shown in Figure 4-23.

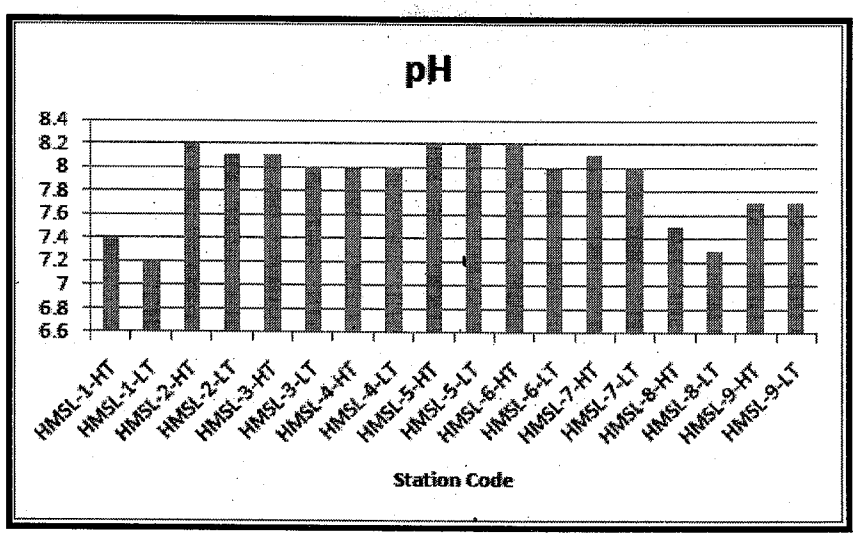

Figure 4-23: Variations in pH

Turbidity: The turbidity varied from 3 to 12 Nephlometric Turbidity Unit (NTU). The minimum turbidity was recorded at HMSL-6 during high & low tide. The maximum turbidity was recorded at HMSL-1 during low tide. The variation of turbidity at all the monitoring locations is shown in Figure 4-24.

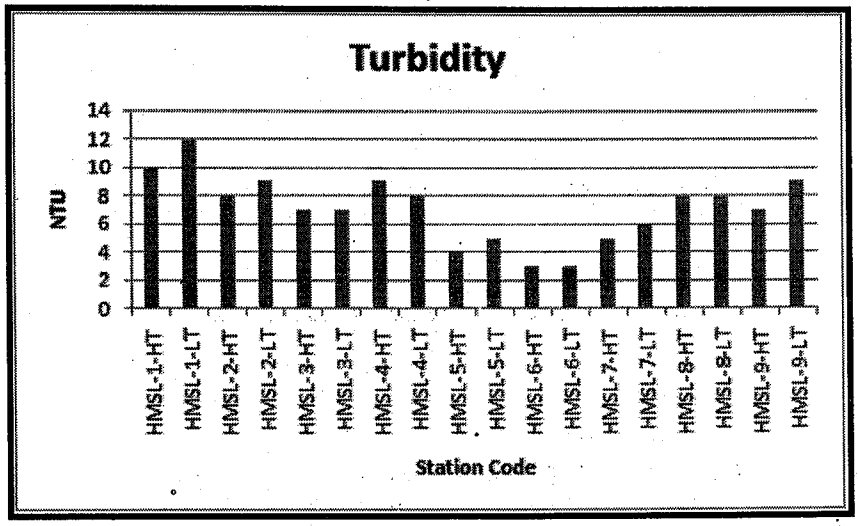

Figure 4-24: Variations of Turbidity Levels

Total Suspended Solids: The Total suspended Solids varied from 24 to 86 mg/l. The minimum level was recorded in HMSL-2 during low tide and the maximum level was recorded at HMSL-6 during low tide. The variation of Total Suspended Solids at all the monitoring locations is shown in Figure 4-25.

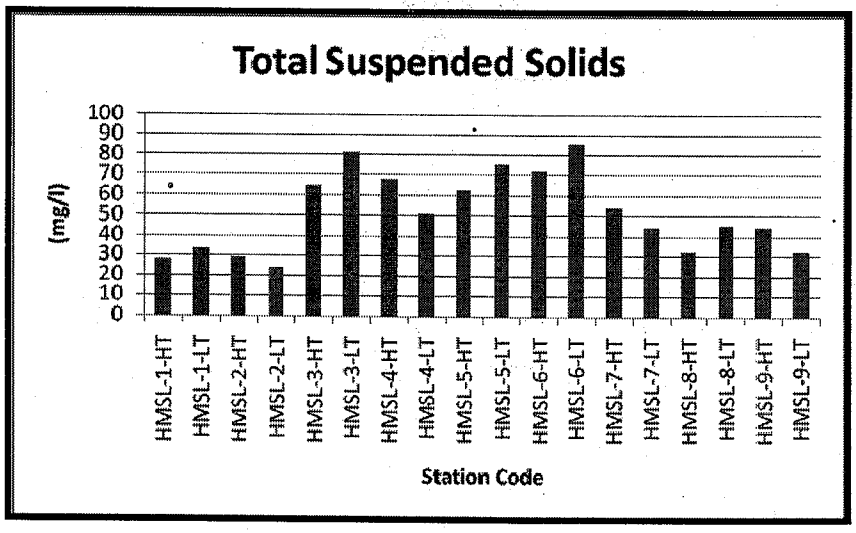

Figure 4-25: Variations in Total Suspended Solids

Oil & Grease levels The oil & grease levels varied from 0.145 µg/ to 0.810 µg/l. The minimum level was recorded in HMSL-4 during low tide and the maximum level was recorded at HMSL-6 during high tide. The variation of Oil and Grease at all the monitoring locations is shown in Table 4-13 & Figure 4-26.

Table 4-13: Oil & Grease Levels in Water

Location Code	Variations in Oil & Grease Levels
HMSL-1-HT	0.655
HMSL-1-LT	0.315
HMSL-2-HT	0.420
HMSL-2-LT	0.250
HMSL-3-HT	0.325
HMSL-3-LT	0.290
HMSL-4-HT	0.175
HMSL-4-LT	0.145
HMSL-5-HT	0.430
HMSL-5-LT	0.470
HMSL-6-HT	0.810
HMSL-6-LT	0.155
HMSL-7-HT	0.280
HMSL-7-LT	0.375
HMSL-8-HT	0.365
HMSL-8-LT	0.355
HMSL-9-HT	0.275

Location Code	Variations in Oil & Grease Levels
HMSL-9-LT	0.315

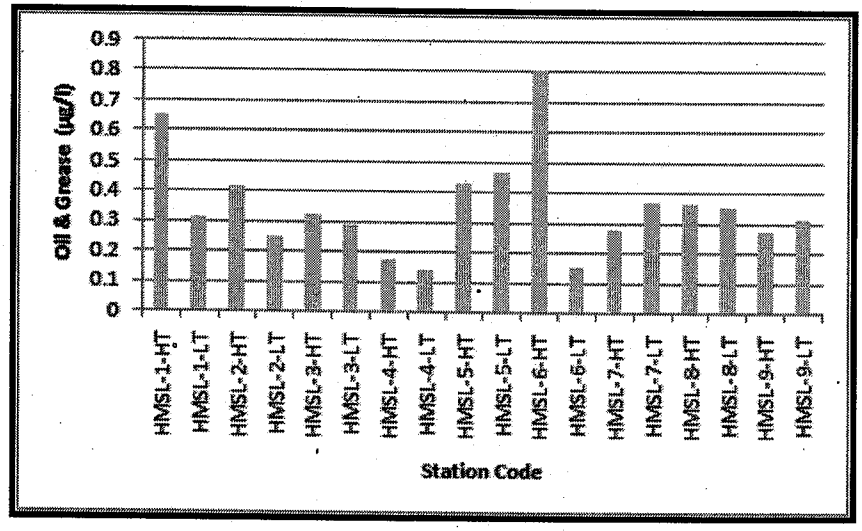

Figure 4-26: Variations in Oil and Grease Levels (Water)

Dissolved Oxygen (mg/l): The Dissolved Oxygen (DO) varied between 5.004 mg/l to 6.866 mg/l. The minimum value was observed at HMSL-4 during low tide and the maximum was recorded at HMSL-9 during high tide. The variation of DO at all the monitoring locations is shown in Figure 4-27.

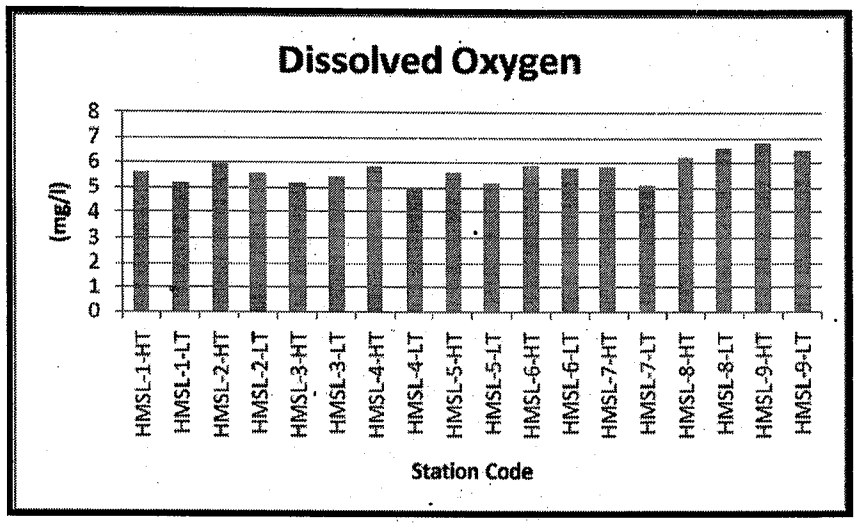

Figure 4-27: Variations in Dissolved Oxygen Levels

Biological Oxygen Demand (mg/l): The Biological Oxygen Demand (BOD) varied between 0.40 mg/l to 1.472 mg/l. The minimum value was observed at HMSL-4 during high tide and the maximum was recorded at HMSL-5 during high tide. The variation of BOD at all the monitoring locations is shown in Figure 4-28.

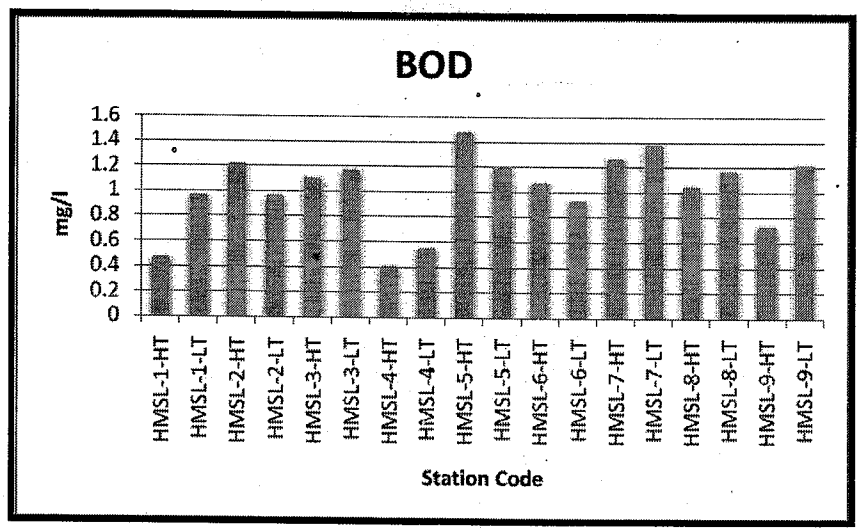

Figure 4-28: Variations in Biological Oxygen Demand

4.4.3.2 Nutrients

The details regarding nutrients for all monitoring locations are given in Table 4-14.

Table 4-14: Nutrients in Water

Location Code	Parameters (µmol/l)						
	NO_2	NO_3	NH_4	TN	IP	TP	SiO_4
HMSL-1-HT	0.345	7.230	0.971	22.950	1.019	1.562	32.204
HMSL-1-LT	0.517	8.435	1.079	25.634	0.831	1.151	32.225
HMSL-2-HT	0.249	10.802	0.648	26.171	0.944	1.069	15.422
HMSL-2-LT	0.268	7.875	0.722	19.729	0.906	1.110	21.499
HMSL-3-HT	0.383	8.177	0.681	21.205	0.755	1.028	25.742
HMSL-3-LT	0.268	8.865	0.664	26.574	0.944	1.274	20.683
HMSL-4-HT	0.326	10.113	0.374	24.695	0.680	1.069	21.590
HMSL-4-LT	0.192	7.832	0.415	25.768	1.019	1.192	18.074
HMSL-5-HT	0.284	8.865	0.174	25.097	0.982	1.110	17.801
HMSL-5-LT	0.555	7.789	0.689	23.218	1.284	1.397	19.888
HMSL-6-HT	0.230	6.756	0.166	26.574	0.982	1.110	15.037
HMSL-6-LT	0.134	8.392	0.257	27.245	0.793	1.069	18.314
HMSL-7-HT	0.115	10.974	0.648	20.534	0.755	1.151	12.607
HMSL-7-LT	0.153	7.875	0.739	17.850	1.284	1.644	13.132
HMSL-8-HT	0.172	8.435	0.432	21.205	1.548	1.726	35.966
HMSL-8-LT	0.149	9.296	0.448	24.560	0.944	1.480	30.299
HMSL-9-HT	0.345	8.005	0.623	25.231	0.906	1.028	37.983
HMSL-9-LT	0.230	8.865	0.988	26.708	1.359	1.767	41.702

Ammonium Ion: The ammonical nitrogen concentration varied from 0.166 to 1.079 µmol/l. The minimum level of ammonical nitrogen recorded at HMSL-6 during high tide, whereas the maximum level was recorded at HMSL-1 during low tide. The variation of ammonical nitrogen at all the monitoring locations is shown in Figure 4-29.

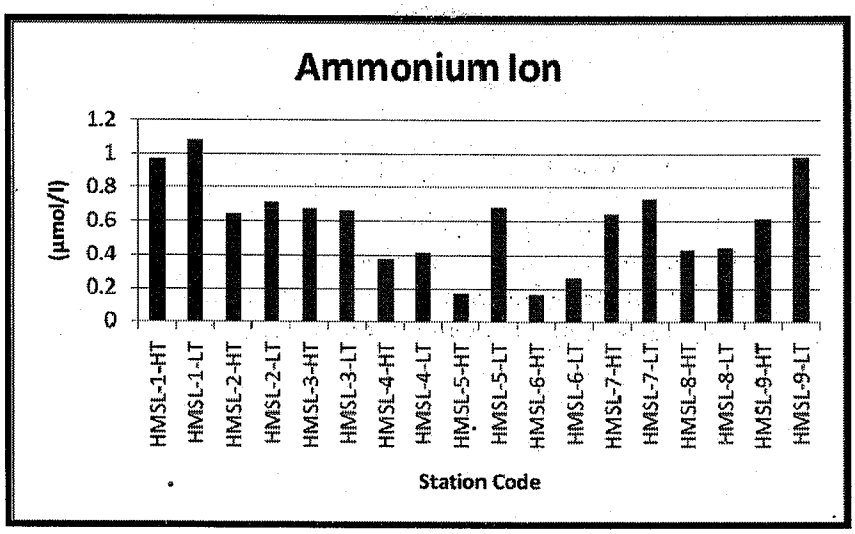

Figure 4-29: Variations in Ammonium Ion Levels

Nitrite: The nitrite concentration varied from 0.115 to 0.555 µmol/l. The minimum level of nitrite was observed at HMSL-7 during high tide whereas the maximum level of was observed at HMSL-5 during low tide. The variation of nitrite at all the monitoring locations is shown in Figure 4-30.

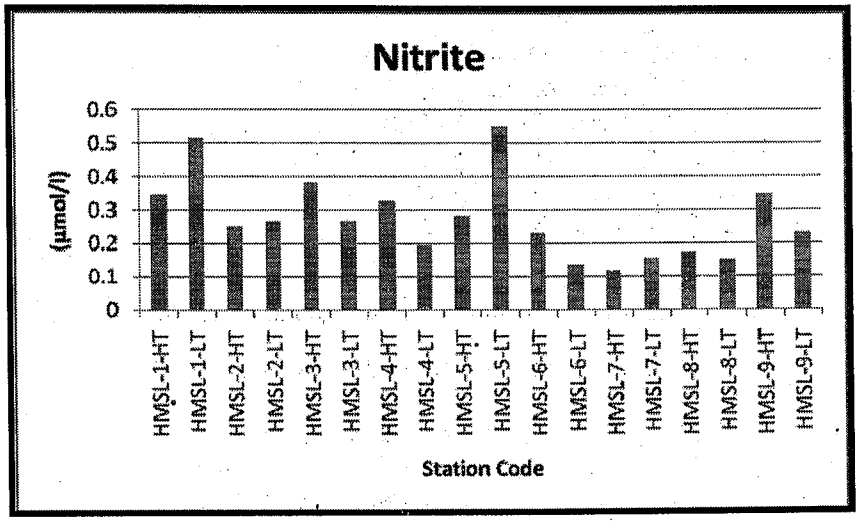

Figure 4-30: Variations in Nitrite Levels

Nitrate: The nitrate concentration ranged between 6.756 to 10.974 µmol/l. The minimum level of nitrate observed at HMSL-6 during high tide, whereas the maximum level of nitrate observed at HMSL-7 during high tide. Nitrate levels at all the monitoring locations are shown in Figure 4-31.

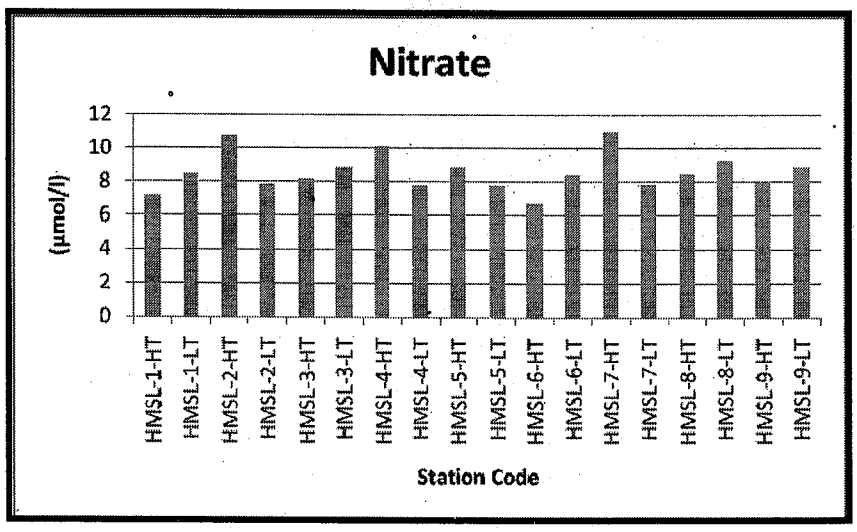

Figure 4-31: Variations in Nitrate Levels

Total Nitrogen: The Total Nitrogen concentration varied from 17.85 to 27.245 µmol/l. The minimum level of Total Nitrogen observed at HMSL-7 during low tide, whereas the maximum level was recorded at HMSL-6 during low tide. Total Nitrogen levels at all the monitoring locations are shown in Figure 4-32.

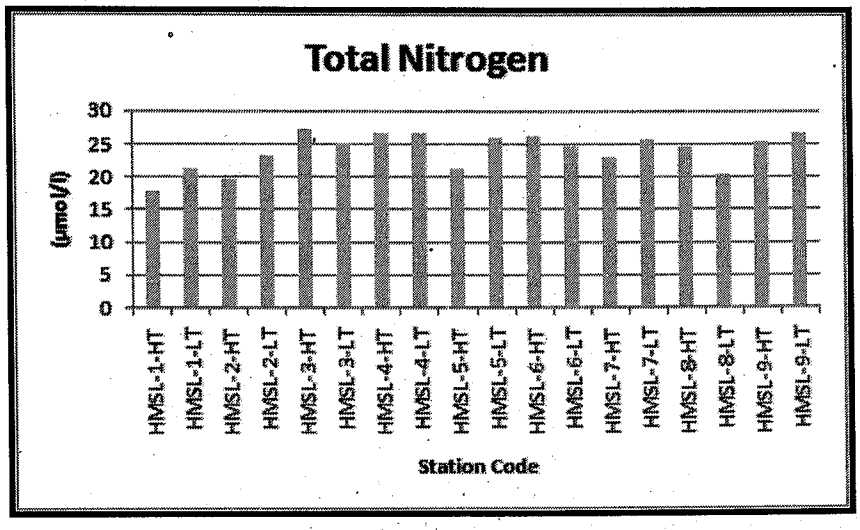

Figure 4-32: Variations in Nitrogen Levels

Inorganic Phosphate: The inorganic phosphate concentrations in the sampling stations were fluctuated between 0.680 and 1.548 µmol/l. The lower level of inorganic phosphate was recorded at HMSL-4 during high tide and the maximum level was recorded at HMSL-8 during high tide. Inorganic phosphate levels at all the monitoring locations are shown in Figure 4-33.

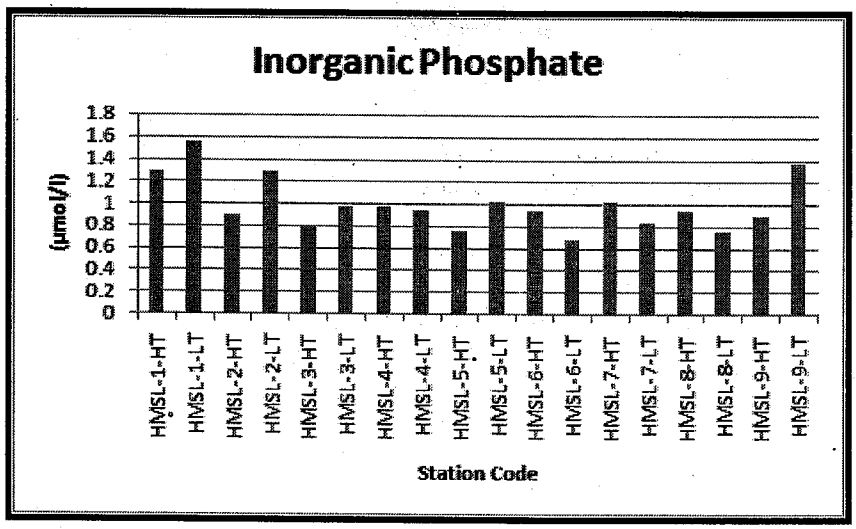

Figure 4-33: Variations in Inorganic Phosphate Levels

Total Phosphorus: The total phosphorus concentration varied from 1.028 to 1.767 µmol/l. The minimum level was recorded at HMSL-3 and HMSL-9 during both high tide the maximum level was recorded at HMSL-9 during low tide. Total Phosphorus levels at all the monitoring locations are shown in Figure 4-34.

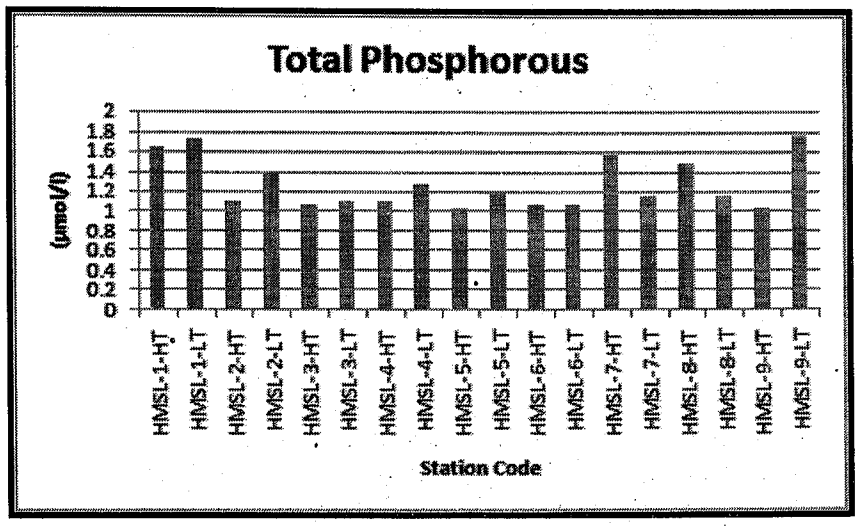

Figure 4-34: Variations in Total Phosphorous Levels

Silicate: The silicate level was ranged from 12.607 to 41.702 µmol/l. The maximum level was recorded at HMSL-9 during low tide and the minimum level was recorded at HMSL-7 during high tide. Silicate levels at all the monitoring locations are shown in Figure 4-35.

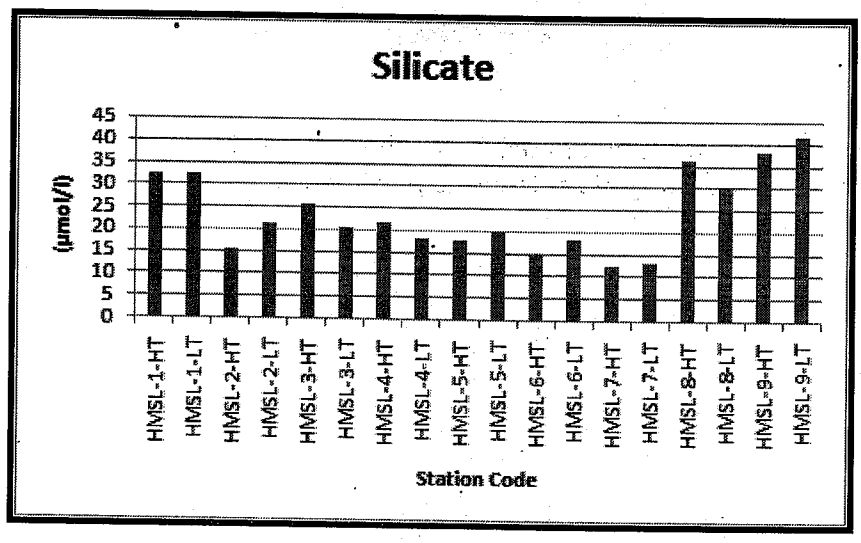

Figure 4-35: Variations in Silicate Levels

Heavy Metals:

In water samples the fluctuations of heavy metal such as Cadmium (Cd), Copper (Cu), Iron (Fe), lead (Pb), Zinc (Zn), and Mercury (Hg) have been examined. The results of heavy metal concentrations in the sampling locations are given in Table 4-15.

Table 4-15: Heavy Metal Concentrations (µg/l) in Seawater

S. No.	Location Code	Parameters (µg/l)					
		Cd	Cu	Fe	Pb	Zn	Hg
1	HMSL-1-HT	1.24	18.12	59.65	16.72	31.88	0.012
2	HMSL -1-LT	1.08	12.06	97.82	15.22	34.62	0.024
3	HMSL -2-HT	1.15	40.92	90.24	16.32	55.64	0.048
4	HMSL -2-LT	1.14	52.82	75.62	20.73	62.96	0.042
5	HMSL -3-HT	0.98	54.24	98.24	23.46	63.32	0.024
6	HMSL -3-LT	1.38	49.44	94.12	25.02	66.36	0.012
7	HMSL-4-HT	1.25	48.24	84.69	22.52	60.72	0.008
8	HMSL-4-LT	1.56	37.98	55.76	11.94	73.56	0.006
9	HMSL-5-HT	1.68	44.78	82.64	33.72	59.63	0.018
10	HMSL-5-LT	0.94	41.56	95.63	34.26	58.58	0.006
11	HMSL-6-HT	0.6	49.23	63.22	22.22	56.25	0.010
12	HMSL-6-LT	1.56	46.92	91.25	19.32	53.04	0.018
13	HMSL-7-HT	1.35	31.56	94.81	11.52	46.96	0.024
14	HMSL-7-LT	0.63	17.94	20.68	16.95	45.42	0.012
15	HMSL-8-HT	0.83	10.74	18.28	15.82	59.94	0.036
16	HMSL-8-LT	1.39	24.36	29.864	19.23	54.38	0.028
17	HMSL-9-HT	1.26	30.56	86.28	28.62	51.32	0.042
18	HMSL-9-LT	1.55	33.91	82.16	26.42	68.06	0.054

Cadmium (Cd): The values ranged from 0.60 µg/l at HMSL-6 (HT) to 1.68 µg/l at HMSL-5 (HT).

Copper (Cu): The values ranged from 10.74 µg/l at HMSL-8 (HT) to 54.24 µg/l HMSL-3 (HT).

Lead (Pb): The values ranged from 34.26 µg/l at HMSL-5 (LT) to 11.52µg/l at HMSL-7 (HT).

Zinc (Zn): The values ranged from 73.56 µg/l at HMSL-4 (LT) to 31.88 µg/l at HMSL-1 (HT). The variation of Cadmium, Copper, Lead and Zinc at all the monitoring locations is shown in Figure 4-36.

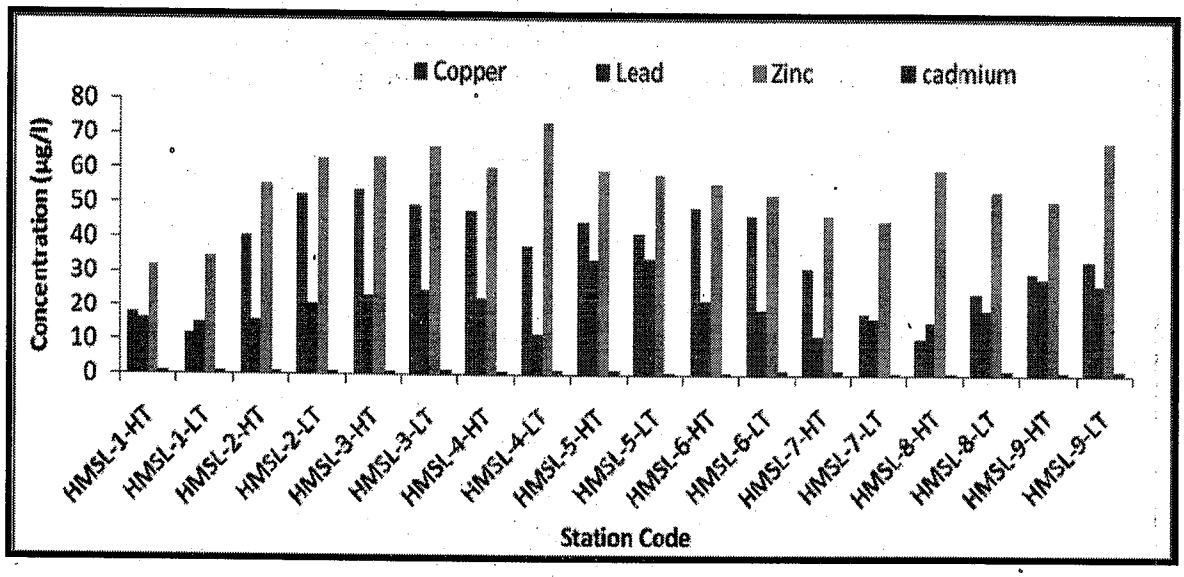

Figure 4-36: Variations in Cadmium, Copper,Zinc and Lead

Iron (Fe): The values ranged from 18.28 µg/l at HMSL-8 (HT) to 98.24 µg/l HMSL-3 (HT). The variation of iron at all the monitoring locations is shown in Figure 4-37.

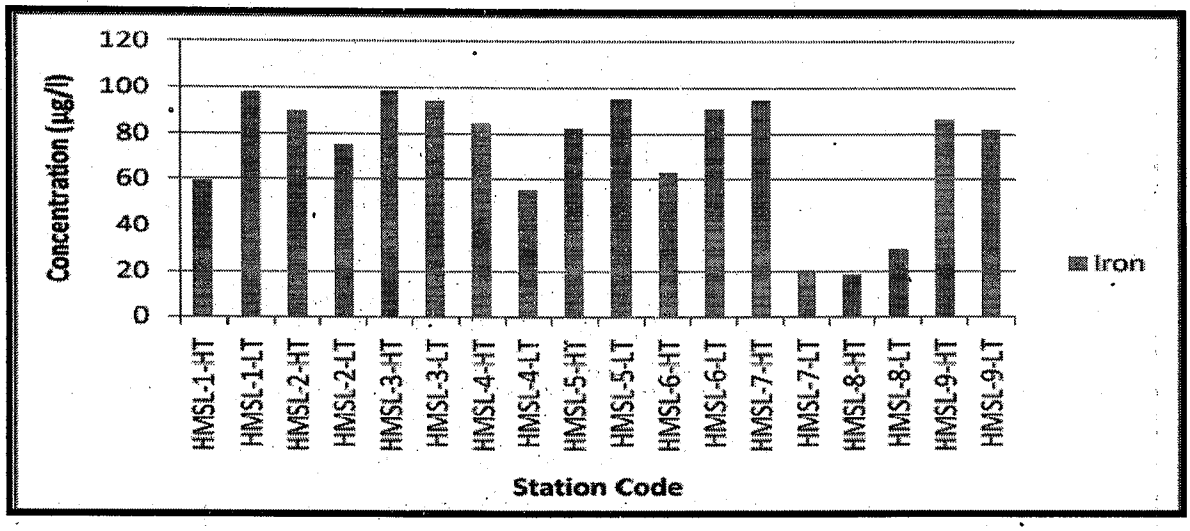

Figure 4-37: Variations in Iron Concentration

Mercury (Hg): The values ranged from 0.006 µg/l at HMSL-4 & HMSL-5 during low tide to 0.054 µg/l at HMSL- 9 during low tide. The variation of mercury at all the monitoring locations is shown in Figure 4-38.

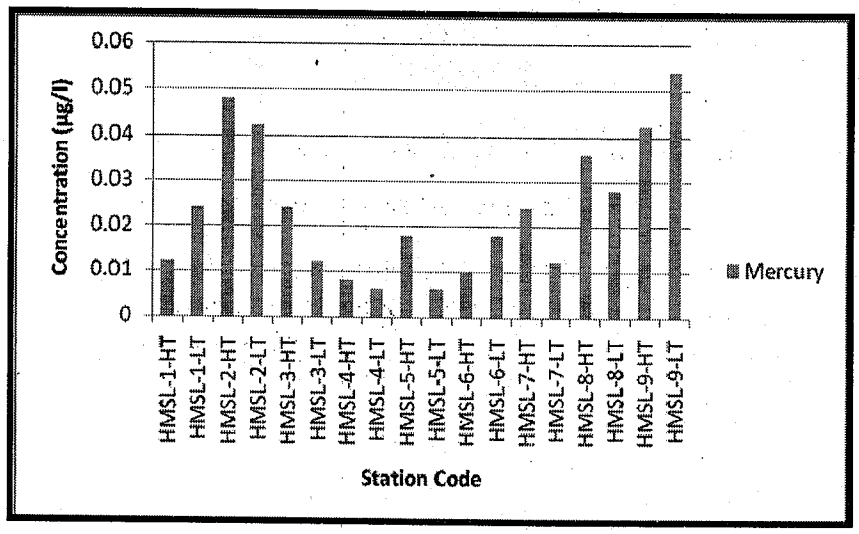

Figure 4-38: Variations in Mercury Concentration

4.5 Biological Environment

4.5.1 Marine/Coastal Ecology

The details of the various biological parameters monitored and the range of values observed are given in the paragraphs below.

4.5.1.1 Phytoplankton

Surface phytoplankton samples were collected from all nine locations. The population density of phytoplankton ranged between 1064 Nos/L at HMSL-1 during low tide to 4139 Nos/L at HMSL-3 during high tide. Around 61 species of phytoplankton were recorded from the study area.

The Number of species of Phytoplankton are given in the Table 4-16 and graphically shown in Figure 4-39.

Table 4-16: Number of Species at Each Sampling Location

Location Code	Phytoplankton Density (Nos./l)
HMSL-1-HT	2150
HMSL-1-LT	1064
HMSL-2-HT	2051
HMSL-2-LT	1290
HMSL-3-HT	4139
HMSL-3-LT	2506
HMSL-4-HT	2905
HMSL-4-LT	2477
HMSL-5-HT	2820

Location Code	Phytoplankton Density (Nos./l)
HMSL-5-LT	1660
HMSL-6-HT	3290
HMSL-6-LT	2860
HMSL-7-HT	2388
HMSL-7-LT	1884
HMSL-8-HT	3232
HMSL-8-LT	2898
HMSL-9-HT	3693
HMSL-9-LT	3022

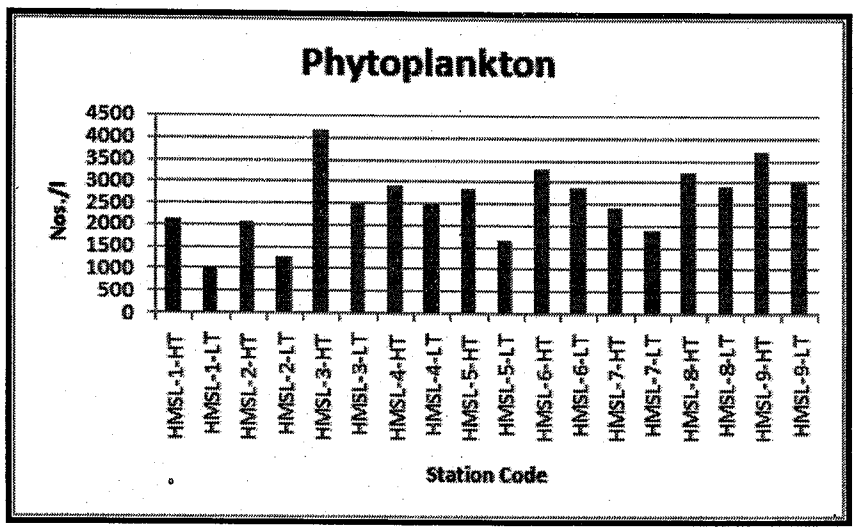

Figure 4-39: Variations in Phytoplankton Density

The details regarding phytoplankton abundance for all monitoring locations are given in **Appendix D**.

Primary ProductivityPrimary Productivity ranged between 46.86 mg C/m^3/hr at HMSL-3 during high tide and 98.80 mg C/m^3/hr at HMSL-4 during low tide.

Chlorophyll-a

Chlorophyll-a ranged between 0.324 mg/m^3 at HMSL-1 during low tide and 1.691 mg/m^3 at HMSL-3 during high tide.

Phaeopigment

Phaeopigment ranged between 0.025 mg/m^3 at HMSL-1 during low tide and 0.874 mg/m^3 at HMSL-3 during high tide.

Total Biomass

Total Biomass varied between 10.46 mg/100 m^3 at HMSL-5 during low tide and 54.08 mg/100 m^3 at HMSL-7 during high tide. Detailed results for the above parameters are given in Table 4-17.

Table 4-17: Primary Productivity, Chlorophyll-a, Phaeopigment, Total Biomass

S. No.	Location Code	Primary Productivity (mg C/m^3/hr)	Chlorophyll a (mg/m^3)	Phaeopigment (mg/m^3)	Total Biomass (ml/100 m^3)
1	HMSL-1-HT	54.94	0.723	0.062	20.73
2	HMSL-1-LT	69.48	0.324	0.025	11.23
3	HMSL-2-HT	80.58	0.821	0.492	33.16
4	HMSL-2-LT	71.01	0.414	0.231	14.22
5	HMSL-3-HT	98.8	1.691	0.874	20.56
6	HMSL-3-LT	87.26	0.749	0.492	13.37
7	HMSL-4-HT	74.34	0.720	0.623	27.95
8	HMSL-4-LT	46.86	0.560	0.430	20.96
9	HMSL-5-HT	66.25	0.623	0.452	14.10
10	HMSL-5-LT	80.83	0.947	0.623	10.46
11	HMSL-6-HT	90.5	1.218	0.512	28.10
12	HMSL-6-LT	75.95	0.676	0.400	17.27
13	HMSL-7-HT	74.74	0.946	0.312	54.08
14	HMSL-7-LT	83.82	0.745	0.623	42.34
15	HMSL-8-HT	91.81	0.614	0.241	32.32
16	HMSL-8-LT	66.26	0.413	0.230	21.21
17	HMSL-9-HT	98.65	1.077	0.600	38.22
18	HMSL-9-LT	81.27	1.589	0.623	36.33

4.5.1.2 Zooplankton

Zooplankton abundance varied from a minimum of 2826 cells/m^3 at HMSL-5 (LT) to 8112 Nos/m^3 at HMSL-7 (HT). Around 42 species of zooplankton were recorded from the study area.

The Number of species of Zooplankton are given in the Table 4-18 and graphically shown in Figure 4-40.

Table 4-18: Number of Species at Each Sampling Location

Location Code	Zooplankton Density (Nos./m^3)
HMSL-1-HT	4144
HMSL-1-LT	2920
HMSL-2-HT	6301
HMSL-2-LT	3553
HMSL-3-HT	4320
HMSL-3-LT	3477
HMSL-4-HT	5590
HMSL-4-LT	4193

Location Code	Zooplankton Density (Nos./m^3)
HMSL-5-HT	3381
HMSL-5-LT	2826
HMSL-6-HT	5059
HMSL-6-LT	3974
HMSL-7-HT	8112
HMSL-7-LT	6777
HMSL-8-HT	5494
HMSL-8-LT	4458
HMSL-9-HT	6880
HMSL-9-LT	5813

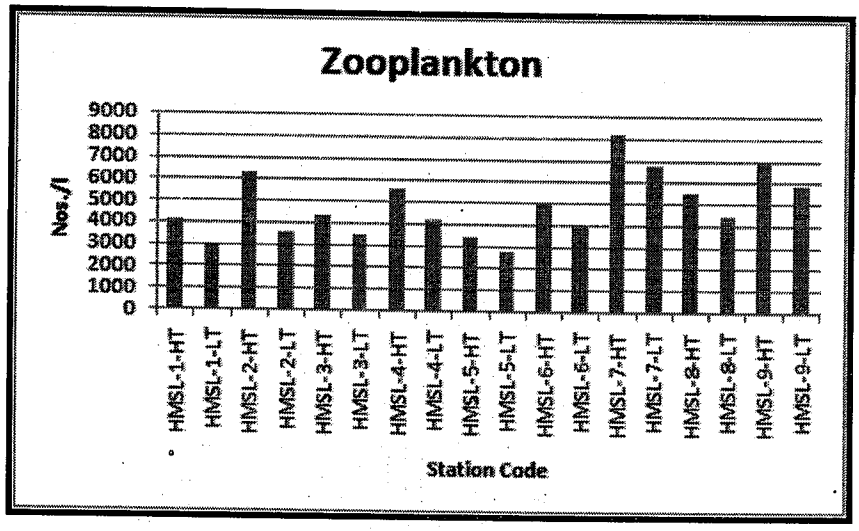

Figure 4-40: Variations in Zooplankton Density

The details regarding zooplankton abundance for all monitoring locations are given in **Appendix D.**

4.5.1.3 Finfish eggs density

Finfish eggs density varied from a minimum of 73 Nos./m^3 at HMSL-8 (LT) to 110 Nos./m^3 at HMSL-8 (HT).

4.5.1.4 Finfish Larvae density

The recorded Finfish larvae density varied from a minimum of 1 Nos./m^3 to 3 Nos./m^3 .

4.5.1.5 Microbial Population

The indicator and pathogenic bacteria isolated from water samples collected from the marine monitoring locations are described below and the details are given below & **Appendix D.**

Escherichia Coli (EC)

The *E.coli* population varied between 10 x 10^1 CFU/ml at HMSL-3 and HMSL-7 during low tide and 28 x 10^1 CFU/ml at HMSL-8 during high tide.

Faecal Coliform (FC)

The Faecal Coliform population ranged between 30 CFU/ml at HMSL- 9 during low tide and 39 x 10^1 CFU/ml at HMSL-5 during high tide.

Pseudomonas Aeurginosa (PA)

The PA population ranged between 70 CFU/ml at HMSL-9 during low tide and 20 x 10^2 CFU/ml at HMSL-5 during high tide.

Proteus-Klebsiella (PK)

The PK population ranged between 11 x 10^1 CFU/ml at HMSL-9 during low tide and 23 x 10^2 CFU/ml at HMSL-8 during high tide.

Streptococcus Faecalis (SF)

The SF population ranged between 10 CFU/ml at HMSL-3 during low tide and 28 CFU/ml at HMSL-4 during high tide.

Shigella (SH)

The SH population observed ranged between 21x10^3 CFU/ml and 90 CFU/ml. The minimum concentration was observed at HMSL-9 during low tide. The maximum concentration was observed at HMSL-6 during high tide.

Salmonella (S)

The Salmonella population ranged between 10 CFU at HMSL-1 during low tide and 22 x 10^1 CFU/ml at HMSL-5 (HT).

Total Coliform (TC)

The Total Coliform population ranged between 11 x 10^2 CFU/ml at HMSL-1 during low tide and 50 x 10^3 CFU/ml at HMSL-5 during low tide.

Total Viable Count -Total Heterotrophic Bacteria (TVC)

TVC observed in water samples ranged between 36 x 10^4 CFU/ml at HMSL-8 during high tide and 10 x 10^4 CFU/ml at HMSL-5 during low tide.

Vibrio Cholera (VC)

The VC population ranged between 10 CFU/ml at HMSL-8 during low tide and 22 x 10^1 CFU/ml at HMSL-3 during high tide.

Vibrio Parahaemolyticus (VP)

The VP population observed in water samples ranged between 5 CFU/ml at HMSL-9 during low tide and 20 x 10^1 CFU/ml at HMSL-6 during high tide. The details regarding Microbial population all monitoring locations are given in **Appendix D.**

4.5.2 Fisheries

The most common species landed at Honnavar is the Indian Mackerel (*Rastrelliger kanagurta*). Its peak season is from June to July, and fished using gillnets. Seer Fish season is from the 15th of August till the end of September. Anchovies (*Engraulidae*) and Sardines (*Sardinella sp.)* are available throughout the year. *Limited* fishing activity in the Sharavati River is observed with Traditional Boats using Trap Nets and Traditional nets. A list of fishes either trapped or caught by local fishermen from the waters of the study area is given in Table-4-19.

Table 4-19: List of Fish Reported from the Study Area.

S. No.	Scientific Names	S. No.	Scientific Names
1	*Epinephelus diacanthus*	25	*Rhinobatos granulatus*
2	*Grammoplites suppositus*	26	*Pristipomoides filamentosus*
3	*Priacanthus hamrur*	27	*Pampus argenteus*
4	*Scomberomorus commerson*	28	*Parastromateus niger*
5	*Scomberomorus guttatus*	29	*Rachycentron canadum*
6	*Euthynnus affinis*	30	*Kowala coval*
7	*Thunnus tonggol*	31	*Dussumieria acuta*
8	*Auxis thazard*	32	*Chirocentrus dorab*
9	*Sphyraena jello*	33	*Stolephorus commersonii*
10	*Sphyraena obtusata*	34	*Stolephorus devisi*
11	*Sphyrna lewini*	35	*Thryssa mystax*
12	*Rhizoprinodon acutus*	36	*Leiognathus bindus*
13	*Scoliodon laticaudus*	37	*Secutor insidiator*
14	*Carcharhinus limbatus*	38	*Saurida tumbil*
15	*Trichiurus lepturus*	39	*Pseudorhombus arsius*
16	*Sardinella longiceps*	40	*Pseudorhombus natelensis*
17	*Rastrelliger kanagurta*	41	*Cynoglossus macrostomus*
18	*Megalaspis cordyla*	42	*Metapenaeus monoceros*
19	*Decapterus russelli*	43	*Portunus pelagicus*
20	*Caranx kalla*	44	*Portunus sanguinolentus*
21	*Scomberoides tol*	45	*Oratosquilla nepa*
22	*Lactarius lactarius*	46	*Sepia aculeata*
23	*Nemipterus japonicus*	47	*Loligo duvauceli*
24	*Nemipterus mesoprion*	48	*Rastrelliger karnagurta*

4.5.3 Flora and Fauna in the Area

A detailed study on flora and fauna was carried out at various locations within the study area. Study methodology and status of flora and fauna in the study area are discussed.

4.5.3.1 General Description of the Study Area

The project area falls towards southern side of the Sharavati river mouth. The coastal zone of the region is populated with a coconut clad villages. The hill chains of the Western Ghats, which run in the north-south direction, parallel to the coast, form the backbone of the district.

This section is concerned with the development of the proposed barge/vessel loading facility site of HPPL. Methodology of the Flora & Fauna Study

Flora and fauna studies were conducted to assess the list of plant and animal species and their habitat in and around the port site. The area meant for the establishment of the barge/vessel loading facility is described as the ***Core Area*** while the area surrounding the core area up to a radius of 10 km is described as the ***Project Influence Area***.

4.5.3.2 Status of Flora & Vegetation

Core Area: The land identified for barge/vessel loading facility (core area) is coastal sand. No major vegetation is observed. The proposed project site is mostly barren and the only vegetation found here are a few grasses, occasional cacti and a few stretches of *Ipomoea pes-caprae.* This type of vegetation is quite common along the Indian Coast. There are no forests or plantations within the core area.

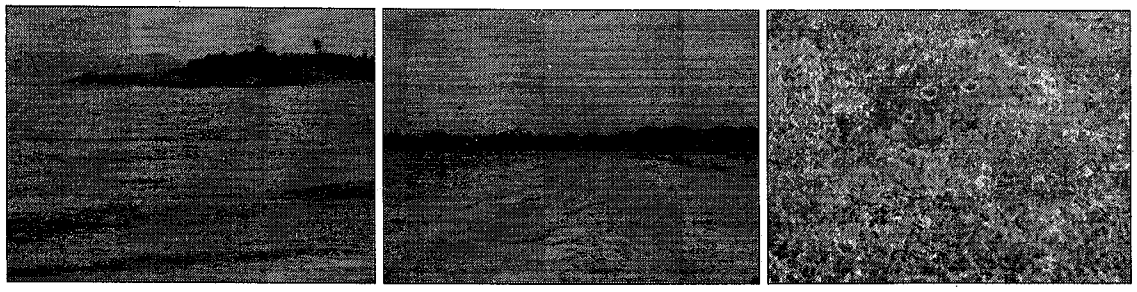

Plate 4-2: Vegetation in Core Area

Project Influence Area: In the project influence area consists of dense forests (78.477 sq. Km) of, scrub forests (61.3676 sq. km). Mangroves occupy about 10.605 Sq. km as per the land use survey. Paddy is most widely grown during the rainy season. Agricultural land (which includes plantations) about 67.165 sq. km comprising about 9.5% of the PIA. Among the other crops, Areca nut, cocoa, nutmeg, chickoo, vanilla, and black pepper are common but limited to small size plots. *Coconut (Cocos nucifera)* is widely grown in PIA. Among the other cultivated trees, Areca nut, Cashew nut, and Mango are important.

4.5.3.3 Forest and Mangrove vegetation and flora of the PIA

There is a dense patch of Mangroves more than 2.5 km towards SE in the Sharavati River. There is a reserve forest near Hebbankere around 10 km, NE and several minor forests around 10 km south aerial distance.

According to published sources*[1]., a total of 268 species of plants have been recorded in the Uttara Kannada district. This includes 14 species of liana, 35 species of climber, 33 species of herb, 59 species of shrub, 4 species of palm, 2 species of grass, 5 species of orchid and 116 species of tree. Among them two species are listed as critically endangered viz. *Semicarpus kathlekanensis, Vateria indica*, and five species as endangered viz. *Chenomorpha fragrans, Dipterocarpus indicus, Dysoxylum malabaricum, Nothapodytes nimmoniana, Persea macrantha*, and about 16 species as vulnerable A detailed list of all the flora of the project area is given in **Appendix E.**

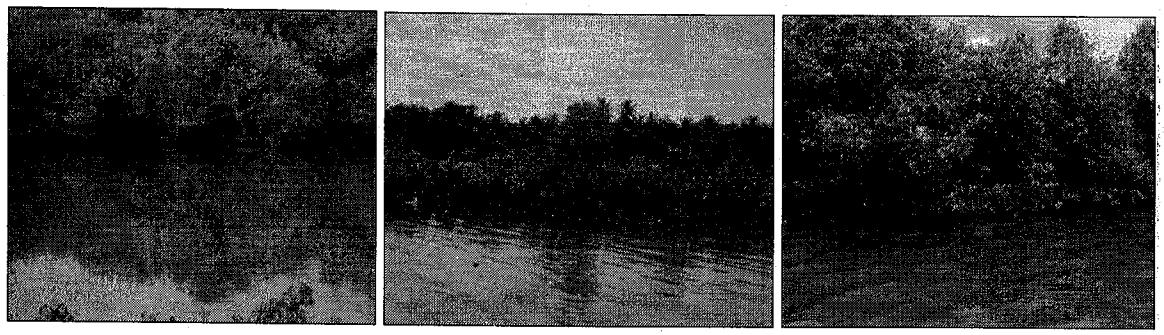

Plate 4-3: Mangroves near Sharavati River

Plate 4-4: Forest Vegetation in Project Impacted Area

4.5.3.4 Non forest and non mangrove vegetation and flora of the PIA

Paddy is the main crop and it is grown as rain fed crop during the rainy season. Other crops include Banana, Betel leaves, Sugar cane, Jute and vegetables, especially brinjal. These crops are very rare and occupy small and isolated areas. Coconut (*Cocos nucifera*), Areca nut (*Areca catechu*), Cashew nut (*Anacardium occidentale*).

[1] H. N. Kumara, Vijay Mohan Raj & K. Santhosh, Indian Institute of Science, & Karnataka Forest Department

4.5.3.5 Status of Terrestrial Fauna

As far as the core area is concerned, there is no fauna that belongs to the REET (Rare Endemic Endangered and Threatened) category. Only a few black kites (*Milvus migrans*) had been seen.

Since it was not possible to cover all the existing fauna in the Project impacted area common check lists have been prepared based mainly on authentic secondary data and also on the basis of direct observation, indirect or circumstantial evidence such as foot prints, feathers, skin, hair, hooves etc. The list of terrestrial fauna found in the study area is provided in **Appendix E**. The lion tailed macaque (*Macaca silenus*) and Grey Langur (Semnopithecus *entellus*.) are reported in the Uttara Kannada district. These primates belong to the Endangered and Near Threatened categories of IUCN (International Union for Conservation of Nature). There were Signboards indicating the presence of the Indian bison *(Bibos gaurus)*.

Migratory birds and the REET category birds had not been observed during the field visit. However, from the secondary data collected from the forest Department, Malabar Grey Hornbill (*Ocyceros griseus*) although not endangered, is endemic to the study area. The Painted stork (*Mycteria leucocephala*), the black headed ibis (*Threskiornis melanocephalus)* had been reported in the study area. *These are* classified as Near Threatened as per IUCN Standards. Commonly observed birds include Paddy field Egrets, Mynas and Kingfishers. Similarly, the Reptiles of the study area are represented by common species of widespread occurrence. There are no Crocodiles and Sea turtles.

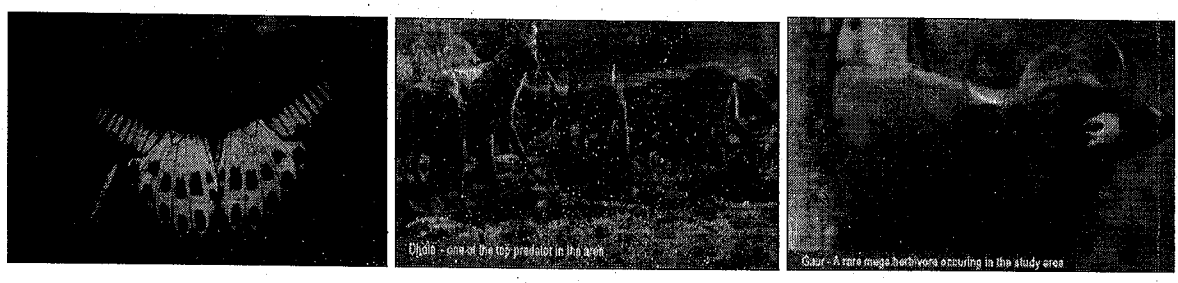

Plate 4-5: Fauna reported in Uttara Kannada District

Plate 4-6: Endemic Fauna reported in Uttara Kannada District

4.5.3.6 Aquatic flora and fauna of the PIA/study area

There are no perennial reservoirs either in the core or project affected area. But a good deal of aquatic ecosystem diversity represented by the marine (Arabian Sea), estuarine (around the Sharavati river mouth and banks), occasional lotic (streams) and a few scattered lentic (ponds and marshes) ecosystems could be noticed.

4.6 Air Environment

4.6.1 Meteorological Data from Nearest Meteorological Station (Honnavar)

The nearest Indian Meteorological Department (IMD) station located to project site is Honnavar. The climatological data for Honnavar (14°17' N and 74°27' E), published by the IMD, based on daily observations at 08:30 and 17:30 hour IST for a 30 year period, is presented in the following sections. The monthly variations of the relevant meteorological parameters are presented in Table 4-20.

Table 4-20: Climatological Summary – Honnavar Region (1951-1980)

Month	Temp (°C)		Rainfall (mm)		Relative Humidity (%)		Station Level Pressure hPa		Mean Wind Speed (km/h)	Predominant Wind Directions (From)*	
	Daily Max.	Daily Min.	Total	No. of days	08:30	17:30	08:30	17:30		08:30	17:30
Jan	31.9	20.0	0.6	0.1	70	58	1010.7	1007.2	6.2	E,NE	W,NW
Feb	31.5	20.5	0.0	0.0	75	63	1010.0	1006.5	6.7	E,NE	W,NW
Mar	32.2	22.9	1.1	0.1	80	65	1009.1	1005.6	6.9	E,NE	W,NW
Apr	32.9	25.2	17.0	1.0	78	67	1007.5	1004.1	7.2	E,NE	W,NW
May	32.5	25.8	171.9	5.7	79	70	1005.8	1003.0	8.4	E, W	W,NW
Jun	29.5	23.9	1016.1	23.9	90	84	1004.8	1002.9	9.2	E, W	W,SW, S
Jul	28.2	23.4	1196.0	28.7	92	88	1004.8	1003.3	9.4	W, E	W,SW
Aug	28.3	23.5	702.7	25.0	92	86	1005.7	1003.8	8.4	W, E	W,SW
Sep	29.1	23.2	363.1	15.4	91	82	1007.0	1004.4	5.9	E, S,W	W, S
Oct	30.9	23.3	171.1	8.0	86	77	1008.0	1005.1	5.7	E,NE	W,S
Nov	32.6	22.2	58.6	2.7	72	64	1009.3	1006.1	5.9	E,NE	W,NW
Dec	32.8	21.2	17.1	0.6	64	57	1010.5	1006.9	7.0	E,NE	W,NW

**Predominant wind in decreasing order (Source: IMD Climatological Data for Honnavar Region)*

As per the above climatological table the following are the observations were drawn from the period of 1951-1980.

- The daily maximum temperature is 32.9°C and the daily minimum temperature is 20.0°C.
- Maximum and minimum relative humidity of 92% and 64% were recorded at 08:30 hours in the months of July, August and December. Maximum and minimum relative humidity of 88% and 57% were recorded at 17:30 hours in the months of July and December.
- The Maximum rainfall observed is 1196.0 mm during July month and no rainfall was recorded in February month. Annual total rainfall was 3753.3 mm.

- Annual Mean wind speed is 7.2 km/h.

4.6.2 Meteorological Scenario during Study Period

Site-specific meteorological data was generated during Pre monsoon season. Automatic weather station was installed to record the meteorological parameters during the study period. Meteorological parameters recorded include temperature, wind speed, wind direction, relative humidity and rainfall.

Temperature: Maximum and minimum temperatures observed during the study period are 33.22°C and 21.72°C respectively.

Humidity and Rainfall: Maximum and minimum relative humidity recorded in the study period is 96.2% and 43.5% respectively. Total rainfall recorded during study period is 14.99 mm.

4.6.3 History of cyclones

Although cyclones affect the entire coast of India, the East Coast is more prone compared to the West Coast. An analysis of the frequencies of cyclones on the East and West coasts of India during 1891-2000 show that nearly 308 cyclones (out of which 103 were severe) affected the East Coast. During the same period 48 tropical cyclones crossed the West Coast, of which 24 were severe cyclonic storms. Out of the cyclones that develop in the Bay of Bengal, over 58 percent approach and cross the east coast in October and November. Only 25 percent of the cyclones that develop over the Arabian Sea approach the west coast. In the pre-monsoon season, corresponding figures are 25 percent over the Arabian Sea and 30 percent over the Bay of Bengal. Cyclone map of the Karnataka state is given in the Figure 4-41

Table 4-21 History of cyclones in west coast during 1891-2001

WEST COAST		
State	**Station Coastal Districts**	**No. of Cyclonic storms**
Kerala (3)	Malappuram Kozikode Kannur	1 1 1
Karnataka (2)	Dakshina Kannada *Uttar Kannada*	1 1
Maharastra(13)	Sindhu durg Ratnagiri Mumbai ,Thane	3 3 3,4
Goa (2)	Goa	2
Gujarat (28)	Surat kaira Bhavnagar Amroli Junngarh	1 1 4 4 7

	Jamnagar Kutch	6 5

(Source: National Cyclone Risk Mitigation Project(NCRMP))

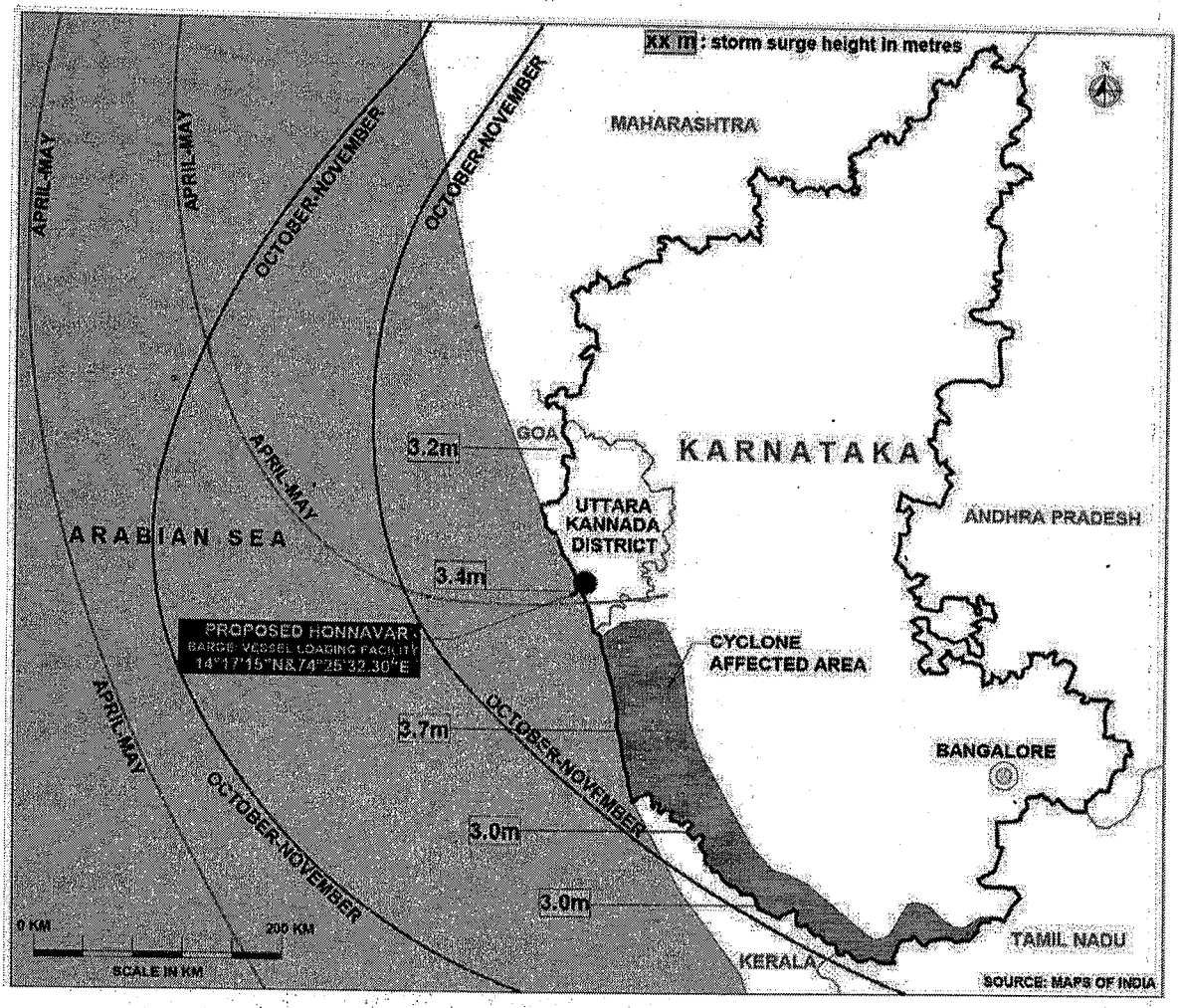

Figure 4-41 Cyclone map of Karnataka coast

4.6.4 Ambient Air Quality

The monitoring locations were selected based on the following:

- Topography/Terrain
- Meteorological conditions
- Minimum two locations in upwind direction
- More sites in downwind side/ impact zone
- Residential and sensitive areas within the study area
- Representatives of regional background air quality/pollution levels and
  - Representation of likely impacted areas

4.6.4.1 Ambient Air Quality Monitoring Stations

To evaluate the baseline air quality of the study area, Six *(6)* monitoring locations have been identified. The details of the locations are given in Table 4-21. Sampling locations within 10 km radius from the proposed site are shown in **Figure FD0406**.

Table 4-22: Ambient Air Quality Monitoring Locations

Station No.	Location	Distance (km) from Project Area	Azimuth Directions	Environmental Setting
A1	Honnavar	2.4	N	Residential Area
A2	Kasarkod	2.5	S	Residential Area
A3	Karki	2.9	N	Residential Area
A4	Ramthirth	3.0	E	Residential Area
A5	Kulkod	4.3	E	Residential Area
A6	Hosad	7.4	SE	Residential Area

4.6.4.2 Ambient Air Quality Monitoring Techniques and Frequency

The techniques used for ambient air quality monitoring and its minimum detectable levels are given in **Appendix F**.

Ambient air quality was monitored twice a week for complete one season. PM_{10}, $PM_{2.5}$, SO_2, NO_2, Hg and were monitored on 24 hourly basis and O_3, CO, HC were monitored on an eight hourly basis. Sampling was carried out as per Central Pollution Control Board (CPCB) monitoring guidelines.

4.6.4.3 Results

The maximum, minimum and mean values of PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO and O_3 are given in **Appendix F**. The variations of PM_{10} and $PM_{2.5}$ are presented in the Figure 4-42.

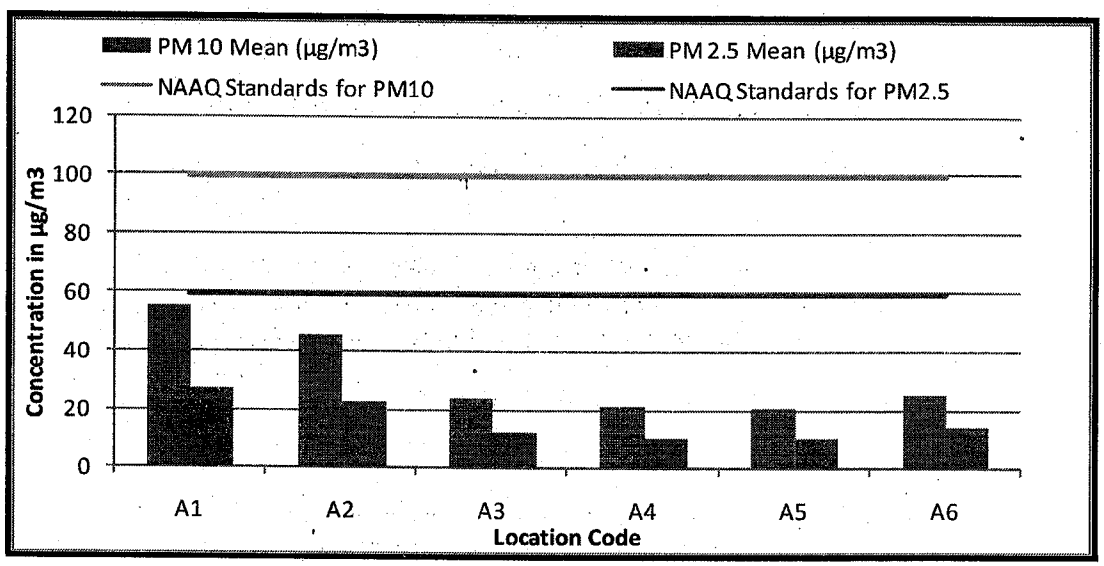

Figure 4-42: Ambient PM_{10} and $PM_{2.5}$ Levels

The variations of SO_2 and NO_2 levels at all the locations are presented in the Figure 4-43.

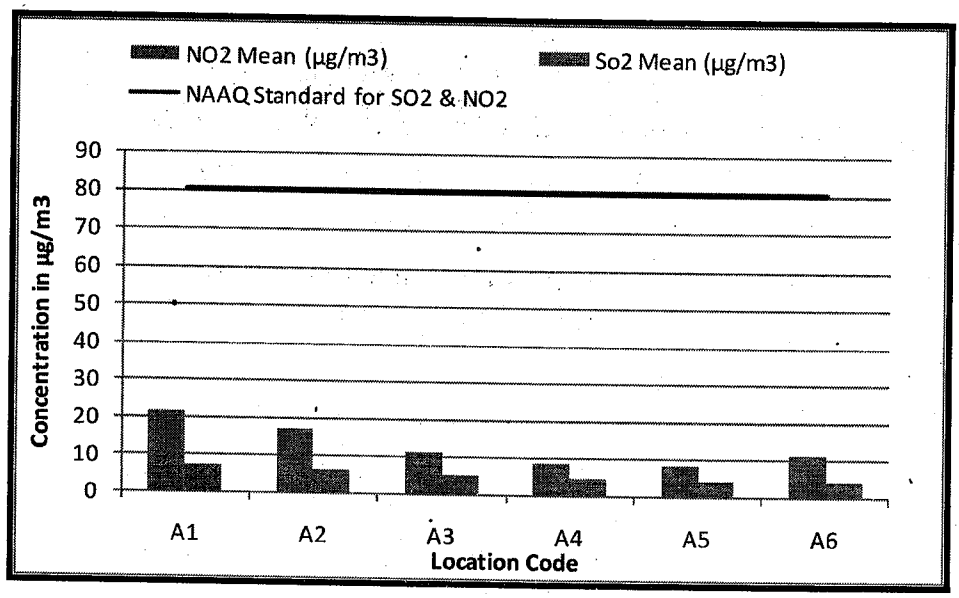

Figure 4-43: Ambient SO_2 and NO_2 Levels

4.6.4.4 Observations

- Maximum concentrations of PM_{10}, $PM_{2.5}$, SO_2 and NO_2 are well within the National Ambient Air Quality Standards during the study period.
- Maximum concentration of PM_{10} ranged between 23.6 µg/m^{3}at Ramthirth and 65.6 µg/m^3 at Honnavar.
- Maximum concentration of $PM_{2.5}$ ranged between 11.6 µg/m^3 at Ramthirth and 35.4 µg/m^3 at Honnavar.
- Maximum concentration of SO_2 ranged between 4.6 µg/m^3 at Kulkod & Hosad and 8.2 µg/m^3 at Honnavar.
- Maximum concentration of NO_2 ranged between 8.6 µg/m^3 at Kulkod and 23.8 µg/m^3 at Honnavar.
- The CO concentration at all locations was observed less than 1.0 ppm.
- Maximum Concentration of Ozone (O_3) ranged between 1.3 µg/m^3 at Karki and 4.1 µg/m^{3}at Honnavar
- Hydro Carbons and Mercury is found to be Below Detectable Limit at all the locations.

4.6.4.5 Inference

The maximum concentrations of PM_{10} and $PM_{2.5}$, SO_2, NO_2 and O_3 observed at Honnavar during the study period. CO and Hydrocarbons are found to be <1.0 and Below Detectable Limit at all the locations. However, all concentrations are within the NAAQ standards.

4.7 Noise

Baseline ambient noise quality has been established by monitoring noise levels at *Six (6)* locations. The noise monitoring locations in the study area were selected after giving due consideration to the various land use categories. The land use categories include

commercial, residential, rural and sensitive areas. Sampling locations within 10 km radius from the barge/vessel loading facility site are shown in **Figure FD0407**. The details of the same are given in Table 4-22. Noise levels were recorded on an hourly basis for one complete day at each location using pre- calibrated noise levels.

Table 4-23: Noise Monitoring Locations

Station No.	Location	Environmental Setting	L_{dn}	L_d	CPCB Standard L_d	L_n	CPCB Standard L_n
N1	Honnavar	Residential Area	47.7	48.9	55	38.8	45
N2	Kasarkod	Residential Area	46.1	47.3	55	37.1	45
N3	Karki	Residential Area	45.1	46.3	55	36.2	45
N4	Ramtirth	Residential Area	43.3	44.4	55	36.0	45
N5	Kulkod	Residential Area	43.5	44.6	55	36.0	45
N6	Hosad	Residential Area	41.4	42.4	55	35.7	45

4.7.1 Results and Discussion

Based on the recorded hourly noise levels at each monitoring location, the day equivalent (L_d) and night equivalent (L_n) were calculated,

L_d: Average noise levels between 6:00 hours to 22.00 hours.
L_n: Average noise levels between 22:00 hours to 6.00 hours.

The Day-Night (L_{dn}) equivalent noise levels were calculated using the US Environmental Protection Agency formula:

$$L_{dn} = 10 \text{ Log } [0.0416 \{16 (10^{Ld/10}) + 8 (10^{Ln+10/10})\}]$$

The comparison of day equivalent noise levels (L_d) and night equivalent noise levels (L_n) with the respective CPCB stipulated noise standards for various land use categories are shown in the Figure 4-44.

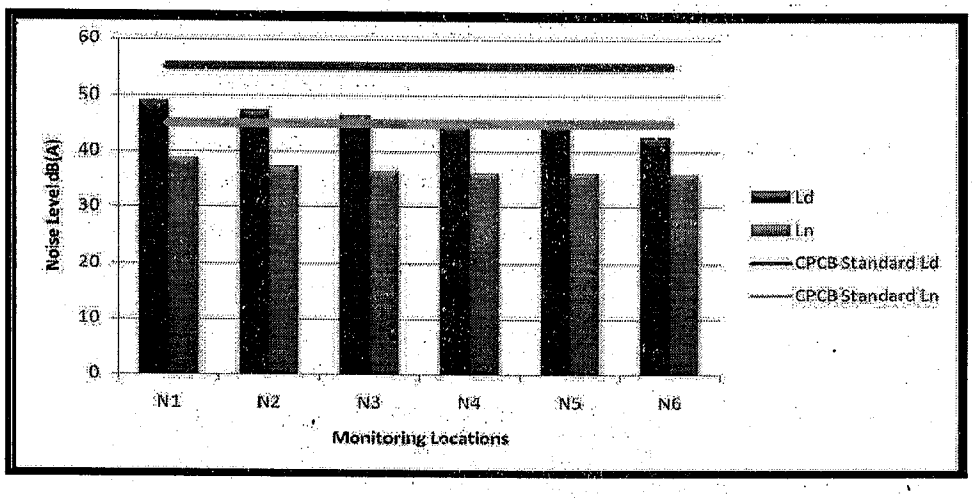

Figure 4-44: Comparison of L_d & L_n with CPCB Standards

4.7.2 Observations

It is observed that day and night time equivalent noise levels at all locations are within CPCB standards for Industrial, residential and silent zones.

- Day equivalent noise levels (L_d) ranged between 42.4 to 48.9 dB(A) in residential zone
- Night equivalent noise levels (L_n) ranged between 35.7 to 38.8 dB(A) in residential zone

4.8 Socio-Economic and Occupational Health Environment

The socio-economic profile of the project influence area was established through compilation of secondary data and 2001 census data for assessing the project influence area profile. The project influence area falls under Uttara Kannada District. Their brief socio-economic data is described in this section.

4.8.1 Population Characteristics

The Honnavar Taluk has a total population of 32808 persons. Further details regarding the socio economic status of villages and settlements in the project influenced area is given as **Appendix G**.

4.8.2 Medical Facilities

The details of community health centres and primary health centres in project influence area are provided in Table 4-23.

Table 4-24: Medical Facilities in PIA

S. No.	Name of the Hospital	Distance from Site (km)
1	St. Ignatius Hospital	2.4
2	Sridevi Maternity Centre	0.5
3	Government Hospital	1.2
4	Sharada Nursing Home	2.7
5	Suvidha Hospital	1.8
6	Balkur Clinic	1.0

4.8.3 Educational Facilities

Details of educational facilities available in the project influence area are given in Table 4-24.

Table 4-25: Educational Facilities in PIA

S.No.	Educational Institution	Distance from Site (km)
1	S.D.M. College of Management Studies, Honnavar	2.2
2	S.D.M. Arts, Science and Commerce College, Honnavar	2.2
3	St. Ignatius School of Nursing, Honnavar	2.4
4	St. Anthony's College for Physical Education, Honnavar	2.0
5	Government Industrial Training Institute, Honnavar	2.8
6	The New English School, Honnavar	0.9

S.No.	Educational Institution	Distance from Site (km)
7	St. Thomas School, Honnavar	0.6
8	Holy Rosary Convent School, Honnavar	2.2
9	Higher Elementary School (Brother School), Honnavar	0.9
10	Marthoma School, Honnavar	1.0
11	Government Kasba Primary School, Honnavar	2.3
12	NMS Higher Primary School, Honnavar	0.6

Further details regarding the socio-economic status of villages and settlements in the project influenced area is given as **Appendix G.**

4.8.4 Details of Fishing Villages and Fish Landing Centres

There are no major fishing zones in the study area. The fish landing centres and fishing settlements in the study area are Honnavar 1.0 km SE and Manki, 11 km SE. The numbers and types of boats and nets in Honnavar harbour is presented in Table 4-25. The population details of Honnavar and Manki are presented in the Table 4-26 and the fish catch statistics are present in Table 4-27.

Table 4-26: Numbers & Types of Boats and Nets in Honnavar Fishing Harbour

Types	Numbers
Purse Sienes	14
Trawlers	85
Gillnet	162
Traditional (including small boats)	645
Total	**906**

(Source: Fisheries department)

Table 4-27: Population details of Fishing Settlements in Honnavar Taluk

Name of the Fish Landing Centre	No. of Fishing settlements	No of Families	Fishermen Population				No.of People engaged in Fisheries		
			Male	Female	Children	Total	Male	Female	Total
Honnavar	16	2555	3063	3076	5709	11848	3342	2939	6281
Manki	6	672	1168	1123	2556	4847	1081	883	1964
Total	22	3227	4231	4199	8265	16695	4423	3822	8245

(Source: Uttarakanada.nic.in)

Table 4-28: (Annual Fish Catch Statistics April 2010 – March 2011)

Period	Total Weight (kg)	Net Worth (in Lakh rupees)
Apr-10	2425.75	404.41
May-10	592.57	124.28
Jun-10	56.29	13.76
Jul-10	21.57	6.44
Aug-10	349.97	122.85

Sep-10	614.07	187.4
Oct-10	1353.94	260.78
Nov-10	2257.34	314.8
Dec-10	2821.88	458.05
Jan-11	4623.62	974.96
Feb-11	1725.03	327.77
Mar-11	1530.36	424.77
Total	**18372.4**	**3620.27**

(Source: Fisheries department)

4.9 Existing Solid and Liquid Waste Disposal Facilities

There are eight chemical industries, 17 engineering industries and 45 other industries in Uttara Kanada district. No common environmental infrastructures such as solid and liquid waste disposal facilities available nearer to the proposed barge/ vessel loading site. Negligible quantity of solid and liquid waste generation is envisaged due to the proposed development. The municipal solid waste will be disposed in to the Municipal solid waste disposal site after obtaining necessary approvals.

4.10 Public Utilities

Water Supply: During construction and operational phase, water requirements will be met through Sharavati River where the river water quality meets the requirement of potable use. The water from the river will be collected and treated before pumping into an Overhead Tank (OHT) for storage purpose. From the OHT, the water will be distributed to the barge/vessel loading facility under gravity.

Power Supply: Power requirement during the construction phase will be met through DG set. Operation phase power requirement will be met from the substation located at Honnavar.

Road: The Barge/vessel loading facility site is well connected with NH 17 & NH 63.

Railway: The Konkan railway is running close to the proposed barge/vessel loading facility.

Air: Goa and Mangalore Airports is located 180 km (N) and 170 km (S) respectively from the Barge/vessel loading facility area.

4.11 Archaeological Monuments

There are no listed monuments in the project study area as per Archaeological Survey of India (ASI).

FIGURES

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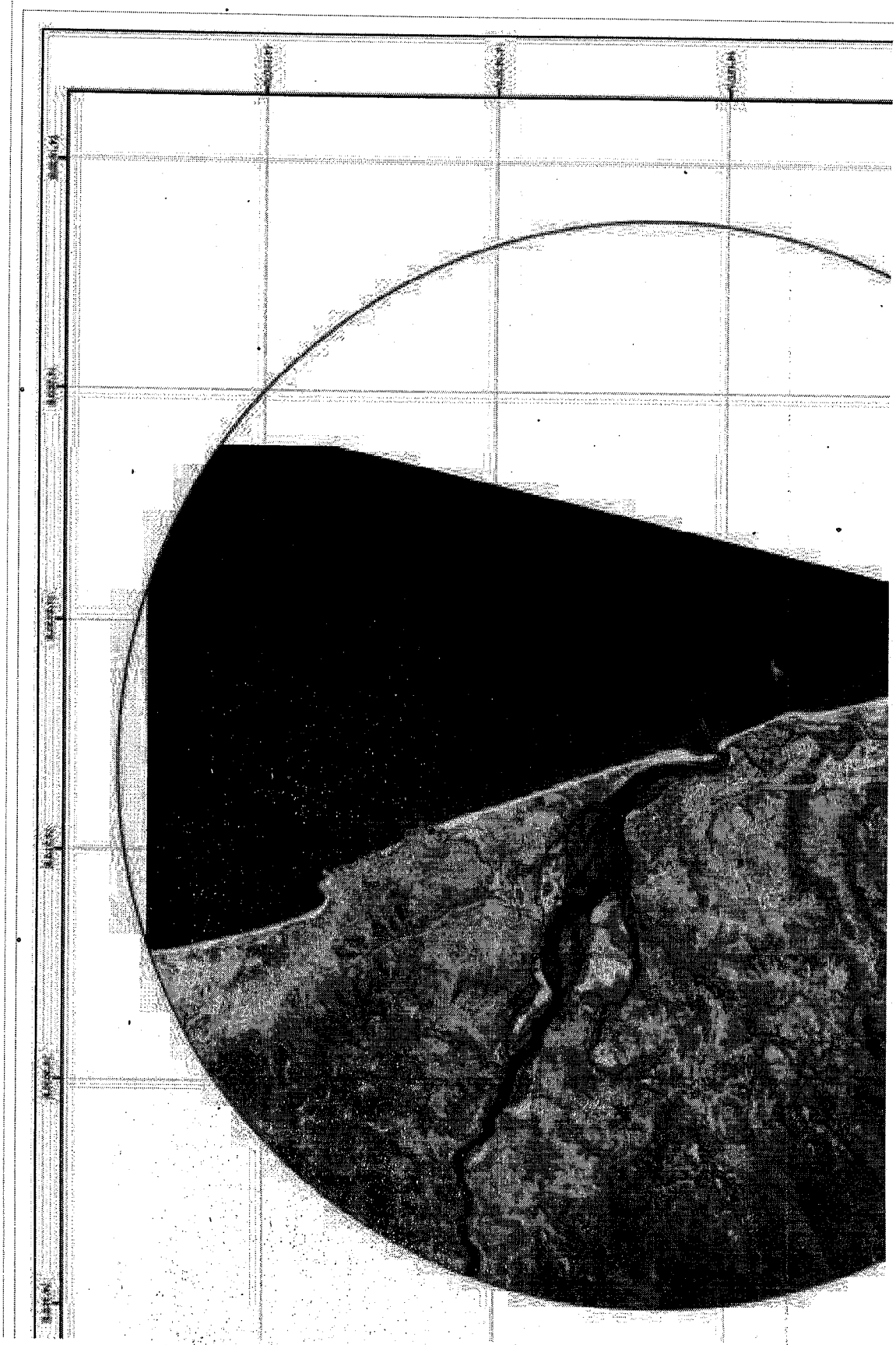

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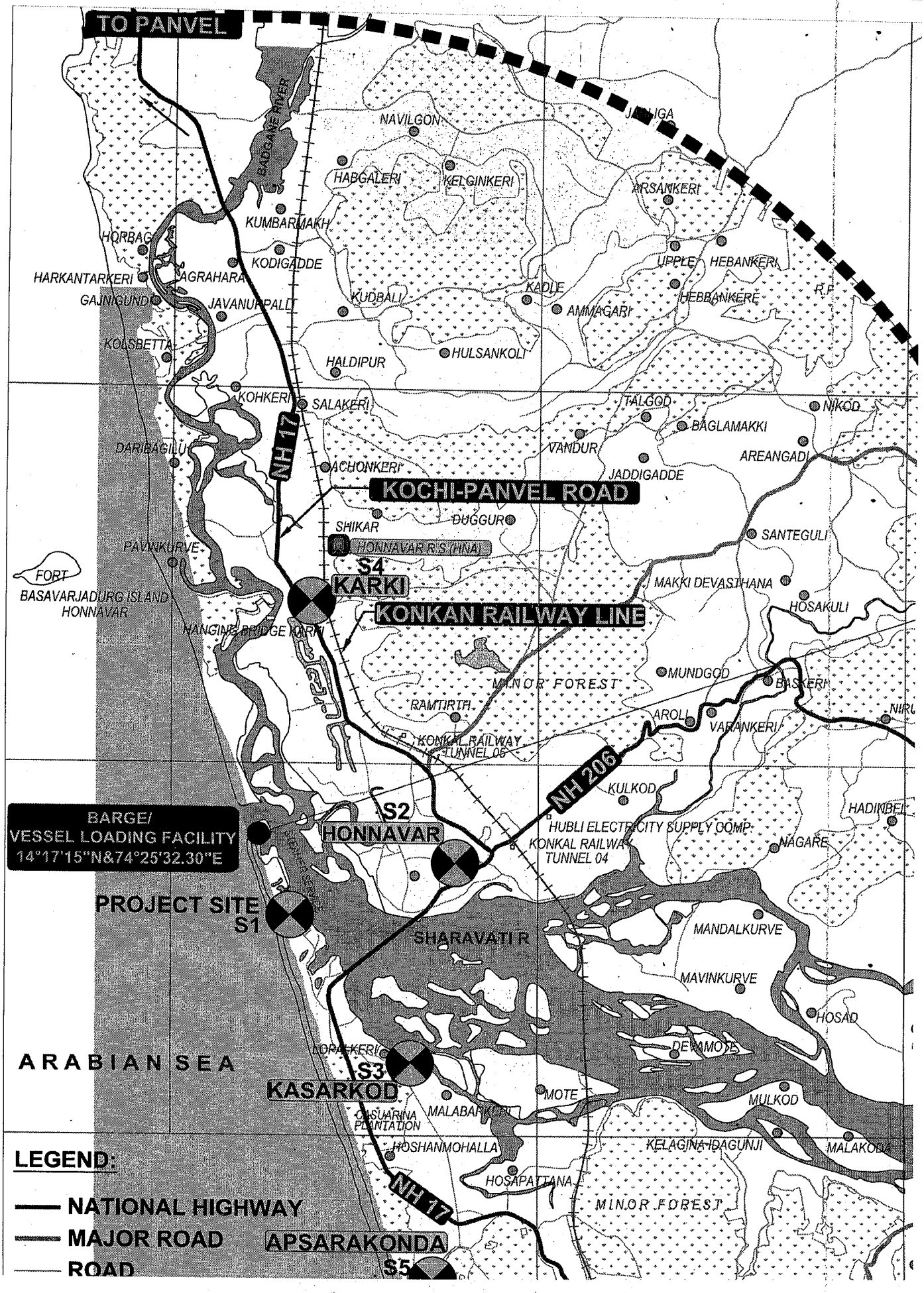

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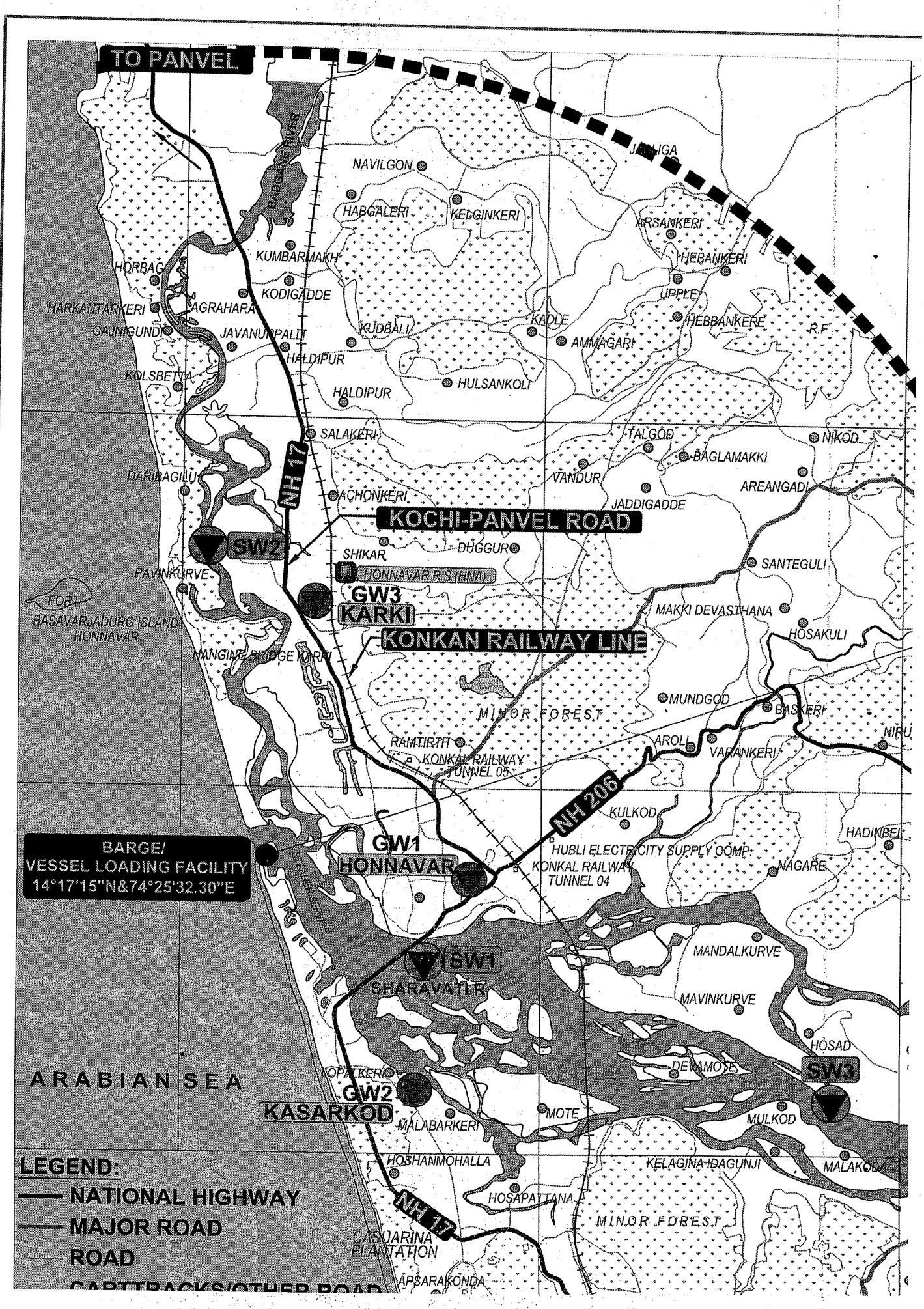

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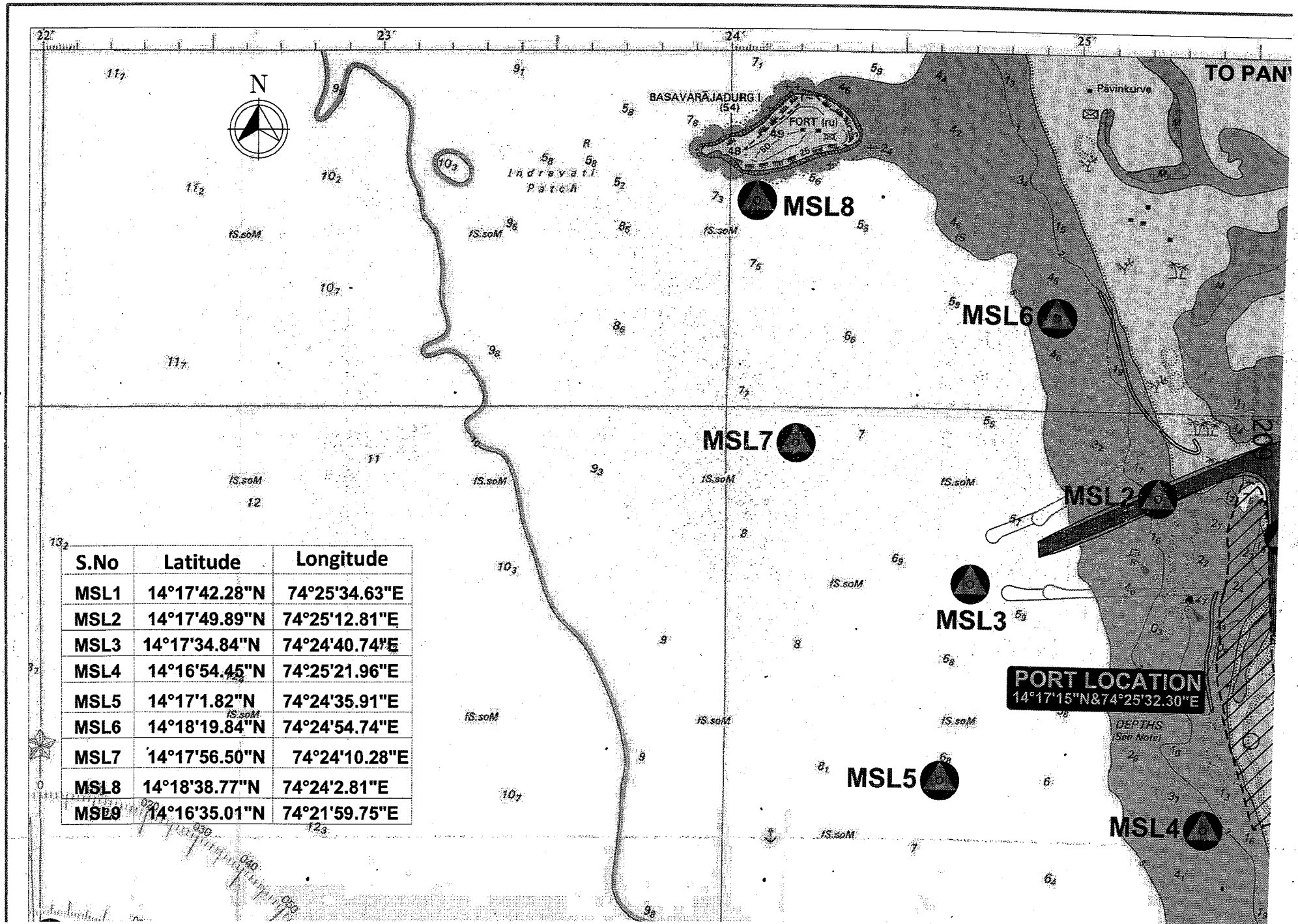

S.No	Latitude	Longitude
MSL1	14°17'42.28"N	74°25'34.63"E
MSL2	14°17'49.89"N	74°25'12.81"E
MSL3	14°17'34.84"N	74°24'40.74"E
MSL4	14°16'54.45"N	74°25'21.96"E
MSL5	14°17'1.82"N	74°24'35.91"E
MSL6	14°18'19.84"N	74°24'54.74"E
MSL7	14°17'56.50"N	74°24'10.28"E
MSL8	14°18'38.77"N	74°24'2.81"E
MSL9	14°16'35.01"N	74°21'59.75"E

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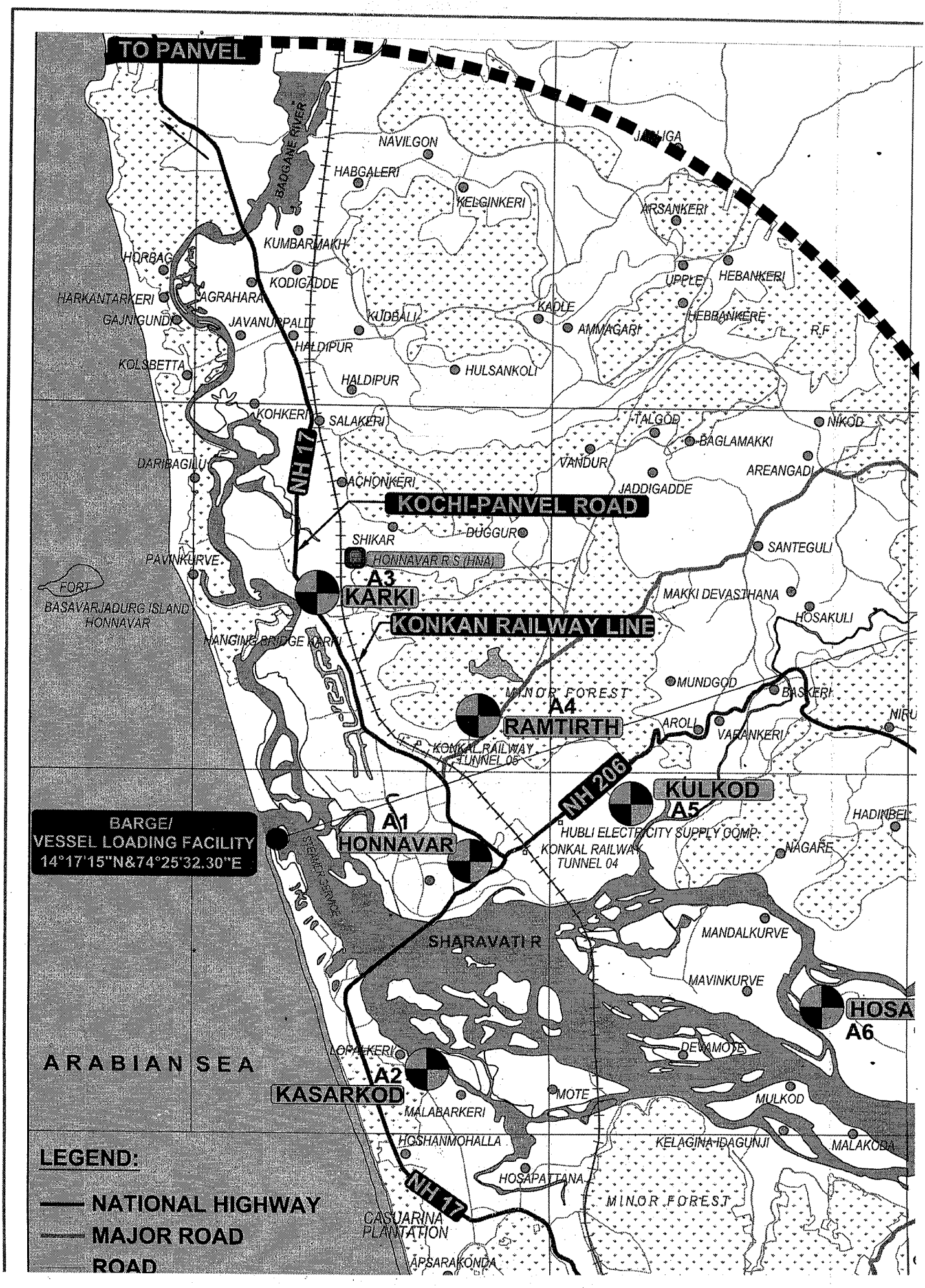
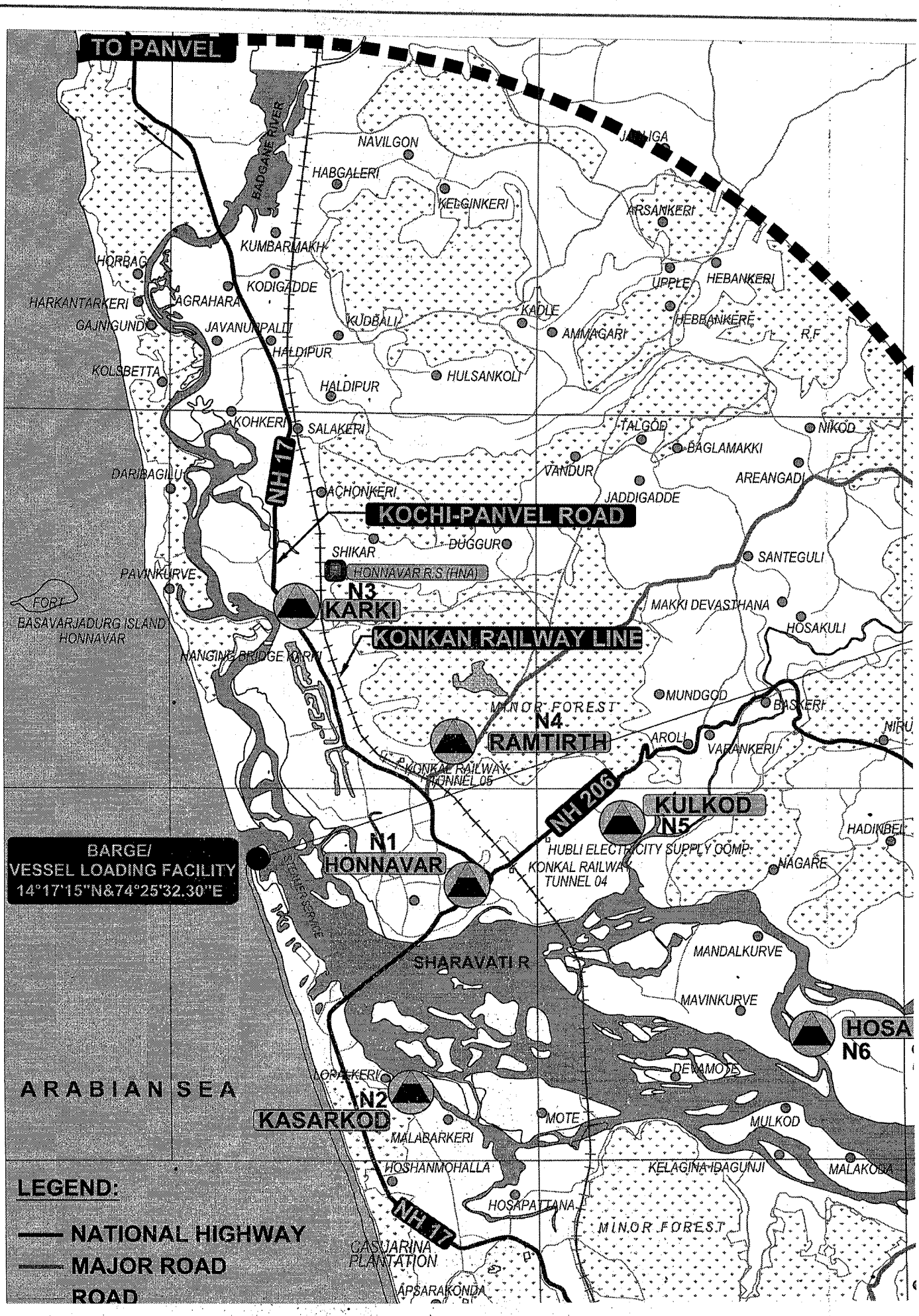


LOCATIONS MAP.DWG



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Chapter 5
Anticipated Environmental Impacts and Mitigation Measures

5 Anticipated Environmental Impacts and Mitigation Measures

5.0 General

The construction and operational phases of Honnavar Barge/ vessel loading facility involves various landside and marine side construction and operational activities. In this chapter, likely impacts of these activities on environmental attributes have been identified, assessed and presented. To mitigate likely environmental impacts during construction and operational phases due to landside and marine side activities, suitable mitigation measures are incorporated as a part of planning process. The impacts have been assessed both quantitatively and qualitatively for various terrestrial and marine environmental components and additional mitigation measures are proposed.

5.1 Land Environment

5.1.1 Potential Impact due to Project Location

5.1.1.1 Impacts due to Land Acquisition

Government of Karnataka has allotted the land for the proposed development. The land proposed for Rail / Road Corridor is about 30Ha, which includes Government / few patches private land and no families are present in the land proposed to be acquired. Hence, No R&R is envisaged due to the proposed development. The alignment is selected such a way that there will not be any disturbance to the existing structures also.

No impacts are envisaged to land environment with respect to land acquisition due to the proposed project.

5.1.1.2 Impacts due to Changes in Land Use Pattern

Proposed project site comprises completely coastal sand and government land. The project area will be reclaimed up to (+) 4.30 m CD for the development of Back up area, however development will be planned in such a way that the existing drainage pattern will not be disturbed.

5.1.1.3 Impacts due to Changes in Coastline/Shoreline

The shoreline/coastline changes such as erosion/accretion is usually expected due to the construction of marine structures such as breakwaters, groynes, etc. The natural setting if disturbed by construction of breakwaters or dredging a channel to deepen locally the seabed, causes imbalance in sand movement along the coast. It has been seen all along the west coast of India, that a breakwater construction causes accretion on the Northern side and erosion on the Southern side.

In the proposed development, a southern breakwater of length 865m and northern breakwater of length of 820 m will be constructed which may have impact on existing coastline/shoreline. Mathematical model studies were carried out and the details are discussed in subsequent sections.

5.1.1.4 Impacts due to Land Reclamation

Land reclamation will be carried out within port limits. About 1.0 MCM[2] of the dredged material will be used for reclamation. Land reclamation with capital dredged material is likely to impact the reclamation area/site with the turbid saline water. Areas to be reclaimed will be defined during detailed engineering stage and protective reclamation bunds will be constructed around the planned reclamation areas to avoid spreading of dredge material and to reduce turbidity. The dredged material will be pumped into the reclamation area enclosed by reclamation bunds wherein the solids will be allowed to settle and the return water will be directed into sea through appropriate return channel/pipelines. The dredge fill will be covered by gravel before hard standing. After completion of the reclamation and hard standing, necessary development shall be carried out.

But predominantly the backup area to be reclaimed is coastal sand and low lying area sloping towards sea. Hence, the impact due to this activity will not be significant. In order to study variations in groundwater quality of nearby villages due to reclamation, regular water quality monitoring will be carried out.

5.1.1.5 Mitigation Measures

Barge/ Vessel loading facility development will take place within the port limits and no agricultural land or settlements are included in the land proposed for development.

Judicial planning of Barge / Vessel loading facilities will be carried out. Existing drainage pattern will not be disturbed. Strom water drainage network at appropriate places will be provided within the facility area.

Reclamation bunds and setting ponds shall be constructed, In order to prevent the seepage of return sea water into the groundwater, suitable impervious liners such as LDPE will be provided all along the return water channel, if necessary. Also minimum required retention time of return water in the reclamation area as well as in the return channel will be ensured.

Regular monitoring of return water (turbid water) from the reclamation area will be carried out at nearby points in the sea.

In order to study variations in groundwater quality of nearby villages due to reclamation, regular water quality monitoring will be carried out.

5.1.2 Potential Impact during Construction

5.1.2.1 Impact on Local Infrastructure

Transportation of Construction and Cargo Material: Transportation of huge quantities of construction material for construction of breakwaters, berths, stockyards, operational and administrative buildings etc results in use of public infrastructure like roads, railways, drainage, water and power supply which in turn results in congestion.

Stones and aggregates required for construction of breakwaters will be sourced from approved quarries nearby Honnavar/ Karwar and Bhatkal. Quantity of quarry stones required

[2]MCM: Million Cubic Meter

is about 4.5 Million Tonnes, which will be transported by road. HPPL will obtain the list of approved quarries from the concern Tahsildar of Honnavar/ Karwar.

To mitigate impacts from transportation of stones and Construction materials, existing roads will be strengthened and widened to enable movement of dumpers. Hence, impacts would not be significant as quarries are accessible.

Also, as a part of infrastructure development for Honnavar Barge/ vessel loading facility, it is proposed to develop 4 km of road from NH-17 to Kasarkod and a new railway of 14.6 km from Manki railway station to the proposed project site. New Proposed railway line will run parallel to existing railway line for a length of about 8 km and then will take a turn towards sea coast which will then run parallel to the sea coast till the proposed project site for the remaining 6.6 km. In order to minimize the strain on the existing infrastructure in the region, dedicated road corridor will be developed at the earliest. Until then existing road will be strengthened and widened to ease the traffic movement.

Construction Workers Camp: There will be a requirement of about 500 work force during the construction phase. To ensure that there is no strain on the existing infrastructure, the worker camps will be self-sufficient and would not rely on any local resource. This would also ensure that there is no conflict with the local population. To mitigate impacts from health hazards, sanitation facilities will be provided. Further, the worker camps will be located away from the coast and habitations.

5.1.2.2 Mitigation Measures

- The dedicated road corridor will be utilised for the transportation of construction material and usage of public roads will be minimised.
- Temporary approach roads may be developed with prior permission from competent authority.
- Transportation Management will be adopted for movement of dumpers transporting quarry stones and construction materials and traffic will be regulated.
- Trucks with construction material susceptible for fugitive suspension will be covered with tarpaulin.
- Vehicles deployed will conform to emission norms (air/noise) of CPCB and with valid Pollution Under Control (PUC) certificates.
- Dumpers and trucks will comply with standards for exhaust emissions and noise levels
- The Worker camps will be adequately equipped with all the necessary facilities such as water supply, power supply, wastewater collection, solid waste collection and sanitation, fuel supply etc.
- The domestic wastes generated from the worker camps will be collected properly treated and disposed after complying with the norms stipulated by statutory authorities.
- No bore wells will be driven for the drinking water requirements to avoid impacts on groundwater resources
- If there are any accidental spillages of hazardous substances on soil that may pose the risk of contaminating run off, such areas will be immediately remediated

5.1.3 Potential Impact during Operations

5.1.3.1 Discharges from Barges on Land

No discharge of wastewater/waste from the Barges/vessel calling at Honnavar Barge loading facility will be permitted into the area.

5.1.3.2 Shoreline Changes – Erosion/Accretion

Analysis of shoreline change and prediction of shoreline behaviour in the presence of coastal structures have become important for integrated coastal zone management. The shoreline occurring between land and sea is dynamic which under goes short term and long term geomorphological changes under the influence of near shore coastal hydrodynamics. These changes to the coastal morphology are cyclic which have continued over the years.

Assessment of Shoreline Evolution with Proposed Breakwaters

Long shore sediment transport takes place when waves approach obliquely to the shore. This process of sediment transport is a cyclic process where river adds sediment to the coast which is transported by waves. The cycle of sediment transport by the waves to and from the coast is continuous which has aided in keeping the equilibrium of the coastline balanced over the geological times. Any change to the sediment transport cycle leads to imbalance to the prevailing shoreline dynamics.

In the normal condition the shoreline undergoes oscillation due to wave and wave induced current. The predominant quantity of sediment transport along shore takes place within the depth of closure. Coastal structure similar to groyne or a breakwater connected to the land when introduced into the sea obstructs the sediment transport resulting in accretion / erosion of sediment.

The proposed development consists of two breakwaters designated as northern (820 m) breakwater and southern (865 m) breakwater extending into the sea to a water depth of (-) 5.0 m respectively. The approach channel will be dredged to (-) 10 m CD. The Channel will be aligned in South West direction.

Shoreline Change Modelling using LITPACK model:

Department of Meteorology and Oceanography, Andhra University, Visakhapatnam has conducted mathematical model study to evaluate the shoreline changes using LITPACK model in the MIKE 21 software.

Out of various modules of LITPACK, LITLINE is best suited for understanding the coastline changes with time provided the wave, bathymetry (one dimensional, profiles) and sediment characteristics are given. LITLINE calculates the coastline position based on input of the wave parameters as a time series. The model is based on a one-line theory, in which the cross-shore profile is assumed to remain unchanged during erosion/accretion. Thus, the coastal morphology is solely described by the coastline position (cross-shore direction) and the coastal profile at a given long-shore position. The main equation in LITLINE is the continuity equation for sediment volumes:

$$\frac{\partial y_c}{\partial t} = -\frac{1}{h_{act}}\frac{\partial Q}{\partial x} + \frac{Q_{sou}}{h_{act}\Delta x}$$

In which y_c is the coastline position, t is time, Q the longshore transport rates, x the long-shore position, Q_{sou} the supply of sediment from sources. The total height of the active profile h_{act} consists of three contributions: 1. The active depth relative to mean water level 2. The height of the beach above mean water level that moves forth and back with the coastline position and finally 3. Possible "dunes", which may erode if the coastline reaches their position during erosive states, but will not accrete again.

The continuity equation for sediment volumes is solved using an implicit Crank-Nicholson scheme, giving the development of the coastline position in time. The variation in time and place of sources and sinks may be included in the calculations by a separate time series, allocated to describe the appearance of sediment sources (or sinks). Both point sources (one single grid point) and distributed sources (coastline stretch) can be considered.

Model setup:

The reference baseline and coastline are given as initial inputs for computing the changes in shoreline. The background wave data extracted at 10 m depth are extended for 10 years using LITPACK toolbox. Beach profiles up to active depth are extracted from the bathymetry file. The Two breakwaters proposed in the layout are included in the model setup for future predictions.

Results:

The model has been simulated for two cases:

- Case I: With breakwaters and without shore protection on the northern side of inlet
- Case II: With breakwaters and with sea wall on the northern side of inlet

Case I:

It is observed that erosion may occur towards northern side of the north-breakwater with shoreline recession of around 20-30m for 10 years (2-3 m/yr). Whereas, on the southern side, deposition occurs with a shoreline advancement of 50-60 m as shown in Figure 5-1.

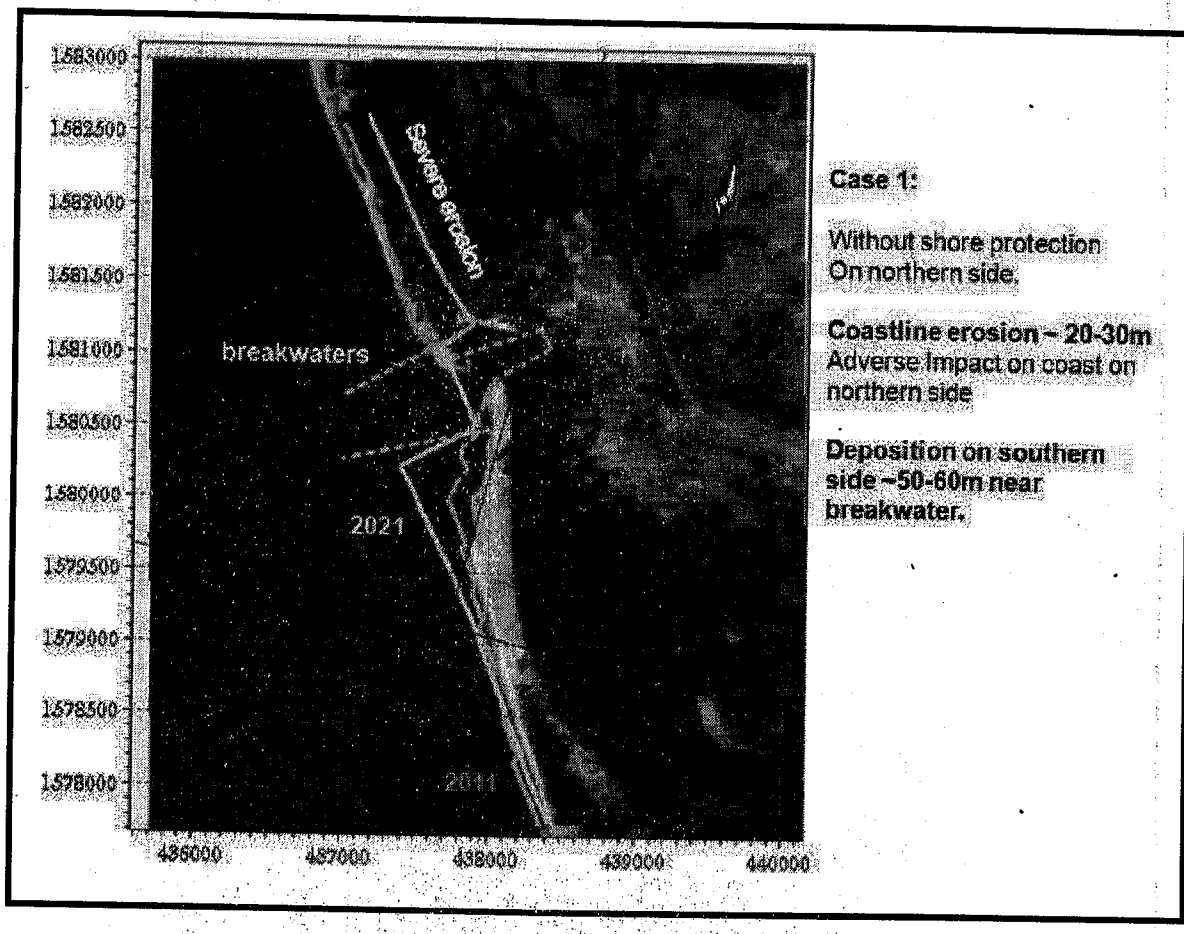


Figure 5-1: Shoreline Evolution without Shore Protection

Case II:

When a shore protection strategy like sea wall is constructed on the northern side of the facility, it is observed that the coast is almost stable and no net change in shoreline towards northern side is observed. Whereas, on the southern side, slight deposition occurs with a shoreline advancement of 30-40 m after 10 years as shown in Figure 5-2.

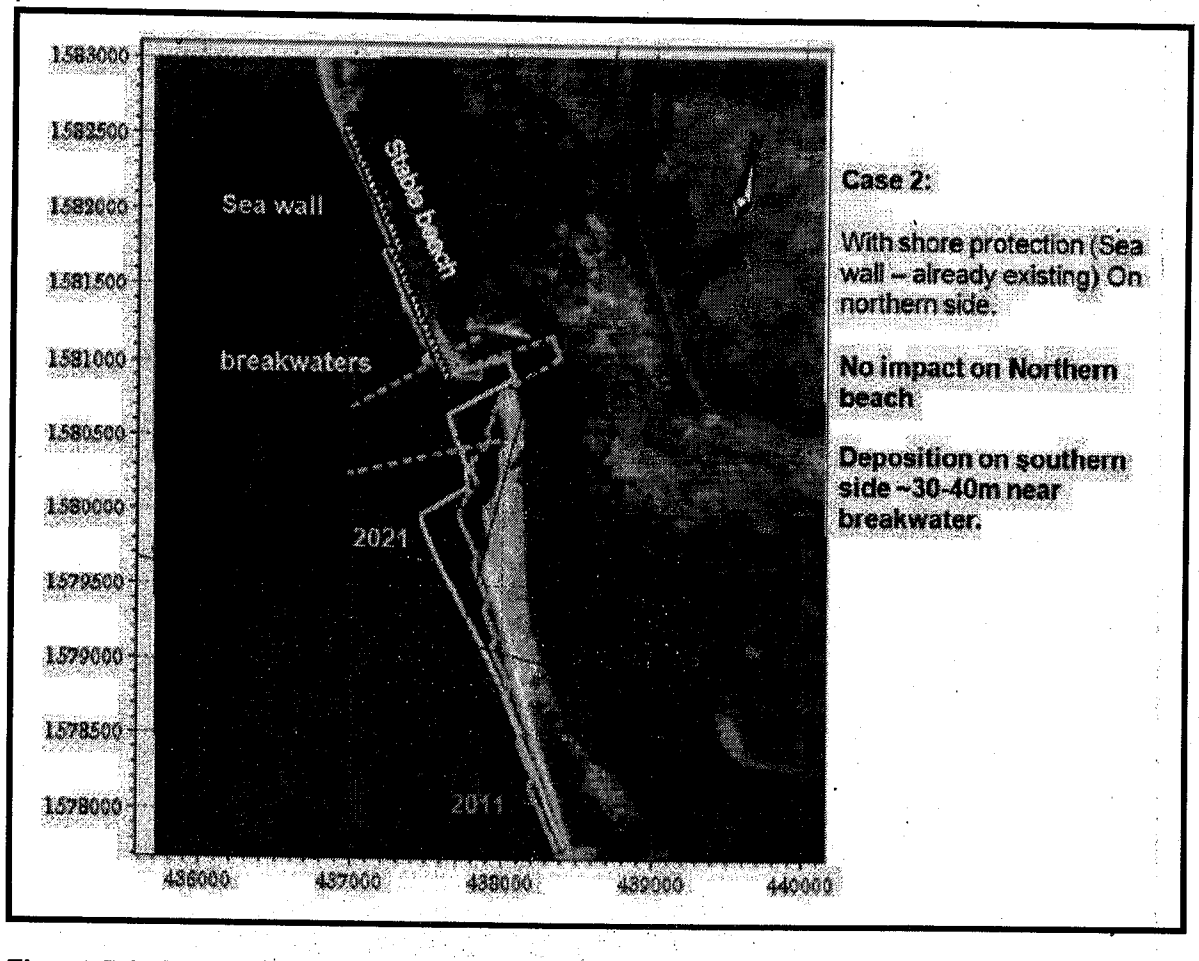


Figure 5-2: Shoreline Evolution with Shore Protection

The predominant direction of alongshore sediment transport is towards north due to S, SSW and SW waves and the net transport of sediment is around $0.6x10^6$ m^3 directed towards north. Overall, the model studies show a general depositional trend along the coastline.

5.1.3.3 Mitigation Measures

Continuous monitoring of shoreline with the help of high resolution satellite imageries, during operation phase and ground truthing/Shoreline surveys.

5.2 Water Environment

5.2.1 Potential Impact due to Barge/ Vessel Loading Facility Location

5.2.1.1 Impact on Existing Water Resources

Water requirement during the construction is expected to be around 15 m^3/day. Water demand during operational phase of barge/vessel loading facility is estimated at 7 m^3/day. The water requirement will be met from Karnataka Rural Water Supply and Sanitation Agency which includes supply to Barge/vessels, staff and users. In addition to that water required for dust suppression system and fire fighting will be sourced from Sharavati River

It is not envisaged to draw groundwater to avoid any possible impacts to local groundwater resources. A dedicated water supply system will be developed by the HPPL for dust suppression, potable water and fire fighting purpose. As water requirement is proposed to be met from water supply department and surface water resource through a dedicated system and not relying on existing facilities, significant impacts are not envisaged.

5.2.1.2 Impact due to Stagnation of Wastewater in Harbour

The construction of marine structures such as breakwaters will change the current patterns and results in tranquil conditions suitable for the operation of the facility. In case, the untreated wastewater from the domestic as well as industrial activities in the vicinity of the barge/vessel loading facility flows into the harbour, it results in stagnation of water. The discharges of the Sharavati River may stagnate in the harbour. There are fishing vessel movements in the mouth of Sharavati River, the discharges from the barge/vessel loading facility visiting vessels and fishing vessels in the harbour may affect the harbour waters. These conditions may deteriorate through increase of phytoplankton and a decrease of dissolved oxygen, resulting from eutrophication of water, caused by effluents containing nutrient salts (chemical compounds including N and P). Anaerobic water leads to the generation of hydrogen sulphide (H_2S). Breakwaters shall be constructed in a way to maintain good tranquil conditions without disturbing the river flow. No discharges from the vessels will be permitted in the harbour area. Further, the area surrounding the barge/vessel loading facility location is undeveloped which will not generate significant sewage and industrial discharges into water resources.

5.2.1.3 Mitigation Measures

The wastewater and sewage generated during construction at site, at labour camp and operation phase will be collected in septic tank followed by soak pit.

5.2.2 Potential Impact due to Construction

5.2.2.1 Impact due to Land Reclamation/Wastewater Generation

Generally, reclamation of low lying areas with capital dredged material is likely to affect groundwater quality due to intrusion of sea water. But predominantly the barge/vessel loading facility land proposed to be reclaimed is coastal sand which is saline in nature and is separated by Sharavati River from the land located towards East. Hence; no significant impact is anticipated due to reclamation on ground water.

5.2.2.2 Mitigation Measures

The return sea water quality from the reclaimed area and groundwater quality of nearby villages will be monitored regularly.

General Mitigation Measures/ Wastewater Management during Construction Phase

The environmental management for sanitary wastewater, vehicle wash water, hydrotest water and storm water is addressed below:

- An adequate drainage system will be provided at the site with separate collection streams to segregate the storm run-off from roads, open areas, material storage

areas, vehicle wash water and other wastewater streams. Suitable measures will also be taken to prevent the washing away of construction materials into the drainage system.

- Contaminated storm water will be collected and conveyed to settling tank for removing grit.
- Sewage generated at site will be collected in the septic tank followed soak pit.
- Run-off from project site will not be discharged into the river.

5.2.3 Potential Impact during Operation

5.2.3.1 Impact on Water Quality due to Cargo Operations

Storm water runoff will be directed into open concrete lined channels alongside the roads and paved areas in the cargo storage areas and other areas of the barge/vessel loading facility. The polluted runoff from berths and stockpiles of cargo storage areas will be intercepted and directed to septic tank .The runoff from uncontaminated areas will be discharged into the greenbelt area. Contaminated storm water will be collected and conveyed to settling tank for removing grit.

The oil contaminated water will be sent to oil water separator, separated oil will be sent to KSPCB approved vendors and water will be sent soak pits

5.2.3.2 Mitigation Measures/Wastewater Management

Mitigation measures are proposed to be adopted to minimise the impacts from wastewater and runoff generated from cargo storage areas. The storage area will be provided with an extensive drainage system so that the contaminated water from the stockyard area does not flow directly into the natural water bodies or into the groundwater system.

The sewerage system will be provided to collect the sewage from administration building; canteen and operation buildings and sent to septic tanks followed by soak pits.

5.3 Marine Environment (Coastal Hydrology/Bottom Contamination, Sea/Harbour Water Quality)

5.3.1 Potential Impact due to Barge/ Vessel Loading Facility Location

5.3.1.1 Sediment Transport

Sediment transport takes place under the action of waves and currents. The oblique wave breaking and currents mainly decides the sand movement in coastal areas. The action of wave is the principal cause of sediment transport as it initiates sediment motion generated by wave breaking current. The proposed barge/vessel loading facility includes breakwaters, navigational channel and turning basin planned near the Sharavati and Badgani river mouth may affect the wave and current pattern in the vicinity and in turn the local sediment transport pattern. The presence of Sharavati and Badgani river confluence points in the harbour area can also influence the local sedimentation pattern. Hence, to study the sediment movement in the near-shore, estimate the maintenance dredging quantity and the erosion/deposition patterns, it is essential to include the environment parameters like waves and current during evaluation of sediment transport.

Flow Model description:

MIKE 21 Flow Model is a modelling system for 2D free-surface flows. MIKE 21 Flow Model is applicable to the simulation of hydraulic and environmental phenomena in lakes, estuaries, bays, coastal areas and seas. It may be applied wherever stratification can be neglected. The hydrodynamic (HD) module is the basic module in the MIKE 21Flow Model. It provides the hydrodynamic basis for the computations performed in the Environmental Hydraulics modules.

The hydrodynamic module simulates water level variations and flows in response to a variety of forcing functions in lakes, estuaries and coastal regions. The effects and facilities include:

- Bottom shear stress
- Wind shear stress
- Barometric pressure gradients
- Coriolis force
- Momentum dispersion
- Sources and sinks
- Evaporation
- Flooding and drying
- Wave radiation stresses

The following equations for the conservation of mass and momentum integrated over the vertical, describe the flow and water level variations.

$$\frac{\partial \zeta}{\partial t} + \frac{\partial p}{\partial x} + \frac{\partial q}{\partial y} = \frac{\partial d}{\partial t}$$

$$\frac{\partial p}{\partial t} + \frac{\partial}{\partial x}\left(\frac{p^2}{h}\right) + \frac{\partial}{\partial y}\left(\frac{pq}{h}\right) + gh\frac{\partial \zeta}{\partial x}$$

$$+ \frac{gp\sqrt{p^2+q^2}}{C^2 \cdot h^2} - \frac{1}{\rho_w}\left[\frac{\partial}{\partial x}(h\tau_{xx}) + \frac{\partial}{\partial y}(h\tau_{xy})\right] - \Omega_q$$

$$- fVV_x + \frac{h}{\rho_w}\frac{\partial}{\partial x}(p_a) = 0$$

$$\frac{\partial q}{\partial t} + \frac{\partial}{\partial y}\left(\frac{q^2}{h}\right) + \frac{\partial}{\partial x}\left(\frac{pq}{h}\right) + gh\frac{\partial \zeta}{\partial y}$$

$$+ \frac{gq\sqrt{p^2+q^2}}{C^2 \cdot h^2} - \frac{1}{\rho_w}\left[\frac{\partial}{\partial y}(h\tau_{yy}) + \frac{\partial}{\partial x}(h\tau_{xy})\right] + \Omega_p$$

$$- fVV_y + \frac{h}{\rho_w}\frac{\partial}{\partial xy}(p_a) = 0$$

Where h(x,y,t) is the water depth, d(x,y,t) is the time varying depth(m), z (x,y,t) is the surface elevation (m), p and q (x,y,t) are the flux densities in x and y-directions ($m^3/s/m$)=(uh,vh); (u,v) = depth averaged velocities in x and y-directions, C(x,y) is the Chezy resistance ($m^{1/2}/s$), g is the acceleration due to gravity (m/s^2), f(V) is the wind friction factor, W (x,y) is the coriolis parameter, pa(x,y,t) is the atmospheric pressure ($kg/m/s^2$), rw is the density of water (kg/m^3), t is the time in seconds, t_{xx}, t_{xy}, t_{yy} are the components of effective shear stress.

Flow Model Validation:

The HD model has been validated with the measured water levels inside the river as well as in the channel provided by Indomer Coastal Hydraulics, Chennai and are shown in Figure 5-3:

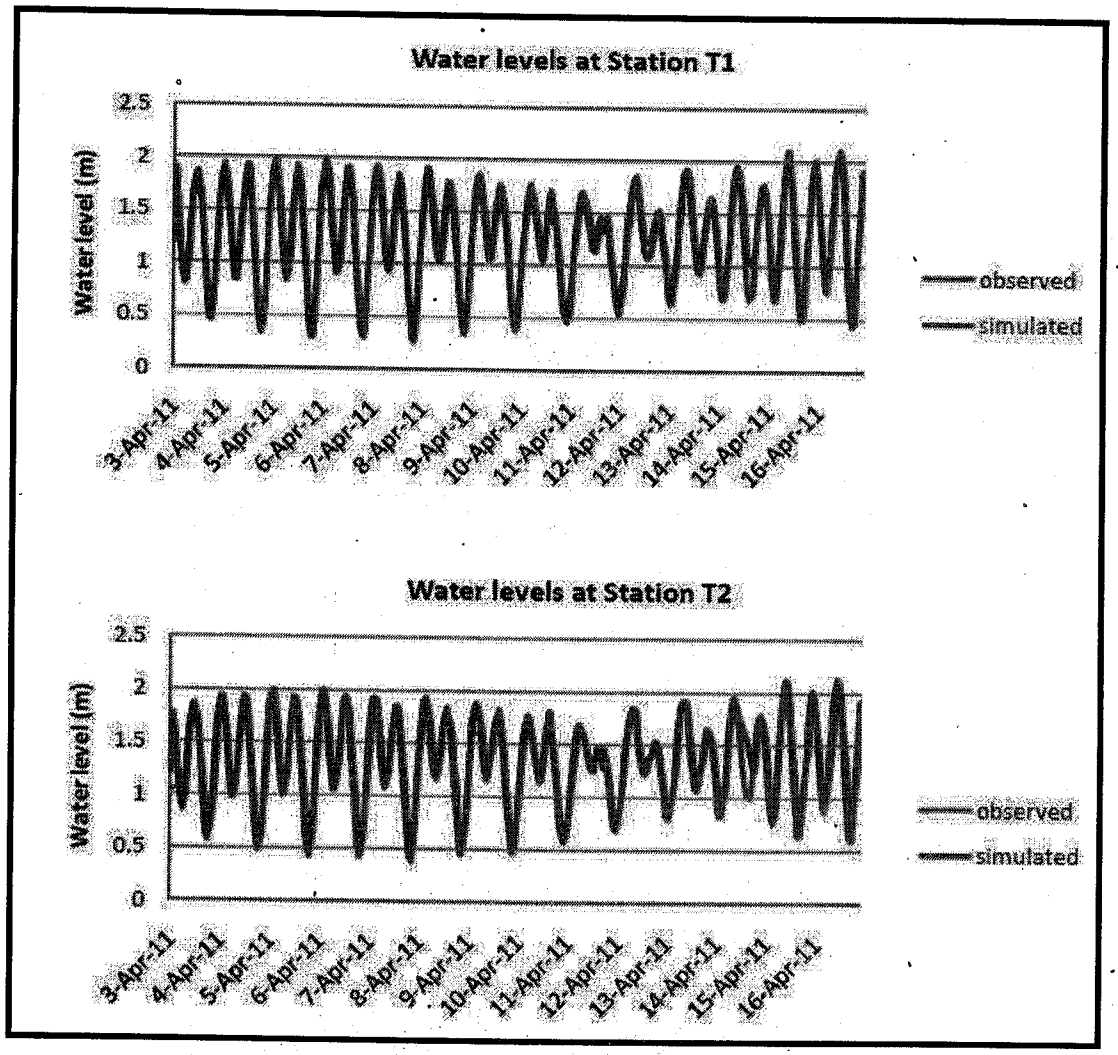


Figure 5-3: Validation of HD model results at tide stations T1 (river mouth) and T2 (inside the river)

Simulated currents for Case-I (without proposed Facility):

(a) Wet season:

The simulated currents for wet season with high river discharge conditions are shown in Figure 5-4 for stations T1, T2 and T3. Peak discharge value of 300 m^3/s recorded in the month of August as provided by Karnataka Power Corporation Ltd. At Gerusoppa dam has been used in the model. SW waves have been included into the model since they appear to be dominant during the wet season. The current patterns for ebb and flood phases of tide during springs and neaps are presented in Figure 5-5 to 5-8:

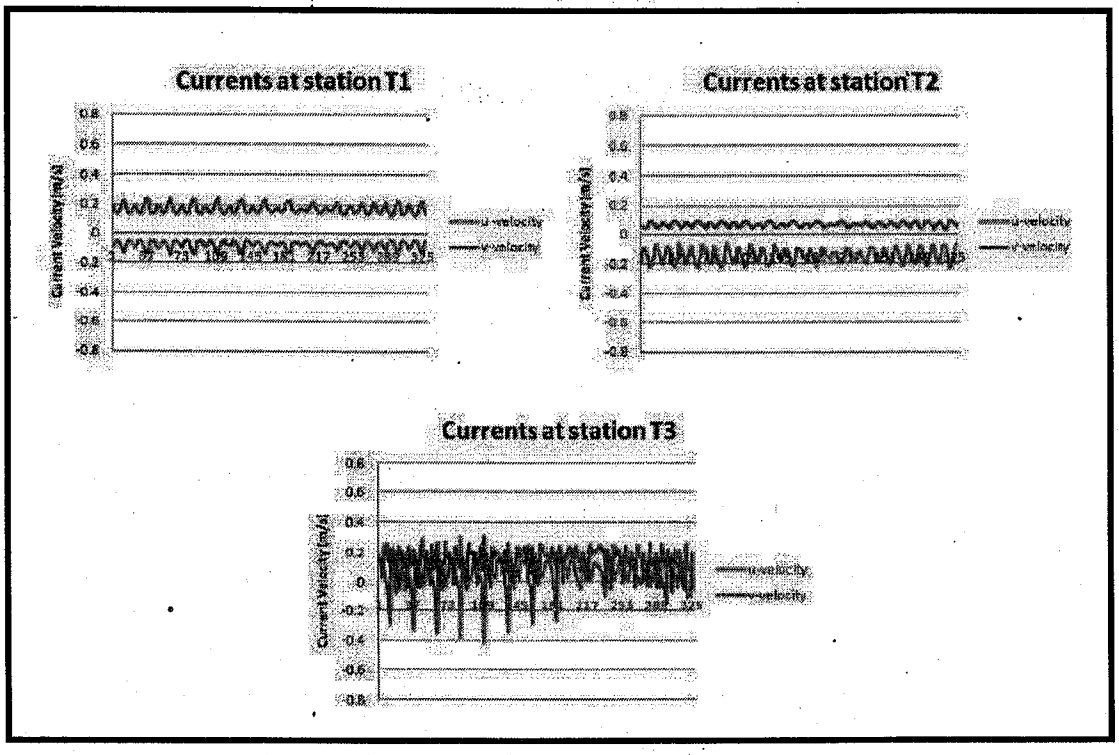


Figure 5-4: Simulated tidal currents during Wet season

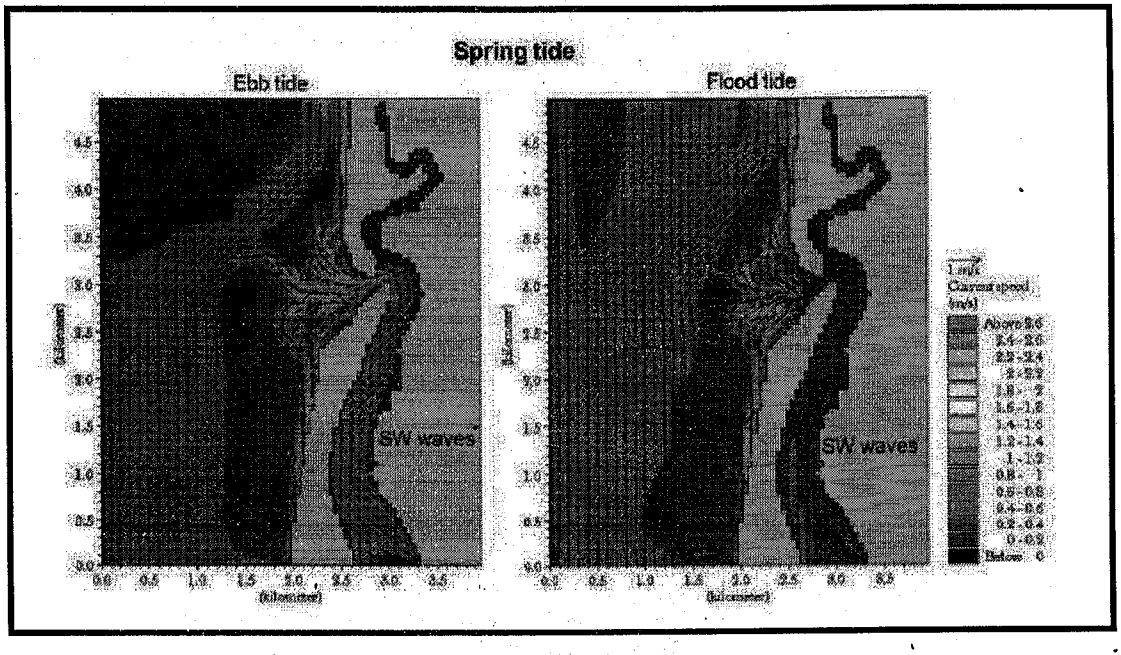


Figure 5-5: Currents for wet season during ebb and flood periods (Spring tide) case-I

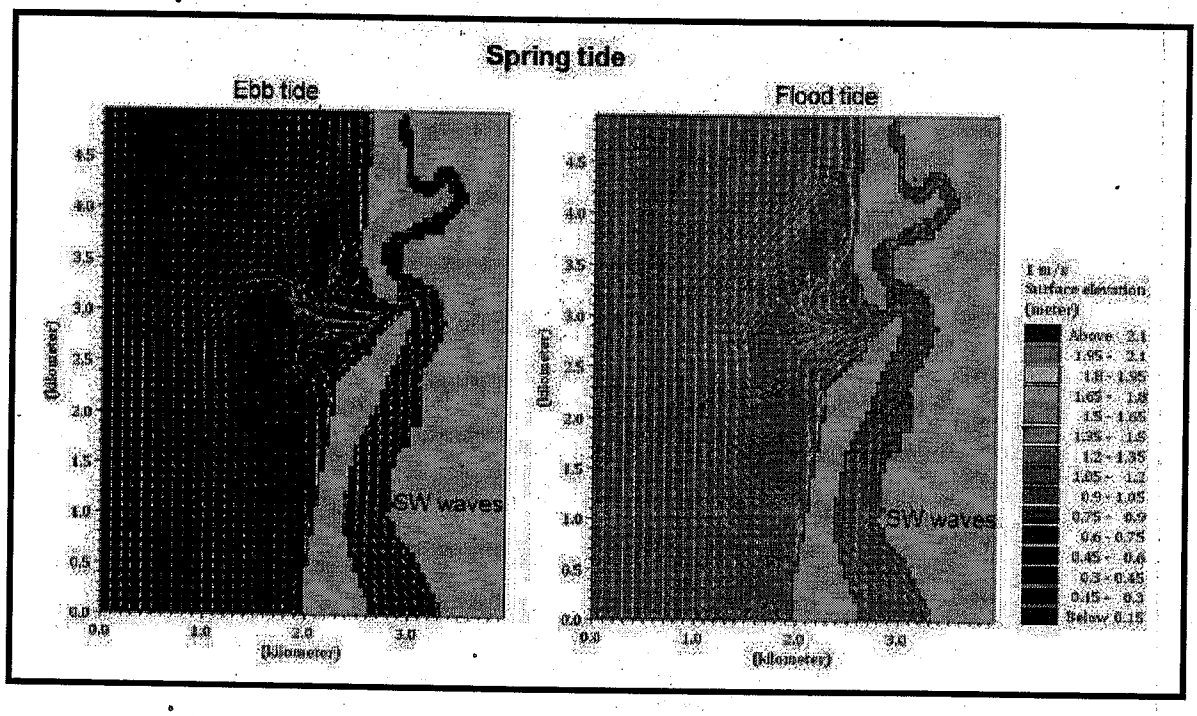


Figure 5-6: Water levels for Wet season during ebb and flood periods (Spring tide)

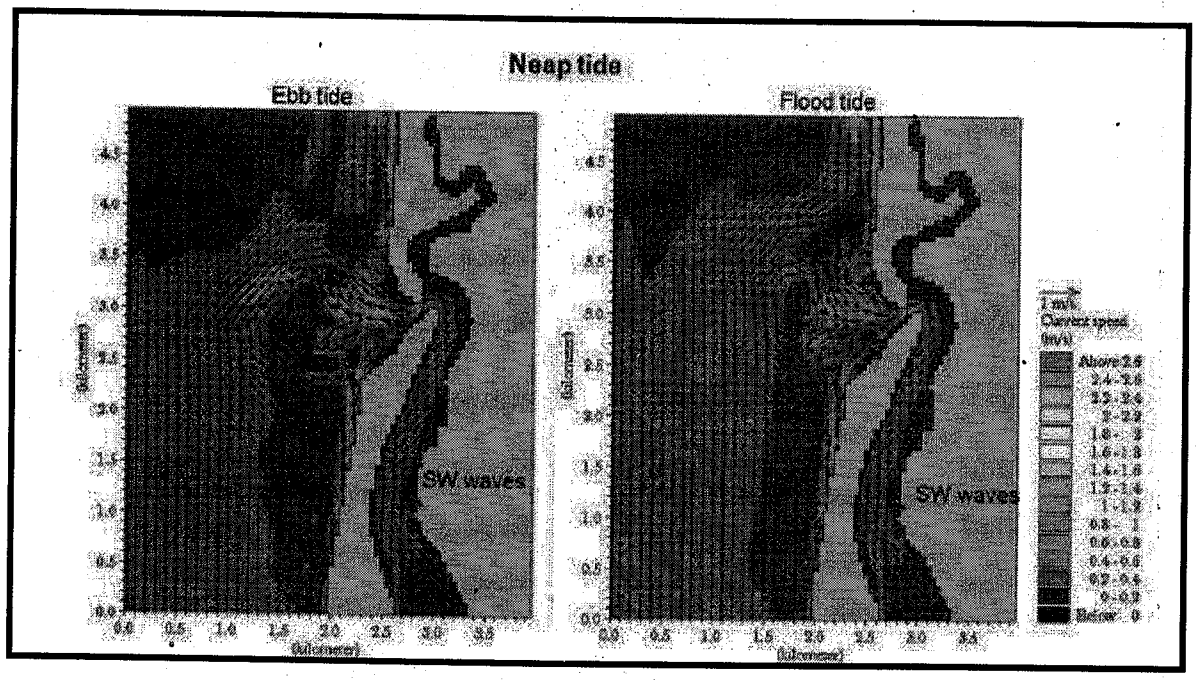


Figure 5-7: Currents for wet season during ebb and flood periods (neap tide)

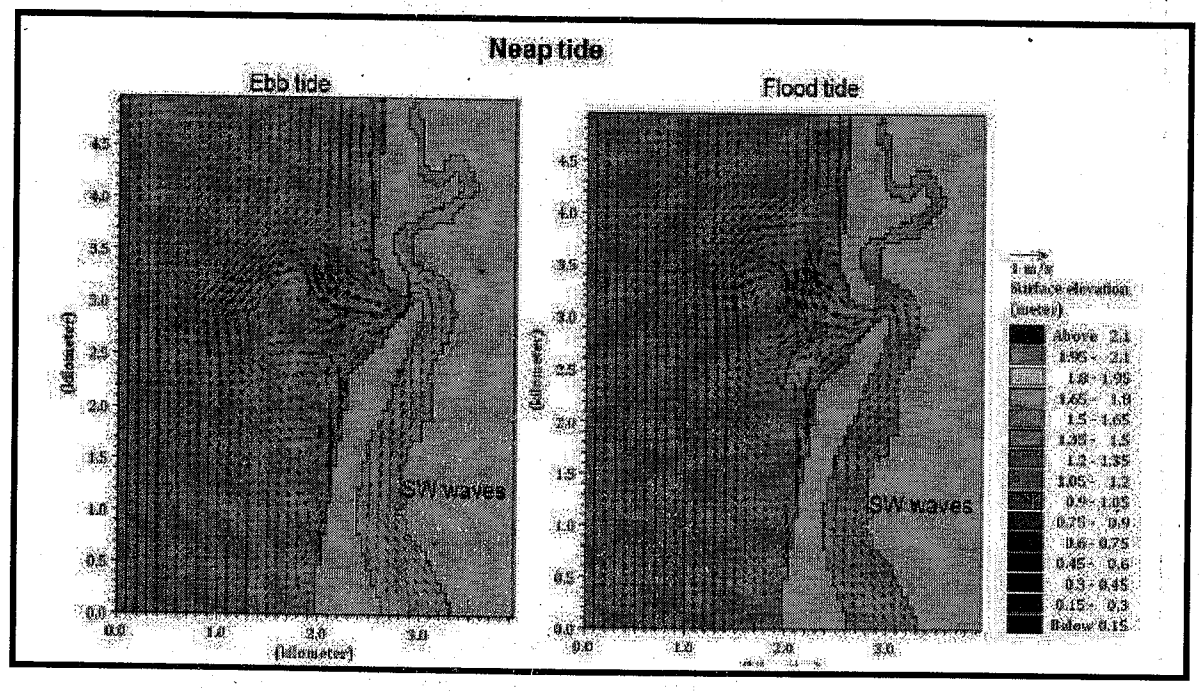


Figure 5-8: Water levels for wet season during ebb and flood periods (neap tide)

b) Currents in dry season:

The simulated currents for dry season at stations T1, T2 and T3 are shown in Figure 5-9. Minimum river discharge of 50 m^3/s and dominant wave direction of WNW have been used for this season. The current patterns for ebb and flood phases of tide during springs and neaps are presented in Figure 5-10 and 5-13.

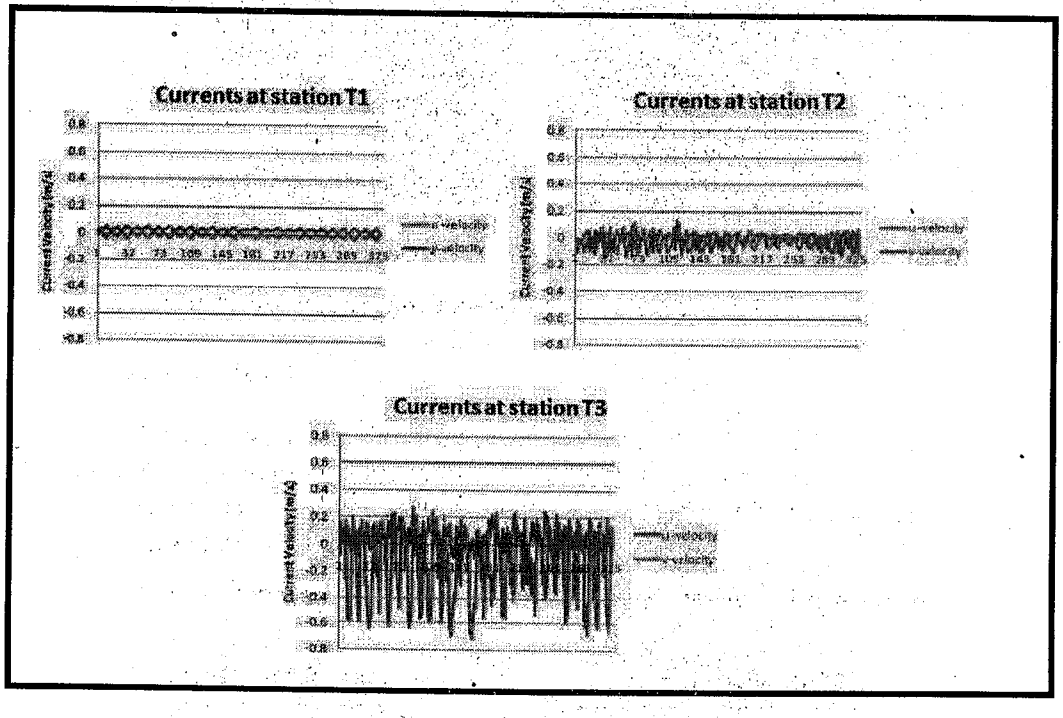


Figure 5-9: Simulated tidal currents during Dry season

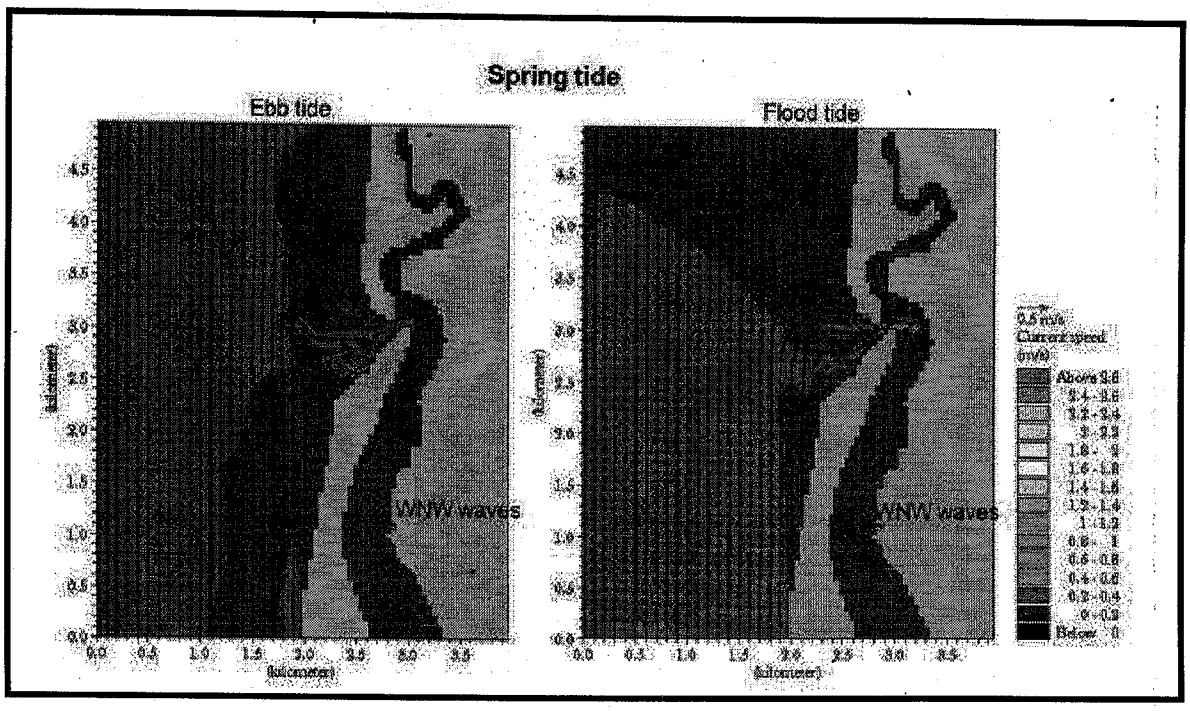


Figure 5-10: Current patterns for dry season during ebb and flood periods (Spring tide)

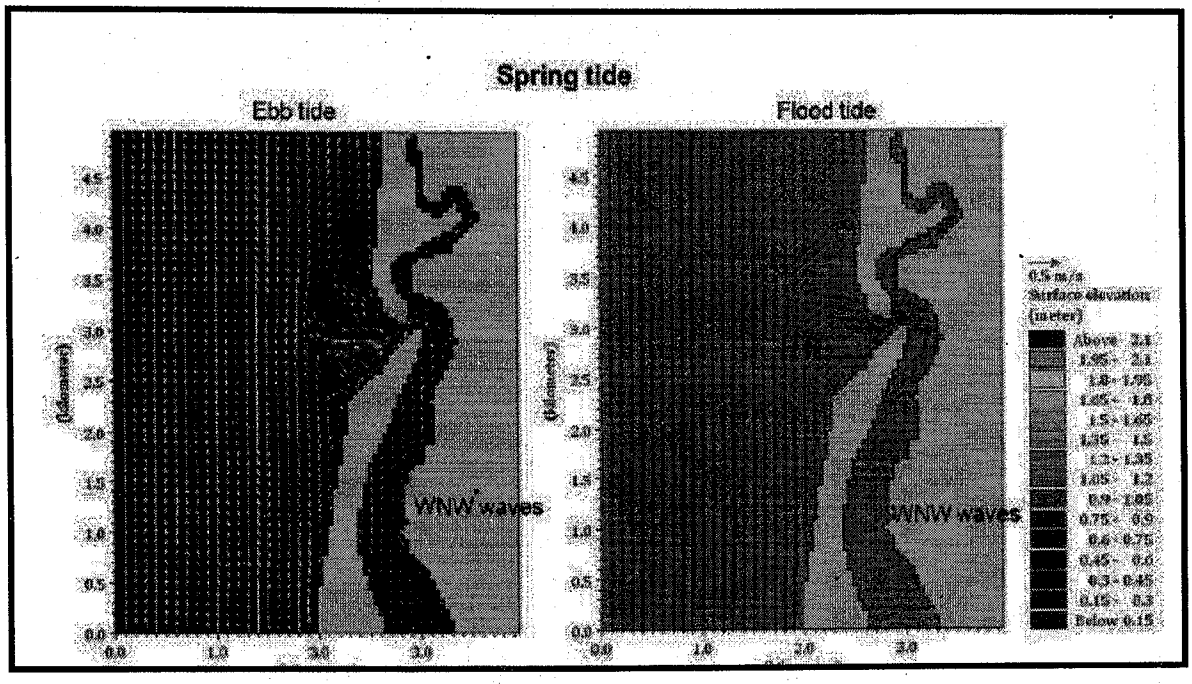


Figure 5-11: Water levels for dry season during ebb and flood periods (Spring tide)

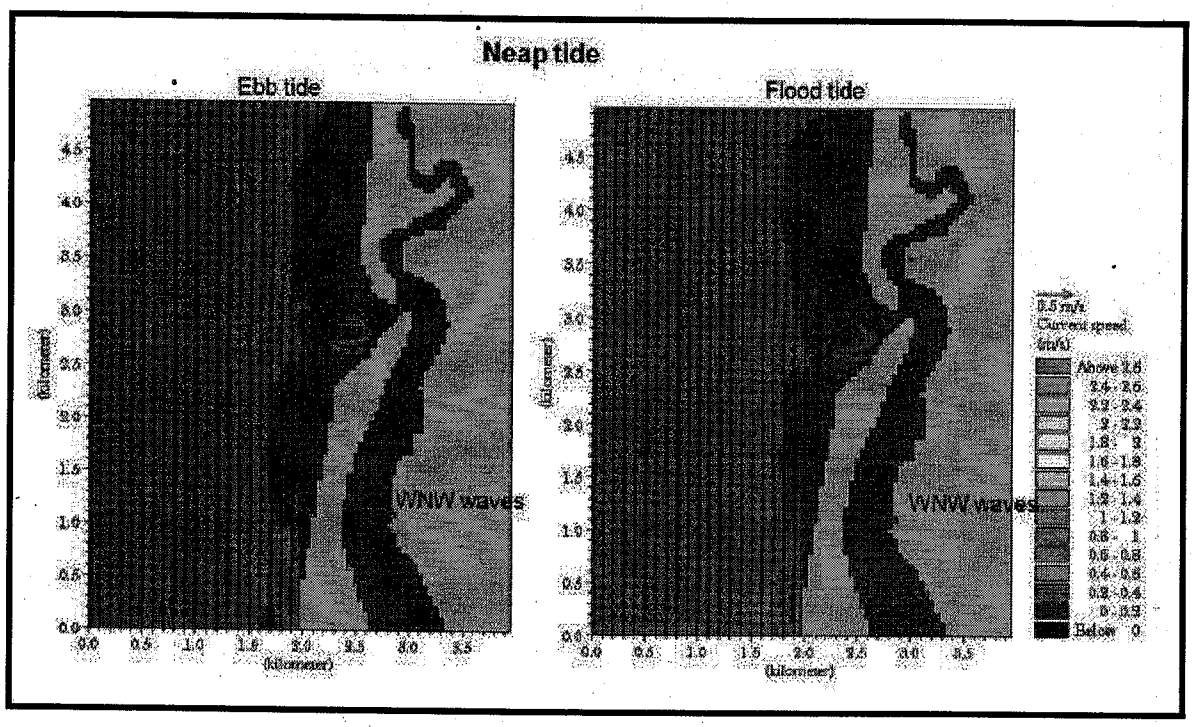


Figure 5-12: Current patterns for dry season during ebb and flood periods (Neap tide)

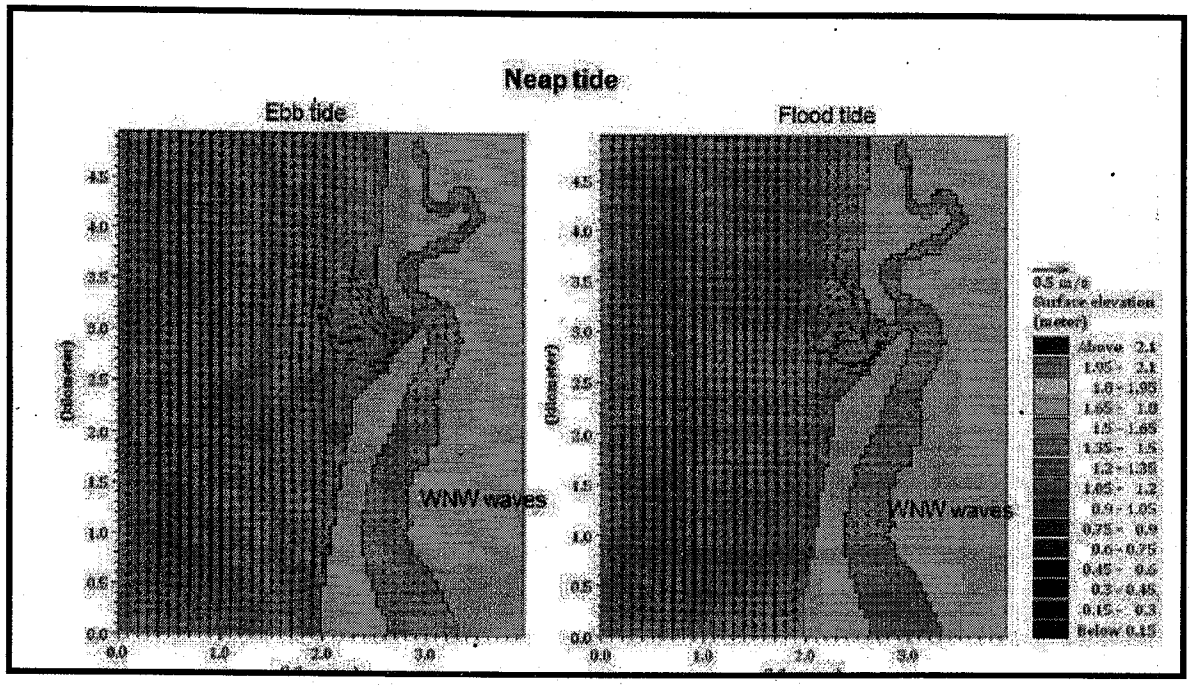


Figure 5-13: Water levels for dry season during ebb and flood periods (Neap tide)

Simulated currents for case-II (with proposed facility):

- Wet season: The currents simulated for wet season at stations T1, T2 and T3 are shown in Figure 5-14. The current patterns for ebb and flood phases of tide during springs and neaps are presented in Figures 5-15 to 5-18

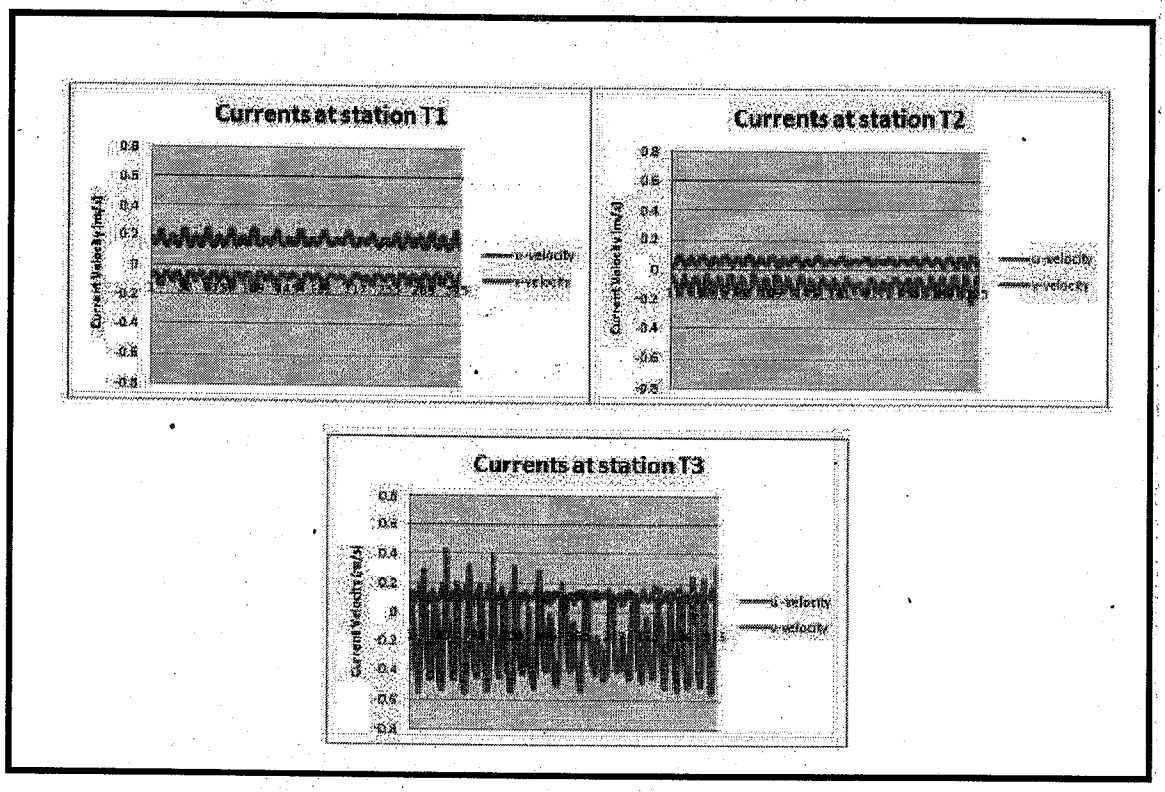


Figure 5-14: Simulated tidal currents during Wet season with proposed facility

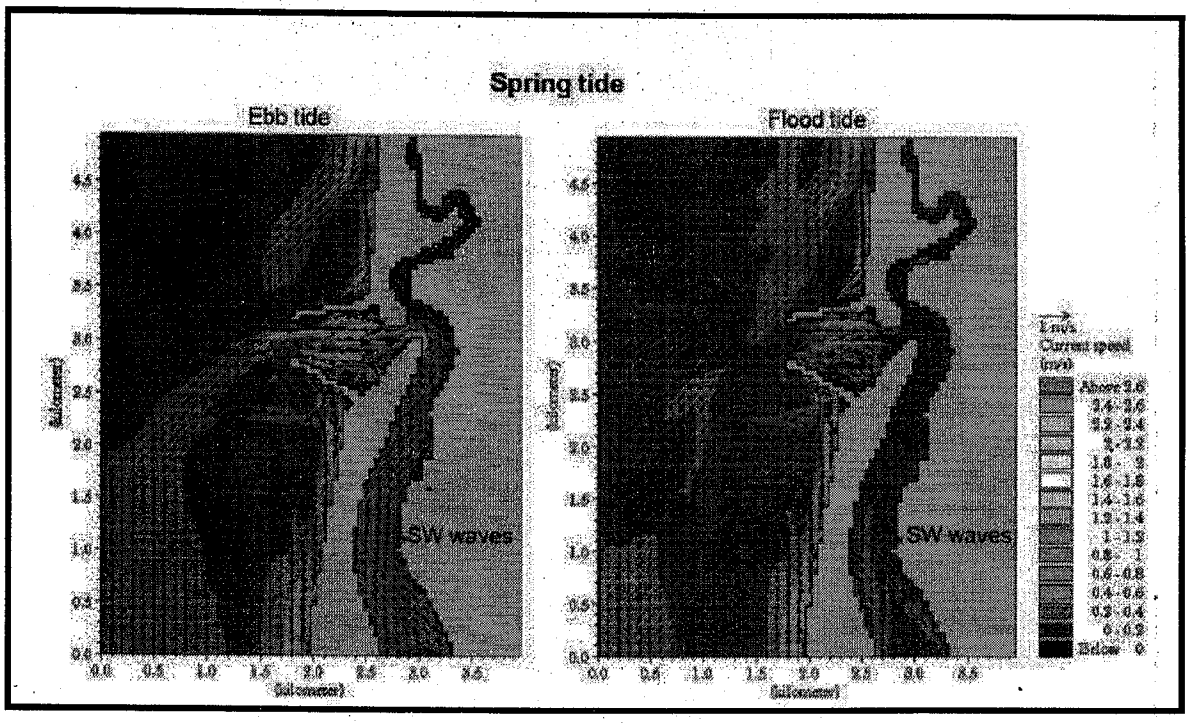


Figure 5-15: Current patterns for wet season during ebb and flood periods (Spring tide) case-2

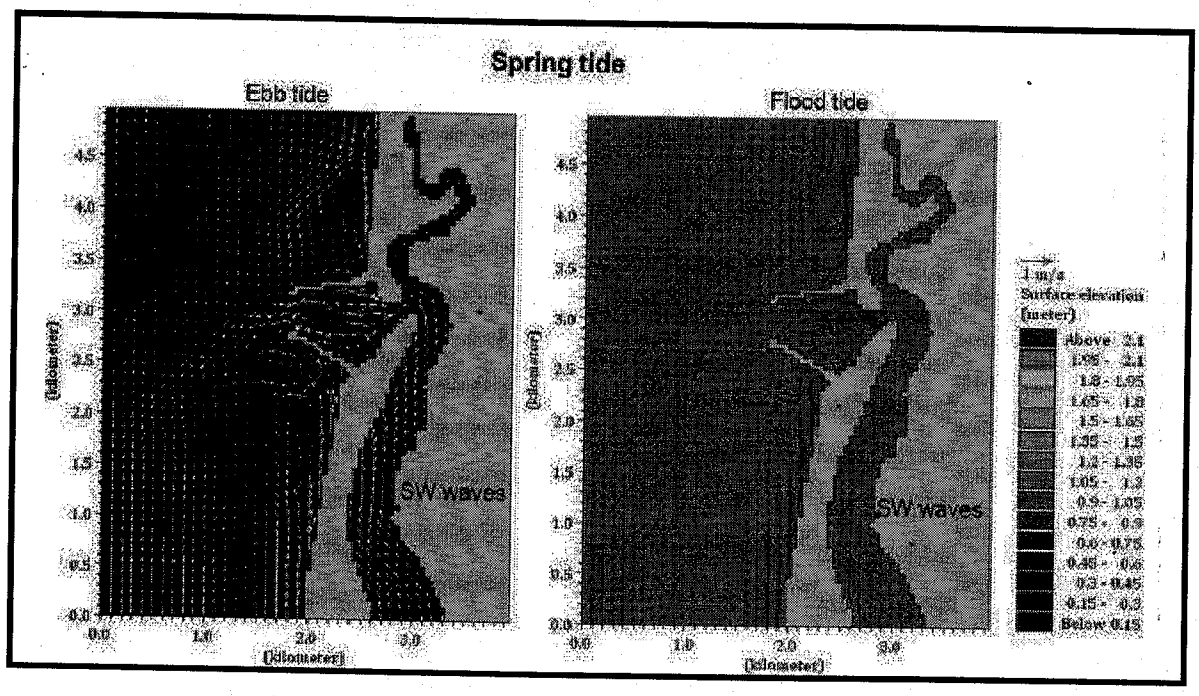


Figure 5-16: Water levels for wet season during ebb and flood periods (Spring tide)

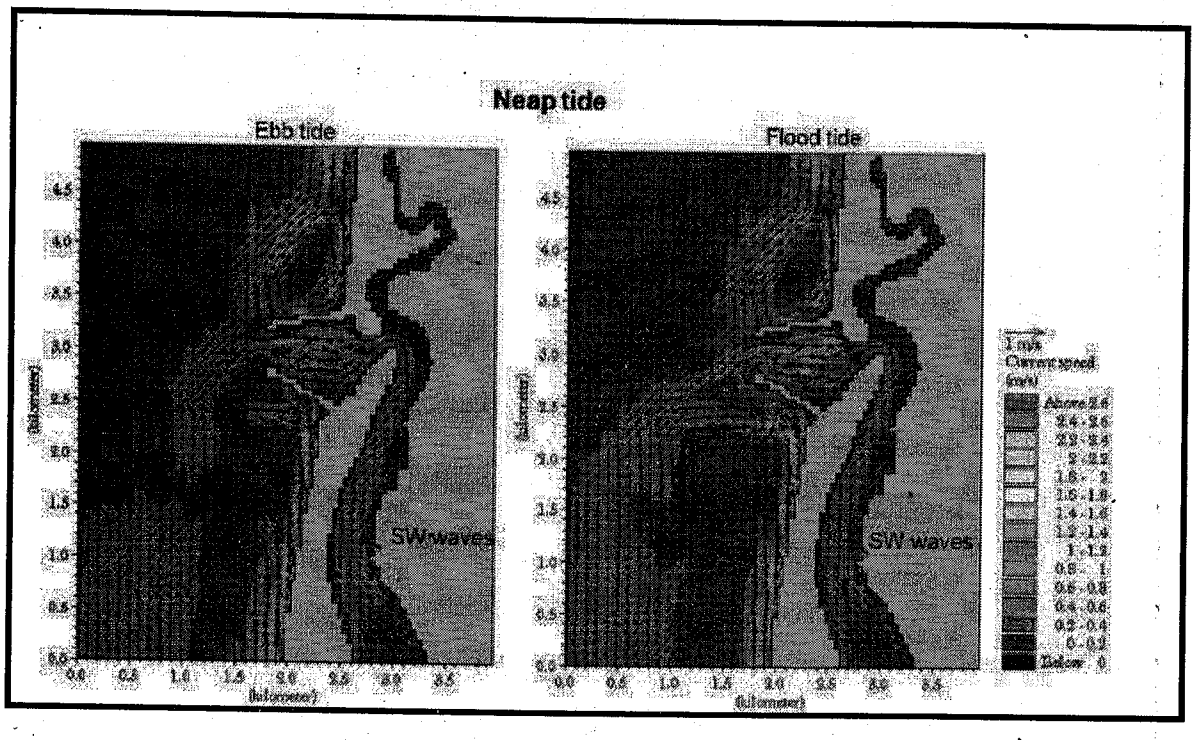


Figure 5-17: Currents for Wet season during ebb and flood periods (Neap tide)

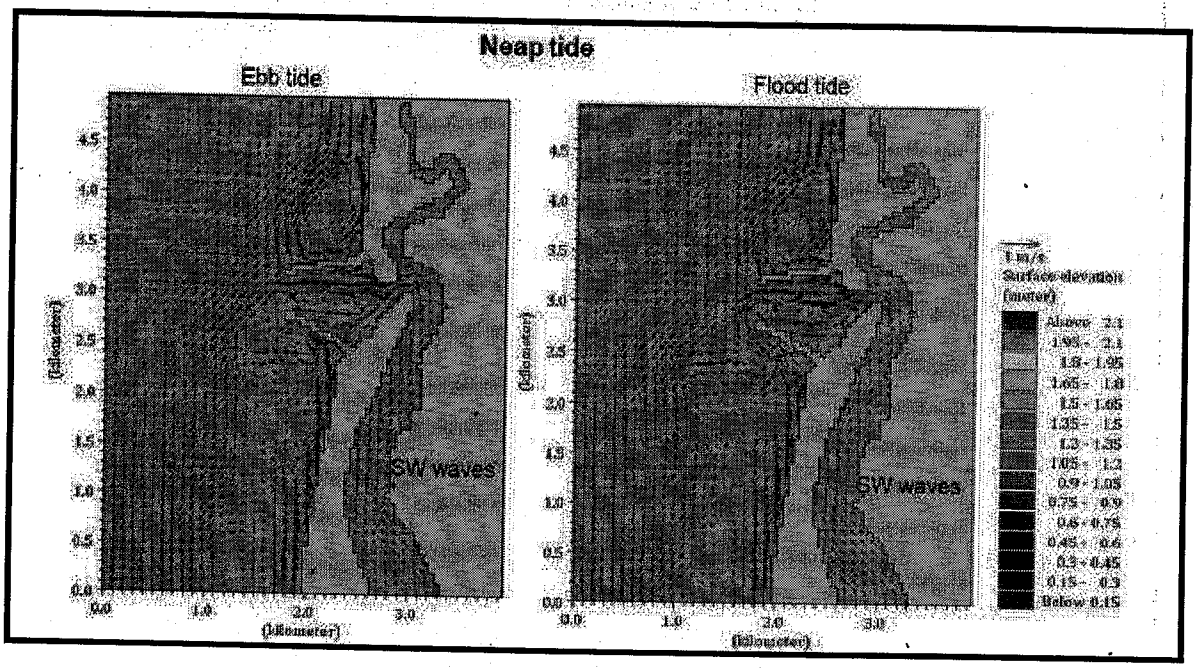


Figure 5-18: Water levels for wet season during ebb and flood periods (Neap tide)

(b) Dry season:

The currents simulated for dry season at stations T1, T2 and T3 are shown in Figure 5-19. The current pattern for different tidal phases (spring and neap) along with flood, ebb and slack periods are presented in Figure 5-20 to 5-23.

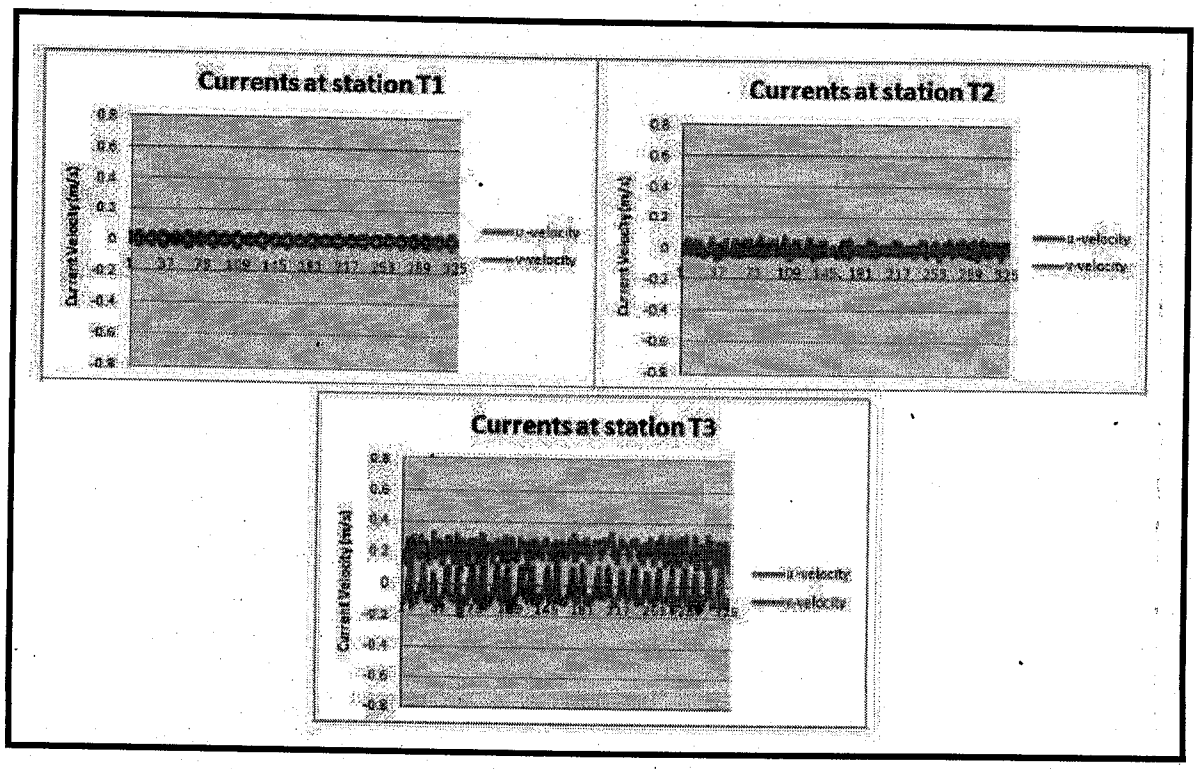


Figure 5-19: Simulated tidal currents during Dry season with proposed facility

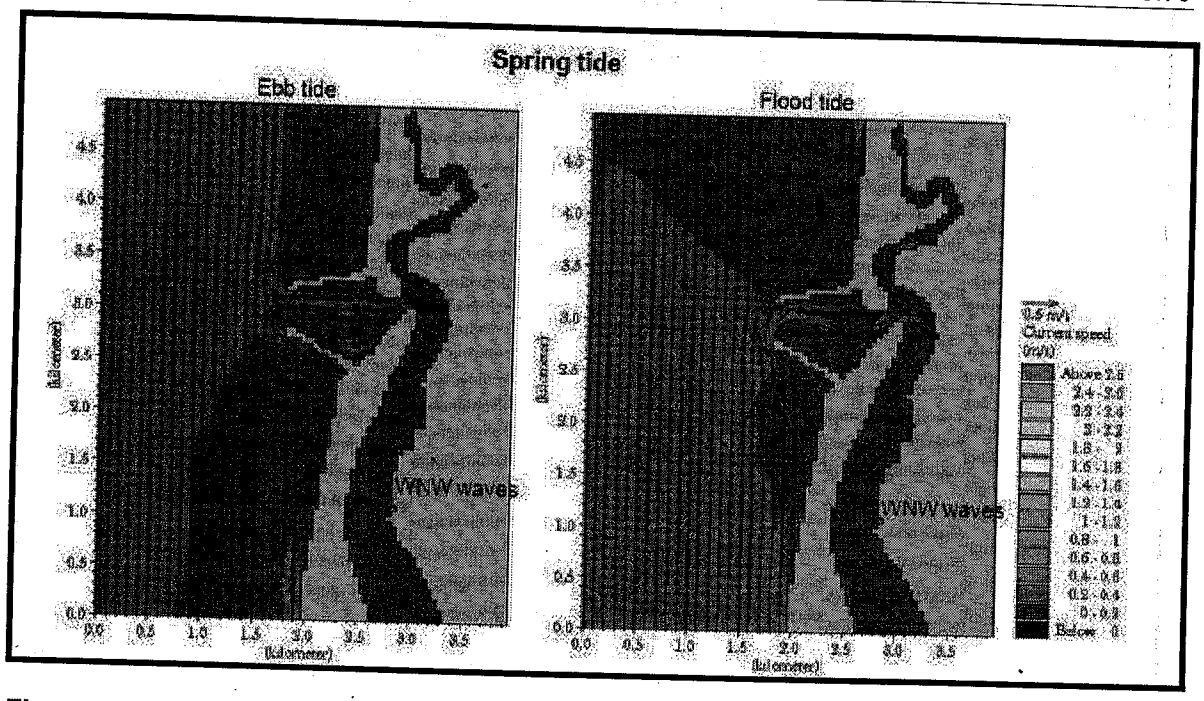


Figure 5-20: Current patterns for dry season during ebb and flood periods (Spring tide)

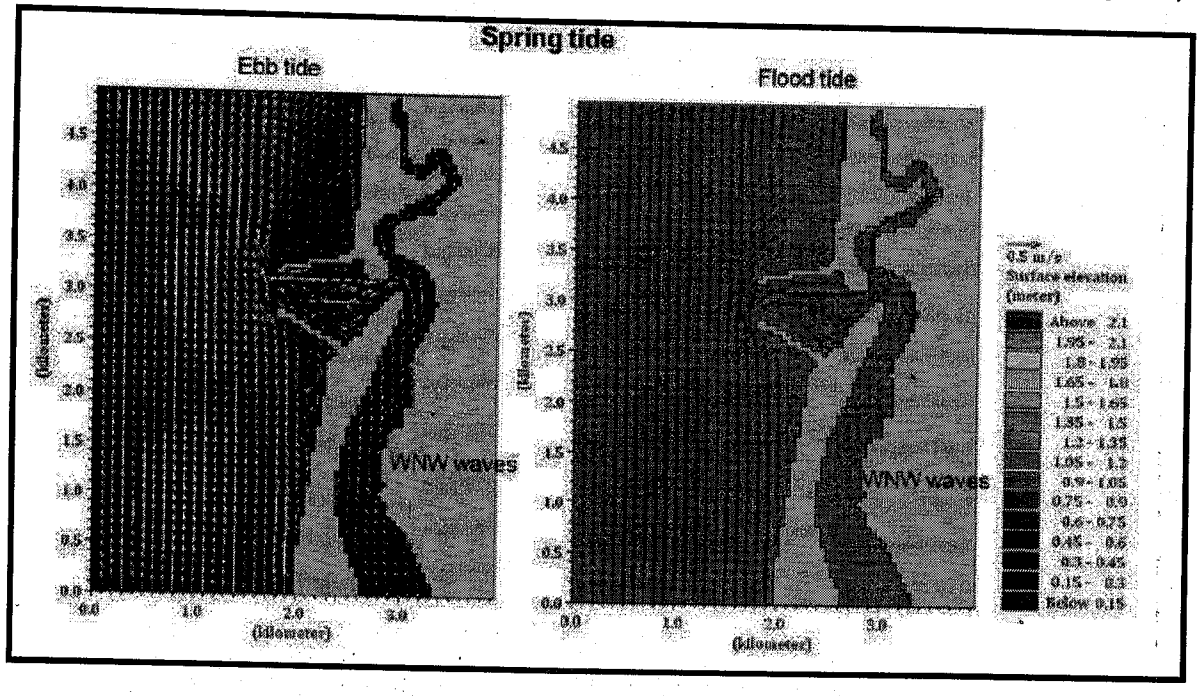


Figure 5-21: Water levels for dry season during ebb and flood periods (Spring tide)

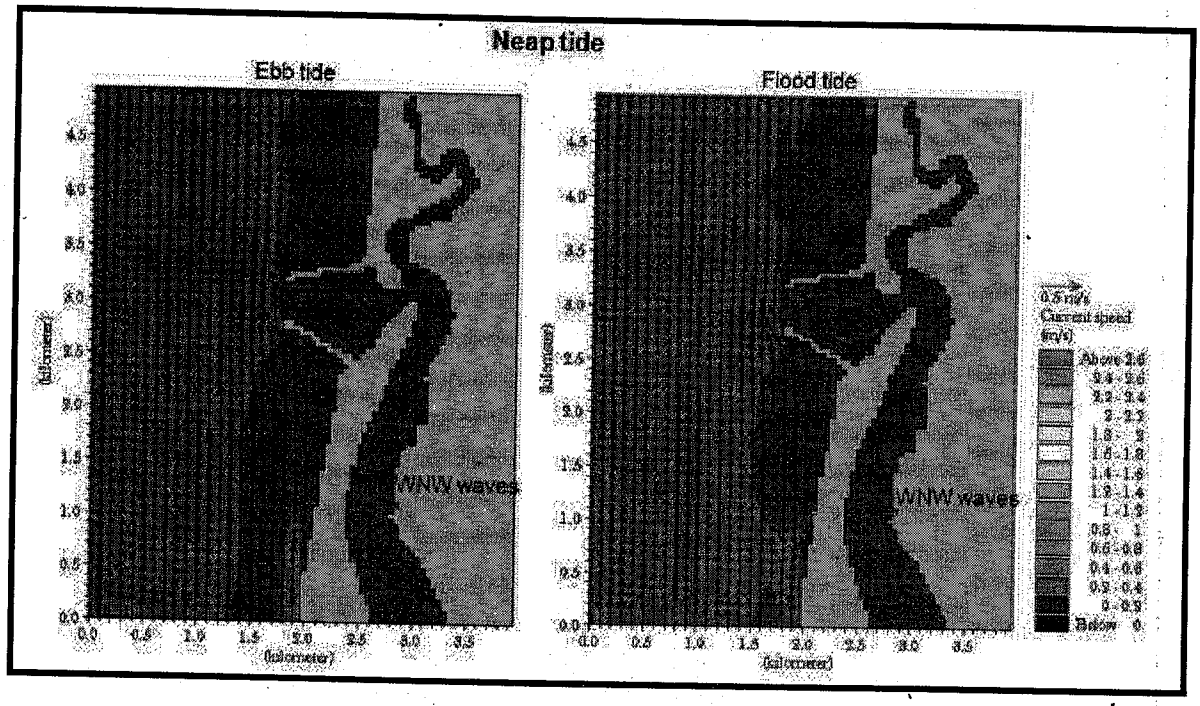


Figure 5-22: Current patterns for dry season during ebb and flood periods (Neap tide)

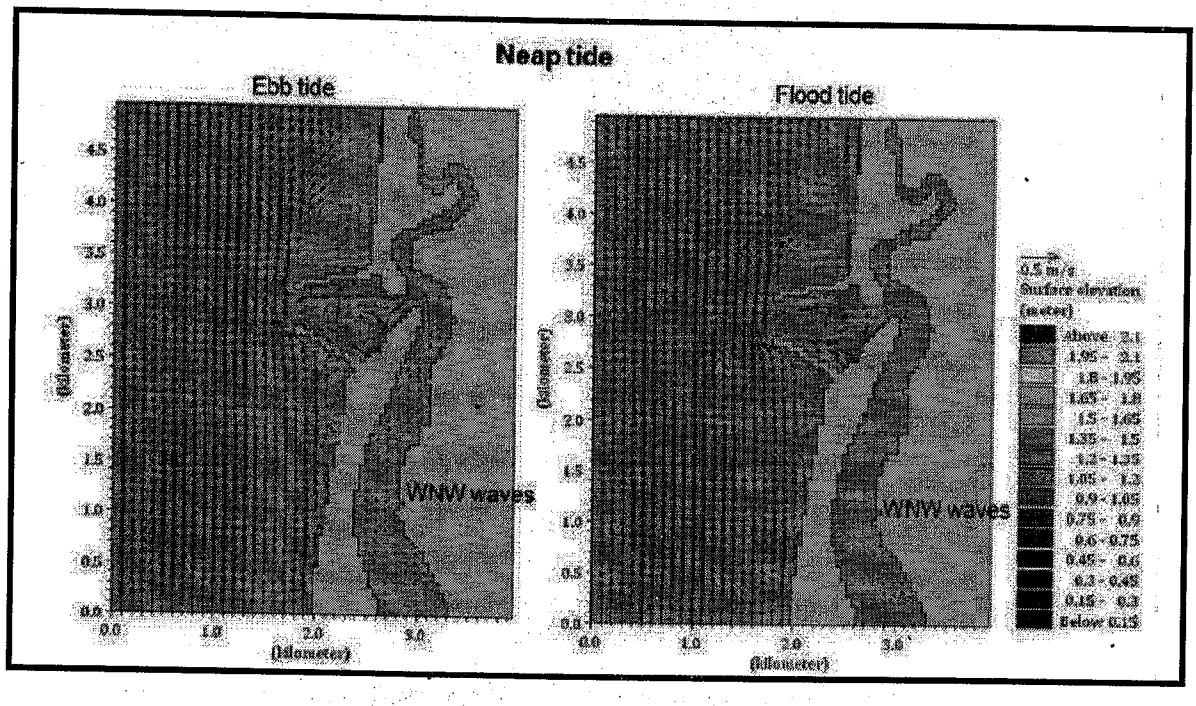


Figure 5-23: Water levels for dry season during ebb and flood periods (Neap tide)

The changes in the current patterns near the inlet - both on the seaside and riverside of the inlet are of interest to us. Similarly, the currents inside the river up to the point of the proposed barge/ vessel loading facilities are also important. The model results show that the ebb currents are strong during wet season when the river discharge is very high. The current strengths increase further during spring tide periods compared to neap tide. For case-I (without breakwaters), during wet season with peak river discharge (300 m^3/s) strong currents of about 1 to 1.2 m/s are noticed inside the channel as well as on the seaward side

of the channel. Inside the river also up to 5 km upstream, the ebb currents are strong (0.4 to 0.6 m/s). During flood period, also the currents continue to be in the ebb direction and no reversal is found. However, there is slight reversal outside the channel to the south. The currents in the river also show no reversal with tide; they continue to be in the ebb direction even during flood period. This is due to the overwhelming effect of the river discharge, which totally controls the circulation. The currents might get reversed with tide at the bottom where sea water could flow up stream; however the model doesn't give the bottom currents. Similar variations of currents are observed during neap tides also.

For case-I during wet season, the impoundment of water within the river and the inlet area is clearly noticed. During ebb period, the water levels in the river are at about 0.6 to 0.75 m while on the seaside, the water levels are around 0.3 to 0.45 m. However, during the flood period the water levels in the river and in the sea remain almost same at around 0.9 m. During dry season the magnitudes of currents have generally decreased to about 0.2 m /s and a clear reversal in tidal currents could be noticed.

For case-II in the wet season strong currents directed seaward are noticed near the inlet during ebb period. The ebb current strength in the river is found to be stronger compared to case-I. With the inclusion of breakwaters, the effective cross sectional area at the entrance has decreased resulting in the increase of current strength. The water levels during the flood period remain almost same as case-I and so it may be inferred that the construction of breakwaters will have negligible effect on the water level changes in the facility.

The increase in current strengths prevents any increase in water levels and no flooding is expected. Since, the currents show higher values only during ebb period, the riverine sediments could be carried offshore by such currents and sedimentation problem within the facility is expected to be lesser. For case-II during dry season reversal of currents in the river are noticed from ebb to flood periods. The water levels also do not show any variations compared to case-I.

COHESIVE SEDIMENT TRANSPORT MODEL STUDIES

Cohesive or mud transport studies are essential for coastal regions where river or tidal inlets are present. Honnavar is such a place where monsoonal rivers discharge significant quantities of sediment into the coastal region. Here, the riverine flow (mud and water) changes rapidly with increase in rainfall and discharge. The cohesive sediment transport model has been simulated for different seasons with different wave approaches, thus including wave-current interactions.

Mud transport (MT) model description:

The MIKE 21 Flow Model, Mud Transport Module (MT) describes erosion, transport and deposition of mud or sand/mud mixtures under the action of currents and waves. MIKE 21 Flow Model, Mud Transport Module, is applicable for:

- Mud fractions alone, and
- Sand/mud mixtures

The following processes can be included in the simulation:

- Forcing by waves
- Sliding

- Salt-flocculation
- Detailed description of the settling process
- Layered description of the bed, and
- Morphological update of the bed

In the MT-module, the settling velocity varies according to the salinity (if included) and the concentration taking into account flocculation in the water column. Waves, as calculated by MIKE 21 NSW for example, may be included.

HD and MT Models setup:

The Flow model (HD and MT) has been simulated for different wave directions obtained from wave radiation stresses output from NSW fine-resolution model simulations. The model setup is divided into two parts one with low discharge conditions (dry monsoon) and the other with high discharge conditions (wet monsoon). For dry monsoon season, the Sharavathi river discharge is very less (50 m^3/s) and for the wet monsoon season, it varies from 200-500 m^3/s during peak discharge periods (KPL river discharge data). We have subjected these values to sensitive analysis and found that the model performed reasonably well for peak discharge of 300 m^3/s. Peak discharge conditions mostly coincide with heavy rainfall events as well as with monsoonal periods. Simulations have been performed for 15 days covering spring and neap tide periods for different cases with open boundary set along the southern part in the riverside. As the riverine discharge in the northern branch of the Pavinkurve is almost negligible, the northern boundary is closed. Eddy viscosity has been considered constant based on velocity formulation to around 0.03 m^2/s. For bed resistance a constant Chezy number of 55 $m^{1/2}/s$ has been used.

For MT model setup, the grain size fraction is taken as 1 and the initial sediment concentration at all the boundaries except at the riverine side are put at 0.01 kg/m^3 (cold start). Dispersion in x and y directions have been taken as constant at a value of 1.5 m^2/s. The outputs obtained from the model results are total net deposition, total bed thickness change, total bed mass change and Total Suspended Sediment concentration (SSC).

Without facility (case-I):

(a) Suspended sediment concentration: The distribution of SSC along Honnavar region has been simulated for predominant wave directions of S, SSW and SW for wet season and with WSW, W and WNE for dry season. The variations at 5 day intervals are shown in below Figure 5-24 to 5-31.

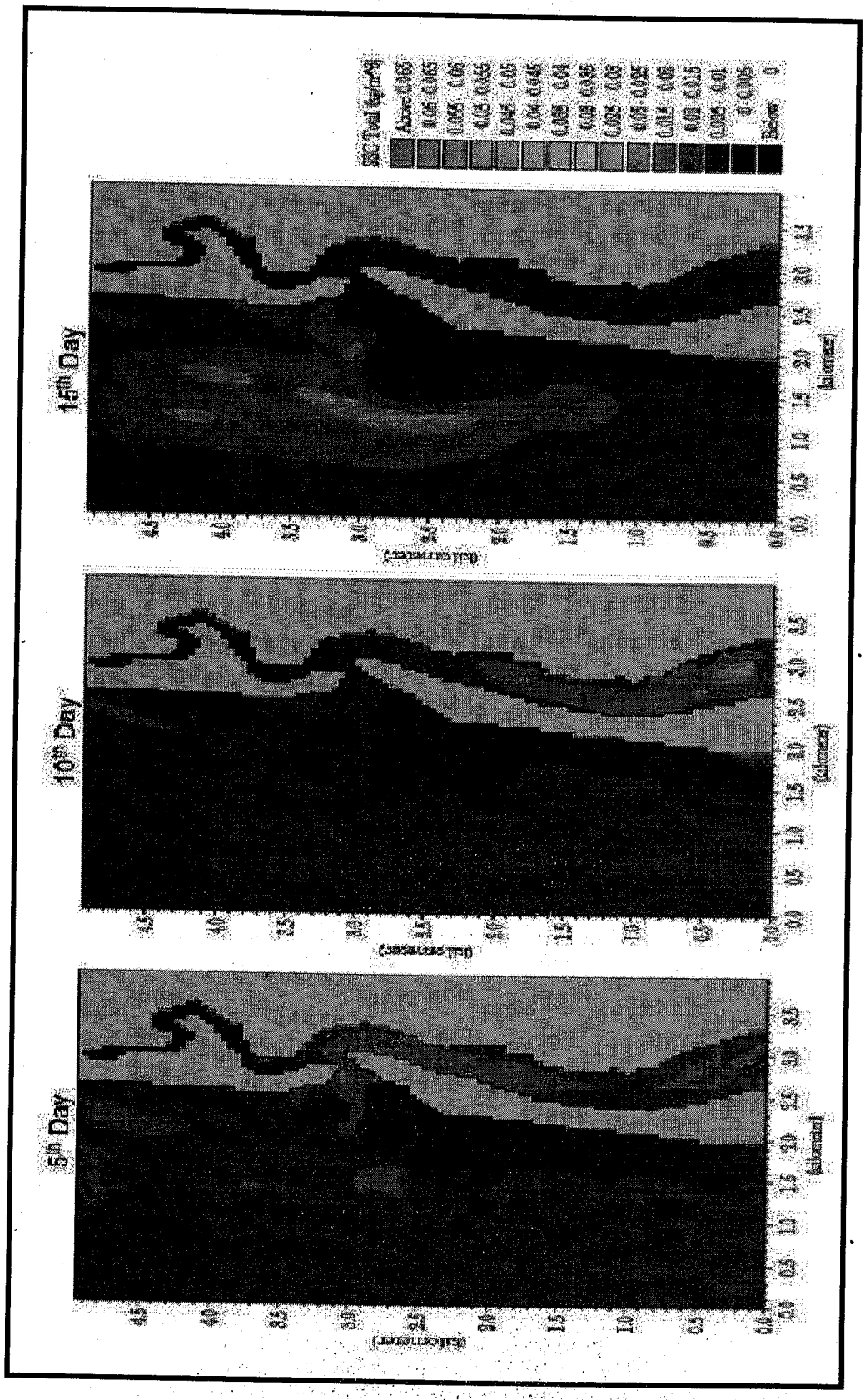


Figure 5-24: Suspended sediment concentration for wet season (SSW waves)

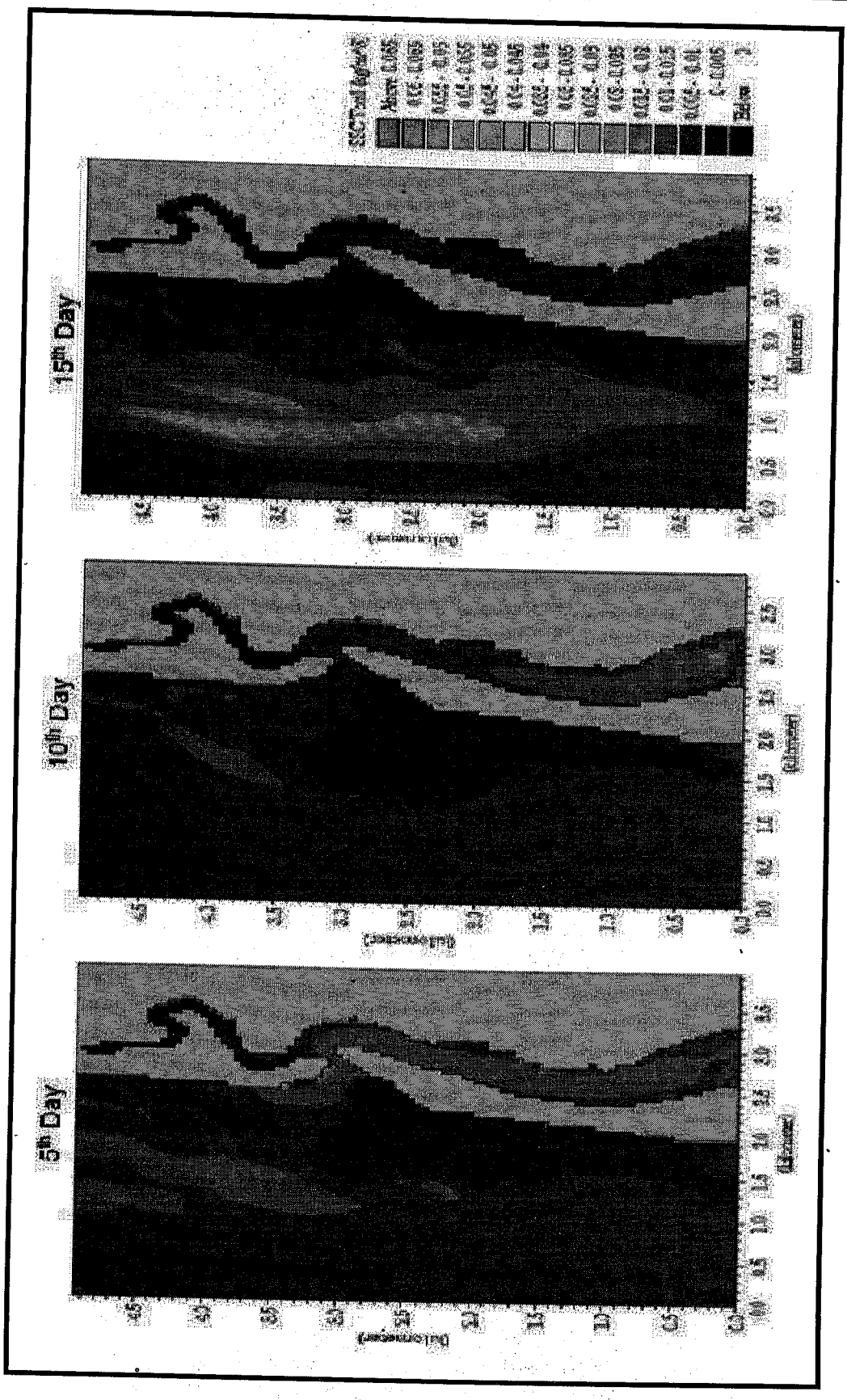


Figure 5-25: Suspended sediment concentration for wet season (SW waves)

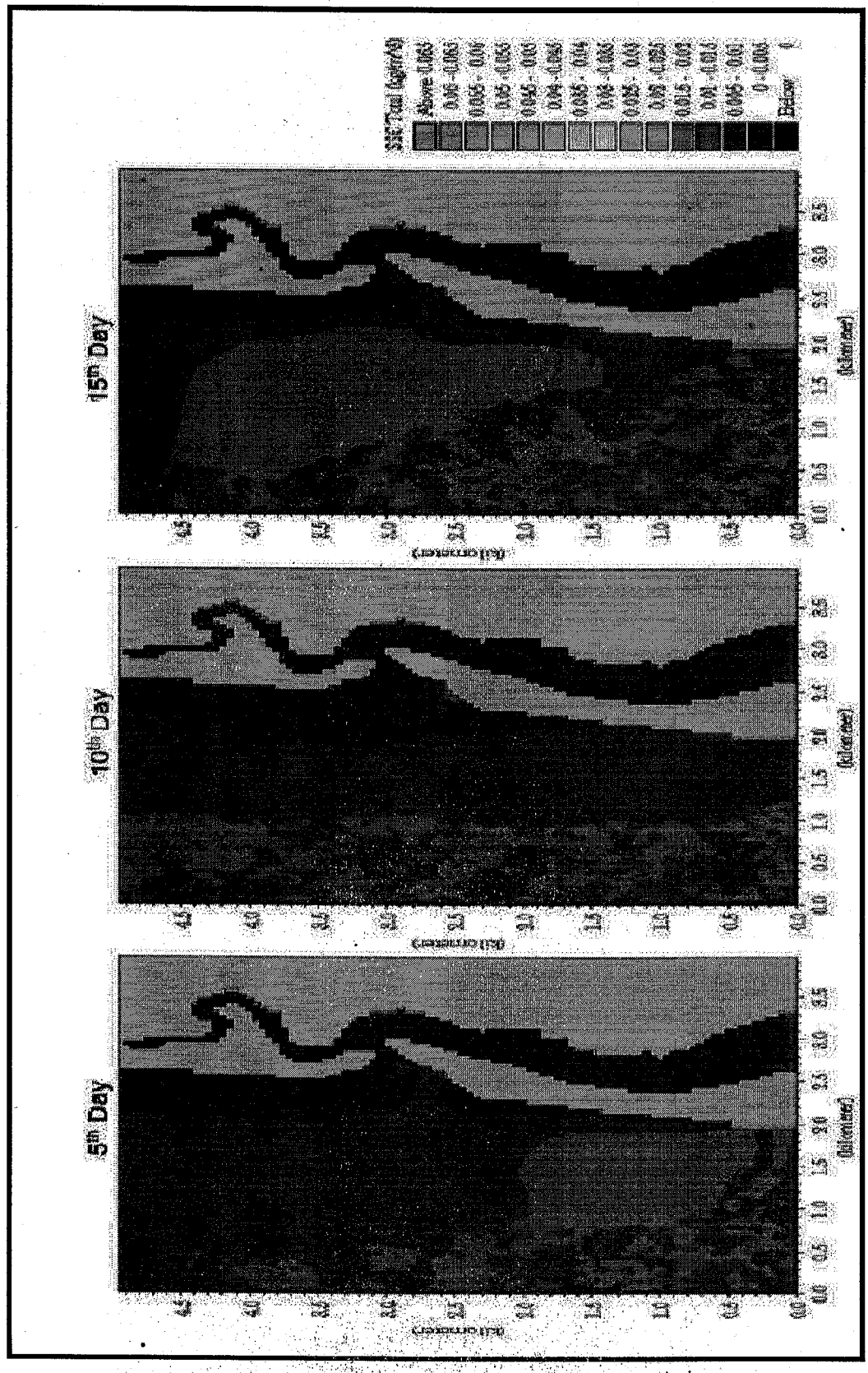


Figure 5-26: Suspended sediment concentration for dry season (WNW waves)

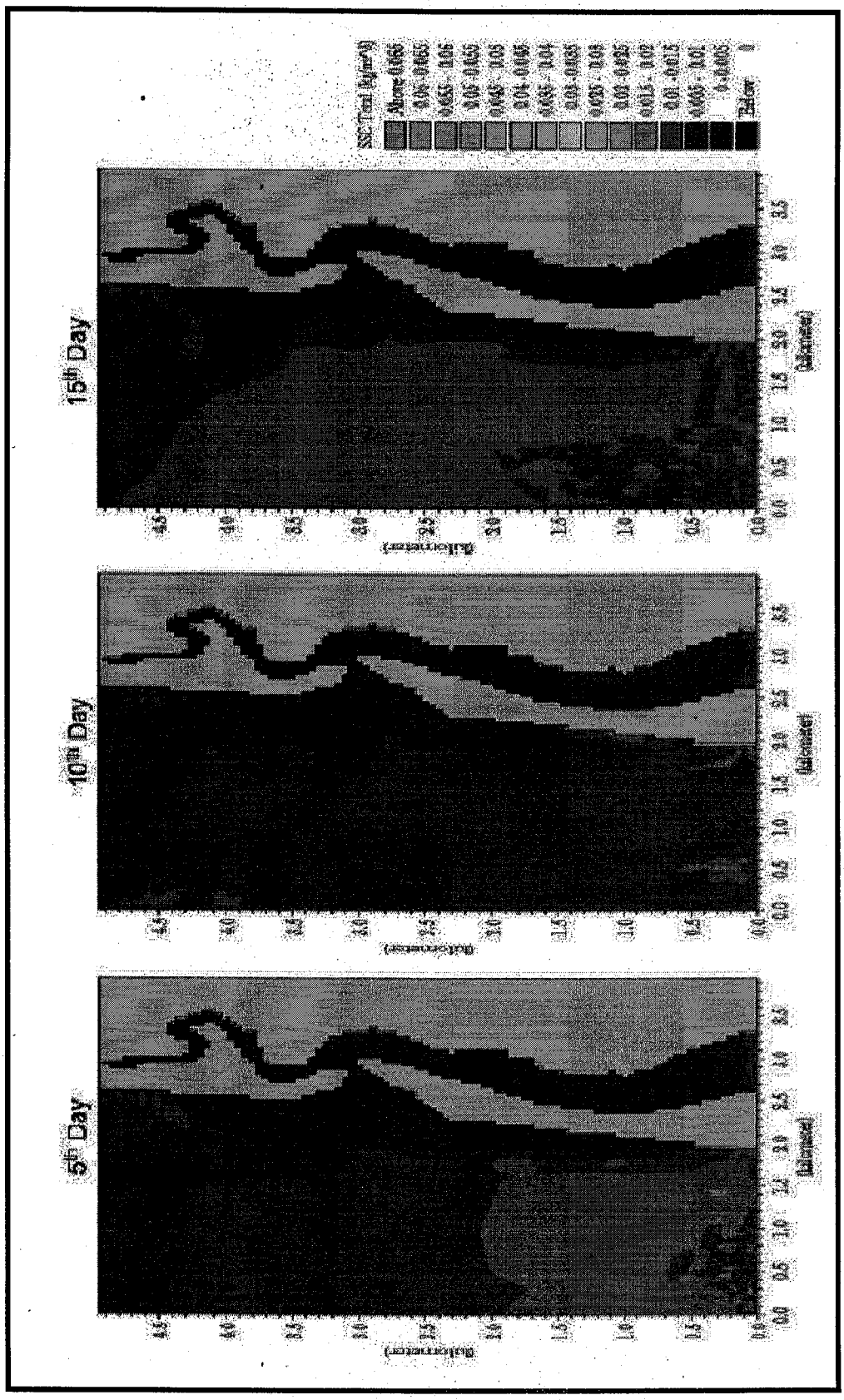


Figure 5-27: Suspended sediment concentration for dry season (W waves)

(b) Total bed thickness change: The total bed thickness change computed for 5 day interval with different directions of wave approach are shown in below figures

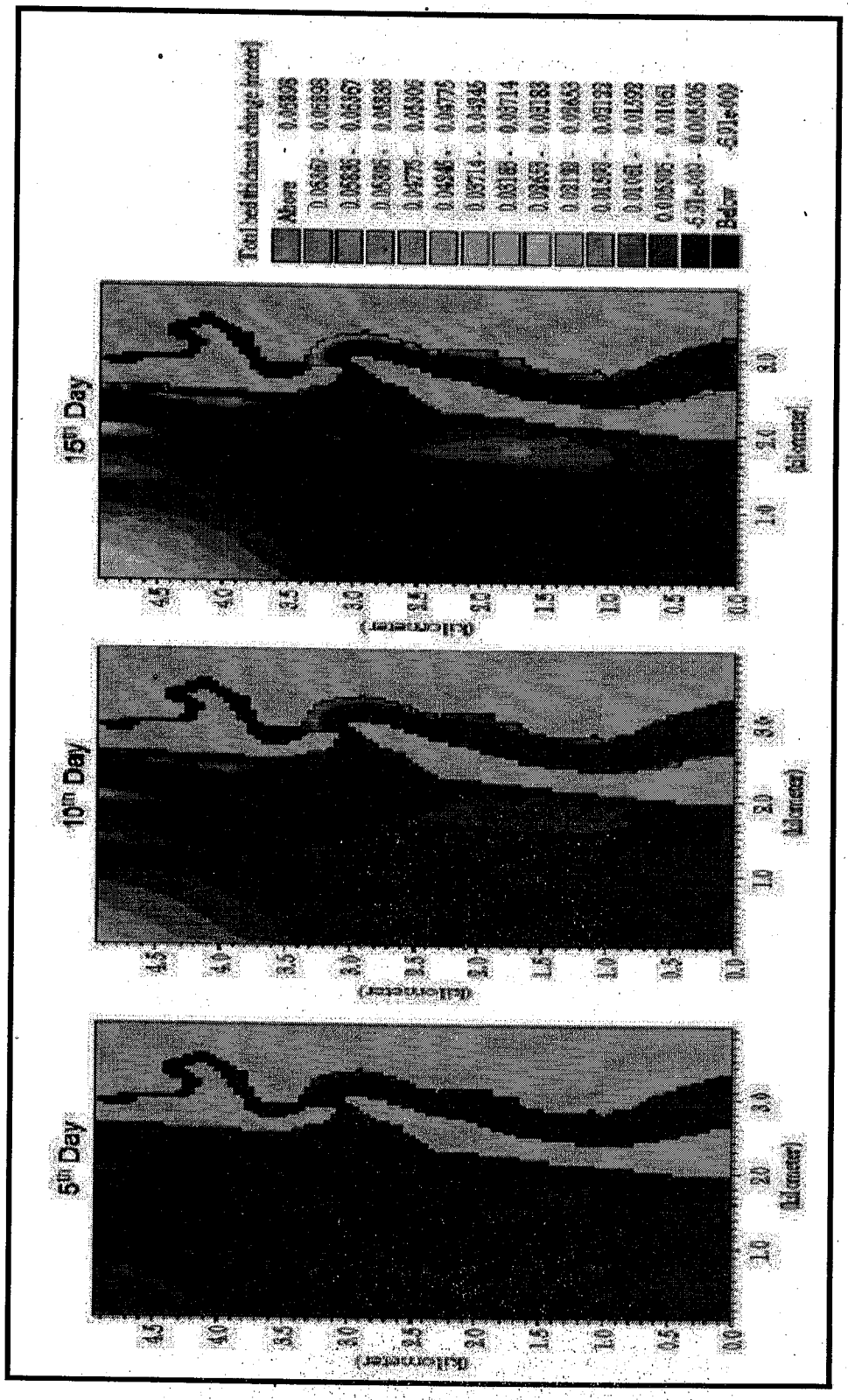


Figure 5-28: Total bed thickness change (m) for wet season (SSW waves)

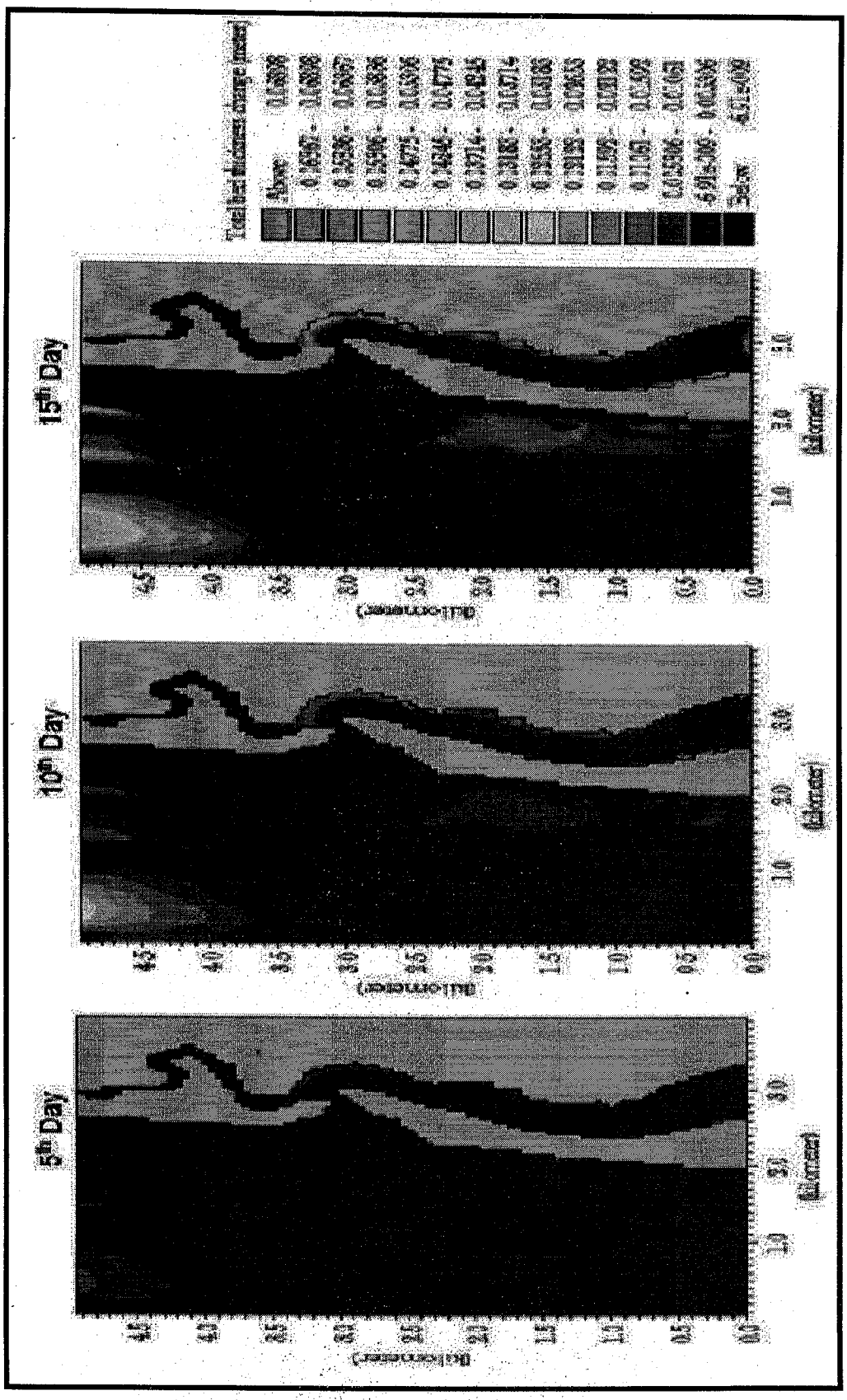


Figure 5-29: Total bed thickness change (m) for wet season (SW waves)

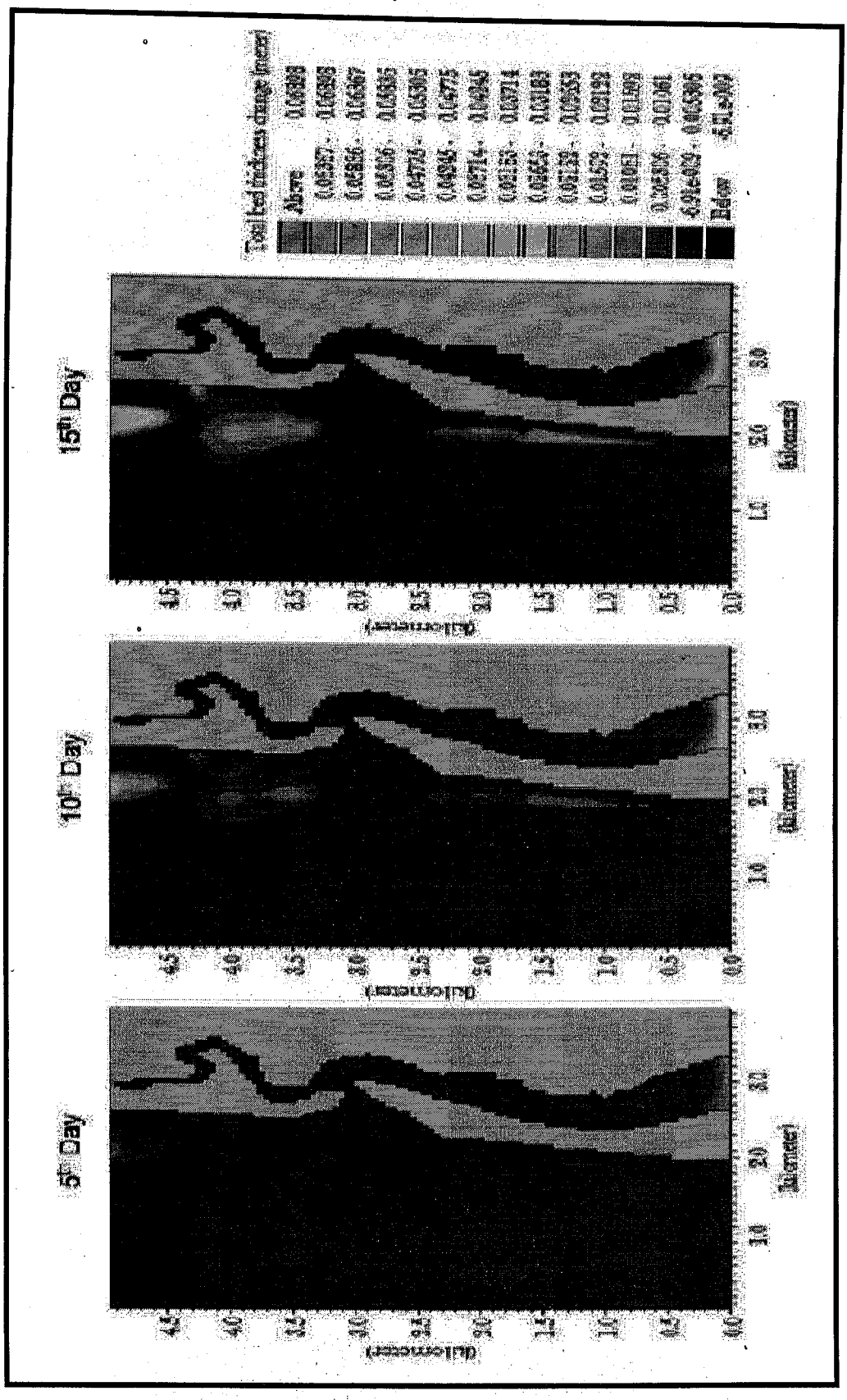


Figure 5-30: Total bed thickness change (m) for dry season (W waves)

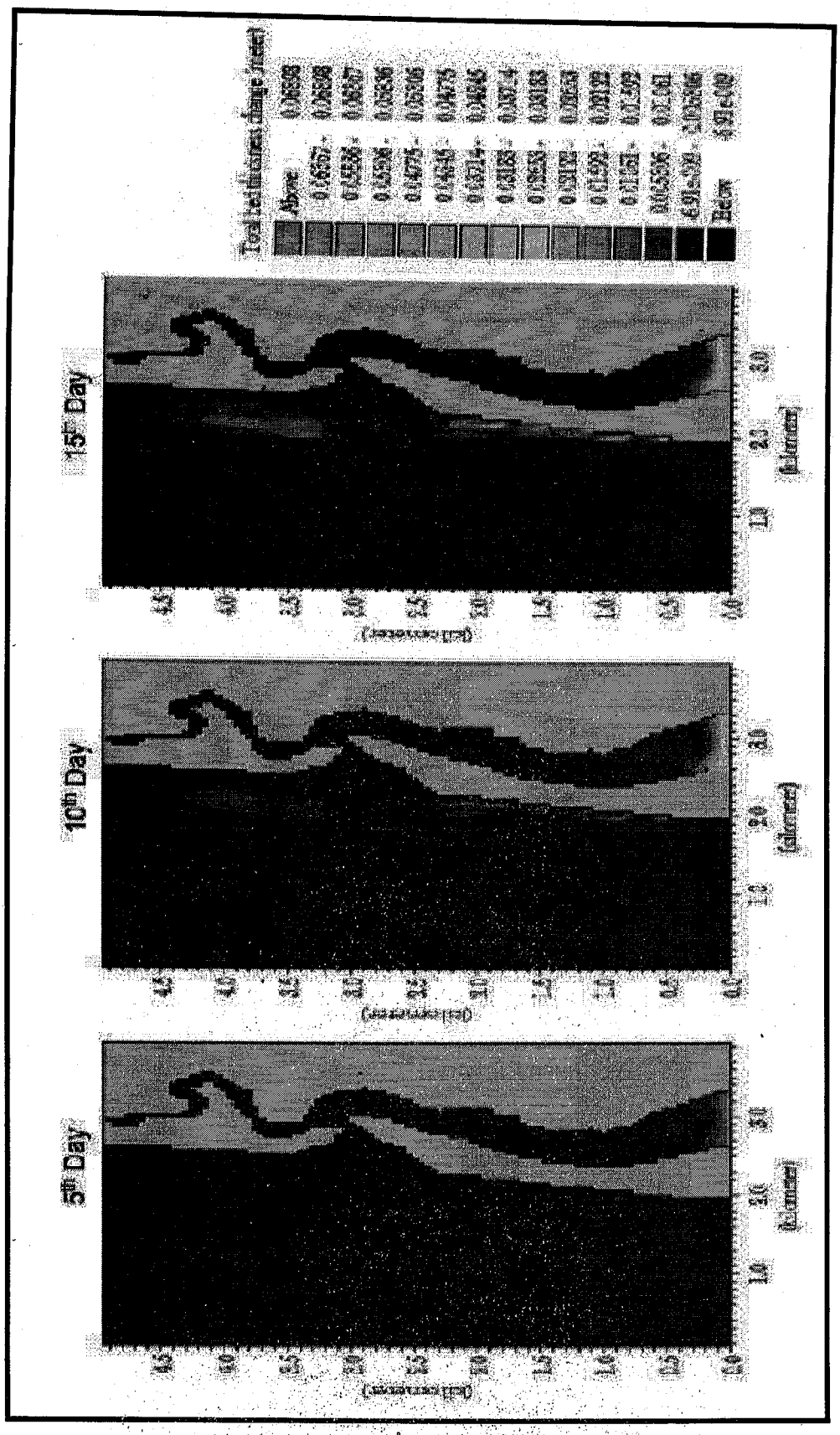


Figure 5-31: Total bed thickness change (m) for dry season (W NW waves)

With Proposed construction (case-II):

Suspended sediment concentration: The distribution of SSC along Honnavar region have been simulated for wet season with predominant directions of approach SSW and SW and for dry season W and WNE. The variations at 5 day intervals are shown in below Figures 5-32 to 5-39.

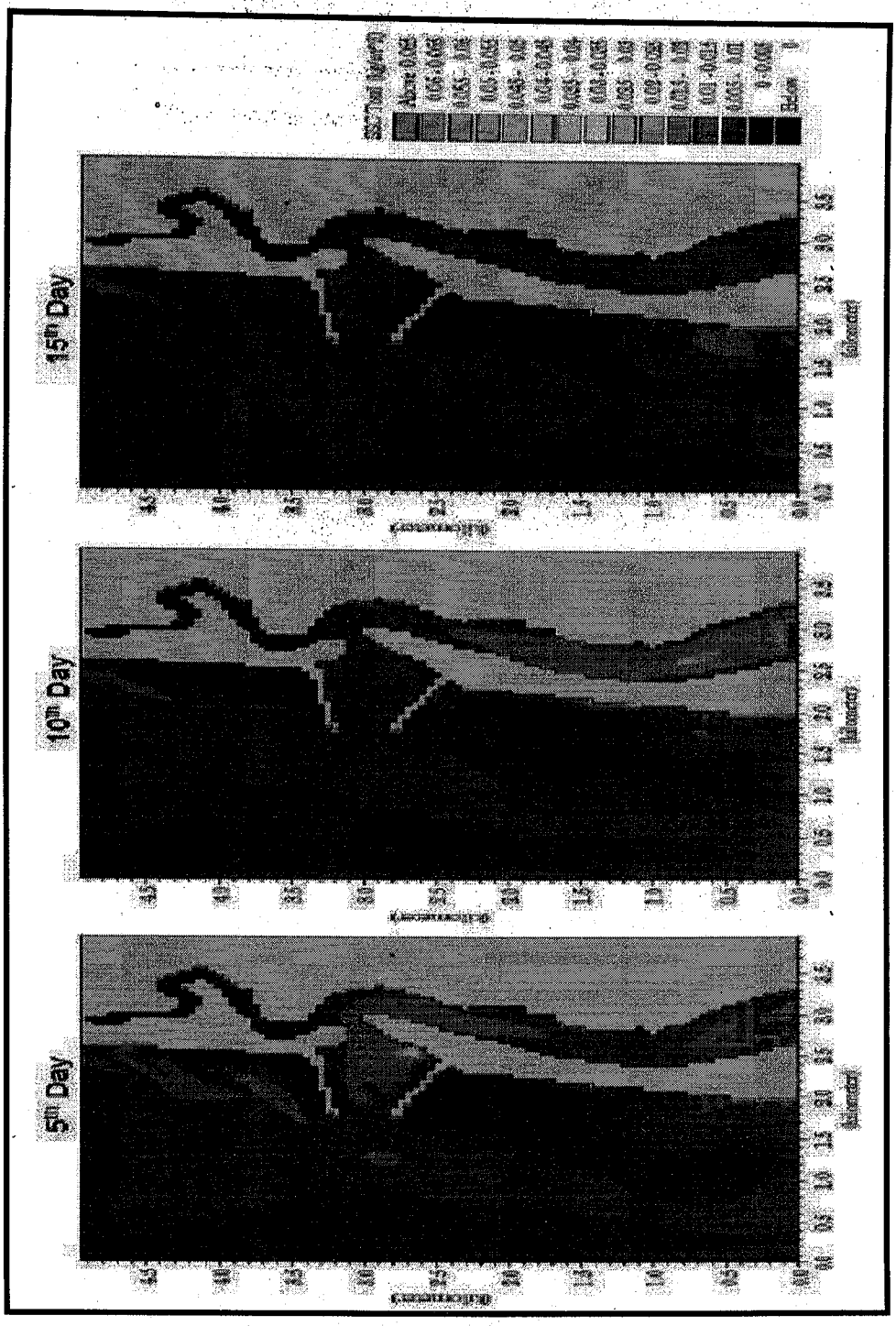


Figure 5-32: Suspended sediment concentration for wet season (SSW waves) with Barge/vessel Loading Facility

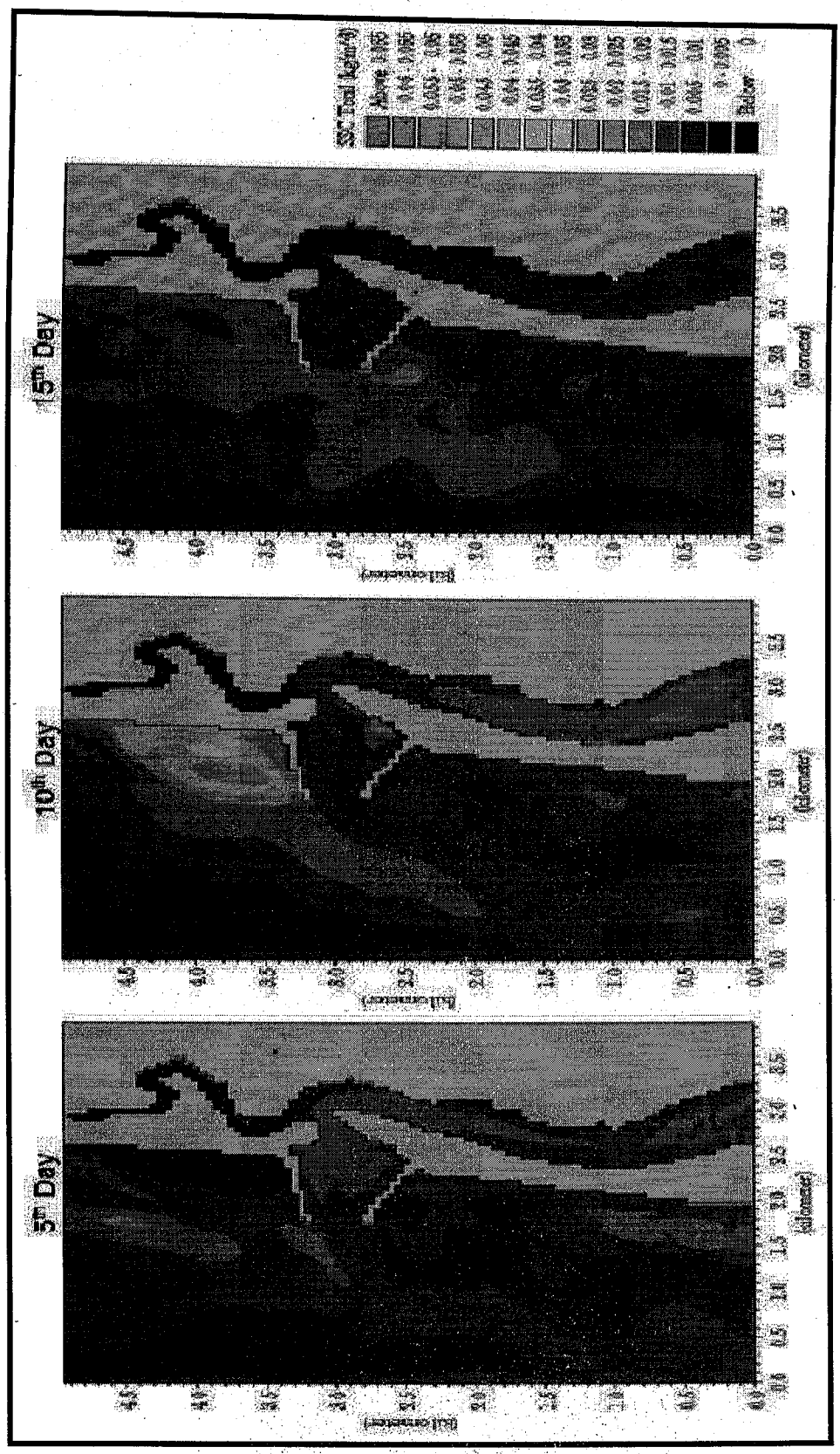


Figure 5-33: Suspended sediment concentration for wet season (SW waves) with Barge/vessel Loading Facility

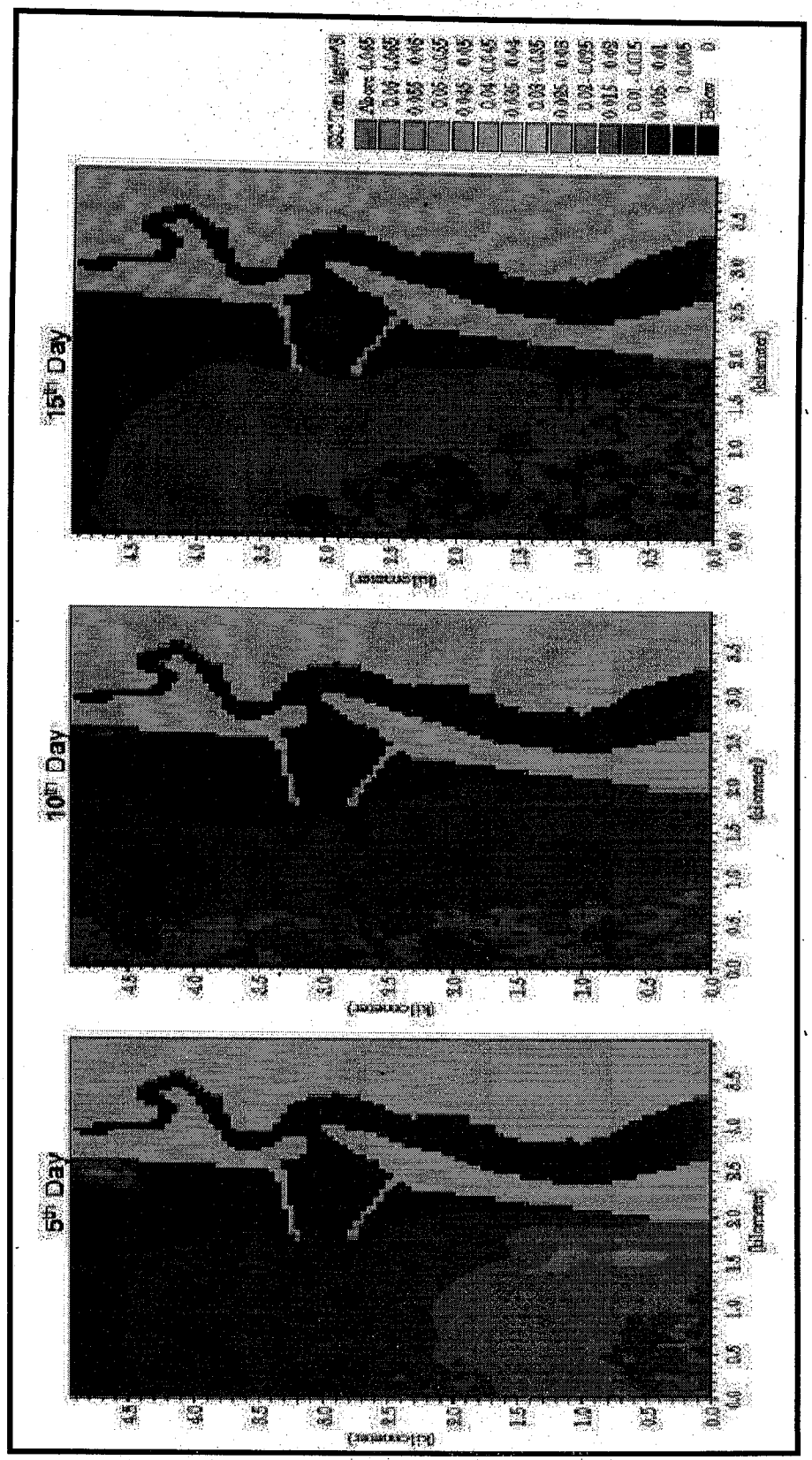


Figure 5-34:.Suspended sediment concentration for dry season (W waves) with Barge/vessel Loading Facility

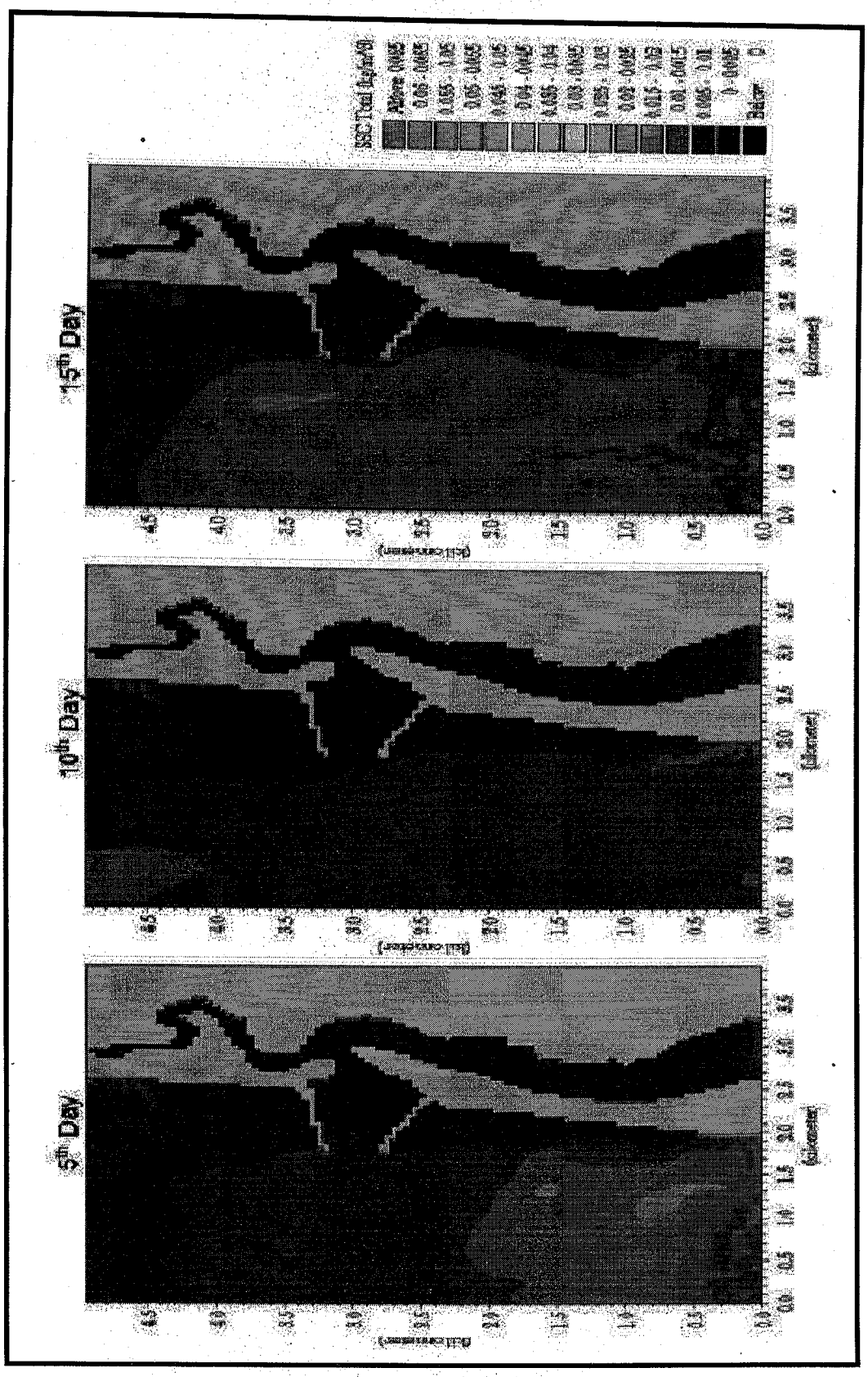


Figure 5-35: Suspended sediment concentration for dry season (WNW waves) with proposed facility

Total bed thickness change: The total bed thickness change computed for 5 day interval with different directions of wave approach is shown in below figures.

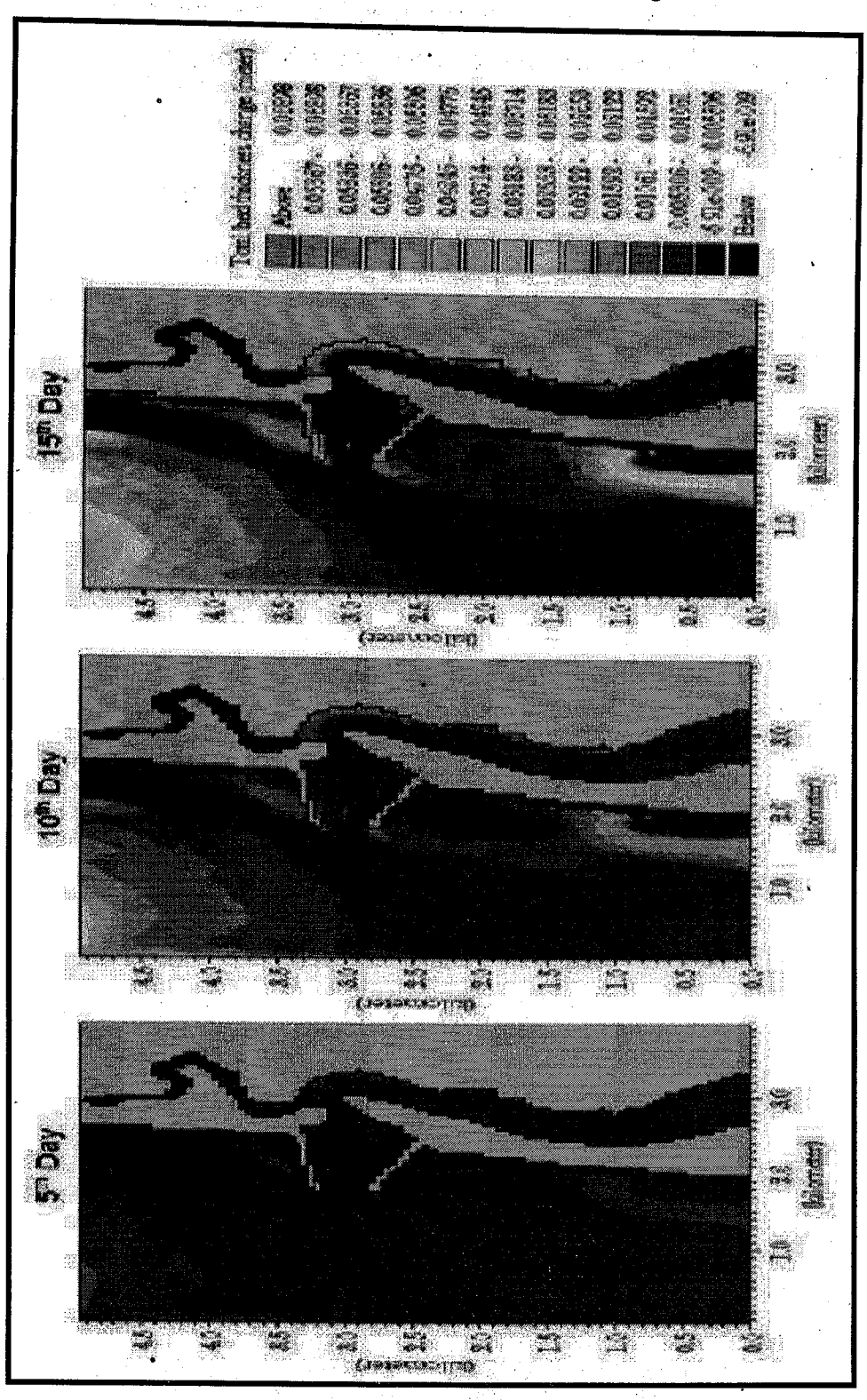


Figure 5-36: Total bed thickness change (m) for wet season (SSW waves) with proposed facility

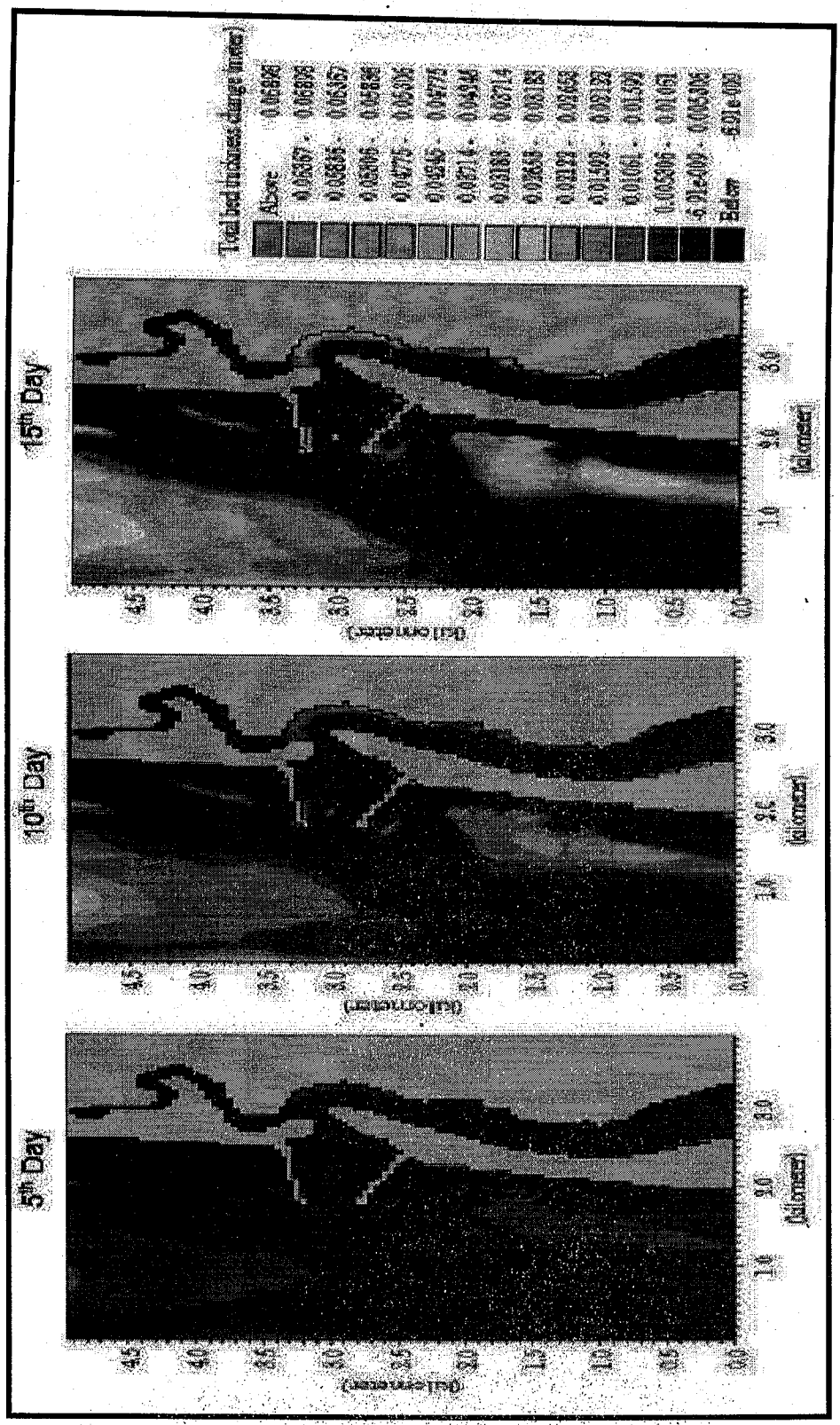


Figure 5-37: Total bed thickness change (m) for wet season (SSW waves) with proposed facility

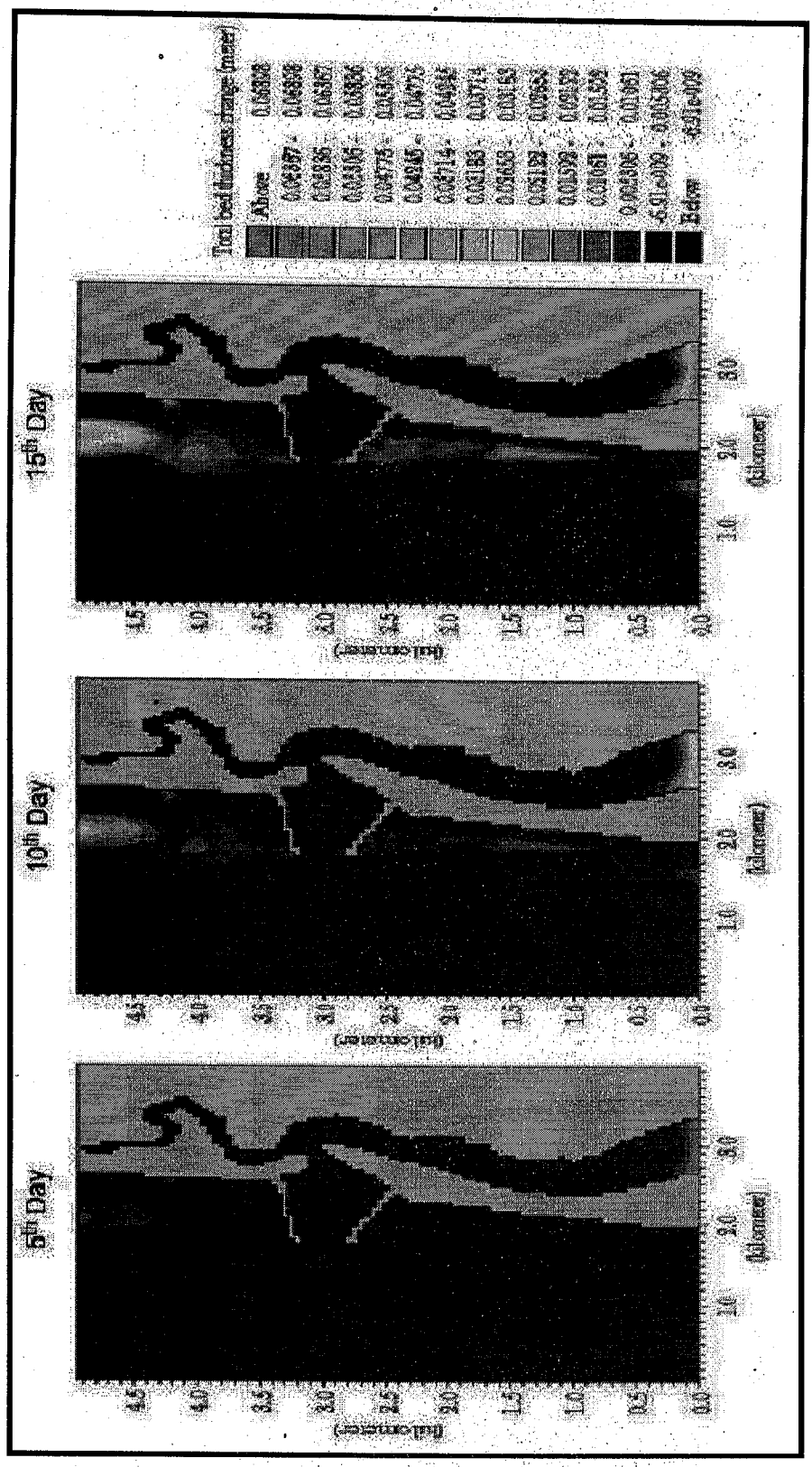


Figure 5-38: Total bed thickness change (m) for dry season (W waves) with proposed facility

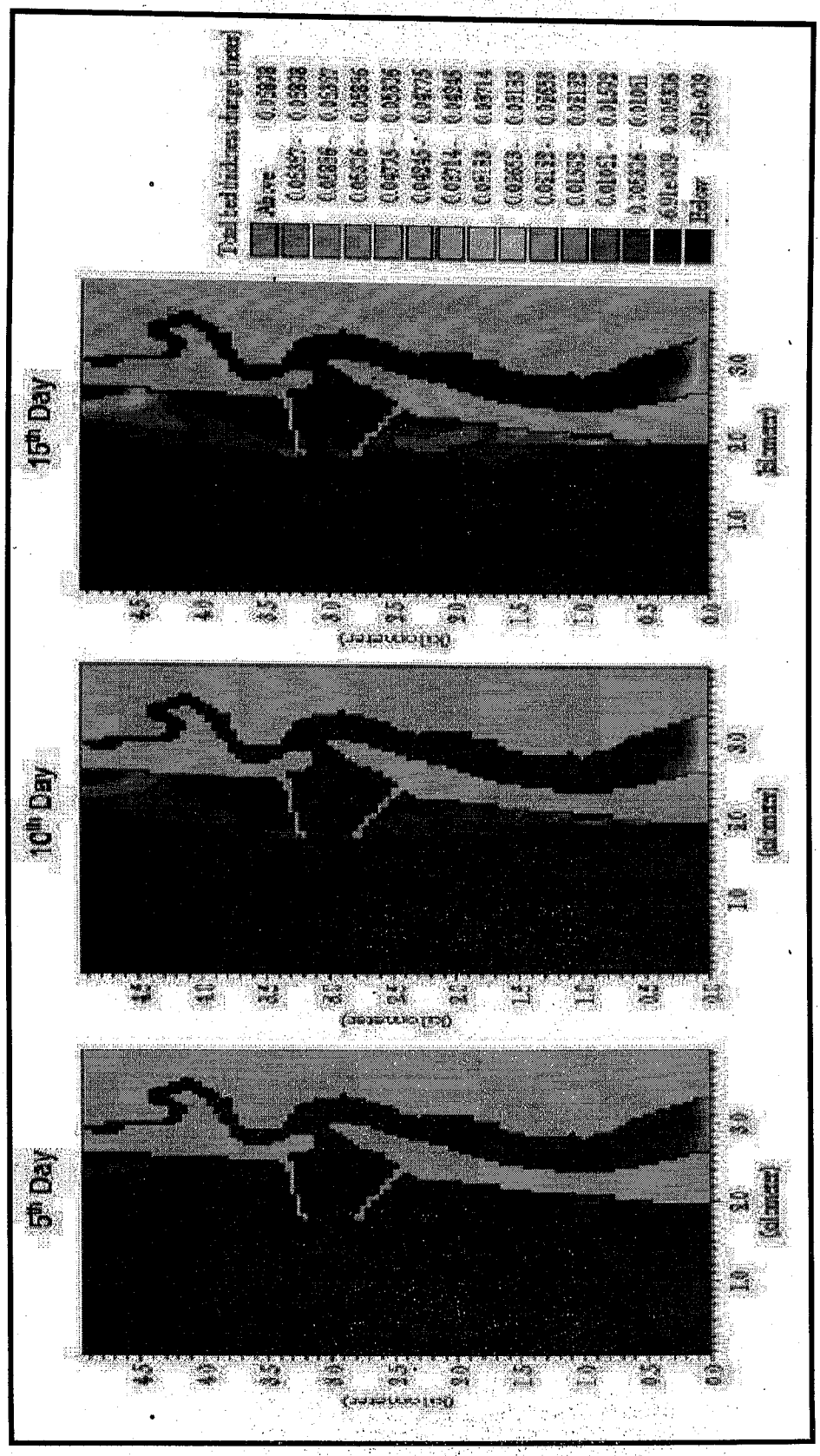


Figure 5-39; Total bed thickness change (m) for dry season (W NW waves) with proposed facility

Conclusion:

For case-I (without breakwaters) in the wet season, on the 5th day of the model run higher SSC values are noticed both inside the river and near the inlet entrance, which gradually decreased and by 10th day became negligible except on the southern end of the river. By 15th day the SSC is completely flushed out and higher SSC values are noticed only far away on the sea side of the channel. For dry season the SSC values continue to be less throughout the model run up to 15 days. The model run for bed level changes shows negligible bed level changes up to 5th day throughout the entire area; but by 10th day slight deposition is noticed on the right bank of the river to the north of the channel entrance and by 15th day the deposition seems to have increased further. For dry season however the bed level changes are negligible for the entire area.

For case-II (with breakwaters) during wet season slightly higher values of SSC are noticed inside the region of breakwaters and also inside the river. But by 10th day the SSC is flushed out and by 15th day the entire area is free of any SSC. During dry season the SSC is negligible throughout the study area. The bed level changes during wet season indicate the sedimentation is negligible up to 10th day; but by 15th day slight deposition appears on the right bank of the river facing the channel inlet. But this siltation is not severe and it can be concluded that the construction of breakwaters will not have any significant effect on siltation in the proposed facility area.

NON- COHESIVE SEDIMENT TRANSPORT MODEL STUDIES:

Honnavar coast is affected mainly by wind waves during all seasons. During wet season swells from south-west predominantly hit the coast and the sediment (sand) is lifted into suspension all along the coast. Since the inlet at Honnavar is very shallow, the waves break frequently on the shoals and cause varying degrees of sedimentation transport. This phenomenon can be examined using MIKE 21 Non-cohesive sediment transport model.

Non-cohesive Sediment transport (ST) model description:

MIKE 21 ST is a module in the MIKE 21 application suite for calculating non-cohesive sediment (sand) transport rates. We can calculate sand transport based on pure current information or with only wave impact. In addition to sand transport rates, a simulation will give the initial rates of bed level changes as well. This is sufficient to identify potential areas of erosion or deposition, but cannot take the place of a full morphological model. MIKE 21 ST can simulate sand transport rates in a wide array of settings, including natural environments like tidal inlets, estuaries and coastlines, and man-made constructions like harbours and bridges. Tide, wind, wave and current can all be taken into consideration for optimum precision in the simulations.

ST model Setup:

For ST model setup, we considered both currents and wave simulations as the coast is exposed to open sea where combined action of waves and currents are important. The HD simulation output for different wave conditions are given separately for executing the ST model. Bjiker's method has been adopted for performing sediment transport calculations with constant relative sediment density taken as 2.65 and water temperature to be 28°C. Bed load transport coefficient has been considered spatially constant. For bed resistance, the Chezy

number with value 55 has been used. Sediment porosity is considered as 0.4 with size 0.2 mm, gradation factor of 1.1.

Results:

Without proposed facility (case-I):

The seasonal distribution of sediment transport (wet and dry seasons) for six predominant deep-water wave directions are presented in below Figures 5-40 to Figure 5-51.

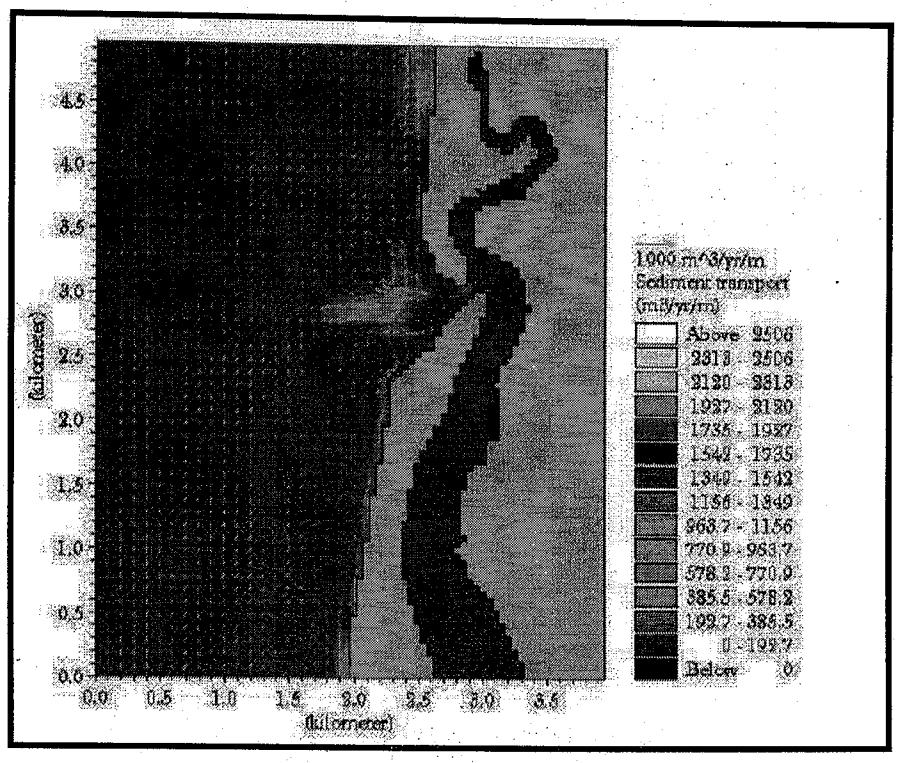


Figure 5-40: Rate of non-cohesive sediment transport during Wet season for S waves

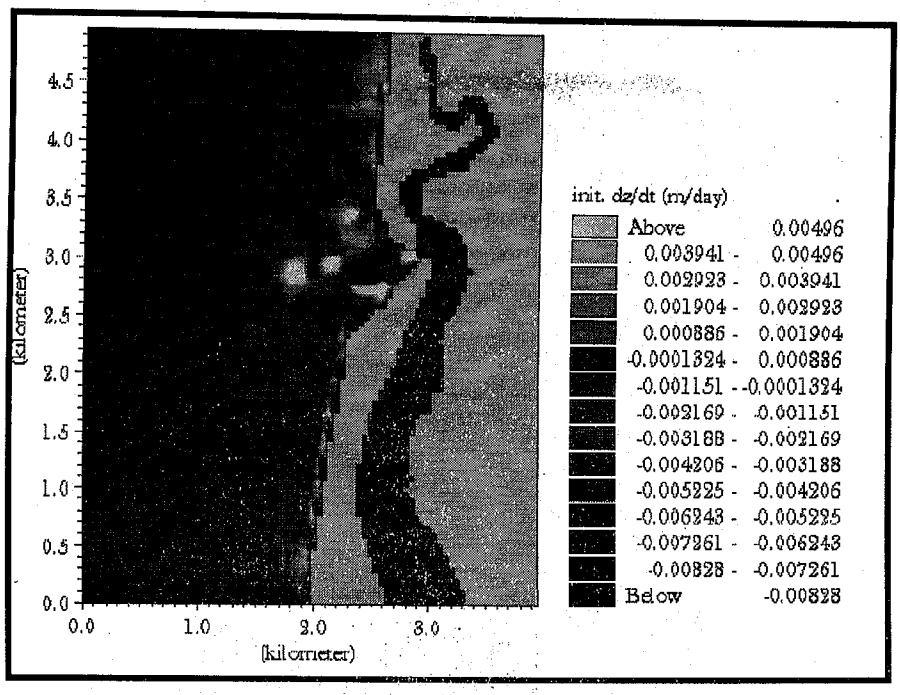


Figure 5-41: Bed level changes (Non-cohesive) from initial condition during wet season (S waves)

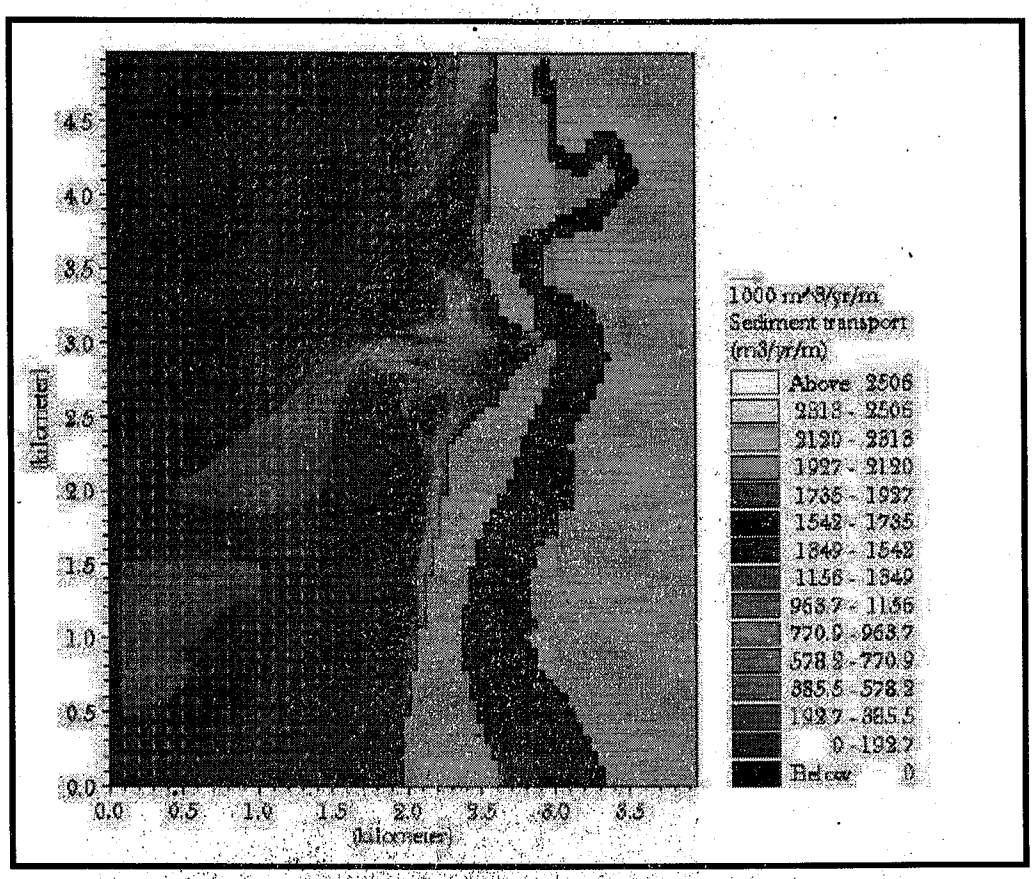


Figure 5-42: Rate of non-cohesive sediment transport during wet season for SSW waves

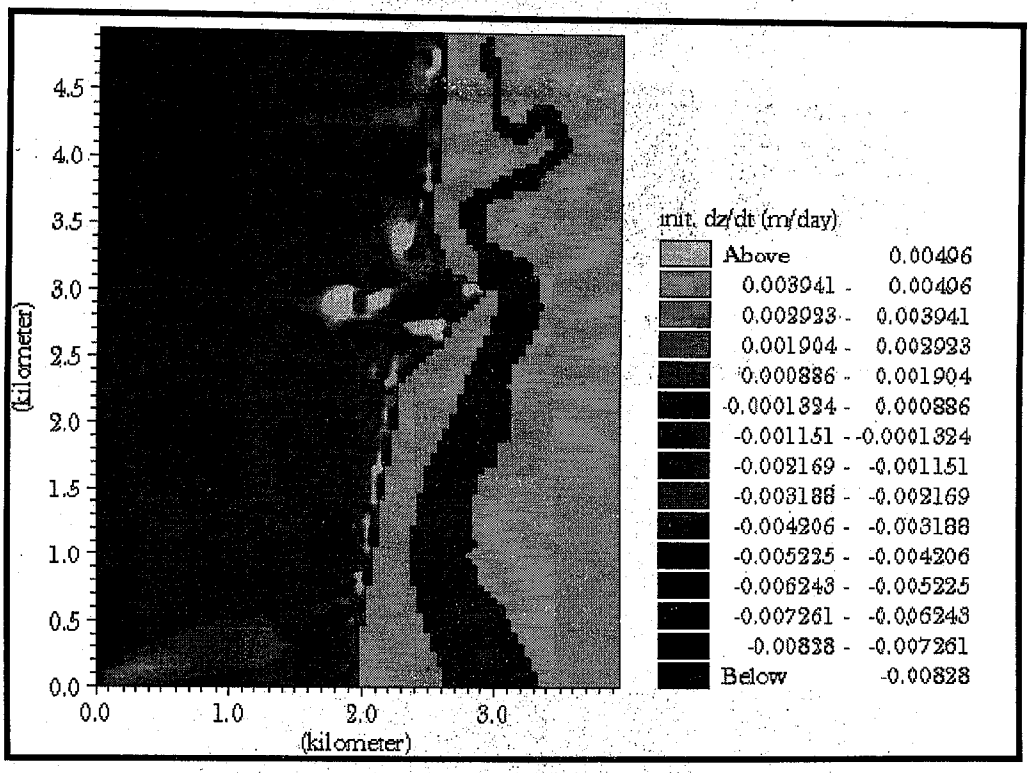


Figure 5-43: Bed level changes (Non-cohesive) during wet season (SSW waves)

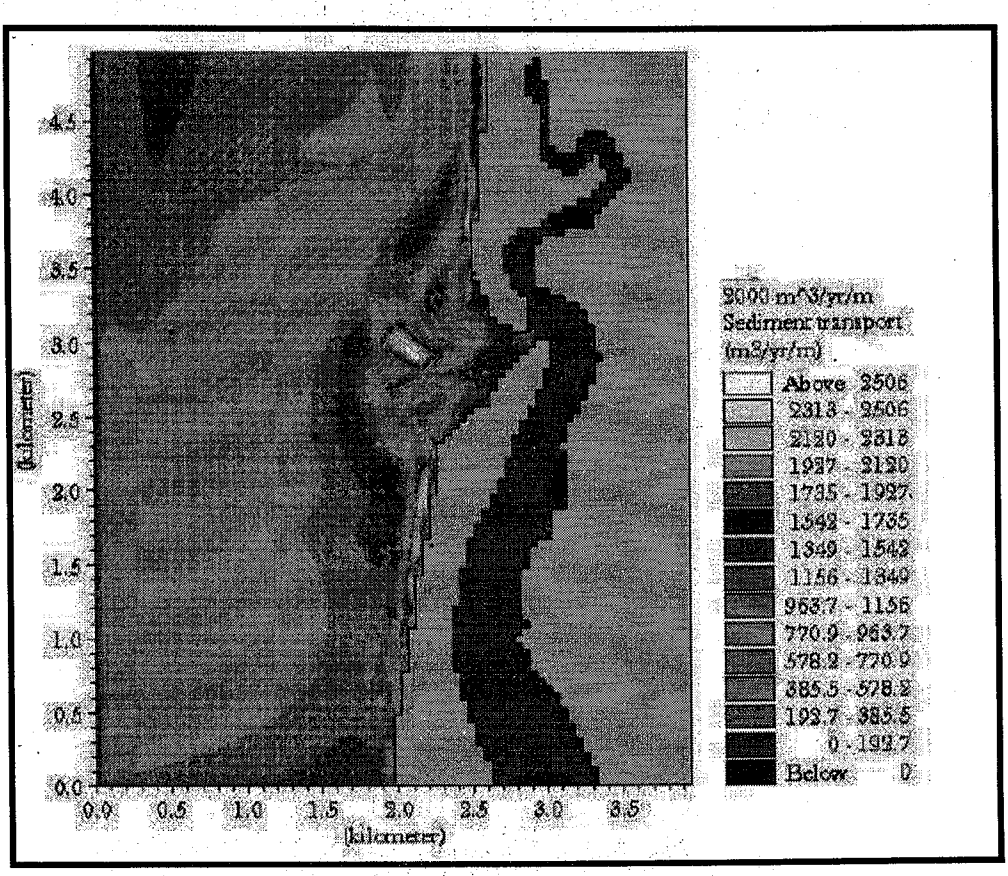


Figure 5-44: Rate of non-cohesive sediment transport during wet season for SW waves

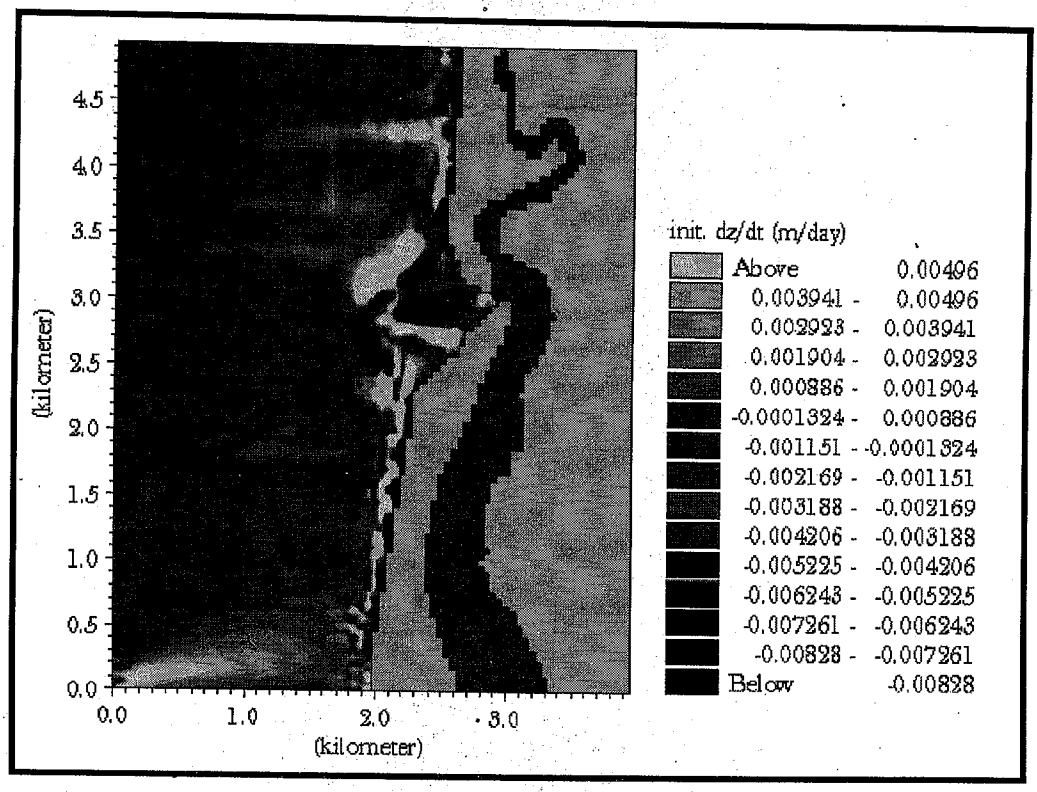


Figure 5-45: Bed level changes (Non-cohesive) from initial condition during wet season (SW waves)

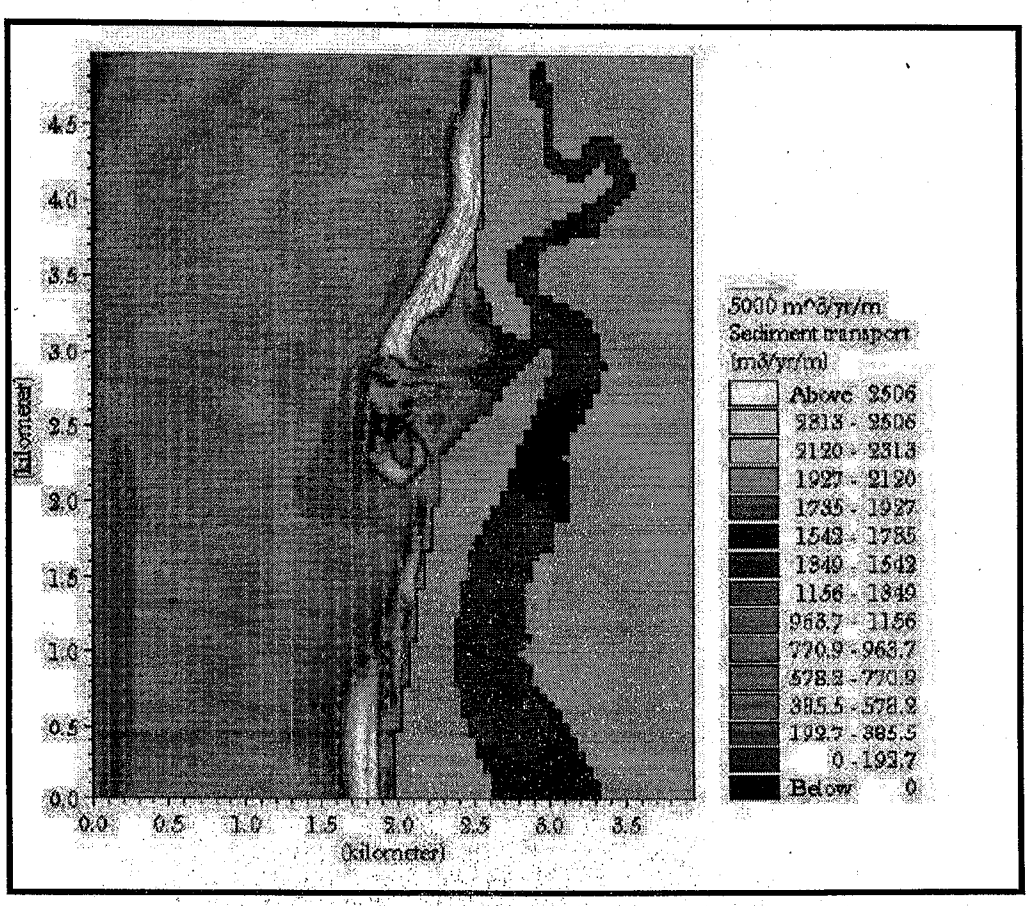


Figure 5-46: Rate of non-cohesive sediment transport during dry season for WSW waves

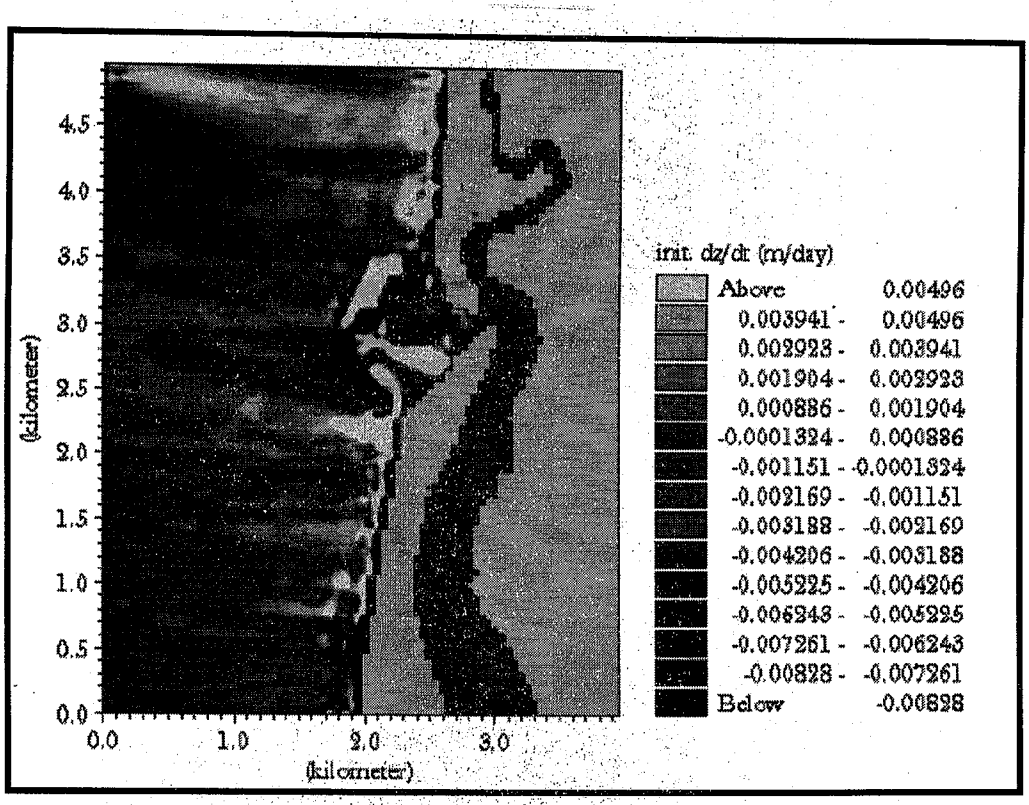


Figure 5-47: Bed level changes (Non-cohesive) during dry season (WSW waves)

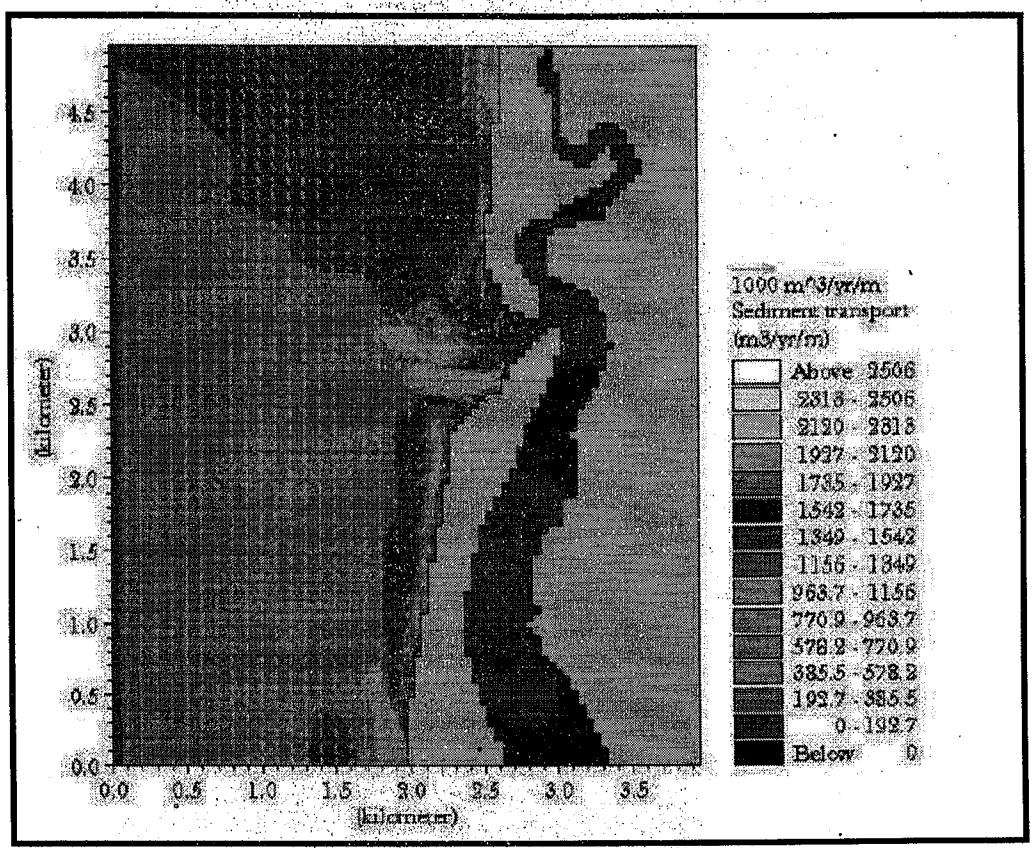


Figure 5-48: Rate of non-cohesive sediment transport during dry season for W waves

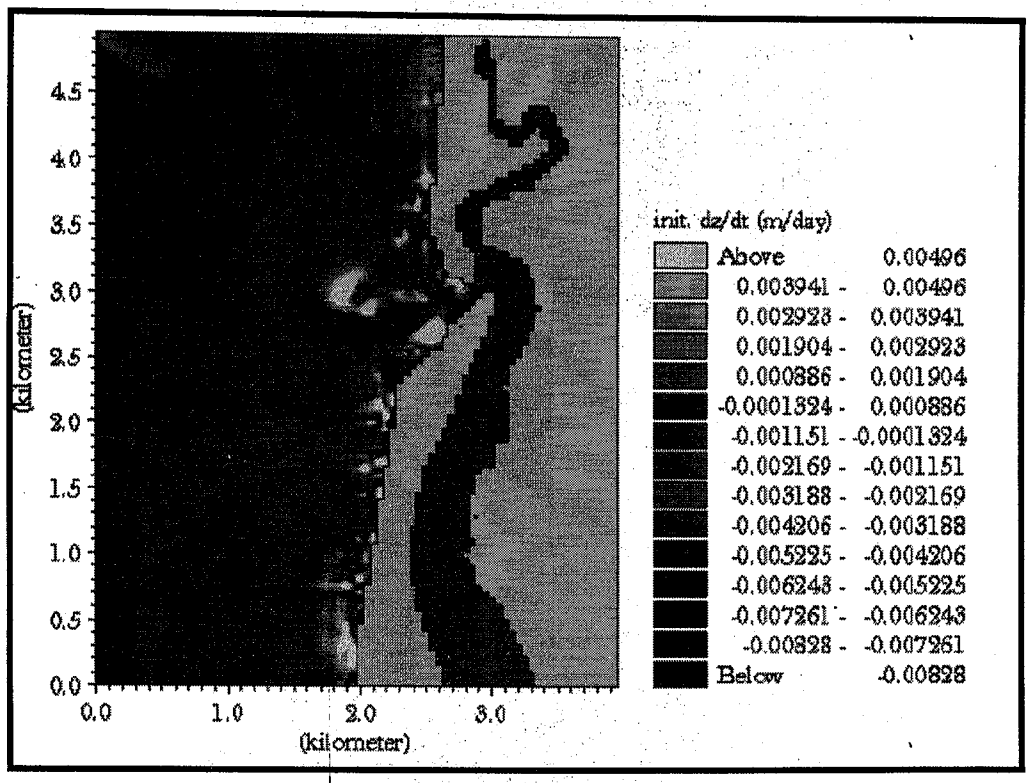


Figure 5-49: Bed level changes (Non-cohesive) from initial condition during dry season (W waves)

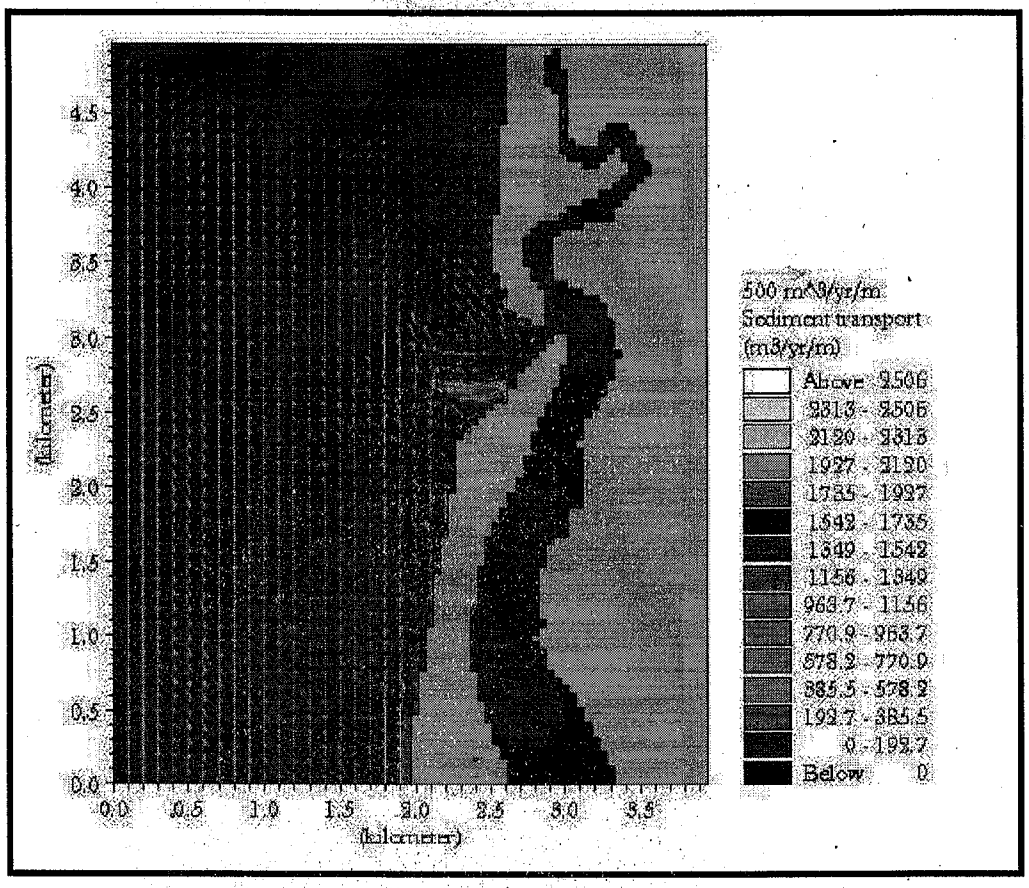


Figure 5-50: Rate of non-cohesive sediment transport during dry season for WNW waves

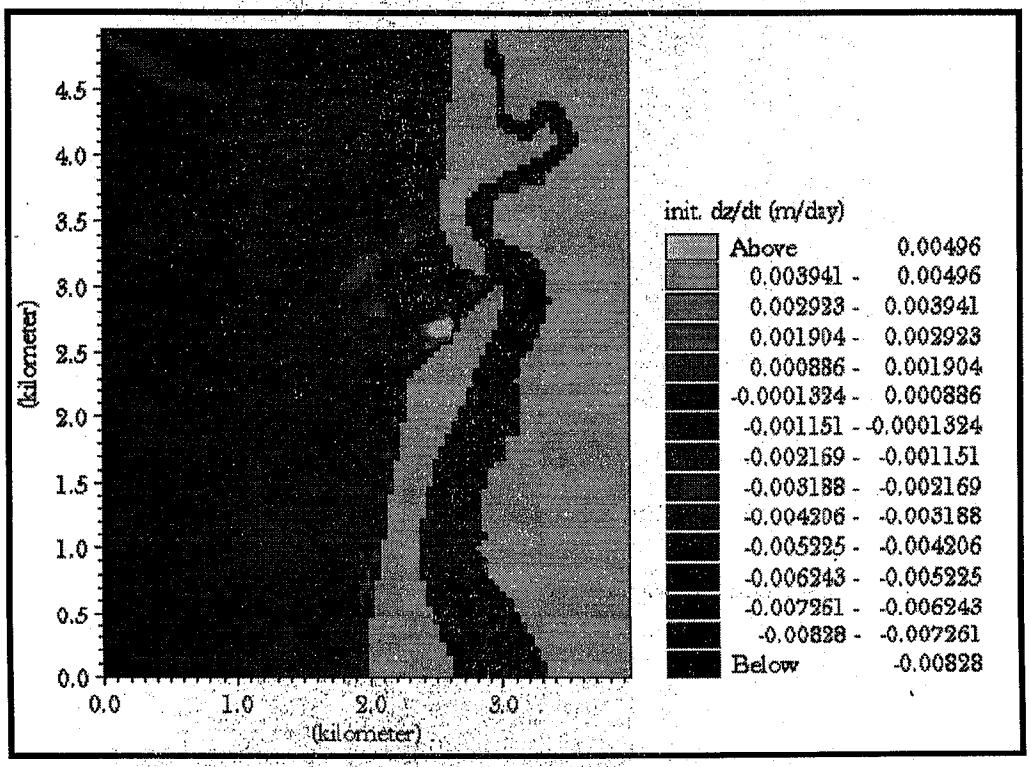


Figure 5-51: Bed level changes (Non-cohesive) during dry season (WNW waves)

With proposed Facility (Case-II):

The seasonal distribution of sediment transport (wet and dry seasons) for six predominant wave directions have been presented in below Figure 5-52 to 5-63

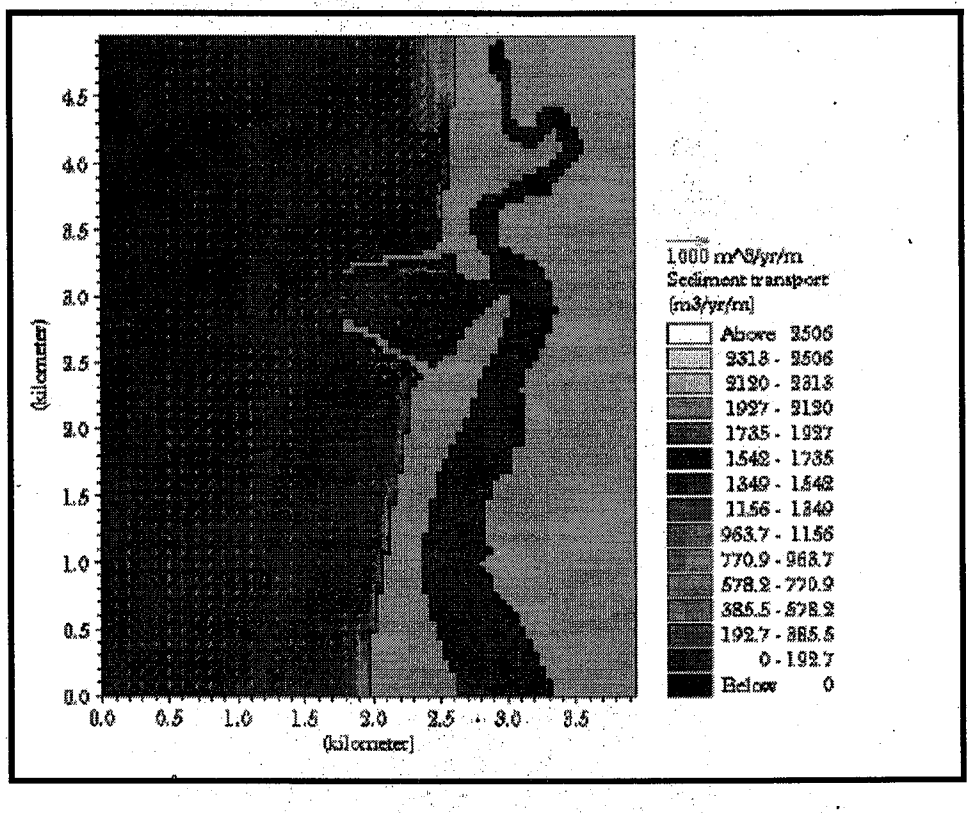


Figure 5-52: Rate of non-cohesive sediment transport during wet season for S waves (with proposed facility)

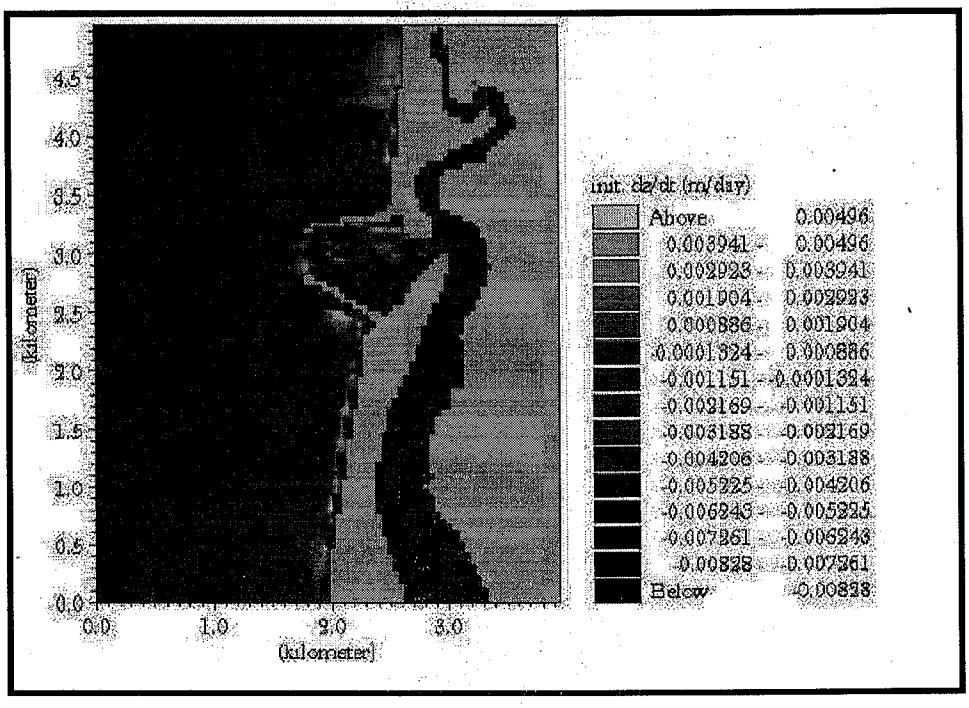


Figure 5-53: Bed level changes (Non-cohesive) during wet season (S waves) with proposed facility

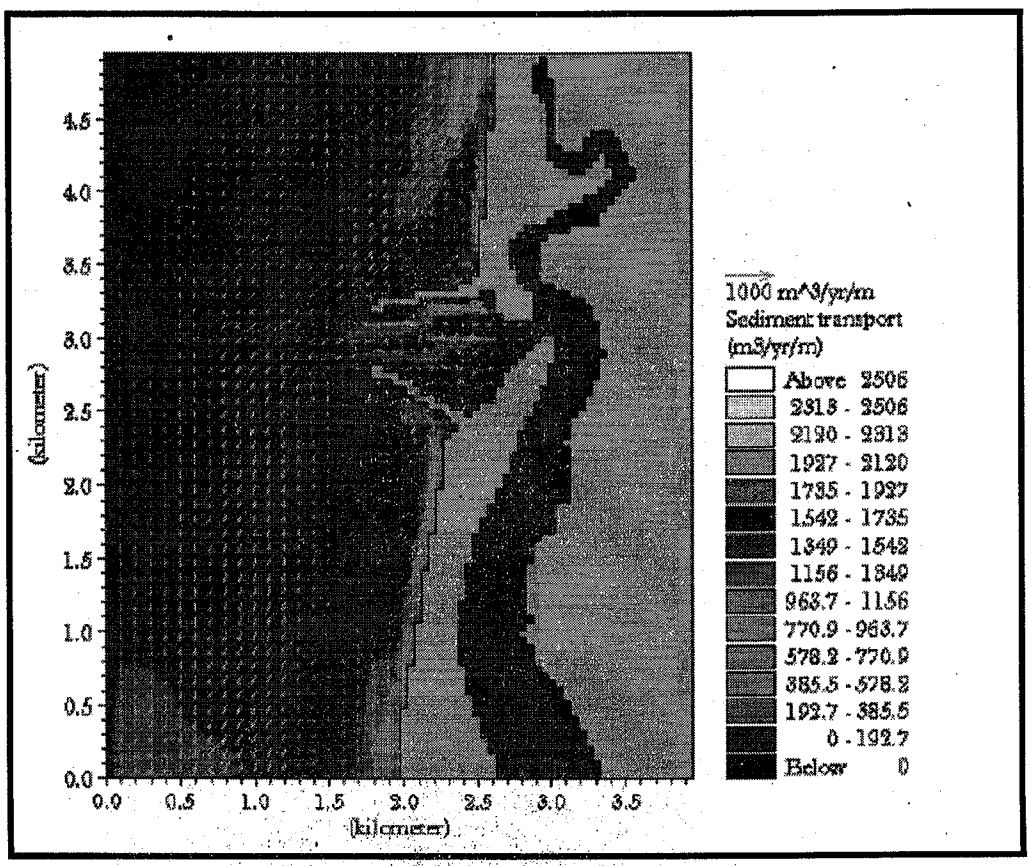


Figure 5-54: Rate of non-cohesive sediment transport during wet season for SSW waves

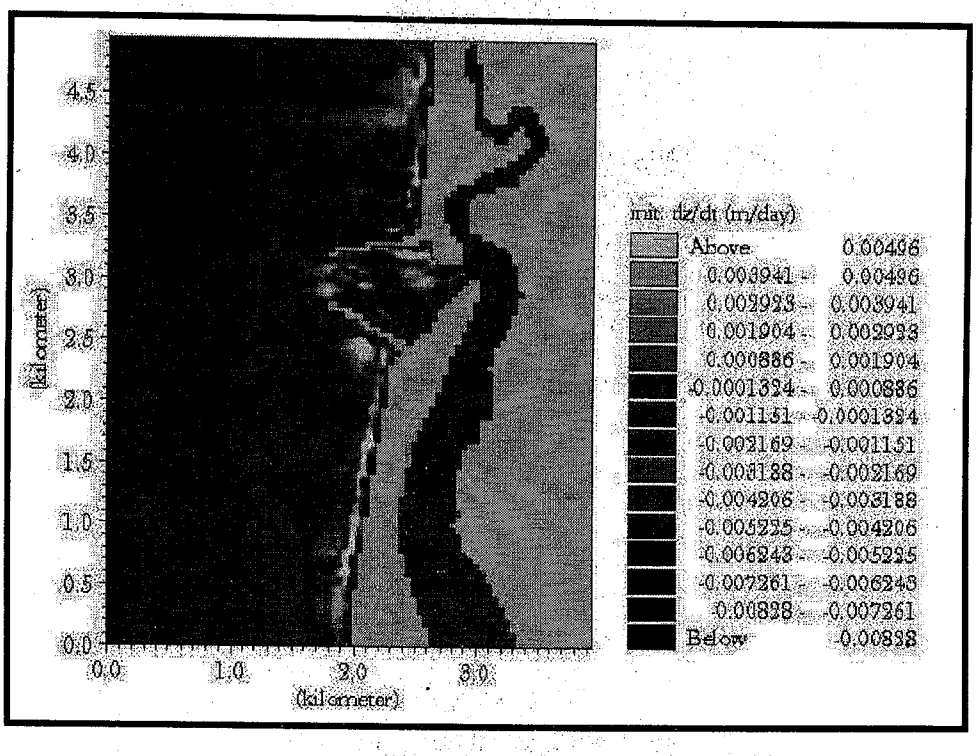


Figure 5-55: Bed level changes (Non-cohesive) during wet season (SSW waves)

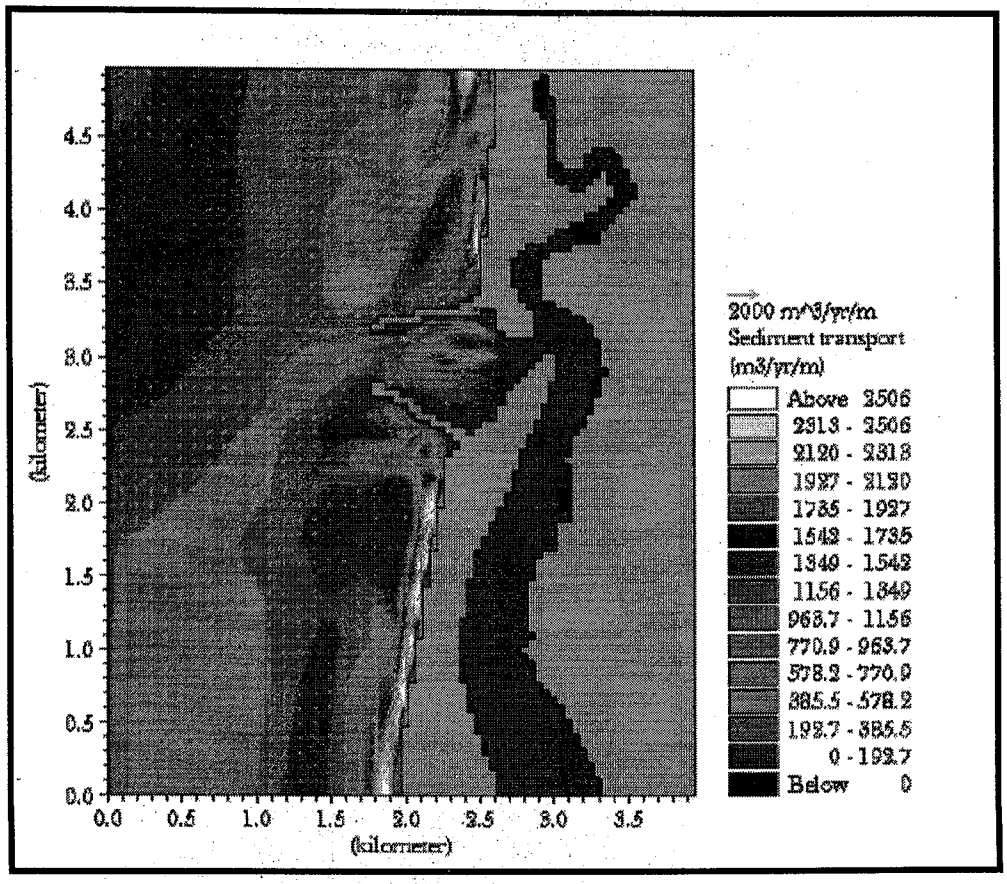


Figure 5-56: Rate of non-cohesive sediment transport during wet season for SW waves

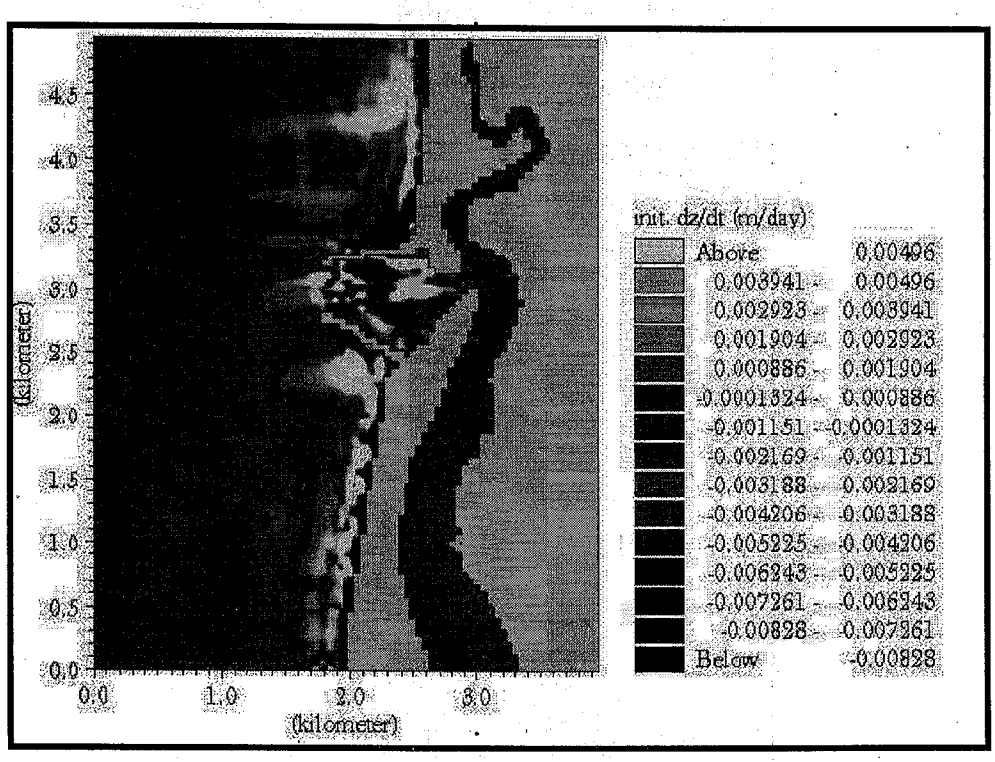


Figure 5-57: Bed level changes (Non-cohesive) during wet season (SW waves)

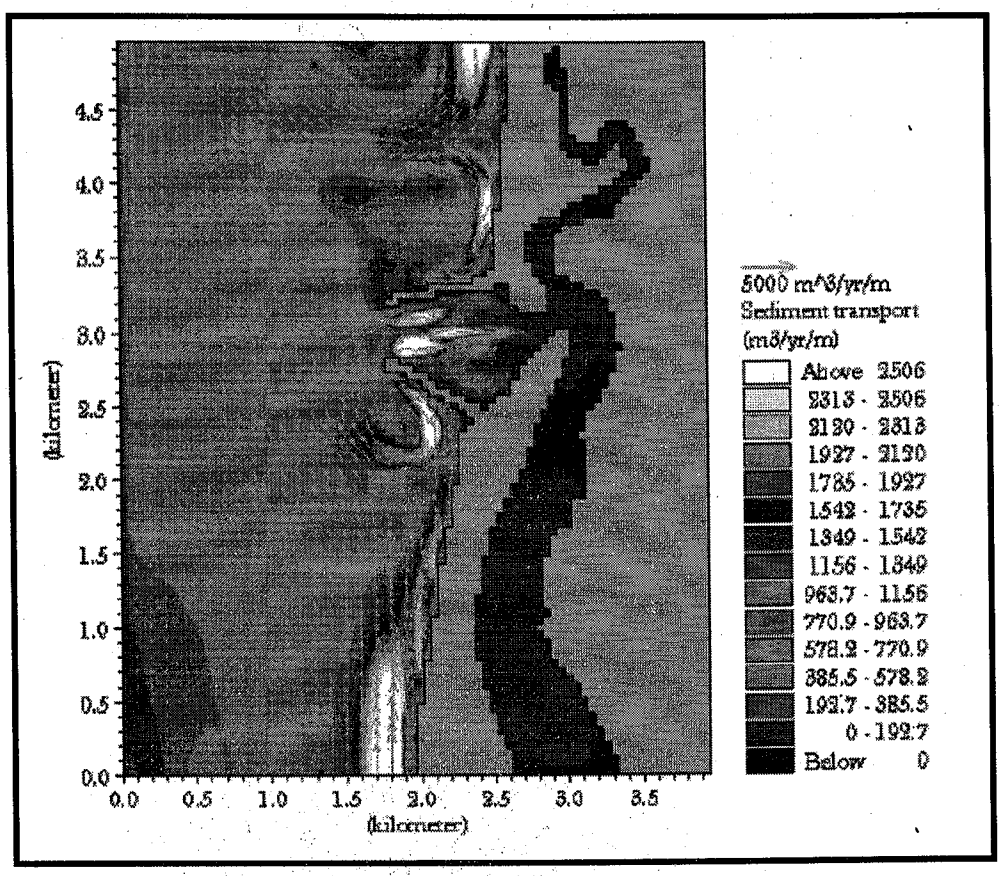


Figure 5-58: Rate of non-cohesive sediment transport during dry season for WSW waves

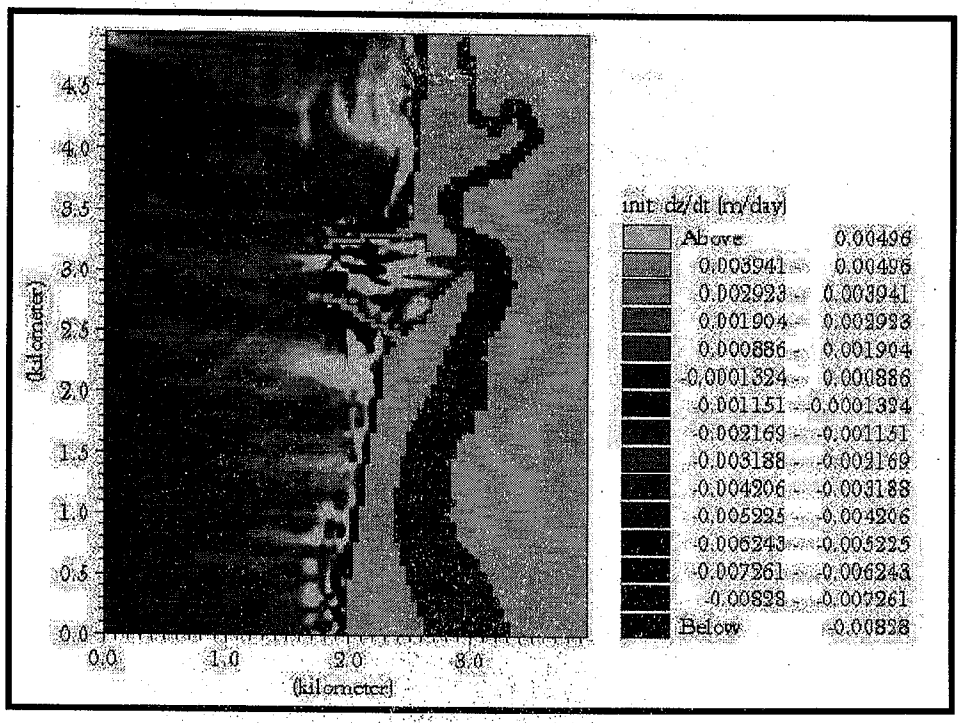


Figure 5-59: Bed level changes (Non-cohesive) during dry season (WSW waves)

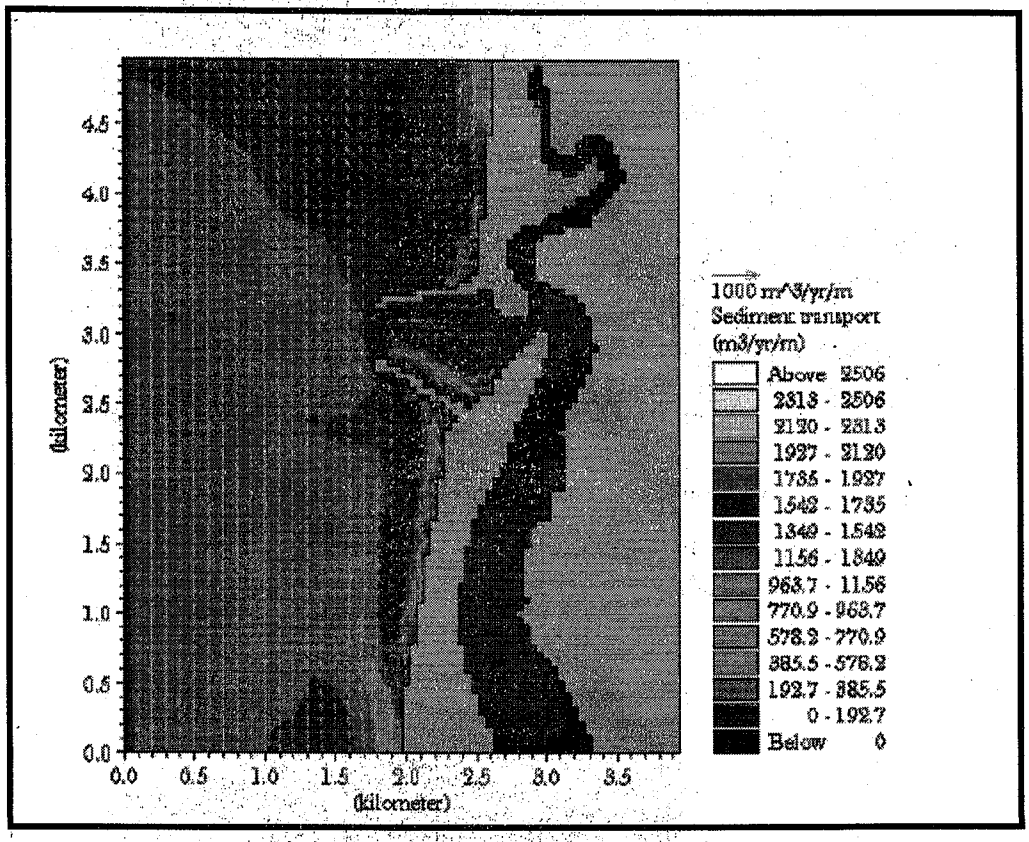


Figure 5-60: Rate of non-cohesive sediment transport during dry season for W waves

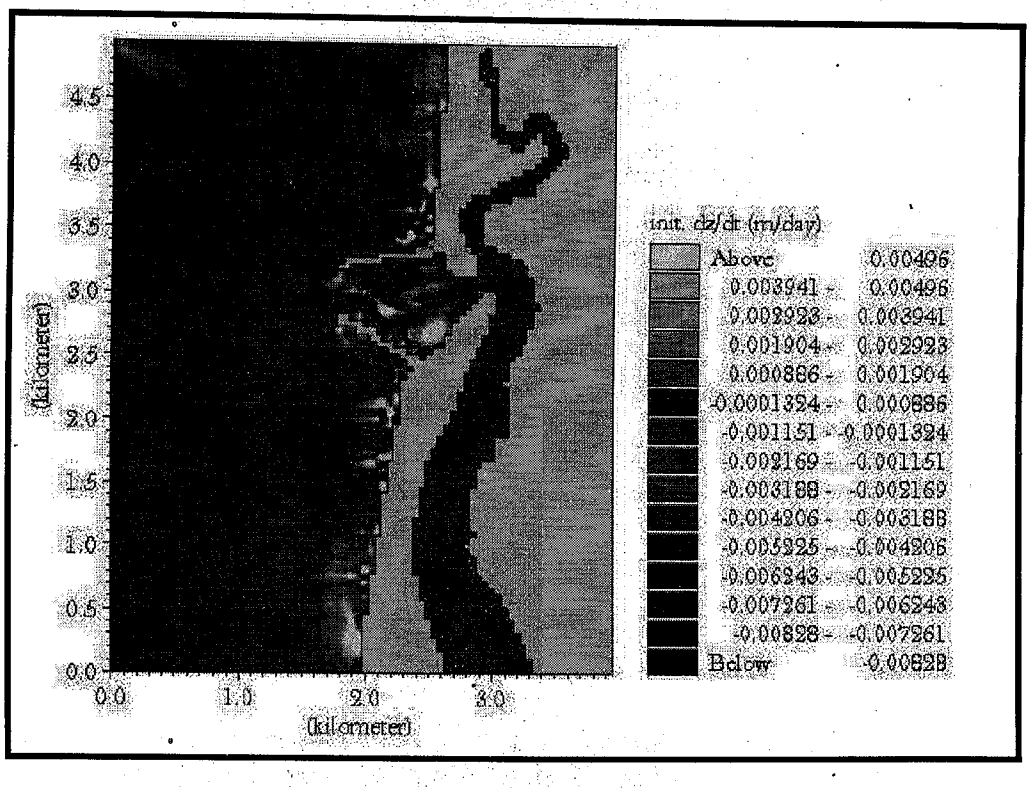


Figure 5-61: Bed level changes (Non-cohesive) from initial condition during dry season (W waves)

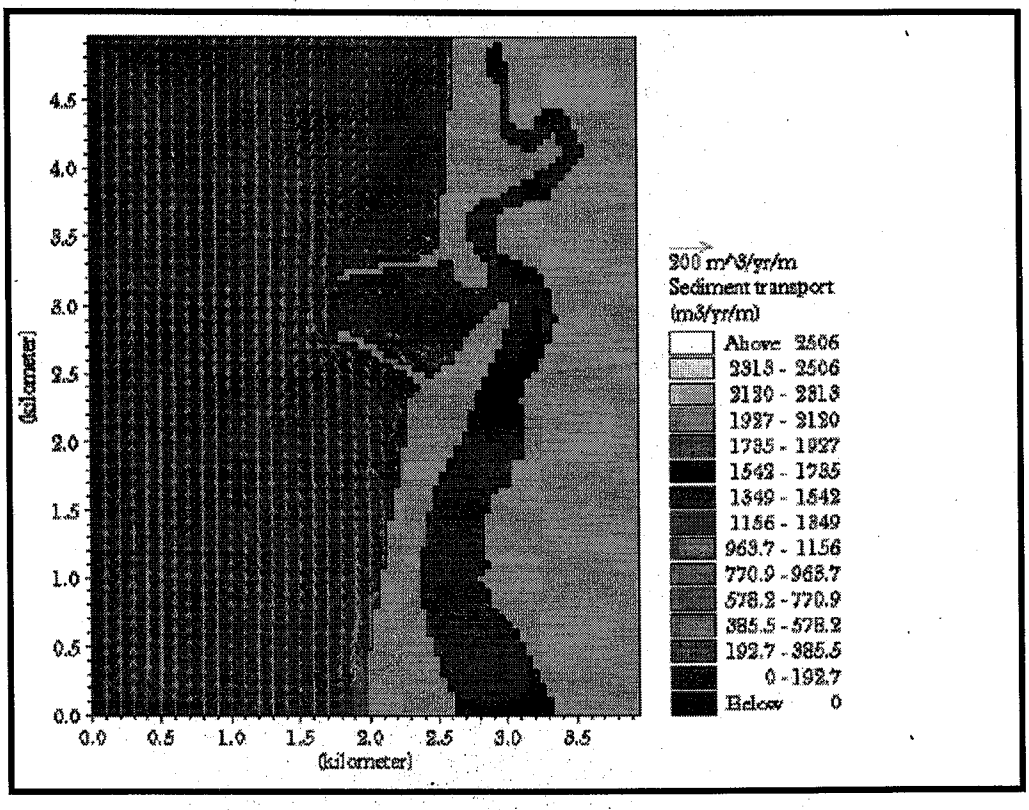


Figure 5-62: Rate of non-cohesive sediment transport during dry season for WNW waves

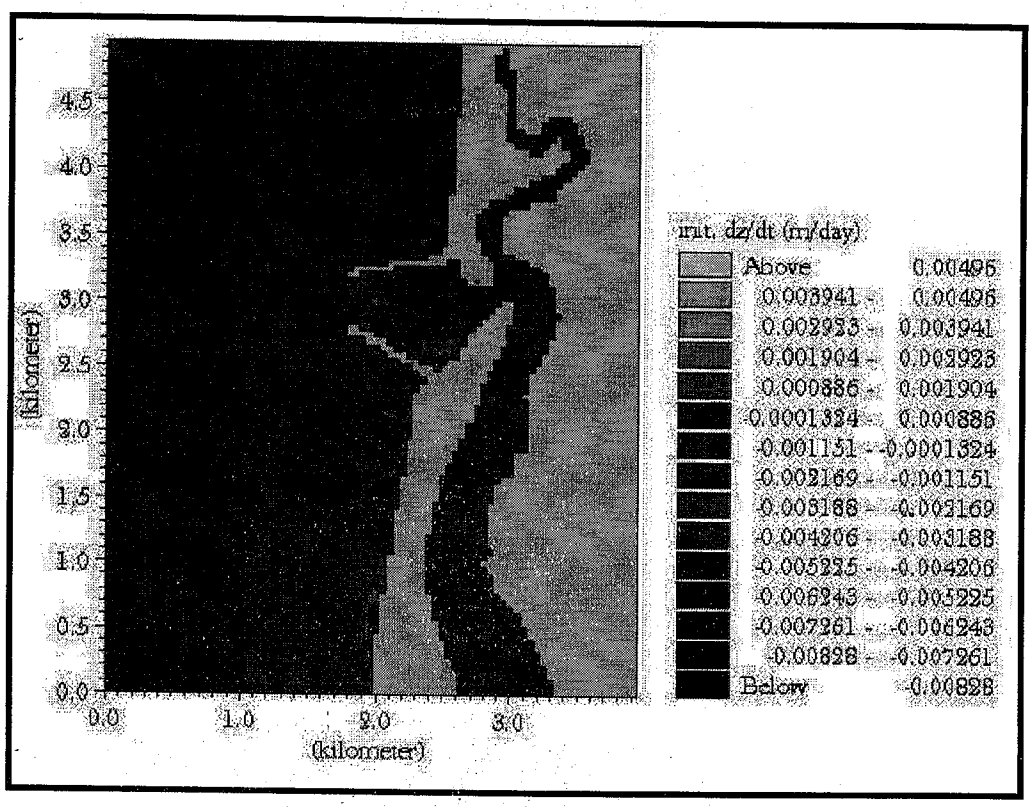


Figure 5-63: Bed level changes (Non-cohesive) during dry season (WNW waves)

Conclusion:

For case-I the rates of sediment transport for deep water waves from S and SSW are much less (< 200 m^3/yr/m) along the entire coastal stretch. However slightly higher values (about 400) are noticed on the seaward side of the entrance where shoals are present. The bed level changes indicate deposition at the mouth and to the south of the inlet. For SW and SSW waves during monsoon season high values of sand transport (>2000 m^3/yr/m) are noticed along the entire coastal stretch due to high and steep waves during this season. The bed level changes indicate significant deposition (0.005 m/day) both to the south and north of the entrance channel. During non-monsoon season, when W and WNW waves prevail the sediment transport as well as the bed level changes are not significant.

For case-II (with breakwaters) during monsoon season when SW and WSW waves prevail the sediment transport is significant (>2000 m^3/yr/m) to the north as well as to the south of breakwaters. Bed level changes indicate deposition to the northern and southern coastline in general; but there is also erosion just to the north of northern breakwater, some deposition is noticed inside the breakwaters zone just at the mouth of the entrance channel, which must be cleared periodically in maintenance dredging. Model studies indicate an annual deposition of about 10,300 m^3/yr in the dredged channel. Again, during non monsoon months there is no significant deposition. On the whole, the sand transport model studies indicate depositional trend near the mouth of the channel as well as to the north of the channel for case I. But for case II, the depositional trend in the channel has somewhat decreased due to breakwaters while some erosional trend is noticed towards the northern shores.

5.3.1.2 Wave Induced Littoral Drift

The littoral currents are mainly responsible for transport of sediments in the surf-zone causing erosion or deposition along a beach. Therefore, wave induced littoral drift (with no interaction of coastal currents) has been modeled in ST model for different wave approaches and are presented in below Figures for case-I and case-II.

Littoral drift without Proposed Facility (case-I):

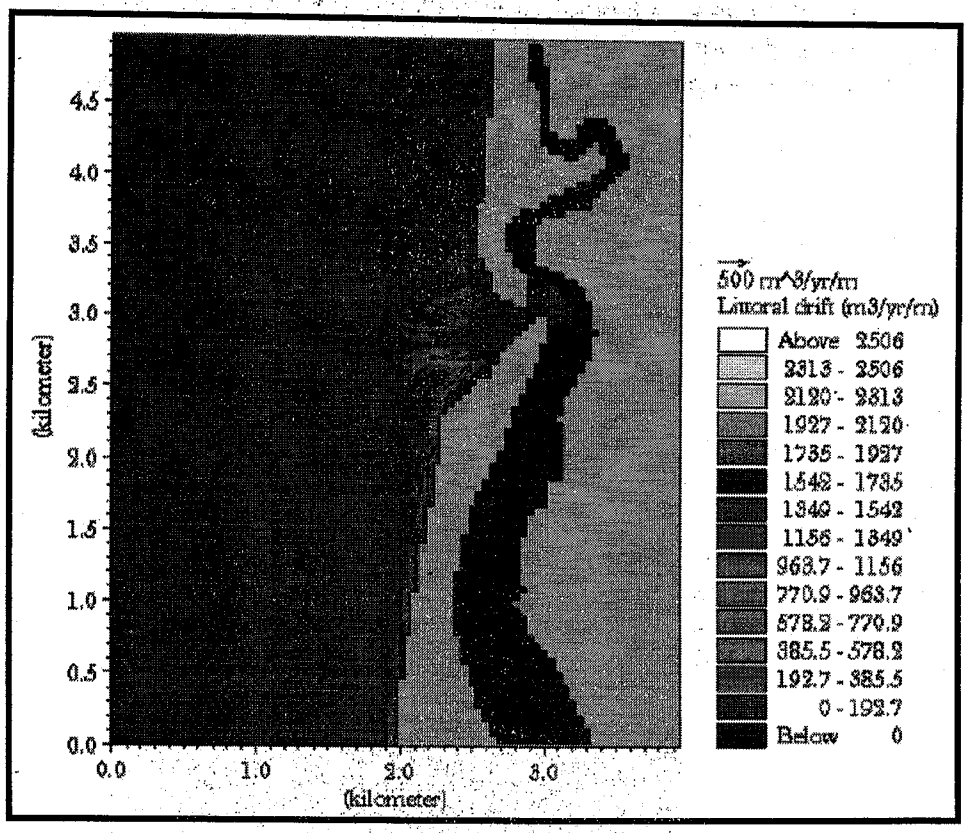


Figure 5-64: Wave induced littoral drift for S waves

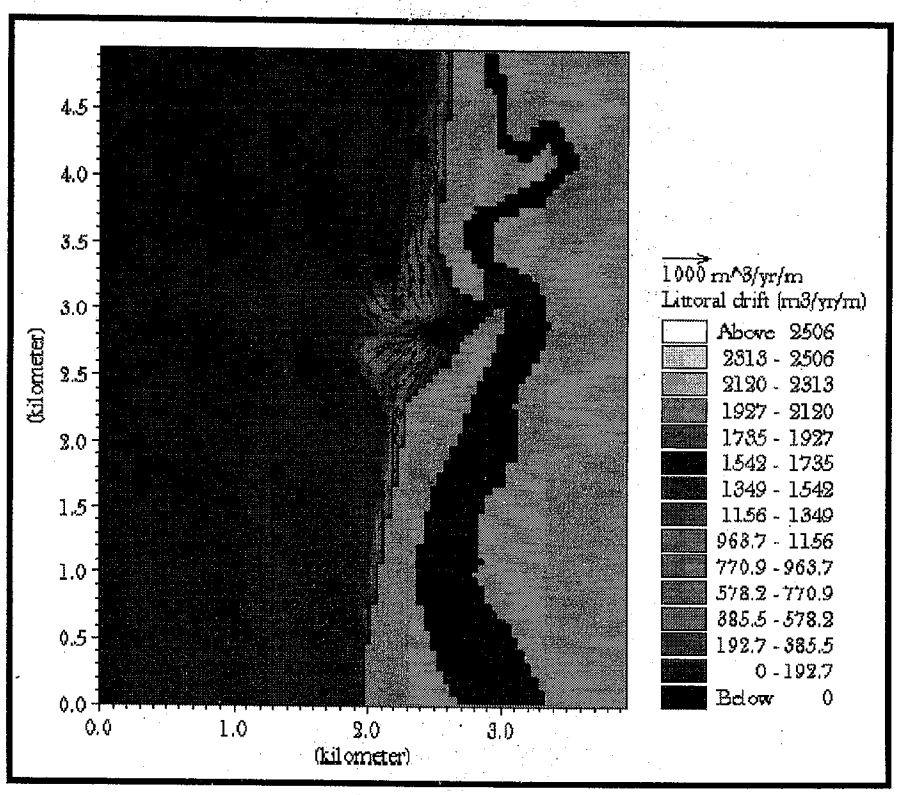


Figure 5-65: Wave induced littoral drift for SSW waves

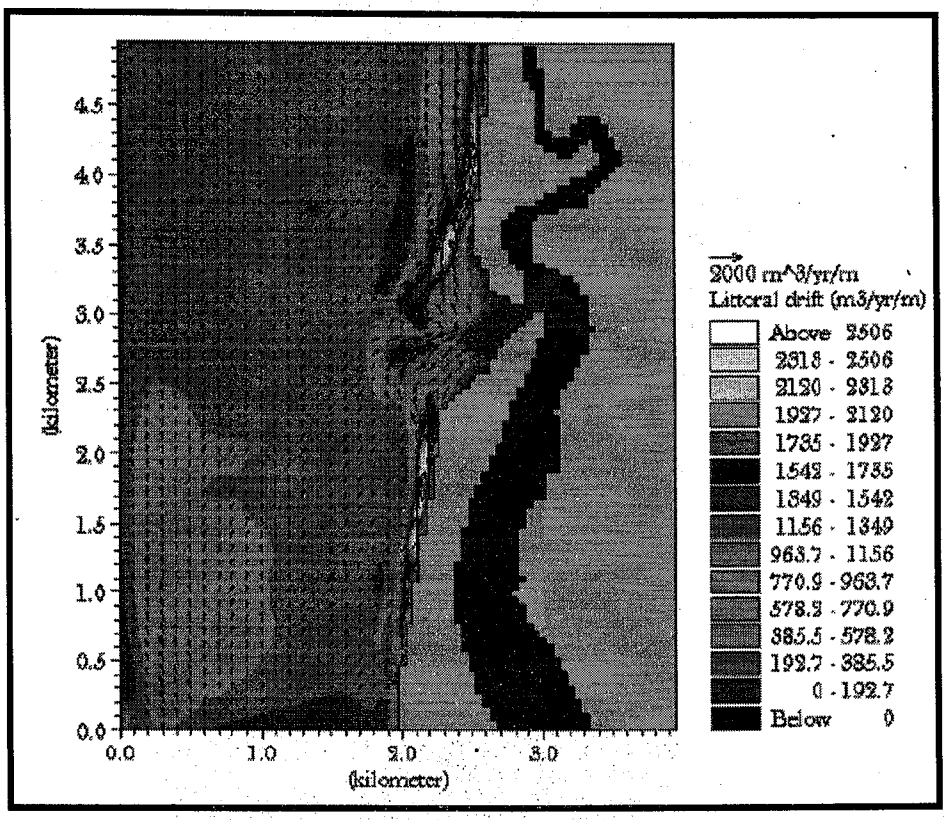


Figure 5-66: Wave induced littoral drift for SW waves

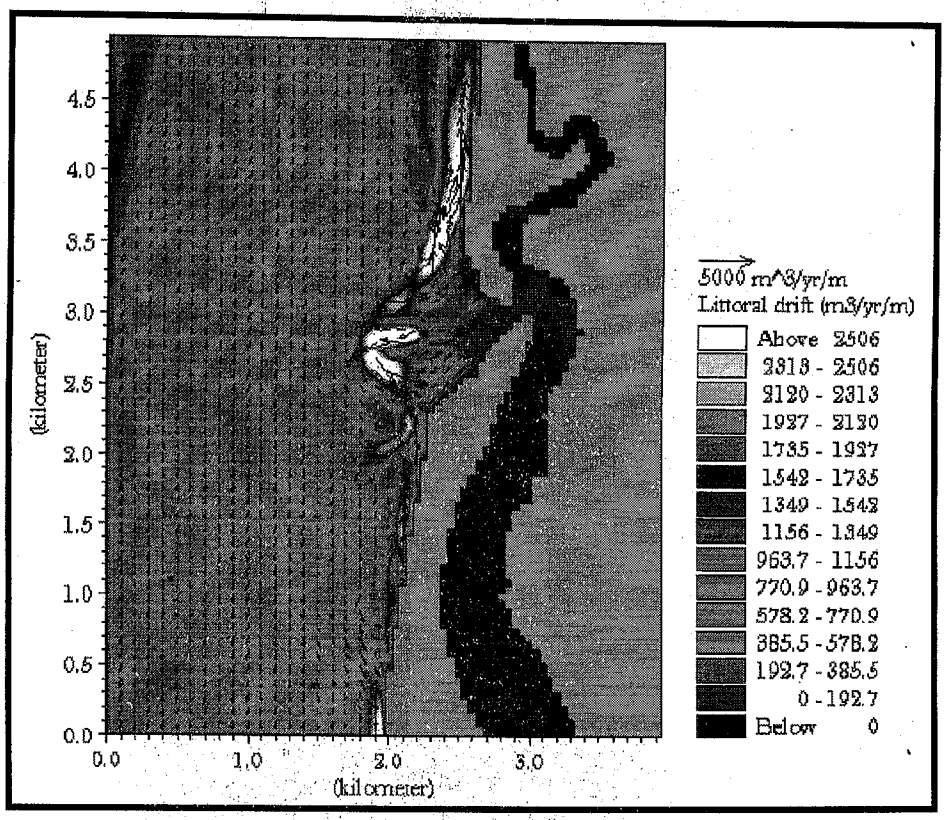


Figure 5-67: Wave induced littoral drift for WSW waves

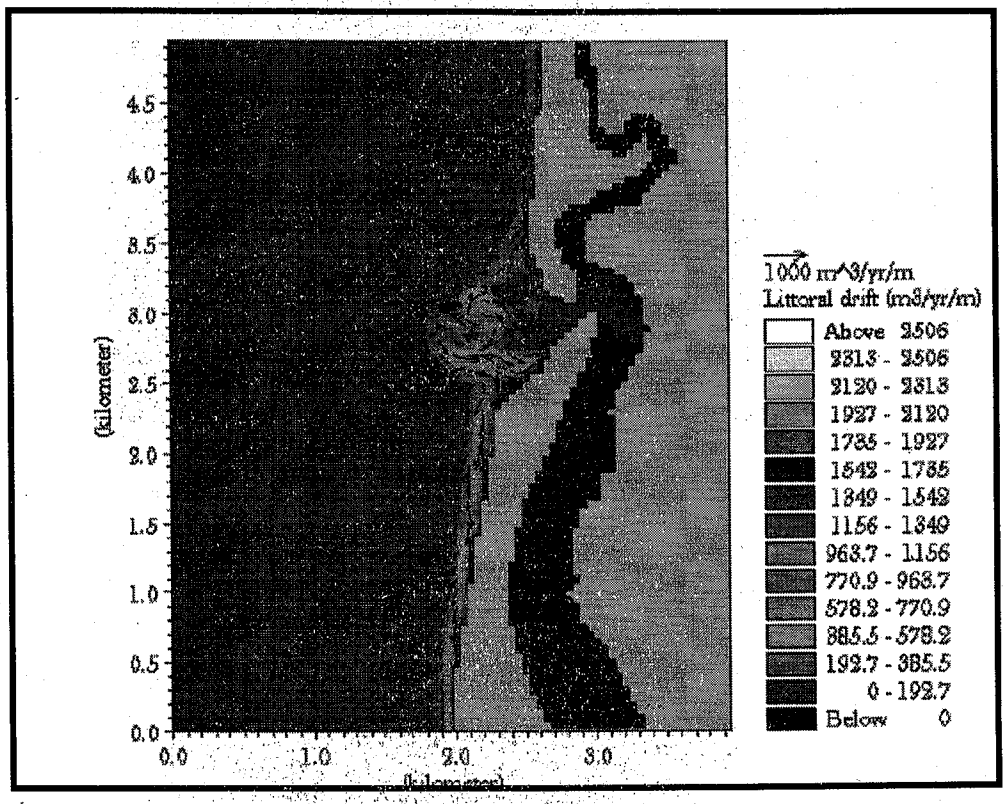


Figure 5-68: Wave induced littoral drift for W waves

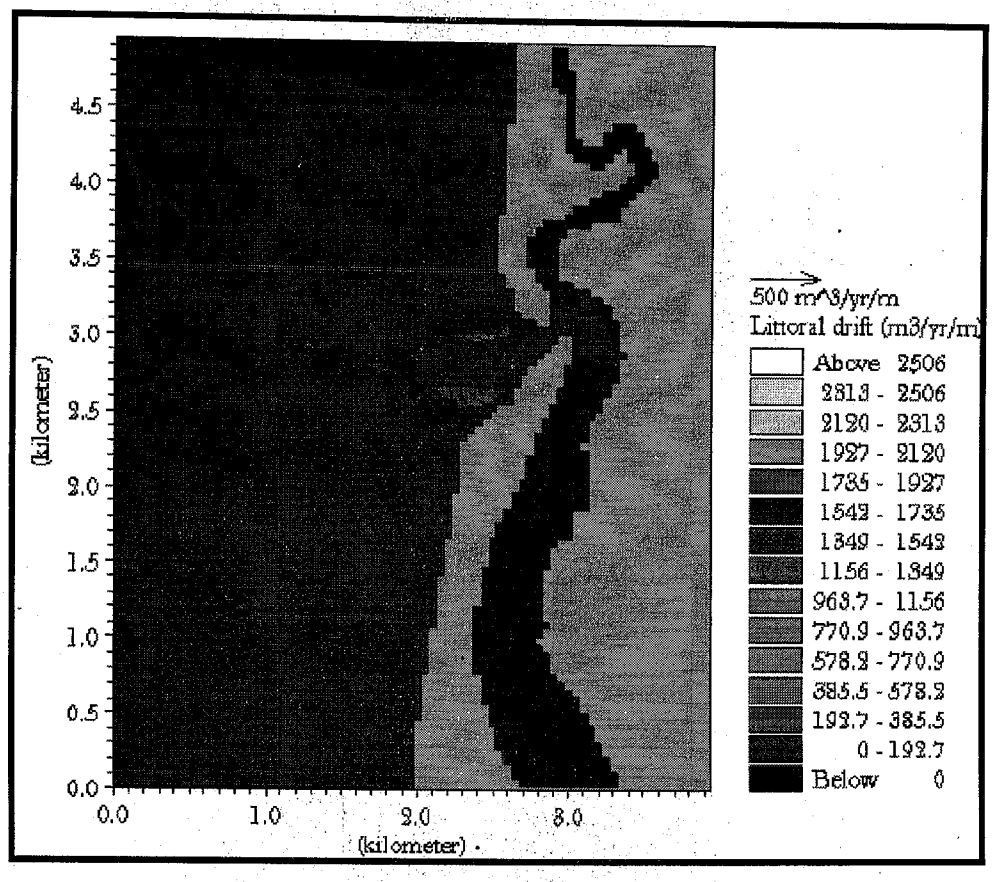


Figure 5-69: Wave induced littoral drift for WNW waves

Littoral drift with proposed facility (case-II):

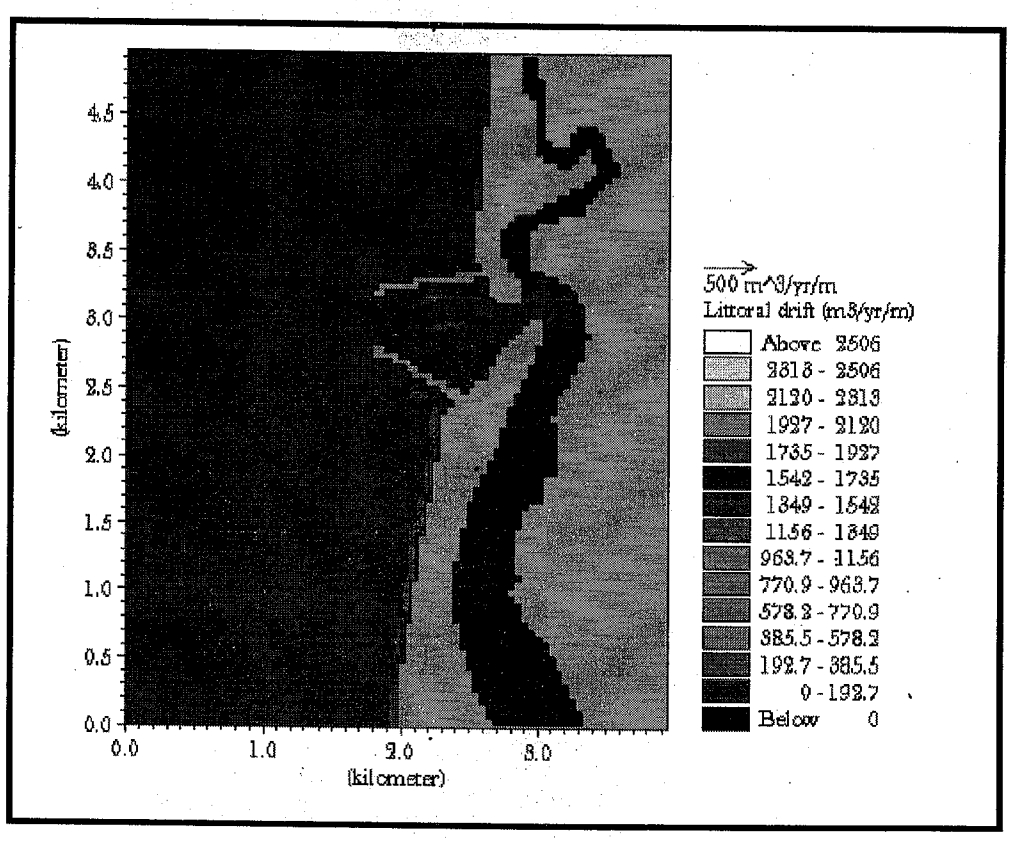


Figure 5-70: Wave induced littoral drift for S waves with proposed facility

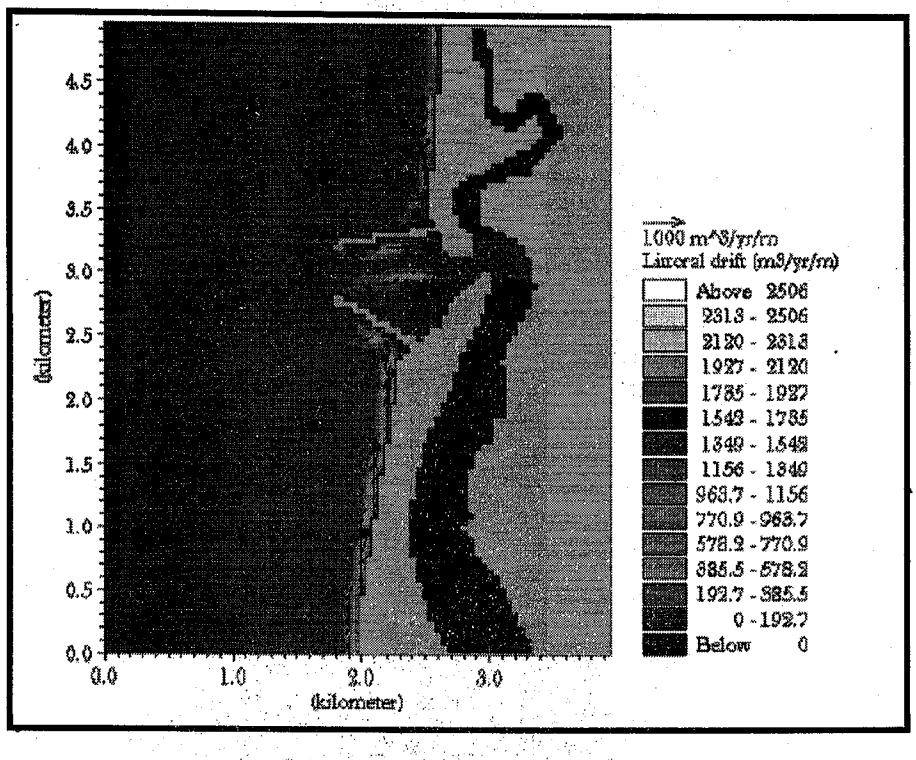


Figure 5-71: Wave induced littoral drift for SSW waves with proposed facility

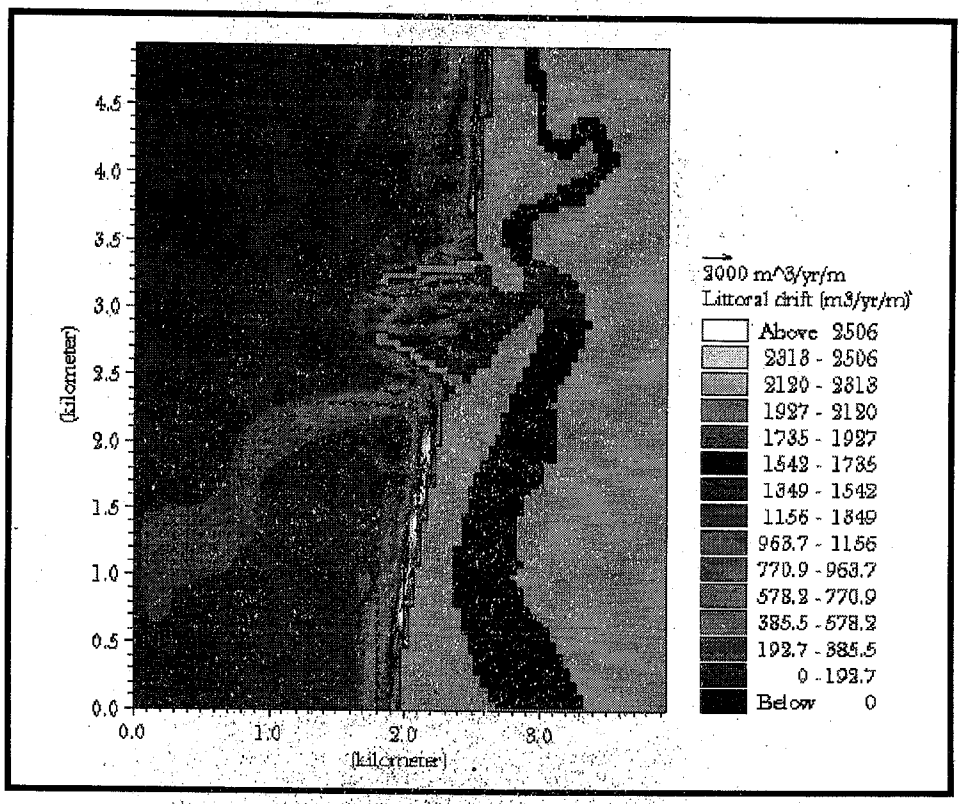


Figure 5-72: Wave induced littoral drift for SW waves with proposed facility

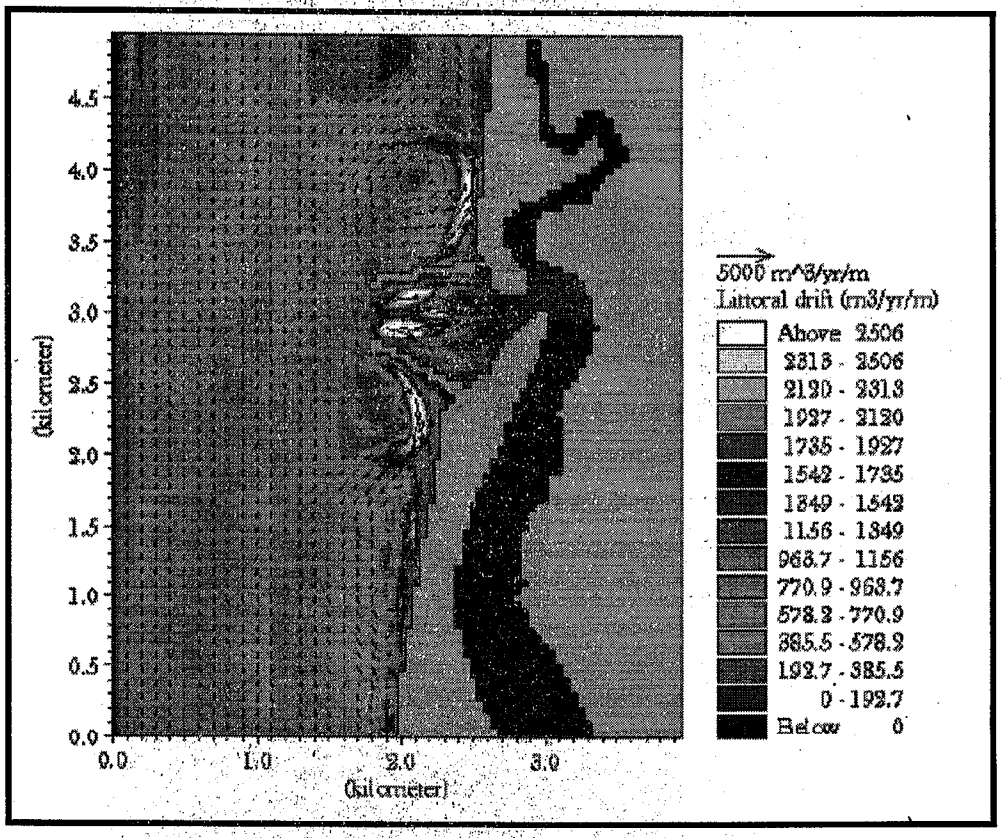


Figure 5-73: Wave induced littoral drift for WSW waves with proposed facility

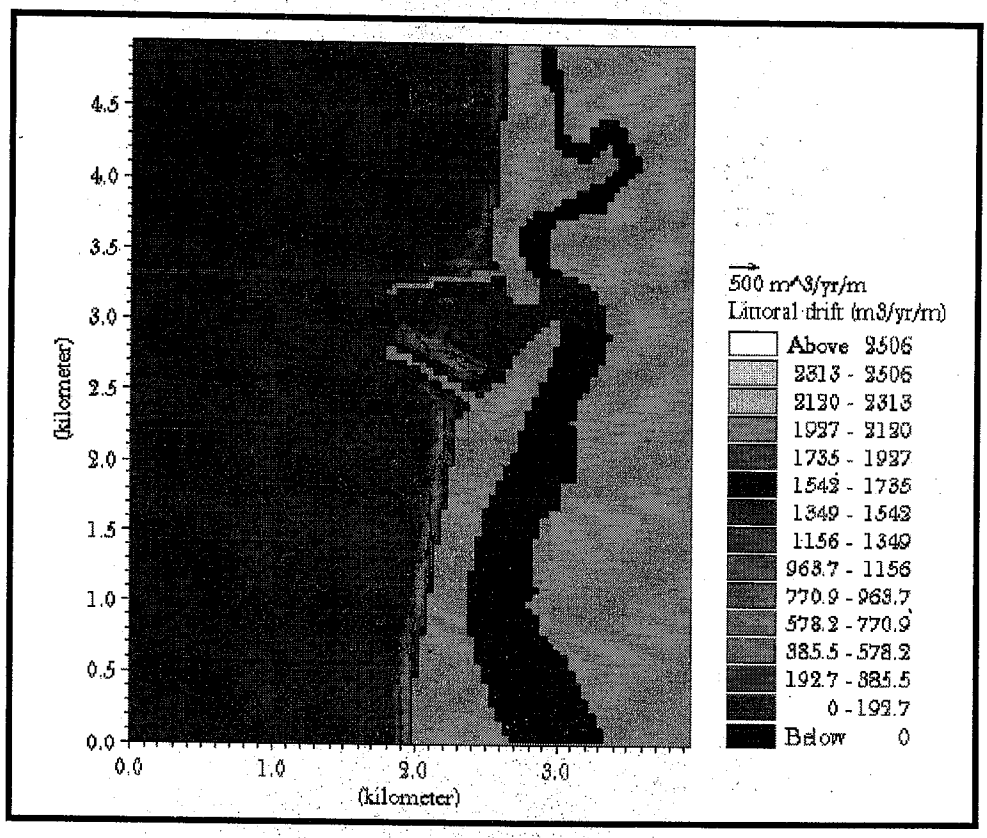


Figure 5-74: Wave induced littoral drift for W waves with proposed facility

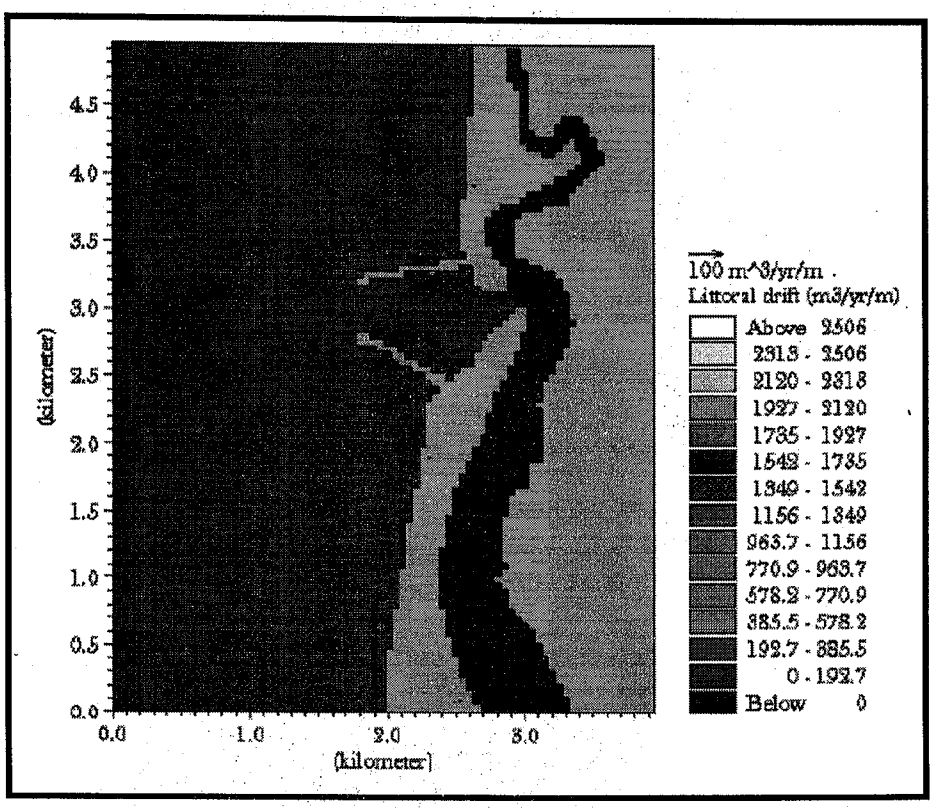


Figure 5-75: Wave induced littoral drift for WNW waves with proposed facility

The drifts computed for different directions of wave approach are shown in Figure 5-76 and Table 5-1. The figure shows that the predominant direction of alongshore sediment transport is towards north due to S, SSW and SW waves and the net transport of sediment is around $0.6x10^6$ m^3 directed towards north. Directional distribution of sediment transport rates is shown in Figure 5-76.

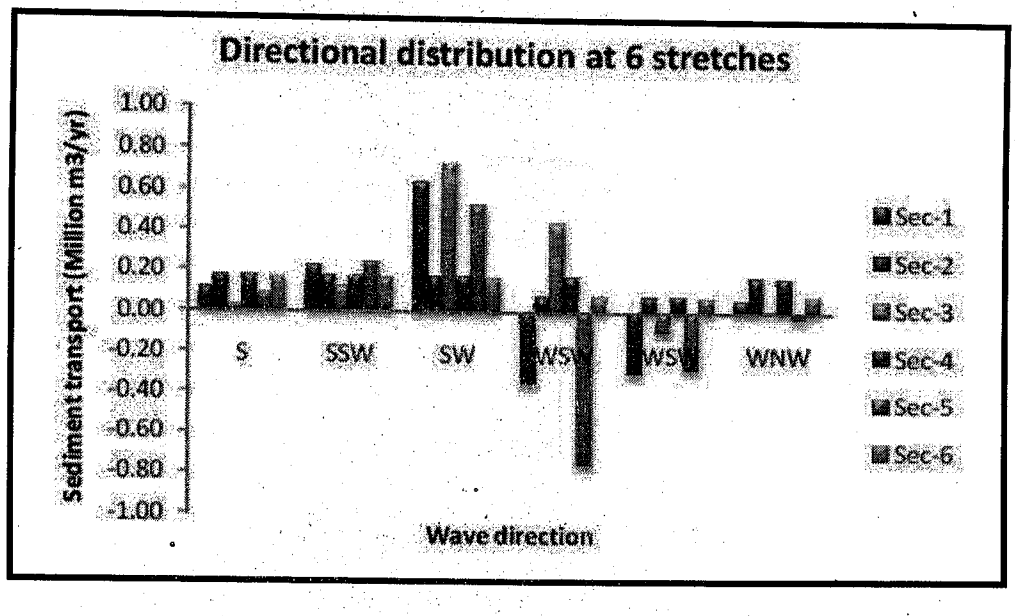


Figure 5-76: Sediment transport rates at 6 coastal stretches along Honnavar coast

Table 5-1: Sediment transport along the Honnavar coast derived from ST model

Station/ Stretch	Southerly transport (Million m3/yr)	Northerly transport (Million m3/yr)	Net transport (Million m3/yr)	Gross transport (Million m3/yr)
1	-0.677	1.023	0.347	1.700
2	0.000	0.822	0.822	0.822
3	-0.106	1.306	1.200	1.412
4	0.000	0.932	0.932	0.932
5	-1.088	0.849	-0.239	1.938
6	0.000	0.709	0.709	0.709
Net	-0.312	0.940	0.629	1.252

Note: (+ve) values indicate northerly drift and (-ve) values indicate southerly drift. Net drift is 0.6×10^6 cubic meters towards north.

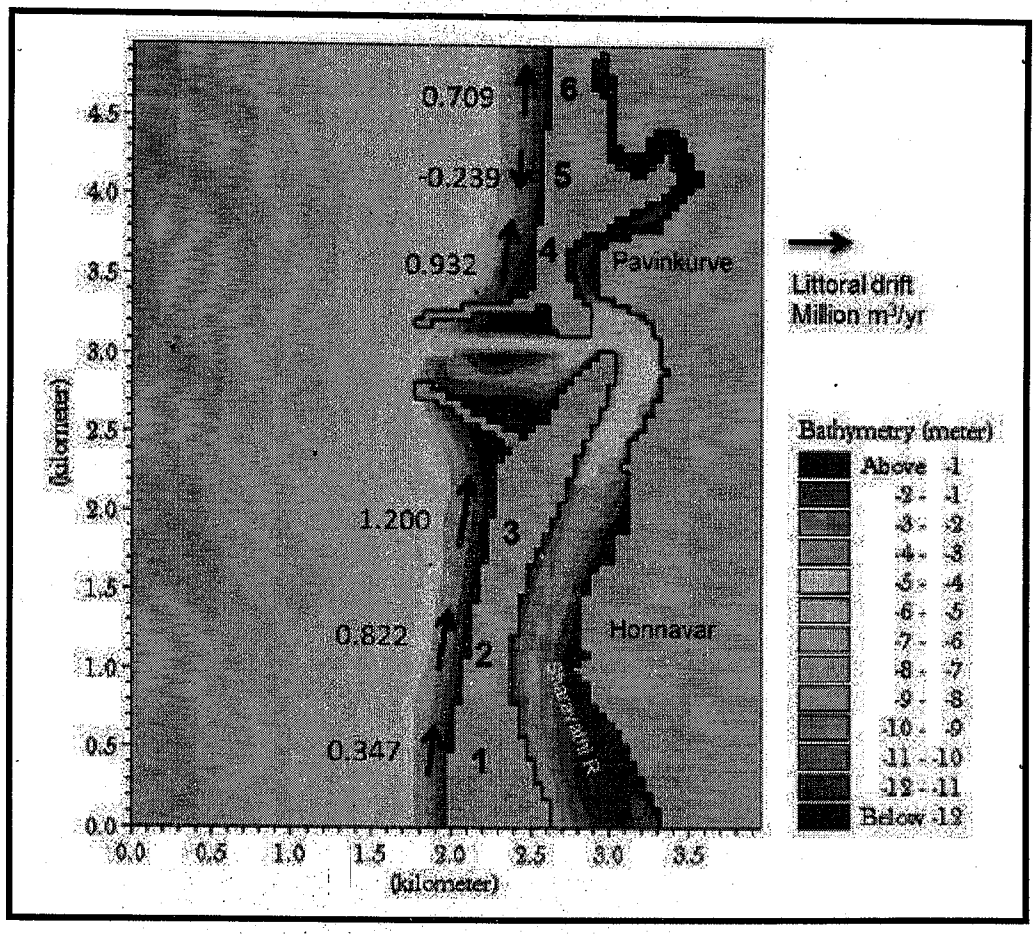


Figure 5-77: The Net sediment transport rates (million m^3/yr) along Honnavar coast

5.3.2 Potential Impact due to Construction

Developmental activities such as capital dredging, dredged material disposal and construction of approach channel and cargo berths will result in disturbance to marine environment. During these activities, particularly dredging, localised and short term impacts on marine water quality are likely to occur due to increased turbidity from suspended sediment. Further, marine sediment quality indicates that it is free from any significant pollution.

5.3.2.1 Capital Dredging and Disposal of Dredged Material

Capital dredging is required to create inner navigation channel, outer navigation channel, turning circle and berthing areas. During the construction stage and operation stage the dredging volume is estimated about 3.9 MCM. About 1.0 MCM of the dredged material will be used for reclamation. Remaining quantity of 2.9 MCM dredged material will be disposed off at the designated offshore area.

The choice of dredging equipment depends primarily on dredge material, disposal methodology and distance of disposal location. The dredgers are mainly classified as Mechanical (Grab, Dipper and Bucket), Hydraulic (Plain suction, Cutter Suction, Wheel, Barge/ Vessel unloading and Trailer suction) and Pneumatic dredgers. The selection of equipment mainly depends on Size of the Project (quantity in cum), Nature of the material

(hard rock, sandy or clay), Volume of the material, Topography of the area with reference to accessibility etc., Distance of disposal ground from the dredging area, Environmental factors at the site and also other environmental aspects and Accuracy of the work required.

Besides the contract conditions, the available time and the equipment available in the market play an important role in selecting the dredging equipment.

Based on the soil conditions appropriate suction dredger will be used for the development of Honnavar Barge/vessel loading facility.

The selection of a disposal site in sea depends on several factors, which can be broadly classified into environmental and economical considerations. The major economic factors are volume of dredged material and distance of the disposal site. The environmental considerations are the characteristics of the material, short-term fate of the dredged material and the initial deposition pattern of the material in the bottom. These factors in turn determine the long-term movement of the disposed material from the disposal site. Generally, coarse material quickly settles to the bottom; while fine material is removed during its descendent to the bottom and transported by currents to adjoining areas.

The disposed material will settle down depending on its own bulk size and grain size with different settling velocity. Hence, the environmental conditions at the location of the disposal site should be such that it is not subjected to high near-bottom current velocities which would cause the disposed material to return to areas of interest like the approach channel. Moreover, the shuttle distance between the disposal site and the areas of dredging should not be too large, as this would increase cost of disposal and consequently the dredging cost. Hence, the selection of the disposal site has to be the result of a balance between the environmental factors and economy of cost.

The dredge spoils will be disposed through a hopper or suitable dredger at the disposal site. The impacts due to disposal of dredged material such as the spreading of turbidity at disposal location, suspension & re-suspension of sediment in the bulk of water column.

Numerical modelling studies for Dredge disposal

The dredging schedule will be covering both the wet season and the dry season. Numerical modelling studies have been conducted with a view to determine the ideal site for the dredge disposal. The studies have been carried out for the predominant waves in the respective seasons; SW waves for wet season and WNW waves for dry season. The peak river discharge values corresponding to wet and dry seasons are set to 300 m^3/s and 50 m^3/s respectively. Boundary conditions and other required parameters (bed resistance, eddy viscosity etc) are set in a way similar to the simulations described in Sediment transport study sections.

As the sediment transport and littoral drift studies revealed that the net transport along this coast is towards north, an appropriate disposal site towards north of the northern breakwater is chosen such that the disposed material does not come back towards the port entrance and at the same time it could be helpful in nourishing the eroding beaches in the area. After examining several locations along the northern coast, the most suitable site for dredge disposal is recommended at a distance of about 2.0 km to the north of port entrance channel located at latitude 14.308°N and longitude 74.415°E as shown in Figure 5-78:

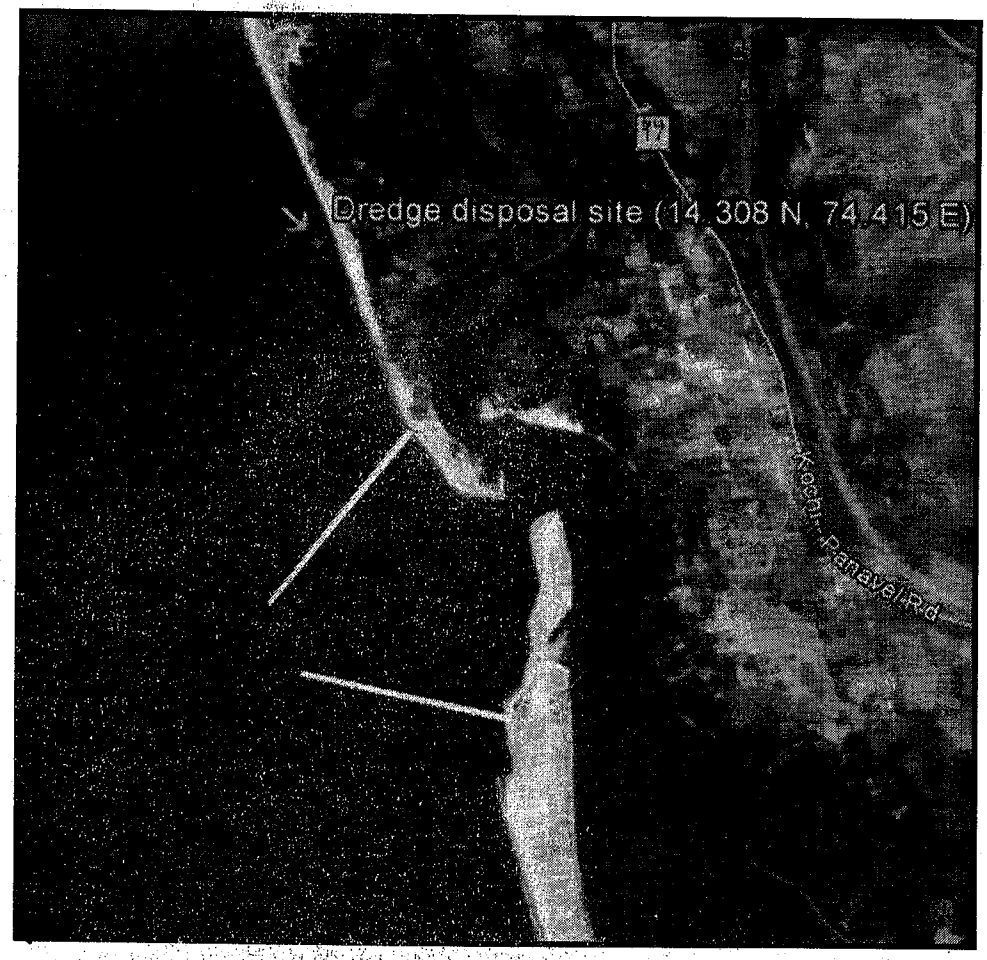


Figure 5-78: Location of the proposed disposal site (Image courtesy: Google Earth)

MIKE 21 hydrodynamic model (with mud transport) has been used to simulate the suspended sediment concentration (SSC) and bed level changes when the dredged material is discharged at a rate of 150 m^3/s with a velocity of 5 m/s in the outlet direction of 10° relative to true North. The results of the modelling studies are shown in Figure 5-79 to Figure 5-82.

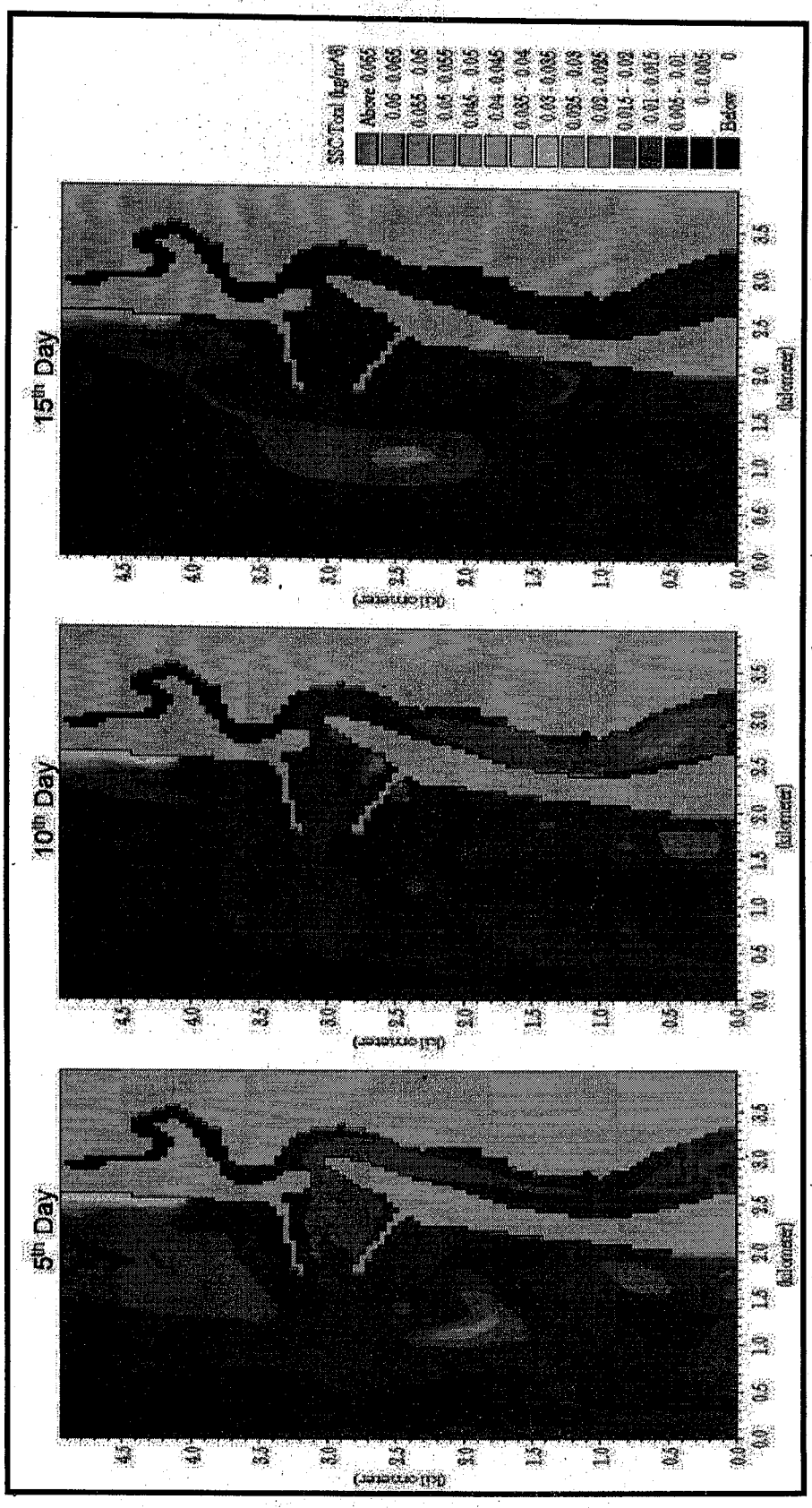


Figure 5-79: Suspended sediment concentration for wet season (SW waves) at disposal site

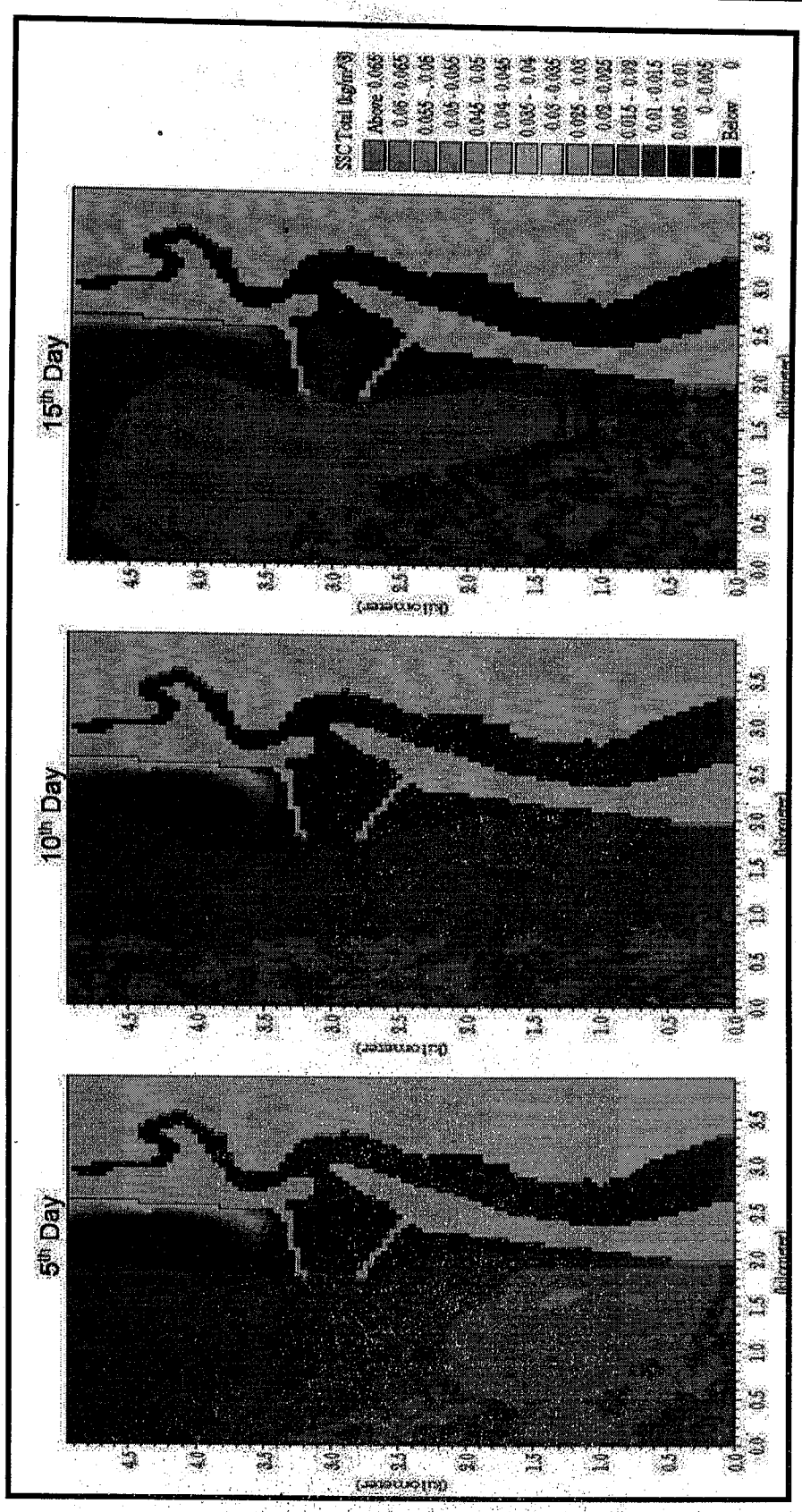


Figure 5-80: Suspended sediment concentration for dry season (WNW waves) at disposal site

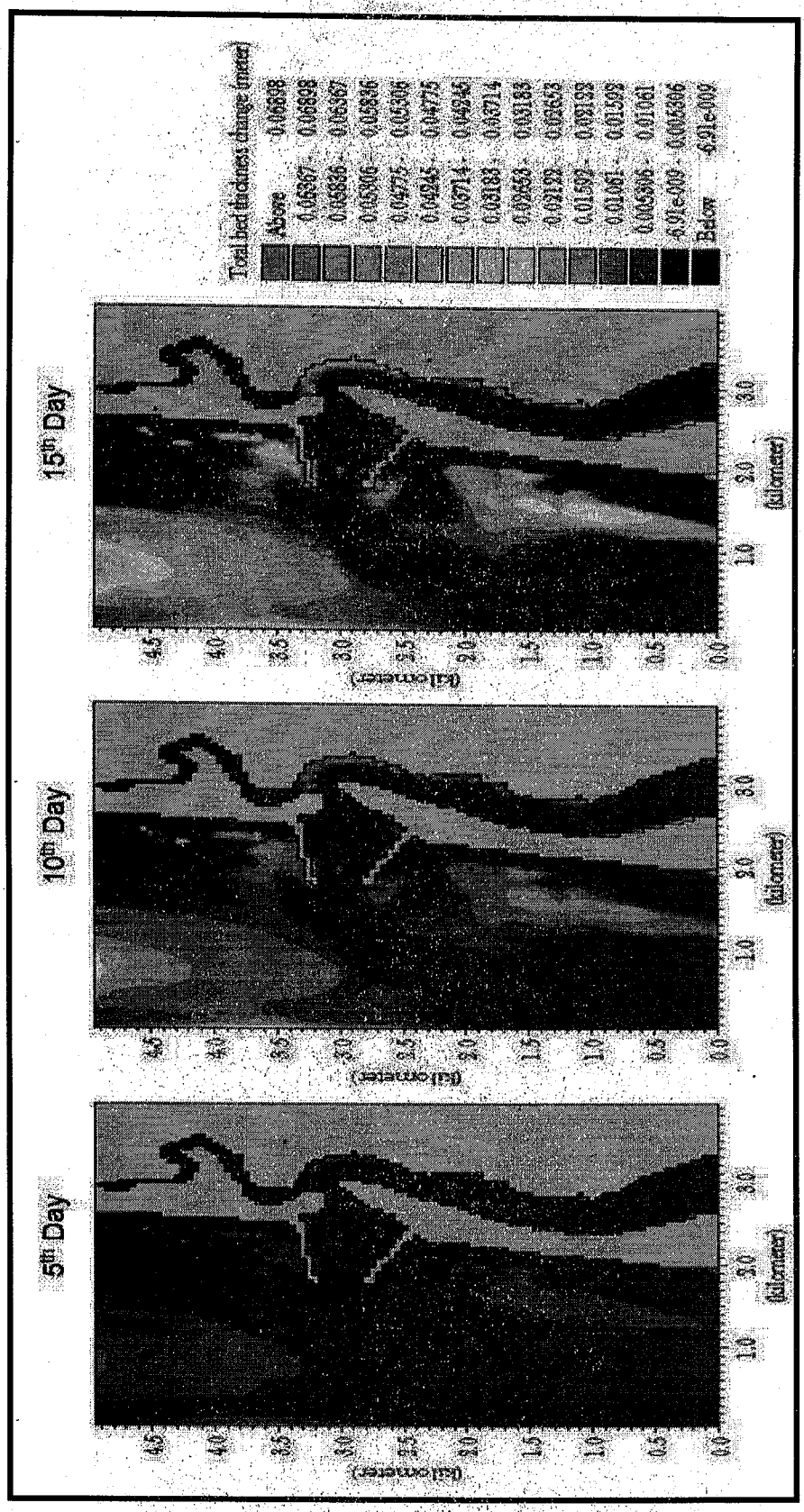


Figure 5-81: Total bed thickness change (m) for wet season (SW Waves) with disposal site

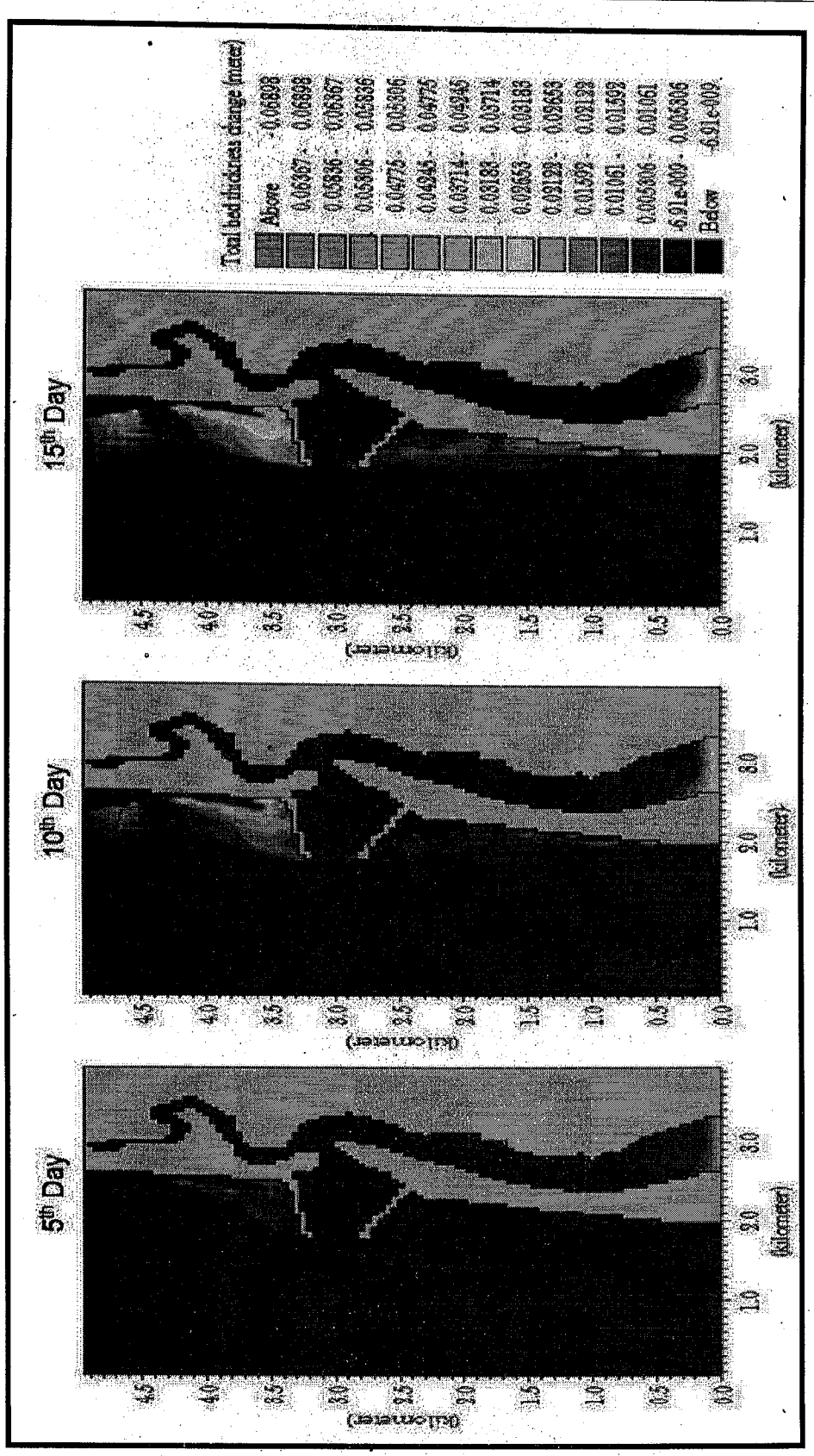


Figure 5-82: Total bed thickness change (m) for dry season (WNW Waves) with disposal site

Dredge Spoil Disposal Study – Results and Discussions:

It is observed that during wet season, the suspended sediment concentration (SSC) is relatively high for a few days after dredge disposal but later it spreads along the coast towards north without any impact to the port entrance area and the nearby environment. However, during dry season with WNW waves, the discharged sediment (SSC) spreads along the coast towards south, but it does not extend up to the entrance channel.

It is evident from the rate of bed level change during wet season; there is very little increase in bed level in the near shore regions at the disposal site. During dry season, the supplied sediment is carried towards south supplying sediment to the northern part of the north breakwater. This positive feedback from the natural near shore current system is quite helpful for nourishing the northern beaches.

During periods of strong near shore currents (during peak wet season), it is suggested to dispose the sediment offshore at greater depths (>30 m). Based on the studies it is concluded that the dredge disposal at the recommended site will not cause any natural imbalance to the nearby shoreline and will not affect the coastal eco-system in any way.

5.3.2.2 Impact on Marine Water Quality

Marine water quality will be impacted due to dredging and disposal, construction of breakwaters, and cargo berths during construction phase. Direct impact of these activities on marine water quality would be increased turbidity due to suspended sediment and will be predominant during dredging.

Turbidity due to dredging operation varies with depth and lateral distance from dredger location. During dredging, transport of sediment depends on velocity and fine material concentration. Very fine cohesive material will remain in suspension for a long time and is independent of hydrodynamic conditions. Due to above factors, there will be an increase in turbidity due to suspended sediment in water column. Thus, it can be inferred that dredging would cause a short-term and localised impact on marine water quality.

Apart from turbidity, the marine water quality may be affected due to aqueous discharge (oily wastes, sanitary wastes, etc.) from the dredgers, barges and workboats involved in the activities. No discharge from the dredgers or work boats shall be allowed into marine waters. The dredging activity will be confined within the project site and the impact due to dredging will cease upon completion. The impact due to dredging can be minimised with the implementation of a dredge management programme.

5.3.2.3 Impact on Marine Ecology

Capital dredging and construction of approach channel, breakwaters and cargo berths will result in disturbance to marine ecology.

Turbulence – Changes in Dissolved Oxygen (DO) Levels: During dredging, oxygen-demanding compounds, nutrients and sediments from the sea bed enter into water column. Since concentrations of oxygen-demanding compounds are normally much higher in pore water than in water column, it will cause a drop in oxygen concentration. Nutrients may stimulate primary production when light and temperatures are sufficient; and may cause eutrophication problems when released in favourable conditions. DO levels in bottom

sediments, which are usually low would increase during dredging period. Changes in DO levels and noise are likely to result in localised and short-term impacts on marine ecology.

Removal of Benthic Communities associated with Bottom Sediments: Dredging would result in removal of benthic communities associated with bottom sediments. During dredging, sessile forms are removed along with sediments and mobile species tend to move away and are likely to increase species diversity in areas adjoining dredging site. Further, it is observed that due to movement of mobile species and transfer of nutrients during dredging, there will be an increase in species diversity and density in areas adjoining dredging site.

To mitigate impacts on marine ecology, measures such as selection of equipment and dredgers, environmental monitoring and regulating activities based on monitoring results will be adopted.

Smothering Effect Due to Settling of Sediment: Settlement of the suspended sediments can result in the smothering or blanketing of sub-tidal communities and/or adjacent inter-tidal communities. Presently, the marine biota in the Indian Coast of India is already subjected to considerable changes in turbidity due to large-scale littoral movement, which is a recurring regular natural phenomenon. Therefore, it would be able to withstand localised turbidity induced during the dredging.

5.3.2.4 Changes in Seabed Profile

Changes in sea bed are envisaged due to the proposed project.

The morphodynamics (study of the seabed changes over long period of time) a coastal sea is studied by using ST model sub-module of CAMS. ST is used for assessing the probable zones of erosion/accretion and the initial bed level changes due to wave action in the proposed harbour vicinity. The results are discussed in Section 5.3.1.1.

5.3.2.5 Mitigation Measures

Prior to commencement of dredging, a Dredging Management Programme will be prepared and implemented, which will include the following details.

- A schedule for dredging shall be prepared and list of DO (s) and DO NOT (s) shall be circulated among the people involved in the construction activities
- Currently, there are no standards in India to regulate turbidity levels during dredging. It is proposed to check turbidity levels during construction phase with baseline turbidity levels as a reference during dredging.
- It will be ensured that suitable dredging equipment is deployed to minimise the suspension of fine sediments at the dredge site.
- Dredging activity will be regulated during rough sea conditions.
- Additional Environmental Monitoring Programme comprising of monitoring of marine water quality, marine sediment quality and marine ecology will be initiated one week prior to commencement of dredging and will be carried out throughout dredging period.
- It will be ensured that barges/workboats have slop tanks for collection of liquid/solid waste generated on board. Discharge of wastes into sea will be prohibited.
- Spill control measures will be adopted while fuelling dredgers, barges, workboats, etc.

- Post dredging monitoring program will carried out to assess effect of dredging and disposal on marine ecology.
- Dredging and dredged material disposal will be monitored for compliance with proposed mitigation measures.

5.3.3 Potential Impact during Operation

5.3.3.1 Impact on Marine Water Quality and Ecology in Harbour Basin

Due to Aqueous Discharges: During the operation phase there will be continuous movement of cargo Barges and port crafts round the clock. There is a possibility of aqueous discharges from the cargo Barges such as dumping of Barges wastes (sullage)/sewage, bilge water, solid wastes, etc. if not regulated.

Barges/vessels calling at Honnavar Barge/vessel loading facility will not be permitted dump the wastes during the berthing period. In addition, land-based sources of pollution such as runoff from the cargo berths, waste water, sewage and effluents from the Barge loading operations would also affect the marine water and sediment qualities in the harbour basin, if disposed without proper treatment. To avoid impacts on the marine water quality, it is proposed to prevent discharges from certain areas and regulate the discharges from other areas. Accordingly, storm water runoff will be directed into open concrete lined channels. The runoff from uncontaminated areas will be discharged directly into the sea. The runoff from berths and other areas liable for pollution will be intercepted and directed to septic tank followed by soak pit.

Due to Maintenance Dredging: During the operational phase, maintenance dredging of the approach channel and the harbour basin will be carried out in order to maintain the required draft in the channel for the free movement of the vessels. The maintenance dredge quantity is estimated at 10,300 cubic meter/year. The maintenance dredge spoil will be dumped at recommended at a distance of about 2.0 km to the north of port entrance channel or beyond 30 m depth contour..

Localised and short term impacts on marine water quality are anticipated from increased turbidity during maintenance dredging. The magnitude of impact due to the maintenance dredging and disposal is dependent on the quality of the dredged material.

As Dredge Management Programme proposed to be adopted, no significant impact are anticipated from maintenance dredging on water quality except locally due to suspension of bottom sediment resulting in increased turbidity levels. Further, during the disposal of the dredge spoil at the identified disposal ground, the dredger hopper will be shifted to minimize the increase in turbidity/suspended solids concentration and built up of the bed material.

Due to Cargo Spills during Handling: Spills do not occur during normal operations, as the cargo will be handled by specialised barge-loaders. In the event of accidental spills of cargo during transfer from/to the ships, the marine water quality, sediment quality and ecology in the harbour basin will be impacted.

Due to Oil Spills during Fuelling: Oil spills do not occur during normal fuelling operations. In the event of accidental oil spills during fuelling of the ships / port crafts, the marine water quality in the harbour basin will be impacted. To minimise the impacts on marine water quality, the spills will be recovered.

5.3.3.2 Mitigation Measures

- Barges/Vessel visiting the facility will comply with MARPOL convention and avoid the discharges.
- Settling Tanks will be provided for containment/treatment of runoff from cargo storage areas and other areas liable for pollution. Lime will be added in the settling ponds to neutralise the heavy metals if any in the runoff from the stockyards and the settled waste will be disposed of complying with the norms stipulated by statutory authorities.
- It will be ensured that the dumping of the maintenance dredge spoil would be uniform.
- Along with the operational phase environmental monitoring, an additional Environmental Monitoring Programme comprising of monitoring of marine water quality, marine sediment quality and marine ecology will be initiated one week prior to commencement of maintenance dredging and will be carried out during the dredging period.
- In case of any cargo spillage during transfer from/to ships, it will be attempted to recover the spills.
- Oil spill control equipment such as booms/barriers will be provided for containment.
- As the accidental spills will be in harboured waters, it would not spread spatially and the response time for shutting down the fuelling, containment and recovery will be quicker.

5.4 Biological Environment (Coastal and Marine Ecology)

5.4.1 Potential Impact due to proposed Facility Location

5.4.1.1 Impact on Mangrove Areas

The land identified for the development of Honnavar Barge/Vessel loading facility does not entail mangroves, however dense mangroves and their associated species are observed towards eastern side of the Sharavati River, but is it is approximately located 2.7 km South East from the proposed barge/vessel loading facility.

As per the Google imagery and satellite imagery the area of the mangrove are in the Figure 5-83.

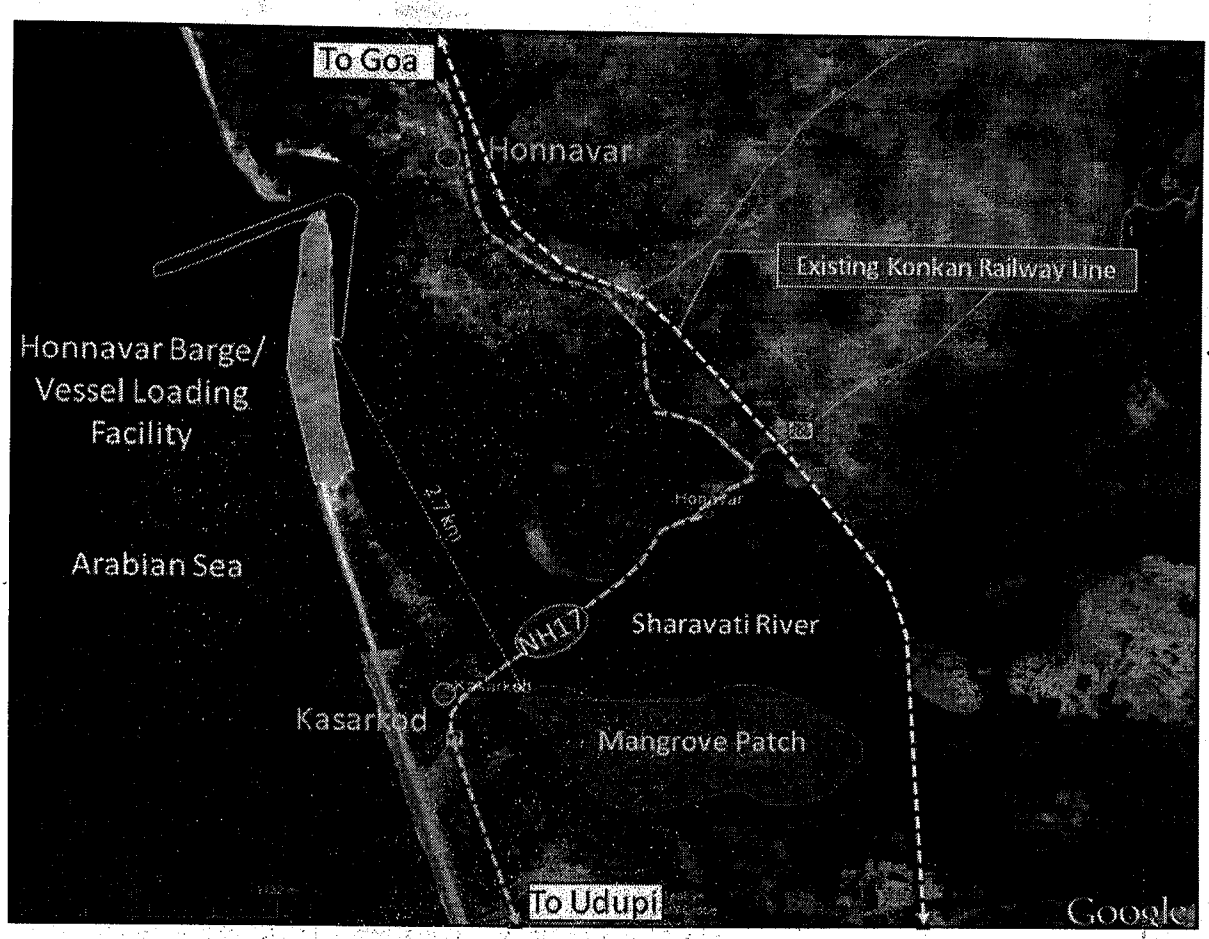


Figure 5-83: Mangroves located towards East of Sharavati River

5.4.1.2 Mitigation/Mangrove Conservation Measures

- Awareness will be given to workers in the Barge/vessel loading facility about the importance of mangroves and their conservation
- Discharge of handling materials during the construction and operation would not be allowed
- During dredging the water quality near the mangrove area will be ensured by adopting suitable mitigation measures.

5.4.1.3 Impact on River Confluence Point/River Mouth

Breakwater construction will lead to accretion/erosion on coast adjacent to that. These will change the morphodynamics of the river mouth/inlet which leads to reduction in tidal water flow in the water body. Reduction in tidal exchange will affect the biodiversity. Studies with MIKE 21 mud transport (MT) model give the details of sedimentation and siltation due to the riverine flow. The model results show that by and large there is a negligible siltation due to riverine flow. Although slight siltation is noticed during wet season at the northern end of the river facing the river mouth, this is not significant.

The model studies show that the tranquillity conditions have improved on the riverside where barge/ vessel loading facilities is proposed, when the breakwaters are incorporated in the model. During wet season slightly higher values of SSC are noticed inside the region of

breakwaters and also inside the river. But by 10th day the SSC is flushed out and by 15th day the entire area including river side is free of any SSC. During dry season the SSC is negligible throughout the study area. The bed level changes during wet season indicate the sedimentation is negligible up to 10th day; but by 15th day slight deposition appears on the right bank of the river facing the channel inlet. But this siltation is not severe and it can be concluded that the construction of breakwaters will not have any significant effect on siltation.

Hydrodynamic Model Studies and other model studies ensures that changes the morphodynamic of the river mouth is not significant. This will ensure the tidal water exchange and thereby maintain the bio diversity.

As a part of EMP, both water quality monitoring and shoreline monitoring is proposed.

5.4.2 Potential Impact due to Construction

5.4.2.1 Impact due to Capital Dredging and Disposal

Capital dredging is required to create inner navigation channel, outer navigation channel, turning circle and berthing areas which may cause temporary disturbance to biological environment. Dredging removes bottom biota and dumping of dredged material covers bottom habitat. Piles, rubble mounds and concrete surfaces will form new habitat. The likely impacts on marine ecology are discussed in Section 5.3.2.1.

5.4.2.2 Mitigation Measures during Dredging and Disposal

In addition to the mitigation measures followed in Section 5.3.2.5, the following will be adopted:

- Appropriate selection of equipment for pile driving and dredging
- Uniform disposal of dredged material at identified disposal location

5.4.2.3 Impact on Ecology due to Reclamation

The Barge/Vessel loading facility areas proposed to be reclaimed is mostly Coastal sand and intertidal zone which is devoid of vegetation. These areas are going to be reclaimed with 1.0 MCM of dredged material.

5.4.2.4 Mitigation Measures during Reclamation

While reclaiming the existing area, bunds will be provided with a suitable overflow facilities so that only clean water will be returned to the sea..

5.4.3 Potential Impact due to Operation

5.4.3.1 Impact due to Aqueous Discharges and Mitigation Measures

During the operation phase there will be continuous movement of cargo Barges and Barge/Vessel loading facility crafts round the clock. There is a possibility of aqueous discharges from the cargo vessels such as dumping of Barges wastes (sullage)/sewage, bilge water, solid wastes, etc. if not regulated. The likely impacts and corresponding

mitigation measures to be followed are discussed in section 5.3.3.2 of Chapter 5 respectively.

5.4.3.2 Potential Impact due to Cargo Operations

Due to Cargo Spills during Handling: Spills do not occur during normal operations, as the cargo will be handled by specialised mechanised Barge/ Vessel -loaders/un-loaders. In the event of accidental spills of cargo during transfer from/to the Barges/ Vessel, the marine water quality, sediment quality and ecology in the harbour basin will be impacted.

5.4.3.3 Mitigation Measures

- Spill contingency plan as a part of Disaster Management Plan will be prepared in accordance to the cargo will be handled.
- Spill recovery/immediate response measures will be displayed at cargo handling areas.
- Material Safety data Sheet (MSDS) of cargo being handled will be displayed.
- Mock drills will be conducted at periodic intervals.

5.5 Air Environment

5.5.1 Potential Impact during Construction

5.5.1.1 Impact due to Transportation of Construction and Cargo Material

As the quarry material will be sourced from approved/licensed quarries, the environmental management at the quarry site will be taken care by the quarry agencies. Hence, no significant impact is anticipated. During material transportation, there is a possibility of impact on air quality along the route due to exhaust emissions, fugitive dust suspension and traffic congestion. The windblown dust during the material movement could impact the road users and also habitations enroute. Fugitive dust could arise during material unloading. This can contribute towards slight build-up of pollutant concentration over the baseline levels. It is proposed to use the dedicated road as well as rail corridor for the transportation of construction material by which the likely impacts due to traffic movement on roads will be minimised.

5.5.1.2 Emissions during Construction

During the construction activities, the sources of potential impacts on the air quality at the construction site can be categorised as:

- Exhaust emissions from diesel run engines, construction machinery and vehicles
- Dust suspension during site preparation, construction, trenching and material transport

Grading and soil compaction will be involved as a part of site preparation before undertaking construction work. Area development will involve developing the internal road, utilities, services and ancillary buildings etc. Fugitive dust is expected particularly during dry weather conditions due to the site preparation and movement of transport vehicles for materials and personnel. Emissions from power generators, construction equipment and transport vehicles will affect the air quality within the work areas, if not adequately managed. Movement of

materials such as cement, steel, sand, etc. will cause disturbance to the adjoining communities.

The baseline concentrations of Particulate Matter (PM_{10} and $PM_{2.5}$), SO_2, NO_X and CO are within the limits of NAAQS stipulated by MoEF/CPCB. With the present background concentrations of air quality parameters, it is expected that there will only be a mild build-up of air pollutants. Further, because of the prevailing strong winds along the coastal region and the resulting dispersion the impact on air quality from pollutants would be reduced.

The impacts during construction are short-term in nature and will cease on completion of the construction. Further, adoption of suitable mitigation measures will ensure that these impacts are rendered insignificant.

5.5.1.3 Mitigation Measures

Construction Yard

- During planning, it will be attempted to prevent/minimise disturbance to adjacent properties/habitations. If unavoidable, same will be restored with consent from affected persons.
- Adequately sized construction yard will be provided at the site for storage of construction materials, equipment tools, earthmoving equipment, etc. In addition, temporary field offices and worker amenities will be provided at site. Appropriate spill control measures and labelling/handling procedures will be maintained.
- Construction sites will be provided with enclosures on all sides to prevent dispersion of dust and transmission of noise.
- Drainage system will be provided at construction yard. Measures will be taken to prevent silting of natural drainage due to runoff from construction areas.
- Proper area will be demarcated for storage of construction material. This will enable proper management of the materials including control of seepage and spillage thereby preventing contamination of the project area.

Movement of Machinery and Equipment

- Movement of material will be mostly during non-peak hours and regulated during peak hours. Mobile equipment such as intermittently used machines and transport vehicles will be either switched off or throttled down to a minimum.
- On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic.
- Construction equipment and transport vehicles will be periodically washed to remove accumulated dirt.

Dust suppression

- Water sprinkling will be carried out to suppress fugitive dust during earthworks and along unpaved sections of access roads.

Environmental Awareness

- Environmental awareness program/training will be organised to the personnel involved in developmental works.

5.5.2 Potential Impact due to Operation

5.5.2.1 Impact due to Emission from Barges/vessels

During the operational phase, there will be an increase in the movement of traffic and hence, emissions from the moving vehicles will also increase. The exhaust from the DG set at the site, the tugs, launches, diesel operated small boats, dredgers etc will enhance a pollution load during operational phase. With the increase in the number of barges and boats, their operation and movement of cargo to and fro will also increase. These activities will increase the pollution load in the atmosphere. The machine generated pollutants (viz. suspended particles and smoke) from repair and maintenance area, storage area and service area will also add up to a considerable amount of pollution load. The stacking of coal if not covered and sprinkled with water would generate dust, however, as described herein, all stacking areas will employ adequate dust suppression measures.

5.5.2.2 Impact due to Cargo Handling and Storage

Cargo proposed to be handled at Honnavar Barge/vessel loading facility is as follows:

Handling Capacity: 4.9 MTPA

Dry and Bulk Cargo

- Coal - 2.7 MTPA
- Iron Ore – 1.0 MTPA

General cargo – 1.2 MTPA

- Granite – 0.16MTPA
- Fertilizer – 0.2 MTPA
- Molasses with Agro Products – 0.15 MTPA
- Steel Products – 0.4 MTPA
- Sugar – 0.29 MTPA

Cargo Handling:

The installation of mechanised cargo handling equipment on berths and in storage/stockyard areas for unloading/loading has been proposed to match the traffic demand. Dry bulk cargo (Iron Ore, Thermal Coal) and general cargo which is non hazardous in nature will be handled using mechanical cargo handling equipment such as Mobile harbour Cranes and pay loaders etc., on berths and in storage/stackyard areas for unloading/loading operations.

In the proposed Barge/Vessel loading facility, cargo handling operations involve the following.

- Barge to-Shore and vice-versa transfer of cargo by Mobile harbour Cranes and loaders.
- Movement of cargo from berth to stockyard and vice-versa by Trucks/Tractor Trailers.
- Appropriate Fork-Lifts and Front-end loaders can be used at General Cargo storage yards.

Cargo Storage:

The cargo storage proposed in the Barge/Vessel loading facility is as follows:

- Open storage for dry bulk cargo
- Open storage and transit sheds for general cargo

There will be impact on air quality due to fugitive emissions during cargo handling and storage. The build up of pollutants would result in impact of air quality.

The impact of air quality due to fugitive emissions from dry bulk cargo has been studied using the Industrial Source Complex, Short Term (ISCST3) dispersion model based on Steady State Gaussian Plume Dispersion, developed by US Environmental Protection Agency (US EPA). The model simulations have been carried out for dispersion of particulate matter from the handling of cargo and cargo storage areas/stockyards.

Modelling Options/Assumptions

- Calm's processing routine is used by default
- Wind profile exponents is used by default, 'Irwin'
- Flat terrain is used for computations
- It is assumed that the pollutants do not undergo any physico-chemical transformation and that there is no pollutant removal by dry deposition
- Meteorological inputs required are hourly wind speed and direction, ambient temperature, stability class, and mixing height
- Washout by rain is not considered

Input Data: The following technical details of Honnavar barge/vessel loading facility are considered for air quality modelling studies:

Source		Details
a)	Cargo details	In chapter 2, section 2.3.4
b)	Cargo Handling Rates	In chapter 2 , section 2.6.1
c)	Silt content in % of coal Silt content in % of iron ore	
d)	Moisture content in % of coal Moisture content in % of iron ore	
f)	VKT = No. of km travelled by each vehicle in case of transport	A total of 4 km to and fro from the berth upto the gate.
g)	Size of Loader / Unloader (cu.m.)	40 cum per lift
h)	Frequency of loading / unloading (No./Hour)	Frequency of unloading – 35 cycles per hour
i)	Capacity of Dumper / Unloader in tons	Capacity of unloader – 30 tons per lift
j)	Drop height	0 to 5 m
k)	Vehicular Information	Coal : 770 truck movements per day Iron ore : 250 truck movements per day General cargo : 300 truck movements per day
l)	Direction and distance of the open sea from the cargo handling and other elevated pollution sources	Direction : West , adjacent to the proposed development
m)	Berth (Unloading from Ship)	Inside the river
n	Storage Area	Coal stack yard Width=120 m Length =450 m Height=10m Iron Ore Stack yard Width=60 m Length =450 m Height=10m
o)	Operating cycles (hrs/day) & days/annum	16 hrs/ day & 260 days/annum

Meteorological Data: Project site specific meteorological data was generated during the study period by installing an automatic weather monitoring station. The parameters like wind speed, wind direction and temperature have been taken based on the primary data generated.

Extrapolation of Wind Speed: Wind speed at stack level is calculated by power law as given below.

$U_{stack} = U_{10}(\text{Stack height}/10)^{p}$

Where U_{10} is the wind speed at 10 m level and p is the power law coefficient (0.07, 0.07, 0.10, 0.15, 0.35 and 0.55 for stability classes A,B,C,D,E and F respectively) as per Irwin for rural areas (USEPA, 1987).

Stability Classification: Stability class can be estimated from wind speed and radiation. Stability classes are classified in to A: Extremely unstable, B: Moderately unstable, C: Slightly unstable, D: Neutral, E: Slightly stable, F: Moderately stable. Hourly stability is determined by wind direction fluctuation method as recommended by CPCB (PROBES/70/1997-1998).

$$\sigma a = W_{dr}/6$$

σ_a, is standard deviation of wind direction fluctuation, W_{dr} is the overall wind direction fluctuation or width of the wind direction in degrees. The table for stability classes is given as under.

Stability Class	σ_a (degree)
A	> 22.5
B	22.4 – 17.5
C	17.4 – 12.5
D	12.4 – 7.5
E	7.4 – 3.5
F	< 3.5

Dispersion Parameters:

Atmospheric dispersion coefficients vary with downwind distance (x) from emission sources for different atmospheric stability conditions (CPCB – PROBES/70/1997-98). Dispersion parameters σ_y and σ_z for open country conditions (Briggs, 1974) are used as the project is located on a flat terrain in a rural area.

Table 5-2: Rural Conditions

Stability Class	σ_y	σ_{az}
A	$0.22x(1+0.0001x)^{-.5}$	0.20x
B	$0.16x(1+0.0001x)^{-.5}$	0.12x
C	$0.11x(1+0.0001x)^{-.5}$	$0.08x(1+0.0002x)^{.5}$
D	$0.08x(1+0.0001x)^{-.5}$	$0.06(1+0.0015x)^{.5}$
E	$0.06x(1+0.0001x)^{-.5}$	$0.03x(1+0.0003x)^{-1}$
F	$0.04x(1+0.0001x)^{-.5}$	$0.16x(1+0.0003x)^{-1}$

Mixing Height:

As site specific mixing heights are not available, mixing heights based on CPCB publication, "SPATIAL DISTRIBUTION OF HOURLY MIXING DEPTH OVER INDIAN REGION", PROBES/88/2002-03 has been considered for Industrial Source Complex model to establish the worst case scenario

Table 5-3: Mixing Height

Hour of The day	Mixing Height Winter Season
7	50
8	100
9	200
10	575
11	700
12	840

Hour of The day	Mixing Height Winter Season
13	1000
14	1050
15	1200
16	1100
17	900
18	500
19	400

Emission Calculation:

For the modelling purpose, Particulate Matter from barge/vessel loading facility is considered. The Barge/ vessel loading facility emissions mainly are from handling and storage of dry bulk cargo such as coal and iron ore. The calculated emissions from Honnavar Barge/ vessel loading facility are given in Table 5-8 below

Table 5-4: Particulate Matter Emission Details

S.No	Emission Source	Unit	Coal	Iron Ore
1	Wind Erosion From Stock yard	g/s	2.383373741	1.265704689
2	Emission due to Handling at berth activities	g/s	1.10554E-05	3.21466E-05
3	Emission due to Vehicular Traffic	(g/s/m travelled)	0.04041799	0.028869993
4	Emission due to loading at Stockpile	g/s	0.721153846	0.267094017
5	Emission due to Unloading at Stockpile	g/s	5.408653846	2.003205128
6	Total Emissions withoutcontrol	g/s	8.553610479	3.564905974
7	Total Emissions withoutcontrol	g/s-m2	0.000122194	0.00019805
8	Emissions after Incorporating Controll measures (50% of total Emissions) (Water Sprinklers)	g/s-m2	6.10972E-05	9.90252E-05
9	PM10(at 60% of controlled Emissions)	g/s-m2	3.66583E-05	5.94151E-05
10	PM2.5(at 40% of PM10)	g/s-m2	1.46633E-05	2.3766E-05

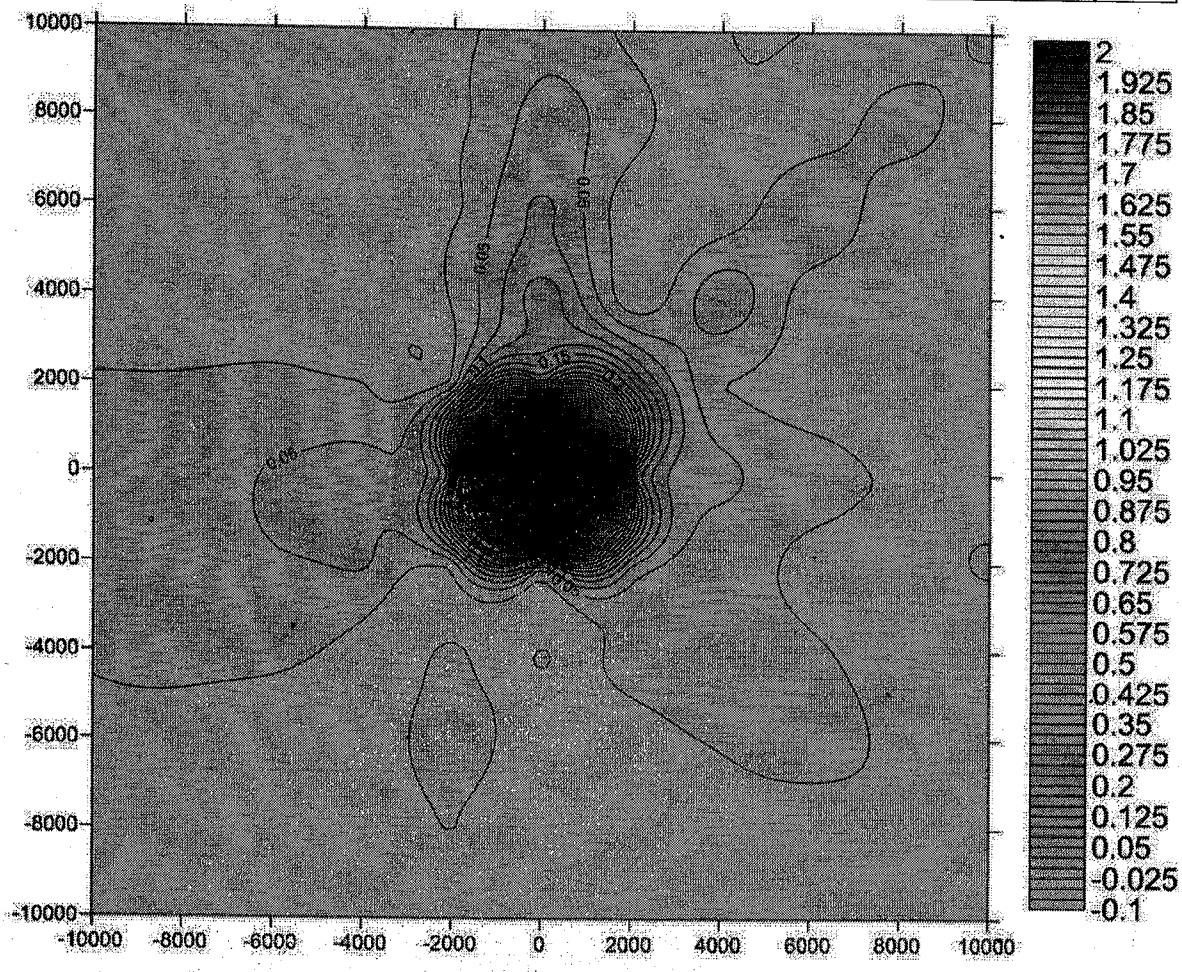
Model Results:

Model simulations have been carried using the hourly Triple Joint Frequency data viz., stability, wind speed, mixing height and temperature. Short-term simulations have been carried to estimate concentrations at the receptors to obtain an optimum description of variations in concentrations over the site covering 16 directions. The maximum incremental Ground Level Concentrations (GLCs) of Particulate Matter due to fugitive emissions from barge/vessel loading operation activities are superimposed on the maximum baseline concentrations of respective air quality parameters recorded during study period to arrive at the likely resultant concentrations during the operational phase of the barge/vessel loading facility.

The incremental and the resultant concentrations of PM_{10} are given in Table 5-5 below and the isopleth corresponding to the incremental concentration is shown in Figure 5-84.

Table 5-5: Resultant 24 Hourly Concentrations of PM_{10} due to Operation of Project

S. No.	Name of the Location	Baseline Data* ($\mu g/m^3$)	Incremental Conc. ($\mu g/m^3$)	Resultant Conc. ($\mu g/m^3$)	NAAQ Standards (Industrial, Residential, Rural, Ecologically Sensitive Area and Other Area) ($\mu g/m^3$)
1.	Honnavar-A1	55.9	0.1175	56.0175	100
2.	Kasarkod-A2	46.0	0.0514	46.0514	100
3.	Karki-A3	24.0	0.1295	24.1295	100
4.	Ramtirth-A4	21.7	0.0638	21.7638	100
5.	Kulkod-A5	21.2	0.049	21.249	100
6.	Hosad-A6	25.6	0.01126	25.61126	100



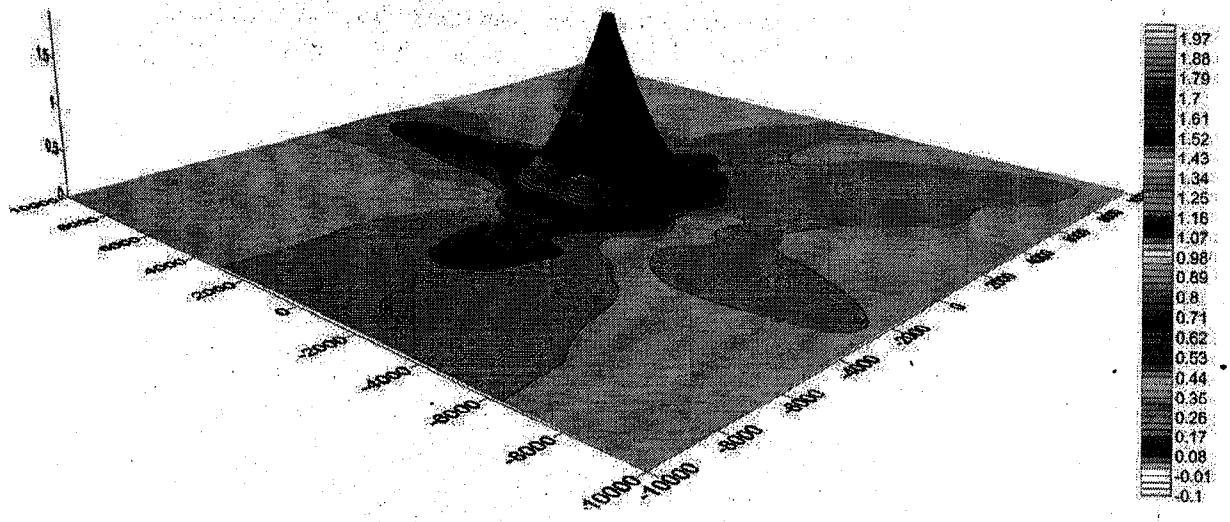


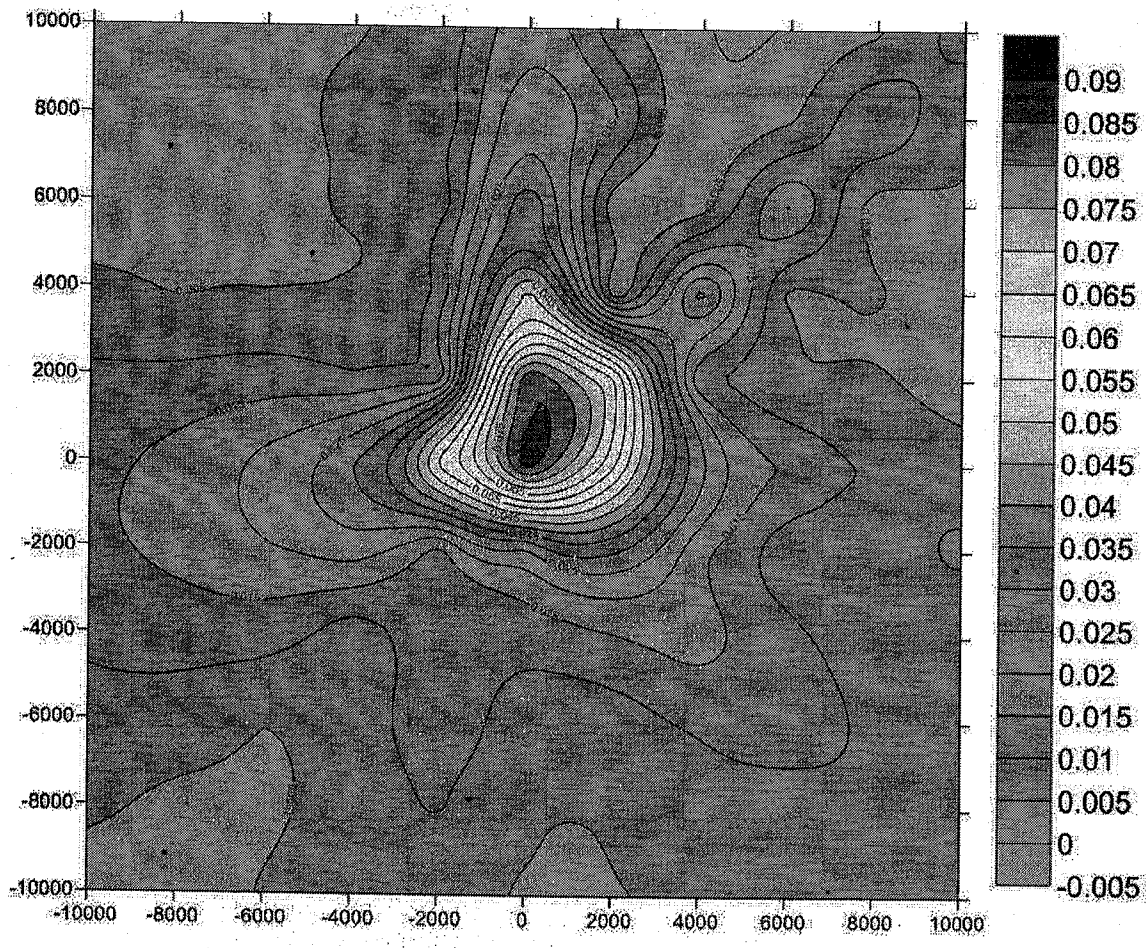
Figure 5-84: Isopleths PM_{10}[3] for control emission (2D & 3D) views

The incremental and the resultant concentrations of $PM_{2.5}$ are given in Table 5-6 below and the isopleth corresponding to the incremental concentration is shown in Figure 5-85.

Table 5-6: Resultant 24 Hourly Concentrations of $PM_{2.5}$ due to Operation of Project

S. No.	Name of the Location	Baseline Data* ($\mu g/m^3$)	Incremental Conc. ($\mu g/m^3$)	Resultant Conc. ($\mu g/m^3$)	NAAQ Standards (Industrial, Residential, Rural, Ecologically Sensitive Area and Other Area) ($\mu g/m^3$)
1.	Honnavar-A1	27.7	0.0477	27.7477	60
2.	Kasarkod-A2	22.9	0.02078	22.92078	60
3.	Karki-A3	12.6	0.0526	12.6526	60
4.	Ramtirth-A4	10.6	0.02592	10.62592	60
5.	Kulkod-A5	10.4	0.01994	10.41994	60
6.	Hosad-A6	14.1	0.0046	14.1046	60

[3] Coordinate (0,0) denotes the centre of the Barge/ Vessel loading facility Honnavar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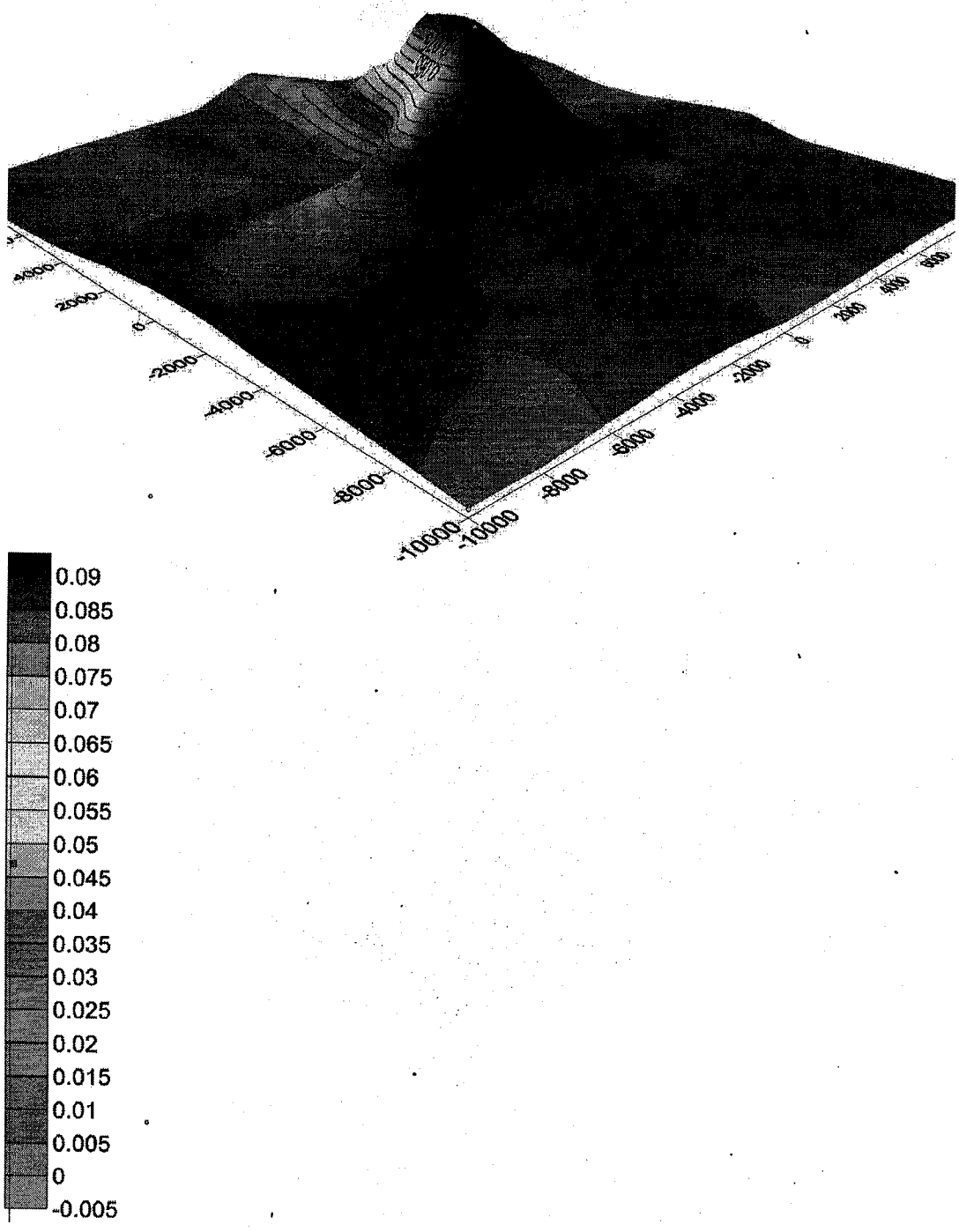


Figure 5-85: Isopleths $PM_{2.5}$(2D & 3D) views

Observations:

The resultant concentrations of PM_{10} and $PM_{2.5}$ at all monitoring stations are found to be well within the National Ambient Air Quality Standards (NAAQS). From the predicted GLCs and the corresponding resultant concentrations, it can be concluded that there is no significant increase over the baseline levels. It must be noted that since the Honnavar barge/ vessel loading facility site is area source and barriers is not considered for computations in practice, the actual concentrations are likely to be lower than indicated.

5.5.2.3 Mitigation Measures

- Water sprinkling will be carried out at cargo storage areas.
- Greenbelt of adequate width will be developed around the cargo storage areas in particular and long the boundary of Barge/vessel loading facility area to minimise the likely impacts due to air pollution.
- Usage of Vehicles with pollution under control certificate
- Ambient air quality monitoring will be carried out regularly at selected locations in the predicted maximum impact zone in order to check and compare the predicted concentrations with the measured concentrations.

5.6 Noise Pollution

5.6.1 Potential Impact during Construction

Construction activities increase ambient noise levels. There would be impact on noise levels due to the following:

- Vehicles transporting construction and Cargo material
- Diesel run engines of construction machinery and dredgers
- Pile driving activities during construction of cargo berths.

Noise is an inherent part of construction activity and response of species / communities would be either attracted or diverted away from the region. Noise generated from diesel engines of dredgers, workboats, etc. could result in movement of mobile faunal species away from area of operation.

There would be a degree of avoidance behaviour exhibited by marine species initially and they would eventually be expected to return once they become accustomed to increased noise levels or once the noise source has moved or ceased. Noise generating sources are mobile and hence, the impact will be localised and short-term in nature.

Marine species in the vicinity of project site are accustomed to noise generated from movement of fishing vessels and are likely to tolerate increased noise generated from workboats and construction activities.

Noise generated from construction activities will be predominantly confined within project site and will impact construction workers at site. Impacts due to these activities would be short-term in nature and localised.

5.6.1.1 Mitigation Measures

The following mitigation measures will be followed to minimise the noise generation and the associated impacts:

- During construction, noise levels will be maintained below threshold levels stipulated by Central Pollution Control Board (CPCB) by selecting appropriate equipment, machinery and using enclosures. Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A).
- Only well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used. Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors.

- Noise attenuation will be practised for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers. The attenuation devices will be properly maintained throughout the construction period.
- High noise generating activities such as piling and drilling will be scheduled to minimise noise impacts.
- Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. especially construction personnel involved in pile driving operations. Rotation of personnel will also be adopted.
- Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimise noise emissions.
- Ambient noise levels will be monitored at regular intervals during construction phase of the project.
- All haul roads (for truck transport and other vehicles) within the boundary and outside will be sealed and maintained properly to avoid excessive noise levels from Engine acceleration and deceleration

5.6.2 Potential Impact during Operation

During the operational phase, noise will be generated due to the operation of the generators, pumps, engines of boats and barges, cranes for handling of goods, cargo and shipment vehicles. Noise will also be generated considerably from the warehouse, repair and maintenance block, service area, goods loading and unloading.

Workers exposed to excessive noise will use appropriate Personal Protecting Equipment (PPE) including ear plugs, muffs, or both when engineering or administrative controls are not feasible to reduce exposure. Hence, it is anticipated that there would not be significant impact of noise on the work personnel.

Impact on noise environment

For the proposed Barge / vessel loading facility the following are the principal source of noise considered for this study,

- Diesel Generates
- Barge Loaders
- Pay loaders
- Harbour Crane

The stationary sources are considered for the present noise modelling study. The noise emission standard for individual unit / equipments as prescribed by central pollution control board is 85dB (A).

$$L_s = L_w - 8 - 20\log(S) - D1 + K_o + \partial L \quad \text{.....(2)}$$

L_s= Expected sound pressure level from the measuring point (receptor)

L_w= Cumulative sound pressure level at the source

S=Distance between the surface noise source and receptor

D1= surface directivity factor due to different radiation angle

K_0= reflection effect from the surrounding environment / building

∂L= Correction factor for other effects (wind , temperature, relative humidity)

Addition of different are based on the following thump rule

$L_1 - L_2$, dB	Add to L_1
0 or 1	3 dB
2 or 3	2 dB
4 - 8	1 dB
9 or more	0 dB

Basic Assumption

- Reflection factor of the surrounding environment / buildings= 3db(A) to 4 db(A)
- surface directivity factor due to different radiation angle =3db(A)
- Correction factor for the other factors such as Wind, Temperature and Relative humidity etc=5 db (A) to 7 db (A).
- $\beta^0=65^0$ Horizontal angle for hemisphere propagation
- $\gamma^0= 10^0$ vertical angle for hemisphere propagation
- $S_=$ assuming 20 M height

Calculation

- Cumulative sound pressure level from the proposed facility = 112.1 db (A) calculated from the equation (1).
- From the equation (2) the expected sound pressure level at the receptors are presented in the below table
- Predicted sound pressure level at receptors

Sl.no	Name of the village	Distance from the facility (M)	Expected sound pressure level db(A)	Baseline Noise level $L_d$db(A)	Cumulative Noise level L_{day}db (A)	Standards for residential zone($L_d$db(A))
Noise level during day time						
1	Honnavar	2300	45.8	48.9	50.9	55
2	kasarkod	2400	45.4	47.3	49.3	55
3	Karki	2800	44.1	46.3	48.3	55
4	Ramthirth	2900	43.8	44.4	46.4	55
5	Kolkod	4200	40.5	44.6	46.6	55
6	Hosad	7300	35.7	42.4	44.4	55
Noise level during night time						
1	Honnavar	2300	45.8	38.8	47.8	45
2	kasarkod	2400	45.4	37.1	47.4	45
3	Karki	2800	44.1	36.2	46.1	45
4	Ramthirth	2900	43.8	36.0	45.8	45
5	Kolkod	4200	40.5	36.0	42.5	45
6	Hosad	7300	35.7	35.7	37.7	45

Observations

- The resultant noise levels at all monitoring stations are found to be well within the Central pollution control board(CPCB). From the predicted Noise level and the corresponding resultant noise level, it can be concluded that there is no significant increase over the baseline levels. It must be noted that since the Honnavar barge/ vessel loading facility site is area source and Noise barriers/ other natural noise attenuations are not considered for computations in practice, the actual noise levels are likely to be lower than indicated or equal to the measured baseline value at respective locations

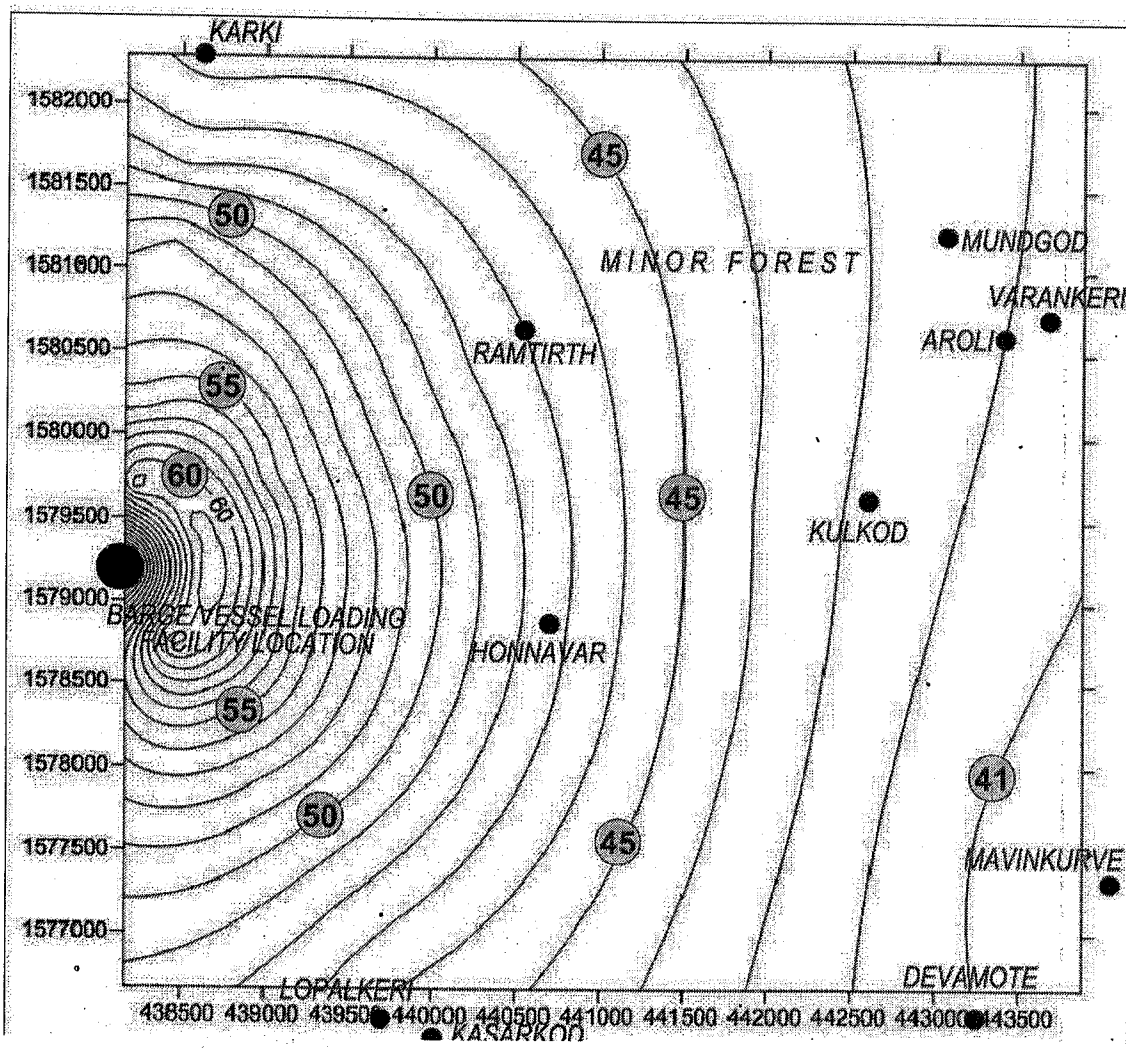


Figure 5-86: Isopleths for noise level-day (L_D) & night (L_N)

5.6.2.1 Mitigation Measures

- Noise attenuation will be practised for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers. The attenuation devices will be properly maintained throughout the construction period.

- Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. especially construction personnel involved in pile driving operations. Rotation of personnel will also be adopted.
- Periodic maintenance of the equipment to be used in the developmental works will be carried out. Worn out parts will be replaced and rotating parts will be lubricated to minimise noise emissions.
- Ambient noise levels will be monitored at regular intervals during operational phase of the project.

5.7 Solid Waste Management

5.7.1 Potential Impact during Construction

5.7.1.1 Construction and Other Wastes

Construction waste will be re-used within project site for filling of low lying areas. Composted bio-degradable waste will be used as manure in greenbelt. Other wastes which can be re-cycled will be sold. Hazardous wastes will be disposed through approved KSPCB vendors. Hence, significant impacts are not envisaged.

5.7.1.2 Mitigation Measures/Solid Waste Management

- The various types of solid wastes generated during the construction phase will be segregated into two main categories, viz., non-hazardous and hazardous. All non-hazardous waste will be covered under solid waste management.
- Construction waste will be used within project site for filling of low lying areas. Composted bio-degradable waste will be used as manure in greenbelt. Other wastes which can be re-cycled will be sold.
- Excavated soil will be stockpiled in a corner of the site in bunded area to avoid run off with storm water.
- General refuse generated on-site will be collected in waste skips and separated from construction waste.
- A local authorised waste handler will be employed to remove general refuse from the site, separately from construction waste and hazardous wastes, on regular basis to minimise odour, pest and litter impacts.
- The burning of refuse at construction sites will be prohibited.

5.7.1.3 Hazardous Materials Management

- Hazardous materials such as lubricants, paints, compressed gases, and varnishes etc., will be stored as per the prescribed/approved safety norms.
- The construction site will be secured by fencing with controlled/limited entry points.
- Hazardous wastes will be disposed through approved KSPCB vendors. Hazardous materials will be stored as per prescribed safety norms in locations with restricted entry and with fire-fighting facilities.
- Medical facilities including first aid will be available for attending to injured workers Occupational Health Construction Equipment and waste.

5.7.2 Potential Impact during Operation

Waste generated from cargo operations such as remains of bulk cargo storage, rubbish from unpacking, and canteen, wastes from daily activities. Solid waste will be generated from the

canteen and administrative area during the operation stage. Wastes will generate odour and health impacts if not managed properly.

5.7.2.1 Mitigation Measures

- Proper collection and disposal of solid waste from office establishment based on the Central Public Health and Environmental Engineering Organization (CPHEEO) manual on "Municipal Solid Waste Management, 2000.
- The solid waste from the utilities like canteen shall be segregated as biodegradable and non-biodegradable waste and collected separately by providing bins at respective places.
- The collected biodegradable waste shall be subjected to composting and the compost will be used as manure for the development of green belt within the Barge/vessel loading facility
- The non-biodegradable waste like plastic shall be disposed off to approved vendors of KSPCB/CPCB in a scientific manner.
- Anticipated Potential impacts due to the proposed Rail/Road alignment

5.7.2.2 Environmental Aspects

The proposed Road /Rail alignments are completely a new link connecting the proposed Barge/Vessel loading facility with exiting NH 17/ Konkan railway line.

5.7.2.3 Ambient Air quality

The proposed alignment is a new link connecting Barge/vessel loading facility with NH17/ Manki Railway station. The baseline ambient air quality is well within the prescribed NAAQ standards due to the less human activity and low industrial activity. During the construction phase ambient air quality along the adjacent villages will get disturbed due to the various construction related activities such as:

- Site Clearance and use of heavy vehicles and Machinery
- Transport of Raw materials, borrow and quarry material to construction site
- Earthworks
- Handling and Storage of aggregates
- Asphalt mixing plant operations

These activities mainly generate dust and emissions such as CO, SO_2, NO_X from construction machineries and also due to other vehicular movements during construction.

During the operation phase the anticipated impacts to the Air quality is due to the movement of vehicles used for transportation of Cargo and transport of other materials.

Mitigation Measures:

- The asphalt plants, crushers will be sited at least 1 km in the down wind direction of human settlement along the Rail/Road corridor.
- During and after compaction of the sub grade, water will be sprayed at regular interval in order to avoid fugitive dust generation
- Vehicles carrying fine and coarse aggregate shall be covered with tarpaulin in order to avoid the spills.
- Pollution Under Control (PUC) certified construction machinery and equipments will be used and checked at regular intervals.

- During the operation stage dust generation will be minimum, because most of surface will be covered by paved shoulder.
- Tree plantation along the Right of way also will act as a major sink of pollutant due to the plying vehicle through corridor
- Regular maintenance of the road, during the operation phase will reduce any negative impacts to an absolute minimum.
- Adequate vehicle maintenance and not to use adulterated fuels shall be confirmed with the contractors.
- Ambient air quality will be monitored at regular intervals during construction and operations phase of the rail/road corridor.

5.7.2.4 Ambient Noise Level

The baseline ambient Noise levels are well within the prescribed CPCB standards. During construction phase, there will be significant increase in the Ambient Noise Level due to the various construction activities and use of the large number of heavy machineries. However, these construction phase impacts are short term in nature, realised in the immediate vicinity and will cease upon completion of construction. This will be occurred along the construction corridor as well as in the secondary site includes construction camps, asphalt mixing plant etc. During the operation stage, incremental noise level is due to the increased traffic volume and Cargo movements.

Mitigation Measures

- During construction, noise levels will be maintained below threshold levels stipulated by Central Pollution Control Board (CPCB) by selecting appropriate equipment, machinery and using enclosures.
- Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A).
- Only well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used.
- Noise attenuation will be practised for noisy equipment by employing suitable techniques such as acoustic controls, insulation etc.
- Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc.
- During operation phase noise levels will be significantly less because of smooth paved shoulders and presence of trees along the Right of way.
- Ambient noise levels will be monitored at regular intervals during construction and operations phases of the rail/road corridor

5.7.2.5 Inland water quality

During construction phase, anticipated impacts are due to spillage of construction materials such as cement, POL and Bitumen etc., falling in to the water bodies and drainage channels from workshops, construction camps etc. During construction phase the natural drainage system will get disturbed and reduction in the capacity of the natural stream. Extraction of the water for the construction activities and labour camp will disturb the local water supply in the contiguous village. Runoff from the construction sites and labour camp will increase the risk of pollution in the natural watercourse. During operation phase there will not be a chance of degradation of water quality during normal operations and spillages will impact the water quality during the accidents if any. Also the entry of vehicles to streams/nallah/rivers for

cleaning could be an impact during operation phase. Surface runoff will be expected due to paved surface.

Mitigation Measures:

- Construction along the water courses will be carried out in the lean flow periods.
- Water will not be extracted from the local resources. Requirement of the water will be met from the ample resource.
- Construction site will not be sited nearer to the surface water or ground water resources.
- Control of the access of Vehicles to the water bodies will be ensured
- Road Safety will be strictly ensured to keep the accident quite low.
- Water Quality will be monitored at regular intervals during construction and operation phase of the project

5.7.2.6 Land

The proposed Road/Rail alignment will traverse across the coastal sand and barren land. During the construction stage accidental spills of fossil fuel and other Hazardous material will increase the risk of soil pollution. Contamination of soil may takes place due to solid waste generated from labour camps. Soil compaction will take place due to the movement of Heavy vehicles and Other Vehicles. During operation phase there will not be degradation of soil quality during normal operations and spillages will impact the soil quality during the accidents if any.

Mitigation Measures

- All the top soil up to 150 mm shall be blended with other barren land to convert in to arable land and will be utilized for land scaping along the corridor,
- Restriction of the plant moving vehicle and machineries in the Agricultural land
- During operational phase, the impacts expected will be minimum due to the proposed green belt
- Soil Quality will be monitored during construction and operation phase of rail/road corridor.

Flora and Fauna

There is no protected Reserve Forest, Wild life sanctuaries and National Parks located in the land proposed for rail/road corridor. The impact on the Flora and Fauna due to this development is insignificant.

Green Belt Development along Road/Rail Corridor

Proposed plantation pattern along the rail/ road corridor will be as follows

- The first row will be of small to medium sized ornamental trees.
- Subsequent rows will comprise of shade bearing species of more height than those in the first row.
- Planting of dwarf shrubs in the median, provide glare free travel to the road user during night time
- Planting of herbaceous species as ground cover in the median, special landscape and the embankment slopes

- Turfing with grass in the median, special landscape and embankments

Following are the recommended species for roadside plantation

Table 5-7: Species recommended for first row

S. No	Botanical name	Importance
1	*Acacia auriculiformis*	Tall Evergreen drought resistant Avenue tree
2	*Ailanthus excelsa*	Tall branched semievergreen tree.
3	*Albizia lebbeck*	Branced evergreen leguminous tree
4	*Alstonia scholaris*	Beautiful medicinal tree.
5	*Neolamarckia cadamba*	Beautiful tree with large leaves.
6	*Azadirachta indica*	Neem oil & neem products
7	*Bauhinia racemosa*	Ornamental tree
8	*Cassia fistula*	Ornamental and bark is a source of tannin
9	*Cassia siamea*	Ornamental avenue tree
10	*Cocos nucifera*	Coconut palm
11	*Dalbergia sissoo*	Avnue and timber tree
12	*Dendrocalamus strictus*	Bamboo products
13	*Casuarina equisetifolia*	Pulp and construction material
14	*Delonix regia*	Ornamental avenue tree
15	*Eucalyptus sp*	Grown in high density along the boundary
16	*Ficus benghalensis*	Shade and a source of food for birds
17	*Ficus racemosa*	Edible fruits
18	*Ficus religiosa*	Shade and a source of food for birds
19	*Gmelina arborea*	Timber
20	*Grewilia robusta*	Avenue tree
21	*Holoptelia integrifolia*	Fibre and timber
22	*Leucaena leucocephala*	Fodder and pulp wood
23	*Mangifera indica*	Edible fruit
24	*Michelia champaca*	Scented flowers
25	*Mimosops elengi*	Shade and edible fruit
26	*Muntingia calabura*	Shade and edible fruit
27	*Phoenix sylvestris*	Palm and the grown up palms can be easily transplanted. Good soil binder.
28	*Pongamia pinnata*	Source of biodiesel
29	*Polyalthia pendula*	Majestic tree with drooping branches
30	*Polyalthia longifolia*	Avenue tree
31	*Samania saman*	Shade, timber and fruits are a good live stock feed.
32	*Shorea robusta*	Tall and locally adapted Timber tree.
33	*Spathodea companulata*	Ornamental avenue tree
34	*Terminalia bellerica*	A common local tree of timber vlue.
35	*Syzygium cumini*	Edible fruits
36	*Tamarindus indica*	Tamarind fruit and leaf
37	*Tectona grandis*	Timber
38	*Terminalia arjuna*	Timber and shade tree
39	*Terminalia catappa*	Edible almond nuts

Table 5-8: Shrubs recommended for Median and Embankments

S.No	Botanical name
1	Bougainvellia
2	Bauhinia alba
3	Bauhinia acuminata
4	calliandra
5	crosandra
6	Gardenia floria
7	Hibiscus SPS
8	Hamelia

9	Musanda
10	Mangnolia SPS
11	Nerium oleander
12	Tecoma stans
13	Tecoma Capensis
14	TMS single and double
15	Thevetia nerifolia

5.8 Vehicular traffic

5.8.1 Potential impact during construction stage

During the construction stage average truck movement is calculated about 150 trucks/day. Potential impacts due to the truck movements are as follows

- Fugitive dust generation during loading and un loading of the construction material
- Vehicular emissions
- Traffic congestion in the existing road
- Increase in noise level due to the movement of vehicles

Mitigation measures

- Trucks will be covered with tarpaulin to avoid fugitive dust generation
- All the vehicle should be warranted with Pollution under control (PUC) certificate
- Usage of appropriate fuels and proper maintenance of vehicles.
- Prohibition of sound horn will significantly reduce the noise level.
- All the vehicles are allowed to use the existing road in the non peak hours.
- Care should be taken by the contractor during the hauling of the construction materials in the project site .

5.8.2 Potential impact during operation stage

During the operation stage average truck movements are given below

Sl.no	Cargo	Truck/day
1	Coal	770
2	Iron ore	250
3	General	300

Potential impacts due to the truck movements are as follows

- Fugitive dust generation during loading and un loading of the construction material
- Vehicular emissions
- Traffic congestion in the existing road
- Increase in noise level due to the movement of vehicles

Mitigation measures

- Trucks will be covered with tarpaulin to avoid fugitive dust generation
- All the vehicle should be warranted with Pollution under control (PUC) certificate
- Usage of appropriate fuels and proper maintenance of vehicles.
- Prohibition of sound horn will significantly reduce the noise level.
- All the vehicles are allowed to use the existing road in the non peak hours.
- Care should be taken by the operator during the hauling of the cargoes in the stock yard.

5.9 Socio-Cultural Impact

5.9.1 Potential Impact due to proposed Facility Location

5.9.1.1 Relocation of Local People

Due to the proposed project, there is no relocation of the local people as the project area is completely on coastal sand.

5.9.2 Potential Impact during proposed Facility Operation

5.9.2.1 Impacts due to Inland Cargo Movement

Proposed Barge/ Vessel loading facility at Honnavar will handle 4.9 MTPA. Proposed road / rail corridor will be used to transport the cargo from/to barge/ vessel loading facility. Hence there will be no congestion of traffic and disturbance to level of service to the existing infrastructure facility

5.9.2.2 Vessel Movement and Impact on Beaches

Barge traffic may disturb fishing activities like fishing nets getting entangled with the moving vessels in outer harbour areas which may cause financial losses to fishing communities. The possibility of accidents in the barge/vessel traffic may affect local people.

Barge/ Vessel loading facility activities may result in the hiring of local labour and procurement of various commodities from a local market. The local economy will be boosted by Barge/ Vessel loading -related activities and be greatly involved in urbanization and industrialization.

Mitigation Measures

- In case of any accident spills, spill recovery will be attempted. A contingency plan will be developed and followed.
- Safe navigation routes will be earmarked for movement of fishing vessels and the route will be finalised in consultation of fishing harbour authorities and fishing communities.

Chapter 6
Environmental Monitoring Programme

6 Environmental Monitoring Programme

In this chapter, environmental monitoring programme for the proposed Honnavar Barge/ vessel loading facility is formulated. Environmental Monitoring Programme is an important component during environmental management of the project. The institutional mechanism to implement the planned mitigation and monitoring measures during all stages of the project is discussed in **Chapter 10**. The project management especially the Environmental Management Cell (EMC) (described in **Chapter 10**) should always go for a rational approach with regards to environmental monitoring. This includes judicious decision making in consultation with responsible agencies (e.g. Karnataka State Pollution Control Board (KSPCB)) or reputed environmental consultants for appropriate changes in the monitoring strategy, changes in the monitoring frequency, and any new requirements. The efficacy of the mitigation measures being followed during construction and operational phases can be assessed and can be revised, made more stringent and reinforced based on the monitoring results. The environmental attributes to be monitored during construction and operational phases of the project, specific description details of environmental monitoring including the monitoring parameters, methodology, sampling locations and frequency of monitoring are presented in Section 6.2 of this chapter.

6.1 Budgetary Estimates for Environmental Management

The budgetary estimate for Environmental Management during construction phase is INR ***16.2 Million*** *(*INR***1.62 Crores)*** and the annual budgetary estimate during operational phase is INR ***6.00 Million*** *(*INR ***0.60 Crores)***. The breakup of cost is given in Tables 6-1 and 6-2.

Table 6-1: Environmental Management - Capital Cost

S. No.	Purpose	Cost items	Cost in ₹	Cost in Million
1.	Green Belt Development	Tree (Greenbelt/green areas) Plantation • Total Area – 3.1 ha (Approx) • Spacing – 2.5 m X 2.5 m	874260.00	0.88
2.	Solid Waste Management	Dustbins for waste collection	29652.00	0.03
3.	Capacity Building	Training Workshop	100000.00	0.1
4.	Marine Life Protection out of Oil Spill	Dust exhausting equipment	200000.00	0.2
5.	Dust Sweeper		4500000.00	4.5
6.	Air Pollution Control	Installation of dust suppression systems	7500000.00	7.5
7.	Environmental Monitoring Construction Phase (Additional Facilities)	Marine & Terrestrial Environment	1500000.00	1.5
8.	Oil Water Separator	--	1250000.00	1.25
9.	Soak Pit (2 Nos.)	--	200000.00	0.2
	Total		16153912.00	**16.15**

S. No.	Purpose	Cost items	Cost in	Cost in Million
	Total Capital Cost Rounded off INR 1.62 Crores: (INR 16.2 Million)			

Table 6-2: Environmental Management - Annual Recurring Cost

S. No.	Purpose	Cost items	Cost in	Cost in Million
1.	EMC Recurring Expenditure	• EMC Expenditure	900000.00	0.9
		• Waste Disposal & House Keeping	1200000.00	1.2
2.	Greenbelt Maintenance		383646	0.38
3.	Maintenance of Dust bins		30000	0.03
4.	Awareness campaigns-Training		200000.00	0.2
5	Maintenance of Dust sweepers		1200000.00	1.2
6.	Maintenance of Sprinkler system		1200000.00	1.2
7.	Wetting of Roads		600000	0.60
8.	Oil Water Separator Maintenance		125000	0.13
9.	Soak pit Maintenance		20000	0.02
10.	Statutory compliance for environmental protection	Environmental Monitoring (marine & terrestrial)	100000 (approx)	0.1
	Total		**5958646**	**6.0**
	Total Recurring Cost Rounded off: INR 0.60 Crores (INR 6.0 Million)			

6.2 Environmental Monitoring Programme

Environmental Attributes	Parameters to be monitored	No. of Sampling Locations	Frequency of Monitoring	Standards Methods for Sampling & Analysis	Compliance
Construction Phase					
Air Quality	PM_{10}, $PM_{2.5}$, SO_2,NO_x CO, HC	Five (5) • Project site • Kasarkod • Honnavar • Kulkod • Ramthirth	Once in 2 weeks during entire construction period	Respirable Dust Sampler Fine Particulate Samplers Single Gas Detector Organic Vapour Sampler	National Ambient Air Quality Standards released during November, 2009
Noise Levels	Day and night noise levels	Five (5) • Project site • Kasarkod • Honnavar • Kulkod • Ramthirth	Once in a fortnight during entire construction period	Portable hand-held integrated noise level meter.	National Ambient Noise Standards, GSR 1063 (E), 1989
Water Quality	Physical, Chemical and Bacteriological	Groundwater (2) • Honnavar • Kasarkod Surface water (2) • Sharavati river • Badgani River	Once in a month during entire construction period	Grab sampling and analysis by using standard methods.	IS10500, 1991 drinking water standards for Groundwater and Designated Best Use (Outdoor bathing – Organised) Classification of Inland Surface Water of National Rivers Conservation Directorate, MoEF for Surface Water
Soil	Soil texture, type, electrical conductivity, pH, infiltration, porosity, etc.	Three (3) • Port Site • Honnavar • Kasarkod	Once in a year during construction period	Collection and analysis of samples as per IS:2720	Baseline data
Marine Water Quality	Physical, Chemical and	Six (6) • Dredge Spoil Disposal	Monthly basis both for low tide and	Bottom sampler (Nishkin Sampler) and analysis by	Primary water quality standards for coastal

Environmental Attributes	Parameters to be monitored	No. of Sampling Locations	Frequency of Monitoring	Standards Methods for Sampling & Analysis	Compliance
	Biological	Areas • Near Northern Breakwater • Near Southern Breakwater • Inner Navigation Channel • Saravathi river, near berthing area • Saravathi/Badagani river Mouth (near confluence point)	high tide periods during entire construction period	using standard methods.	water (SW–IV) Given as **Appendix H**
Plankton and Benthic Communities	Phytoplankton, Zooplankton and Benthic Communities	Six (6) • Dredge Spoil Disposal Area • Near Northern Breakwater • Near Southern Breakwater • Inner Navigation Channel • Saravathi river, near berthing area Saravathi/Badagani river Mouth (near confluence point)	Monthly basis during entire construction period	Plankton net of diameter of 0.35 m, No.25 mesh size 63 µ and analysis by using standard methods.	Baseline data
Sediment Quality	Physical, Chemical and Biological	Six (6) • Dredge Spoil Disposal Area • Near Northern Breakwater	Monthly basis during entire construction period	Peterson's Grab Sampler and analysis by using standard methods	Baseline data

Environmental Attributes	Parameters to be monitored	No. of Sampling Locations	Frequency of Monitoring	Standards Methods for Sampling & Analysis	Compliance
		• Near Southern Breakwater • Inner Navigation Channel • Saravathi river, near berthing area • Saravathi/Badagani river Mouth (near confluence point)			
Operation Phase					
Air Quality	PM_{10}, $PM_{2.5}$, SO_2,NO_x CO, HC	Five (5) • Project site • Kasarkod • HonnavarKulkod • Ramthirth	Once in a month	Respirable Dust Sampler Fine Particulate Samplers Single Gas Detector Organic Vapour Sampler	National Ambient Air Quality Standards released during November, 2009.
Noise Levels	Day and night noise levels	Five (5) • Project site • Kasarkod • Honnavar • Kulkod • Ramthirth	Once in a month	Portable hand-held noise level meter.	National Ambient Noise Standards, GSR 1063 (E), 1989
Water Quality	Physical, Chemical and Biological	Groundwater (2) • Honnavar • Kasarkod Surface water (2) • Sharavati river • Badgani River	Once in a quarter of the year	Grab sampling and analysis by using standard methods.	IS10500, 1991 drinking water standards for Groundwater and Designated Best Use (Outdoor bathing – Organised) Classification of Inland Surface Water of National Rivers Conservation Directorate, MoEF for Surface Water
Soil	Soil texture, type,	Three (3)	Once in a year	Collection and analysis of	Baseline data

Environmental Attributes	Parameters to be monitored	No. of Sampling Locations	Frequency of Monitoring	Standards Methods for Sampling & Analysis	Compliance
	electrical conductivity, pH, infiltration, porosity, etc.,	• Port Site • Honnavar • Kasarkod		samples as per IS 2720	
Marine Water Quality	Physical, Chemical and Biological	Six (6) • Dredge Spoil Disposal Area • Near Northern Breakwater • Near Southern Breakwater • Inner Navigation Channel • Saravathi river, near berthing area • Saravathi/Badagani river Mouth (near confluence point)	Once in a quarter of the year	Bottom sampler (Nishkin Sampler) and analysis by using standard methods.	Primary water quality standards for harbour waters (SW –IV) Given as **Appendix H**
Plankton and Benthic Communities	Phytoplankton, Zooplankton and Benthic Communities	Six (6) • Dredge Spoil Disposal Area • Near Northern Breakwater • Near Southern Breakwater • Inner Navigation Channel • Saravathi river, near berthing area • Saravathi/Badagani river Mouth (near	Once in a quarter of the year	Plankton net of diameter of 0.35 m, No.25 mesh size 63 μ and analysis by using standard methods.	Baseline data

Environmental Attributes	Parameters to be monitored	No. of Sampling Locations	Frequency of Monitoring	Standards Methods for Sampling & Analysis	Compliance
		confluence point)			
Sediment Quality	Physical, Chemical and Biological	Six (6) • Dredge Spoil Disposal Area • Near Northern Breakwater • Near Southern Breakwater • Inner Navigation Channel • Saravathi river, near berthing area • Saravathi/Badagani river Mouth (near confluence point)	Once in a quarter of the year	Peterson's Grab Sampler and analysis by using standard methods	Baseline data

6.3 Compliance Reports

- As a part of environmental monitoring programme, following compliance reports shall be submitted to KSPCB.
- Half yearly compliance report on 1st June and 1st December of every calendar year
- Environmental statement for the financial year ending 31st March to KSPCB on or before 30th September every year
- Format for maintaining records of hazardous waste if any in Form 3 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2008
- Format for maintaining hazardous waste imported and exported in Form 10 as per Hazardous Waste (Management, Handling and Transboundary movement) Rules, 2008
- Safety data sheet for hazardous chemicals shall be maintained as per schedule 9 of MSIHC rules, 1989 (amended 2000)
- Format for maintaining notification of major accident in schedule 6 as per MISHC rules, 1989 (amended 2000)
- Water Cess returns in Form 1 as per Rule 4 (1) of Water (Prevention & Control of Pollution) Cess Rules 1978 on or before the 5th of every calendar month

6.4 Plantation Monitoring Programme

Environmental Management team will monitor the following activities of greenbelt development:

- Watering
- Fencing and Nursery shed
- Transport of seedlings/Weeding and soil working
- Application of insecticides
- Pruning (trimming of plant)
- Replacement/ Inter planting

During Operation phase periodic monitoring of application of insecticides, pruning, and replacement will be performed in order to properly maintain vegetation, greenbelt and green cover.

6.5 On-site Mock Drills Requirements

On-site mock drills are very important as employees should know how to react during the time of crisis. Conducting mock drills at regular intervals enhances preparedness and checks the viability of environmental/ disaster management plan. Mock drills are essential for the following reasons:

- Helps in revising/ improving the environmental/ disaster management plan
- Helps to evaluate whether the responsible officials are trained efficiently for the unforeseen event
- Helps in evaluating whether HPPL maintains all the emergency equipment

To ensure efficient environmental/ disaster management, HPPL shall conduct periodic on-site mock drills in case of occurrence of the following activities:

- Fire
- Natural calamities (cyclones, floods, tsunami, earthquakes)
- Collision of vessels calling at barge/vessel loading facility

- Power break down
- Oil spill
- Bomb threats
- War alerts/ terrorist attacks

Mock drills should also involve fire department, police, municipal authorities, hospitals and other department/ agencies that are mandated to provide emergency support to Honnavar Barge/ vessel loading facility. Documenting the outcome of mock drills is an important aspect as this helps in revising the existing plan more efficiently.

CHAPTER 7
ADDITIONAL STUDIES

7 Additional Studies

7.1 Public Hearing

In line with the requirements of EIA Notification, 2006 (as amended) for Category B1 projects, Public Hearing was conducted at Project Site, kasarkod-tonka, honnavar taluk, uttara kannada district for the proposed Barge/Vessel Loading Facility development. For conducting Public Hearing, the Draft EIA Report was prepared in accordance to SEAC approved ToR and Executive summaries in English and Local (Kannada) languages were submitted to Karnataka State Pollution Control Board (KSPCB). The Public Hearing was conducted on January 27, 2012 by KSPCB in the presence of Dy. Commissioner & District Magistrate, Uttar Kannada District. Karwar. Regional State Pollution Control Board Officer, Karwar and Public. The advertisements, Minutes of Meeting (MoM) of Public Hearing are given in **Appendix J**

7.1.1 Responses of HPPL on Views Expressed by Public

Responses provided by HPPL on the each aspects discussed during Public Hearing are given Table 7-1

Table 7-1: Responses of HPPL on Views Expressed by Public

Name of the speaker &Place	Issues Raised	Response of HPPL
1. Smt. Laxmi Algod:	She stated that, • 90% of the local populations are fishermen. They are practicing traditional fishing and depend on it for their livelihood. She stated that, the project proponents have not given clear information about the project.	• The details of the project and its components were well described in Chapter 2 of Draft EIA report as well as in Executive Summaries both in English and Kannada Languages were legally displayed as per the law of the country During Public Hearing also the project development details were spelt in vernacular language out clearly and presented. • The details of the Fishing villages, Fish landing centres, number of families, Fishermen population etc., in the study area and fish catch details were provided in the DEIA report. The details have been collected from the Department of Fisheries and National Information Centre.
	• She expressed concern about adverse effect on public health in case of accidents occurring due to loading of cargo from barges to ship, dust pollution and other problems due to handling of different cargo.	• Proposed facility is barge/vessel loading facility and planned to handle coal, Iron Ore and General Cargo. The loading/ unloading of Barges to ship will not be carried out at the Harbour and will be done at deep waters where the mother ship used to be anchored by taking necessary well accepted pre cautionary measures and adopting best available Technologies and when concerned with the Berth/Vessel loading of cargos, technologically advanced mobile loader cranes will be used which suppress the dust to a maximum extent/captures the dust. • In the event of accidental spills of cargo during transfer from/to the ships, the Spill contingency plan provided in the EIA will be adopted to contain and recover the same at the earliest possible. If the accidental spills will be in harboured waters, since the harbour will be protected by Breakwaters, it would not spread spatially and the response time, containment and recovery (ie remedial measures) will be quicker. • If the accidental spills due to liquid cargo such as Edible oil and fules for barges/vessel, the oil spill contingency plan provided in the EIA

Name of the speaker &Place	Issues Raised	Response of HPPL
		report will be adopted. Depends on the quantities of spill, necessary assistance will be sought from the nearby ports/ coast guard. • The necessary mitigation measures such as Green Belt development and Water Sprinkling etc., to suppress the dust while handling and storage will be followed as a part Environmental Management Plan. Proper dust suppression will be ensured in the port premises.
	• She also expressed that, the study on the said project has been carried out by outside agencies instead of local agencies and University.	• As per MoEF Requirment, QCI, NABET Accredited and Experienced consultant in Port EIA studies is engaged to carry out EIA Study for Proposed Barge/Vessel Loading facility.
	• She expressed doubts on whether the study has been carried out properly or not.	• The study has been carried out as per the ToR prescribed by KSEIAA and the Guidance Manual for Ports and Harbours published by MoEF.
	• She also stated that, there was no clear information in the presentation regarding road, railway track etc. made by the project proponent. • She also expressed that, they were already put into a lot of inconveniences due to the Sharavati project and felt that they are again being made a	Proposed Dedicated Rail/Road Corridor details are provided in the EIA report, Executive Summaries disclosed for public scrutiny before Public Hearing as per the EIA Notification, 2006. Proposed Rail corridor connecting project site to Manki railway station of 15.0 km and proposed road connecting project site to NH-17 of 4.0 km will be constructed as a part development. The proposed facility will be developed strictly adhering the Environmental Management Plan suggested in the EIA to ensure the development as a sustainable one.

Name of the speaker &Place	Issues Raised	Response of HPPL
	scape goat and felt it was not justifiable.	
	• She further expressed is it was justified to give good health facilities as assured by the project proponent after spoiling the health of the local community by establishing this kind of project.	As a part of Corporate Social Responsibility (CSR), to improve the medical facilities and Health Environment conditions, HPPL is proposed to provide better health services such as Strengthening area Government hospitals by assisting them in procurement of essential medical equipments and Providing quality health care through regular medical camps. The impacts due to the proposed development and necessary mitigation measures to render these impact as insignificant was addressed in the EIA report and the respective budgetary provision to implement the mitigation measures is made as a part of EMP.
	• She expressed that, the project proponent has mentioned that, the main cargo handled in the project is coal, but at present situation, there is already scarcity of coal to the industries that use it as raw material, in this situation the coal handling as main activity is false and they have hidden plans to handle Iron Ore.	The proposed barge/vessel loading facility is planned to handle coal, Iron Ore and Other General cargo and the same was mentioned in the EIA report, Executive Summaries and During Public Hearing Presentation also. The developer is committed to the national regulations and therefore Iron ore will be handled as and when the handling is legally permitted. As true to the report submitted we are handling coal as our major cargo and which is imported to fulfil the requirement of the hinterland coal dependent industries. This will cater to the scarcity of the coal in the hinterland.

Name of the speaker &Place	Issues Raised	Response of HPPL
	• She further expressed the project cost ` 450. Crores will be collected from local community and fishermen in the form of taxes.	The project will be developed by HPPL and the company is registered under the laws of the country. HPPL is committed to follow all the regulatory requirements of the country only. Entire investment of Rs.450 Crores is made by HPPL only. The government is not investing anything therefore the question of imposing taxes does not arise
	• She also informed that, they have seen fishing activity suffered due to discharge of waste water by fish processing unit in the areas during earlier days.	As per our EIA/EMP commitments ,no discharge of wastewater/waste from the Barges/vessel calling at Honnavar Barge loading facility will be permitted into the area. There will not be any discharge in to the sea from the proposed barge/vessel loading facility.
	• Further, she also expressed that, public hearing notification is given like tender notification & failed to attract attention of the public.	Advertisement regarding the date of public hearing and venue and project detail etc, were given in Newspapers in local and English Languages as per the procedure for conduct of public hearing given in the EIA Notification 2006.
	She expressed that, the project proponents have planned to establish the project without giving information to public. Hence, she on behalf of public and women organizations is opposing the said project.	

Name of the speaker &Place	Issues Raised	Response of HPPL
2. Smt. Laxmi Naik, Snehakunja, Honnavar	She expressed that, it is not right to organize public hearing without giving proper report of the project to the public.	Advertisement regarding the date of public hearing and venue and project detail etc, were given in Newspapers in local and English Languages as per. the procedure for conduct of public hearing given in the EIA Notification 2006. The necessary Document such as Executive Summaries (Both in English and Kannada), Copy of DEIA were submitted to KSPCB and the same was displayed in Deputy commissioners office, Karwar Chief Executive officer - Karwar District Industries Center,Karwar hasildhar's office - Karwar. Thasildhar's Office - Honnavar. Taluk/Town Panchayat - Honnavar. Gram Panchayat - Kasarkod. Zilla panchayat - Karwar. Library - Karwar. Library - Honnavar. KSPCB - Karwar. KSPCB - Bangalore. CRZ office - Karwar. Asst Commissioner - Bhatkal. Asst Commissioner - Kumta. (Acknowledgement for the same is also obtained by KSPCB)by KSPCB.
	Further she expressed that, this project will create local employment only during the construction phase and is doubtful whether locals will be employed once the project is operational.	It is estimated that during construction stage & operation stage the employment generation will be about 500 & 50 people respectively. Based on the skill set of the people such as skilled, semi skilled and unskilled, the preference will be given to the local people during the operation stage.

Name of the speaker &Place	Issues Raised	Response of HPPL
	Further she mentioned that the project proponent is misleading the public by stating this project will help local fishing boats in their activity because once the project is completed and is in full operation, this area will become prohibited area and local fishing boats will not have access to the area.	Fishing Vessel movements and access will not be prohibited even during the operation phase. This is one of the commitments to the state and we are bound to follow these and more over we need all support and well wishes of all sections of the local communities There is a capsizing of fishing vessels near the river mouth due to insufficient depth. Creation of approach channel and provision breakwater as a part of the development which will rule out the capsizing incidence. Safe navigation routes will be earmarked for movement of fishing vessels and the route will be finalized in consultation of fishing harbour authorities and fishing communities. Awareness will be given to fisherman about the barge/vessel movement's time schedule and clearances required for safe manoeuvring etc., During berthing of barges/vessels, necessary clearances shall be made available to ensure the fishing vessels movements.
	She informed that, the proposed project proponent have not given clear picture of survey number of the 109 acres of land to be acquired by the project.	As this being a reclaimed land it does not have any survey numbers at the moment. Thashildhar is in the process of carrying out the survey of the existing land and provide new survey numbers to them.

Name of the speaker &Place	Issues Raised	Response of HPPL
	She also shared her experiences during the health survey conducted by their organization in the Kaiga area and stated that, the local people of the Kaiga area were not provided medical facilities by Kaiga authorities, though there is a very good hospital in Kaiga established by Kaiga authorities. She expressed fear that the same will be repeated in the present project.	We are not aware of the Kaiga situation but we are committed to provide the promised services to the local communities. As a part of Corporate Social Responsibility (CSR), to improve the medical facilities and Health Environment conditions, HPPL is proposed to provide better health services such as Strengthening area Government hospitals by assisting them in procurement of essential medical equipments and Providing quality health care through regular medical camps.
	She objected to the acquisition of land for development of railway line and road for the project as land holdings of local people are very less.	A new independent access road is being developed for the traffic to and from the facility, without disturbing the existing roads by the facility traffic The alignment is planned in such a way that it has minimum disturbance to the local communities. More over the road is not an access controlled therefore the local public also can use the road for their needs.
	She insisted to give detail project report of the said project to the local fishermen community.	Before Public Hearing, the necessary Documents such as Executive Summaries (Both in English and Kannada), Copy of DEIA were submitted to KSPCB and the same was displayed in Thashildhar's office, Honnavar, Town Panchayat Honnavar, Gram panchayat, Kasarkod (Acknowledgement for the same is also obtained by KSPCB) by KSPCB for Public.
3. Shri. K. Ramesh, Snehakunja, from Ankola	He stated that, project proponents are misleading the locals by stating that, the proposed project is only for barge and vessel loading facility, instead they are trying to handle hazardous cargo like Iron ore,	The proposed facility is a Barge/Vessel Loading facility only and planned to handle 4.9 MTPA of cargo. This facility will handle coal, Iron Ore and Other General cargo and the same was mentioned in the EIA report, Executive Summaries and During Public Hearing Presentation also.

Name of the speaker &Place	Issues Raised	Response of HPPL
	Oil, Coal etc	
	and trying to conduct public hearing under heavy police protection creating fear among local people to express their factual opinions. He complained that, the activities viz. handling of iron ore, coal, oil are not mentioned in the paper notification published.	Advertisement regarding the date of public hearing and venue and project detail etc, were given in Newspapers in local and English Languages as per the procedure for conduct of public hearing given in the EIA Notification 2006. The Public Hearing was conducted by KSPCB as per the procedures and the proceedings of the same were forwarded to respective authorities.
	He explained that, while he was residing at Ankola he has experienced the adverse effect on the environment and safety problems faced during handling of iron ore at Belekeri. He explained details of environmental pollution and nuisance to public during handling of iron ore iron ore at Belekeri Port which has caused financial loss to Govt and other problems faced by common public is well known to the entire nation. He complained that the	The proposed facility will be developed strictly adhering the Environmental Management Plan suggested in the EIA to ensure the development as a sustainable one. Fishing Vessel movements and access will not be prohibited even during the operation phase. Safe navigation routes will be earmarked for movement of fishing vessels and the route will be finalized in consultation of fishing harbour authorities and fishing communities. Awareness will be given to fisherman about the barge/vessel movement's time schedule and clearances required for safe manoeuvring etc., During berthing of barges/vessels, necessary clearances shall be made available to ensure the

Name of the speaker &Place	Issues Raised	Response of HPPL
	local people who handed over their land to project like Kaiga, Sea bird did not get benefit from the project and also are not made a part of the decision making process in the said project and expressed fear that, same will be repeated in the said project also. He stated that he is totally opposed to the proposed project, which is proposed to handle commodities like iron ore and coal because this activities will create environmental damage in the area and also health problems to the local people besides traffic congestion in the area and affect traditional fishing activity of local fishermen on which they depend for their livelihood.	fishing vessels movements.

<table>
<tr><th>Name of the speaker &Place</th><th>Issues Raised</th><th>Response of HPPL</th></tr>
<tr><td>4. Shri Abdul Hussain, Masjid Secretary, Honnavar</td><td>He stated that, project proponents have not given detailed report regarding the requirement and usability of land for the proposed project.</td><td>The land required for the development of Barge/ Loading Facility is 44 Ha. The layout Showing the same is presented in the DEIA report. The proposed land use Pattern is given below.
<table>
<tr><th>S.No</th><th>Description</th><th>Area (Ha)</th></tr>
<tr><td>1.</td><td>Coal Stockyard</td><td>7.00</td></tr>
<tr><td>2.</td><td>Iron Ore Stockyard</td><td>1.80</td></tr>
<tr><td>3.</td><td>General Cargo Storage (Open)</td><td>4.00</td></tr>
<tr><td>4.</td><td>General Cargo Storage (Closed)</td><td>2.00</td></tr>
<tr><td>5.</td><td>Liquid cargo storage</td><td>0.10</td></tr>
<tr><td>6.</td><td>Roads and Circulation Area</td><td>8.15</td></tr>
<tr><td>7.</td><td>Operation Building</td><td>0.05</td></tr>
<tr><td>8.</td><td>Canteen</td><td>0.02</td></tr>
<tr><td>9.</td><td>Vehicle Parking</td><td>0.09</td></tr>
<tr><td>10.</td><td>Substation</td><td>0.02</td></tr>
<tr><td>11.</td><td>Gate House/Security/Weigh Bridge</td><td>1.50</td></tr>
<tr><td>12.</td><td>Truck Parking</td><td>5.40</td></tr>
<tr><td>13.</td><td>Fuel Station</td><td>0.02</td></tr>
<tr><td>14.</td><td>Control Tower</td><td>0.01</td></tr>
<tr><td>15.</td><td>Green Belt</td><td>3.10</td></tr>
<tr><td></td><td>Sub total</td><td>33.26</td></tr>
<tr><td>16.</td><td>Area available for other Operations and area earmarked for future expansion</td><td>6.72</td></tr>
<tr><td>17</td><td>Rock armour area(approx)</td><td>4.00</td></tr>
<tr><td></td><td>Total</td><td>44.00</td></tr>
</table></td></tr>
<tr><td></td><td>He added that, the project proponents have not included mitigation measures for oil spillages problem due to operation of project in the area.</td><td>Mitigation measures for oil spillages were addressed in the EIA report. The barge/vessel loading facility will be equipped with minimum equipment to contain and recover oil spills. Oil spill control equipment such as booms / barriers will be provided for containment and skimmers will be provided for recovery. In case of any cargo spillage during transfer from/to mother ships, Barges/ Vessels, it will be attempted to recover the spills. If the accidental spills</td></tr>
</table>

Name of the speaker &Place	Issues Raised	Response of HPPL
		will be in harbor waters, it would not spread spatially and the Response time for shutting down the fuelling, containment and recovery will be quicker.
	He expressed concern that the sea eco system in vicinity of the project would be disturbed due to operation of said project and there may lead to extinction of certain species of fishes which are observed only in this area.	The impact on Biological Environment (Coastal and Marine Ecology) due to the proposed barge/vessel loading facility and respective mitigation measures is addressed in the EIA report. The proposed port will be developed strictly adhering the Environmental Management Plan suggested in the EIA to ensure the development as a sustainable one. The post project monitoring covering marine environment monitoring will also be carried out.
	He complained that, the project proponents have not informed the local Panchayat, so as to prevent public from attending the public hearing and expressed strong objection to the proposed project in the area.	Advertisement regarding the date of public hearing and venue and project detail etc, were given in Newspapers in local and English Languages as per the procedure for conduct of public hearing given in the EIA Notification 2006. Before Public Hearing, the necessary Documents such as Executive Summaries (Both in English and Kannada), Copy of DEIA were submitted to KSPCB and the same was displayed in Deputy commissioners office,Karwar Chief Executive officer – Karwar District Industries Center,Karwar Thasildhar's Office - Karwar. Thasildhar's Office - Honnavar. Taluk/Town Panchayat - Honnavar. Gram Panchayat - Kasarkod. Zilla panchayat - Karwar. Library - karwar. Library - Honnavar. KSPCB - Karwar. KSPCB - Bangalore. CRZ office - Karwar. Asst Commissioner - Bhatkal. Asst Commissioner - Kumta.

Name of the speaker &Place	Issues Raised	Response of HPPL
		(Acknowledgement for the same is also obtained by KSPCB) by KSPCB for Public. English & Kannada Executive Summary, DEIA report were placed in the respective office on 22nd December 2011. Pamphlet distribution and Auto announcement was conducted in the local region (specifically giving more priority to Kasarkod area) on 25th January 2012.
5. Shri M. N. Subramanya, Advocate, Honnavar	He stated that the location is ecologically sensitive as it is an estuary point of Sharavati river joining the Arabian Sea and that the location is critically sensitive for marine ecology as big fish and particular species of fishes depend on this area for their breeding activity. He expressed fear that there would be ecological imbalance of marine ecology due to development and operation activities of the project and requested presiding officer not to allow such project in the area in the larger interest of sustaining ecological balance of marine life in the region.	Impact on River Confluence Point/River Mouth due to the proposed barge/vessel loading facility is studied by appropriate mathematical modeling and other marine biological studies and addressed in the EIA report. Breakwater construction will lead to accretion/erosion on coast adjacent to that. These will change the morpho dynamics of the river mouth/inlet which leads to reduction in tidal water flow in the water body. Reduction in tidal exchange will affect the biodiversity. Hydrodynamic Model Studies and other model studies ensures that changes the morphodynamic of the river mouth is not significant. This will ensure the tidal water exchange and thereby maintain the bio diversity. However, as a part of EMP, both water quality monitoring and shoreline monitoring will be carried out during construction as well as operation phases of the project.
	He also expressed that the project proponent have not mentioned about the applicability	Coastal Regulation Zone compatibility of the proposed barge/vessel loading facility is discussed in Chapter 2 of EIA report.

Name of the speaker &Place	Issues Raised	Response of HPPL
	of CRZ Notification, 2011 for the said project at the said area. He questioned that the CRZ notification was applied to construction of houses for fishermen and not done in the case of big projects like this.	Physical demarcation of HTL, LTL and delineation of CRZ setbacks for the project site were carried out by Centre for Earth Science Studies (CESS). Based on the perusal of the CRZ Notification, 2011 and the HTL/LTL survey outcome, following are the inferences arrived: • Proposed site falls on the sandy beach near the river mouth. • CRZ Setback lines indicate that the proposed barge/ vessel loading site mostly falls within the CRZ I (B) (i.e. Area between LTL and HTL) ,CRZ (III) undeveloped rural area and CRZ IV (near shore waters and back waters). • Proposed location does not contain environmentally sensitive areas such as National parks / marine parks, sanctuaries, wildlife habitats, corals / coral reefs. It also does not include breeding and spawning grounds of fish and other marine life, area of outstanding natural beauty / historically / heritage area, area rich in genetic diversity. Based on perusal of Coastal Regulation Zone (CRZ) Notification, 2011 and Karnataka Coastal Zone Management Plan (CZMP), Proposed Honnavar barge/vessel loading is a permissible activity in CRZ as it requires waterfront and foreshore facilities. The project layout superimposed on HTL, LTL and CRZ setbacks is given the EIA Report.
	He expressed fear that, the operation of such project would create shortage of electricity in the entire Honnavar Taluk.	Power requirement during construction phase is expected to be around 1 MVA. The power demand is estimated at 1 MVA during operation. Construction phase power requirement will be met from DG sets and operation phase power will be drawn from Substation located at Honnavar (~2 km) after obtaining the necessary permissions from respective Electricity department. Hence, no competitiveness with the local people is envisaged.

Name of the speaker &Place	Issues Raised	Response of HPPL
	He expressed his dissatisfaction over absence of information on rehabilitation, alternative business to affected fisherman community due to the proposed project. He also expressed dis-satisfaction over the information given with regard to employment generation to local people and expressed strong objection to proposed project in the area.	HPPL has been allotted to use the government land of 44 hectares by Government of Karnataka near Sharavati river mouth in Kasarkod Tonka village to develop a barge/vessel loading facility. There are no land acquisition and encroachers involved. It is estimated that during construction stage & operation stage the employment generation will be about 500 & 50 people respectively. Based on the skill set of the people such as skilled, semi skilled and unskilled, the preference will be given to the local people during the operation stage.
6. Shri. Nivel Fernadis, Secretary Pershian Boat owners association, Honnavar	He expressed pollution of the sea and surrounding area due to operation of said project, which would directly affect the fishing activity in the area. He opined that, project will create water scarcity in the area.	No discharge of wastewater/waste from the Barges/vessel calling at Honnavar Barge loading facility will be permitted into the area. There will not be any discharge in to the sea from the proposed barge/vessel loading facility. Water requirement during the construction is expected to be around **15m^3/day.** Water demand during operational phase of barge/ vessel loading facility is estimated as **7m^3/day**. The water requirement will be met from Karnataka Rural water supply and sanitation agency which includes supply to Barge/vessels, staff and users. In addition to that water required for dust suppression system and fire fighting will be sourced from Sharavati River. Hence, no competitiveness with the local people is envisaged.
	He expressed doubt of controlling generation of dust by proposed tarpaulin cover on ore storage heaps as wind velocity in the area is very high and expressed fear of dust nuisance to the surrounding areas	Dust suppression equipment will be provided for efficient control of dust pollution on environment during storage and handling of Coal and Iron ore at berth and stockyard. An efficient dust suppression system will contain dust particles before it is airborne. A common system consisting of suitable pump, storage tank, nozzles have been proposed for efficient dust control system. Dust control is envisaged at following locations: 1) barge/ vessel loading /unloading area 2) Stockyards

Name of the speaker &Place	Issues Raised	Response of HPPL
		Water sprinkling system at high pressure with swivelling type nozzles will be installed to cover entire stockpile. Nozzles will be installed on pipes at different levels from ground. Nozzles will be installed along stockpile at regular intervals to cover stockpile height and width.
	He requested to construct break water in the alive area (River joining Sea) area which would facilitate the fishermen.	As a part of development, construction of Southern and Northern Breakwater are envisaged and navigational channel was planned in between the breakwater as well as in the said alive area (river joining sea). Hence this arrangement of breakwater as well as navigation channel will help the fisher folk to navigate their fishing vessels very safely.
	He pointed out that, project proponent have not given a clear picture of vehicular movement and proposed route for the project area and proposed mitigation methods to avoid nuisance created due to movement of heavy vehicles during development and operational phase He objected to the said project in order to avoid environmental damage and to avoid problems that would be created due to vehicular movement of the project.	Proposed road connectivity starts from NH 17 at Kasarkod. This road will then run south east for some distance and then aligns parallel to the shoreline till it reaches the proposed project site. This will be parallel to the existing single lane road at an offset distance of 100 m. The total length of this road from NH 17 to the proposed site is 4.0 km. This road connectivity will have a width of 25 m. Proposed railway line will take off from the existing railway station at Manki. The new railway line will have to be laid for a distance of 14.6 km from Manki railway station to the proposed project site. Proposed railway line will run parallel to existing railway line for a length of about 8 km and then will take a turn towards sea coast which will then run parallel to the sea coast till the proposed project site for the remaining 6.6 km. Anticipated Potential impacts due to the proposed Rail/Road alignment and respective mitigation measures are provided in the EIA report.

Name of the speaker &Place	Issues Raised	Response of HPPL
7. **Shri. Abdul Khadar, local resident, Honnavar:**	He stated that, maximum fisherman living in this area have migrated from Mallukurva area which was destroyed due to flood and till date have not obtained their land rights from the Govt. He informed that, most of the fishermen in the area are holding small lands and expressed fear that, their land may be acquired for the said project and they may be evacuated from the area without suitable rehabilitation as they do not have land records in their names.	As there is no land acquisition , so there is no rehabilitation is envisaged.
	He expressed his dis-satisfaction on preparation of project report by the people who have no knowledge of local geology.	QCI, NABET Accredited and Experienced consultant in Port EIA studies is engaged to carry out EIA Study for Proposed Barge/Vessel Loading facility.
	Further, he questioned the permission given for the project since the same is denied for local poor people since 1974.	Directorate of Ports and Inland Water Transport Department, Government of Karnataka signed a lease agreement with HPPL to develop Honnavar Port. Based on perusal of Coastal Regulation Zone (CRZ) Notification, 2011 and Karnataka Coastal Zone Management Plan (CZMP), Proposed Honnavar barge/vessel loading is a permissible activity in CRZ as it requires waterfront and foreshore facilities.
8. Shri. Basha Ahmed Patel, Gram	He informed that, he came to know about the proposed project very recently as a result of which he could not understand the	Advertisement regarding the date of public hearing and venue and project detail etc, were given in Newspapers in local and English Languages as per the procedure for conduct of public hearing given in the EIA Notification 2006. Before Public Hearing, the necessary Documents such as Executive

Name of the speaker &Place	Issues Raised	Response of HPPL
Panchayat Member, Honnavar	project as there was lack of publicity given about the proposed project.	Summaries (Both in English and Kannada), Copy of DEIA were submitted to KSPCB and the same was displayed in Deputy commissioners office,Karwar Chief Executive officer – Karwar District Industries Center,Karwar Thasildhar's- office - Karwar. Thasildhar's Office - Honnavar. Taluk/Town Panchayat - Honnavar. Gram Panchayat - Kasarkod. Zilla panchayat - Karwar. Library - karwar. Library - Honnavar. KSPCB - Karwar. KSPCB - Bangalore. CRZ office - Karwar. Asst Commissioner - Bhatkal. Asst Commissioner - Kumta

Name of the speaker &Place	Issues Raised	Response of HPPL
	He also informed that school, masjid, temples and residential area are situated on the way to the proposed project as well as the proposed road and railway track. He also informed that the school, religious places and residential areas will be affected if the project is allowed to come up. He objected to the development of road and railway track as it will affect local ecosystem.	Proposed road connectivity starts from NH 17 at Kasarkod. This road will then run south east for some distance and then aligns parallel to the shoreline till it reaches the proposed project site. This will be parallel to the existing single lane road at an offset distance of 100 m. The total length of this road from NH 17 to the proposed site is 4 km. This road connectivity will have a width of 25 m. Proposed railway line will take off from the existing railway station at Manki. The new railway line will have to be laid for a distance of 14.6 km from Manki railway station to the proposed project site. Proposed railway line will run parallel to existing railway line for a length of about 8 km and then will take a turn towards sea coast which will then run parallel to the sea coast till the proposed project site for the remaining 6.6 km. Proposed road/rail alignment will traverse across the coastal sand and barren land. The alignment is selected such a way that there will not be any disturbance to the existing structures. The proposed road connectivity is not an access controlled private facility and hence local people will be allowed to use as required. Anticipated Potential impacts due to the proposed Rail/Road alignment and respective mitigation measures are provided in the EIA report.
	He expressed surprise over Govt. officers attending the public hearing when they failed to visit the area during the recent floods. He welcomed the Deputy Commissioner for her first visit to the area and requested for basic infrastructure for the fishing activities and also strongly objected to the proposed project.	--

Name of the speaker &Place	Issues Raised	Response of HPPL
9. Shri. Umesh Mesta, Society Chairman, Honnavar	He stated that, project proponent have not obtained clearance from CRZ as CRZ notification is applicable to the project. He also expressed that the proponents have failed to present clear picture of the proposed project. He also objected for the project on behalf of the Society.	Final EIA report is prepared based on the proceedings of the public hearing with necessary responses for the clarifications raised by the public. The same will be submitted to the respective CZMA authorities to obtain CRZ Clearance. The proponent is legally bound to obtain all clearances as per the regulatory frame work of the country. This public hearing is also part of the legal process to obtain all clearances required for the project. • The details of the project and its components were well described in Chapter 2 of Draft EIA report as well as in Executive Summaries both in English and Kannada Languages. During Public Hearing also the project development details were spelt out clearly and presented.
10. Shri. J.D.Naik, MLA, Honnavar	He informed that, he was attending the public hearing as a public representative. He expressed that he was in support of the project if it fulfills long pending demand for development works such as construction of break water, Dredging, harbor development which will facilitate the local fishermen community in their fishing activity.	As a part of proposed development, construction of Breakwater, Dredging etc., will be carried out.

Name of the speaker &Place	Issues Raised	Response of HPPL
	However he was opposed to the project if the life of the local community, their profession & business are likely to be affected. He also informed that the final say on the proposed project was entirely dependent on the will of the local community and that he would stand by their decision.	Construction activities involve dredging, construction of cargo berths which may likely to disturb the fishing activity at nearyby villages. However, necessary marker buoys shall be installed and interactions shall be initiated with the fishing communities about the marker buoys indicating the areas of operation so that they may avoid those areas during construction period. During operation phase, barges/vessels movements may hinder the fishing vessels approach to the fish landing wharf and to the sea. Awareness will be given to the fishermen about the barges/vessels movement's time schedules and clearances required for safe maneuvering etc., During berthing of barges/vessels, necessary clearances shall be made available to ensure the fishing vessels movements.

7.2 Preliminary Risk Analysis

7.2.1 Hazard Identification

A classical definition of hazard states "hazard is in fact the characteristic of a system/plant/process that presents potential for an accident." Hence, all the components of a system such as process, storage of chemicals, etc., need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident.

Hazards in the proposed facility were identified in this section in terms of:

- Hazards during Construction Phase
  - Mechanical Hazards
  - Transportation Hazards
  - Physical Hazards
  - Storage and Handling of Hazardous Materials
- Hazards during Operation Phase
  - Material Hazards
  - Handling Hazards
- Hazards due to Natural Calamities
  - Earthquake
  - Tsunami
  - Cyclone

The summary of potential hazards and the probable impacts are given in the Table 7-2.

Table 7-2: Summary of Potential Hazards

S. No	Potential Hazard	Probable Impacts
Man Made		
1	Berthing Accidents	Impact on jetty (mooring, structure)
2	Carrier Running Aground	Oil Spills, Wreckage
3	Fuel/ Oil Spills, Leaks	Impact on aquatic (marine) environment
4	Break/leak in	Asphyxiation/ breathing problems due to fine dust in the air, shutting down of operation
5	Cargo loading/Unloading	Failure of loaders/unloaders may result in cargo deposition in sea and settling on seabed
Natural		
1	Tropical Storms, Cyclones, Heavy Rain	Rough seas during particular seasons during which carrier berthing is not possible; accidents due to collision with jetty
2	Earth Quake/Tsunami	Damage buildings and equipment, inundation of jetty
Others		
1	Fire	Fire outbreaks can vary in size and location can cause extensive damage
2	Accident	Can occur at any time especially due to falling debris during construction; operation procedure

7.2.2 Hazards during Construction Phase

Potential hazards during the construction phase of the project could be due to the mechanical hazards, navigation/ transportation hazards, physical hazards and storage and handling of hazardous materials.

Mechanical Hazards: Mechanical hazards during the construction phase arise due to the moving parts in the machinery, especially the belts and bolts of the construction equipment, which are heavy and pose a threat to the work personnel. Other hazards include falling (during working at heights), falling objects like hand held tools, etc; failure of slips and traps created for scaffolding; and due to faulting of electrical equipment.

Navigation/ transportation Hazards: The planning of access/egress to the construction site also plays a significant role in minimizing the associated hazards such as vehicles collision.

Physical Hazards: The noise and vibrations generated during the construction phase may affect the workers health, hinder effective communication and may jeopardise sensitive organs. In addition to noise and vibration, hot works also pose a considerable hazard to the workers.

Storage and handling of hazardous materials: During the construction period, storage of hazardous materials like fuel for the engines, lubricants, paints and other flammable materials is likely to pose a fire and explosion risk. Due care shall be taken in locating these materials away from the work place, free of any influence of temperature or sparks or fire. Proper wiring of the electrical appliances like lights, exhausts, etc., would be made to ensure that there are no live wires causing short circuits to ignite these materials.

7.2.3 Hazards during Operational Phase

Material Hazards: The proposed Barge/ vessel loading facility handles coal, iron ore, edible oil, fertilizer and other general cargo which can be classified as non-hazardous.

Hazard Intensity Classification

The hazard ratings of various cargos proposed to be stored in the barge/vessel loading facility w.r.t National Fire Protection Agency (NFPA) rating is provided in Table 7-3.

Table 7-3: NFPA Ratings of Various Materials

S. No.	Material	Properties	NFPA Hazard Intensity			Hazards due to Human Exposure
			H	F	R	
1	Coal	• Melting Point: 750°F • Flash Point: >260°F • Auto Ignition Temperature: 260-365°F	1	1	0	• The chronic stage involves massive pulmonary fibrosis that does impair pulmonary function and shorten life. • Chronic Bronchitis (lung inflammation, coughing attacks, difficult breathing,

S. No.	Material	Properties	NFPA Hazard Intensity			Hazards due to Human Exposure
			H	F	R	
						etc.) and emphysema can result from excessive coal dust inhalation. • Rheumatoid arthritis can be exacerbated by pneumonias leading to rapidly developing lung damage (Caplan's Syndrome).
2	Iron Ore	-	1	0	0	• Inhalation may cause irritation to mucous membranes • Skin & eye contact may cause irritation

H: Health

- 0: Material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.
- 1: Material that on exposure would cause irritation but only minor residual injury.
- 2: Material that on intense or continued but not chronic exposure could cause temporary incapacitation or possible residual injury.
- 3: Material that on short exposure could cause serious temporary or residual injury.
- 4: Material that on very short exposure could cause death or major residual injury.

F: Flammability (Susceptibility of material to burning)

- 0: Will not burn.
- 1: Must be preheated before ignition can occur.
- 2: Must be moderately heated or exposed to relatively high temperature environment before ignition can occur.
- 3: Can be ignited at almost all temperatures.
- 4: Will rapidly or completely vaporize at atmospheric pressure and normal temperature or will rapidly disperse in air and burn easily.

R: Reactivity (Susceptibility of Material to release Energy either by themselves or in combination with other materials)

- 0: Normally stable; even under fire exposure conditions.
- 1: Normally stable except in combination with certain other materials or at elevated temperatures and pressures.
- 2: Normally unstable; readily undergoes violent chemical change at elevated temperature and pressures.
- 3: Can detonate or explode under a strong initiating force or after heating under confinement.
- 4: Readily detonates or explodes at normal temperatures and pressure.

Coal

Fire hazard: Coal is susceptible to spontaneous combustion, most commonly due to oxidation of pyrite or other sulphidic contaminants in coal.

Coal reacts with atmospheric oxygen even at ambient temperatures and this reaction is exothermic. If the heat liberated during the process is allowed to accumulate, the rate of the above reaction increases exponentially and there is a further rise in temperature. When this temperature reaches the ignition temperature of coal, the coal starts to burn and the phenomena is described as spontaneous combustion.

Initiation of spontaneous combustion is through development of hot spots in the coal stockpiles. The significant factors to be considered for prevention of this development are as follows:

- Ventilation
- Coal Quality: low carbon content and large amounts of volatile components support combustion
- Particle Size: the smaller the particles, the larger the surface, the higher the risk
- Stockpile Design
- Humidity

Dust explosion: Coal dust is prone to ignition depending on its concentration in air and presence of ignition sources. Coal dust therefore represents a significant explosion hazard in coal storage and handling facilities where coal dust clouds may be generated in enclosed spaces. The significant factors which contribute to the dust explosion are:

- Concentration of dust in suspension
- Sufficient oxygen to enable combustion
- Source of energy for ignition
- A certain degree of confinement of the suspended dust mixed with oxygen

This hazard is associated with empty Barge/ vessels, unloaders and hoppers.

Health hazards: Coal dust poses a possibility of reduced lung function. Workers exposed to coal dust may develop lung damage and pulmonary fibrosis. The occupational exposure standard (OES) for coal dust is 2 mg/m^3 of respirable dust (Exposure limit eight-hour TWA). OES is the level of dust at which there is no evidence of injury to people exposed day after day.

7.2.3.1 Handling Hazards

Cargo handling:. The major components of proposed Barge/ vessel cargo handling system are Barge loaders, Mobile Harbour Cranes and pay loaders etc.,

Barge/ vessel movements: The possible hazards during Barge/ vessel movements at the barge/ vessel loading facility are collision, grounding, etc.

Barge/ vessel unloading: During Barge/ vessel unloading operations, the possible hazard may arise due to collision by other Barge/ vessels and others.

Transfer operation: The transfer operation involves transfer of cargo from mother ship to Barge/ vessel and Barge/ vessels to stock yard or others. During this operation there is a possibility of mal-operation/non-synchronisation/misalignment leading to cargo spillage.

7.2.3.2 Hazards due to Natural Calamities

Earth Quake: As per Seismic Zoning Map of India, the project area falls under Zone-III (moderate to low risk zone) as per the IS: 1893, Part-I, 2002. The design of the facilities should incorporate this factor which would give the required structural integrity.

Cyclone/Tsunami: Karnataka is one of the cyclone prone areas in west coast of India. In general west coast experienced less inundation during December 2004 Tsunami. However, necessary mitigation steps shall be taken during cyclone as per Cyclone Contingency Plan and during Tsunami as per "Ship Action Policy against Tsunami".

7.2.4 Enumeration of Potential Accidents

The possible accidents from the proposed barge/vessel loading facility are envisaged from the spontaneous ignition of coal.

Fire due to spontaneous combustion of coal dust: Coal dust when dispersed in air and ignited would explode. Stock yards are most susceptible to this hazard. To be explosive, the dust mixture should have:

- Particles dispersed in the air with minimum size
- Dust concentrations must be reasonably uniform
- Minimum explosive concentration for coal dust (33% volatile) is 50 g/m^3.

Failure of dust extraction and suppression systems may lead to abnormal conditions and increasing the concentration of coal dust to the explosive limits. Sources of ignition present are incandescent bulbs with the glasses of bulkhead fittings missing, electric equipment and cables, friction, spontaneous combustion in accumulated dust.

Dust explosions may occur without any warnings with maximum explosion pressure up to 6.4 bar. Another dangerous characteristic of dust explosion is that it sets off secondary explosions after the occurrence of the initial dust explosion. Many a time, the secondary explosions are more damaging than primary ones.

The dust explosions are powerful enough to destroy structures, kill or injure people and set dangerous fires likely to damage a large portion of the Coal Handling Plant.

7.2.5 Safety Features

The built in safety features in the proposed facility are given in this section.

Fire fighting facilities shall be provided with fire hydrant systems and jockey pump. Based upon the type of fire, additional combustible material onsite fire extinguishers of Class A, B, and C will be planted to suppress/prevent the spreading of the fire. The fire fighting facilities (hydrant system etc.) to be provided in the barge/vessel loading facility are discussed below:

The fire fighting in the port shall consist of the following:

- Fire protection
- Fire alarms
- Fire-fighting equipment
- Means of escape in case of fire

- All sources of ignition (especially in the warehouses) shall be highly controlled. Appropriate use of fire fighting equipment shall be provided throughout the barge/vessel loading facility area.
- All portable fire-fighting equipment shall be grouped at clearly marked fire points, which are marked with conspicuous signs and markings. The choice of fire fighting equipment depends on the nature of the cargo stored.
- The entire barge/vessel loading facility area shall be provided with fire fighting system, which must include portable first-aid fire extinguishers and fixed system (Hoses and hydrant) and the same shall be tested at regular intervals and renewed periodically.
- In accordance with the International & National guidelines and codal requirement, the type, location and number of fire fighting equipment shall be determined
- Fire points shall not be more than 80 m apart and they shall be marked clearly with signs and shall be visible at all times, it shall be located in such a way that fire fighting system is brought into action quickly (Hydrants at warehouses shall be close to doors)
- Depending upon the type of fire, which may likely to occur and nature of material involved, the fire fighting agents shall be selected. Catastrophe may occur if an improper fire-fighting agent will be selected.
- Commonly used fire-fighting agents are water, foam, carbon dioxide and powder. In most of the cases when water shall be used as the fire-fighting agent, the intake mains should be below water at any point of time and protected from damages.

7.2.5.1 Fire Hydrant System

The system comprises of a main working pump set, a stand-by main pump set, Jockey Pump Set and a network of hydrant main's with Single Headed Hydrants, double heated hydrants, Fire Escape Hydrants for staircases & all accessories.

- Jockey pump set, min. 1 no. shall be provided to:
- Maintain the water pressure in the Hydrant line.
- Provide a means of pumping pressurised water to the system in case of small system demands.
- Jockey pump shall start automatically upon receipt of a signal from pressure switches installed at the downstream of NRV provided for the Jockey Pump.

The main pumping system comprises of two nos. Centrifugal pumps with end suction and top discharge nozzle pumps one working and one standby. Working Pump shall be of Electric motor driven and Standby Pump Diesel Engine driven. These pump sets shall satisfy Tariff Advisory Committee (TAC) conditions of performance as a minimum.

The main pump set shall start at lower pressure level sensed by pressure switch installed downstream of the non-return valve for the main pump.

A master panel shall be provided in the pump house. This panel shall receive all the signals from the various pressure switches etc. and then relay the signals onwards to the respective local panels to initiate action to start/stop, etc. the respective pump. The selector switch housing for the selection of main working or stand-by pump set shall be in this master control panel.

- Accessories

The fire and Jockey pumps shall be complete with the following accessories:

- Suction and discharge eccentric reducers.

- Pump coupling guard.
- Common base frame
- Suction & Discharge Piping with all necessary piping & valves.
- Each pump shall have independent set of pressure switches.

- Master Control Panel

The composite power cum control panel is proposed to be located in the Firewater Pump House. Incoming power supply for the control panel shall be 415V, 3 phase, 50 Hz.

The motor starters shall consist of electrically actuated contactors. The starter shall be complete with ON - OFF push buttons, timers & auxiliary contacts & shall be fully automatic. There shall be an indicating lamp with each of the pumps & an ammeter & selector switch with the fire pumps. In addition provision shall be made for starting the motor manually to check the performance after maintenance.

The Master Control panel must be fulfilling the requirement of TAC and Visual alarm would be in the form of annunciation with the following inscriptions:

- Fire water pump(s) fail to start.
- Jockey pump fail to start.
- Low header pressure.

One hooter shall be provided to alert in fire condition & the event of any of the above fault conditions. Fire pump starting shall be annunciated through an electric siren.

One common alarm contact shall be provided to indicate a fire alarm in any of the areas. This signal shall be brought up to a terminal block in vendor's panel for further cabling to clients control system (overall).

The Fire Hydrant System installation shall conform to and meet with the requirements set out by the latest editions of:

IS:1648 : 1961	Code of Practice for Fire Safety of Buildings (General) Fire Fighting Equipment and its maintenance.
IS : 3844 : 1998	Code of Practice for Installation of Internal Fire Hydrants in Multi-Storied Buildings.
TAC : 1998	Fire Hydrant System, sprinkler system & spray system
IS : 778 : 1984	Gun metal gate, globe and check valves
IS : 1239 / 3589 : 1991	Mild Steel Pipes
IS :12469 :1988	Specification of pumps
IS :5290 : 1983	Specification for Landing Valves
IS : 10001 : 1981 & 10002 : 1981	Specification of Diesel Engine
IS : 5312 :1984	Specification for Non-Return Valve
BS : 5150 (Latest Edition)	Specification for Sluice Valve (Rising stem), PN 16.
IS : 10221 : 1982	Specification for Wrapping and Coating materials.
IS : 636 : 1988	Non-Percolating Flexible Fire Fighting Delivery Hose
IS : 903 : 1984	Specification for Hose Coupling

7.2.5.2 Fire Hydrant Posts

The height of the hydrant post shall be minimum 1200 mm overall from the ground level at readily accessible and visible locations.

7.2.5.3 Hydrant Valves

Design manufacture and construction of hydrant valves shall be conforming to IS: 5290 - 1983. Requirements regarding material, types, and dimensions, construction, finish painting shall conform to IS: 5290 - 1983 type A in general.

The following tests shall be carried out by the contractor strictly as per IS: 5290 – 1983:-

- Hydrostatic pressure test
- Flow test
- Water tightness test for valves
- Marking on the Hydrant valves shall be done as per IS: 5290 - 1983

7.2.6 Risk Reducing Measures

7.2.6.1 General

- Monitoring System for process parameters including manual checking should be established.
- Automation of the preliminary fire fighting/system cooling initiation based on temperature and smoke detectors should be ensured to prevent a small incident from escalating. This would also give adequate time for effective personnel response and intervention.
- All sources of ignition should be removed from the storage and process areas. De-matching and removal of spark generating electronic equipment such as cellular phones should be strictly followed.
- Procedures for ensuring use of relevant Personal Protective Equipments (PPE) should be delineated and strictly enforced to prevent exposure to personnel.
- Periodic Inspection/Corrosion Monitoring
- Periodic Training to Personnel

Above all, consistent and total quality assurance for engineering design, hardware selection, through construction to commissioning and subsequent operation and maintenance has to be adopted.

7.2.6.2 Coal Handling – Prevention of Coal Dust Generation

Recommendations to prevent and control fugitive coal emissions and generation of coal dust include the following:

- Design of the facility layout to facilitate emissions management
- Use of loading and unloading equipment to minimize the height of coal drop to the stockpile
- Providing access for fire fighting
- Eliminating the presence of potential sources of ignition, providing appropriate equipment grounding to minimize static electricity hazards
- Installing dust collector systems to capture fugitive emissions from coal handling equipment or machinery

7.2.6.3 Control of Exposure of Coal Dust

- Keeping away people who do not need to be in dusty areas
- Using totally enclosed, continuous handling systems - these usually provide the best control and should be used whenever reasonably practicable
- Suppressing dusts with sprays of water or other binding agents
- Use appropriate PPEs.

7.2.6.4 Navigation and Barge/ vessel/ Ship Movements

Construction Phase: Good communications and exchange of information when planning work boats/Barge/ vessel movements are essential. The master and pilot should exchange information and agree on a berthing plan which should include the above information taking into account the position of obstructions such as the cranes, piles, dredgers etc. The master should inform the Barge/ vessel operator, the characteristics such as the bow flare, cranes etc.

The authorities should ensure that the construction area is well lit and that the Barge/ vessel operators and Barge/ vessel are fully informed of the berthing requirements and position of obstructions. All obstructions such as cranes should be moved out of the way.

If necessary, movement of boats/ Barge/ vessels/ berthing should be delayed until the cranes had been moved to a less vulnerable position.

Operational Phase: Charts, tidal information and other information about the prevailing conditions at the Barge/ vessel loading facility should be checked prior to berthing and cargo operations. If there is any doubt about the conditions at the berth, including the available depth of water, clarification should be obtained before berthing or cargo operations start.

Even apparently minor contacts with piers and jetties should be taken very seriously and experts called in immediately to assess the extent of damage.

7.2.6.5 Safety

Construction Phase: All workers, technicians and supervisors should make use of all safety equipment such as masks, goggles, helmets, safety belts, ear muffs safety shoes, etc., as required, during the construction phase. Danger areas will be marked in order to restrict unauthorized entry into the Project area. Proper security arrangements will be made during nights to avoid any accidents due to unauthorised entry of workers or civilians. Adequate and proper fire-fighting facilities will be provided by the management in all areas so as to take care of all unexpected fire accidents.

Operational Phase: The following safety measures in addition to those outlined in previous subsections are recommended:

- Preparation of detailed operational procedures including instructions for emergency situations
- Preparation of strict working procedures in connection with repair and maintenance of the various equipment and systems.

7.2.6.6 Hazardous Material Storage

The hazardous materials anticipated to be stored at the site during construction are gas for welding, fuel for operating construction equipment, paint, etc. All these and other materials of a dangerous or hazardous nature will be stored as per the norms of industrial safety.

7.3 Disaster Management Plan

The disaster management plan mainly deals with:

- Prevention of loss of life
- Damage limitation
- Preparedness to deal with any disaster
- Return of normal working after the crisis
- The plan also delegates specific assignments to available manpower with a view to avoid over-lapping of activities between various groups.

7.3.1 Causes of Disaster

- Natural: Flood, Earth Quakes, cyclones, Tsunami and Lightning
- System failure, design deficiency, bad operating practice, sabotage resulting in
  - Fire
  - Explosion
  - Release of toxic/ inflammable gases

7.3.2 Categorisation of Emergency

Any emergency situation has to be first categorised as an onsite emergency or an offsite emergency, the difference being that the effects of the onsite emergency are confined within the premises while those of an offsite emergency spill over beyond the Barge/ vessel loading facility premises or even beyond the project site premises. Thus, the onsite and offsite emergency plans are detailed below:

7.3.2.1 Onsite Emergency Plan

The plan would have the following components:

- Formulation of Disaster Management Plan and Emergency Services
- Organisation Structure
- Roles and Responsibilities of Emergency Teams
- Communication
- Emergency Control Centre
- Alarm Systems & Assembly Points
- Mutual Aid Scheme
- Onsite Emergency Plan and Rehearsals
- Spillage & Contingency Plan
- Formulation of Disaster Management Plan for Cyclones

7.3.2.2 Offsite Emergency Plan

The components of an offsite emergency plan would include:

- Identification of locations of hazardous or dangerous substances, personnel and emergency control rooms.

- Technical information such as chemical and physical properties, dangers, etc. Background information, past accidents, control techniques and effects of hazardous materials of relevance.
- Identification of facilities and transport routes for toxic materials.
- Contact for further advice such as meteorological information, transport, temporary food and accommodation, first aid and hospital services, water etc.
- Establishing communication links including fire fighting materials, damage control and repair items.
- Detailing emergency response procedures.
- Notification to public at large.
- Evacuation arrangements.
- Press/media handling.
- Addressing longer term environmental cleanup.

7.3.3 Onsite Emergency Plan

7.3.3.1 Formulation of Disaster Management Plan and Emergency Services

The assessment of the risks and hazards leads either to improvements being made at the installation in the form, for example, of additional safeguards or better procedures, or the decision being taken that the risk is sufficiently small to be accepted.

The Disaster Management Plan must be related to the final assessment and it is the responsibility of the HPPL management to formulate it. The plan will include the following elements.

- Assessment of the magnitude and nature of the events foreseen and the probability of their occurrence
- Formulation of the plan and liaison with outside authorities, including the emergency services
- Procedures for raising the alarm and communication both within and outside the barge/vessel loading facility
- Appointment of key personnel and their duties and responsibilities (organizational structure)
- Emergency Control Centre and Action on site/Action off site

7.3.3.2 Organization Structure

The first few minutes after the incident/accident are invariably the most critical period in prevention of escalation. Therefore, the personnel available at or near the incident site (and often responsible for or carrying out that particular activity) and on a round the clock basis play a vital role in an emergency. This concept is made use of in nominating the KEY PERSONS.

In each hazardous location it is necessary to nominate a functionary as the *"Incident Controller"* who is invariably a shift-in-charge of the facility. The Incident Controller tackling the emergency in real terms requires support from various other services e.g. fire & safety, medical services, security, engineering, administration, technical services covering communication, transport and personnel functions, etc. A KEY PERSON for each one of these services, therefore, should be nominated.

The "SITE MAIN CONTROLLER" (SMC) will be the Unit In-charge. The various controllers selected to carry out the work will co-ordinate with the SMC through the functional KEY

PERSONS at the incident site. The KEY PERSONS will generally be at the site of incident and the CONTROLLERS will report at the EMERGENCY CONTROL CENTRE.

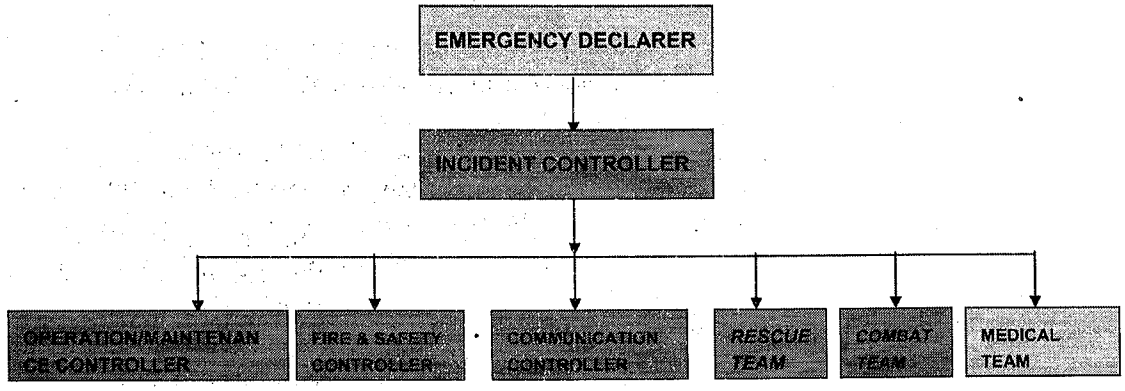
The duties and responsibilities of various KEY PERSONS AND CONTROLLERS will be written down ensuring no grey areas or overlapping responsibilities.

Various Controllers will be drawn from the organisation and clear-cut responsibilities will be spelt out for the following controllers:

- Operation Controller
- Maintenance Controller
- Fire and Safety Controller
- Communication Controller
- Environment Controller

A Succession chart will be developed as above nominating second-line controller who would act as controller in the absence of any of the above officials.

An emergency organisation chart is as follows:



7.3.3.3 Roles and Responsibilities of Emergency Team

i) Site Main Controller (In-charge)

- To access the extent and magnitude of the damage and by maintaining communication with the Site Incident Controller (SIC).
- To determine how far the emergency control plan can be extended
- Prepare action for monitoring and controlling the emergencies
- To decide whether any section/process/area to be shut down/isolated in the event of any accident
- To finalise the means of evaluation and explore the possibilities of taking help from offsite sources
- Review the fire fighting operations in consultation with Safety Coordinator
- Co-ordination with the safety officer regarding evacuation and shelter rehabilitation aspects
- Arrange for restoration and normalcy in consultation with Incident Controller
- Announcement of conclusion of emergency
- Issuance of authorised statements and ensures that all evidences of the incident are preserved.

(ii) Site Incident Controller (Shift in-charge)

- Establish Emergency Control Centre and inform SMC
- Ensure availability of Controllers/Team members
- Priority decisions for strategy for development of resources for incident control
- Periodic assessment of actual disaster zone and resource deployment (own / external)
- Periodic status report of SMC
- Seek help for:
  - Fire Fighting
  - Medical Aid
  - Rescue
  - Transport
  - Traffic Arrangement
  - Law and Order
- Inform the following authorities about the incident through zonal/sector authorities:
  - District Collector
  - Superintendent of Police
  - District Environmental Engineer
  - District Health Officer
  - Inspector of Factories
  - Neighbouring Installations
- Establish contacts with the following, through controllers:
  - Superintendents of nearby hospitals
  - Chief Fire Officer of nearby fire services
  - Insurance Company
  - Establish First Aid Centre through Safety Coordinator
- Establish Information Centres

7.3.3.4 Emergency Co-ordinators

Logistics Coordinator: The duties and responsibilities in the event of any emergency include:

- Report at the affected area to the SMC & SIC
- Arrange to attend all maintenance jobs as instructed by SIC
- Ensure that all essential services like power, water etc are maintained without interruption
- Ensure adequate manpower availability at the affected area
- Reporting all the incidents to SIC
- Arrange for all the tools, materials at the site of emergency

Communication Coordinator: Responsibilities include:

- Report to SMC & SIC
- Removal of non essential personnel from the emergency area in consultation with SIC
- Contact with SIC and arrange for necessary facilities
- Control over entry and maintain law & order and arrange for police help in consultation with SMC
- Liaison with external agencies in consultation with SMC
- Co-ordination of transportation requirements for moving personnel for first aid, evacuation, rehabilitation etc.
- Maintenance of inventory systems in the Emergency Control Centre

Safety Coordinator: Responsibilities include:

- Immediate Reporting to SIC
- Co-ordination with Security officer and security personnel

- Ensure availability of all safety equipments at site
- Co-ordination of all rescue operations
- Co-ordination of availability of first aid to all injured personnel
- Advice to SIC on fire fighting operations
- Ensure availability of necessary antidotes/medicines in case of toxic release

7.3.3.5 Communication

An essential component of any emergency preparedness programme is the communication links for gathering information needed for overall co-ordination e.g. emergency control centre with in-house as well as outside emergency services. Too much reliance on the telephone system Fixed lines/Mobile phones is risky as it can soon be overloaded in an emergency situation. A computer with internet and printer facility and photocopying machine, wireless networks, fax, intercom units are recommended for higher reliability.

- Help line numbers will be setup for emergency related queries

The description of the tasks and responsibilities, reporting place, etc. for each key functionary will be, as far as possible, so drafted as to reduce the communication needs between the interacting groups and permit good mutual understanding and well co-ordinated independent actions to tackle emergency situations.

7.3.3.6 Emergency Control Centre

The emergency control centre should be established separately for Barge/ vessel loading facility and should be equipped with the following:

- An adequate number of external telephones. If possible, one should accept outgoing calls only, in order to bypass jammed switchboards during an emergency.
- An adequate number of internal telephones, Radio equipment/pager system.
- A layout plan of the facility showing.
- Location of possible spillage/fire points.
- Sources of safety equipment and other fire-fighting system elements.
- Escape Routes.
- A nominal roll of employees at the facility.
- A list of KEY PERSONNEL with addresses, telephone numbers, etc.
- An adequate number of personnel protective/safety equipment available on site/back up in warehouse or with other member groups of mutual aid programme.
- Locations of various fire fighting arrangements at the facility.

7.3.3.7 Alarm Systems

The emergency (due to fires or spillages) should be initiated by the first person noticing it by activating the fire alarm from the nearest call-point or by contacting the fire control room immediately on the internal telephone in case of any emergency.

If in the opinion of the shift in-charge in consultation with the fire safety officer, the severity of the emergency is such that it can primarily be coped with by HPPL's own resources (aided by fire fighting appliances from the fire brigade, if required) the siren code for ONSITE CRISIS will be sounded through the hooter. The siren codes for distinguishing between an ONSITE & OFFSITE CRISIS will be clearly established.

The onsite/offsite siren codes should be informed to the neighbouring population of the facility.

7.3.3.8 Mutual Aid Scheme

Assistance in terms of equipment and manpower will be taken from the neighbouring installations under a Mutual Aid Scheme/Zonal Disaster Management Plan.

7.3.3.9 Assembly Points

Shifting or evacuating facility personnel during an onsite crisis will be done to a predetermined assembly point in a safe part of the facility. The assembly point will be identified at safe locations (Barge/ vessel loading facility administrative building).

7.3.3.10 Onsite Emergency Plan and Rehearsals

Once the emergency programme is finalised, it should be made known to all personnel so that each one knows his or her role in the event of an emergency. The plan will be regularly tested through the rehearsals, at a regular frequency and updated accordingly.

7.3.3.11 Spillage and Contingency Plan

The purpose of this plan is to identify, prevent and control all probable spillages in Barge/ vessel loading facility for safe and healthy working of facility personnel and machinery.

Probable materials for spillage:

- Electrical equipment area (Transformer oil and cable filling compounds)
- Liquid and solid wastes
- Cargo (coal and Iron Ore) spills
- Oil during bunkering, from Ships, Barge/ vessels, tugs and other facility crafts

Spillages in the Barge/ vessel loading facility can lead to:

- Causing loss of property
- Interfaces with safe moving of personnel
- Damage to equipment when left unattended
- Health hazard i.e., toxic when released in air or mixes with the main Barge/ vessel loading facility drain system and further to sea.
- Fire hazard

Prevention of spillage:

Routine checks of the system have to be made to ensure that no leak or spill starts. Any minor leakage has to be reported to the concerned person (Shift In-charge, Operation & Maintenance team member). Leakage has to be arrested in the shortest possible time. Necessary arrangements have to be made to collect the leakage and to store in proper place.

In case of spillage the following measures would be adopted:

- Oil spill on the land should be properly cleaned using absorbents, cotton waste, sand, saw dust, etc.
- The collected oil is disposed to SPCB/CPCB authorized agency.

- Oil spill on the barge/vessel loading facility premises should be properly cleaned using absorbents, cotton waste, sand, saw dust, etc., and the materials used for cleaning should be incinerated.
- Major oil spills can be taken to oil separator and the same to be reused depending on the quality.

7.3.3.12Oil Spill Contingency Plan

The barge/vessel loading facility will be equipped with minimum equipment to contain and recover oil spills. In addition, HPPL will develop a customised Oil Spill Contingency Plan to cope with any accidental oil spill during bunkering if any. The contingency plan will be prepared by HPPL in consultation with the Department of Ports, GoK.

In case of an oil spill, immediate steps would be taken to contain and control the spill. An Oil Spill Contingency Plan will outline the steps to be taken before, during and after a spill. In the present case, an Oil Spill Contingency Plan covering the following will be prepared:

- Hazard Identification
- Vulnerability Analysis
- Risk Assessment
- Response Actions.

Hazard Identification: All conditions which can lead to an oil spill will be identified and necessary information to react to a spill under different conditions will be studied.

Vulnerability Analysis: Vulnerability analysis will help to identify the resources and communities which could be affected due a spill and accordingly they can be informed or quick measures can be taken so that it results in minimum damage. Information on the following will be collected as a part of vulnerability analysis:

- Public safety officials
- Schools, nursing homes, hospitals and prisons in the area
- Recreational areas
- Special events such as festivals and when they occur
- Ecologically sensitive areas specially areas susceptible to oil or water pollution

Risk Assessment: Based on hazard identification and vulnerability analysis, the extent of risks involved will be assessed.

Response Actions: Response actions will provide information on all the immediate actions that will be taken in the event of a spill. It will have information on the following:

- Measures to prevent further flow of oil
- Measures to prevent ignition
- Agencies responsible for clean-up effort
- Information on the extent of spill
- Measures to contain spill to a limited area
- Measures to remove oil
- Measures to dispose the spilled oil

Mock drills will be carried out to test the effectiveness of the contingency plan.

7.3.3.13Coal Dust Suppression System

The stack height of the coal stack yard would be limited to 10-12 m from the point of view of safety against fires. During coal handling and storage activities there may be fugitive dust

emission which might cause occupational health hazards. Hence, dust suppression will be provided.

Dust control equipment system consisting of suitable pump, storage tank for water and sprinklers & nozzles for dust suppression will be provided. In addition to the above, suitable spray system shall also be provided at ship unloader & coal stockyard.

The water sprinkling system with nozzles shall be installed to cover the entire stockpile. The nozzles shall be installed on pipes at about 2 to 3 meters elevation from ground. The nozzles shall be installed along the stockpile which can cover the stockpile height and proposed width.

7.3.3.14District Disaster Management Committee

The District Level Disaster Management Committee is set up for major off-site emergencies along with Port Officers for Uttara Kanada. This committee would comprise of the following members:

District Collector	Chair Person
ADM, Uttara Kanada	Member
Sub Collector, Uttara Kanada	Member
RTO, Uttara Kanada	Member
EE (R&B), Uttara Kanada	Member
EE, Irrigation Division, Uttara Kanada	Member
Deputy Director (Agriculture), Uttara Kanada	Member
District Development Officer, Uttara Kanada	Member
District Emergency Officer	Member, Convener

7.3.3.15Disaster Management Plan for Cyclones/Floods

In line with the Disaster Management Plan of Uttara Kannada District, HPPL will develop a customised DMP to cope during disasters from natural calamities such as rough weather conditions, cyclones, Tsunami and floods, etc. Proper planning can reduce the potential damage from disasters in terms of losses to human lives, port assets, and environmental damage and rehabilitation costs. The DMP for Cyclones and Tsunami will be prepared by HPPL in consultation with the Department of Ports, Government of Karnataka.

The rough weather operations will be controlled in three stages:

- Green Status – The operations of loading/unloading will be carried out as planned.
- Yellow Status – This is an alert stage indicating possibility of rough weather. Still operations can be continued with all emergency precautions
- Red Status – Emergency situations or rough weather; operation will be suspended.

Activities controlled by in-charge of emergency operations. The vessel/tanker is to be moved to safe anchorage or will be advised to proceed to sea.

The main components of the DMP for cyclones will include the following:

- Pre-Disaster (or Pre-Cyclone/Flood) Plan
- On (or During Cyclone/Flood) Disaster Plan
- Post (or After Cyclone/Flood) Disaster Plan

Pre-Cyclone/Flood Plan

Pre-Cyclone Measures: Barge/ vessel loading facility will maintain and exchange information continuously with the local IMD authorities at Honnavar, Uttar Kanada district for continuous updates of meteorological conditions in general and emerging/predicted weather phenomenon such as cyclones and prolonged or intensive rainfall in particular. Upon issue of a cyclone/flood warning by the IMD, the management would immediately initiate the Pre-Cyclone/flood Measures. The Department of Ports and District Collector of Uttar Kanada would be informed of the imminent cyclone. All barge/vessel loading facility officials dealing with operations and disaster management will be informed.

Pre-Cyclone/flood Exercise: On signalling of a cyclone alert, the Control Room will be manned 24 hours a day for disaster management. The 'Weather Signals' depending on the data available about the cyclone/intensive rainfall and flow details Sharavati/Badgani and its threat perception will be informed to all personnel. The marine side operations will be regulated as per the rough-weather classification and will be continued with all emergency precautions. The different personnel of Barge/ vessel loading facility would assume their roles and responsibilities as previously identified for disaster management. The standby arrangement for power supply will be checked. Pre-identified 'Rescue Centres' will be kept ready. A pre-alert will be issued regarding suspension of all operations in case of emergency and to await instructions regarding the same. All Port Crafts and barges/vessels will be fully secured inside the harbour area. Communication system including standby arrangement will be tested for working condition. Vehicles involved in rescue operations will be checked for working condition. Port crafts to be engaged in rescue will be kept in readiness. The safety in the project area will be ensured.

The following Flood warning messages will also be given:

- Flood Alert – Flooding is possible
- Flood Warning – Flooding of homes, businesses and main roads is expected
- Severe Flood Warning – Severe flooding may cause Imminent danger
- All Clear – No Flood Alerts or Warnings are in force

When a flood warning message is received, an Emergency team In-charge shall alert relevant agencies. The following advice shall be given to the Public:

- Flood warning: 'GO IN, STAY IN, TUNE IN'
- Stay calm
- Ensure that neighbours know of the warning, and be prepared to help them
- Monitor local radio
- Make a flood kit: medications, warm clothing, sealed food, blankets, matches, candles, flashlights, portable radio, spare batteries, rubber gloves, personal documents

During Cyclone/Flood Plan: The emergency alarm siren will be raised as per the 'Alarm System'. All personnel will be evacuated except essential operational personnel and personnel dealing with disaster management. The cargo handling operations will be suspended. The vessel will be moved to safe anchorage or will be advised to proceed to sea. Power supply will be disconnected and alternative power supply will be restored in essential operational areas. Port Crafts and Tugs will continue to be in readiness for rescue.

Depending upon the scale of potential flooding, the following steps shall be taken:

- Care of evacuated, hurt or homeless people
- Protecting of utilities
- Availability of transport
- Flood alleviation e.g. clearing blocked culverts and drains
- Providing emergency health advice
- Providing road barriers and signs
- Coordinating emergency support

Post Cyclone/Flood Plan: This would be the rescue and rehabilitation stage after passing of the cyclone/flood. The damages would be assessed and rehabilitation work initiated to restore operations at the earliest. The records of the events during the cyclone/flood will be maintained and reviewed for possible enhancements to the DMP.

7.3.4 Recommendations for Implementation of Off-site Emergency Plan

- Emergency control centre will be the focal point to co-ordinate emergency activities. Emergency control centre would be equipped with adequate number of equipment mentioned under heading "Emergency Control Centre".
- Succession or second-line controllers would be named for assuming responsibilities in case disaster occurs in absence of principal co-ordinators.
- Hot line would be provided between Barge/ vessel loading facility and Fire Brigade at Honnavar/karwar
- HPPL would make arrangement for coded siren system or through some other suitable means to alert people in surrounding areas in case of off-site crisis.

A summarised version of action procedures detailing the "Role of Essential Staff in Major Emergency" would be issued in a flip chart like booklet form to all concerned persons (officers and supervisors) at work places and also to senior officers of the civic administration.

7.3.5 Conclusion

The broad Disaster Management Plan is prepared in conjunction with and taking into consideration all technical reviews and suggestions as per acceptable norms. These details shall be considered as guidelines to Disaster Management Plan based on detailed risk analysis which will be prepared by project proponent.

7.4 Dredge Material Utilization & Disposal Plan

The capital dredging quantity will be 3.9 MCM during the construction stage. Reclamation will be carried out in the back up area 1.0 MCM of dredged spoil material is proposed to utilise for reclamation and remaining will be dumped back in to the sea at designated dumping location. The total maintenance dredging quantity is estimated to be around 10,300 m^3/hr, which will be disposed at the designated disposal site.

7.5 Social Impact Assessment

7.5.1 Social Impacts during Construction Phase

7.5.1.1 Land Acquisition

HPPL has been allotted to use the government land of 44 hectares by Government of Karnataka near Sharavati river mouth in Kasarkod Tonka village to develop a barge/vessel loading facility. There are no land acquisition and encroachers involved.

7.5.1.2 Impact on Nearby Settlements

The impact on nearby settlements during construction phase will be due to air pollution and the noise generating activities. However, the activities are limited to the construction phase and will cease upon completion of the construction. Hence, this impact is considered to be negligible and therefore can be classified as insignificant.

The dust suppression measures such as sprinkling of water and suitable enclosures around the high noise generating areas within construction area will be provided.

The noise generating equipment will be provided with suitable enclosures such that cumulative noise will be within permissible limits.

7.5.1.3 Fishing Activity

The construction activities involve dredging, construction of cargo berths which may likely impact the fishing activity at nearby fishing villages. There are no major fishing zones in the study area. The fish landing centres and fishing settlements in the study area are at Honnavar, 1.0 km SE and Manki, 11 km S.

However, necessary marker buoys shall be installed and interactions shall be initiated with the fishing community about the marker buoys indicating the areas of operation so that they may avoid those areas during construction period. Hence, minimal hindrance to fishing activity is anticipated during construction phase of the proposed barge/vessel loading facility.

7.5.1.4 Employment Potential

The employment potential from the construction phase of the proposed port is estimated as 500 persons.

7.5.2 Social Impacts during Operational Phase

7.5.2.1 Fishing Activity

During operation phase, barges/vessels movement may hinder the fishing vessels approach to the fish landing wharf and to the sea. Awareness will be given to fisherman about the barge/vessel movement's time schedule and clearances required for safe manoeuvring etc., during berthing of barges/vessels, necessary clearances shall be made available to ensure the fishing vessels movements.

Necessary marker buoys shall be installed and interactions shall be initiated with the fishing community about the marker buoys indicating the areas of operation so that they may avoid those areas during construction period.

7.5.2.2 Employment Potential

The expected direct employment will be 50 persons. The proposed project is likely to have positive impact on socio-economic condition of the region overall.

7.5.2.3 Public Health and Safety

The proposed Barge/ Vessel loading facility handles coal and other cargos which can be classified as non-hazardous. However exposure to coal dust is likely to have minimum impacts on public health and safety. However suitable safety procedures will be followed by HPPL during handling and transportation of cargo.

An effective Disaster Management Plan (DMP) which includes Onsite and Offsite emergency plan will be prepared and followed to minimize the probability of occurrence of emergency situations and mitigate the impacts.

7.6 Corporate Social Responsibility

As a part of Corporate Social Responsibility (CSR), HPPL proposed to take up following activities for improving the way of living of people of Kasarkod Tonka, Apsarkonda and other nearby villages.

- Providing better health services
- Providing better educational facilities for children of employees
- Creating job opportunities
- Facilitate self-employment through training and credit linkage
- Outsourcing opportunities to Self Help Groups (SHG)
- Providing protected water supply system to Kasarkod Tonka and Apsarkonda villages.
- Strengthening area Government hospitals by assisting them in procurement of essential medical equipments.
- Providing quality health care through regular medical camps.

7.6.1 Education Facilities

Basic education facilities for the children of the employees will be provided.

7.6.2 Budgetary Allocation for CSR Activities

7.6.2.1 Treated Drinking Water

Kasarkod Tonka and Apsarkonda are the villages identified for regular treated drinking water provision. The cost for implementing the same is estimated as below.

S. No.	Particulars	Amount (Lakhs)
1	Reverse Osmosis plant (2 units)	40
	Total	**40**

7.6.2.2 Budgetary Provision for Educational Facilities

There are two (2) Schools nearby barge/ vessel loading facility area.

S. No.	Particulars	Amount (` Lakhs)
1	Adoption of two Schools	12
2	Building & Furniture	6
3	Library Facility	5
4	Science Library Facility (2 Schools)	5
5	Sanitary & Water Supply	2
6	Electricity Facility	2
7	Sports Equipment Facility	2
8	Miscellaneous & Contingency	1
	Total	**35**

Chapter 8
Project Benefits

8 Project Benefits

8.1 Introduction

Liberalization of the Indian economy has led to significant growth and India is fast emerging as one of the largest economies of the world. This growth will provide a major thrust to trade. About 95% by volume and 70% by value of Indian exports are channelled through maritime Route. Foreign Trade Policy envisages doubling of Indian share in the global market. Hence, there is an immediate necessity to augment the Indian infrastructure by expanding or creating new Ports. Since, existing ports are saturated or congested and have limited scope for expansion there is a great need for development of green-field ports along East and West coasts. Based on the growing demand/export potential in the state, the Government of Karnataka also has estimated that Karnataka coast would need more seaports/barge/vessel loading facility along Coast. Bellary district in Karnataka is blessed with many industrial projects that makes it second fastest growing city in the state .Out of the ports of the state, NMPT, the major port currently caters to the cargo requirements in the southern districts of the state and is operating at 89% capacity (in 2008 – 2009). Cargos such as granite, fertilizer, molasses, iron ore, wood logs, coal with other agro products and steel products also has the potential to grow in demand and supply which will increase the traffic. The capacity at the port is not adequate to cater to the demand of this region. This will increase the traffic across the proposed Barge/ Vessel loading facility.

About 27% of the power demand of Karnataka is met by that generated from coal based power plants. JSW Energy Limited (JSWEL) has commissioned coal based thermal power plant in Karnataka. JSWEL is also proposing to develop another unit of 600 MW in Bellary. Two coastal coal based thermal power plants are also proposed to be set up with capacities of 1015 MW and 4000 MW in Tadri and Mangalore respectively. The demand supply gap of coal is expected to increase in the coming years. The development of Barge/ Vessel loading facility will meet the capacity requirements of the region and Karnataka State and in turn is expected to boost the economy of State

8.2 Infrastructure Facilities

The following infrastructure facilities will be developed; Good road and rail connectivity is an essential requirement for the efficient functioning of any port. As far as Honnavar Barge/ Vessel facility is concerned, the main commodities being handled are coal, iron ore, fertilizer, and edible oil. Hence good road and rail connectivity plays a vital role in the successful functioning of Honnavar Barge/ Vessel loading facility.

8.2.1 Rail Connectivity

The nearest railway station is Honnavar Railway station which is on the Konkan stretch connecting Kerala to Mumbai. The railway station is at about 5 km from the present Honnavar barge/vessel loading facility.

The proposed railway line will take off from the existing railway station at Manki. The new railway line will have to be laid for a distance of 14.6 km from Manki railway station to the proposed port. The new railway line will run parallel to existing railway line for a length of

about 8 km and then will take a turn towards sea coast which will then run parallel to the sea coast till the proposed barge/vessel loading facility for the remaining 6.6 km.

8.2.2 Road Connectivity

The site has good road connectivity. The Honnavar fishing harbour is about 1 km off NH 17. The site is connected to Bellary through NH 63 and NH 17. NH 17 meets NH 63 at Ankola at about 45 km from the site. There are also alternate routes through Kumta which is about 30 km from the site.

The proposed road starts from NH 17 at Kasarkod. This road will then run south east for some distance and then aligns parallel to the shoreline till it reaches the proposed port. This option will lie parallel to the existing single lane road at an offset distance of 100 m. The total length of this road from NH17 to the proposed berth is 4 km. This road connectivity will have a width of 25 m.

8.3 Induced development

Apart from the surrounding region, the adjoining states would also benefit a lot because of the proposed development of Honnavar Barge/ Vessel loading facility. The benefits may be realised with the upcoming of industries such as steel plants, thermal power plants and their allied ancillary units. Other benefits would be generation/providing of either direct or indirect employment to the local people. With the new connectivity through rail and road, there will be a facility to improve the trading, marketing and as well as value addition of local products. The proposed connectivity will also serve to the tourist places nearby thereby improving employment to the local people. The development of Honnavar Barge/ Vessel loading facility will be a boon for the development of the region.

8.4 Improved Socio-economic Conditions

The proposed project is likely to have a positive impact on the socio economic conditions of the region. The social infrastructure in the region is likely to change due to the creation of more job opportunities and avenues for income generation. People will have higher income due to direct employment as well as indirect employment and will have higher earning and buying capacities.

8.4.1 Quality of Life

The quality of life in the region is likely to improve due to the creation of jobs for the local people so that the dependency changes and there will be more than one earning member in the family, which will provide economic freedom.

8.4.2 Health

As part of the CSR, it will also be proposed to conduct periodic health camps and carryout health campaigns which will lead to better health conditions of the local people. As a part of CSR, procurement of essential medical equipment.

8.4.3 Educational Facilities

HPPL is planning to undertake the following activities in the project region as part of Corporate Social Responsibility (CSR):

- Basic education facilities for the children of the employees will be provided
- Strengthen the primary schools with teaching aids and student education material
- Strengthen the upper primary and high schools with teaching aids, mobile laboratory and computer education
- Initiatives for reducing school dropouts Funds for setting up of Libraries

8.5 Corporate Social Responsibility (CSR)

HPPL is planning the following in the project region as part of Corporate Social Responsibility (CSR):

- Providing better health services
- Providing better educational facilities for children of employees
- Creating job opportunities
- Facilitate self-employment through training and credit linkage
- Outsourcing opportunities to Self Help Groups (SHG)
- Providing protected water supply system to Kasarkod Tonka and Apsarkonda villages.
- Strengthening area Government hospitals by assisting them in procurement of essential medical equipments.
- Providing quality health care through regular medical camps.

8.6 Employment Opportunities

The proposed project will provide direct as well as indirect employment to the locals.

There will be a huge demand for skilled, semi skilled and unskilled work force during the construction and operational phase of the port and it is imperative that mostly local people would be employed based on their skills and educational qualifications. The employment potential from the construction phase of the proposed Barge/ Vessel loading facility is estimated as 500 persons (approximately). The expected direct employment during operation phase will be 50 people. The proposed project is likely to have positive impact on socio-economic condition of the region overall. Indirect employment will be generated due to overall improvement of socio-economic growth of the project region.

Chapter 9
Environmental Cost Benefit Analysis

9 Environmental Cost Benefit Analysis

As per "***EIA Guidance Manual for Ports and Harbours***" released by MoEF in February 2010, Environmental Cost Benefit Analysis of the project needs to be included as a part of EIA Study if recommended by Expert Appraisal Committee at the scoping stage.

Honnavar Port Private Limited (HPPL) submitted the Form-1, Draft ToR and Prefeasibility Report for consideration by the Karnataka State level expert appraisal committee (KSEAC) meeting held on August 20, 2011 at Bangalore to determine the Terms of Reference (ToR) for undertaking detailed EIA study for obtaining environmental clearance in accordance with the provisions of the EIA Notification, 2006 (as amended) and CRZ notification, 2011 has not mentioned on an Environmental Cost Benefit Analysis.

Therefore, KSE EAC approved the ToR vide letter No: SEIAA 22 IND 2011 of September 13, 2011and Environmental Cost Benefit Analysis of the project is not recommended by the State appraisal committee. A copy of the letter is enclosed as **Appendix A** for reference.

CHAPTER 10
ENVIRONMENTAL MANAGEMENT PLAN

10 Environmental Management Plan

A generic Environmental Management plan (EMP) is provided in this Chapter. This gives the project proponent the broad general guide lines (Framework) for managing the Environmental aspects of the project during pre construction, construction and operational stages of the project.

The main objectives of Environmental Management are to:

- Ensure the mitigation measures are implemented
- Establish systems and procedures for implementing mitigation measures
- Monitor the effectiveness of mitigation measures
- Take necessary prompt action when unforeseen impacts occur

10.1 Components of EMP

The environmental impact mitigation and avoidance measures for each likely impact on the prevailing environment have been discussed in detail at the respective sections in **Chapter 5**. The Environmental Monitoring Programme has been discussed in **Chapter 6**.Various project activities, associated impacts and mitigation measures are summarised in Table 10-1.

Table 10-1: Project Activities, Associated Impacts and Mitigation Measures

S. No.	Activity	Relevant Environmental components likely to impacted	Proposed Mitigation Measures
		Construction Phase	
1.	Capital dredging and reclamation	Marine water quality	– Check turbidity levels with baseline levels as reference during entire monitoring programme – Dredge Management Programme will be prepared and implemented, – Ensure that slop tanks will be provided to barges/ Vessel / workboats for collection of liquid/ solid waste – Discharge of waste into sea will be prohibited – Oil Spill control measures will be adopted – Marine environmental monitoring as per environmental monitoring programme – Dredge Spoil Disposal at the identified disposal site
		Marine ecology	
		Changes in Sea Bed Profile	– Provision of rip-rap structures, side screens while laying piles – Post construction/ implementation survey of pile positioning is suggested
		Mangrove area	– Mangroves are located at 2.7 km (approx) inside the river Sharavati River towards South East of the proposed barge/vessel loading facility port and no significant impacts are expected.
2	Material transport and construction activities	Air Quality	– To reduce impacts from exhausts, emission control norms will be enforced / adhered. – All the vehicles and construction machinery will be periodically checked to ensure compliance to the emission standards – Construction equipment and transport vehicles will be periodically washed to remove accumulated dirt – Providing adequately sized construction yard for storage of construction materials, equipment tools, earthmoving equipment, etc – Provide enclosures on all sides of construction site – Movement of material will be mostly during non-peak hours. – On-site vehicle speeds will be controlled to reduce excessive dust suspension in air and dispersion by traffic – Water sprinkling will be carried out to suppress fugitive dust – Environmental awareness program will be provided to the personnel involved in developmental works
		Noise	– Noise levels will be maintained below threshold levels stipulated by Central/State Pollution Control Board (CPCB)/KSPCB

S. No.	Activity	Relevant Environmental components likely to impacted	Proposed Mitigation Measures
			– Procurement of machinery / construction equipment will be done in accordance with specifications conforming to source noise levels less than 75 dB (A) – Well-maintained construction equipment, which meets the regulatory standards for source noise levels, will be used – Any equipment emitting high noise, wherever possible, will be oriented so that the noise is directed away from sensitive receptors – Noise attenuation will be practised for noisy equipment by employing suitable techniques such as acoustic controls, insulation and vibration dampers – High noise generating activities such as piling and drilling will be scheduled to daytime to minimise noise impacts – Personnel exposed to noise levels beyond threshold limits will be provided with protective gear like earplugs, muffs, etc. – Ambient noise levels will be monitored at regular intervals
		Disturbance to Natural Drainage pattern	– Adequate storm water drainage system will be provided. if natural drainage disturbed, it will be reinstated
		Vegetation and Strain on existing infrastructure	– Adequate greenbelt will be developed – Temporary workers camp with self sufficient infrastructure.
		Existing Traffic	– New road link will be developed to connect the NH 17 with proposed barge/vessel loading facility site – New rail way link will be developed to connect the Konkan rail way link at Manki station with the barge / vessel loading facility site.
3.	Land Reclamation	Existing Water Resources like Groundwater and surface	– Protective bunds will prevent inundation of sea water to the adjoining land. – Return sea water will be flown back to sea through appropriate channels.

S. No.	Activity	Relevant Environmental components likely to impacted	Proposed Mitigation Measures
		water	
4.	Solid Waste Management	Soil quality	– Construction waste will be used within site for filling of low lying areas. – Composted bio-degradable waste will be used as manure in greenbelt. Other recyclable wastes will be sold. – Excavated soil will be stockpiled in a corner of the site in bunded area to avoid run off with storm water. – General refuse generated on-site will be collected in waste skips and separated from construction waste. – Burning of refuse at construction sites will be prohibited.
5.	Handling of hazardous wastes	Human safety and property loss	– Hazardous materials such as lubricants, paints, compressed gases, and varnishes etc., will be stored as per the prescribed/approved safety norms. – Construction site will be secured by fencing with controlled/limited entry points. – Hazardous wastes will be disposed through approved KSPCB/CPCB vendors. – Medical facilities including first aid will be available for attending to injured workers Occupational Health Construction Equipment and waste. – Handling and storage as per MoEF guidelines Fire protection system.
6.	Fishing	Fishermen and fishing villages	– Signboards will be placed at the construction activities in order to make fishermen aware of the ongoing activities – Necessary marker buoys will be installed – Interactions will be initiated with the fishing community before commencement of construction works
			Operation Phase
1.	Cargo handling and Inland Cargo movement and storage areas	Air Quality	– Use of specialised ship loaders/ Barge /Vessel loaders and Unloaders – Dust suppression measures such as water sprinkling – Scientific and regulated stacking of cargo piles – Cargo unloading through underground wagon tipplers – Regularization of truck movement – Periodic cleaning of cargo spills, – Use of tarpaulin covers and speed regulations for vehicles engaged in transportation – Greenbelt Development
		Noise	– Acoustic Barriers and Enclosures – Personal Protecting Equipment (PPE) – Greenbelt Development – Counselling and traffic regulation

S. No.	Activity	Relevant Environmental components likely to impacted	Proposed Mitigation Measures
2.	Aqueous discharges in harbour basin	Marine water quality and ecology	– Barges / Vessels are prohibited from discharging wastewater, bilge, oil wastes, etc. into the near-shore as well as harbour waters. – Barges/ Vessels would also comply with the MARPOL convention. – As a mitigation measure for spillages an Oil spill contingency plan will be prepared and implemented.
3.	Cargo and Oil spills	Marine water quality and ecology	– In case of any cargo spillage during transfer from/to mother ships, Barges/ Vessels, it will be attempted to recover the spills. – Oil spill control equipment such as booms / barriers will be provided for containment and skimmers will be provided for recovery. – Response time for shutting down the fuelling, containment and recovery will be quicker.
4.	Maintenance dredging	Marine water quality Marine Ecology	– It will be ensured that the dumping of the maintenance dredge spoil would be uniform. – Environmental Monitoring Programme comprising of monitoring of marine water quality, marine sediment quality and marine ecology will be initiated one week prior to commencement of dredging and will be carried out during the dredging period.
5.	Water Supply	Water resources	– The water requirement will be met from Karnataka Rural water supply and sanitation agency which includes supply to Barge/vessels, staff and users. In addition to that water required for dust suppression system and fire fighting will be sourced from Sharavati River.
6.	Wastewater Discharge	Water Quality	– Collection of runoff from stock piles and directing into settling ponds – Neutralization using lime to ensure settlement of heavy metals, if any
7.	Solid Waste Management	Groundwater and Soil quality	– Composted bio-degradable waste will be used as manure in greenbelt. – Other recyclable wastes will be sold.

S. No.	Activity	Relevant Environmental components likely to impacted	Proposed Mitigation Measures
8.	Handling of hazardous wastes	Fire accidents due to products handling	– Hazardous materials will be stored as per the prescribed/approved safety norms. – Construction site will be secured by fencing with controlled/limited entry points. – Hazardous wastes (used oil & used battery) will be sent to KSPCB/CPCB approved recyclers. – Medical facilities including first aid will be available for attending to injured workers – Emergency alarms, provision of fire hydrant system and fire station. – Effective Disaster Management Plan (DMP) which covers onsite and offsite emergency plans. – Recovery of spills to the extent possible.
9.	Fishing activity	Fishermen livelihood	– Educating the fishermen about the orientation of approach channel – Regular Interactions will be initiated with the fishing community – Conflicts if any with fishing community will be amicably resolved in all cases
10.	Operation of Barge/Vessel loading facility	Socio-economic conditions of the region	During construction phase, the employment potential is estimated at about 500 persons. During operational phase, the Barge/ Vessel loading facility is likely to generate employment for 500 persons. Local people will be given preference based on their qualification and skill set. Together with this employment potential, project will help to enhance the socio economic conditions of the area with better schooling, communication and transport facilities that will be developed/ triggered as a part of overall economic development of the region.
		Natural Hazards	Disaster Management Plan (DMP) will be prepared; Manager (EHS) will act as the overall in-charge of the control of educative, protective and rehabilitation activities to ensure least damage to life and property.
		Induced Development	Offers an efficient and cost effective supply chain/ value proposition to the local importers and exporters in states of Karnataka, Goa and Andhra Pradesh.

10.1.1 Administrative and Technical Setup for Environmental Management

A Highly qualified and experienced person in the field of Environmental Management of barge/vessel loading facility shall be considered for the position of Senior Manager for Environmental management along with adequate supervisory staff.

10.1.2 Institutional Framework of EMP

The proposed organization of all personnel involved in the EMP process is depicted in Figure 10-1. The roles and responsibilities of the various parties involved in the EMP process are summarized below.

Project Proponent: Honnavar Port Private Limited, Environmental Management Cell.

Project Design, Construct and Operate: Contractor employed by the Project Proponent to carry out design, construction and operate the Barge/ vessel loading facility.

Environmental Management Team (EMT): The EMT will be responsible for implementing all environmental measures and EMP requirements recommended in the EIA Report throughout the construction, operation, restoration, aftercare of the barge/vessel loading facility and report to the barge/vessel loading facility Contractor on all environmental aspects of the Project. The EMT can be a separate consultant employed by the barge/vessel loading facility Contractor or the Contractor's in house environmental specialists.

Independent Consultant (IC): The IC will be appointed by the Project Proponent to provide an independent review and certification of the design, construction, operation, restoration and aftercare of the port.

Independent Environmental Checker (IEC): The IEC will be appointed by the Project Proponent as part of the IC to provide independent monitoring and audit to verify the overall environmental performance of the project and to assess the effectiveness of the ET in their duties. An IEC will be responsible to certify all environmental submissions to the Environmental Protection Division (EPD).

Environmental Protection Division (EPD): The Project EPD will be the authority to approve all submissions under The Environmental Impact Assessment Ordinance (EIAO) Authority.

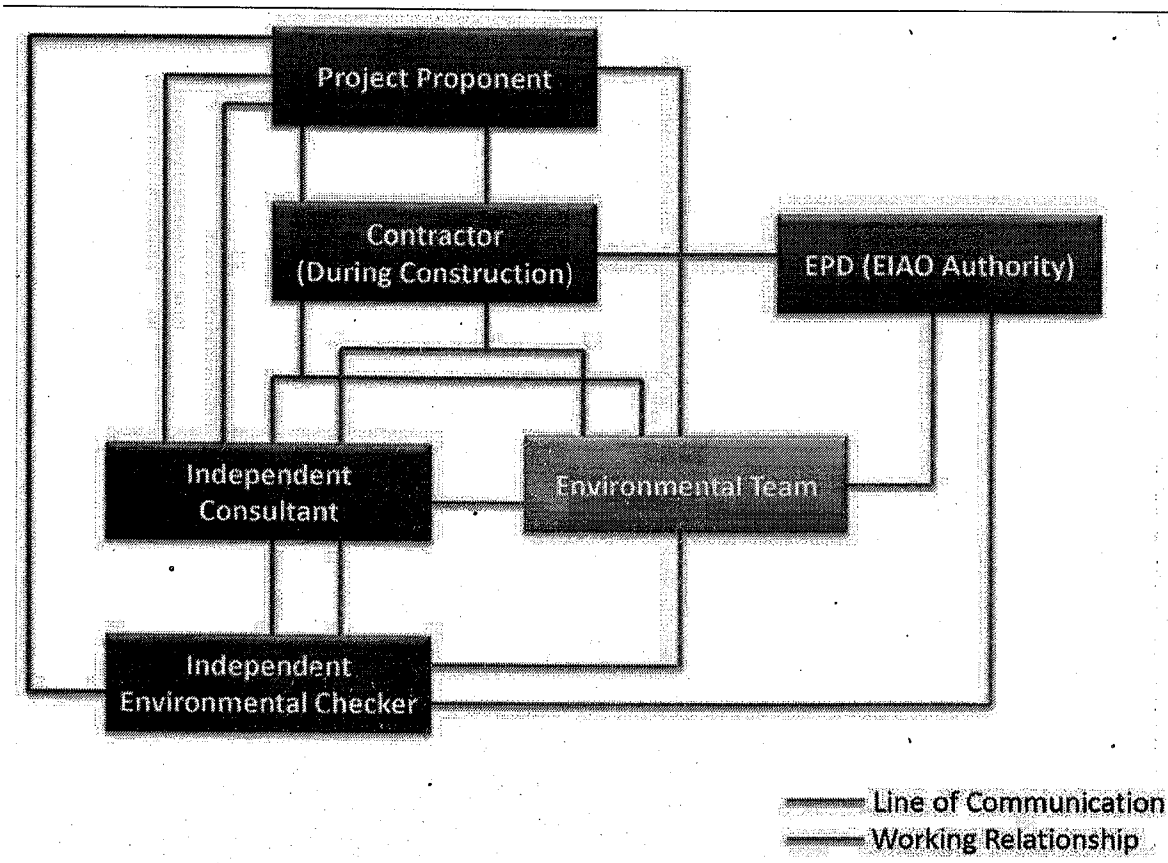


Figure 10-1: Proposed Institutional Mechanism for Environmental Management

10.1.3 Institutional Mechanism for Implementation of Mitigation Measures

The effective implementation and close supervision of the environmental management to mitigate the environmental impacts, which are likely to arise due to the construction and operational phases of the project could be achieved through a suitable institutional mechanism. The proposed institutional mechanism recommended for the implementation of the mitigation measures is presented in Figure 10-2.

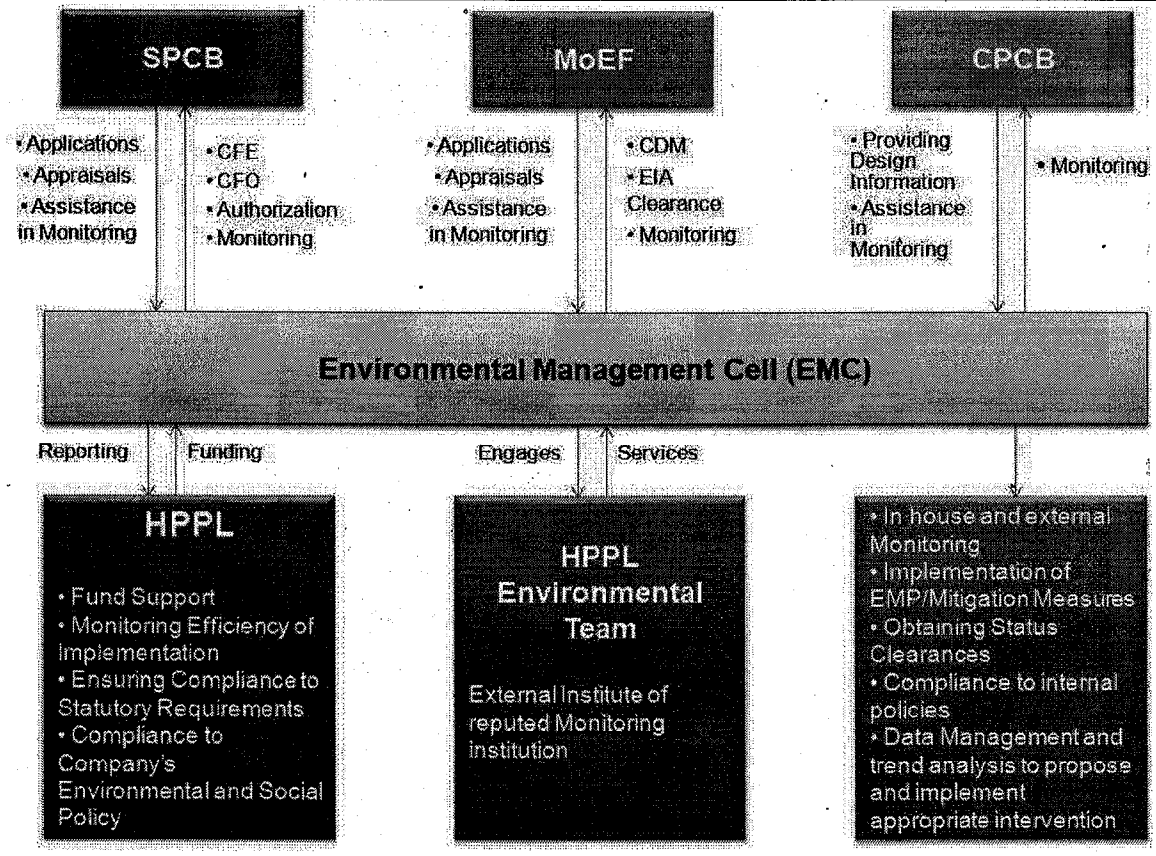


Figure 10-2: Institutional Mechanism for Implementing Mitigation Measures

A proper institutional mechanism to understand and implement appropriate environmental management measures during various stages of the project is a pre requisite and has a strong bearing for the overall success of the project management. Implementation of the Environmental Management measures will become easy once a good project management team is in place.

10.1.4 Approach towards Voluntary Compliance

During operational phase, HPPL may adopt an Environmental Management System (EMS) which can be proposed to be certified under ISO 14000. The objective of ISO 14000 is to establish a system to assess, monitor and manage environmental performances, which can be used to promote continual environmental improvement and prevention of pollution.

- Identify and list out environmental aspects due to the operation of the proposed project
- Determine the key operations that have significant environmental impacts
- Identify and track environmental legislations, policies, codes and other relevant requirements
- Establish objectives and targets (Environmental Management Plan)
- Formulate an Environmental Management System

For successful implementation of the formulated Environmental Management System, HPPL will ensure that the essential resources (with defined roles and responsibilities) are made available to implement, maintain and improve the Environmental Management System.

10.2 Environmental Management Cell (EMC)

Apart from having an Environmental Management Plan, it is also necessary to have a permanent organizational set up charged with the task of ensuring its effective implementation of mitigation measures and to conduct environmental monitoring. The major duties and responsibilities of Environment Management Cell are:

- To implement the environmental management plan
- To assure regulatory compliance with all relevant rules and regulations
- To ensure regular operation and maintenance of pollution control devices
- To minimize environmental impacts of operations as by strict adherence to the EMP
- To initiate environmental monitoring as per approved schedule
- Review and interpretation of monitoring as per approved schedule
- Review and interpretation of monitoring results and corrective measures in case monitored results are above the specified limit
- Maintain documentation of good environmental practices and applicable environmental laws as ready reference
- Maintain environmental related records
- Coordination with regulatory agencies, external consultant, monitoring laboratories
- Maintain log of public complain and the action taken

The proposed environmental management cell should have all basic record keeping facilities such as hard ware/software facilities, adequate space, vehicle (transport) and basic furniture and all simple instruments such as GPS, Digital camera, Hand held noise metre etc. The cell should have all basic environmental management data of the project that includes but not limited to the following:

- Environmental Impact Assessment Reports (both well preserved soft and hard copy)
- All valid and up to date environmental clearances papers
- All latest Environmental legislations, policies, codes and manuals for ready references
- A list of consultants on environmental management need to be kept with yearly revision of the list. This will help to receive proper advice in case of an emergency or a requirement and also to implement day to day environmental management activities

Over a period of time a system to understand and absorb the new revisions and changes in the environmental requirements and practices are to be established. This can only be achieved by regular training and genuine capacity building initiatives. All this require a sound positive attitude of top level management towards environmental management.

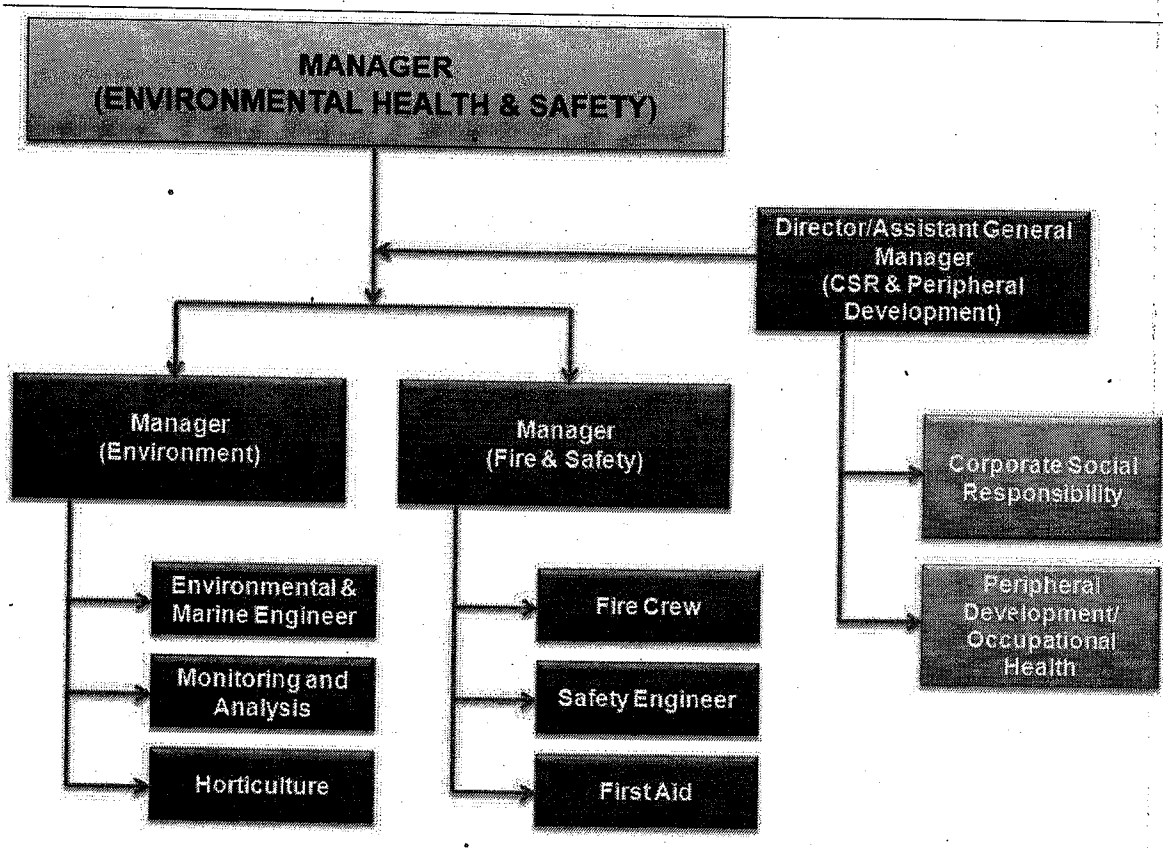


Figure 10-3: Organizational Setup for Environmental Management Cell

10.3 Greenbelt Development Plan

With rapid industrialization and consequent deleterious impact of pollutants on environment, values of environmental protection offered by trees are becoming clear. Trees are very suitable for detecting, recognizing and reducing air pollution effects. Monitoring of biological effects of air pollutant by the use of plants as indicators has been applied on local, regional and National scale. Trees function as sinks of air pollutants, besides their bio-aesthetical values, owing to its large surface area.

The greenbelt development not only functions as foreground and background landscape features resulting in harmonizing and amalgamating the physical structures of the plant with surrounding environment, but also acts as pollution sink. Thus, implementation of afforestation program is of paramount importance. It will also check soil erosion, make the ecosystem more complex and functionally more stable and make the climate more conducive. With a view to attenuate noise propagation and mitigate fugitive air pollution impacts, it is planned to develop a greenbelt all along the periphery of project site. Compatible species will be identified by HPPL for greenbelt. Saplings will be suitably nurtured. Regular watering will be undertaken. Soil conditioning and fertiliser application will be undertaken. If required, suitable soil treatment will be provided to ensure good growth of tree cover. Greenbelt development will be carried out in and around the proposed port along the roadside and on the vacant areas to reduce pollution as well as to improve aesthetic value within barge/vessel loading facility premises. Species recommended by horticulturists will be selected on the basis of air pollution tolerance index of tree. Selection of the plant species will be based on their adaptability to the existing geographical conditions and the

vegetation composition of the forest type of the region. During the development of the green belt within the project area, it has to be emphasized that those native plant species should be planted which are good ornamental values and are fast growing with excellent canopy cover.

The selection of plant species for the development depends on various factors such as climate, elevation and soil. The plant species should exhibit the following desirable characteristic in order to be selected for plantation.

- Should be fast growing and providing optimum penetrability.
- Should be wind-firm and deep-rooted
- Should form a dense canopy
- As far as possible, the species should be indigenous and locally available.
- Species tolerant to air pollutants like PM, SO_X and NO_X should be preferred
- Should be permeable to help create air turbulence and mixing within the belt
- Plants will be preferably indigenous and would be native of the area.
- Introduction of monocultures and alien plant species would be avoided to the maximum possible extent
- Further Plants will:
- Be fast growing and attaining a height of 5 m or more in 3 to 4 years
- Have thick canopy cover
- Be preferably evergreen
- Have large leaf area index
- Be resistant to specific air pollutants
- Maintain species diversity
- Be able to attenuate noise generated within the area
- Be well adapted to the existing soil conditions

As per the stipulations of MoEF, greenbelt will be provided all around the project site boundary.

10.3.1 Species for Plantation

The species proposed will have broad leaves. Trees will be selected based on the type of pollutants, their intensity, location, easy availability and suitability to the local climate like coastal adoptability. They have different morphological, physiological and bio-chemical mechanism/ characters like branching habits, leaf arrangement, size, shape, surface (smooth/hairy), presence or absence of trichomes, stomatal conductivity proline content, ascorbic acid content, cationic peroxides and sulphite oxidize activities etc to trap or reduce the pollutants. Species to be selected will fulfil the following specific requirements of the area:

- Tolerance to specific conditions or alternatively wide adaptability to eco-physiological conditions
- Rapid growth
- Capacity to endure water stress and climate extremes after initial establishment
- Differences in height and growth habits
- Pleasing appearances; and
- Providing shade

The pollutants namely dust/fugitive emissions, sulphur dioxide, smoke and carbon dioxide along with the noise pollution can be effectively curbed by planting the below mentioned specific floral species. Based on the above, the recommended species for greenbelt and plantation are given in Table 10-2.

Table 10-2: Recommended Plants for Greenbelt

S. No.	Botanical name	Importance
1	*Acacia auriculiformis*	Tall Evergreen drought resistant Avenue tree
2	*Ailanthus excelsa*	Tall branched semievergreen tree
3	*Albizia lebbeck*	Branced evergreen leguminous tree
4	*Alstonia scholaris*	Beautiful medicinal tree
5	*Neolamarckia cadamba*	Beautiful tree with large leaves
6	*Azadirachta indica*	Neem oil & neem products
7	*Bauhinia racemosa*	Ornamental tree
8	*Cassia fistula*	Ornamental and bark is a source of tannin
9	*Cassia siamea*	Ornamental avenue tree
10	*Cocos nucifera*	Coconut palm
11	*Dalbergia sissoo*	Avnue and timber tree
12	*Dendrocalamus strictus*	Bamboo products
13	*Casuarina equisetifolia*	Pulp and construction material
14	*Delonix regia*	Ornamental avenue tree
15	*Eucalyptus sp*	Grown in high density along the boundary
16	*Ficus benghalensis*	Shade and a source of food for birds
17	*Ficus racemosa*	Edible fruits
18	*Ficus religiosa*	Shade and a source of food for birds
19	*Gmelina arborea*	Timber
20	*Grewilia robusta*	Avenue tree
21	*Holoptelia integrifolia*	Fibre and timber
22	*Leucaena leucocephala*	Fodder and pulp wood
23	*Mangifera indica*	Edible fruit
24	*Michelia champaca*	Scented flowers
25	*Mimosops elengi*	Shade and edible fruit
26	*Muntingia calabura*	Shade and edible fruit
27	*Phoenix sylvestris*	Palm and the grown up palms can be easily transplanted. Good soil binder
28	*Pongamia pinnata*	Source of biodiesel
29	*Polyalthia pendula*	Majestic tree with drooping branches
30	*Polyalthia longifolia*	Avenue tree
31	*Samania saman*	Shade, timber and fruits are a good live stock feed
32	*Shorea robusta*	Tall and locally adapted Timber tree.
33	*Spathodea companulata*	Ornamental avenue tree
34	*Terminalia bellerica*	A common local tree of timber vlue.
35	*Syzygium cumini*	Edible fruits
36	*Tamarindus indica*	Tamarind fruit and leaf
37	*Tectona grandis*	Timber
38	*Terminalia arjuna*	Timber and shade tree
39	*Terminalia catappa*	Edible almond nuts

10.4 Biodiversity Conservation and Management Plan

The main aim of Conservation of Biodiversity is to ensure "No Net Loss". The biodiversity-related conventions are based on the premise that further loss of biodiversity is unacceptable. Biodiversity must be conserved to ensure it survives, continuing to provide services, values and benefits for current and future generations. The following approach has been chosen by the International Association for Impact Assessment (IAIA) to help achieve *'no net loss'* of biodiversity:

- Avoidance of irreversible loss of biodiversity.
- Seeking alternative solutions to minimize biodiversity losses.
- Use of mitigation to restore biodiversity resources.

- Compensation for unavoidable loss by providing substitutes of at least similar biodiversity value.
- Looking for opportunities for enhancement

Chapter 11
Summary and Conclusion

11 Summary and Conclusion

11.1 Introduction

As a part of major initiative to propel the industrial growth of Karnataka, the State Government has introduced Industrial Policy 2006-11 with an aim to increase the growth of GDP, strengthen manufacturing industries, increase share of exports from Karnataka, to generate additional employment of at least 10 lakh persons in the manufacturing and service sectors, to reduce regional imbalance and ultimately aim at overall socioeconomic development of the State. In line with, the Directorate of Ports and Inland Water Transport Department, Government of Karnataka signed a lease agreement with Honnavar Port Private Limited (HPPL), a consortium formed by North Canara Seaports Private Limited (NCS) and GVPR Engineers Limited (GVPRL) to develop Honnavar port" at the mouth of Sharavathi River in Uttarakannada district of Karnataka. The consortium also signed a lease agreement for the use of Portland to develop port related activities at Honnavar.

11.2 Project Location

The proposed barge /vessel loading facility is located at the mouth of River Sharavati towards North west of Kasarkod Tonka village in Uttara Kanada district in Karnataka. The identified shoreline for Honnavar Barge / Vessel loading facility is in the notified port limits (declared as minor port by Government of Karnataka) and latitude / longitude of port limits are given below.

Point	Latitude	Longitude
Point A	14°18'02.86"N	74°25'11.94"E
Point B	14°18'02.86"N	74°22'01.12"E
Point C	14°13'26.69"N	74°24'17.81"E
Point D	14°13'26.69"N	74°26'35.36"E

11.3 Need for Development of Barge / Vessel loading facility

Liberalization of the Indian economy has led to significant growth and India is fast emerging as one of the largest economies of the world. This growth will provide a major thrust to trade. About 95% by volume and 70% by value of Indian exports are channeled through maritime Route. Foreign Trade Policy envisages doubling of Indian share in the global market. Hence, there is an immediate necessity to augment the Indian infrastructure by expanding or creating new Ports. Since, existing ports are saturated or congested and have limited scope for expansion there is a great need for development of green-field ports along East and West coasts. Based on the growing demand/export potential in the state, the Government of Karnataka also has estimated that Karnataka coast would need more seaports/barge/vessel loading facility along Coast. Bellary district in Karnataka is blessed with many industrial projects that makes it second fastest growing city in the state .Out of the ports of the state, NMPT, the major port currently caters to the cargo requirements in the southern districts of the state and is operating at 89% capacity (in 2008 – 2009). Cargos such as granite, fertilizer, molasses, iron ore, wood logs, coal with other agro products and steel products also has the potential to grow in demand and supply which will increase the traffic. The capacity at the port is not adequate to cater to the demand of this region. This will increase the traffic across the proposed Barge/ Vessel loading facility.

About 27% of the power demand of Karnataka is met by that generated from coal based power plants. JSW Energy Limited (JSWEL) has commissioned coal based thermal power plant in Karnataka. JSWEL is also proposing to develop another unit of 600 MW in Bellary. Two coastal coal based thermal power plants are also proposed to be set up with capacities of 1015 MW and 4000 MW in Tadri and Mangalore respectively. The demand supply gap of coal is expected to increase in the coming years.The development of Barge/ Vessel loading facility will meet the capacity requirements of the region and Karnataka State and in turn is expected to boost the economy of State.

11.4 Project Benefits

- Employment potential during construction phase and operational phase is estimated about 500 and 50 persons respectively.
- Employment opportunities to the local people for skilled, semi-skilled and unskilled work force during the construction and operation phases
- Increase in education and health facilities in the project area
- Significant benefits to local people and to the region as a whole and positive impact on the socio-economic conditions of the project region
- Proposed dedicated rail/road corridor will provide good connectivity and also offers an efficient and cost effective supply chain/ value proposition to the local importers and exporters in the State of Karnataka and neighbouring states

11.5 Project Description

11.5.1 Salient Features of Barge/ Vessel Loading Facility

S. No	Parameter	Description
12.	Land Area	44 Ha (~98.84 acres)
13.	Cargo handling capacity	**Handling Capacity: 4.9 MTPA** • Coal - 2.7 MTPA • Iron Ore – 1.0 MTPA • General cargo – 1.2 MTPA • Granite – 0.16 MTPA • Fertilizer – 0.2 MTPA • Molasses with Agro Products – 0.15 MTPA • Steel Products – 0.4 MTPA • Sugar – 0.29 MTPA
14.	Cargo Storage	• Iron Ore – 1.8 Ha • Coal - 7 Ha • Other General Cargo – 6.10 Ha
15.	Cargo handling equipment	Barge/Vessel loader, mobile harbor cranes, pay loaders
16.	Berthing facilities	Berth of length 440 m and width 30 m
17.	Length of Northern Breakwater	820 m
18.	Length of Southern Breakwater	865 m
19.	Navigation Facilities	Approach Channel (Inner/ Outer): Length: 1395/2280 m; Width: 100/100 m; Depth:(-) 10/10 m Turning Circle: Diameter: 250 m; depth: (-)10.0 m
20.	Dredging and Reclamation	• Capital dredge material: 3.9 MCM • Reclamation: 1 MCM of dredged material will be used.. • Remaining dredge material will be disposed

S. No	Parameter	Description
		During periods of strong near shore currents (during peak wet season), it is suggested to dispose the sediment offshore at greater depths (>30 m).
21.	Navigational Aids	• Channel marker buoys; Fairway marker Buoy; Breakwater marker lights; Berth Corner Lights
22.	Connectivity	• National Highway - NH 17 (~ 2.0 km) towards East. • Nearest Railway Station - Honnavar (~ 5.0 km) towards East • Proposed Rail Corridor Connecting project site to Manki Railway station of about 15 km • Road Corridor connecting project site to NH17.

11.5.2 Utilities & Services

11.5.2.1 Water Supply

Water requirement during the construction is expected to be around 15m^3/day. Water demand during operational phase of barge/ vessel loading facility is estimated as 7m^3/day. The water requirement will be met from Karnataka Rural water supply and sanitation agency which includes supply to Barge/vessels, staff and users. In addition to that water required for dust suppression system and fire fighting will be sourced from Sharavati River.

11.5.2.2 Power Supply

Power requirement during construction phase is expected to be around 1 MVA. The power demand is estimated at 1 MVA during operation. Construction phase power requirement will be met from DG sets and operation phase power will be drawn from Substation located at Honnavar (~2 km).

11.5.2.3 Dust Suppression System

Dust suppression equipment will be provided for efficient control of dust pollution on environment during storage and handling of coking Coal and Iron ore at berth and stockyard. An efficient dust suppression system will contain dust particles before it is airborne.

A common system consisting of suitable pump, storage tank, nozzles have been proposed for efficient dust control system. Dust control is envisaged at following locations:

- barge/ vessel loading /unloading area
- Stockyards

Water sprinkling system at high pressure with swivelling type nozzles will be installed to cover entire stockpile. Nozzles will be installed on pipes at different levels from ground. Nozzles will be installed along stockpile at regular intervals to cover stockpile height and width.

11.5.2.4 Wastewater Management

The wastewater and sewage generated during construction at site and at labour camp will be collected in holding tank and periodically transferred to nearby Treatment Plant. During operation, the sewerage system will be provided to collect the sewage from port administration building, canteen and operation buildings and it will be collected in septic tank followed by soak pits. The cargo storage area will be provided with an extensive drainage and treatment system so that the contaminated water from the stockyard area does not flow directly into the natural water bodies or into the groundwater system. Drainage pits will be provided in the workshop areas, which will be connected to an oily wastewater tank. Oily wastewater if any collected in the oily wastewater separator and will be treated (if required) to meet the discharge standards.

11.5.2.5 Rainwater Harvesting System

Rain water collected from roof of buildings will be channelised through rain water down comers and routed to garland drain around the buildings. These garland drains are connected to the plant storm water drainage network system all around the proposed barge/ vessel loading facility area. Several recharge wells will be located at strategic locations within the port and will be interconnected to the storm water drain network system.

11.5.2.6 Solid Waste Management System

Solid waste from the utilities such as canteen shall be segregated as biodegradable and non-biodegradable waste and collected separately by providing bins at respective places. The collected biodegradable waste shall be subjected to composting and the compost will be used as manure for the development of green belt within the port. The non-biodegradable waste like plastic shall be disposed off to approved vendors of KSPCB/CPCB in a scientific manner.

11.5.2.7 Fire Fighting System

Fire fighting system will be provided to both control and extinguish fires. It is proposed to install Fire Hydrant System, which will be designed to give adequate fire protection for the facility based on Indian Standards or equivalent and will conform to provisions of Tariff Advisory Committee's Fire Protection Manual. A centralised fire station will be provided for attending to all calls which will house three mobile fire tenders. One fire tender will be provided with snorkel attachment.

11.6 Greenbelt Development

An area of about ~3.10 Ha is proposed to be developed as greenbelt. Greenbelt will be developed at stockyards, administration building and along the road areas. The tree species to be used for the green belt development will be in line with the local ecology (indigenous species).

11.7 Project Cost

The capital cost estimate for development proposed barge / vessel loading facility is estimated at ` 450.00 Crores.

11.8 Environmental Impact Assessment

In accordance with the provisions of the EIA Notification, 2006 (as amended) and CRZ notification, 2011, HPPL submitted the proposal (Form-1, Draft Terms of Reference (ToR) and Prefeasibility Report) for consideration by the Karnataka State Level Expert Appraisal Committee (KSEAC) in its meeting held on August 20 , 2011 at Bangalore. The committee approved the ToR vide SEIAA letter No: 22 IND 2011 dated September 13, 2011.

11.9 Description of Environment

Project Influenced Area: An area within 10 km radius with port site as boundary has been earmarked for the study as the **Project Influenced Area**. The project site is considered as **core area**. The baseline environmental data was generated for one season (12 Weeks – non monsoon season).

11.9.1 Marine Environment

Existing marine environmental conditions in study area were established through collection and analysis of water and sediment samples at selected locations. Parameters monitored include physical parameters, chemical parameters and biological parameters.

- Temperature is ranged from 29.0°C to 31.0°C
- Salinity is ranged between 21.00 and 34.00 Practical Salinity unit (PSU),
- The presence of a good plankton community structure, good benthic structure and higher Oxygen levels indicate that the waters are free from pollution and also support good aquatic life.
- Observations in terms of chemical and biological parameters reflect ambient coastal processes which are at normal levels coinciding the basic bio-geochemical process of the coastal environment.

11.9.2 Terrestrial Environment

11.9.2.1 Meteorology

As per the IMD climatological table the following are the observations were drawn for period of 1951-1980.

- The daily maximum temperature is 32.9°C and the daily minimum temperature is 20.0°C.
- Maximum and minimum relative humidity of 92% and 64% were recorded at 08:30 hours in the months of July, August and December. Maximum and minimum relative humidity of 88% and 57% were recorded at 17:30 hours in the months of July and December.
- The Maximum rainfall observed is 1196.0 mm during July month and no rainfall was recorded in February. Annual total rainfall was 3753.3 mm.
- Mean wind speed is 7.2 kilometre per hour.

11.9.2.2 Ambient Air Quality

Ambient air quality was monitored at Six *(6)locations* with twice a week frequency during the season. The air quality parameters such as PM_{10}, $PM_{2.5}$, SO_2, NO_2, Hg were monitored on 24

hourly basis and CO, O_3, HC were monitored on eight hourly basis. The details of locations and results are given in Table 11-1.

Table 11-1: Ambient Air Quality Monitoring Locations

Station No.	Location	Distance (km) from Project Area	Azimuth Directions	Environmental Setting
A1	Honnavar	2.4	N	Residential Area
A2	Kasarkod	2.5	S	Residential Area
A3	Karki	2.9	N	Residential Area
A4	Ramthirth	3.0	E	Residential Area
A5	Kulkod	4.3	E	Residential Area
A6	Hosad	7.4	SE	Residential Area

- Maximum concentrations of PM10, $PM_{2.5}$, SO_2 and NO_2 are well within the National Ambient Air Quality Standards during the study period.
- Maximum concentration of PM_{10} ranged between 23.6 µg/m^3 at Ramthirth and 65.69 µg/m^3 at Honnavar.
- Maximum concentration of $PM_{2.5}$ ranged between 11.64 µg/m^3 at Ramthirth and 35.4 µg/m^3 at Honnavar.
- Maximum concentration of SO_2 ranged between 4.6 µg/m^3 at Kulkod & Hosad and 8.2 µg/m^3 at Honnavar.
- Maximum concentration of NO_2 ranged between 8.6 µg/m^{3}at Kulkod and 23.8 µg/m^3 at Honnavar.
- Maximum Concentration of ozone ranged between 1.3 µg/m^3 at Karki and 4.1 µg/m^{3}at Honnavar
- The CO concentration at all locations was observed less than 1.0 ppm.
- Hydro Carbons and Mercury is found to be Below Detectable Limit at all the locations.

Air quality concentrations are well within the National Ambient Air Quality Standards for Industrial, Residential and Rural areas at all monitoring locations during the study period. Hydro Carbons and Mercury is found to be Below Detectable Limit at all the locations.

11.9.2.3 Ambient Noise Levels

Noise levels were monitored at Six (6) locations once in during study period for 24 hours and the details of locations and results are given in the Table 11-2.

Table 11-2: Ambient Noise Levels

Station No.	Location	Environmental Setting	L_{dn}	L_d	CPCB Standard L_d	L_n	CPCB Standard L_n
N1	Honnavar	Residential Area	47.7	48.9	55	38.8	45
N2	Kasarkod	Residential Area	46.1	47.3	55	37.1	45
N3	Karki	Residential Area	45.1	46.3	55	36.2	45
N4	Ramtirth	Residential Area	43.3	44.4	55	36.0	45
N5	Kulkod	Residential Area	43.5	44.6	55	36.0	45
N6	Hosad	Residential Area	41.4	42.4	55	35.7	45

Day and night time noise levels at all locations are well within CPCB standards for Rural and Residential Areas.

11.9.2.4 Inland Water Quality

Ground and surface water samples were collected at Six (6) locations and the details of sampling locations is given in Table 11-3.

Table 11-3: Water Sampling Locations

Location Code	Location Name	Source	Usage
Groundwater (GW)			
GW1	Honnavar	Bore well	Drinking, Washing and Bathing
GW2	Kasarkod		
GW3	Karki		
Surface Water (SW)			
SW1	Sharavati River at Honavar	River	Nil
SW2	Badgane River at Pavinkurve	River	Nil
SW3	Sharavati River at Nagare	River	Nil

Groundwater:

- pH is ranged between 6.68 & 6.84
- Total dissolved solids ranged between 74 mg/l & 92 mg/l
- Total hardness (as $CaCO_3$) ranged between 40 mg/l & 48 mg/l
- Chlorides (as Cl^-) ranged between 7.1 mg/l & 14.2 mg/l
- Fluorides as (F^-) at all locations is 0.1 mg/l
- Total Coliforms and Faecal were not found in all the monitored locations

All the parameters for groundwater are within the limits specified as per Drinking Water Quality Standards (IS: 10500, 1991)

Surface Water:

- pH is ranged between 6.96 & 7.64
- Total dissolved solids ranged between 26 mg/l & 5496 mg/l
- Total hardness (as $CaCO_3$) ranged between 12 mg/l & 1040 mg/l
- BoD5 is ranged between 4-12 mg/l.
- Chlorides (as Cl^-) ranged between 7.1 mg/l & 2982 mg/l
- Fluorides as (F^-) at all locations is <0.1 mg/l & 1.6 mg/l
- Total Coli forms ranged between 1 MPN/100 & 32 MPN/100
- Faecal Coliforms were not found in all the monitored locations

The parameters for surface water samples are within the limits except Bio Chemical Oxygen Demand (4.0-12.0 mg/l) specified as per Class B, Outdoor bathing (organized), as per Guidelines for Water Quality Management – CPCB 2008.

11.9.2.5 Soil Quality

Considering the soil profile in study area, Five (5) sampling locations were selected and the details of sampling locations are given in Table 11-4.

Table 11-4: Soil Sampling Locations

Station No.	Location	Distance (km) from Project Site Boundary	Environmental Setting

S1	Port Site	--	--
S2	Honnavar	2.4	Agricultural Land
S3	Kasarkod	2.5	
S4	Karki	2.9	
S5	Apsarkonda	6.2	

Soil types are sandy (S1, S3, S4 and S5) and sandy clay (S2); pH of soils ranged between 6.62 (S4) and 7.86 (S2) indicating slightly acidic to alkaline in nature. Electrical Conductivity varied between 88 µmhos/cm (S3) and 112 µmhos/cm (S2); Phosphorus as P varied between 12 mg/100 gm (S4) and 26 mg/100 gm (S2); Potassium (K) varied between 32 mg/100 gm (S4) and 92 mg/100 gm (S2); Sodium Absorption Ratio varied between 1.82 (S3) and 2.12 (S1); Infiltration Rate ranged between 52mm/hr (S2 & S5) and 58mm/hr (S1 & S4); Water Holding Capacity varied between 6.1 % (S4) and 9.3 % (S2); Porosity varied between 32 v/v % (S2) and 38 % v/v (S4); Zinc (Zn) varied between 0.49 mg/kg (S4) and 0.92 mg/kg (S2); Iron (Fe) varied between 0.36 mg/kg (S1) and 0.84 mg/kg (S2); Lead (Pb) is less than 0.02 mg/kg at all locations; Nickel (Ni) is less than 0.02 mg/kg at all locations.

11.9.2.6 Flora and Fauna

None of the Flora and Fauna species observed from the core area/project site belongs to the Rare/Endangered / Endemic / Threatened category.

11.9.3 Socio-economic Conditions

Socio-economic profile in the study area is assessed based on 2011. Census and latest statistical abstract of Uttara Kanada district.

- Total population in Honnavar Taluk is 166390
- Main Workers constitute about 32.3%, Marginal Workers to be about 7.4% of the total population and remaining 60.3% are Non-Workers
- Literacy rate is about 75.8% of total population
- Honnavar town have primary schools, secondary schools and primary health centres
- Fish landing centre within the study area is located at Honnavar.

11.10 Additional Studies

11.10.1 Preliminary Risk Analysis

Various risks associated with the construction and operation of the proposed Barge / Vessel loading facility in terms of identifying the hazards and suggesting the mitigation measures have been addressed under Preliminary Risk Analysis. The Preliminary Risk Analysis (PRA) thus carried out also provided inputs for formulating the onsite Disaster Management Plan (DMP).

Preliminary risk analysis was carried out under the following heads:

- Hazard identification
- Enumeration of potential accidents and typical failure frequencies
- Risk reducing measures

11.10.2 Disaster Management Plan

A framework for Disaster Management Plan was prepared to minimise damages in the event of a disaster. An On-Site Emergency Preparedness Plan and Off-Site Emergency Preparedness Plan were broadly prepared to deal with emergencies and prevent disasters. An institutional framework with clear assignment of roles and responsibilities was broadly prepared with which location of Emergency Control Centre and Assembly Points will be identified. Communication system and alarm systems for effective communication in the event of a disaster are broadly identified. Disaster Management Plan (DMP) for natural hazards such as cyclones was broadly prepared. Mutual aid scheme, composition of District Level Emergency Committee and aspects relating to community involvement for dealing with off-site disasters were broadly prepared.

11.10.3 Social Impact Assessment

The land identified for development of Barge / Vessel loading facility is about 44 ha within the port limits issued by Government of Karnataka. Government of Karnataka has allotted the land for the proposed development. The land proposed for Rail / Road Corridor is a Government / few patches private land and no families are present in the land proposed to be acquired. Hence, No R&R is envisaged due to the proposed development.

11.11 Project Benefits

The Hinterland of the proposed Honnavar barge/ vessel loading facility includes some of the major existing Iron reserve in Bellary Hospet region of Karnataka. The project proponent is involved with suitable mining and mineral exploration for more than two decades. In addition to that project proponent planning to export/import thermal coal, wooden logs, fertilizer and edible oil from various sources. Hence development of Honnavar Barge/ Vessel loading facility offers an efficient and cost effective supply chain/value proposition to the local importers and exporters. One of the main aims of the proposed project is to bring significant socio-economic benefits to the local people and also to the region as a whole. The various project benefits are discussed in this chapter.

In the proposed rail connectivity, railway line will take off from the existing railway station at Manki. The new railway line will have to be laid for a distance of 14.6 km from Manki railway station to the proposed port. New railway line will run parallel to existing railway line for a length of about 8 km and then will take a turn towards sea coast which will then run parallel to the sea coast till the proposed port for the remaining 6.6 km.

Due to the proposed development of Honnavar Barge/ Vessel loading facility, apart from the surrounding region, even the adjoining states would also get a lot of benefits. The benefits may be realised as upcoming of industries such as steel plants, thermal power plants and their allied ancillary units. Other benefits would be generation/providing of either direct or indirect employment to the local people. With the new connectivity through rail and road, there will be a facility to improve the trading, marketing as well as value addition of the local products. The proposed connectivity will also serve to the tourist places nearby thereby improving employment to the local people. The development of Honnavar Barge loading facility will be a boon for the development of the region .The proposed project is likely to have positive impact on the socio economic conditions of the region. The social infrastructure in the region is likely to change due to the creation of more job opportunities and avenues for

income generation. People will have higher income due to direct employment as well as indirect employment and will have higher earning and buying capacities.

The proposed project is likely to have a positive impact on the socio economic conditions of the region. The social infrastructure in the region is likely to change due to the creation of more job opportunities and avenues for income generation. People will have higher income due to direct employment as well as indirect employment and will have higher earning and buying capacities.

The quality of life in the region is likely to improve due to the creation of jobs for the local people so that the dependency changes and there will be more than one earning member in the family, which will provide economic freedom.

As part of corporate responsibility (CSR) initiatives, it is envisaged to create health infrastructure in the form of primary health centre, which will be beneficial to the employees and also local people living in the region as their dependence on nearby towns and cities for quality medical treatment will be reduced. As part of CSR, it is also proposed to conduct periodic health camps and carryout health campaigns which will lead to better health conditions of the people.

HPPL has planned to set up a continuous effort in developing and improving the skills and personality of the youth living in the periphery villages (Kasarkod and Apsarkonda) of the project site. HPPL is planning to undertake the following activities in the project region as part of Corporate Social Responsibility (CSR):

- Basic education facilities for the children of the employees will be provided
- Strengthen primary schools with teaching aids, student education material
- Strengthen upper primary and high schools with teaching aids, mobile laboratory and computer education
- Strengthening of Government hostels for better amenities
- Initiatives for reducing school dropouts
- Financial assistance for professional education
- Funds for setting up of Libraries

11.12 Environmental Management Plan

The effective implementation and close supervision of the environmental management to mitigate the environmental impacts, which are likely to arise due to the construction and operation phases of the project could be achieved through a suitable institutional mechanism. The institutional mechanism responsible for the implementation of the mitigation measures is presented in the **Chapter 10**.

11.13 Environmental Monitoring Programme

The environmental attributes to be monitored during construction and operation phase of the project, specific description along with technical details of environmental monitoring including the monitoring parameters, methodology, sampling locations and frequency of monitoring are presented in **Chapter 6**.

11.14 Disclosure of Consultants Engaged

Consultant	Type of Service

Consultant	Type of Service
L&T-RAMBØLL Consulting Engineers Limited, Hyderabad	Environmental Impact Assessment Study
Centre for Advanced Study in Marine Biology (CASMB), Annamalai University, Parangipettai, Chidambaram	Marine Environmental Surveys
M/s. Vison Labs, Hyderabad	Terrestrial Environmental Surveys
Centre for Earth Science Studies (CESS), Thiruvananthapuram	Delineation of HTL, LTL and CRZ Boundaries with respect to 2011 CRZ notification
Dept of Meteorology and Oceanography Andhra University Vishakapattinam Prof B.S.R. Reddy Prof. K.V.S.R. Prasad Chairman, Board of Studies	Mathematical Modeling study

Chapter 12
Disclosure Of Consultants Engaged

12 Disclosure of Consultants

HPPL has engaged L&T-RAMBØLL Consulting Engineers Limited (L&T-RAMBØLL), Hyderabad to undertake EIA study for the Honnavar Barge/ Vessel Loading Facility in Karnataka. The nature of consultancy service rendered covers both terrestrial and marine environmental assessment.

12.1 Brief Profile of L&T RAMBØLL

L&T-RAMBØLL Consulting Engineers Limited (L&T-RAMBØLL) is a leading multi-disciplinary Indian Consultancy firm formed in 1998 between Larsen & Toubro Limited (L&T – the largest Indian Engineering and Construction Conglomerate) and RAMBØLL (a leading firm of Consultants in Europe). Both L&T and RAMBØLL have over six decades of experience. Following the footsteps of such illustrious parents, L&T-RAMBØLL has made a distinctive mark by creating new standards in providing sustainable solutions. Today, L&T-RAMBØLL is distinguished from others not limited to its lineage but its relentless quest for quality - a unique tradition of placing client's needs above all.

L&T-RAMBØLL has complete access to the technology of RAMBØLL. This technology is customised by L&T-RAMBØLL to serve the needs of Developing World. We offer a diverse array of talents together with practical experience. We assure our clients a professional approach by innovation and evolving optimal solutions. At L&T-RAMBØLL, we recognise that human resources are the key to organisational success.

L&T-RAMBØLL's expertise ranges across a broad spectrum of sectors with special forte in Infrastructure Projects and Industrial Parks/SEZ's. L&T-RAMBØLL has expertise in carrying out Techno-Economic Feasibility Studies, Preparation of Master Plans & Detailed Project Reports and Bid Process Management. L&T-RAMBØLL is rendering the following services for Specialised Industrial Clusters/SEZ's/Industrial Parks/Investment Regions:

- Environmental and Social Impact Assessment including assistance to Client in obtaining necessary clearances/approvals from various statutory authorities: State PCB's, Coastal Zone Management Authorities (CZMA's), MoEF (GoI)
- Field surveys (Terrestrial & Marine Environments) and investigations
- Project formulation/conceptualisation & configuration
- Market study and demand assessment
- Master planning
- Infrastructure design and engineering
- Block cost estimation
- Economic and financial analysis
- Bid Process Management
- Assistance in domestic and international marketing including road shows / investors conference (or meet) for marketing the project.
- Assistance to Client in achieving technical and financial closures

Strengths of L&T-RAMBØLL

L&T-RAMBØLL has a well-equipped Corporate Office at Chennai where RAMBØLL's Danish Experts are positioned permanently. L&T-RAMBØLL's staffs is replete with a wide range of professionals – Planners, Engineers, Designers, Environmental and Social Specialists, Financial Analysts, Project Structuring, Marketing and Privatisation Experts, Construction Supervision Managers – covering a wide spectrum of services. The skills of the Experts are

continuously aligned to suit the changing Client requirements. L&T-RAMBØLL has strategic tie-ups with Associates for specialized services. Services of an eminent group of Expert Consultants are also available to L&T-RAMBØLL. Our clients value the highly motivated and dedicated team of professionals who assure them international quality service through focused and optimal solutions.

L&T- RAMBØLL provides a stimulating working environment. We have assembled a team of skilled, creative and dynamic professionals who strive to translate the organisational ethos into reality. We are supported by experts from RAMBØLL with proven expertise in various fields. To enhance the efficiency of the personnel and enable them to be updated with the latest developments in technology, we organise comprehensive technical training programmes and organisational development programmes at regular intervals.

A creative work environment, motivated staff, structured training, latest methodologies and tools, continuous adherence to quality, adoption of best ethical standards and a keen client orientation are the factors that spur on L&T-RAMBØLL's journey into the future. Our driving philosophy is 'Client First'. We work towards complete satisfaction of our clients by adopting good work practices and meeting their requirements through timely delivery of appropriate solutions. Further for achieving this objective, we have acquired state-of-the-art IT facilities and software to ensure quality in all spheres of our activity.

L&T-RAMBØLL has modern fully computerized offices with latest computational and communication facilities. A large number of high-end computers are available and are connected by a network. Further, Data-one Internet connectivity enables fast exchange of information with the clients, as well as within the offices and the parent companies. These facilities help us to provide our clients high quality services within the shortest possible time.

L&T-RAMBØLL has more than 300 employees at 4 offices with a leading consulting group with extensive operations at Chennai, Hyderabad, Delhi and Mumbai.

Quality Policy of L&T-RAMBØLL

L&T-RAMBØLL is committed to achieve and sustain excellence in consultancy services to customers world-wide through an in-house Quality Management System that conforms to ISO 9001:2008. The commitment stated above will be fulfilled by:

- Working towards compete satisfaction of L&T-RAMBØLL's customers by adopting good work practices and meeting their requirements through timely delivery of appropriate solutions.
- Striving to achieve continual improvement of quality management system through periodic review of quality policy, processes and quality objectives.
- Striving to maintain well-qualified and motivated staff by empowering them and proving a stimulating work environment.
- Adhering to the best ethical standards for business behaviour by respecting the rules of law governing L&T-RAMBØLL's business and presenting a well-audited financial statement every year.
- Impelling employees at all levels in achieving the objectives of the organisation and ensuring that all employees are aware of and act within the policy framework of L&T-RAMBØLL.
- Propagating our quality policy and procedures to our sub-consultants and associates and ensuring adherence to the relevant components of the quality system.

Further details may be seen on the following URL: www.ltramboll.com

12.2 Sub Consultants Engaged

The Environmental Impact Assessment study for proposed development of Honnavar Barge/ Vessel loading facility at Karnataka involves both terrestrial and marine environmental surveys. For these surveys, HPPL and L&T-RAMBØLL appointed reputed institutions/agencies and coordinated the surveys as per the guidelines of statutory authorities. The agencies/ organizations identified for conducting the marine and terrestrial environmental surveys are **Centre for Advanced Study in Marine Biology** (CASMB), Annamalai University, Parangipettai, Chidambaram, and **M/s. Vision Labs**, Hyderabad.

As per the requirement of 2011, January CRZ notification, studies with respect to HTL and LTL and surveys were conducted by Centre for Earth Science Studies, Trivandrum.

These three agencies/organizations have been identified based on the credentials, commitment to the quality of output and deliverables, relatively low price, flexibility in fee negotiations, etc.

12.2.1 Brief Profile of "Centre for Advanced Studies in Marine Biology", Annamalai University, Parengipettai

Nature of consultancy service rendered: Marine Environmental Surveys

The Centre of Advanced Study (CAS) in Marine Biology is a reputed Marine Institute in India which is actively engaged in teaching, research and extension activities with an ideal location and easy access to different biotopes such as estuary, mangrove, backwaters and coastal waters. It has made rapid strides in various facets of Marine Science.

Research contribution through the years to Marine Science pertaining to the tropical environment by this Centre resulted in the establishment of exchange programmes with research institutions of the United Kingdom and the United States of America. The major thrust areas identified for the Centre by the experts of the UGC visiting committee are Biological Oceanography, Physical & Chemical Oceanography, Physiology, Biochemistry & Microbiology, Fishery Science and Ecology & Aquaculture.

The ENVIS Centre (Environmental Information System), which is one among the 78 Centres in the country sponsored by the Ministry of Environment and Forests (MoEF), Government of India, New Delhi, started functioning from March 2, 1992 at the Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu, a pioneering Marine Biological Research Institute.

This Centre is meant to collect information on Estuaries, Mangroves, Coral reefs and Lagoons. The Centre has been serving with a motto to "Collect, Collate and Disseminate" and is engaged in several information services viz., query/answer, and abstract service, press clipping service, publication and development of database for the benefit of user community.

In addition to ENVIS Centre, ENVIS Node on the Environmental Management Capacity Building - Technical Assistance Project (EMCB-TAP) on Estuaries, Mangroves, Coral reefs and Lagoons has been established by the Ministry of Environment and Forests (MOEF), Government of India, under the World Bank (WB) Assistance.

ENVIS centre has also been selected as one among the 20 Sustainable Development Network Partners (SDNP) of ENVIS under Indo-Canada Environmental Facility (ICEF) Project, India. Further details on the agency may be seen on the following URL: www.casmbenvis.nic.in.

12.2.2 M/s. Vison Labs, Hyderabad

Nature of consultancy service rendered: Terrestrial Environmental Survey

M/s. Vison labs was established in 2002. The agency is offering consultancy services in generation of baseline terrestrial environmental data for the detailed EIA studies. The organization has attained the recognition from the Ministry of Environment & Forests (MoEF), GoI (with vide Gazette Notification No. S.O.2728 (E), dated 25.11.2008). Vison Labs is also an ISO 9001:2000 Certified agency in the fields of environmental monitoring and analytical chemistry and other similar services. Further details on the agency may be seen on the following URL: www.visonlabs.com

12.2.3 Centre for Earth Science Studies (CESS)

Understanding the earth in its totality, transcending the boundaries of disciplines and gaining knowledge on the interactive and competing processes that shape the earth, from its evolution to the present status of ever increasing demand for natural resources, call for an all encompassing and multidisciplinary approach. Establishment of CESS in 1978 by Prof. C. Karunakaran was a recognition and realisation of this need to study earth's processes with a holistic approach.

The primary objective of CESS is to promote modern scientific and technological research and focus on developmental programmes relevant to the country in general and Kerala State in particular. CESS undertakes studies in tune with these objectives in the fields of geosciences, environmental sciences, marine sciences and atmospheric sciences. Programmes are focused in unravelling new scientific knowledge on the internal and surface processes of the south Indian lithosphere and the adjoining Arabian Sea as well as their interaction with the atmospheric cover, to develop knowledge and expertise needed for the use of natural resources in a sustainable way. All programmes have an emphasis to contribute to the thrust areas of research in earth sciences and to the societal needs of the State. Unlike many institutions in the area of geosciences, CESS fosters a tie-up between basic and applied research, with a focus on areas relevant to the society. CESS had, over the years, endeavoured to contribute substantially to natural hazard assessment and mitigation, in understanding atmospheric parameters, coastal processes, natural resource management and probing the dynamic processes of earth. CESS takes pride to be the only 'multidisciplinary earth science institute' in the country today.

Research programmes of CESS are broadly grouped under five major themes as crustal evolution and geodynamics, natural hazards, coastal processes and management, natural resources and environmental management, and atmospheric dynamics. Activities are presently organised under seven divisions, namely, Geosciences Division, Marine Sciences Division, Atmospheric Sciences Division, Resources Analysis Division, Environmental Sciences Division, Chemical Sciences Division and Training & Extension Division with several supporting laboratories.

CESS believes in the motto "Committed to our earth, our future" and strives to take benefits of its research to the society. It also believes that flourishing of basic research will lead to applied technologies that would eventually benefit the industry, prudent environmental management, and natural hazard mitigation, sustainable use of natural resources and in improving the quality of life.

www.cess.in

12.2.4 Flora and Fauna Survey

A detailed survey of flora and fauna of proposed development of Honnavar Barge/Vessel Loading Facility and its environs extending up to a radius of 10 km was carried out under the supervision and guidance of Prof. K. B. Reddy, Professor of Environmental Biology (S. G. H. R & M. C. M. R College of Post Graduate Studies, Malla Reddy Nagar, Guntur) and a senior consultant for flora, fauna and ecology for several major irrigation and hydroelectric projects and his team.

12.2.5 Andhra University

The Department of Meteorology & Oceanography, Andhra University has been the first and foremost in India to offer post graduate teaching and research programs in Oceanic and Atmospheric sciences. The Department was started in 1948 and over the years it contributed immensely for the development of newly emerging branches of science under the stewardship of Late Prof. R. Ramanadham, Prof. V.P. Subhramaynam and Prof. P Koteswararam, etc. The department has produced several distinguished alumni who played key roles in setting the direction for the development of Meteorology & Oceanography at national and international levels. The Department has been identified for DST – FIST sponsored Department in strengthening the teaching and research in the fields of Meteorology and Physical Oceanography

www.andharauniv.in

Appendix A
ToR & Compliance

No. SEIAA 22 IND 2011

STATE LEVEL EXPERT APPRAISAL COMMITTEE, KARNATAKA

(Constituted by MoEF, GoI)

Department of Ecology and Environment
7th Floor M.S. Building, Bangalore.
Dated: 13th September 2011.

To,

M/s. Honnavar Port Pvt. Ltd.,
103, Lalehzar Apartments, 45/1-2,
Palace Road, Bangalore -560 001.

Sir,

Sub: Development of barge/vessel loading facility at Coastal Sand Spit, Kasarakod Tonka, Honnavar Taluk, Uttarakannada District of M/s. Honnavar Port Pvt. Ltd., - ToRs & Additional ToRs – Regarding.

****

This has reference to your letter-dated: 09.06.2011 regarding the subject mentioned above. Information furnished subsequent to your letters has also been considered.

The proposal is for Development of barge/vessel loading facility at Coastal Sand Spit, Kasarakod Tonka, Honnavar Taluk, Uttarakannada District. This is a project falling under the category 7(e) of the Schedule of EIA Notification 2006.

The State Expert Appraisal Committee (SEAC), Karnataka considered the project during its meeting held on 20th of August 2011. Based on the consideration of the documents submitted and the presentation made by the project proponent, the Committee prescribed the following Terms of Reference (TORs) & Additional ToRs for preparing draft Environmental Impact Assessment (EIA) report for the above mentioned project. You are requested to prepare and submit the draft EIA Report as per ToRs prescribed as follows: -

Executive Summary of the project – giving a *prima facie* idea of the objectives of the proposal, use of resources, justification, *etc.* In addition, it should provide a compilation of EIA report, including EMP and the post-project monitoring plan in brief.

MODEL TORs

1.0 Introduction

This chapter should cover the following:

- Purpose of the project, project proponent, brief description of the project-name, nature, size, location of the project, its importance to the country and the region.

- Land description- plot/ survey nos/ village, tehsil, district, state & extent of the land.
- Profile of the project proponent, name and contact address with e-mail, implementing organization, organizational chart, project consultants etc.
- Whether the project attracts the provisions of General Conditions of EIA Notification 2006. If so applicability should be discussed.
- The proponent should confirm that the project meets the central/state/local environmental regulations and standards applicable for the project.
- Any litigation pending against the proposed project and/ or any direction/order passed by any court of law against the project, if so, details thereof.
- In case of expansion/ modernization of the project, the environmental compliance status for the existing project should be explained.

2.0 Project Description

This chapter should cover the broader details of the basic activities, location, layout and implementation schedule of the project.

- Type of the project- new, expansion, modernization, container cargo handling facility, fishing, minor / major port etc.
- Relevance of the project in the light of the existing development plans of the region.
- Project coverage, master plan, phasing and scope.
- Description of a project site, geology, topography, transport and connectivity, demographic aspects, socio, cultural and economic aspects, villages, settlements.
- Capacity of the port, types of cargo proposed for handling, cargo handling equipments, ancillary operations, housing, truck parking details etc.
- Technologies involved for design, construction, equipment and operation.
- Use of existing public infrastructure – road, railway and inland waterway net works, water supply, electrical power etc.
- Estimated water budget for the proposed project during construction/ operation stages.
- Estimated cost of development of the project, environmental cost, funding agencies i.e., whether governmental or on the basis of BOT etc.
- Details of land acquisition, rehabilitation of communities / villages present status of such activities
- Resources, manpower and time frame etc –required for project implementation.
- A map specifying locations of the state, district and project location.
- A map of project area and 10 km area from boundary of the proposed/existing project area, delineating protected areas notified under the wild life (Protection) Act, 1972 / critically polluted areas as notified by

the CPCB from time to time / notified eco sensitive areas / inter-state boundaries and international boundaries.

- A map covering aerial distance of 15 km on the landward side from the proposed project boundary delineating environmental sensitive areas as specified in column no 9(iii), Form 1 of EIA notification dated 14th Sep 06.
- Land use map of the study area to 1: 25,000 scale based on recent satellite imagery of the project area and 10 kms from the proposed project boundary delineating the cropping pattern, wastelands, forest area and built-up areas, water bodies, human habitation and other surface features such as railway tracks, ports, airports, roads, NH, major industries etc.
- Site lay out plan of the proposed development shall be submitted to a scale of 1:5000, clearly marking the layout of breakwaters, navigation channels, harbour basin, berths, dry docks, workshops, container freight station, cargo handling systems, conveyors, covered and uncovered storage yards, ware houses, roads, railway tracks, effluent disposal point, administrative and operational buildings, utilities, town ships, greenbelt, dredged material disposal, etc. Boundaries of the proposed port shall be shown therein with latitude and longitude.
- Area drainage contour map of the project area and 2-5 km from the proposed project area shall be clearly indicated. In case of any proposed diversion of nallah/canal/river, same shall also be shown in the map.
- Hydrographic charts of the offshore area giving general morphology of the coastal stretch to a scale of 1:50,000 shall be submitted covering water depth up to 10m beyond the maximum proposed dredging depths of the project and covering a distance of 5 km along the coast from the project limits on both sides.
- The CRZ maps indicating the High Tide Level (HTL), Low Tide Level (LTL), demarcated by one of the seven authorized agencies and the project lay out superimposed on the map should be submitted on 1:5000 scale map. This map shall be recommended by the state/Union Territory CZM authority.

3.0 Analysis of alternatives (Technology & Sites)

In case, the scoping exercise results in need for alternatives this chapter shall include:

- Description of various alternatives like locations or layouts or technologies studied.
- Description of each alternative.
- Summary of adverse impacts of each alternative
- Selection of alternative.

4.0 Description of the Environment

4.0 Study Area

As a primary requirement of EIA process, the proponent should collect primary baseline data in the project area as well as in the area falling 5 km from

the proposed project boundary and secondary data should be collected within 15 kms aerial distance from the project boundary, as specifically mentioned at column 9(iii) of Form I of EIA Notification 2006. The study areas mentioned in this document shall be considered for guidance purpose but the exact study area for different environmental attributes (water, air, noise, soil, etc) is to be submitted considering the proposed activities and location, along with proper reasoning, for review and approval by the expert appraisal committee.

4.1 Land Environment

4.1.1 Land

Availability of land for earmarking for the port without causing a due hardship to local habitat and their socio cultural and economic aspects is very important. Data on the land availability is to be ascertained from local authorities, revenue records etc. Justification for the proposed quantum of the area is to be given.

4.1.2 Topography

Baseline data to be given on description of existing situation of the land at the proposed project area including description of terrain hill slopes coastal and inland topography, coastal features (lowland, beaches, littoral areas, shoal areas), terrain features, slope and elevation. Study of land use pattern, habitation, cropping pattern, forest cover, environmentally sensitive places etc, by employing remote sensing techniques (if available) and also through secondary data sources.

4.1.3 Geology

Baseline data to be provided on rock types, regional tectonic setting (reported fractures/faulting, folding, warping), and history of any volcanic activity, seismicity and associated hazards, mainly in the coastal area. Information on quarry yields, strengths of rock, distance of quarries from habitat, restrictions for quarrying, environmental controls, statutory permissions etc., should be provided.

4.1.4 Soil

Soil data including type, classification, characteristics, soil properties etc., are important from engineering considerations for design of structures, loading capacities of cargo stockpiles, green belt development etc. Changes in parameters of soil also may affect plantation and vegetative growth, which in turn may endanger the health of local habitat. Baseline data of the soil, results of investigations carried out to be provided for the project area.

4.1.5 Meteorological Data

Meteorological data covering the following should be incorporated in the EIA report. The data for at least a 10 year period should be presented from the

nearest meteorological station, except for the history of cyclones and tidal surges for which 100 year data is required.

- Wind speed and direction
- Rainfall
- Relative humidity
- Temperature
- Barometric pressures
- History of cyclones

4.2 Water Environment

4.2.1 Ground water

Baseline data of ground water including data of pH, dissolved solids, suspended solids, BOD, DO, coli-form bacteria, oil, heavy metals (depending upon the type of cargo) is to be collected at least for one season. Usage purpose of the ground water, if any, is to be indicated.

4.2.2 Surface Water

Baseline data on location of surface water like lagoons, lakes, tidal inlets, streams, rivers, their details, present quality and their utility, if any, is to be provided. Details of water bodies in the project area shall be described specifically. Water quality is to be monitored for one season.

4.3 Marine Environment

4.3.1 Coastal Hydrology/geomorphology

Coastal hydrology requires collection of oceanographic data during the study period, covering the following parameters:

- Tides
- Waves (wind waves and swells)
- Storm surges
- Currents
- Salinity
- Sea water temperature
- Suspended load, and
- Seabed bathymetry

Baseline oceanographic data should extend at least to depths more than 10m of proposed deepening of the harbor approach and basin as per master plan proposed. A study on likely changes in the sediment transport and littoral drift due to the construction of port particularly the breakwater should to be taken up. Details of mangroves, marshes and other coastal vegetation, sand dunes, coastal stability, seismic characteristics, history of any endangered species, coastal erosion, and shoreline changes should be furnished.

4.3.2 Bed Sediment Contamination

Baseline data on bottom sediments and the associated bottom biota and other physical habitat, at the proposed project area and the neighborhood areas has to be collected and analyzed.

4.3.3 Sea/Harbor Water Quality

Baseline data shall be collected on chemical parameters in the open sea and in the proposed port area for understanding hydro chemical characteristics in the marine environment (such as sea water temp, BOD, DO, pH, TSS, salinity, heavy metals depending upon the cargo, etc.)

4.4 Biological Environment

4.4.1 Marine/Coastal Ecology

Baseline data of aquatic flora and fauna at the project area, including the coastal area is to be ascertained by proper surveys including mangroves and marshes and other coastal vegetation, sand dunes. Data on coastal stability, seismic characteristics, history of any endangered species, coastal erosion, shoreline changes, if any, is also necessary.

4.4.2 Flora and Fauna in the Neighborhood

Details on secondary data on the existing flora and fauna in the study area as well as 15km from its boundary, carried out by an university/institution under the relevant discipline (such as BSI, ZSI, WII, etc) shall be included in the list of flora and fauna along with classification as per Schedule given in the Wild Life Protection Act, 1972 (for fauna) and in the Red Book Data (flora) and a statement clearly specifying whether the study area forms a part of an ecologically sensitive area or migratory corridor of any endangered fauna.

4.5 Air Environment

Base line data of ambient air parameters namely RSPM, nitrogen dioxide, sulphur dioxide, carbon monoxide, heavy metals and other harmful air pollutants depending upon the type of the cargo should be monitored. This data should be collected in an area extending at least 5 km from the project boundary by observation at a number of locations. Specific importance should be attached to areas in close proximity of project say up to 1 km. One season data should be monitored other than monsoon as per the CPCB Norms. One station should be in the up-wind/ non-impact/ non-polluting area as a control station.

4.6 Noise

Baseline data on noise pollution at the project area and the neighbourhood up to 1 km or nearest residential areas is to be monitored as per the CPCB norms.

4.7 Existing Solid Waste Disposal Facilities

Details of authorized municipal solid waste facilities, biomedical treatment facilities and hazardous waste disposal facilities in the area should be inventorized, in case if it is proposed to utilize the same

4.8 Socio-economic and Occupational Health Environments

Baseline data at the project area shall include the demography, particularly on human settlements, health status of the communities, existing infrastructure facilities in the proposed area and area of impact due to the proposed activity. Present employment and livelihood of these populations, awareness of the population about the proposed activity shall also be included.

4.9 Public Utilities

Base line data of existing public utility infrastructure shall be ascertained and reported to assess the impacts of the project on these public utilities in order to incorporate desired methods in the EMP and monitor the same during the construction as well as operational phases of the port.

5.0 Anticipated Environmental Impacts and Mitigation Measures

This Chapter should describe the likely impact of the project on each of the environmental parameters, methods adopted for assessing the impact such as model studies, empirical methods, reference to existing similar situations, reference to previous studies, details of mitigation methods proposed to reduce adverse effects of the project, best environmental practices and conservation of natural resources. The identification of specific impacts followed with mitigation measures should be done for different stages i.e., location of the port, construction including dredging, ship traffic including discharges from vessels and cargo operations.

5.1 Land Environment

5.1.1 Land

Anticipated Impacts:

Impact of project construction/operation on the land requirement / land use pattern should be assessed. Affect of future growth of the port facility and/or of the ancillaries should be carefully assessed by preparing master plans for the port and the ancillaries. Impact on the public utilities arising out of the utilities for the project activities and impact on the natural drainage system are equally important. Prediction of impacts should include impacts on the existing infrastructures like road network, housing, ground water/surface water etc., and loss of productive soil and impact on natural drainage pattern.

Mitigation Measures:

Mitigation measures to reduce adverse effects like adopting soil improvement techniques and adopting suitable design methods to reduce land requirement. Where land acquisition and consequential R&R methods are called for, it should be implemented duly adhering to the norms and complying with pertinent statutory requirements for such land acquisition. Strengthening of road and rail network infrastructure to handle the increase in traffic and truck parking arrangements, integration of Port development with the local land use plan should be planned.

5.1.2 Topography, geology and soil

Anticipated Impacts:

Impact of port construction/operation on the topography due to activities like depletion of hills due to large scale quarrying, filling of low lying area with dredged spoil and borrowed material, damage to existing vegetation/green belt and plantation, changes in land use patterns, disturbance to existing protected areas like mangroves, forests and environmentally sensitive areas/zones should be assessed Flooding due to filling up of low-lying areas should be assessed. Impacts on the surrounding land use pattern, on infrastructure like housing, ground water, etc should be assessed. Impact of the project construction on the geology and vice-versa should to be studied in detailed. Impact of project construction/operation on the soil parameters, probability of settlement, subsidence, slides, surface drainage, leachets etc., are to be estimated.

Mitigation Measures:

Mitigation measures to reduce adverse effects include study of alternative sites, improving green belt, obtaining construction materials from other sources, usage of alternative construction materials like fly ash, where possible; storm water management etc. Adopting soil improvement techniques and adopting suitable design methods, ground covering etc.

5.2 Water Environment

5.2.1 Ground Water

Anticipated impacts:

Discharge of trade effluent and sewage and its impact. Impact of project construction/operation on the ground water on account of leachets, run off from material and cargo storages and toxic or harmful substances, percolation, sea water intrusion etc.,

Mitigation measures:

Mitigation measures to reduce adverse effects like impervious paving the cargo areas, impervious roads, lined drains, routing surface drainage to settlement tanks/pits etc. Treatment of effluent, recycle/ reuse and disposal

should be planned. Groundwater study on leaches should be carried out periodically and should be correlated with baseline data. Remedial measures should be taken in case of any deviation. Based on the total water budget of the project, the use of ground water should to be reviewed and alternatives to be presented.

5.2.2 Surface Water

Anticipated impacts:

Impact of port operations on surface water sources, contamination due to cargo operations, impact on utility of surface water resources by the neighboring colonies, impact on surface water flow (ex. flooding) due to anticipated obstructions, etc

Mitigation measures:

Protection measures to surface water resources to prevent reduction in their quality due to construction and operational activities and choice of alternative resources. Proposals to treat effluents confirming to standards notified under EP Act 1996 should be submitted.

5.3 Marine Environment

5.3.1 Coastal Hydrology

Anticipated impacts:

Impact of the project construction/operation on the coastal hydrology on account of port construction should be assessed by suitable model studies.

Mitigation measures:

Careful site selection and port design should be planned to minimize impacts due to changes in current patterns and other coastal hydrology. Model experiments or computer simulations of these changes are useful in developing an appropriate design. Shore protection works like construction of sea walls, groynes, sand bye- passing or beach nourishment should be studied.

5.3.2 Bed Sediment contamination

Anticipated impacts:

Impact of the project construction/operation on the bed sediment contamination on account of port construction/operations is to be assessed by suitable empirical/model studies.

Mitigation measures:

A survey of contamination of bottom sediments should be undertaken before dredging.

5.3.3 Sea/Harbor Water Quality

Anticipated impacts:

Impact of the project construction/operation on the sea/harbour water quality on account of port construction is to be assessed by suitable empirical/model studies.

Mitigation measures:

Proper collection and disposal of liquid and solid waste from shore establishment and ships should be planned.

5.4 Biological Environment

Anticipated impacts:

Impacts of the project construction/operation on the marine/coastal ecology on account of port construction should be assessed by suitable empirical/model studies. Impacts due to floodlights on the nesting of sea turtles and other species should be studied

Mitigation measures:

Mitigation measures to reduce adverse effects should be provided.

5.5 Air Environment

Anticipated Impacts:

Impact of project construction/operation on the ambient air quality on account of emissions of dust during construction and cargo handling as well as emission of gases from equipment deployed for construction and cargo handling should be assessed. Prediction due to emissions during cargo handling/ emissions from the ships in the port area/ emissions due to increased traffic, emission inventory for critical pollutants with and without mitigation measures, prediction of the impact due to the existing activity on the proposed project, prediction of impacts due to sanctioned/ongoing projects in the surrounding area on the proposed project and the ambient environment shall be carried out.

Mitigation measures:

Mitigation measures proposed during the construction stage should include dust suppression measures by suitable techniques. Mitigation measures proposed during the operation stage should include alternative solutions such as closed conveyor system, closed silos, closed vehicles to transport dusty cargo etc, mitigation measures to lower the emissions from the ships and green belt development.

5.6 Noise Pollution

Anticipated impacts:

Impact of project construction/operation on the noise and vibration on account of construction equipment, cargo handling equipment and road traffic.

Mitigation measures:

Mitigation measures to reduce adverse effects should be provided.

5.7 Solid Waste Management

Anticipated impacts:

Impact due to non-hazardous and hazardous solid waste generated during the construction and operational stages should be assessed.

Mitigation measures:

Mitigation measures to comply the norms should be planned. Options for minimization of solid waste and environmentally compactable disposal/ recycling of waste to conserve natural resources should be planned. Management and disposal of temporary structures, made during construction phase should be planned.

5.8 Socio-economic and Occupational Health Environment

Anticipated impacts:

Predicted impact on the communities of the proposed activity. Details of public and private land in the proposed and immediate surroundings socio-economic status of the affected owners of the private land shall be properly complied. Present status of health, housing, public utilities, commercial structures and transportation should be collected. Impact of the project on socio cultural aspects should be assessed. Socio-economic impacts due to displacement of fishing settlements and population influx due to increased activities should be assessed.

Mitigation measures:

Mitigation measures to reduce adverse effects including satisfactory R&R methods should be planned.

6.0 Environmental Monitoring Program

This Chapter shall include details of environmental monitoring programme. It should include the technical aspects of monitoring the effectiveness of mitigation measures (including measurement methodologies, data analysis, reporting schedules, emergency procedures, detailed budget & procurement schedules).

- Summary matrix of environmental monitoring, during construction and operation stage
- Requirement of monitoring facilities
- Frequency, location, parameters of monitoring
- Compilation and analysis of data, comparison with base line data and
- compliance to accepted norms and reporting system
- Plantation monitoring program

7.0 Additional Studies

Specific condition Study required	Specific condition Study required
Studies identified by the proponent and the Regulating Authority	Studies directed by the Expert Appraisal Committee while deciding the TOR for the project
Studies identified by the public and other stake holders	Public hearing with the issues raised by the public and the response of the project proponent in tabular form shall be discussed
Risk Analysis and Disaster Management Plan (DMP)	• Risk analysis • Safety measures for handling bulk liquid substances • Personal protection equipment • Disaster management Plan (DMP) • Oil spill contingency plan • Emergency response procedures
Natural resource conservation and optimization	Plan of action for conservation of natural resources such as utilization of fly ash and other suitable waste materials availability for the construction of the project. Dredged material utilization and disposal plan should be furnished. Water Conservation measures should be addressed. Energy efficiency measures in the activity arte to be drawn up.
R & R action plans	Detailed R&R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternative livelihood concerns/employment and rehabilitation of the displaced people, civil and housing amenities being offered, etc and the schedule of the implementation of the project specific R&R Plan. Details of provisions (capital & recurring) for the project specific R&R Plan
Specific studies requirement depending on the site and activity proposed shall be discussed	

8.0 Project Benefits

This chapter shall include benefits accruing to the locality, neighbourhood, region and nation as a whole. It should bring out details of benefits by way of:

- Improvements in the physical infrastructure by way addition of project
- infrastructure, ancillary industries that may come up on account of the project
- Improvements in the social infrastructure like roads, railways, townships, housing, water supply, electrical power, drainage, educational institutions, hospitals, effluent treatment plants improved waste disposal systems, improved environmental conditions, etc.
- Employment potential -skilled; semi-skilled and unskilled labour both during construction and operational phases of the project with specific attention to employment potential of local population as well as necessity for imparting any
- specialized skills to them to be eligible for such employment in the project on a long
- term ba is i.e., during operational and maintenance stages of the project and
- Other tangible benefits like improved standards of living, health, education etc.

9.0 Environmental Cost Benefit Analysis

If recommended by the Expert Appraisal Committee at the scoping stage, this chapter shall include the environmental cost benefit analysis of the project.

10.0 Environmental Management Plan (EMP)

- Summary of potential impacts & recommended mitigation measures.
- Allocation of resources and responsibilities for plan implementation
- Administrative and technical setup for management of environment
- Institutional arrangements proposed with other organizations/Govt. authorities for effective implementation of environmental measures proposed in the EIA
- Safe guards/mechanism to continue the assumptions/field conditions made in the EIA Environmental specifications for contractors should cover the required safeguards during the design and construction stage

11.0 Summary & Conclusion (Summary EIA)

It shall be a summary of the full EIA report condensed to ten A-4 size pages at the maximum. It should necessarily cover in brief the following chapters of the full EIA report – Introduction/ Project description/ Description of the environment//Anticipated environmental impacts & mitigation measures/Additional studies/Environmental monitoring programme/Project benefits/Environmental management plan /Disclosure of consultants engaged

12.0 Disclosure of Consultants Engaged

This chapter shall include the names of the consultants engaged with their brief resume and nature of consultancy rendered.

12.1 Additional Corporate Environmental Responsibility :-

(i) (a) Does the company have a well laid down Environment Polity approved by its Board of Directors? If so, it may be detailed in the EIA report.

(b) Does the Environment Policy prescribe for standard operation process/procedures to bring into focus any infringement/deviation/violation of the environmental or forest norms/conditions? If so, it may be detailed in the EIA.

(ii) What is the hierarchical system or Administrative order of the company to deal with environmental issues and for ensuring compliance with the Environmental Clearance conditions details of this system may be given.

(iii) Does the company have a system of reporting of non-compliances/violations of environmental norms to the Board of Directors of the company and / or shareholders or stakeholders at large? This reporting mechanism should be detailed in the EIA report.

Additional TORs: -

1. Details of handling, uploading, transportation of export material.
2. Details of materials proposed to be imported.
3. Breeding season of fish and their abundance.
4. Identification of mangroves in backwaters and the impact of the project on the flora and fauna in the mangroves.
5. Impact of dredging on fish breeding and the juveniles

The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India/National Accreditation Board of Education and Training (QCI/NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and the data provided by other Organization(s)/Laboratories including their status of approvals etc. In this regard Office Memorandum No. F. No. J-11013/77/2004-IA.II(I) dated 30th June, 2011 available on the MoEF, GoI website http://www.moef.nic.in may please be referred.

The ToRs prescribed by the State Expert Appraisal Committee, Karnataka should be considered for the preparation of EIA / EMP report for the above mentioned project in addition to all the relevant information as per the Generic Structure of EIA given in Appendix III and III-A in the EIA Notification, 2006. On finalization of EIA/EMP prepared as per ToRs and addressing and incorporating all concerns raised during public consultation, the same should be submitted to the SEAC for prior environmental clearance.

The ToRs prescribed will be valid for a period of two years for submission of the EIA/EMP report.

You are also requested to submit the filled up information as per the format enclosed as Annexure.

Yours faithfully

(Dr. M. H . Balakrishnaiah)
Secretary,
SEAC.

Copy to: -

1. The Secretary to Government, Department of Ecology and Environment, Govt. of Karnataka, Bangalore.
2. Chairman, Karnataka State Pollution Control Board, KSPCB, Parisar Bhavan, 4th & 5th Floor, Church street, Bangalore -560 001, it is requested that the public consultation of the above project may be conducted within stipulated period in accordance to the procedure laid in the EIA notification, 2006.
3. Guard File.

ToR- Compliance

SL.NO	TOR – SEIAA, Karnataka	COMPLIANCE

1	Introduction	**Chapter 1 : Introduction , Page Number 1.1, Final EIA**
		• Background
		• Details of Project Proponent
		• Applicable Legal and Policy Framework
		• Project Site
		  ◦ Features of Project Site and its surroundings
		  ◦ Connectivity
		• Need for Development of Honnavar Barge/ Vessel Loading Facility
		• Project Development Plan
		• Environmental Impact Assessment
		• Approach and Methodology
		  ◦ Project Influenced Area (PIA)/Study Area
		  ◦ Study Period
		  ◦ Methodology
		• Structure of EIA Report

2	Project Description	**Chapter 2 : Project Description , Page Number 2-1, Final EIA**
		• General
		• Location
		• Land Availability
		• Barge /Vessel Loading - Traffic
		  ◦ Iron Ore
		  ◦ Coal
		  ◦ General and Other Cargos
		  ◦ Traffic for Honnavar
		• Field Surveys and Investigations
		  ◦ Bathymetry
		  ◦ Geotechnical Investigation
		  ◦ Oceanic Investigation
		• Mathematical Model Studies
		  ◦ Wind-wave model and near shore wave transformation and Wave Tranquillity
		  ◦ Hydrodynamic Model Studies
		  ◦ Cohesive/Mud transport (MT) model
		  ◦ Non- Cohesive Sediment transport
		  ◦ Shoreline Changes Study
		  ◦ Dredge Disposal study
		• Honnavar Barge/Vessel Loading Facility Development Plan
		  ◦ Barge/Vessel Loading Facility Layout
		  ◦ Cargo Handling Capacity
		  ◦ Design Vessel Size and Dimension
		  ◦ Berthing Facilities
		  ◦ Operation Downtime and Effective Working Hours
		  ◦ Breakwaters
		  ◦ Approach Channel and Turning Circle
		  ◦ Dredging and Disposal
		  ◦ Cargo Handling

		• Cargo Storage Area • Shore Protection Works • Fendering and Mooring Systems • Navigational Aids • Port Crafts • Existing Hinterland Connections and Road/Rail Network • Proposed Dedicated Rail/Road Corridor • Utilities and Services • Pollution Control Aspects • Coastal Regulation Zone Compatibility • Green areas and Greenbelt Development • Project Cost • Project Implementation Schedule • Corporate Social Responsibility
3	Analysis of Alternatives	**Chapter 3: Analysis of Alternatives , Page Number 3-1 in Final EIA** • General • Alternate Options • Alternative 1: Straight Channel with berth and Stockyard on Kasarkod side • Alternative 2: Channel along the present river mouth and berth and Stockyard on Kasarkod side • Alternative 3: Channel made after cut opening the Kasarkod spit with the berth and backup area on Kasarkod side • Alternative 4: Channel made after cut opening the Kasarkod spit with berth and backup area on Honnavar side • Comparison of Layouts • Selection of Best Layout
4	Description of the Environment	**Chapter 4: Description of the Environment , Page Number 4-1 in Final EIA** • General • Study Area • Land Environment • Land • Land Use – Land Cover Study Methodology • Topography • Geology • Soil • Water Environment • Groundwater • Surface Water • Marine Environment • Coastal Hydrology/ Geomorphology • Bed Sediment Contamination/Bed Sediment Quality • Sea/Harbour Water Quality • Biological Environment

		• Marine/Coastal Ecology • Fisheries • Flora and Fauna in the Area • Air Environment • Meteorological Data from Nearest Meteorological Station (Honnavar) • Meteorological Scenario during Study Period • Ambient Air Quality • Noise • Results and Discussion • Observations • Socio-Economic and Occupational Health Environment • Population Characteristics • Medical Facilities • Educational Facilities • Details of Fishing Villages and Fish Landing Centres • Existing Solid and Liquid Waste Disposal Facilities • Public Utilities • Archaeological Monuments
5	Anticipated Environmental Impacts and Mitigation Measures	**Chapter 5 : Anticipated Environmental Impacts & Mitigation Measures , Page Number 5-1, Final EIA** • General • Land Environment Potential Impact due to Project Location Potential Impact during Construction Potential Impact during Operations • Water Environment Potential Impact due to Barge/ Vessel Loading Facility Location Potential Impact due to Construction Potential Impact during Operation • Marine Environment (Coastal Hydrology/Bottom Contamination, Sea/Harbour Water Quality) Potential Impact due to Barge/ Vessel Loading Facility Location Potential Impact due to Construction Potential Impact during Operation • Biological Environment (Coastal and Marine Ecology) Potential Impact due to proposed Facility Location Potential Impact due to Construction Potential Impact due to Operation • Air Environment Potential Impact during Construction Potential Impact due to Operation • Noise Pollution Potential Impact during Construction Potential Impact during Operation • Solid Waste Management Potential Impact during Construction Potential Impact during Operation • Anticipated Potential impacts due to the proposed Rail/Road

		alignment • Socio-Cultural Impact Potential Impact due to proposed Facility Location Potential Impact during proposed Facility Operation
6	Environmental Monitoring	**Chapter 6:Environmetal Monitoring , Page Number 6-1, Final EIA** • Budgetary Estimates for Environmental Management • Environmental Monitoring Programme • Compliance Reports • Plantation Monitoring Programme • On-site Mock Drills Requirements
7	Additional Studies	**Chapter 7: Additional Studies , Page Number 7-1 , Final EIA** • Public Hearing • Preliminary Risk Analysis • Disaster Management Plan • Dredge Material Utilization & Disposal Plan • Social Impact Assessment • Corporate Social Responsibility
8	Project Benefits	**Chapter 8 : Project Benifts, Page Number 8-1, Final EIA** • Introduction • Infrastructure Facilities Rail Connectivity Road Connectivity • Induced development • Improved Socio-economic Conditions Quality of Life Health Educational Facilities • Corporate Social Responsibility (CSR) • Employment Opportunities
9	Environmental Cost Benefit Analysis	SEIAA not Suggested Environmental Cost benefit Analysis in the scoping stage of the Project
10	Environmental Management Plan	**Chapter 10 : Environmental Management Plan , Page number 10-1, Final EIA** • Components of EMP • Administrative and Technical Setup for Environmental Management Institutional Framework of EMP Institutional Mechanism for Implementation of Mitigation Measures Approach towards Voluntary Compliance • Environmental Management Cell (EMC) • Greenbelt Development Plan Species for Plantation • Biodiversity Conservation and Management Plan
11	Summary & Conclusion	**Chapter 11 : Summary & Conclusion , Page Number 11-1, Final EIA** • Introduction • Project Location • Need for Development of Barge / Vessel loading facility

		• Project Benefits • Project Description Salient Features of Barge/ Vessel Loading Facility Utilities & Services • Greenbelt Development • Project Cost • Environmental Impact Assessment • Description of Environment • Marine Environment • Terrestrial Environment • Socio-economic Conditions • Additional Studies • Preliminary Risk Analysis • Disaster Management Plan • Social Impact Assessment • Project Benefits • Environmental Management Plan • Environmental Monitoring Programme • Disclosure of Consultants Engaged
12	Disclosure of Consultants Engaged	Incorporated in the Report.
Additional ToRs		
1	Details of Handling , Uploading , transportation of export material	Cargo handling Details are provided in the chapter 2 : Project Description in Section 2.3
2	Details of materials proposed to be imported	Traffic for the Proposed Barge/ Vessel Loading facility are discussed in the chapter 2: Project description
3	Breading season of fish and their abundance	Most common Varieties of fish are discussed in the chapter 4: Description of Environment in section 4.5.2: Fisheries.
4	Identification of mangroves in back waters and the impact of the project on the flora and fauna in the mangroves	There is no mangroves in the project site, in the project influence area (PIA) there are mangroves but is about 2.4 km away from the proposed site. Impacts due to the proposed project are negligible.
5	Impact of dredging on fish breeding and the juveniles	Impacts due to dredging activities are discussed in Chapter 5: Anticipated potential impacts.

Appendix B
Soil Analytical Results

Appendix B Soil Analysis Result

Table B-1: Soil Analysis result

S. No	Parameters		Units	S1	S2	S3	S4	S5	Agriculture Soil Limits
1	Texture		–	Sandy	Sandy Clay	Sandy	Sandy	Sandy	–
2	Particle Size Distribution	Sand	%	72	62	70	74	68	–
		Silt	%	04	10	06	04	08	–
		Clay	%	24	28	24	22	24	–
3	Color		Hazen	Light Brown	Brown	Light Brown	Light Brown	Brown	–
4	Soil Type		–	Sandy	Sandy Clay	Sandy	Sandy	Sandy	–
5	pH (10% Slurry)		–	7.23	7.86	6.78	6.62	6.92	6.50-8.00
6	Conductivity		µS/cm	96	112	88	92	102	<500
7	Bulk density		gram/cc	1.04	1.16	1.05	1.02	1.09	1.0-1.5
8	Porosity		% v/v	36	32	36	38	36	–
9	S.A.R		%	2.12	1.96	1.82	1.93	1.97	–
10	Infiltration capacity		mm/h	58	52	56	58	52	–
11	Nitrogen as N		mg/100grm	26	86	28	25	28	150-300
12	Potassium as K		mg/100grm	36	92	34	32	36	300-360
13	Phosphorus as P'		mg/100grm	16	26	16	12	18	65-80
14	Zinc as Zn		mg/kg	0.63	0.92	0.73	0.49	0.63	–
15	Cadmium as Cd		mg/kg	0.02	0.02	0.02	0.02	0.03	–
16	Cat ion exchange Capacity		meq/100gr	1.36	1.28	0.88	0.92	0.82	–
17	Alkali Metals		mg/kg	1.2	0.98	1.13	0.99	0.76	–
18	Permeability		Cm/s	8.3	9.8	8.6	8.9	8.4	–
19	Water holding capacity		%	6.3	9.3	6.5	6.1	6.7	–
20	Chromium as Cr		mg/kg	0.02	<0.02	0.02	0.02	0.02	–
21	Copper as Cu		mg/kg	0.12	0.08	0.16	0.11	0.1	–
22	Iron as Fe		mg/kg	0.36	0.84	0.46	0.42	0.46	–
23	Manganese as Mn		mg/kg	0.06	0.04	0.04	0.06	0.04	–
24	Lead as Pb		mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	–
25	Nickel as Ni		mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	–

S1 - Port Site
S2 – Honavar
S3 – Kasarkod
S4 – Karki
S5 – Apsarakonda

APPENDIX C
INLAND WATER QUALITY RESULTS

Appendix C Inland Water Quality Results

Table C-1: Groundwater Quality

S. No.	Parameter	Requirement (Desirable Limits)	Permissible Limits in the Absence of Alternate Source	Units	GW1	GW2	GW3
1	pH	6.5 – 8.5	No Relaxation	-	6.68	6.78	6.84
2	Colour	5	25	Hazen	01	02	01
3	Taste	Agreeable	-	-	Agreeable	Agreeable	Agreeable
4	Odour	Unobjectionable	-	-	Unobjectionable	Unobjectionable	Unobjectionable
5	Conductivity	--	--	00000000	126	118	146
6	Turbidity	5	10	NTU	1.10	1.20	1.1
7	Temperature	--	--	OC	25.2	25.4	25.6
8	Total Dissolve solids	500	2000	mg/L	78	74	92
9	Total Solids	--	--	mg/L	80	76	96
10	Total Hardness as CaCO3	300	600	mg/L	40	40	48
11	Total Alkalinity	200	600	mg/L	30	40	40
12	Calcium as Ca	75	200	mg/L	12.8	12.8	12.8
13	Magnesium as Mg	30	100	mg/L	1.9	1.9	3.8
14	Residual Chlorine	0.2 min	-	mg/L	<0.02	<0.02	<0.02
15	BOD (3 days at 27oC)	03	03	mg/L	Nil	Nil	Nil
16	COD	05	05	mg/L	Nil	Nil	Nil
17	Dissolved Oxygen	04	04min	mg/L	5.0	4.9	5.0
18	Chloride as Cl-	250	1000	mg/L	14.2	7.1	14.2
19	Sulphate as SO4	200	400	mg/L	10.6	6.7	9.6
20	Fluorides as F-	1.0	1.5	mg/L	0.1	0.1	0.1

S. No.	Parameter	Requirement (Desirable Limits)	Permissible Limits in the Absence of Alternate Source	Units	GW1	GW2	GW3
21	Nitrates as NO3	45	100	mg/L	1.3	1.3	1.9
22	Sodium as Na	--	--	mg/L	9.2	7.4	9.7
23	Potassium as K	--	--	mg/L	0.4	0.4	0.4
24	Phenolic Compounds	0.001	0.002	mg/L	<0.001	<0.001	<0.001
25	Cyanides	0.05	NO Relaxation	mg/L	<0.02	<0.02	<0.02
26	Anionic Detergents	0.2	1.0	mg/L	<0.02	<0.02	<0.02
27	Cyanides as CN	0.05	--	mg/L	<0.02	<0.02	<0.02
28	Cadmium as Cd	0.01	NO Relaxation	mg/L	<0.01	<0.01	<0.01
29	Arsenic as As	0.01	NO Relaxation	mg/L	<0.001	<0.001	<0.001
30	Copper as Cu	0.05	1.5	mg/L	<0.01	<0.01	<0.01
31	Lead as Pb	0.05	NO Relaxation	mg/L	<0.02	<0.02	<0.02
32	Manganese as Mn	0.1	0.3	mg/L	<0.02	<0.02	<0.02
33	Iron as Fe	0.3	1.0	mg/L	<0.1	<0.1	<0.1
34	Chromium as Cr6+	0.05	NO Relaxation	mg/L	<0.01	<0.01	<0.01
35	Zinc as Zn	5	15	mg/L	<0.02	<0.02	<0.02
36	Salinity	100	--	mg/L	02	04	04
37	Mercury as Hg	0.001	NO Relaxation	mg/L	<0.002	<0.002	<0.002
38	Total Nitrogen	--	--	mg/L	0.04	0.06	0.06
39	Total phosphorus	--	--	mg/L	0.01	0.02	0.02
40	Free Ammonia As NH4	--	--	mg/L	Nil	Nil	Nil
41	Coliform Organisms	--	--	MPN/ 100 ml	Nil	Nil	Nil
42	Faecal Coli	--	--	MPN/	Nil	Nil	Nil

S. No.	Parameter	Requirement (Desirable Limits)	Permissible Limits in the Absence of Alternate Source	Units	GW1	GW2	GW3
	form Organisms			100 ml			

Table C-2: Surface water Quality

S. No	Parameter	Units	IS:2296 Class C Limits	SW1	SW2	SW3
1	Ph	-	6.50 – 8.50	7.08	7.64	6.96
2	Colour	Hazen units	300	22	26	02
3	Conductivity	µS/cm	--	1186	8668	48
4	Turbidity	NTU	5.0	6.30	8.8	2.20
5	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
7	Temperature	°C	°C	25.6	25.4	25.1
8	Dissolved Oxygen	mg/L	4 min	4.60	4.80	4.90
9	BOD (3 days at 27°C)	mg/L	3	12	10	04
10	COD	mg/L	5	38	34	10
11	Total Dissolved Solids	mg/L	1500	744	5456	26
12	Total Solids	mg/L	--	758	5468	30
13	Total Hardness	mg/L	--	152	1040	12
14	Chloride as Cl^-	mg/L	600	35.5	2982.0	7.1
15	Fluorides as F^-	mg/L	1.5	0.8	1.60	<0.1
16	Sulphate as SO_4	mg/L	400	468.5	65.3	3.9
17	Alkalinity	mg/L	--	40	50	10
18	Nitrates as NO_3	mg/L	--	8.9	15.2	0.04
19	Cyanides as CN	mg/L	0.05	<0.02	0.02	<0.02
20	Calcium as Ca	mg/L	--	35.2	312.0	3.2
21	Magnesium as Mg	mg/L	--	15.4	62.4	0.96

S. No	Parameter	Units	IS:2296 Class C Limits	SW1	SW2	SW3
22	Sodium as Na	mg/L	--	197.8	1507.9	4.6
23	Potassium as K	mg/L	--	3.1	8.4	0.4
24	Iron as Fe	mg/L	50	0.22	0.22	0.04
25	Chromium Cr^{6+}	mg/L	0.05	0.02	0.03	<0.01
26	Cadmium as Cd	mg/L	0.01	<0.01	<0.01	<0.01
27	Lead as Pb	mg/L	0.1	<0.02	<0.02	<0.02
28	Copper as Cu	mg/L	1.5	0.08	0.09	<0.01
29	Arsenic as AS	mg/L	0.2	<0.001	<0.001	<0.001
30	Selenium as Se	mg/L	0.05	<0.01	<0.01	<0.01
31	Phenolics as C_6H_5OH	mg/L	0.005	< 0.001	< 0.001	< 0.001
32	Zinc as Zn	mg/L	15	0.012	0.22	<0.02
33	Mercury as Hg	mg/L	--	<0.0002	0.0004	<0.0002
34	Salinity	ppt	100	212	326	06
35	Anionic detergents as mbas	mg/L	1	0.06	0.12	0.02
36	Residual Chlorine	mg/L	0.2	<0.04	<0.04	<0.04
37	Manganese as Mn	mg/L	0.002	<0.02	0.04	<0.02
38	Total Nitrogen	mg/L	--	0.28	0.21	0.06
39	Total phosphorus	mg/L	--	0.08	0.11	<0.02
40	Free Ammonia as NH4	mg/L	--	Nil	Nil	Nil
41	Coli form Organisms	MPN/100 ml	--	26	32	01
42	Faecal Coli form Organisms	MPN/100 ml	--	06	12	Nil

Appendix D
Marine Analytical Results

Appendix D Marine Analytical Results

Table D-1: Physico-Chemical Properties

S. No.	Location Code	Temp. (°C)	Salinity (‰)	pH	TSS (mg/l)	Turbidity (NTU)	DO (mg/l)	BOD (mg/l)
1.	HMSL- 1-HT	29.0	26	7.4	28.0	10	5.658	0.464
2.	HMSL-1-LT	30.5	21	7.2	33.6	12	5.222	0.960
3.	HMSL-2-HT	29.0	32	8.2	29.0	8	5.947	1.216
4.	HMSL-2-LT	30.0	34	8.1	24.0	9	5.593	0.960
5.	HMSL-3-HT	29.0	31	8.1	65.0	7	5.189	1.104
6.	HMSL-3-LT	31.0	30	8.0	81.4	7	5.462	1.168
7.	HMSL-4-HT	30.0	32	8.0	68.6	9	5.801	0.400
8.	HMSL-4-LT	31.0	31	8.0	51.0	8	5.004	0.544
9.	HMSL-5-HT	31.0	33	8.2	62.6	4	5.642	1.472
10.	HMSL-5-LT	30.0	33	8.2	75.4	5	5.220	1.200
11.	HMSL-6-HT	29.0	33	8.2	72.2	3	5.852	1.072
12.	HMSL-6-LT	30.0	30	8.0	86.0	3	5.769	0.928
13.	HMSL-7-HT	29.0	31	8.1	54.4	5	5.820	1.264
14.	HMSL-7-LT	30.0	30	8.0	44.2	6	5.092	1.376
15.	HMSL-8-HT	29.0	25	7.5	32.4	8	6.205	1.040
16.	HMSL-8-LT	30.0	24	7.3	45.6	8	6.624	1.168
17.	HMSL-9-HT	31.0	28	7.7	44.2	7	6.866	0.720
18.	HMSL-9-LT	31.0	28	7.7	32.2	9	6.545	1.216

Table D-2: Nutrients – Water

Location Code	Parameters (µmol/l)						
	NO_2	NO_3	NH_4	TN	IP	TP	SiO_3
HMSL-1-HT	0.345	7.230	0.971	22.950	1.019	1.562	32.204
HMSL-1-LT	0.517	8.435	1.079	25.634	0.831	1.151	32.225
HMSL-2-HT	0.249	10.802	0.648	26.171	0.944	1.069	15.422
HMSL-2-LT	0.268	7.875	0.722	19.729	0.906	1.110	21.499
HMSL-3-HT	0.383	8.177	0.681	21.205	0.755	1.028	25.742
HMSL-3-LT	0.268	8.865	0.664	26.574	0.944	1.274	20.683
HMSL-4-HT	0.326	10.113	0.374	24.695	0.680	1.069	21.590
HMSL-4-LT	0.192	7.832	0.415	25.768	1.019	1.192	18.074
HMSL-5-HT	0,284	8.865	0.174	25.097	0.982	1.110	17.801
HMSL-5-LT	0.555	7.789	0.689	23.218	1.284	1.397	19.888
HMSL-6-HT	0.230	6.756	0.166	26.574	0.982	1.110	15.037
HMSL-6-LT	0.134	8.392	0.257	27.245	0.793	1.069	18.314
HMSL-7-HT	0.115	10.974	0.648	20.534	0.755	1.151	12.607
HMSL-7-LT	0.153	7.875	0.739	17.850	1.284	1.644	13.132
HMSL-8-HT	0.172	8.435	0.432	21.205	1.548	1.726	35.966
HMSL-8-LT	0.149	9.296	0.448	24.560	0.944	1.480	30.299
HMSL-9-HT	0.345	8.005	0.623	25.231	0.906	1.028	37.983
HMSL-9-LT	0.230	8.865	0.988	26.708	1.359	1.767	41.702

Table D-3: Heavy Metal variations in Water

Parameters	Parameters (µg/l)					
	Cd	Cu	Fe	Pb	Zn	Hg
HMSL-1-HT	1.24	18.12	59.65	16.72	31.88	0.012
HMSL-1-LT	1.08	12.06	97.82	15.22	34.62	0.024
HMSL-2-HT	1.15	40.92	90.24	16.32	55.64	0.048
HMSL-2-LT	1.14	52.82	75.62	20.73	62.96	0.042
HMSL-3-HT	0.98	54.24	98.24	23.46	63.32	0.024
HMSL-3-LT	1.38	49.44	94.12	25.02	66.36	0.012
HMSL-4-HT	1.25	48.24	84.69	22.52	60.72	0.008
HMSL-4-LT	1.56	37.98	55.76	11.94	73.56	0.006
HMSL-5-HT	1.68	44.78	82.64	33.72	59.63	0.018
HMSL-5-LT	0.94	41.56	95.63	34.26	58.58	0.006
HMSL-6-HT	0.6	49.23	63.22	22.22	56:25	0.010
HMSL-6-LT	1.56	46.92	91.25	19.32	53.04	0.018
HMSL-7-HT	1.35	31.56	94.81	11.52	46.96	0.024
HMSL-7-LT	0.63	17.94	20.68	16.95	45.42	0.012
HMSL-8-HT	0.83	10.74	18.28	15.82	59.94	0.036
HMSL-8-LT	1.39	24.36	29.864	19.23	54.38	0.028
HMSL-9-HT	1.26	30.56	86.28	28.62	51.32	0.042
HMSL-9-LT	1.55	33.91	82.16	26.42	68.06	0.054

Table D-4: Heavy Metal variations in Sediment

Sl. No.	Station Code	µg/g					
		Cd	Cu	Fe	Pb	Zn	Hg
1.	HMSL-1-HT	1.08	12.00	1459.2	14.48	17.92	0.024
2.	HMSL-1-LT	0.84	8.04	1978.0	13.48	13.08	0.028
3.	HMSL-2-HT	0.79	27.28	15880.0	10.88	35.76	0.016
4.	HMSL-2-LT	0.76	35.20	17500.0	13.80	44.64	0.015
5.	HMSL-3-HT	0.85	36.16	18664.0	15.64	48.88	0.012
6.	HMSL-3-LT	0.92	32.96	19436.0	16.68	44.24	0.006
7.	HMSL-4-HT	0.80	32.16	18400.0	15.00	40.48	0.012
8.	HMSL-4-LT	1.04	25.32	5576.0	17.96	13.04	0.008
9.	HMSL-5-HT	1.12	56.52	22860.0	22.48	66.40	0.014
10.	HMSL-5-LT	1.10	61.04	22368.0	22.84	65.72	0.011
11.	HMSL-6-HT	0.40	0.80	1132.28	14.48	42.35	0.013
12.	HMSL-6-LT	1.04	31.28	16396.0	12.88	39.36	0.012
13.	HMSL-7-HT	0.75	21.04	9480.0	17.68	18.64	0.010
14.	HMSL-7-LT	0.81	11.96	2068.0	14.60	16.28	0.014
15.	HMSL-8-HT	1.12	7.16	1828.8	13.88	15.96	0.012
16.	HMSL-8-LT	1.38	16.24	2986.4	16.00	12.92	0.016
17.	HMSL-9-HT	1.15	47.04	18628.0	19.08	52.20	0.018
18.	HMSL-9-LT	0.95	42.60	18216.0	17.60	58.04	0.014

Table D-5: Microbiology in Water

S. No.	Station Code	EC	FC	PA	PK	SF	SH	S	TC	TVC	VC	VP
1.	HMSL-1-HT	$27x10^1$	$29x10^1$	$18x10^1$	$23x10^1$	-	$16x10^1$	23	$13x10^2$	$25x10^2$	8	16
2.	HMSL-1-LT	$22x10^1$	$24 x10^1$	$15x10^1$	$20x10^1$	-	$10x10^1$	10	$11 x10^2$	$16x10^2$	10	-
3.	HMSL-2-HT	$23 x10^1$	$31 x10^1$	$14 x10^2$	$18 x10^2$	23	$20 x10^2$	$16 x10^1$	$16 x10^3$	$31x10^4$	$15x10^1$	$19x10^1$
4.	HMSL-2-LT	$18 x10^1$	$28 x10^1$	$11 x10^2$	$15 x10^2$	18	$15 x10^2$	$11x10^1$	$14x10^3$	$22x10^4$	$10x10^1$	$15x10^1$
5.	HMSL-3-HT	$15 x10^1$	$35 x10^1$	$13 x10^2$	$21 x10^2$	15	$11 x10^2$	$20 x10^1$	$10 x10^3$	$19x10^4$	$22 x10^1$	$13 x10^1$
6.	HMSL-3-LT	$10 x10^1$	$32 x10^1$	$10 x10^2$	$18 x10^2$	10	$18 x10^2$	$15 x10^1$	$18x10^3$	$13x10^4$	$16x10^1$	$11x10^1$
7.	HMSL-4-HT	$21x10^1$	$28 x10^1$	$12x10^2$	$15x10^2$	28	$20x10^2$	$13x10^1$	$13 x10^3$	$24x10^4$	$20 x10^1$	$18x10^1$
8.	HMSL-4-LT	$15 x10^1$	$20 x10^1$	$17x10^2$	$10 x10^2$	22	$13 x10^2$	$10 x10^1$	$16x10^3$	$26x10^4$	$12 x10^1$	$15 x10^1$
9.	HMSL-5-HT	$24x10^1$	$39 x10^1$	$20x10^2$	$19x10^2$	-	$15x10^2$	$22x10^1$	$19x10^3$	$15x10^4$	19	24
10.	HMSL-5-LT	$19x10^1$	$27 x10^1$	$16x10^2$	$13x10^2$	-	$11x10^2$	$16x10^1$	$50 x10^3$	$10x10^4$	14	8
11.	HMSL-6-HT	$20 x10^1$	$33 x10^1$	$17 x10^2$	$14 x10^2$	21	$21x10^3$	$15 x10^1$	$17 x10^3$	$31x10^4$	$12x10^1$	$20x10^1$
12.	HMSL-6-LT	$13 x10^1$	$31 x10^1$	$18x10^2$	$11x10^2$	16	$14 x10^3$	$10 x10^1$	$13 x10^3$	$23x10^4$	80	$13x10^1$
13.	HMSL-7-HT	$14x10^1$	$25 x10^1$	$15x10^2$	$10x10^2$	-	$12x10^2$	$18x10^1$	$12 x10^3$	$21x10^4$	25	20
14.	HMSL-7-LT	$10x10^1$	$20 x10^1$	$10x10^2$	$16x10^1$	-	$17x10^2$	$14x10^1$	$18x10^3$	$15x10^4$	13	24
15.	HMSL-8-HT	$28x10^1$	$29 x10^1$	$18x10^2$	$23x10^2$	-	$22x10^2$	$14x10^1$	$21 x10^3$	$36x10^4$	13	18
16.	HMSL-8-LT	$23 x10^1$	$23 x10^1$	$14x10^2$	$17 x10^2$	-	$12x10^2$	$10x10^1$	$20 x10^3$	$28x10^4$	10	12
17.	HMSL-9-HT	$19x10^1$	33	$12x10^1$	$15x10^1$	16	$14x10^1$	19	$26 x10^3$	$29x10^4$	-	8
18.	HMSL-9-LT	$14x10^1$	30	70	$11x10^1$	12	90	12	$14 x10^3$	$22x10^4$	-	5

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Table D-6: Microbiology in Sediment

S. No.	Station Code	EC	FC	PA	PK	SF	SH	S	TC	TVC	VC	VP
1.	HMSL-1-HT	$23x10^2$	$36x10^2$	$15x10^2$	$20x10^2$	26	$19x10^2$	$21 x10^1$	$10x10^4$	$20x10^5$	$14 x10^1$	$18 x10^1$
2.	HMSL-1-LT	$12x10^2$	$30 x10^2$	$12x10^2$	$10x10^2$	18	$15x10^2$	$17 x10^1$	$17 x10^4$	$18x10^5$	$11 x10^1$	$11 x10^1$
3.	HMSL-2-HT	$28 x10^2$	$24 x10^2$	$10 x10^3$	$15 x10^2$	$23 x10^1$	$15 x10^2$	$13 x10^2$	$19 x10^4$	$34x10^5$	$18x10^2$	$15x10^2$
4.	HMSL-2-LT	$15 x10^2$	$22 x10^2$	$18 x10^3$	$12 x10^2$	$15 x10^1$	$10 x10^2$	$10x10^2$	$13x10^4$	$30x10^5$	$15x10^2$	$13x10^2$
5.	HMSL-3-HT	$19 x10^2$	$31 x10^2$	$18 x10^3$	$24 x10^2$	$20 x10^1$	$13 x10^2$	$24 x10^2$	$13 x10^4$	$22x10^5$	$20 x10^2$	$18 x10^2$
6.	HMSL-3-LT	$17 x10^2$	$22 x10^2$	$13 x10^3$	$20 x10^2$	$12 x10^1$	$16 x10^2$	$20 x10^2$	$10 x10^4$	$18x10^5$	$18x10^2$	$15x10^2$
7.	HMSL-4-HT	$23x10^2$	$25 x10^2$	$16x10^3$	$18x10^2$	$25 x10^1$	$24x10^2$	$16x10^2$	$11 x10^4$	$20x10^5$	$25 x10^2$	$28x10^2$
8.	HMSL-4-LT	$12 x10^2$	$20 x10^2$	$10 x10^3$	$13 x10^2$	$17 x10^1$	$20 x10^2$	$12 x10^2$	$18 x10^4$	$13x10^5$	$21 x10^2$	$23 x10^2$
9.	HMSL-5-HT	$20x10^2$	$35 x10^2$	$24x10^3$	$13x10^2$	18	$13x10^2$	$13x10^2$	$13 x10^4$	$18x10^5$	$13 x10^1$	$21 x10^1$
10.	HMSL-5-LT	$15x10^2$	$30 x10^2$	$21x10^3$	$10x10^2$	10	$18x10^2$	$16x10^2$	$11 x10^4$	$15x10^5$	$10 x10^1$	$15 x10^1$
11.	HMSL-6-HT	$26 x10^2$	$30 x10^2$	$12 x10^3$	$17 x10^2$	$25 x10^1$	$24x10^2$	$17 x10^3$	$15 x10^4$	$26x10^5$	$16x10^2$	$13x10^2$
12.	HMSL-6-LT	$18 x10^2$	$24 x10^2$	$17 x10^3$	$13x10^2$	$20 x10^1$	$20 x10^2$	$13 x10^3$	$17 x10^4$	$20x10^5$	$15x10^2$	$10x10^2$
13.	HMSL-7-HT	$10x10^2$	$28 x10^2$	$18x10^3$	$15x10^2$	18	$16x10^2$	$21x10^3$	$18 x10^4$	$17x10^5$	$21 x10^1$	$25 x10^1$
14.	HMSL-7-LT	$18x10^2$	$22 x10^2$	$13x10^3$	$10x10^2$	14	$10x10^2$	$17x10^2$	$15x10^4$	$12x10^5$	$18 x10^1$	$20 x10^1$
15.	HMSL-8-HT	$23x10^2$	$34 x10^2$	$12x10^3$	$21x10^2$	22	$20x10^2$	$16x10^2$	$16 x10^4$	$32x10^5$	$18x10^1$	$13 x10^1$
16.	HMSL-8-LT	$18 x10^2$	$30 x10^2$	$17x10^3$	$15 x10^2$	17	$15x10^2$	$12x10^2$	$12 x10^4$	$25x10^5$	$15 x10^1$	80
17.	HMSL-9-HT	$15x10^2$	$25 x10^2$	$10x10^2$	$19x10^2$	$20 x10^1$	$18x10^2$	$13 x10^1$	$12 x10^4$	$25x10^5$	28	23
18.	HMSL-9-LT	$10x10^2$	$21 x10^2$	$15x10^2$	$13x10^2$	$15 x10^1$	$15x10^2$	80	$10 x10^4$	$20x10^5$	23	18

Table D-7: Phytoplankton

Sl.No	Name of the Species	Nos./l					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
1.	*Trichodesmium erythraeum*	63	62	68	51	127	75
2.	*Coscinodiscus gigas*	9	*	13	10	35	13
3.	*Coscinodiscus centralis*	32	12	141	120	193	61
4.	*Coscinodiscus radiatus*	12	*	68	103	*	31
5.	*Skeletonema costatum*	*	*	*	*	175	66
6.	*Cyclotella* sp.	*	*	*	2	13	*
7.	*Planktonella sol*	*	6	*	*	*	*
8.	*Lauderia borealis*	*	89	*	*	*	31
9.	*Thalassiosira subtilis*	*	128	26	*	18	48
10.	*Ditylum brightwelli*	36	54	*	*	39	92
11.	*Triceratium favus*	8	9	12	*	13	13
12.	*Triceratium reticulatum*	*	*	*	*	22	*
13.	*Chaetoceros indicus*	421	236	128	111	478	241
14.	*Chaetoceros affinis*	440	151	103	128	539	325
15.	*Chaetoceros coarctatus*	*	*	64	*	*	*
16.	*Chaetoceros debilis*	123	*	64	*	*	66
17.	*Chaetoceros diversus*	99	*	51	34	189	136
18.	*Biddulphia heteroceros*	*	*	43	26	*	*
19.	*Bellerochea* sp.	*	*	111	*	*	*
20.	*Bellerochea malleus*	10	10	17	*	158	57
21.	*Odontella sinensis*	*	12	111	26	66	35
22.	*Odontella mobiliensis*	24	16	132	34	44	22
23.	*Eucampia zoodiacus*	*	*	12	*	*	48
24.	*Streptotheca thamensis*	*	*	*	10	*	*
25.	*Leptocylindrus danicus*	*	*	43	13	114	*
26.	*Bacillaria paradoxa*	12	*	*	*	*	*
27.	*Rhizosolenia setigera*	75	*	13	*	92	*
28.	*Rhizosolenia styliformis*	71	39	47	30	211	246
29.	*Rhizosolenia alata*	95	47	103	34	171	158
30.	*Pleurosigma normanii*	12	10	*	11	18	18
31.	*Pleurosigma directum*	*	*	*	*	48	*
32.	*Nitzschia sigma*	*	*	43	26	39	*
33.	*Nitzschia longissima*	*	*	12	38	180	61
34.	*Nitzschia seriata*	290	89	77	77	224	92
35.	*Stephanopyxis palmeriana*	24	*	*	*	57	*
36.	*Thalassiothrix frauenfeldii*	131	58	128	112	197	136
37.	*Thalassionema nitzschioides*	91	*	64	73	298	75
38.	*Asterionella glacialis*	*	*	265	98	272	263
39.	*Prorocentrum micans*	4	*	*	*	*	*
40.	*Ceratium macroceros*	*	16	*	21	*	*
41.	*Ceratium furca*	20	9	26	11	*	48

Sl.No	Name of the Species	Nos./l					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
42.	*Ceratium tripos*	*	*	8	34	35	*
43.	*Ceratium fusus*	*	*	11	10	*	*
44.	*Ceratium extensum*	*	*	*	*	*	31
45.	*Ceratium trichoceros*	36	11	21	26	*	*
46.	*Protoperidinium oceanicum*	*	*	*	*	48	18
47.	*Protoperidinium depressum*	*	*	*	*	26	*
48.	*Peridinium sp.*	*	*	*	21	*	*
49.	*Noctiluca sp.*	*	*	26	*	*	*
50.	*Anabeana nostac*	12	*	*	*	*	*
	Total	2150	1064	2051	1290	4139	2506

No.	Name of the Species	Nos./l					
		HMSL-4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL-6-LT
1.	*Trichodesmium erythraeum*	83	60	158	91	75	49
2.	*Coscinodiscus gigas*	12	7	12	10	*	28
3.	*Coscinodiscus centralis*	159	179	77	48	67	69
4.	*Coscinodiscus radiatus*	75	83	12	20	52	45
5.	*Skeletonema costatum*	123	155	77	63	60	49
6.	*Cyclotella* sp.	*	*	*	2	*	*
7.	*Lauderia borealis*	*	10	54	40	32	37
8.	*Thalassiosira subtilis*	40	*	36	56	12	16
9.	*Ditylum brightwelli*	44	13	50	28	40	65
10.	*Triceratium favus*	28	14	10	12	*	*
11.	*Triceratium reticulatum*	12	16	*	*	*	*
12.	*Chaetoceros peruvians*	*	*	27	*	*	*
13.	*Chaetoceros messanesis*	218	*	*	*	*	*
14.	*Chaetoceros currvisetus*	*	*	54	48	270	175
15.	*Chaetoceros indicus*	377	314	324	190	*	*
16.	*Chaetoceros affinis*	313	242	428	306	321	346
17.	*Chaetoceros coarctatus*	*	*	27	*	*	*
18.	*Chaetoceros debilis*	*	*	63	28	*	*
19.	*Chaetoceros diversus*	159	119	*	*	488	439
20.	*Chaetoceros brevis*	*	*	41	*	*	*
21.	*Bacteriastrum comosum*	*	*	*	12	*	*
22.	*Biddulphia heteroceros*	*	*	27	*	*	*
23.	*Bellerochea malleus*	28	83	*	11	179	73
24.	*Odontella sinensis*	12	*	32	24	48	45
25.	*Odontella mobiliensis*	16	*	59	36	32	33
26.	*Leptocylindrus danicus*	32	44	*	*	56	49
27.	*Rhizosolenia setigera*	32	24	*	*	67	85
28.	*Rhizosolenia styliformis*	151	131	86	60	52	53
29.	*Rhizosolenia alata*	60	56	68	52	175	122
30.	*Hemidiscus hardmannianus*	*	*	14	*	40	33

31.	*Hemiaulus sinensis*	*	*	*	*	32	12
32.	*Pleurosigma normanii*	28	*	11	12	*	53
33.	*Pleurosigma directum*	*	32	*	*	*	*
34.	*Nitzschia sigma*	*	12	45	24	60	37
35.	*Nitzschia longissima*	*	*	54	36	*	*
36.	*Nitzschia seriata*	60	83	333	139	190	85
37.	*Nitzschia closterium*	*	48	*	*	*	*
38.	*Stephanopyxis palmeriana*	83	*	*	*	*	49
39.	*Thalassiothrix frauenfeldii*	131	155	302	103	246	159
40.	*Thalassionema nitzschioides*	159	123	63	63	119	130
41.	*Asterionella glacialis*	286	321	54	44	421	329
42	*Dinophyses tripos*	*	11	12	*	*	*
43	*Ceratium macroceros*	*	*	86	28	*	*
44	*Ceratium furca*	44	28	41	36	52	28
45	*Ceratium tripos*	*	*	23	*	*	*
46	*Ceratium fusus*	40	10	14	10	40	37
47	*Ceratium trichoceros*	*	40	*	12	*	*
48	*Protoperidinium oceanicum*	32	52	23	16	36	61
49	*Protoperidinium depressum*	28	12	*	*	12	57
50	*Noctiluca sp.*	40	*	*	*	16	12
51	*Anabeana nostac*	*	*	23	*	*	*
	Total	2905	2477	2820	1660	3290	2860

Sl.No	Name of the Species	Nos./l					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
1.	*Trichodesmium erythraeum*	60	50	75	63	108	73
2.	*Coscinodiscus gigas*	10	*	33	13	*	53
3.	*Coscinodiscus centralis*	115	96	96	54	125	98
4.	*Coscinodiscus radiatus*	28	25	46	38	63	45
5.	*Skeletonema costatum*	*	125	163	163	271	248
6.	*Planktonella sol*	3	*	*	*	*	*
7.	*Lauderia borealis*	*	*	21	13	13	11
8.	*Thalassiosira subtilis*	24	25	*	*	*	*
9.	*Ditylum brightwelli*	*	*	142	188	42	41
10.	*Triceratium favus*	10	4	38	42	54	20
11.	*Triceratium reticulatum*	*	*	33	29	33	12
12.	*Chaetoceros messanesis*	*	*	163	283	167	126
13.	*Chaetoceros currvisetus*	*	*	*	*	*	85
14.	*Chaetoceros indicus*	552	254	*	*	*	*
15.	*Chaetoceros affinis*	425	375	267	213	213	187

Sl.No	Name of the Species	Nos./l					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
16.	*Chaetoceros debilis*	48	38	*	*	*	*
17.	*Chaetoceros diversus*	44	21	388	267	300	142
18.	*Bacteriastrum comosum*	40	50	*	*	*	*
19.	*Biddulphia heteroceros*	24	25	*	*	*	*
20.	*Bellerochea malleus*	28	25	71	63	138	171
21.	*Odontella sinensis*	36	38	46	17	63	126
22.	*Odontella mobiliensis*	48	50	38	13	42	85
23.	*Eucampia zoodiacus*	*	*	54	42	513	57
24.	*Leptocylindrus danicus*	*	*	33	*	*	85
25.	*Bacillaria paradoxa*	16	13	*	*	*	*
26.	*Rhizosolenia setigera*	*	*	*	88	188	*
27.	*Rhizosolenia styliformis*	48	79	213	163	200	183
28.	*Rhizosolenia imbricata*	32	*	*	*	*	57
29.	*Rhizosolenia alata*	175	100	188	213	217	142
30.	*Hemidiscus hardmannianus*	*	*	29	21	38	20
31.	*Hemiaulus sinensis*	*	*	13	13	46	12
32.	*Pleurosigma normanii*	12	13	*	11	*	*
33.	*Pleurosigma directum*	*	*	42	*	*	*
34.	*Nitzschia sigma*	24	25	*	*	*	*
35.	*Nitzschia longissima*	123	79	88	*	*	*
36.	*Nitzschia seriata*	91	113	146	108	258	159
37.	*Nitzschia closterium*	44	*	*	*	*	*
38.	*Stephanopyxis palmeriana*	20	12	46	21	*	*
39.	*Thalassiothrix frauenfeldii*	115	125	142	67	167	211
40.	*Thalassionema nitzschioides*	99	*	75	204	88	183
41.	*Asterionella glacialis*	*	*	275	250	133	171
42.	*Ceratium macroceros*	12	13	50	42	46	*
43.	*Ceratium furca*	*	25	*	*	*	45
44.	*Ceratium tripos*	12	13	42	33	29	65
45.	*Ceratium fusus*	10	11	21	25	*	85
46.	*Ceratium extensum*	*	*	*	*	54	*
47.	*Ceratium trichoceros*	*	33	*	*	*	*
48.	*Protoperidinium oceanicum*	12	*	67	71	38	24
49.	*Protoperidinium depressum*	*	*	46	46	33	*
50.	*Noctiluca sp.*	48	29	42	21	13	*
	Total	**2388**	**1884**	**3232**	**2898**	**3693**	**3022**

Table D-8: Zooplankton

Sl. No	Name of the Species	Nos./m^3					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
1.	*Evadne* sp.	*	*	287	174	*	*
2.	*Paracalanus parvus*	230	197	575	304	522	266
3.	*Pontella danae*	3	*	*	*	*	*
4.	*Pseudodiaptomus serricaudatus*	*	*	*	*	261	48
5.	*Pseudodiaptomus aurivilli*	*	*	41	43	*	*
6.	*Acrocalanus gibber*	262	230	800	543	261	*
7.	*Acrocalanus gracilis*	131	164	677	587	174	*
8.	*Temora stylifera*	*	*	*	*	290	*
9.	*Acartia danae*	*	*	103	65	116	97
10.	*Acartia spinicauda*	125	131	*	4	58	193
11.	*Acartia erythraea*	98	*	*	*	*	*
12.	*Oithona similis*	16	131	390	152	*	*
13.	*Oithona brevicornis*	*	66	328	*	290	145
14.	*Oithona spinirostris*	*	*	924	*	*	*
15.	*Onçaea venusta*	*	*	62	43	*	*
16.	*Corycaeus danae*	131	98	41	65	145	241
17.	*Corycaeus catus*	295	230	103	52	145	97
18.	*Euterpina acutifrons*	131	164	677	391	377	410
19.	*Lucifer hanseni*	*	*	21	*	*	*
20.	*Oikopleura parva*	*	*	*	*	58	*
22.	*Oikopleura dioica*	262	197	205	174	*	*
23.	Shrimp zoea	33	*	*	*	*	*
24.	Tintinnopsis tubulosa	*	*	*	*	232	217
25.	*Tintinnopsis beroidea*	66	*	*	*	*	*
26.	*Tintinnopsis butzschi*	*	*	*	*	261	97
27.	*Eutinnus tennuis*	*	*	*	*	174	*
28.	*Favella philipiensis*	131	98	103	87	29	97
29.	Bivalve veliger	459	230	*	*	*	217
30.	Gastrpod veliger	492	*	*	*	*	*
31.	Crustacean nauplii	*	*	*	*	*	217
32.	Copepod nauplii	1082	918	841	869	927	1087
33.	Barnacle nauplii	131	*	123	*	*	*
34.	Polychaete larvae	66	66	*	*	*	48
	Total	**4144**	**2920**	**6301**	**3553**	**4320**	**3477**

S.no.	Name of the Species	Nos./m^3					
		HMSL-4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL-6-LT
1.	*Diphyses dispar*	*	45	39	29	*	*
2.	*Evadne* sp.	*	*	393	202	*	*
3.	*Penilia* sp.	*	*	*	29	*	*

S.no.	Name of the Species	Nos./m^3					
		HMSL-4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL-6-LT
4.	*Paracalanus parvus*	671	476	275	202	534	321
5.	*Pontella danae*	*	45	*	*	*	*
6.	*Pseudodiaptomus aurivilli*	*	*	39	*	*	*
7.	*Acrocalanus gibber*	373	249	118	173	314	184
8.	*Acrocalanus gracilis*	149	113	197	202	220	138
9.	*Temora stylifera*	*	136	*	*	*	*
10.	*Labidocera pavo*	*	*	*	*	126	46
11.	*Acartia danae*	186	91	*	*	314	115
12.	*Acartia spinicauda*	112	68	157	58	126	46
13.	*Acartia erythraea*	*	*	315	*	*	*
14.	*Oithona similis*	*	227	*	29	189	230
15.	*Oithona brevicornis*	373	91	*	*	314	184
16.	*Oncaea venusta*	186	159	*	*	157	92
17.	*Corycaeus danae*	410	227	118	58	314	276
18.	*Corycaeus catus*	186	204	236	115	189	138
19.	*Copilia vitrea*	37	23	*	*	*	*
20.	*Euterpina acutifrons*	335	385	275	144	314	344
21.	*Sagitta enflata*	*	*	*	29	*	*
22.	*Oikopleura parva*	*	136	79	*	*	*
23.	Shrimp zoea	*	*	39	*	*	*
24.	Tintinnopsis tubulosa	335	181	*	*	126	184
25.	*Tintinnopsis butzschi*	298	*	*	*	*	92
26.	*Eutinnus tennuis*	75	272	*	*	157	*
27.	*Favella philipiensis*	*	91	79	115	*	*
28.	Bivalve veliger	*	249	472	461	346	482
29.	Gastrpod veliger	*	*	*	*	251	344
30.	Copepod nauplii	1565	725	511	951	1068	758
31.	Barnacle nauplii	224	*	*	*	*	*
32.	Polychaete larvae	75	*	39	29	*	*
		5590	**4193**	**3381**	**2826**	**5059**	**3974**

Sl. No	Name of the Species	Nos./m^3					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
1.	*Exoskeleton from molt of Barnacle*	*	*	*	23	*	30
2.	*Evadne* sp.	276	276	*	*	*	*
3.	*Penilia* sp.	*	46	*	*	*	*
4.	*Paracalanus parvus*	827	896	511	482	680	623
5.	*Pontella danae*	*	*	170	92	240	119
6.	*Pseudodiaptomus aurivilli*	98	46	49	46	*	*
7.	*Acrocalanus gibber*	2166	2067	243	230	80	237
8.	*Acrocalanus gracilis*	1871	2526	292	161	400	178
9.	*Centropages furcatus*	39	92	*	*	320	*
10.	*Temora stylifera*	*	115	73	230	*	*

Sl. No	Name of the Species	Nos./m^3					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
11.	*Labidocera pavo*	*	*	97	*	*	*
12.	*Acartia danae*	*	*	146	46	160	119
13.	*Acartia spinicauda*	98	46	122	69	80	89
14.	*Acartia erythraea*	39	*	*	*	*	*
15.	*Oithona similis*	79	*	243	138	600	326
16.	*Oithona brevicornis*	*	*	170	230	320	237
17.	*Oncaea venusta*	98	*	243	69	120	178
18.	*Corycaeus danae*	59	*	267	230	400	326
19.	*Corycaeus catus*	39	*	146	138	200	356
20.	*Microsetella rosea*	20	*	*	*	*	*
21.	*Euterpina acutifrons*	138	92	535	482	600	593
22.	*Sagitta enflata*	*	46	*	*	*	*
23.	*Oikopleura dioica*	79	161	*	*	*	*
24.	Shrimp zoea	20	23	24	23	*	*
25.	Tintinnopsis tubulosa	*	*	*	92	160	59
26.	*Tintinnopsis butzschi*	*	*	97	138	400	178
27.	*Eutinnus tennuis*	*	*	194	23	0	89
28.	*Favella philipiensis*	79	115	73	230	160	119
29.	Bivalve veliger	591	184	316	253	440	504
30.	Gastrpod veliger	*	*	413	344	320	326
31.	Crustacean nauplii	*	*	292	*	*	*
32.	Copepod nauplii	1122	*	778	*	1200	1127
33.	Barnacle nauplii	276	46	*	689	*	*
34.	Phyllosoma larvae	98	*	*	*	*	*
	Total	**8112**	**6777**	**5494**	**4458**	**6880**	**5813**

** - Organisms not present*

Table D-9: Finfish Eggs

Sl. No	Name of the Species	Nos./m^3					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
	Enraulidae						
1.	*Setipinna taty*	18	15	22	10	13	15
2.	*Stolephorus tri*	5	3	6	4	2	5
3.	*Engraulis* sp.	18	13	15	6	3	9
	Clupeidae						
1.	*Sardinella fimbriata*	8	7	3	10	12	10
2.	*Sardinella gibbosa*	7	6	5	9	5	8
3.	*Sardinella longiceps*	3	9	4	3	6	9
	Mugilidae						
1.	*Mugil cephalus*	20	23	25	18	13	20
2.	*Mugil* sp.	15	13	16	*	*	*
3.	*Liza tade*	*	*	*	12	10	9

4.	*Liza dussumieri*	10	8	5	10	15	13
		104	**97**	**101**	**82**	**79**	**98**
Sl. No	**Name of the Species**	**Nos./m^3**					
		HMSL-4-HT	**HMSL-4-LT**	**HMSL-5-HT**	**HMSL-5-LT**	**HMSL-6-HT**	**HMSL-6-LT**
	Enraulidae						
1.	*Setipinna taty*	13	12	10	12	10	9
2.	*Stolephorus tri*	*	*	*	2	5	2
3.	*Thryssa dussumieri*	5	6	3	5	9	6
4.	*Thryssa hamiltonii*	*	*	*	4	3	5
5.	*Thryssa mystax*	4	2	3	2	4	2
6.	*Engraulis* sp.	8	4	7	8	5	6
	Clupeidae						
1.	*Anadontostoma chacunda*	3	4	5	*	*	*
2.	*Sardinella fimbriata*	6	9	5	5	4	8
3.	*Sardinella gibbosa*	*	*	*	6	3	2
4.	*Sardinella longiceps*	5	5	3	7	9	5
5.	*Sardinella* sp.						
	Mugilidae						
1.	*Mugil cephalus*	10	12	15	15	18	13
2.	*Mugil* sp.						
3.	*Liza tade*	13	10	12	12	15	12
4.	*Liza dussumieri*	10	10	13	10	12	11
	Total	**77**	**74**	**76**	**88**	**97**	**81**
Sl. No	**Name of the Species**	**Nos./m^3**					
		HMSL-7-HT	**HMSL-7-LT**	**HMSL-8-HT**	**HMSL-8-LT**	**HMSL-9-HT**	**HMSL-9-LT**
	Enraulidae						
1.	*Setipinna taty*	10	15	18	12	18	15
Sl. No	**Name of the Species**	**Nos./m^3**					
		HMSL-7-HT	**HMSL-7-LT**	**HMSL-8-HT**	**HMSL-8-LT**	**HMSL-9-HT**	**HMSL-9-LT**
2	*Thryssa dussumieri*	5	6	3	*	*	*
3.	*Thryssa hamiltonii*	4	2	5	*	*	*
4.	*Thryssa mystax*	2	2	3	*	*	*
5.	*Engraulis* sp.	10	9	8	*	*	*
	Clupeidae						
1.	*Sardinella fimbriata*	10	12	10	8	9	5
2.	*Sardinella longiceps*	15	13	12	10	11	15
	Mugilidae						
1.	*Mugil cephalus*	12	10	15	15	13	18
2.	*Mugil* sp.	10	12	18	*	*	*
3.	*Liza tade*	*	*	*	10	15	17
4.	*Liza dussumieri*	10	15	18	18	12	13
	Total	**88**	**96**	**110**	**73**	**78**	**83**

** - Organisms not present*

Table D-10: Finfish Larvae

Sl. No	Name of the Species	Nos./m^3					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
	Enraulidae						
1.	*Thryssa* sp.	*	*	1	*	*	*
2.	*Sardinella longiceps*	*	*	1	*	*	*
	Clupeidae						
1.	*Anadontostoma chacunda*	*	*	1	1	*	*
2.	*Sardinella* sp.	*	*	*	*	*	1
	Carangidae						
1.	*Caranx* sp.	1	*	*	*	*	*
	Teraponidae						
1.	*Terapon jarbua*	*	1	*	*	*	*
	Total	**1**	**1**	**3**	**1**	**0**	**1**

Sl. No	Name of the Species	Nos./m^3					
		HMSL-4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL-6-LT
	Enraulidae						
1.	*Thryssa* sp.	*	*	1	*	*	*
2.	*Stolephorus tri*	*	*	1	*	*	*
3.	*Engraulis* sp.	*	*	*	*	1	*
	Chirocentridae						
1.	*Chirocentrus dorab*	1	*	*	1	*	*
	Lutjanidae						
1.	*Lutjanus* sp.	*	1	*	*	*	*
	Teraponidae						
1.	*Terapon jarbua*	1	*	*	*	*	*
	Ambassidae						
1.	*Ambassis commersoni*	*	*	*	1	*	*
	Total	**2**	**1**	**2**	**2**	**1**	**0**

Sl. No	Name of the Species	Nos./m^3					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
	Clupeidae						
1.	*Sardinella* sp.	*	*	1	*	*	*
2.	*Stolephorus tri*	*	*	*	*	*	1
	Chirocentridae						
1.	*Chirocentrus dorab*	*	*	*	*	1	*
	Mugilidae						
1.	*Liza* sp.	1	*	*	*	*	*
	Ambassidae						

1.	*Ambassis commersoni*	1	*	*	*	*	*
	Platycephalidae						
1.	*Platycephalus indicus*	*	*	*	1	*	*
	Total	**2**	**0**	**1**	**1**	**1**	**1**

Table D-11: Macrobenthos

Sl. No.	Name of the Species	Nos./m^2					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
	Polychaetes						
1	*Armandia longicaudata*	25	*	50	*	75	50
2	*Armandia intermedia*	*	75	*	50	*	*
3	*Chone collaris*	50	*	25	*	50	25
4	*Cirratulus chrysoderma*	*	50	*	75	*	*
5	*Dorvillea gardineri*	25	*	50	*	25	75
6	*Euclymene annandalei*	*	25	*	50	*	25
7	*Exogone clavator*	75	*	*	75	50	*
8	*Fabricia filamentosa*	*	*	25	*	*	50
9	*Lopadorhynchus uncinatus*	50	25	*	25	25	*
10	*Nephtys sphaerocirrata*	*	*	75	*	*	25
11	*Notomastus aberans*	25	50	*	25	75	*
12	*Polydora ciliata*	*	*	*	75	*	75
13	*Prionospio cirrifera*	*	25	25	*	50	*
14	*Syllis longocirrata*	50	*	*	25	*	25
	Bivalves						
1	Anadara veligers	25	50	75	*	25	*
2	Cardium veligers	*	75	*	25	*	50
3	Donax veligers	50	*	25	*	75	*
4	Meretrix veligers	*	50	*	50	*	100
	Gastropods						
1	Nassarius veliger	*	50	*	75	*	50
2	Natica veliger	25	*	75	*	25	*
3	Oliva veliger	*	50	*	50	*	75
4	Turritella veliger	75	*	25	*	50	25
	Amphipods						
1	*Gammarus* sp.	75	*	25	*	50	*
2	*Grandidierella* sp.	*	75	*	50	*	25
3	*Ampithoe romondi*	50	*	25	*	100	*
4	*Phaxocephalus holbolli*	*	25	*	75	*	50
	Isopods						
1	*Angeliera phreaticola*	*	125	75	*	25	*
2	*Mirocerberus* sp.	50	*	*	100	*	75
3	*Jaeropsis beuroisi*	*	25	50	*	25	*
	Total	**650**	**775**	**625**	**825**	**725**	**800**

** - Organisms not present*

Sl. No.	Name of the Species	Nos./m^2					
		HMSL -4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL -6-LT
	Polychaetes						
1	*Armandia longicaudata*	25	*	50	*	75	*
2	*Boccardia polybranchia*	*	75	*	25	*	25
3	*Chone collaris*	50	*	25	*	50	*
4	*Cirratulus filiformis*	*	25	*	75	*	50
5	*Dorvillea gardineri*	75	*	50	*	25	*
6	*Eunice indica*	*	75	*	25	*	75
7	*Epidiopatra gilchristi*	25	*	25	*	50	*
8	*Goniada emerita*	*	50	*	50	*	50
9	*Nereis capensis*	*	*	*	*	25	*
10	*Notomastus aberans*	25	25	*	25	*	25
11	*Scoloplella capensis*	*	*	75	*	75	*
12	*Polydora ciliata*	50	50	*	25	*	75
13	*Prionospio cirrifera*	*	*	75	*	50	*
14	*Syllis longocirrata*	*	75	*	50	*	25
15	*Syllidia armata*	50	*	25	*	25	*
	Bivalves						
1	Anadara veligers	*	75	*	25	*	50
2	Cardium veligers	50	*	75	*	25	*
3	Donax veligers	*	50	*	50	*	75
4	Meretrix veligers	75	*	25	*	50	*
	Gastropods						
1	Nassarius veliger	25	*	75	*	50	*
2	Littorina veliger	*	50	*	25	*	25
3	Bullia veliger	75	*	25	*	75	*
4	Natica veliger	*	25	*	50	*	25
5	Oliva veliger	50	*	75	*	25	*
	Amphipods						
1	*Grandidierella* sp.	25	*	75	*	50	*
2	*Ampithoe romondi*	*	50	*	25	*	25
3	*Ampithoe rubricata*	50	*	50	*	75	*
4	*Caprella mendax*	*	75	*	25	*	50
5	*Phaxocephalus holbolli*	25	*	25	*	25	*
	Isopods						
1	*Angeliera phreaticola*	*	25	*	*	*	50
2	*Mirocerberus* sp.	25	*	75	*	25	*
3	*Calabozoa pellucida*	*	75	*	25	*	25
4	*Paragnathia formica*	25	*	50	*	50	*
	Total	**725**	**800**	**875**	**500**	**825**	**650**

** - Organisms not present*

Sl. No.	Name of the Species	Nos./m^2					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
	Polychaetes						
1	*Armandia longicaudata*	*	*	50	*	25	*
2	*Chone collaris*	25	50	25	*	75	*
3	*Cirratulus chrysoderma*	*	25	*	50	*	50
4	*Dorvillea gardineri*	25	*	75	*	25	*
5	*Eunice indica*	*	50	*	25	*	75
6	*Exogone clavator*	50	75	25	*	*	*
7	*Goniada emerita*	*	*	*	75	25	25
8	*Prionospio malmagreni*	*	25	*	100	*	25
9	*Nephtys dibranchis*	25	*	25	*	*	*
10	*Notomastus aberans*	*	75	*	25	*	75
11	*Onuphis* sp.	75	*	50	*	25	*
12	*Scoloplella capensis*	*	25	*	75	*	50
13	*Phyllodoce tubicola*	25	*	75	*	50	*
14	*Pisionidens indica*	*	50	*	100	*	25
15	*Prionospio cirrifera*	*	25	*	*	75	*
16	*Syllidia armata*	25	*	25	50	25	*
	Bivalves						
1	Anadara veligers	75	*	50	*	75	*
2	Cardium veligers	*	100	*	75	*	25
3	Donax veligers	50	*	25	*	50	*
4	Meretrix veligers	*	75	*	50	*	25
	Gastropods						
1	Littorina veliger	100	*	50	25	50	*
2	Natica veliger						
3	Oliva veliger	*	75	*	75	*	25
4	Turritella veliger	25	*	25	*	25	*
	Amphipods						
1	*Ampithoe romondi*	75	*	50	25	*	125
2	*Ampithoe rubricata*	*	25	*	*	50	*
3	*Phaxocephalus holbolli*	50	*	25	50	*	100
	Isopods						
1	*Angeliera phreaticola*	25	*	50	*	50	*
2	*Calabozoa pellucida*	*	75	*	50	*	75
3	*Paragnathia formica*	25	*	25	*	50	*
	Total	**675**	**750**	**650**	**850**	**675**	**700**

** - Organisms not present*

Table D-12: Meiobenthos

Sl. No.	Name of the Species	Nos./10 cm^2					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
	Nematodes						
1	*Daptonema conicum*	11	13	10	14	15	16
2	*Desmoscolex falcatus*	6	8	7	9	5	6
3	*Enoploides* sp.	8	9	13	15	10	11
4	*Halalaimus filum*	10	12	16	18	12	14
5	*Pandolaimus* sp.	12	14	10	11	11	13
6	*Polygastrophora* sp.	6	8	7	9	5	8
7	*Pselionema* sp.	4	6	3	5	9	10
8	*Theristus* sp.	13	14	15	17	10	12
9	*Viscosia* sp.	10	12	8	9	12	14
10	*Diodontolaimus* sp.	5	8	4	7	6	9
11	*Neochromodra* sp.	10	12	13	14	16	18
12	*Spirinia* sp.	8	9	6	7	5	9
	Foraminiferans						
1	*Ammonia beccarii*	3	6	7	9	10	12
2	*Bolivina abbreviata*	4	5	6	7	6	8
3	*Cibicides lobatulus*	2	3	5	8	5	7
4	*Cornoboides advena*	5	7	3	5	8	9
5	*Cymbaloporetta bradyi*	*	*	5	7	2	3
6	*Discorbis* sp.	5	6	8	9	4	6
7	*Eliphidium* sp.	4	5	7	8	3	4
8	*Eponides repandus*	7	9	4	5	6	7
9	*Globigerinoide glutinata*	6	7	6	8	4	5
10	*Hauerina miocenica*	3	5	2	5	6	7
11	*Lagena semistriata*	*	*	5	9	*	*
12	*Lagena striata*	3	6	*	*	3	7
13	*Lagena marginata*	2	4	5	6	4	9
14	*Loxostoma perrectum*	5	6	4	5	7	8
15	*Neoconorbina crustata*	3	5	3	7	2	4
16	*Nonion depressulum*	2	4	5	6	4	5
17	*Oridosalis umbonatus*	6	8	4	5	3	7
18	*Quinqueloculina* sp.	7	9	3	8	6	9
19	*Rosalina bradyi*	2	5	*	*	3	6
20	*Rosalina globularis*	7	8	5	6	9	11
21	*Rotalia calcar*	3	4	3	7	5	8
22	*Ammonia tepida*	6	9	10	12	13	14
23	*Ammonia dentata*	2	5	4	7	6	8
24	*Spirillina limbata*	3	4	5	6	4	5
25	*Spiroloculina* sp.	5	7	8	9	5	6
26	*Textularia agglutinans*	7	9	6	8	6	9
	Cumacea						

Sl. No.	Name of the Species	Nos./10 cm^2					
		HMSL-1-HT	HMSL-1-LT	HMSL-2-HT	HMSL-2-LT	HMSL-3-HT	HMSL-3-LT
1	*Campylaspis* sp.	3	*	4	*	5	*
2	*Nannastacus* sp.	*	5	*	6	*	*
	Harpacticoids						
1	*Canuella* sp.	7	9	5	8	3	6
2	*Euterpina acutifrons*	5	6	3	7	5	8
3	*Laophonte thoracica*	2	4	5	6	4	5
4	*Macrosetella* sp.	6	8	*	*	3	4
5	*Microsetella* sp.	3	5	2	4	*	*
6	*Stenhelia* sp.	4	6	3	5	4	7
	Ostrocodes						
1	*Conchoecia* sp.	3	7	4	8	3	5
2	*Cypridina* sp.	5	8	3	7	8	9
3	*Leptocythere* sp.	2	3	*	*	4	6
4	*Tanella indica*	*	*	7	9	*	*
	Archiannelid						
1	*Protodrilus helgolandicus*	4	6	3	5	7	8
2	*Protodrilus brevis*	*	*	4	6	*	*
	Tanaidacea						
1	*Sphaerosyllis* sp.	7	9	5	8	3	5
	Total	**256**	**347**	**283**	**386**	**299**	**387**

* - *Organisms not present*

Sl. No.	Name of the Species	Nos./10 cm^2					
		HMSL-4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL-6-LT
	Nematodes						
1	*Daptonema conicum*	10	12	11	14	10	12
2	*Desmoscolex falcatus*	7	9	5	8	9	11
3	*Enoploides* sp.	10	12	10	12	13	14
4	*Gonionchus* sp.	6	8	7	9	8	9
5	*Halalaimus filum*	7	9	5	7	6	8
6	*Pandolaimus* sp.	13	15	10	12	10	12
7	*Quadricoma* sp.	8	9	4	5	7	8
8	*Theristus* sp.	12	16	8	9	13	15
9	*Tricoma* sp.	7	8	5	7	5	8
10	*Stephanolaimus* sp.	9	10	13	14	7	9
11	*Odontophora* sp.	3	5	*	*	4	7
12	*Spirinia* sp.	12	13	11	14	10	12
13	*Neochromodora,sp.*	8	9	4	7	5	6
	Foraminiferans						
1	*Ammonia beccarii*	3	5	8	9	7	5
2	*Bolivina abbreviata*	5	7	9	10	8	9

Sl. No.	Name of the Species	Nos./10 cm^2					
		HMSL-4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL-6-LT
3	*Cornoboides advena*	9	10	6	8	10	12
4	*Cymbaloporetta bradyi*	7	9	5	7	5	8
5	*Diffusilina* sp.	2	3	*	*	3	6
6	*Discorbis* sp.	6	8	4	5	4	8
7	*Eponides repandus*	7	9	6	8	9	7
8	*Globigerina rubber*	3	6	5	6	5	9
9	*Globigerinoides glutinata*	8	9	4	7	6	8
10	*Hauerina miocenica*	3	5	7	8	3	5
11	*Lagena striata*	2	3	3	5	4	6
12	*Lagena marginata*	4	5	*	*	2	4
13	*Lagena quadrata*	*	*	3	4	*	*
14	*Loxostoma perrectum*	5	6	2	5	3	5
15	*Nonion depressulum*	8	9	4	6	4	6
16	*Oridosalis umbonatus*	3	5	3	7	2	4
17	*Planorbulinella larvata*	6	9	2	6	3	7
18	*Quinqueloculina* sp.	8	10	6	9	5	6
19	*Rosalina bradyi*	*	*	3	5	*	*
20	*Rosalina globularis*	10	12	8	9	7	9
21	*Ammonia tepida*	7	9	6	8	6	8
22	*Ammona dentata*	11	10	13	14	12	15
23	*Asterorotalia trispinosa*	9	10	7	8	4	6
24	*Spirillina limbata*	3	4	*	*	5	8
25	*Spiroloculina* sp.	8	9	5	6	3	5
26	*Textularia agglutinans*	2	6	8	9	5	7
27	*Triloculina austriaca*	4	5	3	4	2	6
	Cumacea						
1	*Campylaspis* sp.	3	*	4	5	*	9
2	*Gynodiastylis* sp.	*	7	*	*	7	*
3	*Nannastacus* sp.	5	*	6	8	*	5
4	**Harpacticoids**						
5	*Canuella* sp.	7	9	4	6	3	6
6	*Cervinia* sp.	3	5	*	*	4	8
7	*Diarthrodes* sp.	5	7	5	9	8	9
8	*Euterpina acutifrons*	2	5	*	*	2	4
9	*Laophonte thoracica*	6	8	3	5	4	6
10	*Macrosetella* sp.	2	3	4	6	8	9
11	*Microsetella* sp.	3	5	*	*	5	6
12	*Stenhelia* sp.	*	*	7	8	*	*
	Ostrocodes						
1	*Conchoecia* sp.	9	11	8	9	3	5
2	*Cypridina* sp.	3	5	*	*	4	7

Sl. No.	Name of the Species	Nos./10 cm^2					
		HMSL-4-HT	HMSL-4-LT	HMSL-5-HT	HMSL-5-LT	HMSL-6-HT	HMSL-6-LT
3	*Leptocythere* sp.	8	10	5	7	*	*
4	*Tanella indica*	*	*	3	4	5	7
5	*Tanella kingmaii*	2	3	*	*	3	4
	Archiannelid						
1	*Protodrilus helgolandicus*	3	4	2	5	5	6
2	*Protodrilus brevis*	2	3	*	*	3	7
	Rotifera						
1	*Rotaria rotatoria*	*	*	3	4	*	*
	Tanaidacea						
1	*Heterotanais oerstedi*	7	8	4	6	5	8
	Total	**325**	**411**	**281**	**373**	**303**	**416**

* - *Organisms not present*

Sl. No.	Name of the Species	Nos./10 cm^2					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
	Nematodes						
1	*Daptonema conicum*	10	12	11	13	8	9
2	*Draconema* sp.	4	5	6	8	4	7
3	*Gonionchus* sp.	6	9	10	12	9	10
4	*Halalaimus filum*	10	12	7	9	7	8
5	*Oxystomina* sp.	7	8	10	12	8	9
6	*Polygastrophora* sp.	8	9	6	7	5	6
7	*Quadricoma* sp.	5	6	10	12	4	7
8	*Theristus* sp.	10	12	15	16	18	21
9	*Tricoma* sp.	7	8	*	*	5	6
10	*Stephanolaimus* sp.	8	9	6	8	4	7
11	*Odontophora* sp.	3	5	5	9	3	8
12	*Neochromadora* sp.	10	15	12	13	19	22
13	*Spirinia* sp.	8	11	15	18	12	14
	Foraminiferans						
1	*Ammonia beccarii*	6	8	4	5	5	9
2	*Bolivina abbreviata*	2	5	6	7	3	6
3	*Cornoboides advena*	7	9	8	9	4	7
4	*Cyclammina* sp.	4	5	*	*	5	8
5	*Cymbaloporetta bradyi*	2	4	2	3	4	5
6	*Discorbis* sp.	6	7	8	10	5	9
7	*Eponides repandus*	8	9	3	5	5	8
8	*Globigerinoides glutinata*	5	8	7	9	3	6
9	*Lagena semistriata*	2	5	*	*	4	5
10	*Lagena striata*	5	7	8	9	6	8

Sl. No.	Name of the Species	Nos./10 cm^2					
		HMSL-7-HT	HMSL-7-LT	HMSL-8-HT	HMSL-8-LT	HMSL-9-HT	HMSL-9-LT
11	*Lagena marginata*	*	*	3	5	*	*
12	*Lagena quadrata*	3	6	*	*	3	5
13	*Nonion depressulum*	6	7	8	9	2	6
14	*Pararotalia minuta*	8	10	6	8	5	7
15	*Quinqueloculina* sp.	9	11	7	9	6	8
16	*Rosalina globularis*	7	9	6	7	4	5
17	*Rotalia calcar*	3	5	*	*	5	6
18	*Ammonia tepida*	7	9	5	9	6	8
19	*Ammonia dentata*	10	12	7	9	4	5
20	*Spirillina limbata*	4	5	6	7	3	6
21	*Spiroloculina* sp.	5	6	3	5	2	4
22	*Textularia agglutinans*	7	8	4	6	3	5
23	*Triloculina austriaca*	8	9	6	7	4	7
	Cumacea						
1	*Campylaspis* sp.	*	2	4	5	3	7
2	*Gynodiastylis* sp.	*	*	3	6	*	*
3	*Nannastacus* sp.	3	5	*	*	4	6
4	*Picrocuma* sp.	*	*	7	9	*	*
	Harpacticoids						
1	*Canuella* sp.	9	11	5	7	4	5
2	*Cervinia* sp.	4	5	*	*	5	6
3	*Diarthrodes* sp.	6	8	4	5	3	4
4	*Euterpina acutifrons*	8	9	3	6	4	5
5	*Laophonte thoracica*	5	6	4	5	5	6
6	*Macrosetella* sp.	6	10	6	9	4	5
7	*Stenhelia* sp.	4	5	6	8	4	6
	Ostrocodes						
1	*Conchoecia* sp.	9	11	3	5	6	9
2	*Cypridina* sp.	4	5	*	*	7	8
3	*Leptocythere* sp.	*	*	5	7	*	*
4	*Tanella indica*	5	6	*	*	3	5
	Archiannelid						
1	*Protodrilus helgolandicus*	3	5	*	*	2	4
2	*Protodrilus brevis*	4	6	4	5	*	*
	Tanaidacea						
1	*Heterotanais oerstedi*	2	5	*	*	6	9
2	*Apseudes setosus*	6	8	4	5	3	7
	Total	**298**	**392**	**278**	**357**	**260**	**369**

** - Organisms not present*

APPENDIX E
FLORA & FAUNA SURVEY RESULTS

Appendix E List of Flora & Fauna in Uttara Kannada District based on Secondary Data

Table E-1: List of plant species and their status

S.no	Name of plant species	Family	Habit	IUCN/ WPA Status
1.	*Acacia concinna*	*Mimoseae*	liana	
2.	*Achronychia pedunculata*	*Rutaceae*	tree	
3.	*Actinodaphne hookeri*	*Lauraceae*	tree	
4.	*Adenia hondala*	*Passifloraceae*	climber	Vulnerable
5.	*Adiantum sp.*	*Adiantaceae*	(fern)	
6.	*Ageratum conyzoides*	*Asteraceae*	Herb	
7.	*Aglaia roxbhurgiana*	*Meliaceae*	tree	
8.	*Agrostistachys longifolius*	*Euphorbiaceae*	shrub	
9.	*Ailanthus malabarica*	*Simarubaceae*	tree	
10.	*Alangium salvifolium*	*Alangiaceae*	shrub	
11.	*Albizzia odoratissima*	*Papilionaceae*	tree	
12.	*Allophyllus cobbe*	*Sapindaceae*	shrub	
13.	*Alpinia galang*	*Zingeberaceae*	Herb	
14.	*Alseodaphne semicarpifolia*	*Lauraceae*	tree	
15.	*Alstonia scholaris*	*Apocynaceae*	tree	
16.	*Amphelocissus tomentosa*	*Vitaceae*	climber	
17.	*Anamirta cocculus*	*Menispermaceae*	climber	
18.	*Ancistocladus heynianus*	*Ansistrocladacea*	shrub	
19.	*Antidesma menasu*	*Euphorbiaceae*	shrub	
20.	*Apama siliquosa*	*Aristolocaeae*	shrub	
21.	*Apananthe cuspidata*	*Meliaceae*	tree	
22.	*Aphanomixis polystachy*	*Meliaceae*	tree	Vulnerable
23.	*Aporosa lindleyana*	*Euphorbiaceae*	tree	
24.	*Archieodendron monodelphum*	*Papilionaceae*	tree	
25.	*Ardesia solanaceae*	*Myrsinaceae*	shrub	
26.	*Arenga wightii*	*Palmae*	palm	
27.	*Argeria nervosa*	*Convolvulaceae*	climber	
28.	*Aristolochia tagala*	*Aristolocaeae*	climber	Vulnerable
29.	*Artabotrys odoratissima*	*Anonaceae*	shrub	
30.	*Artocarpus heterophyllus*	*Moraceae*	tree	
31.	*Artocarpus hirsutus*	*Moraceae*	tree	
32.	*Asparagus racemosus*	*Liliaceae*	tree	
33.	*Atlantia racemosa*	*Rutaceae*	ree	
34.	*Beilschmedia wighti*	*Lauraceae*	herb	
35.	*Bigonia sp.*	*Bigoniaceae*	tree	
36.	*Bischofia javanica*	*Euphorbiaceae*	orchid	
37.	*Bombax ceiba*	*Malvaceae*	palm	
38.	*Bridelia scandens*	*Euphorbiaceae*	liana	
39.	*Bulbophylum sp.*	*Orchidaceae*	tree	
40.	*Calamus thwitessii*	*Palmae*	tree	
41.	*Calicarpa tomentosa*	*Verbinaceae*	shrub	
42.	*Calicopteris floribonda*	*Combretaceae*	tree	
43.	*Calophylum apetalum*	*Clusiaceae*	climber	
44.	*Calophylum tomentosum*	*Clusiaceae*	shrub	
45.	*Calotropis gigantea*	*Asclapiadaceae*	shrub	
46.	*Canarium strictum*	*Simarubaceae*	tree	
47.	*Canthium angustifolium*	*Rubiaceae*	tree	
48.	*Canthium dicoccum*	*Rubiaceae*	shrub	
49.	*Capparis heyneana*	*Capparidaceae*	palm	
50.	*Caralia brachiata*	*Rhizoporaceae*	tree	

S.no	Name of plant species	Family	Habit	IUCN/ WPA Status
51.	*Careya arborea*	*Myrtaceae*	shrub	
52.	*Carissa carandus*	*Apocynaceae*	herb	
53.	*Caryota urens*	*Palmae*	shrub	
54.	*Casearia ovata*	*Flacourtiaceae*	tree	
55.	*Casereia rubicans*	*Flacourtiaceae*	tree	
56.	*Cassia tora*	*Papilionaceae*	tree	
57.	*Cassine glauca*	*Celastraceae*	tree	
58.	*Cayratala sps.*	*Vitaccae*	climber	
59.	*Celastrus paniculatus*	*Celastraceae*	climber	Lower Risk / Near Threatened
60.	*Celtis philiphinensis*	*Urticaceae*	tree	
61.	*Centela asiatica*	*Umbelliferae*	herb	
62.	*Chassalia curviflora*	*Rubiaceae*	shrub	
63.	*Chassalia ophioxyloides*	*Rubiaceae*	herb	
64.	*Chenomorpha fragrans*	*Apocynaceae*	liana	Endangered
65.	*Chilocarpus atriviridis*	*Apocynaceae*	climber	
66.	*Chionanthus malabarica*	*Oleaceae*	tree	
67.	*Chromolina oderata*	*Asteraceae*	herb	
68.	*Chrysophyllum lanceolatum*	*Sapotaceae*	tree	
69.	*Cinnamomum malabathrum*	*Lauraceae*	tree	Vulnerable
70.	*Cissus javanica*	*Vitaceae*	climber	
71.	*Clausena wildenovii*	*Rutaceae*	tree	
72.	*Cleidon speciform*	*Euphorbiaceae*	tree	
73.	*Clematis gouriana*	*Rananculaceae*	climber	
74.	*Clerodendron viscosum*	*Verbinaceae*	herb	
75.	*Combretum latifolium*	*Combretaceae*	liana	
76.	*Combretum ovalifolium*	*Combretaceae*	liana	
77.	*Connarus wighti*	*Combretaceae*	shrub	
78.	*Croton malabaricus*	*Euphorbiaceae*	shrub	
79.	*Curcuma Spp.*	*Zingeberaceae*	herb	
80.	*Cyclea peltata*	*Menispermaceae*	climber	
81.	*Cymbidium biclor*	*Orchidaceae*	orchid	
82.	*Cyperus rotundus, Linn*	*Cyperaceae*	grass	
83.	*Dalbergia horrida*	*Papilionaceae*	liana	
84.	*Dalbergia rubiginosa*	*Papilionaceae*	liana	
85.	*Dalberiga tamerindifola*	*Papilionaceae*	liana	
86.	*Debregasea longifolia*	*Urticaceae*	shrub	
87.	*Delinia pentagyna*	*Dilliniaceae*	tree	
88.	*Dendrobium macrostachy*	*Orchidaceae*	herb	
89.	*Dendrobium Spp.*	*Orchidaceae*	orchid	
90.	*Derris scandens*	*Papilionaceae*	liana	
91.	*Derris uliginosa*	*Papilionaceae*	liana	
92.	*Desmodium triquetrum*	*Papilionaceae*	herb	
93.	*Desmos lawii*	*Anonaceae*	shrub	
94.	*Dimocarpus longan*	*Sapotaceae*	tree	
95.	*Dimorphocalyx beddomei*	*Euphorbiaceae*	tree	
96.	*Dioscorea bulbifera*	*Dioscoriaceae*	climber	
97.	*Dioscorea oppositifolia*	*Dioscoriaceae*	climber	
98.	*Diospyros buxifolia*	*Ebenaceae*	tree	
99.	*Diospyros candolleana*	*Ebenaceae*	tree	Vulnerable
100.	*Diospyros crumenata*	*Ebenaceae*	tree	
101.	*Diospyros oocarpa*	*Ebenaceae*	tree	
102.	*Diospyros paniculata*	*Ebenaceae*	tree	Vulnerable
103.	*Diospyros pruriens*	*Ebenaceae*	tree	
104.	*Diploclisia glaucansis*	*Menispermaceae*	climber	

S.no	Name of plant species	Family	Habit	IUCN/ WPA Status
105.	Diploclisia palmatus	Cucurbitaceae	climber	
106.	Dipterocarpus indicus	Dipterocarpaceae	tree	Endangered
107.	Dracena terniflora	Liliaceae	Herb	
108.	Drypetes confertiflorus	Euphorbiaceae	Tree	
109.	Dysoxylum malabaricum	Meliaceae	tree	Endangered
110.	Elatostemma lineolatum	Urticaceae	herb	
111.	Eleagnus conferta	Eleagnaceae	shrub	
112.	Eleocarpus serratus	Urticaceae	tree	
113.	Elephantophus scaber	Asteraceae	herb	
114.	Embelia ribes	Myrsinaceae	liana	
115.	Embelia tsjeriun -cottam	Myrsinaceae	shrub	Vulnerable
116.	Emelia sonchifolia	Asteraceae	herb	Vulnerable
117.	Epiprinus malotoformis	Euphorbiaceae	shrub	
118.	Eranthemum sps.	Acanthaceae	herb	
119.	Erycibe paniculata var. wightiana	Convolvulaceae	climber	
120.	Eryciebe paniculata	Convolvulaceae	climber	
121.	Eugenia macreocephala	Myrtaceae	shrub	
122.	Euodia-luna anakanda	Rutaceae	tree	
123.	Euonymus indica	Celastraceae	tree	
124.	Euphorbia hirta	Euphorbiaceae	herb	
125.	Ficus callosa	Moraceae	tree	
126.	Ficus drupacea	Moraceae	tree	
127.	Fucyus heterophyla	Moraceae	tree	
128.	Ficus hispida	Moraceae	tree	
129.	Ficus nervosa	Moraceae	tree	
130.	Ficus racemosa	Moraceae	tree	
131.	Flacourtia montana	Flacortiaceae	tree	
132.	Flacourtia sepiaria	Flacortiaceae	shrub	
133.	Garcinia gummi-gatta	Clusiaceae	tree	Lower Risk / Near Threatened
134.	Garcinia morella	Clusiaceae	tree	Vulnerable
135.	Garcinia talbotii	Clusiaceae	tree	
136.	Glochidion mlabaricum	Euphorbiaceae	shrub	
137.	Glochidion velutinum	Euphorbiaceae	tree	
138.	Glycosmis pentaphylla	Rutaceae	shrub	
139.	Gnetum ula	Gnetaceae	liana	
140.	Gomphandra tetrandra	Icacinaceae	shrub	
141.	Goniothalamus cardiopetalus	Anonaceae	shrub	
142.	Gouania microcarpa	Rhamnaceae	liana	
143.	Gymnocranthera canarica	Myristicaceae	tree	Vulnerable
144.	Gymnostachium sp.	Acanthaceae	herb	
145.	Hemidesmus indica	Apocynaceae	climber	
146.	Hibiscus furcatus	Malvaceae	shrub	
147.	Hippocrateya grahami	Hippocrataceae	liana	
148.	Holigarna arnottiana	Anacardiaceae	tree	
149.	Holigarna grahami	Anacardiaceae	tree	
150.	Homalium zeylanica	Flacourtiaceae	tree	
151.	Hopea ponga	Dipterocarpaceae	tree	
152.	Hoya ovalifolia	Asclapiadaceae	climber	
153.	Hydnocarpus pentadra	Flacourtiaceae	tree	Vulnerable
154.	Hyminodictyon obvatum	Rubiaceae	tree	
155.	Ichinocarpus fruitiscence	Apocynaceae	climber	
156.	Ixora brachiata	Rubiaceae	shrub	
157.	Ixora lanceolata	Rubiaceae	shrub	
158.	Ixora nigricans	Rubiaceae	shrub	

S.no	Name of plant species	Family	Habit	IUCN/ WPA Status
159.	*Ixora polyantha*	*Rubiaceae*	shrub	
160.	*Jasminum malabaricum*	*Oleaceae*	climber	
161.	*Knema attenuata*	*Myristicaceae*	tree	Lower Risk / Near Threatened
162.	*Lagestroemia lanceolata*	*Lythraceae*	tree	
163.	*Lansium annamalayanum*	*Meliaceae*	tree	
164.	*Leea indica*	*Leeaceae*	shrub	
165.	*Legenandra sp*	*Araceae*	herb	
166.	*Litsea floribunda*	*Lauraceae*	tree	
167.	*Litsea mysorense*	*Lauraceae*	tree	
168.	*Lobelia nicotifoliana*	*Lobeliaceae*	herb	
169.	*Lophopetalm whightianum*	*Celastraceae*	tree	
170.	*Luvanga sarmentosa*	*Rutaceae*	climber	
171.	*Macaranga peltata*	*Euphorbiaceae*	tree	
172.	*Madhuca neerifolia*	*Sapotaceae*	tree	Vulnerable
173.	*Mallotus philippinensis*	*Euphorbiaceae*	tree	
174.	*Mallotus stananthus*	*Euphorbiaceae*	shrub	
175.	*Mallotus tetracaucus*	*Euphorbiaceae*	tree	
176.	*Mangifera indica*	*Anacardiaceae*	tree	
177.	*Margaratiera indica*	*Euphorbiaceae*	tree	
178.	*Maytenus rothiana*	*Celastraceae*	shrub	
179.	*Melastoma malabathrum*	*Melastomaceae*	herb	
180.	*Memecylon malabaricum*	*Melastomaceae*	shrub	
181.	*Memecylon terminale*	*Melastomaceae*	shrub	
182.	*Memecylon umbelatum*	*Melastomaceae*	tree	
183.	*Mesa indica*	*Myrsinaceae*	shrub	
184.	*Mesua ferrea*	*Clusiaceae*	tree	
185.	*Meyna Laxiflora*	*Rubiaceae*	tree	
186.	*Mimosa pudica*	*Mimoseae*	herb	
187.	*Mimusops elengi*	*Sapotaceae*	tree	
188.	*Molluva spicata*	*Papilionaceae*	climber	
189.	*Morinda citrifolia*	*Rubiaceae*	shrub	
190.	*Musenda frondosa*	*Rubiaceae*	shrub	
191.	*Myristica dactyloides*	*Myristicaceae*	tree	Vulnerable
192.	*Myristica fetua*	*Myristicaceae*	tree	
193.	*Myristica malabarica*	*Myristicaceae*	tree	Vulnerable
194.	*Neolitsea zeylanica*	*Lauraceae*	tree	
195.	*Nergamia alata*	*Rutaceae*	herb	
196.	*Nothapodytes nimmoniana*	*Icacinaceae*	shrub	Endangered
197.	*Nothopegia racemosa*	*Anacardiaceae*	tree	
198.	*Oberonia sp.*	*Orchidaceae*	orchid	
199.	*Ochlandra rheedi*	*Graminae*	grass	
200.	*Olea dioca*	*Oleaceae*	tree	
201.	*Ophiorhiza mungo*	*Rubiaceae*	herb	
202.	*Ophiorhiza pumila*	*Rubiaceae*	herb	
203.	*Osyris arborea*	*Santalaceae*	shrub	
204.	*Oxalis corniculata*	*Oxalidaceae*	herb	
205.	*Palaquium ellepticum*	*Apocynaceae*	tree	
206.	*Palidata pallida*	*Orchidaceae*	Herb	
207.	*Pandanus tectorius*	*Pandanaceae*	shrub	
208.	*Peramigyna monophlly*	*Rutaceae*	shrub	
209.	*Persea macrantha*	*Lauraceae*	tree	Endangered
210.	*Pinanga dicksonii*	*Palmae*	palm	
211.	*Piper sps*	*Pipreraceae*	herb	
212.	*Polyaithia fragrans*	*Anonaceae*	tree	

S.no	Name of plant species	Family	Habit	IUCN/ WPA Status
213.	*Pongamia pinnata*	*Papilionaceae*	tree	
214.	*Pothos scandans*	*Araceae*	climber	
215.	*Psychotria dalzelli*	*Rubiaceae*	shrub	
216.	*Psychotria flavida*	*Rubiaceae*	shrub	
217.	*Psychotria nigra*	*Rubiaceae*	shrub	
218.	*Pterocarpus marsupium*	*Papilionaceae*	tree	
219.	*Pterospermum diversifolium*	*Teliaceae*	tree	
220.	*Pterospermum reticulatum*	*Teliaceae*	tree	
221.	*Randia dumentorum*	*Rubiaceae*	tree	
222.	*Randia rugulosa*	*Rubiaceae*	climber	
223.	*Rhyncostylis tomentosum*	*Orchidaceae*	herb	
224.	*Rubia cordifolia*	*Rubiaceae*	climber	
225.	*Rubus fockei*	*Rosaceae*	climber	
226.	*Saraca asoca*	*Papilionaceae*	tree	
227.	*Scheflera venulosa*	*Araliaceae*	climber	
228.	*Semicarpus kathlekanensis*	*Anacardiaceae*	tree	Critically Endangered
229.	*Smilax zeylanica*	*Smalacaeae*	climber	Lower Risk / Near Threatened
230.	*Solanum xanthocarpum*	*solanaceae*	shrub	
231.	*Sterculia guttata*	*Sterculiaceae*	tree	
232.	*Strereospermum personatum*	*Bignoniaceae*	tree	
233.	*Strobilanthus Spp.*	*Acanthaceae*	hrub	
234.	*Strombosea zeylanica*	*Olacaceae*	tree	
235.	*Strychnos walichiana*	*Loganiaceae*	shrub	
236.	*Stmplocos racemosa*	*Symplocaceae*	tree	
237.	*Synadeniurm grahami*	*Euphorhiaceae*	shrub	
238.	*Syzygium caryophylatum*	*Myrtaceae*	tree	
239.	*Syzygium cumuni*	*Myrtaceae*	tree	
240.	*Syzygium gardneri*	*Myrtaceae*	tree	
241.	*Syzygium hemispericum*	*Myrtaceae*	tree	
242.	*Syzygium laetum*	*Myrtaceae*	tree	
243.	*Syzygium zeylanica*	*Myrtaceae*	tree	
244.	*Taebernmontana heyniana*	*Apocynaceae*	tree	
245.	*Terminalia paniculata*	*Combretaceae*	tree	
246.	*Tetrameles nudiflora*	*Dasticaceae*	tree	
247.	*Thunbergia fragrans*	*Thunbergiaceae*	tree	
248.	*Toddelia asiatica*	*Rutaceae*	climber	
249.	*Tragia hispida*	*Urticaceae*	climber	
250.	*Trema orientalis*	*Urticaceae*	tree	
251.	*Trichelia connaroides*	*Papilionaceae*	tree	
252.	*Tridax procumbens*	*Asteraceae*	Herb	
253.	*Uvaria narum*	*Anonaceae*	shrub	
254.	*Vateria indica*	*Dipterocarpaceae*	tree	Critically Endangered
255.	*Venda Sp.*	*Orchidaceae*	orchid	
256.	*Ventilago calculeata*	*Rhamnaceae*	shrub	
257.	*Ventilago maderaspatensis*	*Rhamnaceae*	shrub	
258.	*Vepris bilocularis*	*Rutaceae*	tree	
259.	*Vitex altissima*	*Verbinaceae*	tree	
260.	*Vitis discolor*	*Vitaceae*	climber	
261.	*Walsura trifolia*	*Meliaceae*	tree	
262.	*Wendlandia thyrsoides*	*Rubiaceae*	shrub	
263.	*Xanthophlum flavoscens*	*Xanthophyllaceae*	shrub	
264.	*Xantolis tomentosa*	*Sapotaceae*	tree	

S.no	Name of plant species	Family	Habit	IUCN/ WPA Status
265.	*Zanthoxylum ovalifolium*	*Rutaceae*	shrub	
266.	*Zingeber cervunum*	*Zingeberaceae*	Herb	
267.	*Zizyphus oenoplia*	*Rhamnaceae*	shrub	
268.	*Zizyphus rugosa*	*Rhamnaceae*	Herb	
269.	*Avicennia alba*	*Avicenniaceae*	mangrove	
270.	*Avicennia marina*	*Avicenniaceae*	mangrove	
271.	*Avicennia officinalis*	*Avicenniaceae*	mangrove	
272.	*Rhizophora apiculata*	*Rhizophoraceae*	mangrove	
273.	*Rhizophora mucronata*	*Rhizophoraceae*	mangrove	
274.	*Excoecaria agallocha*	Euphorbiaceae	mangrove	

Table E-2: List Of Amphibians (Frogs) Reported To Occur In Uttara Kannada District

S.No	Family	Scientific Name	Endemiic
1	*Icthyophiidae*	*Ichthyophis bombayensis*	Yes
2	*Icthyophiidae*	*Ichthyophis malabarensis*	No
3	*Bufonidae*	*Duttaphyrnus melanostictus*	Yes
4	*Bufonidae*	*Pedostibes tuberculosus*	No
5	*Microhylidae*	*Microhyla ornate*	No
6	*Microhylidae*	*Microhyla rubra*	Yes
7	*Micrixalidae*	*Micrixalus saxicola*	Yes
8	*Ranixalidae*	*Indirana beddomii*	Yes
9	*Ranixalidae*	*Indirana semipalmata*	No
10	*Dicroglossidae*	*Euphlyctis cyanophlyctis*	Yes
11	*Dicroglossidae*	*Fejervarya brevipalmata*	Yes
12	*Dicroglossidae*	*Fejervarya caperata*	Yes
13	*Dicroglossidae*	*Fejervarya granosa*	Yes
14	*Dicroglossidae*	*Fejervarya kudremukhensis*	Yes
15	*Dicroglossidae*	*Fejervarya mudduraja*	Yes
16	*Dicroglossidae*	*Fejervarya rufescens*	No
17	*Dicroglossidae*	*Fejervarya sahyadris*	Yes
18	*Dicroglossidae*	*Hoplobatrachus tigerinus*	Yes
19	*Dicroglossidae*	*Sphaerotheca leucorhyncus*	No
20	*Dicroglossidae*	*Sphaerotheca breviceps*	Yes
21	*Rhacophoridae*	*Philautus cf. bombayensis*	Yes
22	*Rhacophoridae*	*Philautus neelanethrus*	Yes
23	*Rhacophoridae*	*Philautus cf. ponmu*	Yes
24	*Rhacophoridae*	*Philautus cf. tuberohumerus*	Yes
25	*Rhacophoridae*	*Philautus cf. wynaadensis*	Yes
26	*Nyctibatrachidae*	*Polypedates maculates*	No
27	*Nyctibatrachidae*	*Polypedates cf. pseudocruciger*	Yes
28	*Nyctibatrachidae*	*Rhacophorus malabaricus*	Yes
29	*Nyctibatrachidae*	*Nyctibatrachus cf. aliciae*	Yes
30	*Nyctibatrachidae*	*Nyctibatrachus cf. humayuni*	Yes
31	*Nyctibatrachidae*	*Nyctibatrachus cf. major*	Yes

S.No	Family	Scientific Name	Endemic
32	*Nyctibatrachidae*	*Nyctibatrachus cf. petraeus*	Yes
33	*Ranidae*	*Clinotarsus curtipes*	No
34	*Ranidae*	*Sylvirana aurantiaca*	Yes
35	*Ranidae*	*Sylvirana temporalis*	No

Table E-3: List Of Avian Fauna (Birds) Reported From The Project influenced area

S.No	Common name	Scientific Name	Conservation Status
1	Grey Junglefowl	*Gallus sonneratii*	
2	Indian Peafowl	*Pavo cristatus*	
3	Lesser Whistling-duck	*Dendrocygna javanica*	
4	Grey-capped Pygmy Woodpecker	*Dendrocopos canicapillus*	
5	White-bellied Woodpecker	*Dryocopus javensis*	
6	Lesser Yellownape	*Picus chlorolophus*	
7	Common Flameback	*Dinopium javanense*	
8	Greater Flameback	*Chrysocolaptes lucidus*	
9	Heart-spotted Woodpecker	*Hemicircus canente*	
10	White-cheeked Barbet	*Megalaima viridis*	
11	Brown headed Barbet	*Megalaima zeylanica*	
12	Crimson-fronted Barbet	*Megalaima rubricapilla*	
13	Coppersmith Barbet	*Megalaima haemacephala*	
14	Malabar Grey Hornbill	*Ocyceros griseus*	Range Restricted, Endemic
15	Great Hornbill	*Buceros bicornis*	
16	Malabar Pied Hornbill	*Anthracoceros coronatus*	
17	Common Hoopoe	*Upupa epops*	
18	Malabar Trogon	*Harpactes fasciatus*	
19	Indian Roller	*Coracias benghalensis*	
20	Common Kingfisher	*Alcedo atthis*	
21	Blue eared Kingfisher	*Alcedo meninting*	
22	Stork-billed Kingfisher	*Halcyon capensis*	
23	White-throated Kingfisher	*Halcyon smyrnensis*	
24	Pied Kingfisher	*Ceryle rudis*	
25	Blue-bearded Bee-eater	*Nyctyornis athertoni*	
26	Green Bee-eater	*Merops orientalis*	
27	Blue-tailed Bee-eater	*Merops philippinus*	
28	Chestnut-headed Bee-eater	*Merops leschenaulti*	
29	Common Hawk Cuckoo	*Hierococcyx varius*	
30	Indian Cuckoo	*Cuculus micropterus*	
31	Banded Bay Cuckoo	*Cacomatis sonnerati*	
32	Asian Koel	*Eudynamys scolopacea*	
33	Greater Coucal	*Centropus sinensis*	
34	Vernal Hanging Parrot	*Loriculus vernalis*	
35	Rose-ringed Parakeet	*Psittacula krameri*	
36	Plum-headed Parakeet	*Psittacula cyanocephala*	

S.No	Common name	Scientific Name	Conservation Status
37	Blue winged Parakeet	*Psittacula columboides*	Range Restricted, Endemic
38	Asian Palm Swift (Palm Swift)	*Cypsiurus balasiensis*	
39	Alpine Swift	*Tachymarptis melba*	
40	Crested Treeswift	*Hemiprocne coronata*	
41	Rock Eagle Owl	*Bubo bubo bengalensis*	
42	Spot belied Eagle Owl	*Bubo nipalensis*	
43	Brown Wood Owl	*Strix leptogrammica*	
44	Sri Lankan Bay Owl	*Phodilus assimilis*	
45	Sri Lanka Frogmouth	*Batrachostomus moniliger*	
46	Grey Nightjar	*Caprimulgus indicus*	
47	Rock pigeon	*Columba livia*	
48	Oriental Turtle Dove	*Streptopelia orientalis*	
49	Spotted Dove	*Streptopelia chinensis*	
50	Emerald Dove	*Chalcophaps indica*	
51	Pompadour Green Pigeon	*Treron pompadora*	
52	Yellow-footed Green Pigeon	*Treron phoenicoptera*	
53	Green Imperial Pigeon	*Ducula aenea*	
54	Mountain Imperial Pigeon	*Ducula badia*	
55	White-breasted Waterhen	*Amaurornis phoenicurus*	
56	Purple Swamphen	*Porphyrio porphyrio*	
57	Common Coot	*Fulica atra*	
58	Bronze-winged Jacana	*Metopidius indicus*	
59	Pheasant tailed Jacana	*Hydrophasianus chirurgus*	
60	Red-wattled Lapwing	*Vanellus indicus*	
61	Oriental Honey-buzzard	*Pernis ptilorhyncus*	
62	Black Kite	*Milvus migrans*	
63	Brahminy Kite	*Haliastur indus*	
64	Crested Serpent Eagle	*Spilornis cheela*	
65	Shikra	*Accipiter badius*	
66	Besra	*Accipiter virgatus*	
67	Eurasian Sparrowhawk	*Accipiter nisus*	
68	Crested Goshawk	*Accipiter trivirgatus*	
69	White-eyed Buzzard	*Butastur teesa*	
70	Black Eagle	*Ictinaetus malayensis*	
71	Rufous-bellied Eagle	*Hieraaetus kienerii*	
72	Common Kestrel	*Falco tinnunculus*	
73	Peregrine Falcon	*Falco peregrinus*	
74	Little Grebe	*Tachybaptus ruficollis*	
75	Darter	*Anhinga melanogaster*	Near Threatened
76	Little Cormorant	*Phalacrocorax niger*	
77	Great Egret	*Casmerodius albus*	
78	Intermediate egret	*Mesophyx intermedia*	
79	Little egret	*Egretta garzetta*	

S.No	Common name	Scientific Name	Conservation Status
80	Cattle Egret	*Bubulcus ibis*	
81	Indian Pond Heron	*Ardeola grayii*	
82	Little Heron	*Butorides striatus*	
83	Black-crowned Night Heron	*Nycticorax nycticorax*	
84	Oriental White Ibis	*Threskiornis melanocephalus*	Near Threatened
85	Woolly-necked Stork	*Ciconia episcopus*	
86	Painted Stork	*Mycteria leucocephala*	Near Threatened
87	Lesser Adjutant Stork	*Leptoptilos javanicus*	Vulnerable
88	Asian Fairy Bluebird	*Irena puella*	
89	Blue-winged Leafbird	*Chloropsis cochinchinensis*	
90	Golden-fronted Leafbird	*Chloropsis aurifrons*	
91	Brown Shrike	*Lanius cristatus*	
92	Long-tailed Shrike	*Lanius schach*	
93	Rufous Treepie	*Dendrocitta vagabunda*	
94	White-bellied Treepie	*Dendrocitta leucogastra*	Range Restricted, Endemic
95	House Crow	*Corvus splendens*	
96	Large-billed Crow	*Corvus macrorhynchos*	
97	Ashy Woodswallow	*Artamus fuscus*	
98	Eurasian Golden Oriole	*Oriolus oriolus*	
99	Black-hooded Oriole	*Oriolus xanthornus*	
100	Black-headed Cuckooshrike	*Coracina melanoptera*	
101	Small Minivet	*Pericrocotus cinnamomeus*	
102	Scarlet Minivet	*Pericrocotus flammeus*	
103	Bar-winged Flycatcher-shrike	*Hemipus picatus*	
104	White-browed Fantail	*Rhipidura aureola*	
105	Black Drongo	*Dicrurus macrocercus*	
106	Ashy Drongo	*Dicrurus leucophaeus*	
107	White-bellied Drongo	*Dicrurus caerulenses*	
108	Bronzed Drongo	*Dicrurus aeneus*	
109	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	
110	Black-naped Monarch	*Hypothymis azurea*	
111	Asian Paradise-flycatcher	*Terpsiphone paradisi*	
112	Common Iora	*Aegithina tiphia*	
113	Large Woodshrike	*Tephrodornis gularis*	
114	Common Woodshrike	*Tephrodornis pondicerianus*	
115	Blue-capped Rock Thrush	*Monticola cinclorhynchus*	
116	Blue Rock Thrush	*Monticola solitarius*	
117	Malabar Whistling Thrush	*Myophonus horsfieldii*	
118	White-throated Thrush	*Zoothera citrina cyanotus*	
119	Eurasian Blackbird	*Turdus merula*	
120	Asian Brown Flycatcher	*Muscicapa dauurica*	
121	Red-throated Flycatcher	*Ficedula parva*	
122	Verditer Flycatcher	*Eumyias thalassina*	

S.No	Common name	Scientific Name	Conservation Status
123	White-bellied Blue Flycatcher	*Cyornis pallipes*	Range Restricted, Endemic
124	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	
125	Oriental Magpie Robin	*Copsychus saularis*	
126	White-rumped Shama	*Copsychus malabaricus*	
127	Chestnut-tailed Starling	*Sturnus malabaricus*	
128	White-headed Starling	*Sturnus erythropygius*	
129	Brahminy Starling	*Sturnus pagodarum*	
130	Common Myna	*Acridotheres tristis*	
131	Jungle Myna	*Acridotheres fuscus*	
132	Hill Myna	*Gracula religiosa*	
133	Velvet-fronted Nuthatch	*Sitta frontalis*	
134	Great Tit	*Parus major*	
135	Black-lored Tit	*Parus xanthogenys*	
136	Dusky Crag Martin	*Hirundo concolor*	
137	Barn Swallow	*Hirundo rustica*	
138	Wire-tailed Swallow	*Hirundo smithii*	
139	Red-rumped Swallow	*Hirundo daurica*	
140	Northern House Martin	*Delichon urbica*	
141	Black-crested Bulbul	*Pycnonotus melanicterus gularis*	
142	Red-whiskered Bulbul	*Pycnonotus jocosus*	
143	Red-vented Bulbul	*Pycnonotus cafer*	
144	Yellow-browed Bulbul	*Iole indica*	
145	Grey headed Bulbul	*Pycnotus priocephalus*	Range Restricted, Endemic
146	Black Bulbul	*Hypsipetes leucocephalus*	
147	Ashy Prinia	*Prinia socialis*	
148	Oriental White-eye	*Zosterops palpebrosus*	
149	Blyth's Reed Warbler	*Acrocephalus dumetorum*	
150	Thick-billed Warbler	*Acrocephalus aedon*	
151	Common Tailorbird	*Orthotomus sutorius*	
152	Common Chiffchaff	*Phylloscopus collybita*	
153	Tickell's Leaf Warbler	*Phylloscopus affinis*	
154	Greenish Warbler	*Phylloscopus trochiloides*	
155	Indian Scimitar Babbler	*Pomatorhinus horsfieldii*	
156	Dark-fronted Babbler	*Rhopocichla atriceps*	
157	Rufous Babbler	*Turdoides subrufus*	Range Restricted, Endemic
158	Jungle Babbler	*Turdoides striatus*	
159	Brown-cheeked Fulvetta	*Alcippe poioicephala*	
160	Bengal Bushlark	*Mirafra assamica*	
161	Malabar Lark	*Galerida malabarica*	
162	Sykes Lark	*Galerida deva*	
163	Pale-billed Flowerpecker	*Dicaeum erythrorynchos*	
164	Thickbilled Flowerpeker	*Dicaeum agile*	

S.No	Common name	Scientific Name	Conservation Status
165	Plain Flowerpecker	*Dicaeum concolor*	
166	Purple-rumped Sunbird	*Nectarinia zeylonica*	
167	Purple Sunbird	*Nectarinia asiatica*	
168	Loten's Sunbird	*Nectarinia lotenia*	
169	Small Sunbird	*Nectarinia minima*	Range Restricted, Endemic
170	Little Spiderhunter	*Arachnothera longirostra*	
171	House Sparrow	*Passer domesticus*	
172	Chestnut-shouldered Petronia	*Petronia xanthocollis*	
173	Forest Wagtail	*Dendronanthus indicus*	
174	White-browed Wagtail	*Motacilla maderaspatensis*	
175	Citrine Wagtail	*Motacilla citreola*	
176	Yellow Wagtail	*Motacilla flava*	
177	Grey Wagtail	*Motacilla cinerea*	
178	Indian Silverbill	*Lonchura malabarica*	
179	White-rumped Munia	*Lonchura striata*	
180	Black-throated Munia	*Lonchura kelaarti*	
181	Scaly-breasted Munia	*Lonchura punctulata*	
182	Common Rosefinch	*Carpodacus erythrinus*	

Table E-4: List Of Mammals Reported to occur in the Project Affected Area

S.No	Common name	Scientific Name	Conservation Status
1	Hanuman langur	*Semnopithecus entellus*	Lower risk/ near Threatened
2	Lion-tailed macaque	*Macaca silenus*	Endangered
3	Bonnet macaque	*M. radiata*	
4	Slender loris	*Loris lydekkerianus*	
5	Tiger	*Panthera tigris*	Vulnerable
6	Leopard	*P. pardus*	Endangered
7	Jungle cat	*Felis chaus*	
8	Leopard cat	*Prionailurus bengalensis*	
9	Rusty spotted cat	*P. rubiginosa*	
10	Dhole	*Cuon alpinus*	Vulnerable
11	Golden jackal	*Canis aureus*	Vulnerable
12	Small Indian civet	*Viverricula indica*	
13	Malabar civet	*V. civettina*	
14	Asian palm civet	*Paradoxurus hermophroditus*	Critically Endangered
15	Brown palm civet	*P. jerdoni*	
16	Brown mongoose	*Herpestes fuscus*	Vulnerable
17	Stripe-necked mongoose	*H. vitticollis*	Data deficient
18	Common mongoose	*H. edwardsi*	
19	Otter	*Lutra sp.*	
20	Nilgiri marten	*Martes gwatkinsi4*	
21	Malabar giant squirrel	*Ratufa indica4*	Vulnerable
22	Giant flying squirrel P	*Petaurista petaurista*	Vulnerable

S.No	Common name	Scientific Name	Conservation Status
23	Travancore flying squirrel	*Petinomys fuscocapillus*	lower risk/Near threatened
24	Muntjac	*Muntiacus muntjak*	Vulnerable
25	Chevrotain	*Tragulus meminna*	
26	Wild pig	*Sus scrofa*	
27	Sambar	*Cervus unicolor*	
28	Gaur	*Bos gaurus*	
29	Elephant	*Elephas maximus*	Vulnerable
30	Porcupine	*Hystrix indica*	Endangered
31	Pangolin	*Manis crassicaudata*	
32	Sloth bear	*Melursus ursinus*	lower risk/Near threatened
33	Black-naped hare	*Lepus nigricollis*	Vulnerable

Table E-5: Important Butterflies, reported in Honnavar region

S.No	Scientific Name
1.	Common Mime Common Jay
2.	Tailed Jay
3.	Common Bluebottle,
4.	Common Mormon
5.	Blue mormon
6.	Five-Bar Swordtail
7.	Malabar Branded Peacock,
8.	Red Helen, ,
9.	Giant Redeye Lime
10.	Common Palmfly, ,
11.	Common Sailer
12.	Short Banded Sailer
13.	Chestnut-streaked Sailer,
14.	Blackvein Sergeant,
15.	Indian Palm Bob Rustic,
16.	Chestnut Angle
17.	Tamil Yeoman
18.	Common Cerulean
19.	Western Centaur
20.	Oakblue
21.	Common Leopard
22.	Common cerulean
23.	Common Silverline,
24.	Common Banded Awl
25.	Large Oak Blue
26.	Brown Awl
27.	Water Snow Flat
28.	Grass Demon
29.	Common Baron
30.	Indian Palm Bob
31.	Conjoined Swift
32.	Common Branded Demon,
33.	Giant Red Eye,
34.	Dark Palm Dart
35.	Common Red Eye
36.	Chestnut Bob
37.	Paris Peacock
38.	Madras Ace

S.No	Scientific Name
39.	Indian Ace
40.	Great Evening Brown
41.	Common Emigrant, ,
42.	Three-spot Grass Yellow
43.	Mottled Emigrant
44.	Common Grass Yellow
45.	Three-spot Grass Yellow
46.	Common Hedge Blue
47.	Dark Cerulean
48.	Plains Cupid
49.	Common Sergeant
50.	Grey Count
51.	Baronet
52.	Redspot Duke
53.	Double-branded Crow
54.	Brown King Crow
55.	Banded Blue Pierrot
56.	Zebra Blue
57.	Malayan
58.	Plains Cupid
59.	Western Centaur Oakblue
60.	Large Oak Blue
61.	Long Banded Silverline
62.	Western Centaur Oakblue
63.	Common Mime Common Jay
64.	Tailed Jay
65.	Common Bluebottle, , ,
66.	Common Mormon
67.	Five-Bar Swordtail
68.	Plains Cupid
69.	Western Centaur Oakblue
70.	Large Oak Blue
71.	Long Banded Silverline
72.	Western Centaur Oakblue
73.	Plains Cupid

APPENDIX F
AIR QUALITY MONITORING RESULTS

Appendix F Ambient Air Quality Results

Table F-1: Air Quality Monitoring Results

Parameter	PM10				PM2.5				NO_2				SO_2				CO				O_3			
Monitoring Station & Category	No. of samples	Maximum ($\mu g/m^3$)	Minimum ($\mu g/m^3$)	Mean ($\mu g/m^3$)	No. of samples	Maximum ($\mu g/m^3$)	Minimum ($\mu g/m^3$)	Mean ($\mu g/m^3$)	No. of samples	Maximum ($\mu g/m^3$)	Minimum ($\mu g/m^3$)	Mean ($\mu g/m^3$)	No. of samples	Maximum ($\mu g/m^3$)	Minimum ($pg/\mu l$)	Mean ($\mu g/m^3$)	No. of samples	Maximum (mg/m^3)	Minimum (mg/m^3)	Mean ($\mu g/m^3$)	No. of samples	Maximum ($\mu g/m^3$)	Minimum ($\mu g/m^3$)	Mean ($\mu g/m^3$)
A1 (Residential)	26	65.6	42.5	55.9	26	35.4	21.2	27.7	26	23.8	18.4	21.3	26	8.2	5.9	7.0	26	<1.0	<1.0	<1.0	26	4.1	2.3	3.2
A2 (Residential)	26	54.9	36.9	46.0	26	26.8	19.3	22.9	26	18.2	16.2	17.1	26	6.9	5.1	5.9	26	<1.0	<1.0	<1.0	26	4.0	2.5	3.3
A3 (Residential)	26	27.1	19.6	24.0	26	21.5	10.3	12.6	26	12.4	10.0	11.2	26	5.9	4.2	5.0	26	<1.0	<1.0	<1.0	26	3.0	1.6	2.2
A4 (Residential)	26	23.6	19.2	21.7	26	11.6	9.6	10.6	26	9.4	8.2	8.7	26	4.8	4.1	4.4	26	<1.0	<1.0	<1.0	26	3.0	1.8	2.5
A5 (Residential)	26	24.6	18.6	21.2	26	12.2	8.9	10.4	26	8.6	7.6	8.2	26	4.6	4.0	4.3	26	<1.0	<1.0	<1.0	26	2.9	2.0	2.5
A6 (Residential)	26	29.4	21.3	25.6	26	16.9	12.0	14.1	26	12.6	10.1	11.3	26	4.6	4.1	4.3	26	<1.0	<1.0	<1.0	26	3.0	2.0	2.4

A1 – Honnavar

A2 – Kasarkod

A3 – Karki

A4 – Ramtirth

A5 – Kulkod

A6 – Hosad

Appendix G
Population Details

Appendix G Population & Socio-Economic Details of Honnavar

Table G-1: population details of settlements within 10km radius of Project site

S.no	Name	Level	Settlement type	No of households	Total population	Total male population	Total female population
1	Mundgod	Taluk	Total	17163	90738	48973	41765
2	Mundgod	Taluk	Rural	13852	74565	40643	33922
3	Mundgod	Taluk	Urban	3311	16173	8330	7843
4	Jaddigadde	Village	Rural	12	57	26	31
5	Kelginkeri	Village	Rural	68	377	206	171
6	Talgod	Village	Rural	185	917	453	464
7	Horbhag	Village	Rural	144	786	378	408
8	Hosad	Village	Rural	32	149	69	80
9	Santeguli	Village	Rural	135	708	347	361
10	Keremane	Village	Rural	118	576	285	291
11	Navilgone	Village	Rural	429	2061	1050	1011
12	Kadle	Village	Rural	355	1609	823	786
13	Haldipur	Village	Rural	2044	10132	5053	5079
14	Pavinakurve	Village	Rural	172	969	455	514
15	Karki	Village	Rural	1274	6007	3039	2968
16	Duggur	Village	Rural	55	291	149	142
17	Vandoor	Village	Rural	184	922	468	454
18	Nilkod	Village	Rural	189	797	395	402
19	Salkod	Village	Rural	910	4073	2064	2009
20	Hosakuli	Village	Rural	556	2660	1321	1339
21	Kasarkod	Village	Rural	1401	7604	3801	3803
22	Apsarkonda	Village	Rural	86	437	218	219
23	Hosapatna	Village	Rural	464	2484	1247	1237
24	Gunavante	Village	Rural	528	2639	1313	1326
25	Kelgin-Idgunji	Village	Rural	324	1534	759	775
26	Arolli-Mundagod	Village	Rural	164	782	394	388
27	Mavinkurva	Village	Rural	700	3348	1607	1741
28	Mandalakurve	Village	Rural	46	257	130	127
29	Nagre	Village	Rural	240	1210	607	603
30	Hadinbal	Village	Rural	439	2075	1036	1039
31	Hadgeri	Village	Rural	79	348	168	180
32	Honavar (TP)	Town	Urban	3750	17824	9006	8818
33	Honavar	Taluk	Total	32808	160331	80018	80313
34	Honavar	Taluk	Rural	29058	142507	71012	71495
35	Honavar	Taluk	Urban	3750	17824	9006	8818
36	Honavar (TP) - Ward No.1	Ward	Urban	238	1192	595	597
37	Honavar (TP) - Ward No.2	Ward	Urban	389	1798	893	905
38	Honavar (TP) - Ward No.3	Ward	Urban	102	474	243	231
39	Honavar (TP) - Ward No.4	Ward	Urban	390	1710	855	855
40	Honavar (TP) - Ward No.5	Ward	Urban	228	1026	510	516
41	Honavar (TP) - Ward No.6	Ward	Urban	275	1251	623	628
42	Honavar (TP) - Ward No.7	Ward	Urban	242	1196	636	560

S.no	Name	Level	Settlement type	No of households	Total population	Total male population	Total female population
43	Honavar (TP) - Ward No.8	Ward	Urban	250	1367	715	652
44	Honavar (TP) - Ward No.9	Ward	Urban	214	886	423	463
45	Honavar (TP) - Ward No.10	Ward	Urban	244	1217	616	601
46	Honavar (TP) - Ward No.11	Ward	Urban	186	989	488	501
47	Honavar (TP) - Ward No.12	Ward	Urban	155	724	371	353
48	Honavar (TP) - Ward No.13	Ward	Urban	143	745	388	357
49	Honavar (TP) - Ward No.14	Ward	Urban	194	947	484	463
50	Honavar (TP) - Ward No.15	Ward	Urban	190	904	451	453
51	Honavar (TP) - Ward No.16	WARD	Urban	138	586	302	284
52	Honavar (TP) - Ward No.17	WARD	Urban	172	812	413	399
53	Mugali	VILLAGE	Rural	11	49	26	23

Table G-2: Literacy Rate in PIA

S. no	Name	Level	Type	Literate population	Male literate population	Female literate population	Illiterate population	Male illiterate population	Female illiterate population
1	Mundgod	Taluk	Total	54452	33602	20850	36286	15371	20915
2	Mundgod	Taluk	Rural	43482	27489	15993	31083	13154	17929
3	Mundgod	Taluk	Urban	10970	6113	4857	5203	2217	2986
4	Jaddigadde	Village	Rural	28	16	12	29	10	19
5	Kelginkeri	Village	Rural	257	147	110	120	59	61
6	Talgod	Village	Rural	623	355	268	294	98	196
7	Horbhag	Village	Rural	564	301	263	222	77	145
8	Hosad	Village	Rural	78	42	36	71	27	44
9	Santeguli	Village	Rural	518	252	266	190	95	95
10	Keremane	Village	Rural	370	209	161	206	76	130
11	Honavar	Taluk	Total	106386	58179	48207	53945	21839	32106
12	Honavar	Taluk	Rural	92439	50734	41705	50068	20278	29790
13	Honavar	Taluk	Urban	13947	7445	6502	3877	1561	2316
14	Navilgone	Village	Rural	1453	820	633	608	230	378
15	Kadle	Village	Rural	1019	573	446	590	250	340
16	Haldipur	Village	Rural	6319	3532	2787	3813	1521	2292
17	Pavinakurve	Village	Rural	580	323	257	389	132	257
18	Karki	Village	Rural	4024	2235	1789	1983	804	1179
19	Duggur	Village	Rural	182	102	80	109	47	62
20	Vandoor	Village	Rural	738	384	354	184	84	100
21	Nilkod	Village	Rural	690	351	339	107	44	63
22	Salkod	Village	Rural	2823	1529	1294	1250	535	715
23	Hosakuli	Village	Rural	2040	1093	947	620	228	392

S. no	Name	Level	Type	Literate population	Male literate population	Female literate population	Illiterate population	Male illiterate population	Female illiterate population
24	Kasarkod	Village	Rural	4936	2696	2240	2668	1105	1563
25	Apsarkonda	Village	Rural	228	141	87	209	77	132
26	Hosapatna	Village	Rural	1571	888	683	913	359	554
27	Gunavante	Village	Rural	1747	956	791	892	357	535
28	Kelgin-idgunji	Village	Rural	1040	577	463	494	182	312
29	Arolli-mundagod	Village	Rural	525	282	243	257	112	145
30	Mavinkurva	Village	Rural	2280	1212	1068	1068	395	673
31	Mandalakurve	Village	Rural	173	100	73	84	30	54
32	Nagre	Village	Rural	821	449	372	389	158	231
33	Hadinbal	Village	Rural	1357	772	585	718	264	454
34	Hadgeri	Village	Rural	116	61	55	232	107	125
35	Honavar (tp)	Town	Urban	13947	7445	6502	3877	1561	2316
36	Honavar (tp) - ward no.1	Ward	Urban	904	474	430	288	121	167
37	Honavar (tp) - ward no.2	Ward	Urban	1429	764	665	369	129	240
38	Honavar (tp) - ward no.3	Ward	Urban	420	222	198	54	21	33
39	Honavar (tp) - ward no.4	Ward	Urban	1470	748	722	240	107	133
40	Honavar (tp) - ward no.5	Ward	Urban	807	415	392	219	95	124
41	Honavar (tp) - ward no.6	Ward	Urban	1048	529	519	203	94	109
42	Honavar (tp) - ward no.7	Ward	Urban	931	517	414	265	119	146
43	Honavar (tp) - ward no.8	Ward	Urban	1064	574	490	303	141	162
44	Honavar (tp) - ward no.9	Ward	Urban	755	375	380	131	48	83
45	Honavar (tp) - ward no.10	Ward	Urban	806	457	349	411	159	252
46	Honavar (tp) - ward no.11	Ward	Urban	595	329	266	394	159	235
47	Honavar (tp) - ward no.12	Ward	Urban	563	313	250	161	58	103
48	Honavar (tp) - ward no.13	Ward	Urban	540	305	235	205	83	122
49	Honavar (tp) - ward no.14	Ward	Urban	749	417	332	198	67	131
50	Honavar (tp) - ward no.15	Ward	Urban	705	378	327	199	73	126
51	Honavar (tp) - ward no.16	Ward	Urban	496	270	226	90	32	58
52	Honavar (tp) - ward no.17	Ward	Urban	665	358	307	147	55	92
53	Mugali	Village	Rural	10	9	1	39	17	22

Table G-3: Scheduled Caste & Scheduled Tribe Population in Project Impacted Atea

S. no	Name	Level	Settlement type	Population of scheduled castes	Male scheduled caste population	Female scheduled caste population	Scheduled tribe population	Male scheduled tribe population	Female scheduled tribe population
1	Mundgod	TALUK	Total	13601	6925	6676	3601	1869	1732
2	Mundgod	TALUK	Rural	10695	5489	5206	3286	1695	1591
3	Mundgod	TALUK	Urban	2906	1436	1470	315	174	141
4	Jaddigadde	VILLAGE	Rural	0	0	0	0	0	0
5	Kelginkeri	VILLAGE	Rural	0	0	0	0	0	0
6	Talgod	VILLAGE	Rural	40	18	22	0	0	0
7	Horbhag	VILLAGE	Rural	0	0	0	0	0	0
8	Hosad	VILLAGE	Rural	0	0	0	0	0	0
9	Santeguli	VILLAGE	Rural	5	2	3	0	0	0
10	Keremane	VILLAGE	Rural	41	24	17	30	14	16
11	Honavar	TALUK	Total	7250	3645	3605	268	130	138
12	Honavar	TALUK	Rural	6737	3405	3332	234	113	121
13	Honavar	TALUK	Urban	513	240	273	34	17	17
14	Navilgone	VILLAGE	Rural	172	83	89	0	0	0
15	Kadle	VILLAGE	Rural	101	50	51	0	0	0
16	Haldipur	VILLAGE	Rural	1018	555	463	2	1	1
17	Pavinakurve	VILLAGE	Rural	0	0	0	0	0	0
18	Karki	VILLAGE	Rural	770	391	379	0	0	0
19	Duggur	VILLAGE	Rural	0	0	0	0	0	0
20	Vandoor	VILLAGE	Rural	45	20	25	0	0	0
21	Nilkod	VILLAGE	Rural	8	3	5	0	0	0
22	Salkod	VILLAGE	Rural	71	33	38	6	2	4
23	Hosakuli	VILLAGE	Rural	298	135	163	6	3	3
24	Kasarkod	VILLAGE	Rural	34	9	25	1	0	1
25	Apsarkonda	VILLAGE	Rural	0	0	0	12	6	6
26	Hosapatna	VILLAGE	Rural	3	2	1	3	0	3
27	Gunavante	Village	Rural	19	12	7	3	2	1
28	Kelgin-Idgunji	Village	Rural	6	4	2	0	0	0
29	Arolli-Mundagod	Village	Rural	4	3	1	4	1	3
30	Mavinkurva	Village	Rural	76	40	36	0	0	0
31	Mandalakurve	Village	Rural	13	5	8	0	0	0
32	Nagre	Village	Rural	0	0	0	0	0	0
33	Hadinbal	Village	Rural	191	108	83	0	0	0
34	Hadgeri	Village	Rural	32	15	17	0	0	0
35	Honavar (TP)	Town	Urban	513	240	273	34	17	17
36	Honavar (TP) - Ward No.1	Ward	Urban	17	8	9	0	0	0
37	Honavar (TP) - Ward No.2	Ward	Urban	19	10	9	6	4	2

S. no	Name	Level	Settlement type	Population of scheduled castes	Male scheduled caste population	Female scheduled caste population	Scheduled tribe population	Male scheduled tribe population	Female scheduled tribe population
38	Honavar (TP) - Ward No.3	Ward	Urban	4	1	3	0	0	0
39	Honavar (TP) - Ward No.4	Ward	Urban	103	48	55	1	1	0
40	Honavar (TP) - Ward No.5	Ward	Urban	29	14	15	0	0	0
41	Honavar (TP) - Ward No.6	Ward	Urban	29	16	13	0	0	0
42	Honavar (TP) - Ward No.7	Ward	Urban	27	11	16	17	9	8
43	Honavar (TP) - Ward No.8	Ward	Urban	32	17	15	0	0	0
44	Honavar (TP) - Ward No.9	Ward	Urban	12	5	7	5	1	4
45	Honavar (TP) - Ward No.10	Ward	Urban	0	0	0	0	0	0
46	Honavar (TP) - Ward No.11	Ward	Urban	52	25	27	0	0	0
47	Honavar (TP) - Ward No.12	Ward	Urban	3	2	1	5	2	3
48	Honavar (TP) - Ward No.13	Ward	Urban	0	0	0	0	0	0
49	Honavar (TP) - Ward No.14	Ward	Urban	176	78	98	0	0	0
50	Honavar (TP) - Ward No.15	Ward	Urban	2	1	1	0	0	0
51	Honavar (TP) - Ward No.16	Ward	Urban	8	4	4	0	0	0
52	Honavar (TP) - Ward No.17	Ward	Urban	0	0	0	0	0	0
53	Mugali	Village	Rural	0	0	0	0	0	0

Table G-4: Employment pattern of The Project Impacted Area

S.no	Name	Level	Settlement type	Total working population	Main working population	Main workers-male	Main workers -female	Marginal working population	Male marginal workers	Female marginal workers	Non working population	Non workers (males)	Non workers (females)
1	Mundgod	Taluk	Total	15459	32234	23282	8952	9245	2738	6507	49259	22953	26306
2	Mundgod	Taluk	Rural	14043	27084	19099	7985	8425	2367	6058	39056	19177	19879
3	Mundgod	Taluk	Urban	1416	5150	4183	967	820	371	449	10203	3776	6427
4	Jaddigadde	Village	Rural	17	19	18	1	19	3	16	19	5	14
5	Kelginkeri	Village	Rural	125	256	139	117	8	0	8	113	67	46
6	Talgod	Village	Rural	145	301	237	64	127	46	81	489	170	319
7	Horbhag	Village	Rural	137	268	202	66	83	12	71	435	164	271
8	Hosad	Village	Rural	19	36	35	1	30	12	18	83	22	61
9	Santeguli	Village	Rural	35	189	165	24	38	27	11	481	155	326
10	Keremane	Village	Rural	180	218	178	40	158	18	140	200	89	111
11	Honavar	Taluk	Total	18081	51810	40701	11109	11900	4928	6972	96621	34389	62232
12	Honavar	Taluk	Rural	16829	46113	36017	10096	11372	4639	6733	85022	30356	54666
13	Honavar	Taluk	Urban	1252	5697	4684	1013	528	289	239	11599	4033	7566
14	Navilgone	Village	Rural	420	880	620	260	199	39	160	982	391	591
15	Kadle	Village	Rural	214	542	459	83	181	50	131	886	314	572
16	Haldipur	Village	Rural	1240	3278	2472	806	841	407	434	6013	2174	3839
17	Pavinakurve	Village	Rural	97	358	271	87	17	7	10	594	177	417
18	Karki	Village	Rural	875	2043	1523	520	573	218	355	3391	1298	2093
19	Duggur	Village	Rural	97	201	104	97	0	0	0	90	45	45
20	Vandoor	Village	Rural	277	573	296	277	1	1	0	348	171	177
21	Nilkod	Village	Rural	198	453	256	197	4	3	1	340	136	204
22	Salkod	Village	Rural	568	1603	1201	402	237	71	166	2233	792	1441
23	Hosakuli	Village	Rural	139	913	820	93	91	45	46	1656	456	1200
24	Kasarkod	Village	Rural	371	2042	1715	327	196	152	44	5366	1934	3432

S.no	Name	Level	Settlement type	Total working population	Main working population	Main workers-male	Main workers -female	Marginal working population	Male marginal workers	Female marginal workers	Non working population	Non workers (males)	Non workers (females)
25	Apsarkonda	Village	Rural	69	160	111	49	22	2	20	255	105	150
26	Hosapatna	Village	Rural	239	769	641	128	149	38	111	1566	568	998
27	Gunavante	Village	Rural	409	851	661	190	346	127	219	1442	525	917
28	Kelgin-idgunji	Village	Rural	327	391	348	43	393	109	284	750	302	448
29	Arolli-mundagod	Village	Rural	143	325	197	128	35	20	15	422	177	245
30	Mavinkurva	Village	Rural	457	1180	866	314	246	103	143	1922	638	1284
31	Mandalakurve	Village	Rural	32	89	72	17	23	8	15	145	50	95
32	Nagre	Village	Rural	94	346	314	32	102	40	62	762	253	509
33	Hadinbal	Village	Rural	273	748	583	165	148	40	108	1179	413	766
34	Hadgeri	Village	Rural	114	26	25	1	203	90	113	119	53	66
35	Honavar (tp)	Town	Urban	1252	5697	4684	1013	528	289	239	11599	4033	7566
36	Honavar (tp) - ward no.1	Ward	Urban	90	322	252	70	41	21	20	829	322	507
37	Honavar (tp) - ward no.2	Ward	Urban	158	503	408	95	174	111	63	1121	374	747
38	Honavar (tp) - ward no.3	Ward	Urban	24	148	128	20	4	0	4	322	115	207
39	Honavar (tp) - ward no.4	Ward	Urban	138	535	411	124	32	18	14	1143	426	717
40	Honavar (tp) - ward no.5	Ward	Urban	111	329	232	97	37	23	14	660	255	405
41	Honavar (tp) - ward no.6	Ward	Urban	81	421	348	73	13	5	8	817	270	547
42	Honavar (tp) - ward no.7	Ward	Urban	66	411	355	56	15	5	10	770	276	494
43	Honavar (tp) - ward no.8	Ward	Urban	55	447	397	50	19	14	5	901	304	597
44	Honavar (tp) - ward no.9	Ward	Urban	60	316	256	60	0	0	0	570	167	403
45	Honavar (tp) - ward no.10	Ward	Urban	64	385	327	58	32	26	6	800	263	537

S.no	Name	Level	Settlement type	Total working population	Main working population	Main workers-male	Main workers -female	Marginal working population	Male marginal workers	Female marginal workers	Non working population	Non workers (males)	Non workers (females)
46	Honavar (tp) - ward no.11	Ward	Urban	94	326	283	43	60	9	51	603	196	407
47	Honavar (tp) - ward no.12	Ward	Urban	51	221	184	37	34	20	14	469	167	302
48	Honavar (tp) - ward no.13	Ward	Urban	36	222	190	32	10	6	4	513	192	321
49	Honavar (tp)- ward no.14	Ward	Urban	78	369	293	76	3	1	2	575	190	385
50	Honavar (tp) - ward no.15	Ward	Urban	71	281	222	59	28	16	12	595	213	382
51	Honavar (tp) - ward no.16	Ward	Urban	26	193	169	24	3	1	2	390	132	258
52	Honavar (tp) - ward no.17	Ward	Urban	49	268	229	39	23	13	10	521	171	350
53	Mugali	Village	Rural	10	17	14	3	8	1	7	24	11	13

Appendix H
Primary Water Quality Criteria For Class SW-IV Waters (For Harbour Waters)

Appendix - H

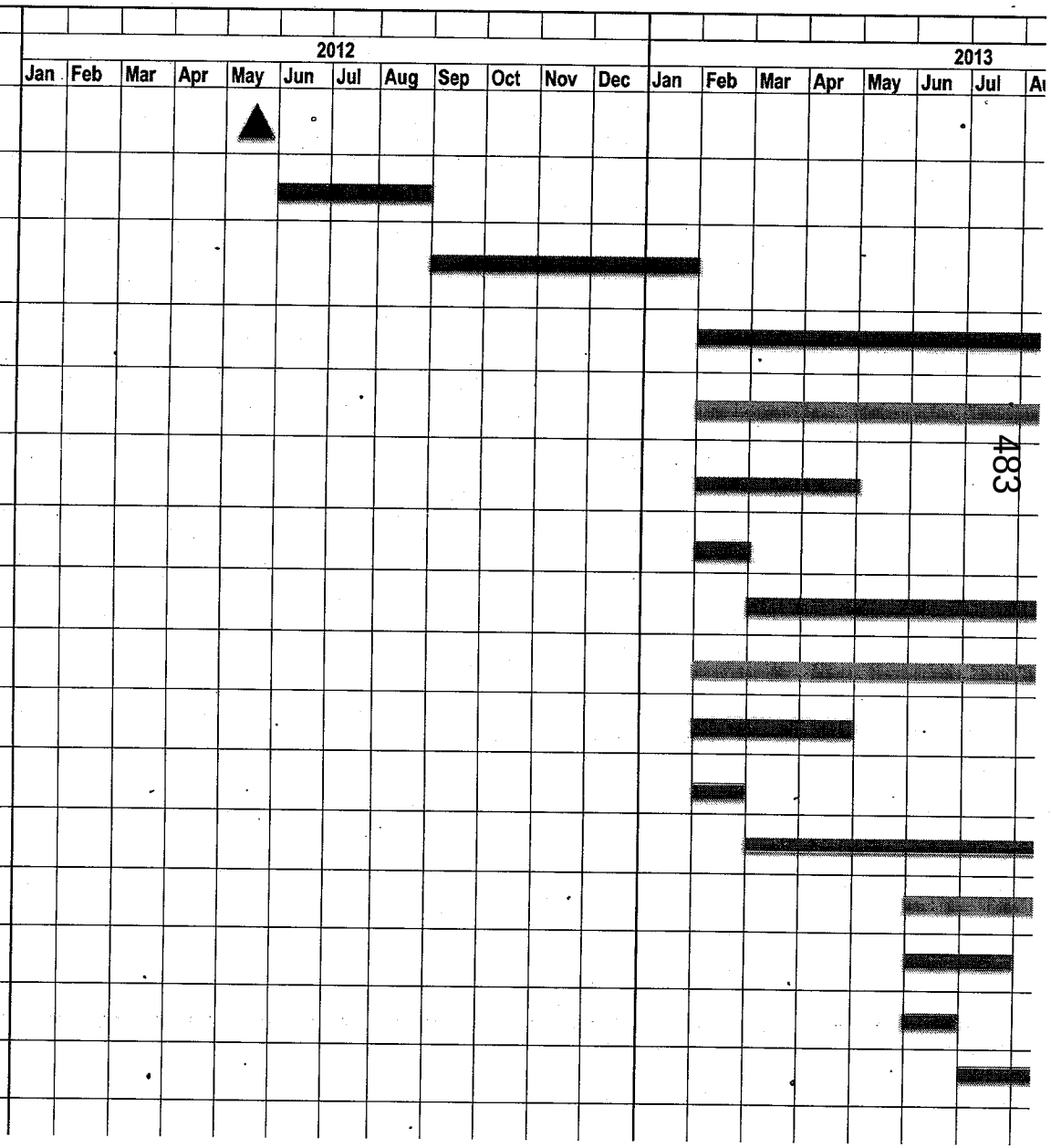
Primary Water Quality Criteria for Class SW-IV Waters (For Harbour Waters)

S.No	Parameter	Standards	Rationale/Remarks
1	pH range	6.5-9.0	To minimize corrosive and scaling effect
2	Dissolved Oxygen	3.0 mg/l or 40 percent saturation value, whichever is higher.	Considering bio-degradation of oil and inhibition to is oxygen production through photosynthesis.
3	Colour and Odour	No noticeable colour oroffensive odour.	None from reactive chemicals which may corrode paints/metallic surfaces.
4	Floating Matters Oil, grease and scum (including Petroleum products)	10 mg/l	Floating matter should be free from excessive living organisms, which may clog or coat operative parts of marine vessels/equipment.
5	Fecal Coliform	500/100 ml (PAN)	Not exceeding 1000/100 ml in 20 percent of samples in the year and in 3 consecutive samples in monsoon months.
6	Biochemical Oxygen Demand (3 days at 27oC)	5 mg/l	To maintain water relatively free from pollution caused by sewage and other decomposable wastes
7	Biochemical Oxygen Demand (BOD) (3 days at 27oC)	3 mg/l	Restricted for bathing (aesthetic quality of water). Also prescribed by IS:2296?1974.

Appendix I
Project Implementation Schedule

DEVELOPMENT OF BARGE LOADING FACILITIES ST HONNAVAR - PROJECT IMPLEMENTATION SCHE

Sl No.	Activity
1	**Feasibility Report**
2	**Preliminary Design**
3	**Tendering Process**
A	**Civil Works**
A.1	**Breakwater**
	Detailed Engineering, Preparation of construction drawings
	Mobilisation of equipments
	Construction of Breakwater
A.2	**Berth Construction**
	Detailed Engineering
	Mobilisation of equipments
	Berth construction
A.3	**Dredging and Reclamation**
	Mobilisation of dredging equipments
	Mobilisation of equipments
	Dredging / Reclamation
A.5	**Onshore Civil Works**



Appendix J
Public Hearing-Minutes of Meeting

Appendix J Public Hearing Disclosure

Date: 29.12.2011 Bangalore

KARNATAKA STATE POLLUTION CONTROL BOARD
Parisara Bhavan, 1st to 5th Floor, # 49, Church Street, Bangalore - 560 001, Karnataka, India
Ph:25581383/25589112/25586520 Fax:25586321
E-mail:ho@kspcb.gov.in Website:http://kspcb.gov.in

ENVIRONMENTAL PUBLIC HEARING NOTIFICATION

No:KSPCB/SEIAA/Non-EIA/EPH-2011-12/685 Date: 20.12.2011

Development of Barge/Vessel Loading facilities by M/s. Honnavar Port Private Limited at Coastal Sand Spit, Kasarakod, Tonka, Honnavar Taluk, Uttarkannada District. The Project has to obtain Environmental Clearance from State level Environment Impact Assessment Authority, Karnataka, as per the EIA Notification dated 14.09.2006 (as amended on 1.12.2009), and is required to go through Environmental Public Hearing. As per the State Level Environment Impact Assessment Authority, Karnataka, Terms of Reference letter dated 19.09.2011 and request of the project proponent letter dated 03.12.2011, the Environmental Public Hearing is being conducted by this Board.

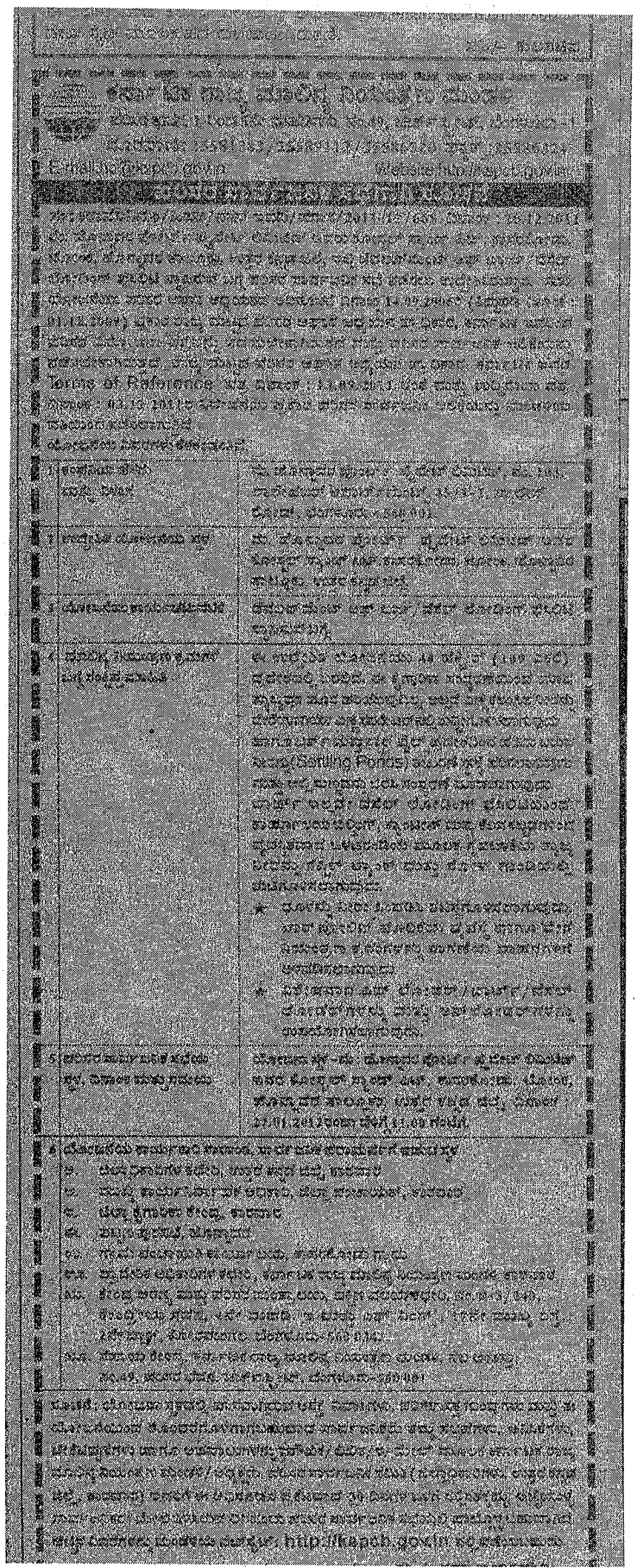
The details of the project are as follows :

1.	**Name of the Company and Address**	**M/s. Honnavar Port Private Limited #103, Lalchzar Apartments, 45/1-2, Palace Road, Bangalore - 560 001**
2.	**Proposed Location of Site**	**M/s. Honnavar Port Private Limited, at Coastal Sand Spit, Kasarakod, Tonka, Honnavar Taluk, Uttarkannada District**
3.	**Details of Activity**	Development of Barge/Vessel Loading facilities
4.	**Brief Description of Pollution Control measures**	The Proposed project is coming up in an extent of 44ha (109 acres). There is no trade effluent generation from the activity of contaminated water will be treated in oil separator. The run off from berth and stock piles of cargo storage area will be directed to settling ponds and lime is added for neutralization. The Sewerage system is provided to collect sewage from barge/vessel loading facility administration building, canteen and operation building. The Sewage proposed to be treated in septic tank and soak pit. * Dust suppression measures such as water sprinkling. * Use of tarpaulin covers and speed regulators for vehicles engaged in transportation. * Use of specialized ship loader/barge/vessel loaders and unloaders.
5.	**Date, time and venue of Public hearing**	**27.01.2012 at 11.00 AM at Project Site- Honnavar Port Private Limited, at Coastal Sand Spit, Kasarakod, Tonka Honnavar Taluk, Uttarkannada District**

6. **Places of availability of project documents as per EIA Notification, which is kept open to public are:**
   a. Office of the Deputy Commissioner, U.K. District, Karwar.
   b. Chief Executive Officer, Zilla Panchayat, U.K. Karwar.
   c. District Industries Centre, U.K. Karwar.
   d. Town Municipal Council, Honnavara.
   e. Village Panchayat Office, Honnavara Village.
   f. Regional Office, Karnataka State Pollution Control Board, Karwar.
   g. Ministry of Environment & Forest, South Zone Office, E-3/240, Kendriya Sadan, 4th Floor, E & F Wings, 17th Main Road, 2nd Block, Koramangala, Bangaluru - 560 034.
   h. **HELP DESK**, Karnataka State Pollution Control Board, Ground Floor, No.49, Parisara Bhavan, Church Street, Bangaluru - 560 001.

NOTE: Suggestions, views, comments and objections of interested bonafide residents, environmental groups and others located at project site and likely to be affected by the proposed project are invited within 30 days from the date of publication of this Notification. They can also make oral /written/E-Mail suggestions to the Karnataka State Pollution Control Board/Chairman, Environmental Public Hearing Committee (Deputy Commissioner, U.K District, Karwar) interested public can participate in the Public Hearing at the above place. For details please visit our Website http://kspcb.gov.in.

Sd/- Member Secretary

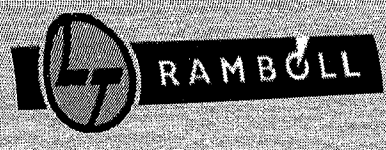


1	ಅರ್ಜಿಯ ಹೆಸರು ಮತ್ತು ವಿಳಾಸ	ಸದಸ್ಯ ಕಾರ್ಯದರ್ಶಿ, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ, ಪರಿಸರ ಭವನ, ಸಂಖ್ಯೆ 49, ಚಾಲುಕ್ಯ ವೃತ್ತ, ಶಿವಾನಂದ ವೃತ್ತ, ಬೆಂಗಳೂರು - 560 001
2	ಅರ್ಜಿಯ ಪ್ರಯೋಜನದ ಸ್ವರೂಪ	ಈ ಪ್ರಸ್ತಾವನೆಯ ಪ್ರಯೋಜನ ಪಡೆಯಲು ಅರ್ಜಿಯ ಸ್ವರೂಪ ಮತ್ತು ಅದಕ್ಕೆ ಅನುಸರಿಸಬೇಕಾದ ಕ್ರಮಗಳ ಬಗ್ಗೆ ಮಾಹಿತಿ.
3	ಯೋಜನೆಯ ಸಂಕ್ಷಿಪ್ತ ವಿವರ	ಯೋಜನೆಯ ಒಟ್ಟು ವೆಚ್ಚ / ಹೊರ ಮೂಲಗಳಿಂದ ಪಡೆದ ಸಾಲದ ಮೊತ್ತ.
4	ಯೋಜನೆಯಿಂದ ಉಂಟಾಗಬಹುದಾದ ಪರಿಣಾಮಗಳು	ಈ ಉದ್ದೇಶಿತ ಯೋಜನೆಯು 14 ಅಶ್ವ ಶ (100 ಬಿಎಚ್‌ಪಿ) ಸಾಮರ್ಥ್ಯದ ಎರಡು ಡೀಸೆಲ್ ಇಂಜಿನ್‌ಗಳನ್ನು ಅಳವಡಿಸಿಕೊಂಡಿರುವ ಒಂದು ಬಾರ್ಜ್ ಅಥವಾ ಹಡಗಿನಲ್ಲಿ ಕಚ್ಚಾ ಗೋಡಂಬಿ ಬೀಜಗಳನ್ನು ಲೋಡ್ ಮಾಡುವುದನ್ನು ಒಳಗೊಂಡಿರುತ್ತದೆ. ಈ ಯೋಜನೆಯಲ್ಲಿ ಯಾವುದೇ ಕೈಗಾರಿಕಾ ಪ್ರಕ್ರಿಯೆಯನ್ನು ಒಳಗೊಂಡಿರುವುದಿಲ್ಲ. ಆದ್ದರಿಂದ ಯಾವುದೇ ಕೈಗಾರಿಕಾ ತ್ಯಾಜ್ಯ ಉತ್ಪತ್ತಿಯಾಗುವುದಿಲ್ಲ. ಆದಾಗ್ಯೂ ಸಿಬ್ಬಂದಿಗಳಿಂದ ಉತ್ಪತ್ತಿಯಾಗುವ ಕೊಳಚೆ ನೀರನ್ನು ಸಂಸ್ಕರಿಸಲು ಸೆಪ್ಟಿಕ್ ಟ್ಯಾಂಕ್ ಮತ್ತು ಸೆಟ್ಲಿಂಗ್ ಪಾಂಡ್ (Settling Ponds) ಅಂತಹ ಸೂಕ್ತ ವ್ಯವಸ್ಥೆಯನ್ನು ಅಳವಡಿಸಲಾಗುವುದು. ಬಾರ್ಜ್ ಅಥವಾ ಹಡಗಿನ ಮೇಲೆ ಸಂಗ್ರಹವಾಗುವ ಮಳೆನೀರಿನ ಹರಿವಿನಿಂದ ಉಂಟಾಗುವ ಪರಿಣಾಮಗಳು ಕಡಿಮೆ ಪ್ರಮಾಣದಲ್ಲಿರುತ್ತವೆ. ಆದರೂ ಸಹ ಮಳೆನೀರಿನ ಹರಿವಿನಿಂದ ಉಂಟಾಗುವ ಪರಿಣಾಮಗಳನ್ನು ಕಡಿಮೆ ಮಾಡಲು ಕೆಳಕಂಡ ಕ್ರಮಗಳನ್ನು ಕೈಗೊಳ್ಳಬೇಕಾಗಿದೆ. ★ ಮಳೆನೀರಿನ ಹರಿವಿನ ಮೂಲಕ ಮಲಿನವಸ್ತುಗಳು ಜಲಮೂಲಗಳಿಗೆ ಸೇರದಂತೆ ಬಾರ್ಜ್ ಅಥವಾ ಹಡಗಿನ ಸುತ್ತಲೂ ಸೂಕ್ತ ಚರಂಡಿ ವ್ಯವಸ್ಥೆಯನ್ನು ಮಾಡಿಕೊಳ್ಳಬೇಕಾಗಿದೆ. ★ ಬಂದರು ಮತ್ತು ದಾಸ್ತಾನು / ಲೋಡಿಂಗ್ / ಇಳಿಸುವ ಪ್ರದೇಶದಲ್ಲಿ ಮಳೆನೀರಿನ ಹರಿವಿನಿಂದ ಮಲಿನವಸ್ತುಗಳು ಜಲಮೂಲಗಳನ್ನು ಸೇರದಂತೆ ಕ್ರಮಕೈಗೊಳ್ಳಬೇಕಾಗಿದೆ.
5	ಪರಿಸರಕ್ಕೆ ಪೂರಕವಾದ ಕ್ರಮಗಳು	ಸೂಚನೆಯಲ್ಲಿ ನೀಡಿರುವ ಮೂಲಭೂತ ಕ್ರಮಗಳನ್ನು ಅನುಸರಿಸಿ ಯೋಜನೆಯನ್ನು ಕಾರ್ಯಗತಗೊಳಿಸಲು ಸೂಚಿಸಿದೆ. ಮೇಲಾಗಿ, ಪರಿಸರ ಸಂರಕ್ಷಣೆಯ ಕುರಿತು ಕ್ರಮಕೈಗೊಳ್ಳಲು ಸೂಚಿಸಿದೆ. ಮೇಲಿನ ಕಾರಣಗಳಿಂದ ಅರ್ಜಿಯನ್ನು ತಿರಸ್ಕರಿಸಿದೆ. ದಿನಾಂಕ 21.01.2013ರಂದು ಪತ್ರವನ್ನು ಬರೆಯಲಾಗಿದೆ.

6 ಯೋಜನೆಯ ಅರ್ಜಿಯ ಸಂಬಂಧ, ಅದರ ಮೇಲೆ ಅಧಿಕಾರಿಗಳ ಅಭಿಪ್ರಾಯ

a. ಮುಖ್ಯಾಧಿಕಾರಿ ಪರಿಸರ ಅಧಿಕಾರಿ
b. ಮುಖ್ಯ ಅರಣ್ಯಾಧಿಕಾರಿ, ಜಿಲ್ಲಾ ಅರಣ್ಯಾಧಿಕಾರಿ, ಕಾರವಾರ
c. ಮುಖ್ಯ ಪ್ರಾದೇಶಿಕ ಕಛೇರಿ, ಕಾರವಾರ
d. ಜಿಲ್ಲಾ ಪೊಲೀಸ್ ಅಧೀಕ್ಷಕರು
e. ಸಹಾಯಕ ಆಯುಕ್ತರು, ಕಾರವಾರ
f. ಸದಸ್ಯ ಕಾರ್ಯದರ್ಶಿ, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ
g. ಕಛೇರಿ ಪತ್ರ ಸಂಖ್ಯೆ: ಪಿಸಿಬಿ/ಸಿಎಸ್‌ಎಸ್/ಎನ್‌ಒಸಿ-ಕೆಎಆರ್-13/2012-13, ದಿನಾಂಕ: 21.01.2013, ಕಛೇರಿ ಪತ್ರ ಸಂಖ್ಯೆ: ಪಿಸಿಬಿ/ಸಿಎಸ್‌ಎಸ್/ಎನ್‌ಒಸಿ-ಕೆಎಆರ್-13/2012-13, ದಿನಾಂಕ: 21.01.2013, ಕಛೇರಿ ಪತ್ರ ಸಂಖ್ಯೆ: ಪಿಸಿಬಿ/ಸಿಎಸ್‌ಎಸ್/ಎನ್‌ಒಸಿ-ಕೆಎಆರ್-13/2012-13, ದಿನಾಂಕ: 21.01.2013
h. ಸಹಾಯಕ ಕಮಿಷನರ್, ಕಾರವಾರ ಉಪವಿಭಾಗ, ಕಾರವಾರ
ಸಂ.ಸ, ಹೊನ್ನಾವರ ತಾಲ್ಲೂಕು, ಉತ್ತರ ಕನ್ನಡ ಜಿಲ್ಲೆ

ಟಿಪ್ಪಣಿ: ಮೇಲಿನಂತೆ ಸಂಬಂಧಪಟ್ಟವರಿಂದ ಅಭಿಪ್ರಾಯ ಪಡೆಯಲಾಗಿದೆ. ಅಭಿಪ್ರಾಯ ಪಡೆಯಲು ಮತ್ತು ಯೋಜನೆಯ ಪರಿಸರ ಅನುಮತಿಯ ಅರ್ಜಿಯನ್ನು ಪರಿಶೀಲಿಸಲು ಸಂಬಂಧಪಟ್ಟ ಅಧಿಕಾರಿಗಳಿಗೆ ಕಳುಹಿಸಿದ ಪತ್ರಗಳ ಪ್ರತಿಗಳನ್ನು ಲಗತ್ತಿಸಲಾಗಿದೆ. ಅಭಿಪ್ರಾಯ ಪಡೆಯಲು ಕಳುಹಿಸಿದ ಪತ್ರಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟವರಿಂದ ಯಾವುದೇ ಉತ್ತರ ಬಂದಿಲ್ಲದಿದ್ದಲ್ಲಿ ಅವರಿಗೆ ಯಾವುದೇ ಅಭಿಪ್ರಾಯವಿಲ್ಲವೆಂದು ಪರಿಗಣಿಸಲಾಗಿದೆ. ಅರ್ಜಿಯ ಪರಿಶೀಲನೆಯ ಸಮಯದಲ್ಲಿ ಅಭಿಪ್ರಾಯ ಪಡೆಯಲು ಕಳುಹಿಸಿದ ಪತ್ರಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟವರಿಂದ ಉತ್ತರ ಬಂದಿದ್ದಲ್ಲಿ ಅವುಗಳನ್ನು ಪರಿಗಣಿಸಲಾಗುವುದು. ಅರ್ಜಿಯ ಪರಿಶೀಲನೆಯ ಸಮಯದಲ್ಲಿ ಅಭಿಪ್ರಾಯ ಪಡೆಯಲು ಕಳುಹಿಸಿದ ಪತ್ರಗಳಿಗೆ ಸಂಬಂಧಪಟ್ಟವರಿಂದ



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