TRACTEBEL

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CONSULTANCY SERVICES FOR PREPARATION OF TWO STAGE DPR OF CLUSTER VII OF PROPOSED 53 NATIONAL WATERWAYS

FEASIBILITY REPORT-RAJPURI CREEK (31KM) - (NW-83)
Project No. P.009051
Document No. P.009051-W-10204-D07
Final Report

Goa and Maharashtra | INDIA

Inland Waterways Authority of India (IWAI) - Government of India Ministry of Shipping - Head Office

23 September 2016

Report

Rev.03

RESTRICTED

CATEGORY-II WATERWAYS: STAGE-I REPORTS

SALIENT FEATURES AT A GLANCE

<table>
<tr><th>Sl.No.</th><th>Particulars</th><th>Details</th></tr>
<tr><td>1.</td><td>Name of Consultant</td><td>Tractebel Engineering Pvt. Ltd.</td></tr>
<tr><td>2.</td><td>Cluster Number & State(s)</td><td>Cluster-VII & Maharashtra</td></tr>
<tr><td>3.</td><td>Waterway stretch, NW#</td><td>Rajpuri Creek (31 km), NW-83</td></tr>
<tr><td>4.</td><td><u>Navigability status</u></td><td></td></tr>
<tr><td>a)</td><td>Tidal & non tidal portions (from…….to, length, average tidal variation)</td><td>Fully Tidal (Chainage 0.0 km to Chainage 27.4 km, average tidal variation of 2.37 m)
Tidal Variation 4.42m/0.32m</td></tr>
<tr><td>b)</td><td>LAD status (w.r.t. CD)
i) Survey period (20 & 21,Feb., 2016)
ii) < 1.0 m (km)
iii) 1.0 m to 1.5 m (km)
iv) 1.5 m to 2.0 (km)
v) >2.0 m (km)</td><td>
<table>
<tr><th rowspan="2">Chainage (Km)</th><th colspan="4">Length of the Study Stretch (Km)</th></tr>
<tr><th><1m</th><th>1-1.5m</th><th>1.5-2.0m</th><th>>2m</th></tr>
<tr><td>0.0-6.0</td><td>-</td><td>-</td><td>-</td><td>6.00</td></tr>
<tr><td>6.0-12.0</td><td>-</td><td>-</td><td>-</td><td>6.00</td></tr>
<tr><td>12.0-18.0</td><td>0.62</td><td>0.20</td><td>0.42</td><td>4.75</td></tr>
<tr><td>18.0-24.0</td><td>-</td><td>-</td><td>0.15</td><td>5.85</td></tr>
<tr><td>24.0-27.4</td><td>2.72</td><td>0.24</td><td>0.45</td><td>-</td></tr>
<tr><td>Total</td><td>3.34</td><td>0.44</td><td>1.02</td><td>22.60</td></tr>
</table>
</td></tr>
<tr><td>c)</td><td>Cross Structures
i) Dams, weirs, barrage etc. (total number; with navigation locks or not)
ii) Bridges, Power cables etc. (total number; range of horizontal and vertical clearances)</td><td>Cross Structures
i) Nil
ii) 1 no. of Bridge. Horizontal Clearance – 20.0 m, Vertical Clearance – 4.0 m.
(Located at the end of study stretch)
(VC are above MHWS / HFL)</td></tr>
<tr><td>d)</td><td>Avg. discharge & no. of days</td><td>Since the entire study stretch is tidal, discharge of River is not relevant for navigability.</td></tr>
<tr><td>e)</td><td>Slope (1 in……)</td><td>1 in 4430</td></tr>
<tr><td>5.</td><td><u>Traffic Potential</u></td><td></td></tr>
<tr><td>a)</td><td>Present IWT operations, ferry services, tourism, and cargo, if any.</td><td>Ferry Services between Agardanda to Rohini, Agardanda to Dighi, Rajpuri to Janjira and Rajpuri to Dighi are operational.
Cargo Handling of 0.78 MMTPA at Dighi Port has been observed.
The existing 13 jetties (apart from the Port jetties) are being utilized for Fishing and Local Transportation.</td></tr>
<tr><td>b)</td><td>Important industries within 50 km</td><td>MIDC-Roha, Agardanda Shipyard, Bharat Petroleum.
(For details Refer Annexure 4.1)</td></tr>
<tr><td>c)</td><td>Distance of Rail & Road from Industry</td><td>Both Rail & Road network is available within 20.0 km of distance from the nearest industrial area (MIDC-Roha).</td></tr>
<tr><td>6.</td><td>Consultant’s recommendation for</td><td>Recommended for development as Class-V waterway for entire</td></tr>
</table>

Sl.No.	Particulars	Details
	going ahead with Stage-II (DPR preparation)	length
7.	Any other information/comment	27.40 km of bathymetric survey is considered and the remaining 4.6 km considered with topographical data. MHWS –4.42m, HTL—4.42m, LTL—0.32m, Average Tidal Variation—2.37m, Port Name: Apollo Bandar.

Date: 23/09/2016

Consultant signature

CONSULTANCY SERVICES FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT OF PROPOSED 53 NATIONAL WATERWAYS

RAJPURI CREEK

(NW-83)

CLUSTER - VII

GOA AND MAHARASHTRA, INDIA

03	23.09.2016	For Acceptance	N Bawa	Pradyumna Machhkhand	B. C. Jha
Rev.	Date	Description	Prepared By	Checked By	Approved By

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LIST OF ABBREVIATIONS

Abbreviations	Acronyms
BFL	Bombay Floating Light
CD	Chart Datum
Ch	Chainage
CRZ	Coastal Regulation Zone
CWC	Central Water Commission
DGPS	Differential Global Positioning System
DFPCL	Deepak Fertilizers & Petrochemical Corporation
DMIC	Delhi Mumbai Industrial Corridor
DPR	Detailed Project Report
FSL	Full Supply Level
GAIL	Gas Authority of India Ltd.
HC	Horizontal Clearance
IO	Iron Ores
IOCL	Indian Oil Corporation Ltd.
IWAI	Inland Waterways Authority of India
IWT	Inland Water Transportation
KP	Km Points
LAD	Least Available Depth
LNG	Liquefied Natural Gas
MHWS	Mean High Water Spring
MIDC	Maharashtra State Industrial Development Corporation
MMB	Maharashtra Maritime Board
MMTPA	Million Metric Tonne Per Annum
MnT	Million Tonnes
MOEFCC	Ministry of Environment, Forest & Climate Change
MOS	Ministry of Shipping
MSEB	Maharashtra State Electricity Board
MSME	Micro Small & Medium Enterprises
MSPGC	Maharashtra State Power Generation company
MTPA	Metric Tonne per Annum
NH	National Highway
NTPC	National Thermal Power Corporation
NW	National Waterway
PGCIL	Power Grid Corporation of India Limited
PWD	Public Works Department
RGPPL	Ratnagiri Gas and Power Private limited
SEB	State Electricity Board
SH	State Highway

UP	Uttar Pradesh
VC	Vertical Clearance
WRD	Water Resources Department
WRIS	Water Resources Information System of India

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EXECUTIVE SUMMARY

A. Introduction

The available water resource in the globe can be used and utilized in various ways whereas Inland Water Transport (IWT) is one among them. The water bodies can be utilized for IWT also. India has been bestowed with vast water bodies consisting of rivers, canals, backwaters, creeks and lakes and having the potential for development of efficient waterways transport network. However, when compared to the development of IWT in certain countries, the same is to be geared up in our country. IWT mode remains underdeveloped and its share in overall internal cargo transport remains abysmally low. IWT sector presently has a meager modal share of 0.1% in India compared to 42% in European Union, 8.7% in China and over 8% in USA. This is a great economic opportunity loss to the country.

Based on various earlier studies on IWT, subsequent to the recommendations of National Transportation Policy Committee (NTPC 1980) and in order to give more thrust to the Inland Water Transport mode, duly keeping in view the major benefits of this mode viz., Cheaper operational cost on comparison / Higher fuel efficiency / Eco friendly nature of the mode, the IWT development system is under consideration in our country. The potential through IWT mode can be used as an alternate and supplementary mode of transportation in certain favourable conditions.

India has about 14,500 km of navigable waterways which comprise Rivers, Canals, Backwaters, Creeks, etc., out of which about 5200 km of the river and 4000 km of canals can be used by mechanized crafts. About 55 million tonnes of cargo is being moved annually by Inland Water Transport (IWT). Its operations are currently restricted to a few stretches in the Ganga-Bhagirathi-Hooghly Rivers, the River Brahmaputra, the River Barak, the Rivers in Goa, the Backwaters in Kerala, Inland Waters in Mumbai area and the Deltaic regions of the Godavari - Krishna Rivers.

Inland Waterways Authorities of India (IWAI), a statutory body under Ministry of Shipping, Government of India intends to explore the navigational potential of newly declared national waterways across the country for year round commercial navigation.

National Waterways Act, 2016 has come into force to make provisions for existing national waterways and to provide for the declaration of certain inland waterways to be national waterways and also to provide for the regulation and development of the said waterways for the purposes of shipping and navigation and for matters connected therewith or incidental thereto. There are now a total of one hundred and eleven national waterways altogether across the country which include five existing national waterway besides 106 newly declared waterways as national waterways through National Waterways Act, 2016. The objective is to

promote integrated development of waterways throughout the country so as to have a considerable and maximum mode shift to IWT which can reduce the density in rail/road apart from the environmental benefits of IWT mode.

It has been planned to study in two stages comprising feasibility study in stage-I followed by preparation of DPR in stage-II and recommending thereafter the possibility of composite and integrated development of proposed newly declared national waterway to achieve navigation and to develop water transport facilities.

This report presents study detail of stage-I of national waterway of Rajpuri Creek in the state of Maharashtra. Rajpuri Creek has been designated as national waterway-83 with its description in the gazette notification as, Rajpuri Creek starts from Arabian Sea at Rajpuri village Lat 18°18'3.15"N, Long 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Long 73° 6'45.35"E

Sl. No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Rajpuri Creek (NW-83)
2	State/ District through which river passes	The Rajpuri Creek passes through the Raigad district of Maharashtra State.
3	Length of the river / canal	Rajpuri Creek starts from Arabian Sea at Rajpuri village Lat 18°18'3.15"N, Long 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Long 73° 6'45.35"E have been declared as new national waterway. The index map of Rajpuri Creek showing proposed waterway stretch, topographic features and road networks are shown in **Figure 1.1 and Figure 1.2**.
4	Catchment Area	The total catchment area of Rajpuri Creek is 592 sq.km.

B. Methodology Adopted

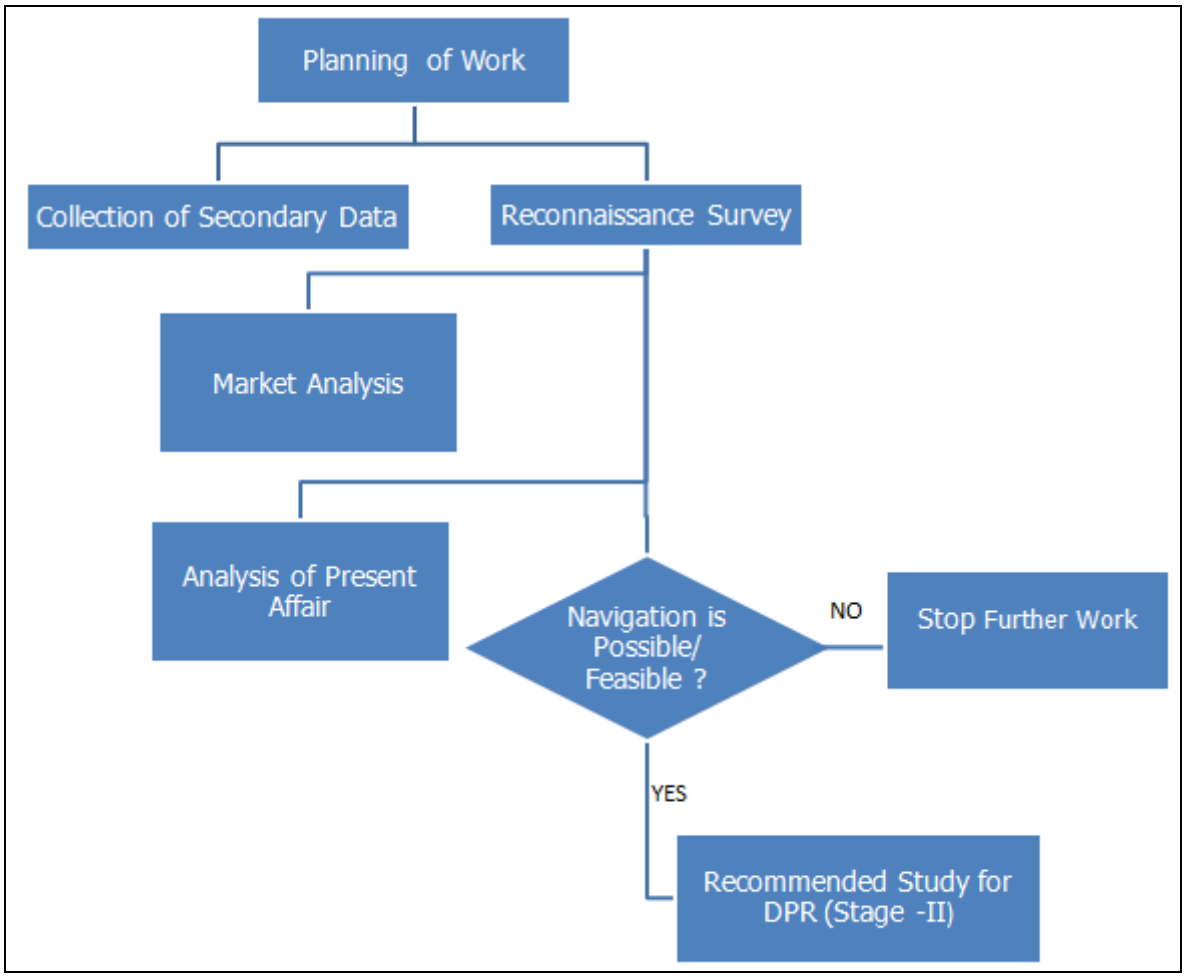
The feasibility of the navigation in the considered waterway has been examined from the following three perspectives:

a. The Physical System:- It includes the study of hydrographic characteristics of the channel/stability of channel/water depth/width of river/ LAD/ terminal/ infrastructure/ cross over structure/ sediment analysis/ physical constraints/ hindrances etc.

b. The Current Functions:- It covers the current utilization of the river – existing navigation/ ferry services/ jetties/ cross over structures/ irrigation facilities/ dam/ barrage/ canals/ fishery/mining etc.

c. The Market Potential: - This aspect covers ferry services, existing cargo movement, existing rail & road network, population served, local produces, industrial establishment, future potential, transfer of cargo movement to inland waterways transport system etc.

Work Execution for stage-I study has been depicted through following diagram.



Execution Diagram of Stage I

C. Collection of Data and Analysis

Reconnaissance survey has been conducted through an expert agency for collection of primary data and various secondary data have also been collected from different sources e.g. benchmark, G & D data & chart datum from IWAI, Govt. of India / MMB, Govt. of Maharashtra / MSME, Govt. of India/ Maharashtra Pollution Control Board, Mumbai/ Cargo Movement Data for the Year 2014 and 2015 provided by IWAI, Govt. of India/ Captain of Ports, Govt. of Goa/ WRD, Govt. of Goa/ WRD, Govt. of Maharashtra/ IOCL, Govt. of India undertaking/ MIDC, Govt. of Maharashtra/ MSEB, Govt. of Maharashtra, respective district authorities of State Govt. of Maharashtra and information available in the public domain through web.

A review of the existing data available with the State Agencies and Central Water Commission for the proposed Inland Waterways has been done for determining the nature, extent, adequacy, validity of the available data and identifying the data gaps.

D. Observations and Inferences

Based on the details presented under Chapter-3, following conclusions have been derived for establishing the navigability of the proposed waterway;

1. The Waterway length in the Rajpuri Creek as given by IWAI is 31.0km whereas the total surveyed length along the Creek to capture the thalweg is 27.40km. The deepest channel route has been reckoned as 27.40km. All inferences derived for identifying the navigable length have been derived with reference to deepest channel length (27.40km).
2. The Creek is tidal affected for full length under study and relevant chart datum has been used. 77% of the surveyed length has water depth more than 2.0m, however not continuous, in the reach starting from 0.00km (At confluence of Creek with sea near village Rajpuri near the creek). The average tidal variation is 2.37m with maximum high tide of 4.42m and low tide of 0.32m as per the records available for this region. The average tide height of 2.37m would be an added advantage for the safe navigation.
3. Feasibility study suggests that the Creek is navigable without any significant obstructions in the entire length except some patches in the upper reaches.
4. The lengths of the waterway, with a depth more than 2.0m, 1.5m and 1.0m with reference to the Chart Datum have been compiled in the main report. This is given in Table 3.8 of the report and is being reproduced below:

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0.0-6.0	9.10	6.20	6.00	-	-	-
6.0-12.0	7.50	2.80	6.00	-	-	-
12.0-18.0	6.00	0.10	4.75	0.42	0.20	0.62
18.0-24.0	6.50	1.90	5.85	0.15	-	-
24.0-27.4	2.00	-2.00	-	0.45	0.24	2.72
Total			**22.60**	**1.02**	**0.44**	**3.34**

5. No H. T. Line is crossing the study stretch and the bridge near Khargaon is at the end of the study stretch. Hence there is no obstruction.

The above description & classification of the waterway has been presented schematically based on the survey observation and duly keeping in view the Creek classification criteria in Table 3.16 as reproduced below.

Criteria	Classification																		
Length of waterway from start (km)	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	26	28	29	31
Chainage length in %	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Draft availble	C-V																C-I			
Rail & raod Bridge Vert. clearance	All Class																			
Rail & raod Bridge Hor. clearance	All Class																			
HT Line Vert. clearance	All Class																			
Bend Radius	C-II																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

E. Cargo Feasibility

The present mobility in the creek area with the coastal movement is about 0.78 MMTPA. The majority of the cargo is Thermal Coal followed with Bauxite and Steel Coil. (As confirmed from the cargo data of 2015-16).

Subsequent to the preliminary market survey and its analysis, there is a possible growth of cargo mobility to the extent of about 0.7 MMTPA to 1.2 MMTPA through the study stretch, which is a considerable increase.

In order to meet the above increase in the cargo potential, the waterway development is felt essential. Accordingly, the waterway is to be developed to Class V to meet the above increase in volume and keeping in view the future industrial growth in upper hinterland.

F. SWOT Analysis

SWOT analysis has been carried out for deriving meaningful information specifying the objectives of the study for development of the waterway for year round commercial navigation and identifying the internal & external factors that are favourable and unfavourable in the development of the waterway.

Strength

1. 77% of the surveyed length has water depth more than 2 m and is safe for navigation.
2. The above depth availability is for about 24kms and small patches may be required to be attended with a minimum conservancy activity involving dredging.
3. Since the majority of the study stretch is tidal affected, this is an additional advantage.
4. Maximum tide in this region was observed in the range of about 4.42m, Minimum tide in the range of 0.32m and the Mean Sea level is observed to be 2.51m and the same is an additional strength for safe navigability.
5. Approximately 6.0 lacs of population is residing in the region of Murud, Roha, Tala, Mangaon, Mhasala and Srivardan in the vicinity of Rajpuri Creek, which will have direct or indirect benefits with the IWT and related projects coming up in the area.
6. The IWT development in this region will support the present Ro Ro activity also.

7. The Mega development of Dighi Port will have its own vibration in its nearby hinterland which will have considerable influence on IWT also.
8. Ro – Ro Cargo mobility will have much more influence on IWT in the entire stretch.
9. Cargo has been identified through Ro – Ro to an extent of about 0.7 MMTPA to 1.2 MMTPA.
10. The industrial planning being considered in the hinterland is more attractive and hopeful for IWT development.

Weakness

1. The proposed Ro – Ro cargo movement should take off without any hindrance, since there is no IWT movement. However, the traffic estimations present an optimistic picture for IWT.

Opportunity

1. 77 % of the existing waterway is having a depth more than 2m, which can be used advantageously for the mobility of hinterland cargo.
2. The proposals of Industrial area in the vicinity / hinterland are an opportunity, if used by IWT.
3. Since the majority of the study stretch is tidal affected, this is an opportunity.
4. The Ro – Ro Cargo mobility will be a big boon for this stretch, since it is having its own Geographical and site specific advantage, which is an opportunity for this stretch development.
5. The present Rail and Road connectivity, though may be competing with IWT, may also be an opportunity for creating an efficient intermodal hub for IWT.
6. Policies are to be firmed up for development of IWT in this stretch.
7. Since the industrial areas of the MIDC are in the upstream stretch, the entire waterway can be best utilized.

Threat

1. NH 17 / NH 66, SH-92, SH 96, SH 97 & SH 98 in the study area may create competing modes of transport especially with respect to cargo traffic for the proposed waterway and the same also be an opportunity for inter modal hub.
2. The present rail network also may pose some threats as an alternative mode of transport.
3. The Rajpuri Creek banks covered by marginal mangrove trees in certain places may invite some socio-environmental issues and may require statutory approvals and clearances to construct the jetties/terminal/ports/intermodal connectivity.
4. Dighi Port development should not snub the IWT and the pro active awareness is to be established for IWT in this area.

G. Development Cost (Tentative)

The reconnaissance survey data with regard to physical constraints may have cost implications for making the Rajpuri Creek stretch navigable. The development of the proposed national waterway involves physical interference in the form of dredging, construction of terminals at the identified locations, modification of HT Lines at crossing locations to provide a minimum vertical clearance of 20.1m (with respect to 220 kVA) or the case may be combined with some unforeseen expenses. Moderate dredging effort has been envisaged with an average dredging of 1.0m required in 4.80km of the length of proposed waterway reckoned with reference to ascertained data. The cost of dredging has been considered @ INR 230 per cum. The cost of terminal has been estimated @ INR 20.0 crore each for two terminals. No HT line is crossing the study stretch. The cost of navigational aids for day/night navigation has been considered as INR 350 lacs. 10% of the amount for Dredging, Terminal construction and Night Navigation aids has been envisaged as unforeseen. The tentative total cost of development to make the Creek navigable round the year to achieve safe navigation for the required classification of vessel mobility has been estimated to INR 52.70 crore. (reproduced below as Table 5.1).

Sl. No.	Name of Waterway	Length of Water way (km)	Dredging Required (w. r. to 2 m draft & 40.0m width) (km)	Dredging Cost @ INR 230/ cum (INR in Cr.)	Terminal Proposed	Terminal Cost @ INR 20 Cr each (INR in Cr.)	Cost of Modification of Transmission line (INR in Cr.)	Night Navigation (INR in Cr.)	Total cost incld. 10% unforeseen (INR in Cr.)
1	Rajpuri Creek	31.00	4.80	4.42	2.00	40.00	---	3.5	52.70

H. Classification of Waterway

Ministry of Shipping, Road Transport and Highways (Inland Waterways Authority of India) has classified the Inland waterways into seven categories for Rivers and Canals for safe plying of self propelled vessels up to 2000 DWT and tug-barge formation in push tug + four barge units of carrying capacity up to 8000 DWT (Ref: IWAI, Gazette Notification dated 26th January 2007).

As per the above Classification of Inland Waterways, the entire waterway of Rajpuri Creek of 31.0km length has been classified based on available minimum water depth, bottom width, minimum vertical and horizontal clearances of cross over structures and bend radius in the Creek. The classification of Rajpuri Creek Waterway is described as detailed below (reproduced as Table 5.2).

Chainage (km)	Minimum Depth (m)	Bottom Width (m)	Minimum Vertical Clearance (m)	Minimum Horizontal Clearance (m)	Bend Radius (m)	Classification of Waterway (Proposed)
0.0 – 31.00	0.1	200.0	--------	--------	160	**Class – V**

The study stretch of the waterway is amenable for development as Class V waterway as explained above. Moderate Dredging is essential in the upper reaches.

The above stretch of the waterway hence falls under Class V which is navigable without any hindrance and shall be used for plying self-propelled vessel of carrying capacity upto 1000 DWT (approximate size 70m overall length, 12m moulded breadth and 1.8m loaded draft) or one tug and four barges combination of 4000 DWT (approximate size 170m overall length, 24m breadth and 1.8m loaded draft).

I. Recommendation

The entire 31km length of national waterway-83 of Rajpuri Creek has been identified having potential for development as waterway of Class-V as described above. This stretch of the Creek is therefore recommended for stage-II study for preparation of Detailed Project Report (DPR) to establish the viability for implementation as a project.

Accordingly, the National Waterway NW-83 of Rajpuri Creek is proposed for development as **Class V** waterway in the entire stretch of the waterway as depicted in Table 3.17 (as reproduced below):

River Stretch	0.0km	31.00km
Classification		
	Class- V	
Horizontal clearance (m)	80	
Vertical clearnce (m)	10	
Minimum Depth (m)	2	
Bottom Width (m)	80	
Self Propelled Vessel		
Dead Weight Tonnage	1000	
Vessel size (m)	70 x 12 x 1.8	
Tug + Barge		
Dead Weight Tonnage	4000	
Vessel size (m)	170 x 24 x 1.8	

Note:

1. All vertical clearances of cross over structures have been reckoned with MHWS of 4.42m above MSL and details are described in Para 3.3.5.
2. MHWS –4.42m, HTL—4.42m, LTL—0.32m, Average Tidal Variation—2.37m, Port Name: Apollo Bandar.

CHAPTER 1: INTRODUCTION

1.1 Introduction to Inland Waterways

The Inland Waterways Authority of India (IWAI) came into existence on 27th October 1986 for development and regulation of inland waterways for shipping and navigation. Inland Waterways Authority of India (IWAI) is the statutory authority in charge of the waterways in India. The Authority primarily undertakes projects for development and maintenance of IWT infrastructure on national waterways through grant received from the Ministry of Shipping, Government of India. The head office of the Authority is at Noida, UP. It does the function of building the necessary infrastructure in these waterways, surveying the economic feasibility of new projects and also administration. The Authority also has its regional offices at Patna, Kolkata, Guwahati and Kochi and sub-offices at Allahabad, Varanasi, Bhagalpur, Farakka, Swaroopganj, Hemnagar, Dibrugarh (Assam), Dhubri, Kollam, Vijayawada (Andhra Pradesh) and Bhubaneshwar (Odisha).

India has about 14,500 km of navigable waterways which comprise Rivers, Canals, Backwaters, Creeks, etc., out of which about 5200km of the river and 4000km of canals can be used by mechanized crafts. About 55 million tonnes of cargo is being moved annually by Inland Water Transport (IWT), a fuel - efficient and environment - friendly mode. Freight transportation by waterways is highly under-utilized in India compared to other large countries and geographic areas like the United States, China and the European Union. Its operations are currently restricted to a few stretches in the Ganga-Bhagirathi-Hooghly Rivers, the River Brahmaputra, the River Barak, the Rivers in Goa, the Backwaters in Kerala, Inland Waters in Mumbai area and the Deltaic regions of the Godavari - Krishna Rivers.

Besides these organized operations by mechanized vessels, country boats of various capacities also operate in various rivers and canals and substantial quantum of cargo and passengers are transported in this unorganized sector as well. The total cargo moved (in tonne kilometres) by the inland waterway was just 0.1% of the total inland traffic in India. There are now one hundred and eleven national waterways across the country which include five existing national waterways besides 106 waterways which have been declared recently as national waterways through a central legislation.

1) National Waterway 1

The Ganga - Bhagirathi - Hooghly river system between Haldia (Sagar) & Allahabad.

Estd. = October 1986.

Length = 1620 km

Fixed terminals = G R Jetty 2, Kolkata, Pakur, Farakka, Gaighat (Patna) & Allahabad.

Floating terminals = Kolkata, Diamond Harbour, Katwa, Bahrampur, Jangipur, Bhagalpur, Semaria, Doriganj, Ballia, Ghazipur, Varanasi, Chunar, Allahabad.

Cargo Movement = 3 million tonnes Approx.

2) National Waterway 2

Sadiya — Dhubri stretch of Brahmaputra river.

Estd = September 1988.

Length = 891 km

Fixed terminals = Pandu

Floating terminals = Dhubri, Jogighopa, Tezpur, Silghat, Jamgurhi, Bogibil, Dibrugarh, Saikhowa and Sadiya

Cargo Movement = 2.0 million tonnes Approx.

3) National Waterway 3

Kottapuram-Kollam stretch of the West Coast Canal, Champakara Canal and Udyogmandal Canal.

Estd = February 1993

Length = 205 km

Fixed terminals = Kottapuram, Aluva, Bolgatty, Willingdon Island, Maradu (Kochi), Cherthala (Vaikom), Thannermukkom, Alappuzha, Thrikkunnapuzha, Kayamkulam (Ayiramthengu), Chavara and Kollam.

Cargo Movement = 1.0 million tonnes Approx.

4) National Waterway 4

Kakinada–Pondicherry stretch of canals and the Kaluvelly Tank, Bhadrachalam – Rajahmundry stretch of River Godavari and Wazirabad – Vijayawada stretch of River Krishna.

Estd = November 2008

Length = 1095 km

Tentative Cargo Potential = 2.0 million tonnes Approx which can go up to 4.0 million tonnes in next 15 years or so.

5) National Waterway 5

Talcher–Dhamra stretch of the Brahmani River, the Geonkhali - Charbatia stretch of the East Coast Canal, the Charbatia–Dhamra stretch of Matai River and the Mangalgadi - Paradip stretch of the Mahanadi River Delta.

Established = November 2008

Length = 623 km

Tentative Cargo Potential = Coal from Talcher to Dhamra and Paradip ports is the most important potential cargo for this waterway. Immediately after the development of the waterway, it is estimated in the DPR that about 11.0 million tonnes of cargo can be transported per year which can go up to 23.0 million tonnes in next 15 years or so.

6) 106 Newly Declared National Waterways

For newly declared national waterways, IWAI is carrying out feasibility studies /DPR through a number of consultants.

1.2 Project Background of the Present Study

IWAI, Ministry of Shipping, Government of India intends to explore the potential of additional waterways across the country for year round commercial navigation. For this, it is planned to study in two stages comprising feasibility study followed by preparation of Detailed Project Report (DPR) and recommending thereafter the possibility of composite and integrated development of proposed waterways to achieve navigation and to develop water transport facilities across India.

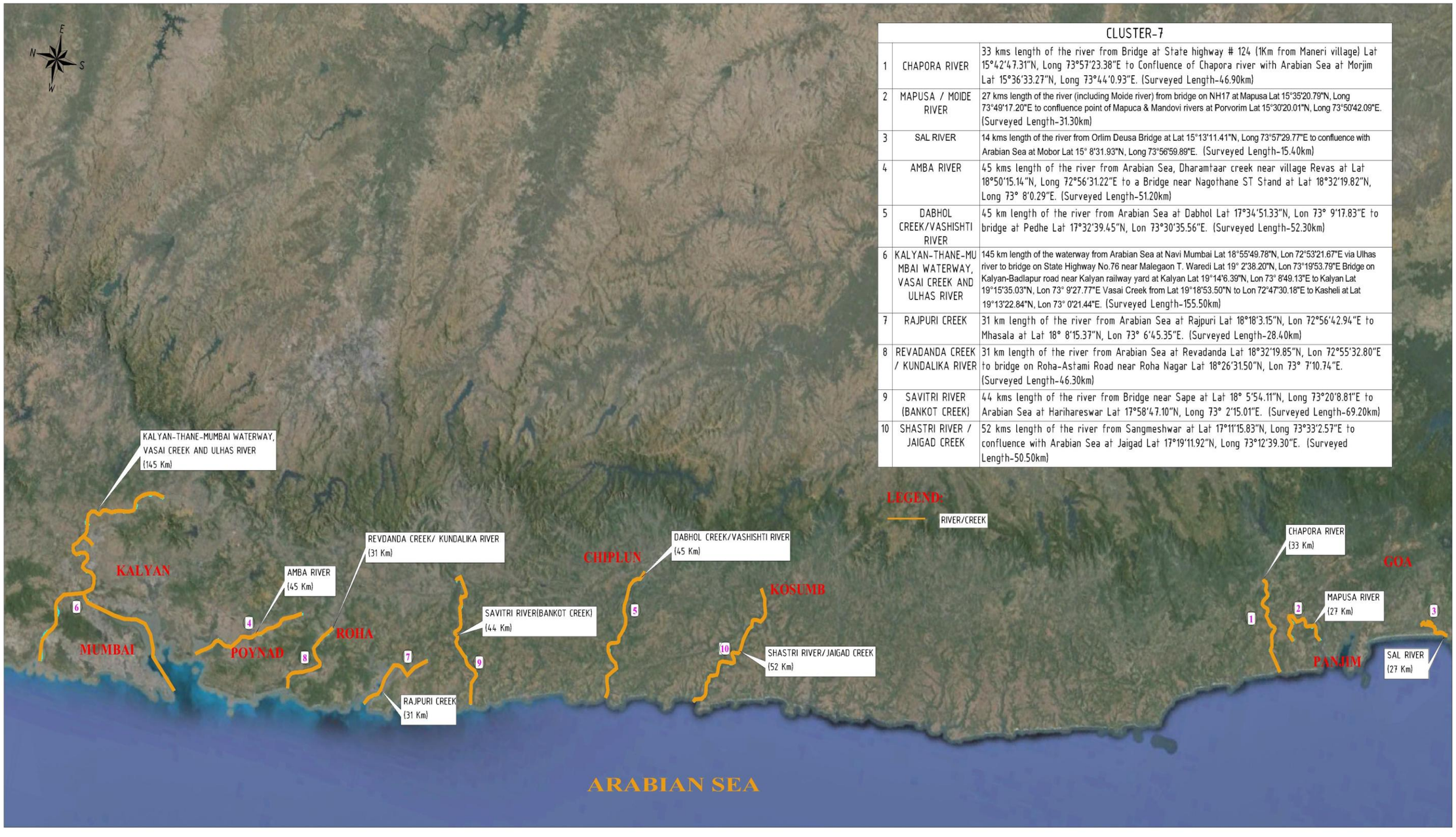
106 more waterways across the country have been declared as new national waterways through a bill passed in the Parliament in March 2016 with contention that the measure is aimed at providing a cheaper mode of transport and reducing traffic burden on the roads. These 106 new national waterways will be in addition to the five existing National Waterways. The proposed legislation is aimed at integrated development of inland waterways throughout the country since the water transport is "lagging behind" road and rail sectors. Promotion of waterways is a priority as it is a cheaper mode of transportation, being economical compared to roads and railways, and at the same time it is environment friendly too.

Feasibility study shall examine the viability of navigational routes and therefore potential to develop waterway transport facility is to be established. This shall be followed by preparation of DPR for those feasible waterways which would include detailed hydrographic surveys and investigation, traffic survey, proposed location for terminals and cost assessment etc. Tractebel Engineering had been awarded two of the clusters i.e. Cluster-VI & Cluster-VII consisting of the rivers/canals/creeks for two stage studies, screen the rivers with respect to navigational feasibility and subsequently prepare a Detailed Project Report for the development of Inland Waterways. This report deals with the study of Rajpuri Creek which is one of the waterways of Cluster-VII which consists of rivers/creeks of Maharashtra and Goa (length-467 km) and described in **Table 1.1** as shown below:-

Table 1.1: List of Rivers/Creeks of Maharashtra and Goa under Cluster-VII (length-467.0 km)

Sl No.	Name of Rivers/ Creeks	National Water Way (NW)	Length (km)	State
1.	Chapora River	NW-25	33	Goa
2.	Mapusa / Moide River	NW-71	27	Goa
3.	Sal River	NW-88	14	Goa
4.	Amba River	NW-10	45	Maharashtra
5.	Dabhol Creek/ Vashishti River	NW-28	45	Maharashtra
6.	Kalyan-Thane-Mumbai waterway, Vasai creek and Ulhas River	NW-53	145	Maharashtra
7.	**Rajpuri Creek**	**NW-83**	**31**	**Maharashtra**
8.	Revadanda creek / Kundalika River	NW-85	31	Maharashtra
9.	Savitri River (Bankot creek)	NW-89	44	Maharashtra
10.	Shastri River/ Jaigad creek	NW-91	52	Maharashtra
	Total		**467**	

The layout plan of all the ten rivers/creeks covered in Cluster-VII, showing the location and Index Map of Rajpuri Creek is are placed as **Figure 1.1 & Figure 1.2** respectively.



CLUSTER-7		
1	CHAPORA RIVER	33 kms length of the river from Bridge at State highway # 124 (1Km from Maneri village) Lat 15°42'47.31"N, Long 73°57'23.38"E to Confluence of Chapora river with Arabian Sea at Morjim Lat 15°36'33.27"N, Long 73°44'0.93"E. (Surveyed Length-46.90km)
2	MAPUSA / MOIDE RIVER	27 kms length of the river (including Moide river) from bridge on NH17 at Mapusa Lat 15°35'20.79"N, Long 73°49'17.20"E to confluence point of Mapuca & Mandovi rivers at Porvorim Lat 15°30'20.01"N, Long 73°50'42.09"E. (Surveyed Length-31.30km)
3	SAL RIVER	14 kms length of the river from Orlim Deusa Bridge at Lat 15°13'11.41"N, Long 73°57'29.77"E to confluence with Arabian Sea at Mobor Lat 15° 8'31.93"N, Long 73°56'59.89"E. (Surveyed Length-15.40km)
4	AMBA RIVER	45 kms length of the river from Arabian Sea, Dharamtaar creek near village Revas at Lat 18°50'15.14"N, Long 72°56'31.22"E to a Bridge near Nagothane ST Stand at Lat 18°32'19.82"N, Long 73° 8'0.29"E. (Surveyed Length-51.20km)
5	DABHOL CREEK/VASHISHTI RIVER	45 km length of the river from Arabian Sea at Dabhol Lat 17°34'51.33"N, Lon 73° 9'17.83"E to bridge at Pedhe Lat 17°32'39.45"N, Lon 73°30'35.56"E. (Surveyed Length-52.30km)
6	KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER	145 km length of the waterway from Arabian Sea at Navi Mumbai Lat 18°55'49.78"N, Lon 72°53'21.67"E via Ulhas river to bridge on State Highway No.76 near Malegaon T. Waredi Lat 19° 2'38.20"N, Lon 73°19'53.79"E Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan Lat 19°14'6.39"N, Lon 73° 8'49.13"E to Kalyan Lat 19°15'35.03"N, Lon 73° 9'27.77"E Vasai Creek from Lat 19°18'53.50"N to Lon 72°47'30.18"E to Kasheli at Lat 19°13'22.84"N, Lon 73° 0'21.44"E. (Surveyed Length-155.50km)
7	RAJPURI CREEK	31 km length of the river from Arabian Sea at Rajpuri Lat 18°18'3.15"N, Lon 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Lon 73° 6'45.35"E. (Surveyed Length-28.40km)
8	REVADANDA CREEK / KUNDALIKA RIVER	31 km length of the river from Arabian Sea at Revadanda Lat 18°32'19.85"N, Lon 72°55'32.80"E to bridge on Roha-Astami Road near Roha Nagar Lat 18°26'31.50"N, Lon 73° 7'10.74"E. (Surveyed Length-46.30km)
9	SAVITRI RIVER (BANKOT CREEK)	44 kms length of the river from Bridge near Sape at Lat 18° 5'54.11"N, Long 73°20'8.81"E to Arabian Sea at Harihareswar Lat 17°58'47.10"N, Long 73° 2'15.01"E. (Surveyed Length-69.20km)
10	SHASTRI RIVER / JAIGAD CREEK	52 kms length of the river from Sangmeshwar at Lat 17°11'15.83"N, Long 73°33'2.57"E to confluence with Arabian Sea at Jaigad Lat 17°19'11.92"N, Long 73°12'39.30"E. (Surveyed Length-50.50km)

Figure 1.1: Location Map of the Proposed Waterway of Cluster-VII in Goa and Maharashtra

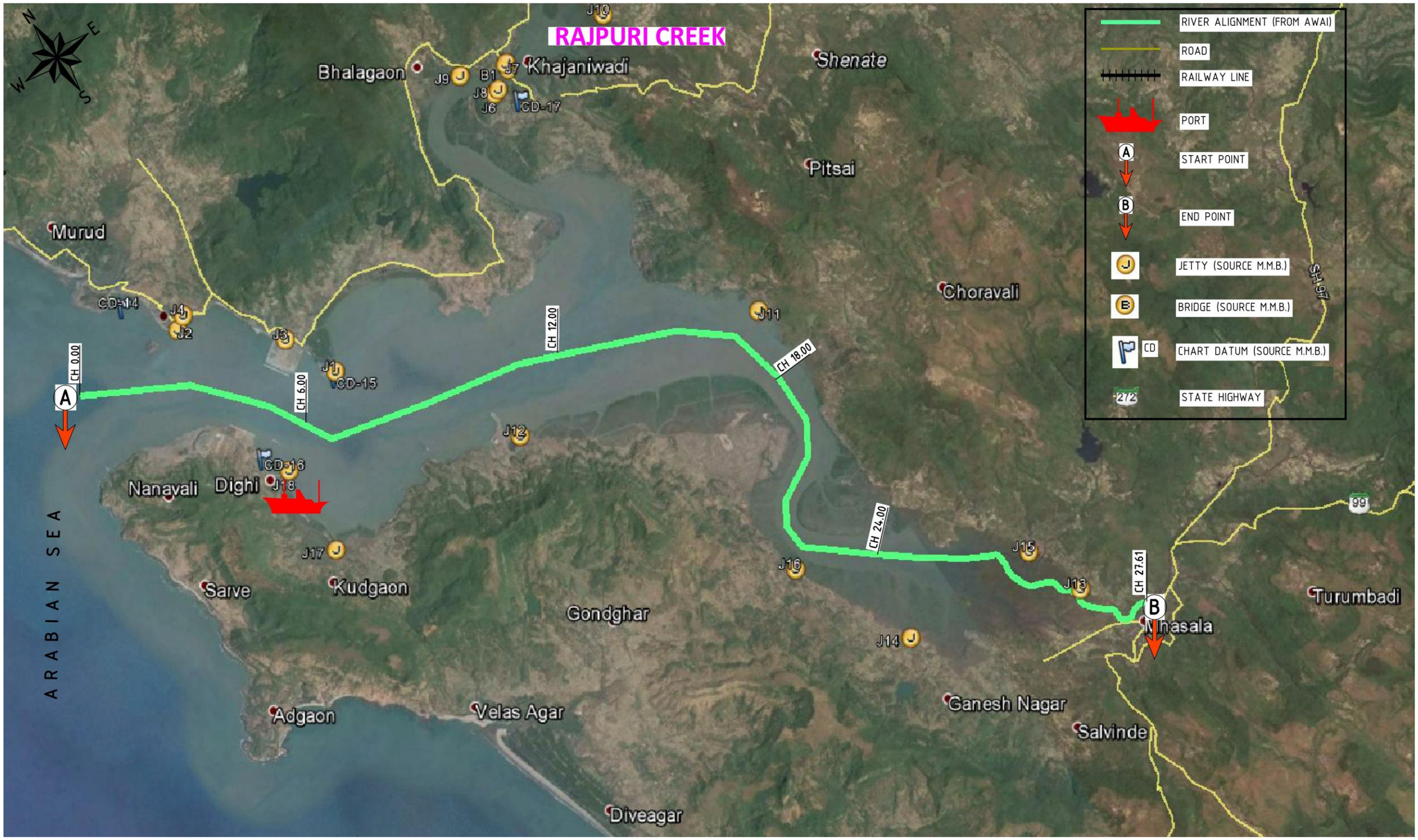


Figure 1.2: Index Map of Rajpuri Creek

1.3 Objectives of the Study

IWAI, Ministry of Shipping, Government of India intends to explore the potential of additional waterways across the country for commercial navigation.

The objectives of the study shall necessarily include:

1. To explore the potential of year round commercial navigation on the proposed National Waterways by conducting feasibility studies.
2. Recommending thereafter the possibility of Composite and Integrated development of proposed waterways under cluster – VII consisting of Creeks/ Rivers to achieve navigation and to develop water transport facilities on these waterways.

After carrying out the feasibility study, if there is scope for navigation and potential to develop waterway transport facility, a Detailed Project Report needs to be prepared for those waterways which would include detailed hydrographic surveys and investigation, traffic survey, proposed location for terminals and cost assessment, viability etc.

1.4 Scope of the Assignment

The complete scope of the assignment shall include the study in two stages:-

1. **Stage-I** is only for feasibility of the waterway for navigation, which may have the potential for year round navigation or at least for a few months in a year.
2. **Stage-II** would consist of the detailed hydrographic survey, topographic survey, detailed traffic survey including the divertible traffic, selection of terminal locations and preparation of detailed project report including the returns /viability analysis for implementation as a project.

This report covers the activities of Stage-I only for feasibility of the **Rajpuri Creek** for navigation, which may have the potential for year round navigation or at least for a few months in a year.

Stage-I consists of the following activities:

A. Reconnaissance Survey

B. Collection and review of available data

C. Feasibility Report

1.5 Methodology Adopted

The Stage I Feasibility Study of the Inland Waterway stretches is based on three approaches:

1. The Physical System
2. The Current Functions and
3. The Market Potential

1.5.1 Physical System

The potential for inland navigation strongly depends on the physical environment. Success of navigation will depend on

- The stability of the channel: frequent variations of channel positions requires river conservancy measures;
- The regime: in most cases good navigation conditions are required most of the time for fluvial navigation to develop as a competitive transport mode, if such conditions are not met, other – more reliable - modes of transportation will be used, making it difficult to get a return on the investments required for navigation (ships, maintenance, port infrastructure):
    - The regime which defines the variability of water depth, draft and water level (position of port infrastructure, vertical clearance at bridges).
    - Sediment supply: certain stretches are characterized by high sediment supply, developing such sections would require high maintenance efforts to keep the channels at depth, it must be economically and technically feasible to maintain a balance between dredging and sediment supply, therefore the decision to construct barrages to increase the water depth, must be taken with care, as these may act as sediment traps.
- Hydrographic characteristics of the channel: depth and width of the channel. The fairway design shall conform to channel geometry. The discharge should guarantee sufficient water depth alternatively, weirs, canals could be constructed to allow required water depth for safe navigation.

From a quick scan of satellite images it becomes clear that the morphological and hydrological conditions of the different rivers vary strongly, even within the same river. Satellite images provide a complete, accessible and qualitative data source for a first appraisal of potential.

Morphological features can be easily derived from satellite images. The morphological analysis of satellite images therefore has been used as a basis for a first, but reliable appraisal of the physical potential of the river for navigation has been considered based on ground verification. Such analysis is therefore proposed as one of the methods in stage I.

It should be pointed out that the period in which the satellite images have been taken may strongly affect the appearance: otherwise dry sections may well be flooded in monsoon season. A careful evaluation shall be contemplated. Also, information obtained from water managers such as CWC, and local authorities will be a useful complement to evaluate navigability.

1.5.2 Current Functions

Current functions of the river have also been taken into consideration:

- Navigation, present in certain areas – it's relevant to know why, how it's organized:
  - Transportation of people (including the tourism potential) and goods
- Structures aligned to rivers
- Crossing infrastructure
  - Bridges: vertical clearance, may even be absent for navigation
  - Weirs, barrages: water supply, regulation, hydropower,
  - Ferry terminals: variations in water levels and terminal infrastructure
- Fishery
- Mining, occurring along certain rivers, and depending on (the often) shallow channels for processing
- Irrigation/ water supply, the available water may be shared between different functions, barrages exist to tap water for supply – as Indian agriculture is important for the GDP and the employment of most of the population, equilibrium must be found between available water resources and additional uses such as use for navigation.

1.5.3 Market Potential

Historically economic demand is a driving force behind waterway development. In several cases waterways were constructed and developed for specific industries. Also navigation was developed using existing irrigation or water supply canals. Further the accessibility also was another driving force, when alternative mode of development was difficult/ uneconomical.

In an emerging economy, such as India, the presence of waterways probably will also stimulate further economic development. While rail and road networks connect cities and industrial areas independently of the hydrographic network, now it must be analyzed where the hydrographic network can establish alternative and new links between cities. In navigable portions such links would be logical.

Environmental concerns viz. the emissions, consequences on air pollution and climate change, and social and economic pressure of congestion, led to a boost of inland navigation projects in all around the world. Such development can also be expected in India, as the development of waterways may be economically and socially more beneficial than the construction of the road and rail networks, not necessarily as a substitute, but to be developed in parallel, in a multi-modal transportation system.

The current scope for Stage I is executed as per following framework shown in **Figure 1.3**.

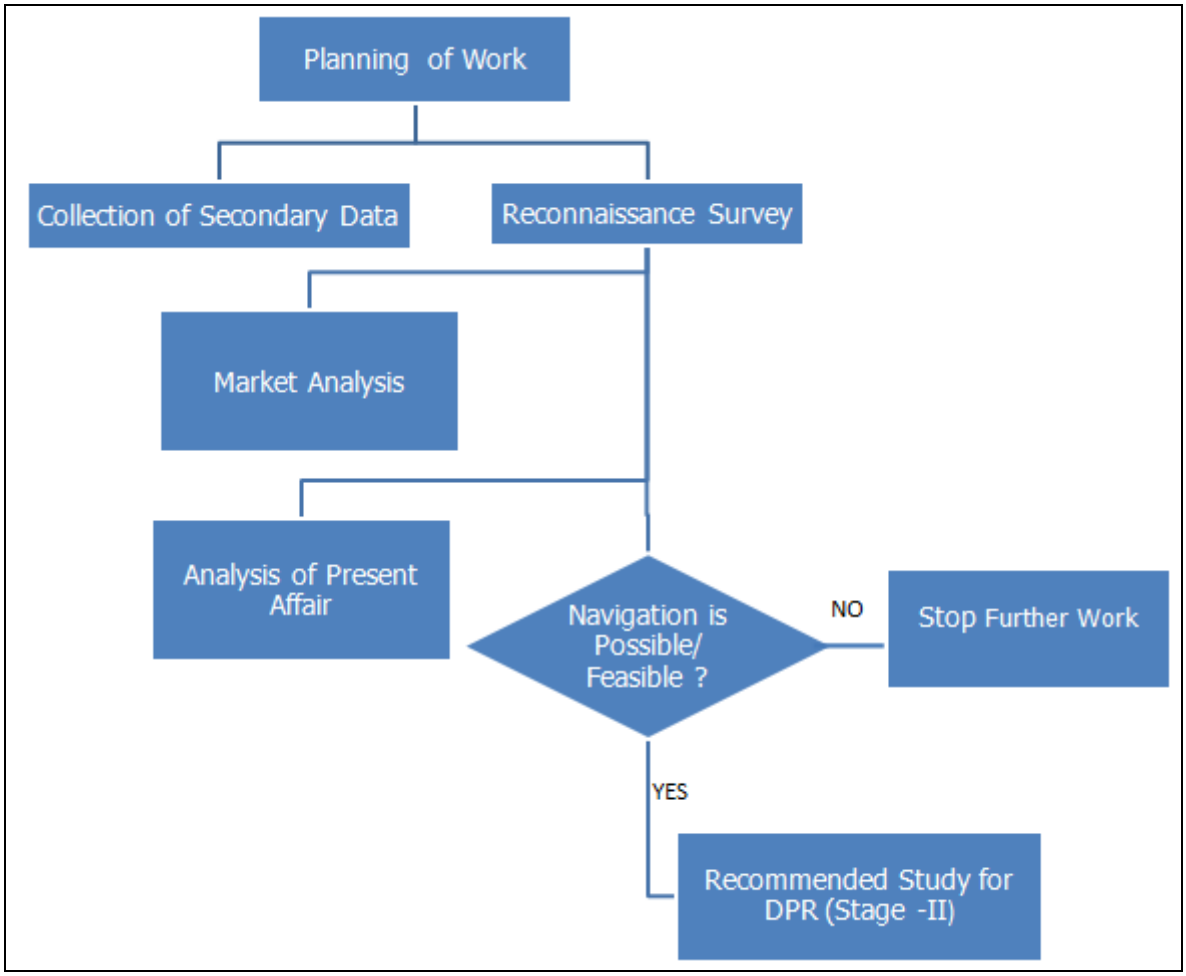


Figure 1.3: Execution Framework for Stage I

1.6 Collection of Data

For evaluating the feasibility of the waterway in Rajpuri Creek for year round navigation, the reconnaissance survey for collecting the Primary data has been taken up. Secondary data have also been collected from various sources. IWAI issued a letter in the name of M/s Tractebel, to all the concerned stakeholders for data collection from State/ Central Government.

(A) **Primary Data:** M/s Tractebel Engineering Pvt. Ltd. has appointed a separate survey agency M/s Fugro Survey (India) Pvt. Ltd. (FSINPVT) for carrying out the reconnaissance survey for collection of following primary data:

(i) Single line longitudinal survey (Bathymetric survey or Topographic survey);

(ii) Details (horizontal and vertical clearances above High Flood Level of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route etc;

(iii) Details of locations of permanent structures viz. Bridges, Barrages, Dams, Locks, Jetties, Ports etc;

(iv) Photographs of important structures along the route;
(v) Topographical features of the proposed Inland Waterways;
(vi) Typical physical features along the alignment i.e. land use pattern;
(vii) Preliminary identification of stretches having year round flow;
(viii) Critical depth for navigational purpose;
(ix) Preliminary Traffic identification on the proposed Inland Waterways;
(x) Inland Waterway width, Terrain, Bridges and structures across the proposed Inland Waterways;
(xi) Urban areas (location & extent);
(xii) Geologically sensitive areas environmental features;
(xiii) Critical areas requiring detailed investigations;
(xiv) Soil (textural classifications) (only visual inspection at every 10km);
(xv) Drainage conditions;
(xvi) Existing utility services along the alignment;
(xvii) Present Status of navigation on different sub stretches of the waterway;

All the data derived from the above reconnaissance surveys shall be utilized for planning and programming the detailed surveys and investigations. All reconnaissance field studies including the traffic surveys have been taken up and the classification of proposed waterway has been carried out as per IWAI guidelines on this matter. The list of data collected and sources of data are being enclosed as **Annexure 1.1**.

(B) **Secondary Data:** The following secondary data has been collected from the concerned authorities as well as from available sources in public domain.

(i) Bench Mark Data from IWAI, Noida;
(ii) Chart Datum data from MMB, Maharashtra;
(iii) Brief Industrial Profile of Raigad District, Ministry of Micro, Small & Medium Enterprises (MSME), Government of India;
(iv) Report on Environmental Status of Raigad Region, Maharashtra Pollution Control Board, Mumbai;
(v) Cargo Movement Data for the Year 2014 and 2015 provided by IWAI and recent data collected by the consultant;

All the data derived from the above reconnaissance surveys details shall be utilized for determining the navigability of the proposed national waterway. A review of the existing data available with the State Agencies and Central Water Commission for the proposed Inland Waterways has been done for determining the nature, extent, adequacy, validity of the available data and identifying the data gaps. Feasibility Report is to be prepared for the proposed national waterway based on the available data, reconnaissance survey and the market analysis. The structure of the report has been elaborated in succeeding section 1.9 of this chapter.

1.7 Expected Outcome of the Assignment

Combining knowledge on the physical constraints, actual and future uses of the river and the valley, economic potential and needs, or absence thereof, allows the characterization of the river for development as a waterway.

The reconnaissance survey data with regard to physical constraints may have cost implications for making the river stretch navigable. The potential of possible navigation in the stretches of proposed inland waterways has been determined using raw water depths reduced to the chart datum in the area of tide affected rivers. To define the navigability of river/creeks, several gradations can be distinguished:

- No or limited effort: navigable (for a specific draft) without measures;
- Limited to moderate effort: e.g. occasional dredging works at a limited number of location;
- Moderate to high: frequent dredging over a considerable length or large number of locations;
- High to very high: the construction of one or more weirs and or locks, or the construction of a canal;

In accordance with the above criteria, the stretch of the proposed waterway of Rajpuri Creek under Cluster VII has been defined in the context of availability of navigable depth (more than 2m). Taking into account for further development in the stretches of less than 2m depth, the solutions for the navigation has been proposed.

Combining economic potential and physical characteristics allows categorizing the river or specific stretches for navigation potential on the basis of following criteria:

(i) Water Availability
(ii) Flow Depth
(iii) Vertical & Horizontal Clearance
(iv) Nautical Continuity
(v) Cargo availability
(vi) Economic & Social Parameters

The analyses of physical and economic parameters have been the basis of a suggestion for classification of Inland waterways for further study. The waterways shall be classified into categories of Class-I to Class VII as per description derived from the compilation of Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulations, 2006. Referring the data derived from the reconnaissance single beam bathymetry survey, cargo traffic details, market potential, vertical and horizontal clearances with respect to existing cross over structures, the proposed waterway has been classified in seven categories on the basis of IWAI guidelines for safe plying of self-propelled vessels up to 2000 Dead Weight Tonnage (DWT) and tug-

barge formation in push-tow units of carrying capacity up to 8000 DWT. A recommendation of a selection of proposed inland waterway stretch has been done (based on IWAI classification) for further analysis and preparation of DPR in Stage II.

1.8 Description of Rajpuri Creek (NW-83)

Rajpuri is one of the important creeks of Maharashtra coast. The Rajpuri Creek passes through the Raigad district and meets Arabian Sea at Rajpuri Village. The detailed description of the creek has been compiled in **Table 1.2**.

Table 1.2: Description of Rajpuri Creek (NW-83)

Sl. No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Rajpuri Creek (NW-83)
2	State/ District through which river passes	The Rajpuri Creek passes through the Raigad district of Maharashtra State.
3	Length of the river / canal	Rajpuri Creek from Arabian Sea at Rajpuri village Lat 18°18'3.15"N, Long 72°56'42.94"E to Mhasala at Lat 18° 8'15.37"N, Long 73° 6'45.35"E has been declared as new national waterway.
4	Map	The index map of Rajpuri Creek showing proposed waterway stretch, topographic features and road networks are shown in **Figure 1.2**. The section of the Rajpuri Creek under feasibility study for inland waterway showing reconnaissance survey routes is presented in **Drawing No. P. 009051-W-20201-A07 (Sheet – 1 to 7)**.
Characteristic of River		
5	River Course	The Rajpuri Creek is named on "Rajpuri", a village situated at a distance of 4 kms from Murud Janjira Taluka, in the Raigad district of India. The Rajpuri village is situated near the confluence with Arabian Sea. The famous island fort of Janjira is situated in the Rajpuri Creek which is the birth place of the famous Balaji Avaji Citnis whose father Avaji was the Diwan of the Sidis of Janjira. As per physical observations, the banks of Rajpuri Creek are stable and covered with mangrove plants in major portion. All-weather Dighi port is located in Rajpuri creek, Raigad District about 45 nautical miles south of Mumbai.
6	Tributaries / Network of Rivers / Basin	The Rajpuri Creek is not having any major tributaries in the study stretch.
7	Catchment Area	The total catchment area of Rajpuri Creek is 592 sq. km.

1.9 Structure of the Feasibility Study Report (FSR)

The Feasibility Study Report for proposed Inland Waterway of **Rajpuri Creek** has been prepared and emphasizes which stretches of proposed inland waterway have the potential for navigation. Stage-II study for preparation of DPR shall be carried out only for those stretches of proposed inland waterway, which have the potential for navigation,

The Feasibility Study Report starts with a comprehensive report in the form of executive summary giving description of the methods used for the data collection and overview of the collected data followed by a description of the Present State of Affairs, Reconnaissance Survey, findings of Market Potential and the observations and inferences thereof.

The executive summary concludes with Waterway Navigation Potential of the proposed waterway on Rajpuri Creek followed with recommendations for going ahead with classification of river. The structure of FSR is as below;

I. **Executive Summary:** Executive summary describes the suitability of the proposed waterway in terms of its navigability and market potential. It contains a brief statement of the characteristics of the river, present use of the river, data captured in the reconnaissance survey, hindrances, acceptability of the waterway, enhanced connectivity to the region, capability to decongest the existing mode of transport, important aspects for techno commercial viability etc. The background information, concise analysis and main conclusions form part of the document. It helps to understand the overall scenario and decide the suitability of development of a specific waterway.

II. **Introduction:** This chapter describes the Project background of the present study, objective of the assignment, scope of the assignment, methodology adopted, outcome of the assignment, river characteristics including the structure of the feasibility study report.

III. **Analysis of Present State of Affairs**: It provides the details about the existing town/ city/ taluka/ historical & tourist places, current utilization of proposed waterway, status of goods transport, road and rail transport as well as existing river facilities. The quantitative and qualitative description of the current utilization of proposed inland waterways are provided in the report. In addition, the descriptions about the status of goods transport, including utilization of road and transport services as well as river facilities have been covered.

IV. **Reconnaissance Survey:** The analysis of the data collected in the reconnaissance survey has been carried out to reflect the possibility of year round flow in the proposed Inland Waterway to achieve the

commercial navigation. Bathymetry survey details, observed bed profiles and soil texture classification @ 10 km are compiled in this section. Observed waterway bed profile has been plotted with respect to existing Chart Datum in case of tidal affected rivers else the bed profile relates to CWC/ Irrigation water level data or FSL in case of canal. Maps of proposed Inland Waterways have been generated and referred with at the relevant locations indicating existing cross structures viz. bridges, jetties, established chart datum locations, dams, barrages, HT line, LT line, water pipe line, cables etc.

V. **Market Analysis:** The analysis of the market and potential usage of proposed Inland Waterway have been carried out. In the analysis, both the existing market and the potential future market have been examined. The details of available existing Industries along the waterway, type of production in these industries, ferry services, cargo movement, type of crop along the waterway, previous history of movement of cargo in the waterway etc. have been collected and included in the report. All the data have been collected after discussion with local people while conducting reconnaissance survey etc. and also after interaction with State Govt. Officials, Irrigation / Water Resources Departments and other stakeholders. The possible divertible cargo to IWT has been assessed.

VI. **Observations and Inferences**: The observations and Inferences of the feasibility study are presented in context of stretches of proposed inland waterway, which have potential for navigation and for which Stage-II studies may be conducted. Technical Feasibility has been discussed which shall establish the navigability and potential usage of proposed Inland Waterway. The stretches of proposed inland waterway which have potential for navigation have been categorized into Class-I to Class VII as per description derived from classification of rivers/canals by Inland Waterways Authority of India Regulations, 2006. SWOT Analysis of Proposed Waterway has also been described covering the overall aspects of the proposed waterway in terms of its Strength, Weakness, Opportunity and Threat to decide the suitability and the ranking of the waterway.

CHAPTER 2 ANALYSIS OF PRESENT STATE OF AFFAIRS

In order to establish the feasibility of waterway the present state of affairs as existing today along proposed inland waterway on Rajpuri Creek (NW-83) is studied. Out of total 44.0km length of the Creek, 31 km has been proposed by IWAI for feasibility study. This chapter provides detail about the current affairs, status of goods transport including utilization of road and rail transport along or near by the waterway.

2.1 Current Utilization

The total length of the Rajpuri Creek is about 44km before joining the sea. The river is under tidal effect of the Arabian Sea (backwater effect) upto Mhasala i.e., about 31 km from sea. Presently, Rajpuri Creek waterway is under multipurpose commercial utilization through Dighi Port at chainage 4km. It is in a strategic international and domestic shipping route. In 2015-16 Dighi Port handled 0.78 MMTPA of cargo which included Thermal Coal, Steel Coil, Bauxite, Carbon Black, Nitrate Potash and Oil. There is a significant passenger movement in this waterway through the existing 19 jetties, including the Dighi Port. In 2015-16, about 18 lakh passengers used ferry services. There are Ro-Ro services at two sites from Agardanda to Rohini and Agardanda to Dighi handling about 115,000 vehicles per year. Rajpuri Creek waterway is also used for fishing purpose by locals. Details of existing structures along and across Rajpuri Creek waterway is presented in following sections.

2.1.1 Existing Waterway Structures

Existing waterway structures/ facilities in Rajpuri Creek waterway include ports and jetties which is being used for cargo movement, Ro-Ro services, passenger movement and fishing activities. **Table 2.1** below provides the detail of existing facilities along Rajpuri Creek Waterway with current utilization status.

Table 2.1: Existing Facilities on Rajpuri Creek (NW 83)

Sl. No.	Existing Facility	Chainage (Km)	Coordinates DD MM SS	Current Utilization
1.	Rajpuri Jetty	3.0	18 17 59.40-N 72 58 15.60-E	Fishing Port Ferry Service between Rajpuri - Janjira Fort (The 15th Century Murud), Rajpuri-Dighi Frequent Ferry services are available between Rajpuri on north bank to Janjira Fort on Island. Without sail boat, tourist can't reach on Janjira fort. Sail boats are available at Rajpuri jetty to reach the Janjira Fort. The ferry takes about 30 minutes to reach the fort.
2.	Rajpuri Kolivada Slope Jetty	3.9	18 18 05.30-N 72 58 25.30-E	Used by locals for fishing and occasional travel.

Sl. No.	Existing Facility	Chainage (Km)	Coordinates DD MM SS	Current Utilization
3.	Rajpuri Kolivada Jetty	4.10	18 18 05 00-N 72 58 26.90-E	Used by locals for fishing and occasional travel.
4.	Dighi Mohalla Jetty	4.50	18°16'37.15"N 72°58'09.99"E	Ferry Service is on between Rajpuri-Dighi
5.	Agardanda Port Jetty	5.30	18°17'6.50"N 72°59'21.40"E	Ferry Service is on between Agardanda – Rohini
6.	Dighi Port	5.80	18°15'47.17"N 72°58'26.02"E	It is a multipurpose, multi cargo, all weather port with deep draft, direct berthing facilities and state-of-the-art cargo handling equipment with adequate Stack Yards and Warehousing facilities, Back up area with ample Land bank of approximately 1600 acres. The North Bank of the port is connected to (National Highway) NH-17 via (State Highway) SH-92 and SH-96 and the South Bank is connected to NH-17 via SH-97 and SH-98. In 2015-16, 0.78 MMTPA cargo handled which included Thermal Coal, Steel Coil, Bauxite, Carbon Black, Nitrate Potash and Oil.
7.	Agardanda Slope Jetty	6.80	18°16'26.00"N 72°59'39.9"E	Ferry Service is on between Agardanda – Rohini
8.	Kudgaon Jetty	6.90	18 14 39.70-N 72 58 21.50-E	Used by locals for fishing and occasional travel.
9.	Bhalgaon Jetty	11.00	18 18 26.30-N 73 03 11.30-E	Used by locals for fishing and occasional travel.
10.	Vashi Jetty	17.00	18 13 56.50-N 73 04 41.50-E	Used by locals for fishing and occasional travel.
11.	Mendadi	22.50	18 11 07.30-N 73 03 11.70-E	Used by locals for fishing and occasional travel.
12.	Kharsai	25.00	18 09 36.70-N 73 03 56.50-E	Used by locals for fishing and occasional travel.
13.	Pabhre Jetty	27.50	18 09 35.70-N 73 05 51.01-E	Used by locals for fishing and occasional travel.
14.	Khargoan Jetty	29.10	18 08 51.20-N 73 06 08.20-E	Used by locals for fishing and occasional travel.
15.	Mandad Slope Jetty		18 18 00.70-N 73 03 26.00-E	Used by locals for fishing and occasional travel. Data given by MMB. Doesn't fall on the Waterway.

Sl. No.	Existing Facility	Chainage (Km)	Coordinates DD MM SS	Current Utilization
16.	Rajpuri creek/Trumbadi Jetty		18°14'26.80"N 73° 1'11.70"E	Ferry Service is on between Agardanda – Rohini. Data given by MMB. Doesn't fall on the Waterway.
17.	Kunda Jetty		18 18 01.60-N 73 03 30.10-E	Used by locals for fishing and occasional travel. Data given by MMB. Doesn't fall on the Waterway.
18.	Khajni Jetty		18 18 13.40-N 73 03 45.90-E	Used by locals for fishing and occasional travel. Data given by MMB. Doesn't fall on the Waterway.
19.	Rahatad Jetty		18 17 59.70-N 73 05 10.50-E	Used by locals for fishing and occasional travel. Data given by MMB. Doesn't fall on the Waterway.

Figure 2.1 to 2.4 shows the view of some of above mentioned facilities.

Figure 2.1: Rajpuri Jetty at Chainage 3.521 Km

Figure 2.2: Dighi at Chainage 4.734 km

Figure 2.3: Agardanda Jetty at Chainage 6.515km

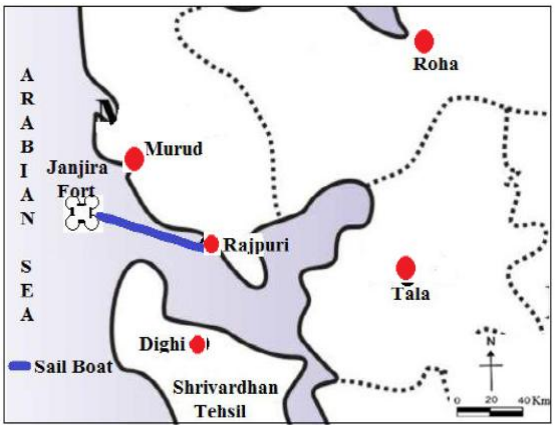


Figure 2.4: Ferry Route Between Hanjra And Rajpuri

2.1.2 Crossing Over Rajpuri Creek Water Way

There is no bridge on Rajpuri Creek in the reach considered for study. However, there is one bridge on right tributary (near Chaingae 12.2km) of river. Bridge joins the Mandad Khajani Road. **Table 2.2** shows the inventory of existing crossing over structures on Rajpuri River on the tributray meeting river in proposed stretch.

Table 2.2: Details of Rail and Road Bridges across Rajpuri Creek

Sl. No.	Name of Structure	Chainage w.r.t to River (km)	Horizontal Clearance from river (m)	Vertical Clearance Above MHWS (m)	Position	
NO BRIDGE ON THE MAIN COURSE OF WATERWAY						
1.	Mhasala to Khargaon Bridge (on the Tributory)	Near 12.2	20	5.5	18°8'11.70"N	73°06'52.70"E

2.2 Connectivity of Waterway

Proposed stretch of Rajpuri Creek waterway lies in the coastal area of Raigad district which is well connected with the state capital and surrounding districts, tehsils and villages through roads and rails. **Figure 2.5** shows road and rail connectivity of the area adjacent to the proposed Rajpuri Creek waterway.

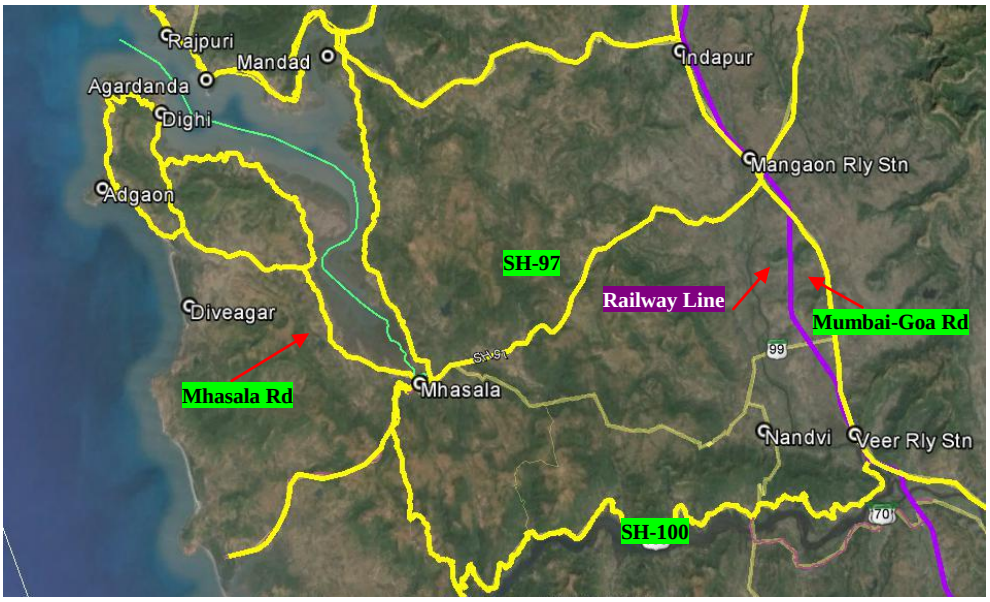


Figure 2.5: View of Rail and Road Network around Rajpuri Creek waterway

In the above figure, Rajpuri Creek is shown in green colour whereas yellow and purple colours represent the road and rail network respectively. From the above, it may be seen that the stretch of Rajpuri Creek under study is well connected with road and rail network.

2.2.1 Important Places

Along the proposed waterway stretch of Rajpuri Creek, following district/ town/ taluka/ historical places/ tourist and pilgrim places are located as shown in **Table 2.3.**

Table 2.3: List of District/Town/Taluka in the vicinity of Rajpuri Creek Waterway (Length-31.0 km)

Sl. No.	Important Places	Category	Distance from Creek/River (km)	Bank
1.	Mangaon	Taluka	21	Right Bank
2.	Mhasala	Taluka	0.4	Left Bank
3.	Murud	Taluka	3.5	Right Bank
4.	Tala	Taluka	9.0	Right Bank
5.	Goregaon	Town	18.0	Right Bank
7.	Ranavali	Village	8.0	Left Bank
10	Gondghar	Village	5.0	Left Bank
11.	Agardanda	Village	0.2	Right Bank
12.	Dighi	Village	0.2	Left Bank
13	Nanavali	Village	1.0	Left Bank
14	Rajpuri	Village	0.3	Right Bank
15	Janjira Fort	Fort on Island	0.7	Creek

2.2.2 Road Connectivity

The district headquarters Raigad and other fifteen tehsils of district are well connected to each other by roadway for transport and trade to major cities within the state. According to the 2001 census, the total length of the roads in district is 5575.06km. Out of which cement concrete road is 247.91km, black topped road is 4098.4km, water bound macadam is 799.96km and other roads are 428.79km. The road network around waterway consists of National Highways (NH), State Highways (SH), Major District Roads and Village Roads.

Roads between Rajpuri-Indapur and Dighi-Mangaon on right bank and left bank of Creek respectively, connect the creek with Mumbai-Goa National Highway.

2.2.3 Rail Connectivity

There is a good connectivity of railways in Raigad district. Central Railway, Konkan Railway and Harbor Railway pass through the district having 39 stations and about 53 express trains halt at different stations in the district. The total length of the railway route in the district is 292.53km. Long journey express trains stop at selected stations like Panvel, Pen, Nagothane, Roha and Mangaon in the district.

End of the proposed Rajpuri Creek waterway is at Mahasala which is about 29.5km form Mangaon railway station and 38km from Veer railway station. Mangaon and Veer railway stations are on Konkan railway line about 41 and 47 km from Panvel (Origin point of Konkan Railway Line)

2.3 Status of Goods Transport

Status of goods transport through Rajpuri Creek waterway is detailed in **Chapter 4 on Market Analysis** of this report.

2.4 Conclusion

a) Rajpuri Creek is one of the important creeks of Maharashtra coast in Raigad. Total length of Rajpuri Creek is 44 km before joining the sea. The Creek is under tidal influence of Arabian Sea (backwater effect) upto Mhasala (about 31 km), thus total study stretch of National Waterway (NW-83) is under tidal effect.

b) Out of 31 km length of proposed waterway, 4 km is presently under multipurpose commercial utilization through existing port at Dighi. Dighi Port is in a strategic international and domestic shipping route. In 2015-16 Dighi Port handled 0.78 MMTPA of cargo which included Thermal Coal, Steel Coil, Bauxite, Carbon Black, Oil and Nitrate Potash

c) Beyond Dighi Port, there is a minimum cargo movement observed in the waterway.

d) There is a significant passenger movement in this waterway. In 2015-16, about 18 lakh passengers used ferry services. The 15th Century Murud – Janjira Fort on Island is a famous tourist place and is accessible through Rajpuri Creek Waterway. Frequent Ferry services are available between Rajpuri on north bank to Janjira Fort on Island. There are Ro-Ro services at two sites from Agardanda to Rohini and Agardanda to Dighi handling about 115,000 vehicles per year.

e) Fishing activity is a common aspect of the creek in current utilization. The fishing season is active throughout the year in Rajpuri Creek.

f) The area in and around proposed waterway is well connected through rail and road network. Panvel is main nodal point of NH-17, NH-4, NH-4B and Expressway and the main junction of Central Railway, Konkan Railway and Harbour Railway. End point of the study reach in Rajpuri Creek waterway at Mahasala which is about 29.5km form Mangaon railway station and 38km from Veer railway station. Mangaon and Veer railway stations are on Konkan railway line about 41 and 47 km from Panvel.

g) There are 19 jetties existing in this waterway. (including the Dighi Port).

h) There is no cross over structure in the study reach of Rajpuri Creek.

CHAPTER 3 RECONNAISSANCE SURVEY

3.1 River Profile

Rajpuri Creek is one of the important Creeks of Maharashtra coast. The Rajpuri Creek is named after "Rajpuri", a village situated at a distance of 4 km from Murud Janjira Taluka in the Raigad district of India. The Rajpuri village is situated near the confluence of Creek with Arabian Sea. The famous island fort of Janjira is situated in the Rajpuri Creek. All-weather Dighi port is located in Rajpuri creek in Raigad district. Dighi port is about 45 nautical miles south of Mumbai.

The total catchment area of Rajpuri creek is 592 sqkm. The total length of the creek from origin to its outfall in the Arabian Sea is about 44.0km. A map showing Rajpuri creek catchment basin is shown in **Figure 3.1**. Rajpuri creek has a relatively small catchment area; its tributaries are small streams and feeder local streams. The important towns located on the banks of Rajpuri creek are Mangaon, Mhasala, Murad, Tala and Goregaon.

Figure 3.1 indicates that most part of the creek flows close to the coastal region; thus the lower stretch of river is expected to be tidal affected zone. Given the size of the creek, lower reaches may have navigation potential. IWAI expects the lower 31.0km, shown in green colour in the **Figure 3.1**, to have potential for navigation and thus, the subject of study under this assignment.

Figure 3.1: Catchment Area of Rajpuri Creek

The stretch of the Rajpuri Creek considered for assessment of navigation potential is defined as below:

31 km length of the river from Arabian Sea at Rajpuri to Mhasala	From: 18°18'3.15"N 72°56'42.94"E	Up to: 18° 8'15.37"N 73° 6'45.35"E	National Waterway: 83

3.2 Reconnaissance Survey

This section presents a stretch-wise description of Rajpuri Creek. It also covers the hydrological analysis of collected data viz Maximum and Minimum water depths. The route map of Rajpuri Creek waterway is shown in **Figure 3.2** below.

Figure 3.2: Route Map of Rajpuri Creek

3.2.1 Methodology of Survey

Single beam bathymetry survey was carried out to determine river profile along its deepest route (single line survey) along the proposed waterway by deploying DGPS positioning system and single beam echo sounder. Wherever bathymetry survey was not feasible due to shallow water depths, survey was continued using topography survey method.

Along with the river bathymetry, other relevant data/information like horizontal and vertical clearances above high flood level of bridges, aqueducts, electric lines, telephone lines, pipe lines, cables en-route were collected along with their coordinates and locations. Soil samples were also collected along the survey area at about 10.0km interval. Texture of the collected soil samples was analyzed visually.

The survey was conducted in WGS84 datum; UTM Projection (Zone 43 N, CM 075° E). The geodetic parameters used during the survey are mentioned in **Table 3.1**:

Table 3.1: Geodetic Datum and Projection Parameters

Global Positioning System Geodetic Parameters	
Datum:	World Geodetic System 1984
Spheroid:	World Geodetic System 1984
Semi Major Axis:	a = 6 378 137.000m
Inverse Flattening:	1/f = 298.257 223 563
Map Projection:	Universal Transverse Mercator
Grid System:	UTM Zone 43 N;
Central Meridian:	075° 00’ 00” East
Latitude of Origin:	0° 00’ 00” North
False Easting:	500 000m
False Northing:	0m
Scale Factor on Central Meridian:	0.9996
Units:	Metre

The layout diagram of the equipment used for bathymetric survey has been shown in **Figure 3.3** below:

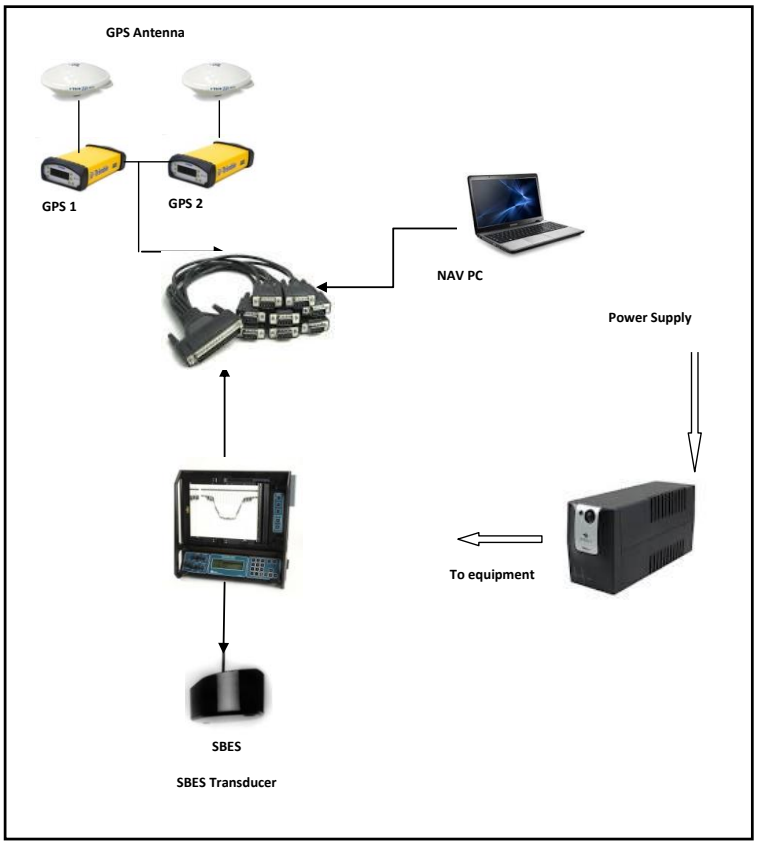


Figure 3.3: Equipment Diagram

Team surveying at site with equipment mounted on the boat is depicted in **Figure 3.4** as shown below:

Figure 3.4: Team Surveying at Site with Equipment Mounted on the Boat

An overview chart for Rajpuri Creek bathymetry is enclosed as **Annexure 3.1**.

3.2.2 Chart Datum of the Proposed Waterway

The water depths have been determined as a result of all soundings reduced to Chart Datum (the lowest tide level observed for a considerable period at specific location) in the area. The locations with coordinates of Chart Datum obtained from MMB (**Annexure 3.2a** to **Annexure 3.2d**), is compiled for record purpose and placed in **Table 3.2**.

Table 3.2: Details of Chart Datum Used for Data Reduction

Sl. No.	Location	Latitude	Longitude	Z_0 *(m)
1	Janjira	18° 18' 35"	72° 57' 50"	2.1640
2	Agardanda	18° 16' 22"	72° 59' 38"	2.3804
3	Dighi	18° 16' 05"	72° 58' 15"	2.2838
4	Mandad	18° 17' 45"	73° 03' 40"	2.5076

**- Below Mean Sea Level*

However, the authenticated data of Chart Datum as ascertained from Indian Tide Table of Apollo Bandar has been used for this subject study, as detailed.

Sl. No.	Location	Latitude	Longitude	Z_0^* (m)
1	Apollo Bandar	18°55'13.29"	72°49'46.65"	2.51

**- Below Mean Sea Level*

3.2.3 Bathymetry and Site Data Collected

A. Rajpuri Creek (Ch 0.00km to 6.00km)

The creek starts from the Arabian Sea at Lat 18° 18' 03.15" N, Long 72° 56' 42.94" E, with Rajpuri located on its north bank and Dighi Port on the south bank. The Murud-Janjira Fort is situated on an island near Ch 3.00km close to the north bank, from where there are passenger boats regularly plying across to the Murud Ferry Jetty near Rajpuri. The Rajpuri Jetty is on the north bank near Ch 3.84km from where there is a ferry route to Dighi Jetty. The Dighi Port is seen near Ch 4.0km with its channel buoys in the river. Near the Ch 5.80km, the Rajpuri to Dighi Ferry Route terminates at Dighi Jetty on the south bank. The minimum depth recorded in this section is 6.2m (Ch 0.10km to Ch 0.40km) and the maximum depth is 9.1m (Ch 4.50km) as tabulated below:

Table 3.3: Maximum-Minimum Depths in Rajpuri Creek from Ch 0.00km – Ch 6.00km

Maximum –Minimum Depths			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
0.0	6.0	9.1	6.2

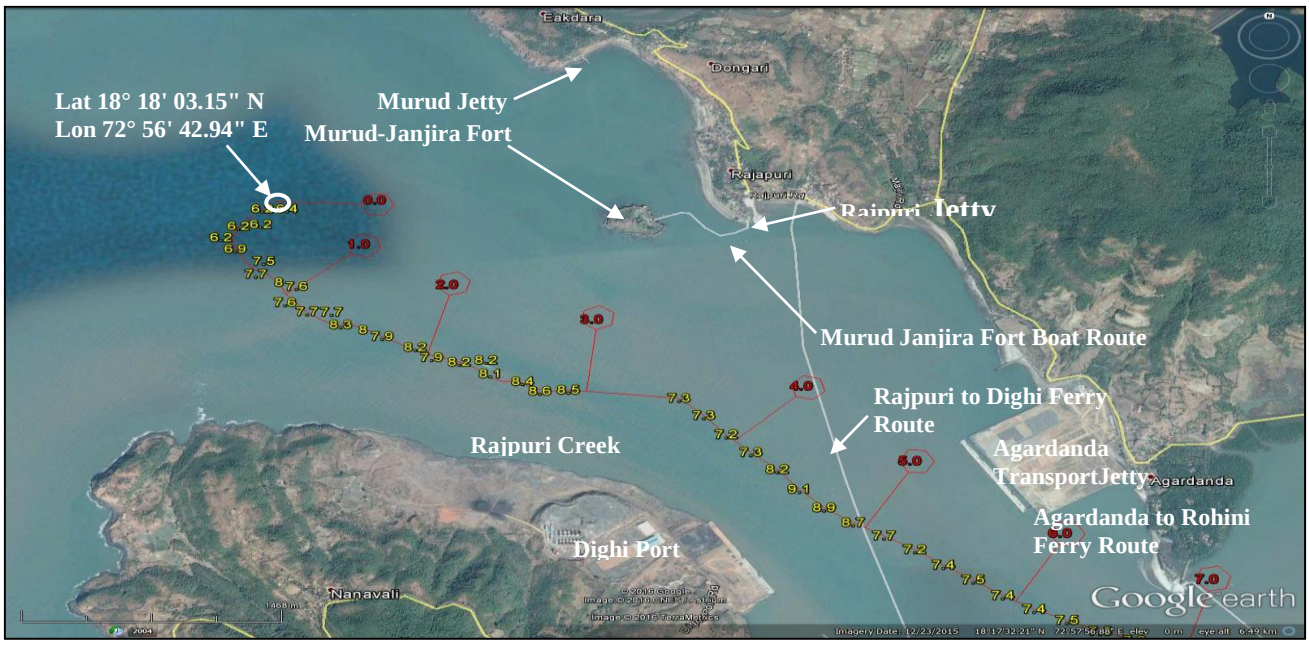


Figure 3.5: Route Chart of the Survey from Ch 0.00km to Ch 6.00km

B. Rajpuri Creek (Ch 6.00km to Ch 12.00km)

There is a ferry route from Agardanda Ferry Jetty on the north bank near Ch 6.84km to Rohini at Trumbadi Jetty on the south bank near Ch 10.10km. The Kudgaon Jetty is on the south bank at Ch 6.80km with a few settlements around it. A small Island was seen on the south bank near Ch 8.40km. The minimum depth recorded in this section is 2.8m (Ch 10.70km to Ch 10.90km) and the maximum depth is 7.5m (Ch 6.30km and Ch 6.50km) as tabulated below:

Table 3.4: Maximum-Minimum Depths in Rajpuri Creek from Ch 6.00km to Ch 12.00km

Maximum –Minimum Depths			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
6.0	12.0	7.5	2.8

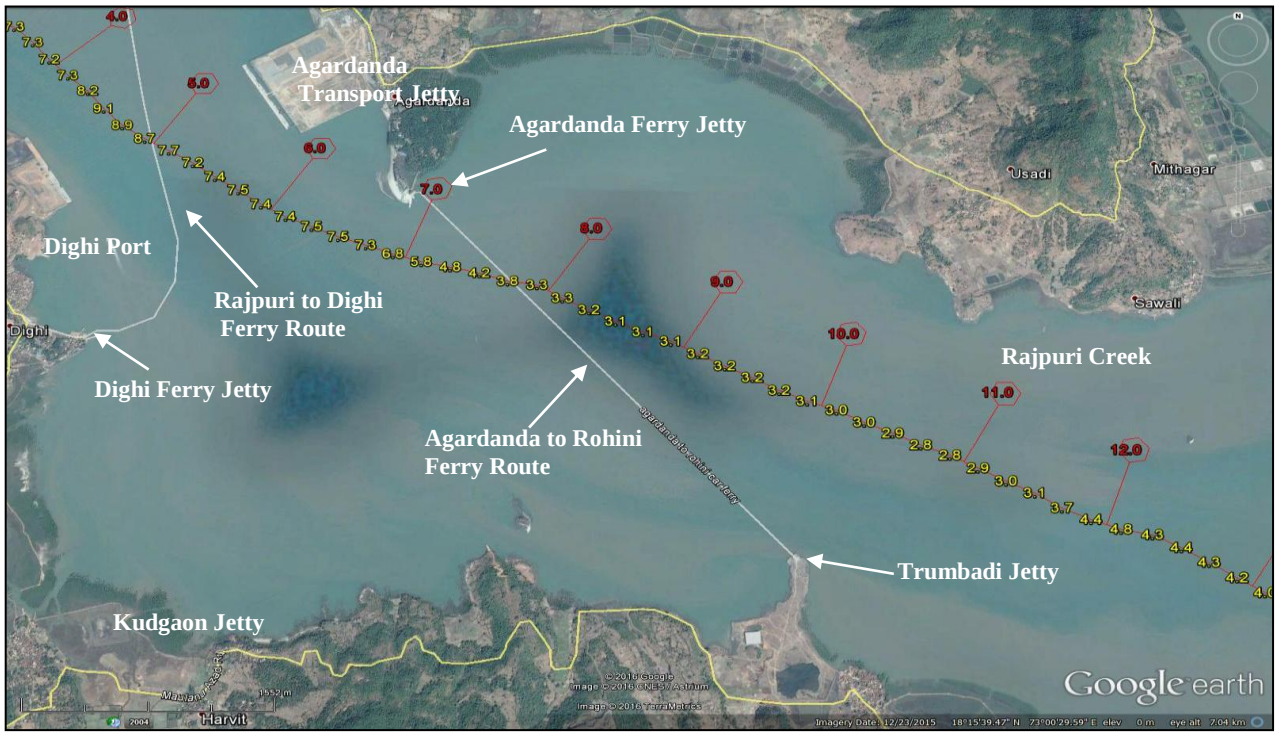


Figure 3.6: Route Chart of the Survey from Ch 6.00km to Ch 12.00km

C. Rajpuri Creek (Ch 12.00km to 18.00km)

In this stretch, the south bank is mostly covered by marshes after the Trumbadi settlements in range from Ch 10.50km and up to Ch 17.00km. Many small parallel streams passing through the marshy area meet in the Rajpuri creek. A tributary meets the river at Ch 12.00km near Sawali from the north (Right bank). Washi Jetty is on the north bank near Ch 16.50km. The river meanders towards the south after this section. The minimum depth recorded in this section is 0.1m (Ch 17.30km) and the maximum depth is 6.0m (Ch 17.90km) as tabulated below:

Table 3.5: Maximum-Minimum Depths in Rajpuri Creek from Ch 12.00km to Ch 18.00km

Maximum –Minimum Depths			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
12.0	18.0	6.0	0.1

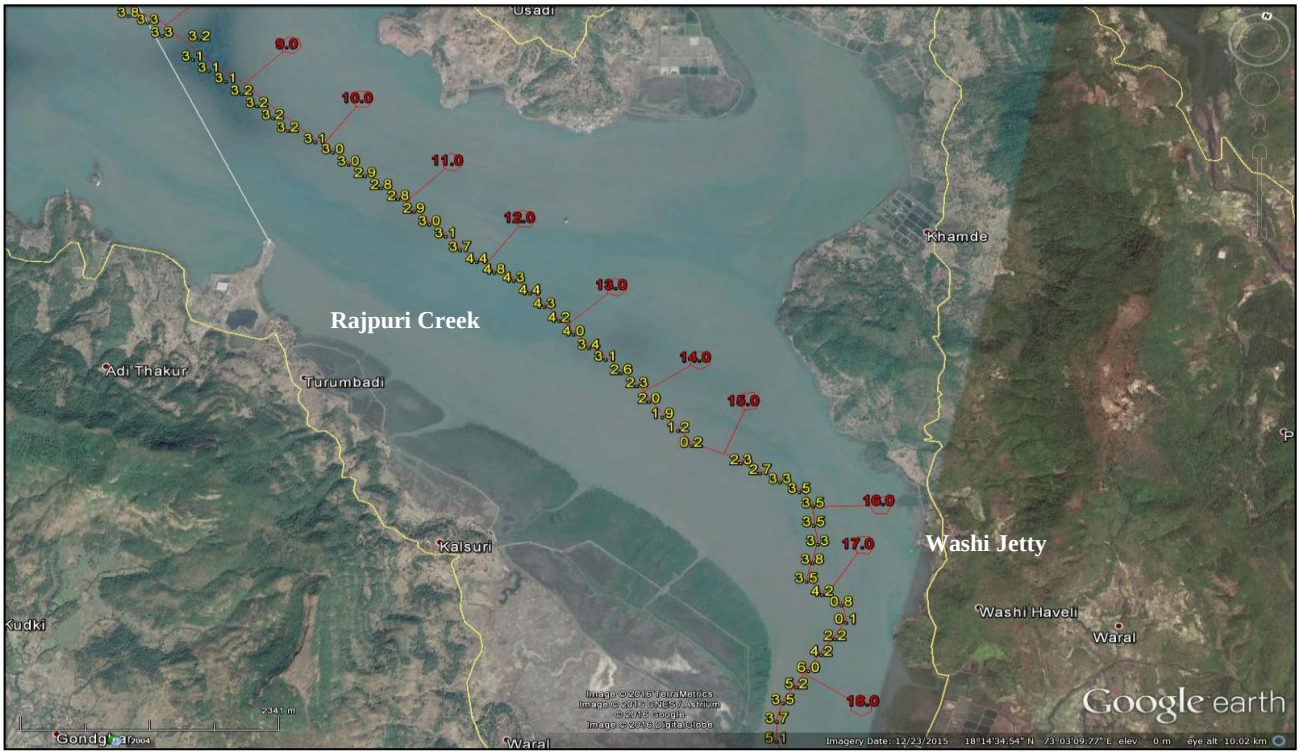


Figure 3.7: Route Chart of the Survey from Ch 12.00km to Ch 18.00km

D. Rajpuri Creek (Ch 18.00km to Ch 24.00km)

Mangroves are observed along the Rajpuri Creek along East bank (Right Bank) in this stretch. Marshes were found along the west and west bank in this stretch. Many parallel streams from both banks pass though these marshes and join the Rajpuri Creek. Large patches of fields were observed on the left bank near Waral. Fields and settlements were seen near Mazgaon on the east bank near Ch 19.00km. The river meanders after Ch 20.50km. A minor right bank tributary merges into the Rajpuri creek near Ch 24.50km. The minimum depth recorded in this section is 1.9m (Ch 23.90km) and the maximum depth is 6.5m (Ch 18.90km) as tabulated below:

Table 3.6: Maximum-Minimum Depths in Rajpuri Creek from Ch 18.00km to Ch 24.00km

Maximum –Minimum Depths			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
18.0	**24.0**	6.5	1.9

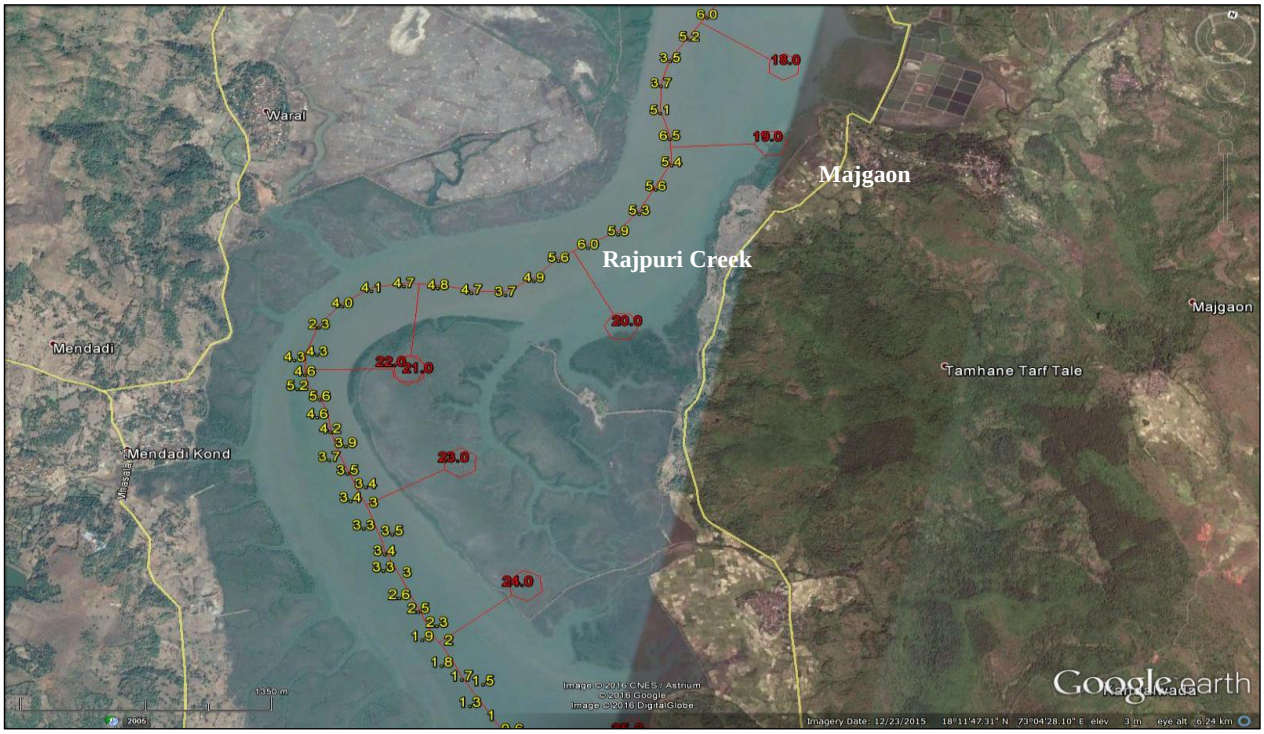


Figure 3.8: Route Chart of the Survey from Ch 18.00km to Ch 24.00km

E. Rajpuri Creek (Ch 24.00km to 31.00km)

Many small parallel streams from West bank (left bank) surrounded by marshes flow into the Rajpuri creek until Ch 26.10km. The survey track diverted towards the East bank (right bank) from this point due to the shallow water depth. Water depths were recorded upto Ch 27.40km near Pabhare Jetty where the bathymetric survey was terminated. The river bifurcates into various distributaries after Ch 26.00km southwards in a dendritic pattern. The minimum depth recorded in this section is -2.0 m (Ch 26.70km) and the maximum depth is 2.0 m (Ch 24.00km) as shown in **Table 3.7.** The route chart of the stretch is depicted in Figure 3.9. The river segment from Ch 27.40km to the end of the stretch was not approachable due to marshy area. However, the cross-structures, such as bridges, HT lines, which are in the proximity in this stretch have been referred based on the observations at the site.

Table 3.7: Maximum-Minimum Depths in Rajpuri Creek from Ch 24.00km to Ch 27.40km

Maximum –Minimum Depths			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
24.0	27.40	2.0	-2.0

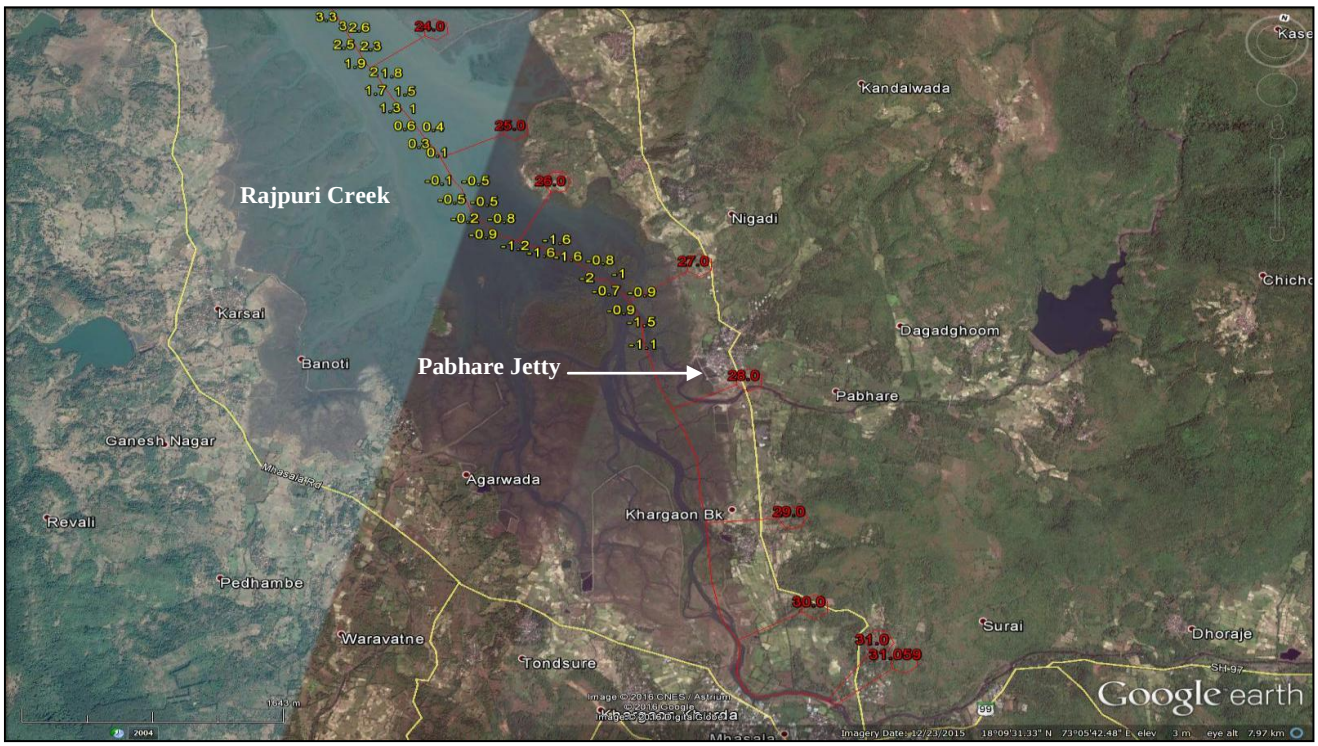


Figure 3.9: Route Chart of the Survey from Ch 24.00km to Ch 31.00km

The maximum and minimum draft with reference to the Chart Datum in the small intervals have been summarized in **Table 3.8** which describes the length of stretch showing various ranges of water depth available.

Table 3.8: Maximum-Minimum Depth in Rajpuri Creek From Ch 0.00km to Ch 27.40km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0.0-6.0	9.10	6.20	6.00	-	-	-
6.0-12.0	7.50	2.80	6.00	-	-	-
12.0-18.0	6.00	0.10	4.75	0.42	0.20	0.62
18.0-24.0	6.50	1.90	5.85	0.15	-	-
24.0-27.4	2.00	-2.00	-	0.45	0.24	2.72
Total			**22.60**	**1.02**	**0.44**	**3.34**

The above data indicates that the availability of water depth is 2.0m and above up to 24.0km of the waterway under study, except in two or three locations where marginal dredging requirement has been observed. It confirms the availability of 2.0m and above water in 77% of river in the proposed stretch under study. It may be noted that the above depths have been reckoned with CD. Since the entire study stretch of Rajpuri Creek is under tidal influence and hence the available effective depths would be more than 2.37m (average tide height) which will be advantageous for safe navigation. The detailed hydrographic survey information indicating location, observed water depth at each point of data reading has been given in **Annexure 3.3**.

3.2.4 Soil Texture Classification

The soil texture has been observed during the reconnaissance survey. The observed soil texture at 10km interval has been given in **Table 3.9**.

Table 3.9: Soil Texture in Rajpuri Creek at 10.00km Interval

Chainage (Km)	Latitude (N)	Longitude (E)	Depth (m)	Soil Texture
1.50	18°18'24.51"	72°57'50.58"	2.9	Clay
3.09	18°18'24.06"	72°57'53.92"	2.5	Clay
10.00	18°15'30.19"	73°01'09.85"	3.0	Clay
20.00	18°12'10.14"	73°04'09.57"	5.7	Clay
27.40	18°09'39.31"	73°05'37.33"	Exposed soil	Clay

From above table it is observed that clayey soil is found in the entire part of the river under study stretch.

3.3 Classification of Waterways

Ministry of Shipping, Road Transport and Highways (Inland Waterways Authority of India) has classified the Inland waterways into seven categories for rivers and canals for safe plying of self propelled vessels up to 2000 Dead Weight Tonnage (DWT) and tug-barge formation in push-two units of carrying capacity up to 8000 DWT (Ref: IWAI, Gazette Notification 2006). The classification criteria of waterways are mentioned in **Table 3.10** for Rivers and in **Table 3.11** for canals.

Table 3.10: Classification of Inland Waterways for Rivers

Class of waterways	Rivers				
	Minimum Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance (m)
I	1.2	30	300	4	30
II	1.4	40	500	5	40
III	1.7	50	700	7	50
IV	2.0	50	800	10	50
V	2.0	80	800	10	80
VI	2.75	80	900	10	80
VII	2.75	100	900	10	100

Table 3.11: Classification of Inland Waterways for Canals

Class of waterways	Rivers				
	Minimum Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance (m)
I	1.5	20	300	4	20
II	1.8	30	500	5	30
III	2.2	40	700	7	40
IV	2.5	50	800	10	50

Class of waterways	Rivers				
	Minimum Depth (m)	Bottom Width (m)	Bend Radius (m)	Vertical Clearance (m)	Horizontal Clearance (m)
V	-	-	-	-	-
VI	3.5	60	900	10	60
VII	-	-	-	-	-

The vessel sizes for self propelled or tug and barge combinations for different classes of waterways are described in **Table 3.12**.

Table 3.12: Classification of Vessel Size

Class of waterways	Self Propelled Vessel Tonnage (Size, L x B x Draft in m)	Tug and Barges combination Tonnage (Size, L x B x Draft in m)
I	100 (32 x 5 x 1)	200 (80 x 5 x 10)
II	300 (45 x 8 x 1.2)	600 (110 x 8 x 1.2)
III	500 (58 x 9 x 1.5)	1000 (141 x 9 x 1.5)
IV	1000 (70 x 12 x 1.8)	2000 (170 x 12 x 1.8)
V	1000 (70 x 12 x 1.8)	4000 (170 x 24 x 1.8)
VI	2000 (86 x 14 x 2.5)	4000 (210 x 14 x 2.5)
VII	2000 (86 x 14 x 2.5)	8000 (210 x 28 x 2.5)

Vertical Clearance for power cables or telephone lines or cables for any transmission purpose for all classes

- Low Voltage Transmission lines and Telephone line — 16.5m
- High Voltage Transmission line not exceeding 110 kV — 19.0m
- High Voltage Transmission line exceeding 110 kv — 19.0m +1 cm per each additional kv

In case of underwater pipelines, power cables and other cables norms are to be decided as per site condition and navigational requirement.

Reference level for vertical clearance for different types of channels

- For Rivers:- Over the Navigational High Flood Level (NHFL), which is the highest flood level at frequency of 5 % in any year over a period of last twenty years;
- For Tidal Canals:- Over the highest high water level;
- For Other Canal:- Over designed full supply level (FSL);

The above classification for rivers and channels shall be effective if:

- Minimum depth of channel is available for about 330 days in a year (about 90% days in a year)
- Vertical clearance at cross structure over the waterways is available at least in central 75% portion of each of the spans in the entire width of the waterways.

The data gathered through the reconnaissance study has been analyzed from the parameters mentioned hereinabove and conclusions have been made with regard to the class of navigation channel that the relevant stretch of Rajpuri Creek falls into. Furthermore, it is to be determined whether the entire 31.0km stretch can be classified under one class of channel or there is a possibility and advantage of developing sub-reaches under different classes of navigation channel.

3.3.1 Cross Over Structures

High Tension line crossing the creek was not observed along the surveyed route. The details of Bridges crossing the Rajpuri creek are given in below in **Table 3.13**.

Table 3.13: Details of Rail and Road Bridges across Rajpuri Creek

Sl. No.	Name of Structure	Chainage w.r.t to River (km)	Horizontal Clearance from river (m)	Vertical Clearance Above MHWS (m)	Position	
NO BRIDGE ON THE MAIN COURSE OF WATERWAY						
1.	Mhasala to Khargaon Bridge (on the Tributary)	Near 12.2	20	5.5	18°8'11.70"N	73°06'52.70"E

There is no hindrance in the study stretch from HT line; hence the stretch can be classified for all class. Mhasala to Khargaon Bridge at Ch 31.31km is located upstream of the end location of proposed waterway; hence its vertical as well horizontal clearance has not been considered for analysis. Therefore, considering above information, the class of the waterway can be elevated for **all Classes**.

Photos of important structures such as port, bridges, jetties, transmission lines and plants as taken during site visit are shown in **Annexure 3.4**.

3.3.2 Dams, Barrages, Reservoirs

No dams, barrages & reservoirs exist along the surveyed route.

3.3.3 Bends along the Route

In the proposed waterway route, there are many bends in Rajpuri Creek, which are given below in **Table 3.14.**

Table 3.14: River Bend Radius in Rajpuri Creek

Sl No.	Chainage (Km)	Radius (m)	Sl No.	Chainage (Km)	Radius (m)
1	3.30	1020.00	12	27.00	230.00
2	5.00	1370.00	13	27.50	610.00
3	6.50	710.00	14	28.00	490.00
4	11.10	2120.00	15	28.40	280.00
5	14.90	990.00	16	28.60	160.00
6	16.50	360.00	17	29.20	340.00
7	17.90	1490.00	18	29.40	420.00
8	19.25	390.00	19	30.10	340.00
9	20.00	310.00	20	30.50	220.00
10	21.50	1040.00	21	30.75	400.00
11	22.40	520.00			

The existing river bend radius is sufficient only for Class I Vessels up to Ch 28.00km with minimal smoothening at Ch 27.00km. Since there is no other hindrance form cross-over structures, the entire stretch can be considered for development as **Class II** with depth improvement at some locations and by smoothening of the bends, however on confirmation of cargo.

The pictorial detailed information showing the proposed waterway indicating various cross-structures (i.e. bridges, transmission lines etc.), major industrial locations and important places along the waterway have been shown in **Drawing No P009051-W-20201-A07** (Sheet 1 to 7). Drawing also depicts various information such as Jetties, Rail and Road location along the waterway.

3.3.4 Gauge & Discharge data

In the Rajpuri creek catchment, no gauge and discharge site as established by Central Water Commission was observed. For the Stage II study, the gauge data will be analyzed if the same is available within a reasonable reach and if found relevant.

3.3.5 Bed Profile of Waterway

All soundings were reduced to Chart Datum in the area. Tidal heights are predicted using MMB data to reduce the raw water depths to Chart Datum. The observed bed profile of Rajpuri creek waterway is shown below in **Figure 3.10** and presented in **Annexure 3.5**.

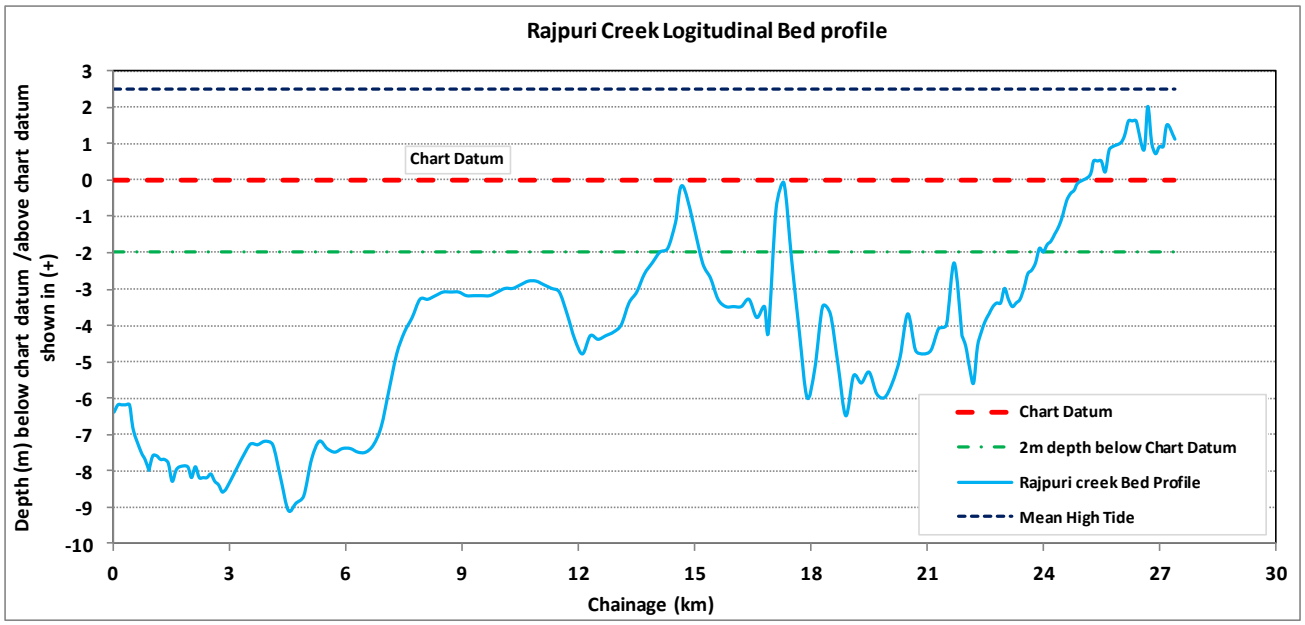


Figure 3.10: Longitudinal River Bed Depth Profile of Rajpuri Creek from Ch 0.00km to Ch 27.40km

Figures 3.10 also shows the Chart Datum line, 2m below the Chart Datum line and mean high tide 2.37m above Chart Datum. However, tides in this region were observed in the range of about 0.32m to 4.42m (MHWS). The following key observations are made from Figure 3.10:

(i) The tidal effect of the Arabian Sea in the Rajpuri Creek is affected up to the Khargaon Khudra.

(ii) As observed at the site, the study stretch generally has the soil texture as clayey.

(iii) Mangroves have been observed marginally on both the banks of Rajpuri creek. The tide in the region has Semi-Diurnal characteristics.

(iv) The initial half of the river stretch from the mouth is flatter which gradually becomes steeper having an overall average slope of 1 in 4430 in 31.00km of the river stretch under study.

(v) Minimum 2m draft is available naturally for up to 24.00km with minimum dredging (**Class V**).

(vi) With some moderate dredging between 24.00km and 31.00km (7km stretch), a minimum draft of 2.0m may be achieved.

3.4 Tidal Effect on Navigability of Rajpuri Creek

The tidal effect on the river navigability may be put to an advantage in order to optimize the cargo movement from import ships and taking bulk cargo to a jetty located upstream of the river bank near the industrial units for planned bulk consumption of the cargo. Industrial units e.g. steel plants/ thermal & gas based plants/ cement plants/ oil terminals are either operational or have been planned near the coast line as a preferred location either on the river banks near the mouth of the river or in creeks meeting high sea.

Shallow waterways in this creek put a restriction on movement of large ships which calls for unloading of the cargo from ships at high sea into smaller vessels. These vessels transport the cargo to smaller jetties of the plants. Normally, there is a travel restriction of the movement of vessels by variation in the available draft in the river/creek due to tide. If the available draft in the river is adequate to sail a particular type of vessel, the vessel can move into the river/creeks or vice versa; else they wait for the high tide. Thus, movement of the vessels through the river depends upon the depth available, which is affected by the tide.

3.4.1 Present Usability of Rajpuri Creek

With the information gathered during the reconnaissance survey, presently no vessels are plying upstream of the Dighi Port. Tide dependent water level in the Rajpuri creek can be used advantageously for the smooth movement of the vessels in the creek.

3.4.2 Chart Datum & Variation in Navigation Draft

The depth variation in the Rajpuri creek has been established from 0.10m to 9.1m with respect to Chart Datum during the reconnaissance survey. The tide tables are available for the region and water level in the creek can be forecasted at any point of time. It helps in knowing that a particular type of vessel can sail in the creek at a given point of time. The tidal variation is in the order of 0.32m to 4.42m in Rajpuri creek as per the records available for this region. Hence, it is noted that if the high tide is considered for navigation, a higher water depth is actually available for navigation along the waterway although water depth with respect to Chart Datum shall depict a lower depth corresponding to the least available depth (LAD). So, conceptually, navigation in a tidal river is more effective considering the tidal effect which is observed in such cases elsewhere. Arabian Sea at the confluence location of Rajpuri creek has a semidiurnal tide having two high and two low water each tidal day, with relatively small differences in the respective highs and lows effect which provides a tidal cycle of 6.0 hours.

The speed of these vessels is normally 8 knots in a still river and the travel time of these vessels may be about 2.0 hours inclusive of the docking time. Hence, a six hour tidal window shall be advantageously used for optimization of vessel movement from sea to destined location as well as unloading the material and low tide shall be made use of to sail from local jetty to the high sea with a lower draft requirement of empty vessel which is again available during the low tide. Similar considerations shall be effective for other industrial units that are either already planned or that may be planned in future on this waterway. This shall also facilitate the classification of the water way either in one category or into various categories with a consideration of river length being actively used currently, and future possibilities for cargo movement beyond the present use.

3.4.3 Benefits of Tidal Effect

The above contention for using tidal window using high tide for facilitating navigation shall help to decide many other logistics which may consist of exact vessel size, loading time, unloading time, facilities available at loading and unloading locations etc. A better insight into tidal information shall help to decide the following:

(i) Classification of the waterway;
(ii) Vessel Size;
(iii) Scheduling of vessel movement;
(iv) Number of vessels for defined quantity of the cargo;
(v) Flotilla Combination;
(vi) Different size of vessels instead of only one size;
(vii) Handling facilities at the terminal location;
(viii) Desirability and quantum of dredging required;
(ix) Vessel allocation decision;

The benefits of tidal effect will be more useful in operation of vessels and in improving the efficiency of vessel operation.

3.5 Agencies to be approached for Clearances, if any

Based on reconnaissance survey, interaction with local people and consultation with government officials, the information regarding clearances and approvals required from the concerned authorities for operation of National Waterway NW-83 (Rajpuri Creek) has been given in **Table 3.15**.

Table 3.15: List of Clearances and Approvals Required

Environmental Clearance	Forest Clearance	Wildlife Clearance	Coastal Regulation Zone (CRZ) Clearance	Consent to Establish/ Operate	No Objection Certificate from Directorate of Fisheries	NOC from WRD/PWD/ Railways
√	To be ascertained at DPR Stage-II	To be ascertained at DPR Stage-II	√	√	√	√

3.5.1 Compilation of Data in Feasibility Format

The field information gathered through single line bathymetry survey, data collection from IWAI, data collection from various agencies, site visit and information derived from web has been compiled in the format as provided

by IWAI for the Rajpuri Creek. The consolidated data shall be useful in deriving basic information about each of the waterway in IWAI format as enclosed in **Annexure 3.6**.

3.6 Conclusion

Based on the survey observation, the classification of proposed waterways based on various criteria has been summarized in below **Table 3.16**.

Table 3.16: Classification of Proposed Waterway

Criteria	Classification																			
Length of waterway from start (km)	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	26	28	29	31
Chainage length in %	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Depth availble	C-V																C-I			
Rail & raod Bridge Vert. clearance	All Class																			
Rail & raod Bridge Hor. clearance	All Class																			
HT Line Vert. clearance	All Class																			
Bend Radius	C-II																			
Index	All Class	Class-V	Class-IV	Class-III	Class-II	Class-I														

Finally with due consideration of all aspects, the classification of the proposed Rajpuri Creek Waterway in light of technical navigability may be adopted as shown in **Table 3.17** below:

Table 3.17: Final Conclusion for Possible Navigation

River Stretch	0.0km	31.00km
Classification		
	Class- V	
Horizontal clearance (m)	80	
Vertical clearnce (m)	10	
Minimum Depth (m)	2	
Bottom Width (m)	80	
Self Propelled Vessel		
Dead Weight Tonnage	1000	
Vessel size (m)	70 x 12 x 1.8	
Tug + Barge		
Dead Weight Tonnage	4000	
Vessel size (m)	170 x 24 x 1.8	

The conclusion has been drawn keeping in view the present river condition and linking the same with various characteristics of classification viz., available draft; vertical clearance under Rail Bridge / Road Bridge/ HT Line and Bend Radius etc. In order to consider the full stretch as **Class V**, smoothening of bends along with moderate dredging are essential.

CHAPTER 4 MARKET ANALYSIS

Rajpuri Creek, out falling into Arabian Sea extends to 31 km from Murud near Creek confluence till Mhasla in Raigarh District and touches six talukas of Murud, Roha, Tala, Managaon, Mhasla and Shrivardhan. Important towns located on the banks of Rajpuri creek are Murud and Mhasla.

The navigable length of the Creek is 31 km. Based on the deepest Bathymetry single line survey carried out during the study and as per the classification of "Inland water ways" as per Ministry of Shipping, Government of India notification, it can be classified as Class V for the first 24 km from start at Chainage Ch0.00Km to Ch24.0Km and balance also can be considered Class 5 with the moderate developments. (**Refer Map 4.1**).

There are 19 jetties along the Creek including 1 Port at Dighi, which are being used for various activities of Cargo, Fishing, Ro-Ro and passenger etc. Off 28.5 Million Metric Tonne Per Annum (MMTPA) of cargo handled at all fifteen Maharashtra Maritime Board (MMB) Ports in the year 2015-16, about 0.78 MMTPA (2.7%) (**Figure 4.1 and Table 4.1**) was handled at Dighi Port, which is in the mouth of the Creek.

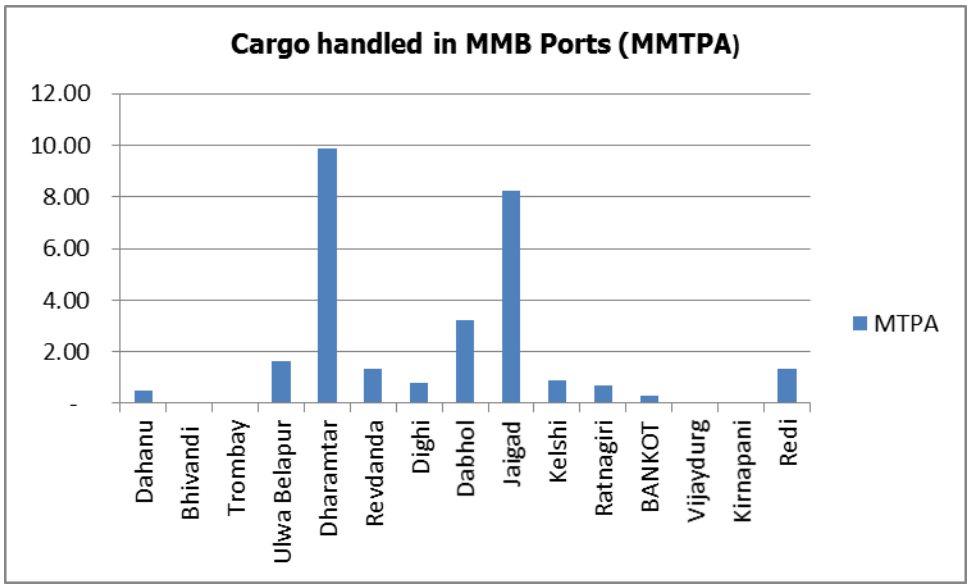


Figure 4.1: Cargo handled at MMB Ports in 2015-16 MMTPA

Table 4.1: Details of Cargo handled in MMB Ports in 2015-16

Cargo Handled			
Sl No.	Ports	MMTPA	%
1	Dahanu	0.47	1.6%
2	Bhivandi	0.003	0.01%
3	Trombay	0.01	0.0%
4	Ulwa Belapur	1.62	5.6%
5	Dharamtar	9.89	34.3%
6	Revdanda	1.34	4.7%
7	Dighi	0.78	2.7%
8	Dabhol	3.22	11.1%
9	Jaigad	8.24	28.6%
10	Kelshi	0.91	3.1%
11	Ratnagiri	0.71	2.5%
12	BANKOT	0.27	0.9%
13	Vijaydurg	0.05	0.2%
14	Kirnapani	-	0.0%
15	Redi	1.34	4.6%
and Total		28.85	100.0%

Dighi Port is located at Ch.4.0Km, where the cargo movement is taking place. Currently there is a very minimal cargo mobility has been observed upstream of Ch4.0Km.

Passenger movement is significant with the usage of ferry services by 18 lakh passengers (**Table 4.2**) per year in this Creek. There are Ro-Ro services at two sites from Agardanda to Rohini and Agardanda to Dighi handling about 115,000 vehicles (**Table 4.3**) per year.

Table 4.2: Rajpuri Creek: Passenger Traffic Handled from April 2015-March 2016

Sl No.	Row Labels	Sum of EM & DIS By Mechanised Vessels	Sum of EM & DIS By Non-Mechanised Vessels	Sum of EM & DIS Total Passenger Traffic Handled
1	**RAJPURI**	630,734	324,543	955,277
2	ALIBAG	11,790	-	11,790
3	BORLI-MANDLA	-	-	-
4	DIGHI	77,358	-	77,358
5	DIGHI TO AGARDANDA	102,614	-	102,614
6	DIGHI TO JANJIRA KILLA	23,066	-	23,066
7	KUMBHARU	1,690	-	1,690
8	MANDAD	-	-	-
9	MURUD	49,192	-	49,192

Sl No.	Row Labels	Sum of EM & DIS By Mechanised Vessels	Sum of EM & DIS By Non-Mechanised Vessels	Sum of EM & DIS Total Passenger Traffic Handled
10	NANDGAON	2,810	-	2,810
11	RAJPURI	71,802	147,438	219,240
12	RAJPURI TO KILLA	-	11,772	11,772
13	Rajpuri Motor Launch	64,152	-	64,152
14	RAJPURI TO DIGHI	43,716	-	43,716
15	RAJPURI TO KILLA	64,568	157,262	221,830
	TOTAL	**1,143,492**	**641,015**	**1,784,507**

Table 4.3: Rajpuri Creek: Ro-Ro Traffic Handled from April 2015-March 2016

Sl No.	Row Labels	Sum of EM & DIS By Mechanised Vessels	Sum of EM & DIS By Non-Mechanised Vessels	Sum of EM & DIS Total Passenger Traffic Handled
1	AGARDANDA TO ROHINI	1,754	-	1,754
2	AGARDANDA TO ROHINI	16,654	-	16,654
3	DIGHI TO AGARDANDA	96,234	-	96,234
	TOTAL	**114,642**	**-**	**114,642**

4.1 Existing Cargo Traffic

Dighi Port handled 0.78 MMTPA of cargo in the year 2015-16 of which 75 % was overseas (68% imports, 32% exports) and 25 % was coastal, most of which was unloaded. The growth of traffic has been steadily increasing since 2012-13, though there was a minor drop in 2015-16.

Table 4.4: Dighi Port: Cargo Handled from April 2015-March 2016 (in MTPA)

	Overseas			Coastal			
COMMODITY	**Unloaded**	**Loaded**	**Total**	**Unloaded**	**Loaded**	**Total**	**Grand Total**
Thermal Coal	333,173	-	333,173	127,908	2,851	130,760	463,933
Steel Coil	41,703	-	41,703	63,969	-	63,969	105,672
Bauxite	-	187,450	187,450	-	-	-	187,450
Carbon black oil	9,967	-	9,967	-	-	-	9,967
Nitrate Potash	17,935	-	17,935	-	-	-	17,935
TOTAL	**402,779**	**187,450**	**590,229**	**191,878**	**2,851**	**194,729**	**784,958**

Source: MMB

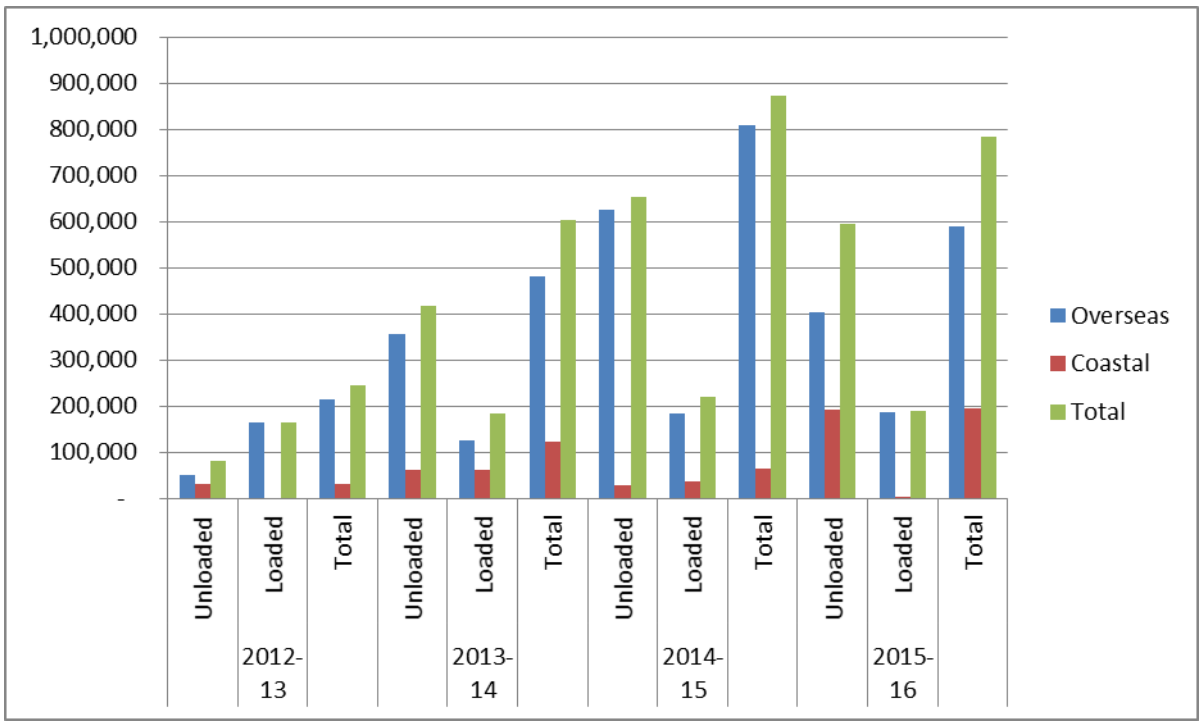


Figure 4.2: Cargo handled (Unloaded & Loaded) at Dighi Port from 2013-16 in MTPA

Major Commodities handled at Dighi port in 2015-16 (**Table 4.4**) were:

- **Thermal Coal:** (**0.46 MMTPA**): Thermal coal, imported (71%) through Cape-size vessels (150,000 DWT) and brought through coastal vessels (29%) was distributed to Bhushan Steel & Power, Bhatia Coal Ltd. and others in the region.
- **Steel (105,672 MTPA):** Steel Coils, imported (40%) through Handi-max vessel (50,000 DWT) and brought through coastal vessels were distributed in the nearby region.
- **Other Ores (187,450 MTPA)**: After Kelshi and Bankot, Dighi is the third most important Port for exporting Bauxite ore. The district of Raigadh has a total reserve of 12.4 million Tonne of Bauxite. The port has been regularly handling export of Bauxite on 75,000 DWT vessels.
- **Chemicals (27,902 MTPA):** A small quantity of carbon black (9,967 MTPA) and Nitrate Potash (17,935 MTPA) was imported for the requirements of industries in the nearby region.

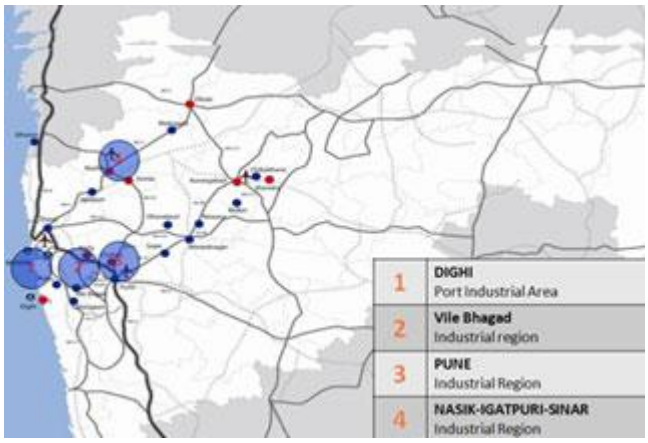
At present, there is no movement of Iron Ore, Coking Coal, Cement, POL, Food grains and containers.

4.2 Future Cargo Potential

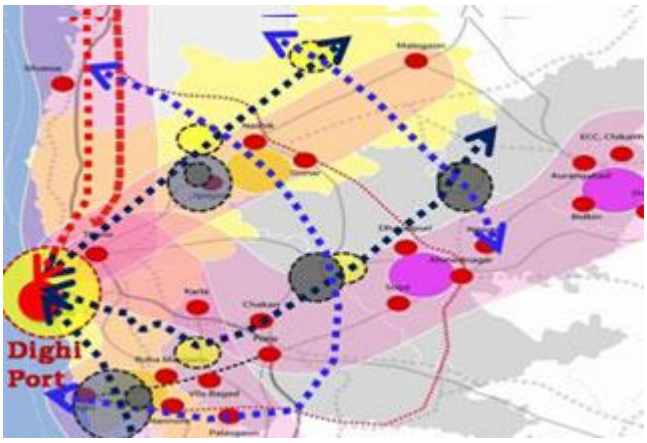
It is important to understand the development of Dighi Port (Figure 4.3) in the context of development of Inland Waterway Transport in the Creek. The Port, located on the banks of the Rajpuri Creek is the first Greenfield port in Maharashtra. It is developed by Balaji Infra Projects Ltd (BIPL) under a 50 year "Build, Own,

Operate, Share, Transfer (BOOST)" concession agreement signed with the Maharashtra Maritime Board (MMB), the Government of Maharashtra. The salient features of the Port are:

- **Deep Berthing Port**: It is being developed as an all-weather port with deep draught, direct berthing facilities with exclusive channel offering a depth of 14.5 m making. It is one of the deepest ports of Maharashtra. Total waterfront of approximately 5 km for development of port related infrastructure has been catered.
- **DMIC & DFCC project**: It is a part of prestigious Dedicated Freight Corridor (DFC) and Delhi Mumbai Industrial Corridor (DMIC) projects which are being jointly developed by Govt. of India & Govt. of Japan.
- **Mega Industrial Development Areas:** It is in the vicinity of Mega Industrial areas such as:
  - Dighi: The Port area has been identified as one of the 7 National Investment and Manufacturing Zones (NIMZ) under the new manufacturing policy. Port based manufacturing/industrial zones such as Automobile, Steel, Project Equipment, Chemical, Agro Parks, Food Processing, Light and Heavy Manufacturing are planned in an area of 230 sq. km.
  - Vile Bhagad: As a part of the DMIC corridor, a large industrial area is planned at Vile - Bhagad about 764.16 Ha in size, about 39 km through MIDC road from Roha. Vile Bhagad is planned for Steel, Power & Project Equipment.
  - Pune Industrial Area: A very large industrial area, about 100 km from Dighi Port is planned at Pune under the DMICDC project.



DELHI MUMBAI INDUSTRIAL CORRIDOR (DMIC) PROPOSED INDUSTRIAL CLUSTERS

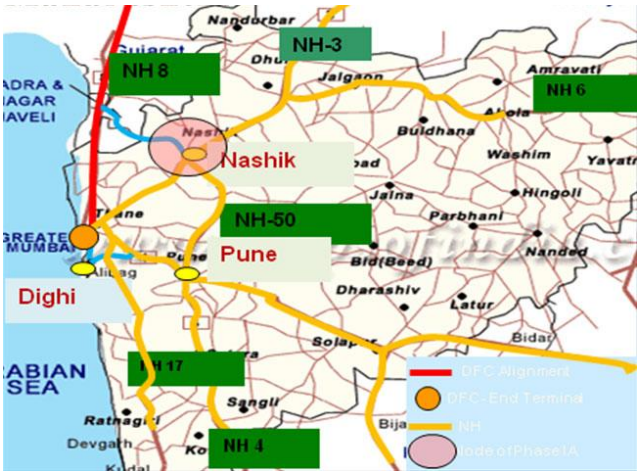


ECONOMIC IMPORTANCE OF DIGHI PORT

Figure 4.3: Economic importance of Dighi Port

- **Multi-Purpose Terminal:** Dighi Port is developed as a Multipurpose capable with a capacity of 30 MMTPA in Phase – I, 60 MMTPA to 90 MMTPA in Phase II of the project at two banks of Rajpuri Creek:
  - **South Bank:** for Bulk, Break-Bulk, Liquid & LNG Terminals
  - **North Bank :** for Clean cargo, Containers and for Ro-Ro Terminals

- **Support Infrastructure:** The plans for infrastructure facilities like warehouses, organised distribution network, transportation fleet and development of multi modal hubs and setting up of Special Economic Zones (SEZ), Free Trade Warehousing Zone (FTWZ), Container Freight Stations (CFS) and cargo hubs are under progress. The Port facilities include state-of-the-art cargo handling equipment with adequate stack yards and warehousing facilities, back up area with ample land on the bank of approximately 1600 acres.
- **Connectivity**: The port is located at a distance of 42 nautical miles (NM) from Mumbai by Sea and 170 km's south of Mumbai by Road. The connectivity (**Figure 4.4**) is as follows:
  - **Highways**: North Bank of the port is connected to National Highway 17 (NH 66) via State Highway SH 92 and SH 96 and the South Bank is connected to National Highway 17 (NH 66) via State Highway SH 97 and 98. Widening of National Highway 17 (NH 66) is under progress and permission from PWD to develop the State Highways on BOT basis has been obtained. Accordingly, the Up-gradation of the existing State Highway from 2 lanes to 4 lanes is also in progress.
  - **Railways:** The nearest Konkan Railway Rail Head Indapur is 47 km from the Port. The plan to extend the rail line to Agardanda for which, the final location survey has been completed. With the signing of MoU between Rail Vikas Nigam Limited (RVNL) and Dighi Port Limited (DPL) for development of Rail line from Dighi to Roha (35 km from the Port) the DMIC region will be better integrated specially with most significant places such as Yavatmal, Gadchiroli, Beed, Nanded and Ahmednagar.



PROPOSED ROAD IMPROVEMENTS

PROPOSED RAIL LINE

Figure 4.4: Road and Rail Connectivity of Dighi Port

Considering that Dighi Port is developed as a Direct Berthing, All weather Port with Multi-purpose, Multi cargo facility with good rail and road connectivity for both dirty and clean cargo and for containers, potential of additional cargo traffic for Inland Water Transport appears to be less. The length of navigable river is 31 km and it may be more economical to move major cargo directly to Dighi Port rather than through Double handling through Inland Waterway Terminal, if constructed. A small amount of cargo from the nearby industrial area with production capacity of 6 MMTPA (**Annexure 4.1**) to the multi modal hub developed at Dighi and directly

to Mumbai may be generated through the Inland Water way beyond Ch31.0 in the hinterland. As per preliminary estimation a small amount of cargo (0.1 MTPA) has been considered. This will be examined in detail at the DPR stage.

- **Fertilizers and Chemicals**

  The fertilizer allocation in Maharashtra is through Rashtriya chemicals and Fertilizers Ltd. (RCF) at Thal, Raigarh and Deepak Fertilizers & Petrochemical Corporation (DFPCL) at Taloja. The allocation to Rajpuri catchment Talukas is 4,869 T which is very small. It is understood that there is plan to move fertilizers allocated to Maharashtra directly through Dighi Port and hence it is unlikely that any Fertilizer movement will take place in the Inland Waterway.

Table 4.5: Allotment of Fertilizers in Rajpuri catchment area and Raigad District

Fertilizer	**Allotment 2016-17**							**in MT**
Taluka	Urea	DAP	SSP	12:32:16	MOP	15:15:15	20:20:20	Total
Murud	470	20	10	-	-	120	-	620
Roha	1,019	75	24	-	42	180	125	1,465
Tala	313	5	6	-	-	65	-	389
Mangaon	1,019	25	65	62	42	250	-	1,463
Mhsala	157	20	5	-	-	90		272
Srivardhan	549	15	6	-	-	90		660
Total in Rajpuri Creek area	**3,527**	**160**	**116**	**62**	**84**	**795**	**125**	**4,869**
Total in Raigad District	**19,401**	**2,000**	**1,700**	**250**	**1,701**	**2,770**	**250**	**28,072**

- **Food grains**

  About 340,000 MT of Rice, Nachni and Tur pulse is produced in Raigad district, of which about 100,000 MT is produced in catchment area of Rajpuri Creek. As per preliminary estimates about 30 % of the above i.e., about 30,000 T of cargo can be transferred to IWT. This possibility will be examined in detail at DPR stage.

Table 4.6: Major Food grain productions in Rajpuri catchment area

S. No	**Taluka**	**Rice**		**Nachni**		**Tur Pulse**		**Total**
		Area (Ha)	**Production (MT)**	**Area (Ha)**	**Production (MT)**	**Area (Ha)**	**Production (MT)**	**Production (MT)**
1	Murud	3,115	9,345	20	18	240	192	9,555
2	Roha	10,304	30,912	519	467	101	81	31,460
3	Tala	2,237	6,711	328	295	22	18	7,024
4	Mangaon	11,719	35,157	1,537	1,383	61	49	36,589
5	Mhsala	1,984	5,952	300	270	34	27	6,249
6	Srivardhan	3,110	9,330	225	203	14	11	9,544

	Total in Rajpuri Area	**32,469**	**97,407**	**2,929**	**2,636**	**472**	**378**	**1,00,421**
	Total in Raigad District	**1,07,918**	**3,23,754**	**10,441**	**9,397**	**1,891**	**1,513**	**3,34,664**

- **Passengers**

  About 6 lakh people live in the catchment of Rajpuri creek **(Table 4.5)** and as per Table 4.2 and 4.3 Passenger Transportation and Ro-Ro services are already operational. Both local and tourists are using these facilities. The potential to extend the services till Mandad and other places exists.

Table 4.7: Population living in Rajpuri Creek area

S. No	Taluka	Area (Sq Km)	Population
1	Murud	231	74,207
2	Roha	629	167,110
3	Tala	250	40,619
4	Mangaon	676	159,613
5	Mhasala	230	59,914
6	Srivardhan	120	83,027
	Total in Rajpuri area	**2,136**	**584,490**
	Total in Raigad District	6,816	2,634,200

- **Tourism**

Maharashtra Tourism Development Corporation (MTDC) is planning to start House Boat services (as in Kerala) and cruise Boat services in the coastal Rivers of Maharashtra. It also has a plan to start Speed Boat and other tourism services at Rajpuri Creek. The possibility of tourism potential through Inland waterway is good at this location and will be examined in the DPR stage.

- **Ro – Ro Cargo Service**

Keeping in view the Ro – Ro passenger mobility and also viewing the Geographical location advantage, discussions were held locally with various stake holders in the vicinity for Ro – Ro Truck mobility (similar to that of the support system existing for ICTT, Kochi) in the study stretch. This will boost the utility of IWT, which will have direct entry to Dighi Port, which is presently aimed for multipurpose big volume growth. This will attract the South bound traffic of the port within the country and also attract South Asia bound traffic / Eastern side of the export / import at Dighi Port. (Cargo originating from the North part). This will decongest the roads to that extent. This proposal got good appreciation from the stake holders. The volumes estimated are about 0.6 MMTPA and expected to grow to 1.2 MMTPA. This is a considerable Cargo. This can be explored at DPR stage.

4.3 Conclusions

Keeping in view the Mega development of Dighi Port, if Ro – Ro cargo operation is established, it is likely that a substantial amount of Inland Waterway Cargo for the 31 km stretch will be generated. A cargo of 0.7 MMTPA to 1.2 MMTPA has been assumed as preliminary estimation, which will be examined in detail at DPR stage.

The potential for tourism and passenger facilities exists at Rajpuri Creek, which will also be examined in detail at DPR stage.

CHAPTER 5 OBSERVATIONS AND INFERENCES

5.1 Waterway Feasibility

Based on the details presented under Chapter-3, following conclusions have been derived for establishing the navigability of the proposed waterway;

1. The Waterway length in the Rajpuri Creek as given by IWAI is 31.0km whereas the total surveyed length along the Creek to capture the thalweg is 27.40km. The deepest channel route has been reckoned as 27.40km. All inferences derived for identifying the navigable length have been derived with reference to deepest channel length (27.40km).
2. The Creek is tidal affected for full length under study and relevant chart datum has been used. 77% of the surveyed length has water depth more than 2.0 m, however not continuous, in the reach starting from 0.00km (At confluence of Creek with sea near village Rajpuri near the creek). The average tidal variation is 2.37m with maximum high tide of 4.42m and low tide of 0.32m as per the records available for this region. The average tide height of 2.37m would be an added advantage for the safe navigation.
3. Feasibility study suggests that the Creek is navigable without any significant obstructions in the entire length except some patches in the upper reaches.
4. The lengths of the waterway, with a depth more than 2.0m, 1.5m and 1.0m with reference to the Chart Datum have been compiled in the main report. This is given in Table 3.8 of the report and is being reproduced below:

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0.0-6.0	9.10	6.20	6.00	-	-	-
6.0-12.0	7.50	2.80	6.00	-	-	-
12.0-18.0	6.00	0.10	4.75	0.42	0.20	0.62
18.0-24.0	6.50	1.90	5.85	0.15	-	-
24.0-27.4	2.00	-2.00	-	0.45	0.24	2.72
Total			**22.60**	**1.02**	**0.44**	**3.34**

5. No H. T. Lineis crossing the study stretch and the bridge near Khargaon is at the end of the study stretch. Hence there is no objection.

The above description & classification of the waterway has been presented schematically based on the survey observation and duly keeping in view the Creek classification criteria in Table 3.16 as reproduced below.

Criteria	Classification																		
Length of waterway from start (km)	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	26	28	29	31
Chainage length in %	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
Draft availble	C-V																C-I			
Rail & raod Bridge Vert. clearance	All Class																			
Rail & raod Bridge Hor. clearance	All Class																			
HT Line Vert. clearance	All Class																			
Bend Radius	C-II																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

5.2 Cargo Feasibility

The present mobility in the creek area with the coastal movement is about 0.78 MMTPA. The majority of the cargo is Thermal Coal followed with Bauxite and Steel Coil. (As confirmed from the cargo data of 2015-16).

Subsequent to the preliminary market survey and its analysis, there is a possible growth of cargo mobility to the extent of about 0.7 MMTPA to 1.2 MMTPA through the study stretch, which is a considerable increase.

In order to meet the above increase in the cargo potential, the waterway development is felt essential. Accordingly, the waterway is to be developed to Class V to meet the above increase in volume and keeping in view the future industrial growth in upper hinterland.

5.3 SWOT Analysis

SWOT analysis has been carried out for deriving meaningful information specifying the objectives of the study for development of the waterway for year round commercial navigation and identifying the internal & external factors that are favourable and unfavourable in the development of the waterway.

Strength

1. 77% of the surveyed length has water depth more than 2 m and is safe for navigation.
2. The above depth availability is for about 24kms and small patches may be required to be attended with a minimum conservancy activity involving dredging.
3. In case of Rajpuri Creek, the majority of the study stretch is under tidal influence, which will strengthen the safe mobility of the vessels in the waterway. Maximum tide in this region was observed in the range of about 4.42m, Minimum tide in the range of 0.32m and the Mean Sea level is observed to be 2.51m.
4. Approximately 6.0 lacs of population is residing in the region of Murud, Roha, Tala, Mangaon, Mhasala and Srivardan in the vicinity of Rajpuri Creek, which will have direct or indirect benefits with the IWT and related projects coming up in the area.
5. The IWT development in this region will support the present Ro Ro activity also.

6. The Mega development of Dighi Port will have its own vibration in its nearby hinterland which will have considerable influence on IWT also.
7. Ro – Ro Cargo mobility will have much more influence on IWT in the entire stretch.
8. Cargo has been identified through Ro – Ro to an extent of about 0.7 MMTPA to 1.2 MMTPA.
9. The industrial planning being considered in the hinterland is more attractive and hopeful for IWT development.

Weakness

1. The proposed Ro – Ro cargo movement should take off without any hindrance, since there is no IWT movement. However, the traffic estimations present an optimistic picture for IWT.

Opportunity

1. 77 % of the existing waterway is having a depth more than 2m, which can be used advantageously for the mobility of hinterland cargo.
2. The proposals of Industrial area in the vicinity / hinterland are an opportunity, if used by IWT.
3. Since the majority of the study stretch is tidal affected, this is an opportunity.
4. The Ro – Ro Cargo mobility will be a big boon for this stretch, since it is having its own Geographical and site specific advantage, which is an opportunity for this stretch development.
5. The present Rail and Road connectivity though may be competing with IWT, may also be an opportunity for creating an efficient intermodal hub for IWT.
6. Policies are to be firmed up for development of IWT in this stretch.
7. Since the industrial areas of the MIDC are in the upstream stretch, the entire waterway can be best utilized.

Threat

1. NH 17 / NH 66, SH-92, SH 96, SH 97 & SH 98 in the study area may create competing modes of transport especially with respect to cargo traffic for the proposed waterway and the same also be an opportunity for inter modal hub.
2. The present rail network also may pose some threats as an alternative mode of transport.
3. The Rajpuri Creek banks covered by marginal mangrove trees in certain places may invite some socio-environmental issues and may require statutory approvals and clearances to construct the jetties/terminal/ports/intermodal connectivity.
4. Dighi Port development should not snub the IWT and the pro active awareness is to be established for IWT in this area.

5.4 Development Cost (Tentative)

The reconnaissance survey data with regard to physical constraints may have cost implications for making the Rajpuri Creek stretch navigable. The development of the proposed national waterway involves physical interference in the form of dredging, construction of terminals at the identified locations, modification of HT Lines at crossing locations to provide a minimum vertical clearance of 20.1m (with respect to 220 kVA) or the case may be combined with some unforeseen expenses. Moderate dredging effort has been envisaged with an average dredging of 1.0m required in 4.80km of the length of proposed waterway reckoned with reference to ascertained data. The cost of dredging has been considered @ INR 230 per cum. The cost of terminal has been estimated @ INR 20.0 crore each for two terminals. No HT line is crossing the study stretch. The cost of navigational aids for day/night navigation has been considered as INR 350 lacs. 10% of the amount for Dredging, Terminal construction and Night Navigation aids has been envisaged as unforeseen. The tentative total cost of development to make the Creek navigable round the year to achieve safe navigation for the required classification of vessel mobility has been estimated to INR 52.70 crore as shown in **Table 5.1**.

Table 5.1: Tentative Development Cost of Rajpuri Creek Waterway (NW-83)

Sl. No.	Name of Waterway	Length of Water way (km)	Dredging Required (w. r. to 2 m draft & 40.0m width) (km)	Dredging Cost @ INR 230/ cum (INR in Cr.)	Terminal Proposed	Terminal Cost @ INR 20 Cr each (INR in Cr.)	Cost of Modification of Transmission line (INR in Cr.)	Night Navigation (INR in Cr.)	Total cost incld. 10% unforeseen (INR in Cr.)
1	Rajpuri Creek	31.00	4.80	4.42	2.00	40.00	---	3.5	52.70

5.5 Classification of Waterway

Ministry of Shipping, Road Transport and Highways (Inland Waterways Authority of India) has classified the Inland waterways into seven categories for Rivers and Canals for safe plying of self propelled vessels up to 2000 DWT and tug-barge formation in push tug + four barge units of carrying capacity up to 8000 DWT (Ref: IWAI, Gazette Notification dated 26th January 2007).

As per the above Classification of Inland Waterways, the entire waterway of Rajpuri Creek 31.0km length has been classified based on available minimum water depth, bottom width, minimum vertical and horizontal clearances of cross over structures and bend radius in the Creek. The classification of Rajpuri Creek Waterway is described as detailed below in **Table 5.2**:

Table 5.2: Classification of Rajpuri Creek Waterway (NW-83)

Chainage (km)	Minimum Depth (m)	Bottom Width (m)	Minimum Vertical Clearance (m)	Minimum Horizontal Clearance (m)	Bend Radius (m)	Classification of Waterway (Proposed)
0.0 – 31.00	0.1	200.0	--------	--------	160	**Class – V**

The study stretch of the waterway is amenable for development as Class V waterway as explained above. Moderate Dredging is essential in the upper reaches.

The above stretch of the waterway hence falls under Class V which is navigable without any hindrance and shall be used for plying self-propelled vessel of carrying capacity upto 1000 DWT (approximate size 70m overall length, 12m moulded breadth and 1.8m loaded draft) or one tug and four barges combination of 4000 DWT (approximate size 170m overall length, 24m breadth and 1.8m loaded draft).

5.6 Recommendation

The entire 31km length of national waterway-83 of Rajpuri Creek has been identified having potential for development as waterway of Class-V as described above. This stretch of the Creek is therefore recommended for stage-II study for preparation of Detailed Project Report (DPR) to establish the viability for implementation as a project.

Accordingly, the national waterway NW-83 of Rajpuri Creek is proposed for development as **Class V** waterway in the entire stretch of the waterway as depicted in Table 3.17 (as reproduced below):

River Stretch	0.0km	31.00km
Classification		
	Class- V	
Horizontal clearance (m)	80	
Vertical clearnce (m)	10	
Minimum Depth (m)	2	
Bottom Width (m)	80	
Self Propelled Vessel		
Dead Weight Tonnage	1000	
Vessel size (m)	70 x 12 x 1.8	
Tug + Barge		
Dead Weight Tonnage	4000	
Vessel size (m)	170 x 24 x 1.8	

ANNEXURE 1.1

DATA COLLECTION & SOURCE OF DATA

Source of Data Cluster-7

Sl. no	Name of Authority, place	Contacted Person	Designation	Required Data	Collected Data	Date of Receiving Data	Remarks
MAHARASHTRA							
1	Office of Hydrographer, Maharashtra Maritime Board, Khar (West), Mumbai	Mr. Sandip Dhuraji	Hydrographer	Chart Datum & Structure Detail in Water Way	Yes	3/4/2016	Official Letter Submitted to the Department. Data Received
2	Office of Hydrographer, Maharashtra Maritime Board, Khar (West), Mumbai	Mr. Anil Kadam	Assistant Hydrographer	River Gauge & Discharge Data/ Structure Detail	Yes	3/4/2016	Official Letter Submitted to the Department. Data Received
3	Kolkewadi Dam Maintainance Division, Alore, WRD, Maharashtra	Mr.K M Mane	Sectional Engineer (Admin)	River Gauge & Discharge Data/ Structure Detail/ Chart Datum	---	---	Official Letter Submitted to the Department. Data is Awaited
4	Indian Oil Corporation Ltd. (IOCL), Indian Oil Bhawan, G-9, Ali Yavar Jung Marg, Bandra (East), Mumbai	Mr. R. D. Kherdekar	GM (Consumer)	POL Data	Yes	7/6/2016	Discussion
5	Maharashtra Maritime Board, Main Office, Ramji Bhai Kamani Marg Ballard Estate, Mumbai	Mr. Atul Patane	Chief Executive Officer	existing traffic data on Cluster-7 Inland waterways and associated ports in Maharashtra	Yes	8/6/2016	Official Letter Submitted to the Department. Data Received
6	Maharashtra Industrial Development Corporation, Udyog Sarathi, Andheri (E), Mumbai	Mr. Yuvraj Poman	OSD (Markering)	Industries along the Cluster-7 Inland waterways in Maharashtra	Yes	8/6/2016	Official Letter Submitted to the Department. Maharashtra MIDC Industrial Area Map Received
7	Maharashtra Tourism Development Corporation Ltd. Opp. LIC (Yogakshema) Building, Madame Cama Road, Mumbai	Mr. Satish Soni	Director of Tourism & Jt. MD	Existing Tourism Development and Future Plan on Cluster-7 Inland waterways in Maharashtra	Yes	8/6/2016	Discussion
8	Direcorate of Industries, Government of Maharashtra	Mr. S. B. Patil	Jt. Director	Industries along the Cluster-7 Inland waterways in Maharashtra	To be Provided	---	Data is Awaited
9	Collectorate & DM Office, Raigarh, Maharashtra	Mr. Sagar Pathak	District Disaster Management Officer	Population data along the Cluster-7 Inland waterways in Ragarh district	Yes	9/6/2016	Population Data Received

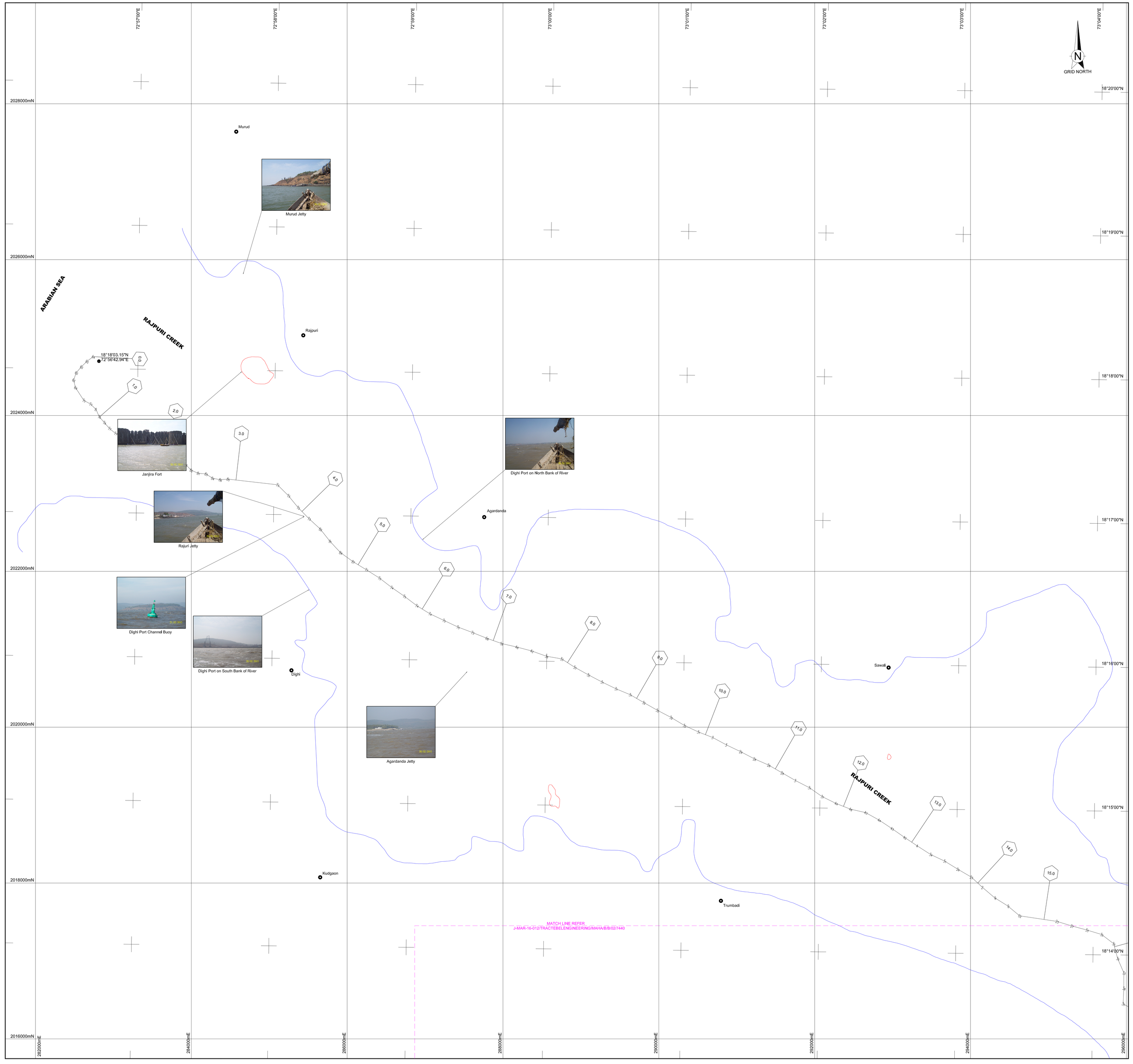
Source of Data Cluster-7

Sl. no	Name of Authority, place	Contacted Person	Designation	Required Data	Collected Data	Date of Receiving Data	Remarks
10	District Industrial Centre, Raigarh, Maharashtra	Mr. Lohnde	GM	Industries along the Cluster-7 Inland waterways in Raigarh district	Yes	9/6/2016	Industrial Data Received
11	Collectorate & DM Office, Raigarh, Maharashtra	Mr. K. Shinde	Superintendent of Agriculture	Crops/Fruits along the Cluster-7 Inland waterways in Raigarh district	Yes	9/6/2016	Agriculture/Horticulture Data Received
12	Collectorate & DM Office, Ratnagiri, Maharashtra	Mr. Suryavanshi	District Disaster Management Officer	Population data along the Cluster-7 Inland waterways in Ratnagiri district	To be Provided	10/6/2016	Data is Awaited
13	Collectorate & DM Office, Ratnagiri, Maharashtra	Mr. Vidyadhar Vaidya	Superintendent of Agriculture	Crops/Fruits along the Cluster-7 Inland waterways in Ratnagiri district	Yes	10/6/2016	Agriculture/Horticulture Data Received
14	District Industrial Centre, Ratnagiri, Maharashtra	Mrs. Ranjana Basantrao Pol	Manager	Industries along the Cluster-7 Inland waterways in Ratnagiri district	Yes	10/6/2016	Industrial Data Received
GOA							
1	Works Division - III, Water Resource Department, Goa	Mr. R. B. Ghanti,	Executive Engineer	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited
2	Water Resource Department, Goa	Mr. S T Nandkarni	Chief Engineer	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited
3	Water Resource Department, Works Division-III, Goa	Mr. P. B. Badami	Executive Engineer	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited
4	Water Resource Department, Works Division-III, Goa	Mr. Rajan	Section Engineer, WRD. Goa	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited
5	Captain of Ports Department, Govt. of Goa.	Mr. Sagar Chandra Rai	Captain	River Gauge & Discharge Data/ Structure Detail	---	---	Official Letter Submitted to the Department. Data is Awaited

ANNEXURE 3.1

OVERVIEW CHART FOR RAJPURI CREEK BATHYMETRY

BATHYMETRY



LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG CENTER LINE

BATHYMETRY

- DEPTHS IN METRES BELOW CHART DATUM

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHALLOW PATCHES
- BRIDGE
- BUOY
- JETTY

NOTES:

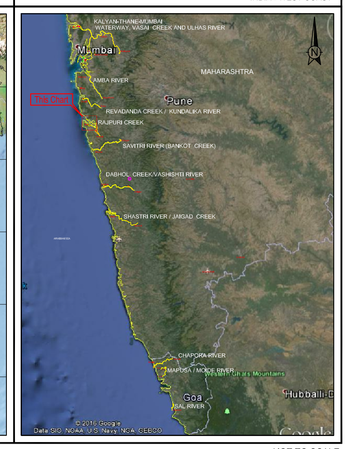
1) SURVEY VESSEL GITANJALI WAS DEPLOYED FOR THIS SURVEY IN FEBRUARY 2016.
2) THE COORDINATES OF THE SURVEY CORRIDOR WERE PROVIDED BY THE CLIENT.
3) FUGRO'S STARFIX SYSTEM WAS USED FOR POSITIONING AND CONTROL OF SURVEY.
4) REFER TO FSINPVT SURVEY REPORT NO. J-MAR-16-012 FOR DETAILS ON THE RESOURCES MOBILISED AND METHODOLOGY ADOPTED FOR THIS SURVEY.
5) SOUNDINGS WERE REDUCED TO CHART DATUM USING CLIENT SUPPLIED PREDICTED TIDES.
6) THE RESULTS OF SURVEY ARE PLOTTED IN WGS84 DATUM, UTM PROJECTION, ZONE 43N: CENTRAL MERIDIAN 075° E.

REFERENCE DRAWINGS

Rev. No:	Date:	Drawing No.	Source	Description:
-	-	-	-	-

OVERVIEW PLAN

LAYOUT PLAN — INDIA - WEST COAST



NOT TO SCALE

CLIENT

TRACTEBEL ENGINEERING PVT. LTD.
2nd FLOOR, BUILDING NO-10C,
DLF CYBER CITY,
GURGAON - 122002
HARYANA (INDIA)

SURVEY CONTRACTOR

FUGRO SURVEY (INDIA) PVT. LTD.
FUGRO HOUSE
D-222/30, TTC INDUSTRIAL AREA, MIDC, NERUL, NAVI
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(AN ISO 9001:2008 COMPANY)

PROJECT TITLE

RECONNAISSANCE SURVEY AND FEASIBILITY REPORT FOR STAGE-1 IN MAHARASHTRA AND GOA WEST COAST OF INDIA

FEBRUARY 2016

CHART SHOWING

OVERVIEW CHART FOR RAJPURI CREEK

BATHYMETRY

SHEET 01 OF 02

HORIZONTAL SCALE 1 : 20,000

400m 0m 400m 800m 1200m 1600m 2000m

Vessel:- GITANJALI — Project Ref: J-MAR-16-012

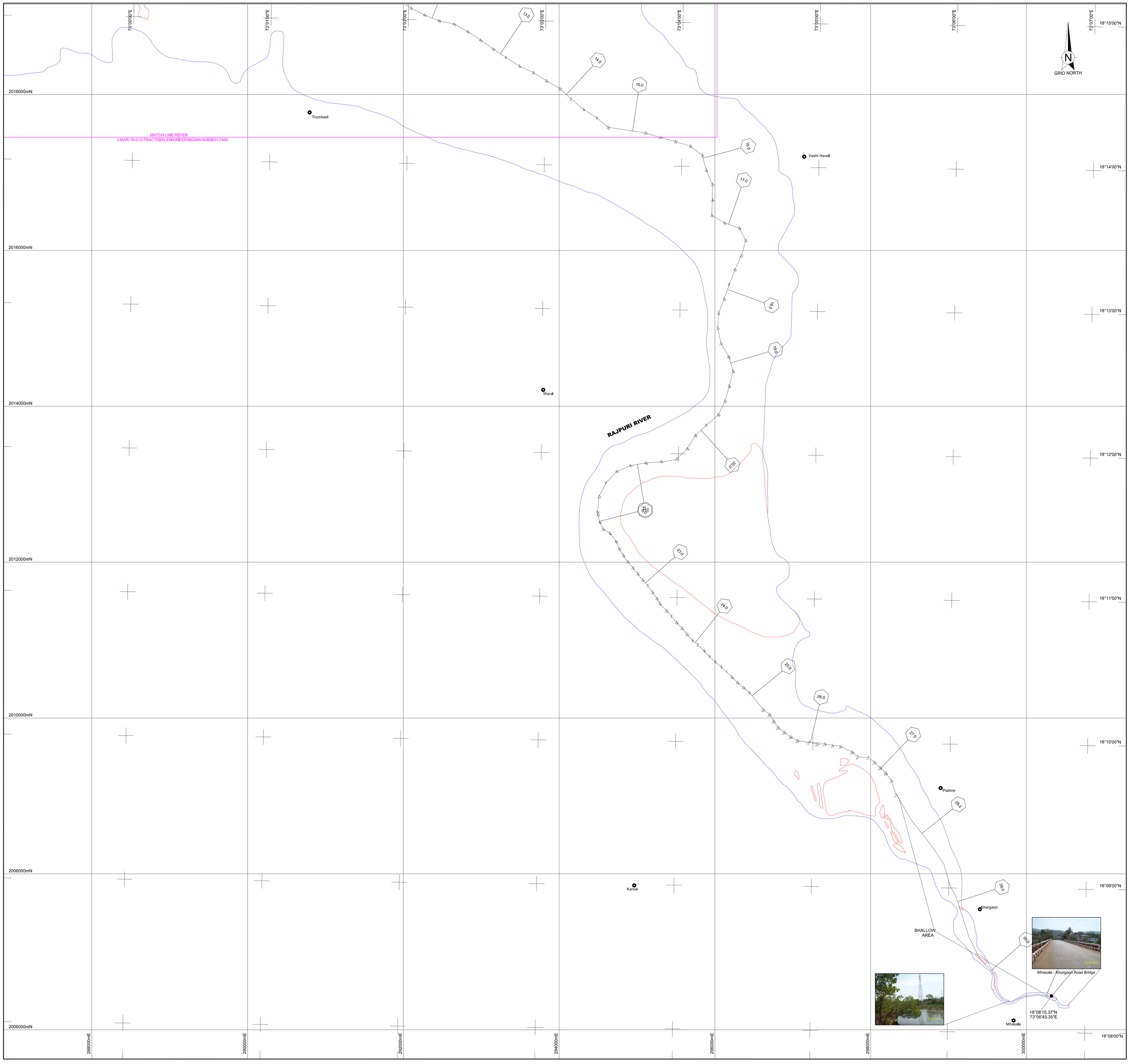
Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	17/06/2016	ISSUED FOR APPROVAL	SD	–	RP/SG	KS/PM	MI

Drawing File No: 7440-01R0

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/01/7440

Encl: 01 OF 02

BATHYMETRY



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- CHAINAGE ALONG CENTER LINE

BATHYMETRY

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- SHALLOW PATCHES
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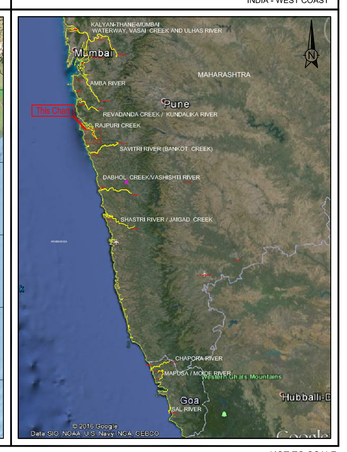
REFERENCE DRAWINGS

Rev. No:	Date:	Drawing No.	Source	Description:
-	-	-	-	-

OVERVIEW PLAN

LAYOUT PLAN — INDIA - WEST COAST



NOT TO SCALE

CLIENT

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2nd FLOOR, BUILDING NO-10C,
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PROJECT TITLE

RECONNAISSANCE SURVEY AND FEASIBILITY REPORT FOR STAGE-1 IN MAHARASHTRA AND GOA WEST COAST OF INDIA

FEBRUARY 2016

CHART SHOWING

OVERVIEW CHART FOR RAJPURI CREEK

BATHYMETRY

SHEET 02 OF 02

HORIZONTAL SCALE 1 : 20,000

400m 0m 400m 800m 1200m 1600m 2000m

Vessel:- GITANJALI — Project Ref: J-MAR-16-012

Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	17/06/2016	ISSUED FOR APPROVAL	SD	–	RP/SG	KS/PM	MI

Drawing File No: 7440-02R0

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/02/7440

Encl: 02 OF 02

ANNEXURE 3.2A

CHART DATUM OF RAJPURI CREEK JANJIRA FROM MMB

Rajpuri creek
24

Page 27

3 Tid. Anal.

SURVEY OF INDIA

List of Harmonic Tidal Constants

Place JANJIRA (Dongri Bunder)

Latitude	Longitude L	Standard time S	Observational data: Length	Observational data: Central day
18 18 35 N	72 57 50 E	I.S.T.	29 days	14-2-53

Notes :—

(1) Description of the tide-gauge site : The Tide Pole was installed along the side of small inclined stone pier at Dongri Bunder.

(2) B.M. of reference : The B.M of reference is with mark B.O.M. cut on bed rock situated east of sea wall and South of road and is 75.9 meters. East of Custom gate at Dongri Bunder (Janjira).

3) Height of chart datum { (a) below B.M. of reference 7.199 ft. ; (b) above Zero of tide-gauge 1.802 ft. }

	H	g		H	g		H	g		H	g
	ft.	°		ft.	°		ft.	°		ft.	°
S_o *	3.966		$2Q_1$			OQ_2			MO_3	0.020	53.6
Z_o †	2.164		σ_1			MNS_2			M_3	0.012	13.0
			Q_1	0.054	54.7	$2N_2$	0.034	293.1	SO_3		
			ρ_1			μ_2	0.029	266.3	MK_3	0.018	176.3
Sa			O_1	0.172	50.6	N_2	0.223	306.6	SK_3		
Ssa			MP_1			ν_2	0.043	309.4			
Mm	0.078	90.0	M_1			OP_2			MN_4	0.010	341.6
Msf	0.031	49.6	χ_1			M_2	0.987	327.4	M_4	0.033	347.4
Mf			π_1			MKS_2			SN_4		
			P_1	0.151	51.8	λ_2			MS_4	0.032	42.3
			S_1			L_2	0.026	335.0	MK_4	0.009	45.2
			K_1	0.458	51.9	T_2	0.023	1.4	S_4		
			ψ_1			S_2	0.383	2.9	SK_4		
			ϕ_1			R_2					
			θ_1			K_2	0.104	5.7	$2MN_6$	0.004	32.7
			J_1	0.039	29.4	MSN_2			M_6	0.008	119.1
			SO_1			KJ_2			MSN_6		
			OO_1			$2SM_2$	0.002	339.5	$2MS_6$	0.003	24.2
									$2MK_6$		
									$2SM_6$	0.001	59.6
									MSK_6		

Sum of all components plus Z_o = 5.151

$M_2+S_2+N_2+K_1+O_1$ = 4.38

* S_o Height of mean sea-level above Zero of tide-gauge.

...of all ...nits

ANNEXURE 3.2B

CHART DATUM OF RAJPURI CREEK AGARDANDA FROM MMB

3 Tid. Anal.

SURVEY OF INDIA

No. 68 (Tidal) Party (GGRB)

List of Harmonic Tidal Constants

Place Agardanda (Rajpuri Creek)

Latitude	Longitude L	Standard time S	Observational data: Length	Observational data: Central day
18° -16-22N	72-59-38E	I.S.T.	31 days	16.4.74

Notes :—

(1) Description of the tide-gauge site: Tide pole was fixed at Agardanda (Rajpuri creek).

(2) B.M. of reference: BOM engraved on the second step of Jumma Masjid in Agardanda village.

(3) Height of chart datum { (a) below B.M. of reference 2.5322 metre; (b) above Zero of tide-gauge 0.1818 metre

	H	g
	m	°
S_o *	~~2.6230~~	
Z_o †	2.3804 ✓	
Sa	0.0433	23.1
Ssa	0.0363	187.4
Mm	0.2310	141.1
Msf	0.0872	295.9
Mf		

	H	g
	m	°
$2Q_1$	0.0047	55.3
σ_1	0.0011	55.3
Q_1	0.0340	54.7
ρ_1		
O_1	0.1867	54.1
MP_1		
M_1	0.0107	57.1
χ_1		
π_1	0.0076	62.3
P_1	0.1319	62.3
S_1		
K_1	0.3986	62.3
ψ_1	0.0032	62.3
ϕ_1	0.0056	62.3
θ_1		
J_1	0.0228	78.7
SO_1		
OO_1	0.0263	112.0

	H	g
	m	°
OQ_2		
MNS_2		
$2N_2$	0.0329	286.3
μ_2	0.0450	322.1
N_2	0.2476	308.3
ν_2	0.0480	308.3
OP_2		
M_2	1.0336	330.3
MKS_2		
λ_2		
L_2	0.0159	330.4
T_2	0.0229	9.0
S_2	0.3876	9.0
R_2		
K_2	1.054	9.0
MSN_2		
KJ_2		
$2SM_2$	0.0095	148.6

	H	g
	m	°
MO_3	0.0149	59.6
M_3	0.0199	24.9
SO_3		
MK_3	0.0173	45.1
SK_3		
MN_4	0.0195	355.8
M_4	0.0490	14.2
SN_4	0.0083	352.4
MS_4	0.0368	60.2
MK_4		
S_4		
SK_4		
$2MN_6$	0.0012	283.8
M_6	0.0135	220.9
MSN_6	0.0041	313.3
$2MS_6$	0.0106	273.1
$2MK_6$		
$2SM_6$	0.0018	354.9
MSK_6		

* S_o = Height of mean-sea-level above Zero of tide-gauge.

† Z_o = chart datum.

ANNEXURE 3.2C

CHART DATUM OF RAJPURI CREEK DIGHI FROM MMB

भारतीय सर्वेक्षण विभाग
SURVEY OF INDIA

सं० ——— पार्टी ( ) सीजन 19
No. 68 (T) Party (G.T.R.B) Season 1980-81

प्रसंवादी ज्वारीय स्थिरांकों की सूची
List of Harmonic Tidal Constants

स्थान
Place DIGHI

अक्षांश Latitude	रेखांश Longitude L	मानक समय Standard time S	प्रेक्षण सामग्री Observational data: लम्बाई Length	मध्यवर्ती दिन Central day
18° 16' 05"	72° 58' 15"	I.S.T.	29 days	3.12.80

टिप्पणियां
Notes :—

(1) ज्वार-माप स्थल का विवरण :
Description of the tide-gauge site: Tide Pole fixed at N.W. corner just at the end of stairs of Jetty at Dighi Bandar shore is sandy and rocky.

(2) सन्दर्भ का त० चि०
B.M. of reference : ~~B.M.~~ BON R cut on step 18th from top at N.W. corner of jetty at Dighi Bandar

(3) आधार चार्ट की ऊंचाई
Height of chart datum
(क) सन्दर्भ के तल चि० से नीचे मी
(a) below B.M. of reference 2.9904 m
(ख) ज्वार माप के शून्य के ऊपर मी
(b) above Zero of tide-gauge 0.1898 m

	H	g
	m 2.4836	°
S_o *	m 2.6050	°
Z_o †	2.2838	
Sa	0.0493	349.81
Ssa	0.0349	246.90
Mm	0.0348	101.18
Msf	0.0418	241.47
Mf	—	—

	H (m)	g (°)
$2Q_1$	0.0046	79.68
σ_1	0.0010	79.68
Q_1	0.0331	67.40
ρ_1	—	—
O_1	0.1839	55.12
MP_1	—	—
M_1	0.0191	52.12
χ_1	—	—
π_1	0.0072	52.24
P_1	0.1247	52.24
S_1	—	—
K_1	0.3768	52.24
ψ_1	0.0030	52.24
ϕ_1	0.0053	52.24
θ_1	—	—
J_1	0.0355	63.73
SO_1	—	—
OO_1	0.0120	158.18

	H (m)	g (°)
OQ_2	—	—
MNS_2	—	—
$2N_2$	0.0313	287.56
μ_2	0.0490	289.82
N_2	0.2352	307.47
ν_2	0.0456	307.47
OP_2	—	—
M_2	0.9934	327.38
MKS_2	—	—
λ_2	—	—
L_2	0.0129	31.44
T_2	0.0223	05.31
S_2	0.3782	05.31
R_2	—	—
K_2	0.1029	05.31
MSN_2	—	—
KJ_2	—	—
$2SM_2$	0.0064	114.21

	H (m)	g (°)
MO_3	0.0189	69.36
M_3	0.0168	03.01
SO_3	—	—
MK_3	0.0101	64.21
SK_3	—	—
MN_4	0.0219	342.68
M_4	0.0467	01.71
SN_4	0.0085	13 36
MS_4	0.0392	46.22
MK_4	—	—
S_4	—	—
SK_4	—	—
$2MN_6$	0.0036	212.98
M_6	0.0080	212.16
MSN_6	0.0028	333.81
$2MS_6$	0.0091	278.69
$2MK_6$	—	—
$2SM_6$	0.0052	264.63
MSK_6		

* S_o=ज्वार- माप के शून्य के ऊपर माध्य समुद्रतल की ऊंचाई ।
* S_o=Height of mean-sea-level above Zero of tide-gauge.

ANNEXURE 3.2D

CHART DATUM OF RAJPURI CREEK MANDAD FROM MMB

...ations were taken by the office of Hydrographer Maharashtra State in 1974-75 Page 79

Tid. Anal.

SURVEY OF INDIA

No. 68 Party (G&RB)

List of Harmonic Tidal Constants

Place Mandad.

Latitude	Longitude L	Standard time S	Observational data	
			Length	Central day
18°-17'-45	73°-03'-40	I.S.T	31 days	25.12.74

Notes:—

(1) Description of the tide-gauge site: Pole Round tide pole erected about 1 Km NE of village Mandad, east of Mandad bunder & about 5 mtrs ahead of big flat rock.

(2) B.M. of reference: BOM engraved on bed rock which is on bed slope of Kardai hill 40 mtrs South of H.W.L and about 1 Km NE. of village Mandad.

(3) Height of chart datum
- (a) below B.M. of reference 7.9313 metre
- (b) above Zero of tide-gauge (Pole) 0.7343 metre

	H	g
	m	°
S_o *	~~3.3375~~	
Z_o †	2.5076	
Sa	0.0433	33.1
Ssa	0.0363	107.4
Mm	0.0833	4.4
Msf	0.0430	14.9
Mf		

	H	g
	m	°
$2Q_1$	0.0049	38.2
σ_1	0.0013	38.2
Q_1	0.0425	47.9
ρ_1	–	–
O_1	0.1959	57.6
MP_1	–	–
M_1	0.0103	84.5
χ_1	–	–
π_1	0.0013	56.3
P_1	0.1280	56.3
S_1	–	–
K_1	0.3867	56.3
ψ_1	0.0031	56.3
ϕ_1	0.0054	56.3
θ_1	–	–
J_1	0.0225	84.1
SO_1	–	–
OO_1	0.0350	73.6

	H	g
	m	°
OQ_2	–	–
MNS_2	–	–
$2N_2$	0.0365	306.9
μ_2	0.0395	331.3
N_2	0.2748	322.5
ν_2	0.0533	322.5
OP_2	–	–
M_2	1.0878	338.2
MKS_2	–	–
λ_2	–	–
L_2	0.0190	306.8
T_2	0.262	23.7
S_2	0.4434	23.7
R_2	–	–
K_2	0.1206	23.7
MSN_2	–	–
KJ_2	–	–
$2SM_2$	0.0259	147.2

	H	g
	m	°
MO_3	0.0302	65.9
M_3	0.0234	34.9
SO_3	–	–
MK_3	0.0259	127.3
SK_3	–	–
	–	–
MN_4	0.0345	44.7
M_4	0.0796	43.4
SN_4	0.0134	94.4
MS_4	0.0625	96.9
MK_4	–	–
S_4	–	–
SK_4	–	–
	–	–
$2MN_6$	0.0156	252.2
M_6	0.0343	243.0
MSN_6	0.0036	112.3
$2MS_6$	0.0392	339.7
$2MK_6$	–	–
$2SM_6$	0.0097	238.6
MSK_6	–	–

* S_o = Height of mean-sea-level above Zero of tide-gauge.

† Z_o = " " " chart datum.

ANNEXURE 3.3

BATHYMETRIC SURVEY AS RECEIVED FROM HYDROGRAPHIC SURVEYOR

Annexure 3.3: Digital Data, Chainage vs Water Depth, Rajpuri Creek

Chainage (Km)	Latitude (N)	Longitude (E)	Observed Water Depth (m)	Reduced Water Depth w.r.t CD (m)
0.00	18° 18' 05.01018"	72° 56' 40.40288"	7.10	6.40
0.10	18° 18' 03.04014"	72° 56' 37.69574"	6.90	6.20
0.20	18° 18' 00.72582"	72° 56' 35.30244"	6.90	6.20
0.30	18° 17' 58.24406"	72° 56' 33.10073"	6.90	6.20
0.40	18° 17' 55.17749"	72° 56' 31.96432"	6.90	6.20
0.50	18° 17' 52.02971"	72° 56' 32.81261"	7.60	6.90
0.70	18° 17' 46.76722"	72° 56' 36.48638"	8.30	7.50
0.80	18° 17' 45.21615"	72° 56' 39.47886"	8.40	7.70
0.90	18° 17' 42.98019"	72° 56' 41.94543"	8.70	8.00
0.90	18° 17' 42.98019"	72° 56' 41.94543"	8.70	8.00
1.00	18° 17' 39.99645"	72° 56' 43.30663"	8.30	7.60
1.10	18° 17' 37.57529"	72° 56' 45.58146"	8.30	7.60
1.20	18° 17' 35.13159"	72° 56' 47.83621"	8.50	7.70
1.30	18° 17' 33.11579"	72° 56' 50.50786"	8.50	7.70
1.40	18° 17' 31.55439"	72° 56' 53.50190"	8.60	7.80
1.50	18° 17' 31.66274"	72° 56' 56.89929"	9.00	8.30
1.60	18° 17' 30.29346"	72° 57' 00.00109"	8.80	8.00
1.70	18° 17' 28.60927"	72° 57' 02.91878"	8.60	7.90
1.90	18° 17' 25.30039"	72° 57' 08.78188"	8.70	7.90
2.00	18° 17' 23.79004"	72° 57' 11.79928"	9.00	8.20
2.10	18° 17' 23.03246"	72° 57' 15.10892"	8.70	7.90
2.20	18° 17' 21.82132"	72° 57' 18.27020"	8.90	8.20
2.30	18° 17' 20.43457"	72° 57' 21.35097"	9.10	8.20
2.40	18° 17' 18.11401"	72° 57' 23.73808"	9.00	8.20
2.50	18° 17' 16.84722"	72° 57' 26.86913"	8.90	8.10
2.60	18° 17' 16.61330"	72° 57' 30.27156"	9.20	8.30
2.70	18° 17' 14.83842"	72° 57' 33.13090"	9.20	8.40
2.80	18° 17' 14.25700"	72° 57' 36.48380"	9.40	8.60
2.90	18° 17' 14.54305"	72° 57' 39.88310"	9.30	8.50
3.50	18° 17' 12.40525"	72° 58' 01.53255"	8.40	7.30
3.70	18° 17' 07.92925"	72° 58' 06.35842"	9.00	7.30
3.90	18° 17' 03.01325"	72° 58' 10.67051"	7.90	7.20
4.10	18° 16' 58.44530"	72° 58' 15.45033"	8.00	7.30
4.30	18° 16' 54.11246"	72° 58' 20.47791"	9.00	8.20
4.50	18° 16' 49.09171"	72° 58' 24.73552"	10.10	9.10
4.70	18° 16' 44.40577"	72° 58' 29.40995"	10.10	8.90
4.90	18° 16' 40.68098"	72° 58' 34.93035"	9.80	8.70
5.10	18° 16' 37.38530"	72° 58' 40.74632"	9.00	7.70
5.30	18° 16' 33.98572"	72° 58' 46.52121"	8.40	7.20
5.50	18° 16' 30.12375"	72° 58' 51.90787"	8.30	7.40
5.70	18° 16' 26.49276"	72° 58' 57.49196"	9.00	7.50
5.90	18° 16' 22.63468"	72° 59' 02.94823"	8.90	7.40
6.10	18° 16' 19.29471"	72° 59' 08.75317"	9.10	7.40
6.30	18° 16' 16.60111"	72° 59' 14.88659"	9.00	7.50
6.50	18° 16' 13.88425"	72° 59' 21.04066"	8.70	7.50
6.70	18° 16' 11.66115"	72° 59' 27.42388"	8.60	7.30
6.90	18° 16' 09.31494"	72° 59' 33.76592"	8.20	6.80
7.10	18° 16' 07.20215"	72° 59' 40.19851"	7.20	5.80
7.30	18° 16' 05.81859"	72° 59' 46.83136"	6.30	4.80
7.50	18° 16' 04.24823"	72° 59' 53.42787"	5.60	4.20
7.70	18° 16' 02.09540"	72° 59' 59.84482"	5.10	3.80
7.90	18° 16' 01.09218"	73° 00' 06.51136"	4.70	3.30

Chainage (Km)	Latitude (N)	Longitude (E)	Observed Water Depth (m)	Reduced Water Depth w.r.t CD (m)
8.10	18° 15' 57.65511"	73° 00' 12.26075"	4.60	3.30
8.30	18° 15' 54.56416"	73° 00' 18.24134"	4.80	3.20
8.50	18° 15' 51.60135"	73° 00' 24.29053"	4.60	3.10
8.70	18° 15' 48.84354"	73° 00' 30.41802"	4.70	3.10
8.90	18° 15' 46.42254"	73° 00' 36.66415"	4.80	3.10
9.10	18° 15' 43.23280"	73° 00' 42.58132"	4.50	3.20
9.30	18° 15' 40.08614"	73° 00' 48.51802"	4.80	3.20
9.50	18° 15' 37.15198"	73° 00' 54.56663"	4.80	3.20
9.70	18° 15' 33.86950"	73° 01' 00.43158"	4.90	3.20
9.90	18° 15' 31.19592"	73° 01' 06.62417"	4.60	3.10
10.10	18° 15' 28.92198"	73° 01' 12.97353"	4.90	3.00
10.30	18° 15' 25.88587"	73° 01' 18.96692"	4.70	3.00
10.50	18° 15' 23.17011"	73° 01' 25.12411"	4.50	2.90
10.70	18° 15' 20.23945"	73° 01' 31.16725"	4.50	2.80
10.90	18° 15' 17.70024"	73° 01' 37.42616"	4.50	2.80
11.10	18° 15' 14.52466"	73° 01' 43.35215"	4.60	2.90
11.30	18° 15' 11.33950"	73° 01' 49.27003"	4.90	3.00
11.50	18° 15' 08.43308"	73° 01' 55.35252"	4.80	3.10
11.70	18° 15' 04.79840"	73° 02' 00.95946"	5.60	3.70
11.90	18° 15' 02.00387"	73° 02' 07.05419"	6.40	4.40
12.10	18° 14' 59.67261"	73° 02' 13.39147"	6.70	4.80
12.30	18° 14' 58.31516"	73° 02' 20.02855"	6.10	4.30
12.50	18° 14' 55.24657"	73° 02' 25.96148"	6.40	4.40
12.70	18° 14' 51.75394"	73° 02' 31.61931"	6.50	4.30
12.90	18° 14' 48.10280"	73° 02' 37.20669"	6.20	4.20
13.10	18° 14' 44.56203"	73° 02' 42.87378"	5.80	4.00
13.30	18° 14' 41.12118"	73° 02' 48.61730"	5.20	3.40
13.50	18° 14' 38.42499"	73° 02' 54.76975"	5.00	3.10
13.70	18° 14' 35.09358"	73° 03' 00.57218"	4.60	2.60
13.90	18° 14' 31.86846"	73° 03' 06.47072"	4.40	2.30
14.10	18° 14' 27.54079"	73° 03' 11.50842"	4.10	2.00
14.30	18° 14' 23.38827"	73° 03' 16.72723"	4.00	1.90
14.50	18° 14' 20.00182"	73° 03' 22.51131"	2.90	1.20
14.70	18° 14' 15.91887"	73° 03' 27.80068"	2.10	0.20
15.20	18° 14' 13.76033"	73° 03' 44.08178"	5.70	2.30
15.40	18° 14' 11.92462"	73° 03' 50.60135"	6.00	2.70
15.60	18° 14' 10.29264"	73° 03' 57.17207"	6.60	3.30
15.80	18° 14' 08.48140"	73° 04' 03.67940"	6.70	3.50
16.00	18° 14' 04.71314"	73° 04' 08.95849"	6.90	3.50
16.20	18° 13' 58.54533"	73° 04' 10.78996"	6.90	3.50
16.40	18° 13' 52.60543"	73° 04' 13.55077"	6.70	3.30
16.60	18° 13' 46.15465"	73° 04' 13.60660"	7.10	3.80
16.80	18° 13' 39.67995"	73° 04' 13.38531"	6.90	3.50
16.90	18° 13' 36.53818"	73° 04' 19.10406"	7.60	4.20
17.10	18° 13' 34.48443"	73° 04' 25.54933"	4.20	0.80
17.30	18° 13' 29.25105"	73° 04' 28.42666"	3.50	0.10
17.50	18° 13' 23.06746"	73° 04' 26.52685"	6.30	2.20
17.70	18° 13' 17.10248"	73° 04' 23.82319"	7.50	4.20
17.90	18° 13' 11.01047"	73° 04' 21.45755"	9.00	6.00
18.10	18° 13' 04.89118"	73° 04' 19.22600"	8.30	5.20
18.30	18° 12' 58.88669"	73° 04' 16.76759"	7.00	3.50
18.50	18° 12' 52.54710"	73° 04' 16.52977"	7.10	3.70
18.70	18° 12' 46.21979"	73° 04' 18.06147"	8.30	5.10

Chainage (Km)	Latitude (N)	Longitude (E)	Observed Water Depth (m)	Reduced Water Depth w.r.t CD (m)
18.90	18° 12' 40.71108"	73° 04' 21.53480"	9.10	6.50
19.10	18° 12' 34.74184"	73° 04' 23.45621"	8.70	5.40
19.30	18° 12' 28.47285"	73° 04' 21.82906"	9.10	5.60
19.50	18° 12' 22.21096"	73° 04' 20.10012"	8.10	5.30
19.70	18° 12' 16.54029"	73° 04' 17.26518"	9.30	5.90
19.90	18° 12' 12.15246"	73° 04' 12.24336"	9.10	6.00
20.10	18° 12' 07.79321"	73° 04' 07.28560"	8.80	5.60
20.30	18° 12' 02.21085"	73° 04' 03.82610"	7.90	4.90
20.50	18° 11' 57.79278"	73° 03' 59.20092"	7.20	3.70
20.70	18° 11' 56.61343"	73° 03' 52.55071"	8.20	4.70
20.90	18° 11' 56.05785"	73° 03' 45.77521"	7.60	4.80
21.10	18° 11' 54.87930"	73° 03' 39.08761"	7.80	4.70
21.30	18° 11' 52.35191"	73° 03' 33.16804"	7.30	4.10
21.50	18° 11' 47.59021"	73° 03' 28.54287"	7.30	4.00
21.70	18° 11' 41.90941"	73° 03' 25.49530"	5.70	2.30
21.90	18° 11' 35.44157"	73° 03' 24.89153"	7.50	4.30
21.90	18° 11' 34.25326"	73° 03' 25.08994"	7.50	4.30
22.00	18° 11' 31.10887"	73° 03' 25.96023"	7.70	4.60
22.10	18° 11' 28.19451"	73° 03' 27.48479"	8.30	5.20
22.20	18° 11' 26.52814"	73° 03' 30.40312"	8.70	5.60
22.30	18° 11' 23.13115"	73° 03' 33.16954"	6.90	4.60
22.40	18° 11' 20.16146"	73° 03' 34.57781"	6.50	4.20
22.50	18° 11' 17.36684"	73° 03' 36.32330"	6.20	3.90
22.60	18° 11' 14.71768"	73° 03' 38.30271"	6.00	3.70
22.70	18° 11' 12.25246"	73° 03' 40.53597"	6.00	3.50
22.80	18° 11' 09.76391"	73° 03' 42.72671"	5.70	3.40
22.90	18° 11' 07.22341"	73° 03' 44.87285"	5.80	3.40
23.00	18° 11' 04.81173"	73° 03' 47.16458"	5.40	3.00
23.10	18° 11' 02.15133"	73° 03' 49.13578"	5.70	3.30
23.20	18° 10' 59.53239"	73° 03' 51.15650"	5.90	3.50
23.30	18° 10' 57.35461"	73° 03' 52.51026"	5.90	3.40
23.40	18° 10' 54.46979"	73° 03' 55.42552"	5.70	3.30
23.50	18° 10' 52.07700"	73° 03' 57.73083"	5.40	3.00
23.60	18° 10' 49.61245"	73° 03' 59.95726"	5.00	2.60
23.70	18° 10' 47.25406"	73° 04' 02.31136"	4.90	2.50
23.80	18° 10' 44.75606"	73° 04' 04.49672"	4.70	2.30
23.90	18° 10' 42.33638"	73° 04' 06.76673"	4.30	1.90
24.00	18° 10' 40.32818"	73° 04' 09.44789"	4.50	2.00
24.10	18° 10' 38.03400"	73° 04' 11.87188"	4.20	1.80
24.20	18° 10' 35.67544"	73° 04' 14.21640"	4.10	1.70
24.30	18° 10' 33.47782"	73° 04' 16.73310"	3.90	1.50
24.40	18° 10' 31.40114"	73° 04' 19.35468"	3.70	1.30
24.50	18° 10' 29.24444"	73° 04' 21.89624"	3.50	1.00
24.60	18° 10' 27.04590"	73° 04' 24.41137"	3.00	0.60
24.70	18° 10' 24.79526"	73° 04' 26.87646"	2.90	0.40
24.80	18° 10' 22.71278"	73° 04' 29.49545"	2.80	0.30
24.90	18° 10' 20.62719"	73° 04' 32.10033"	2.50	0.10
25.20	18° 10' 13.55282"	73° 04' 38.28039"	2.90	-0.10
25.30	18° 10' 11.59570"	73° 04' 41.00683"	2.50	-0.50
25.40	18° 10' 08.85408"	73° 04' 42.84464"	2.50	-0.50
25.50	18° 10' 06.18090"	73° 04' 44.78366"	2.40	-0.50
25.60	18° 10' 04.22752"	73° 04' 47.50402"	2.80	-0.20
25.70	18° 10' 02.37797"	73° 04' 50.30390"	2.20	-0.80

Chainage (Km)	Latitude (N)	Longitude (E)	Observed Water Depth (m)	Reduced Water Depth w.r.t CD (m)
25.80	18° 10' 00.81111"	73° 04' 53.27820"	2.10	-0.90
26.00	18° 10' 00.20172"	73° 04' 58.49021"	1.50	-1.00
26.10	18° 09' 59.48044"	73° 05' 01.81580"	1.30	-1.20
26.20	18° 09' 59.62865"	73° 05' 05.20896"	0.90	-1.60
26.30	18° 09' 59.02538"	73° 05' 08.55674"	1.00	-1.60
26.40	18° 09' 58.66543"	73° 05' 11.93901"	0.90	-1.60
26.60	18° 09' 56.35267"	73° 05' 17.19788"	2.10	-0.80
26.70	18° 09' 54.23458"	73° 05' 19.77343"	0.90	-2.00
26.80	18° 09' 54.06606"	73° 05' 24.34980"	1.60	-1.00
26.90	18° 09' 52.08664"	73° 05' 27.05769"	1.90	-0.70
27.00	18° 09' 49.85859"	73° 05' 29.53756"	1.70	-0.90
27.10	18° 09' 47.62064"	73° 05' 32.01295"	1.70	-0.90
27.20	18° 09' 44.67272"	73° 05' 34.39976"	1.20	-1.50
27.40	18° 09' 38.61662"	73° 05' 36.58202"	1.50	-1.10

Note: Reduced depth has been reckoned by applying tide variation Min 0.70m & Max 4.10m

ANNEXURE 3.4

PHOTOS CAPTURED BY SURVEY TEAM DURING RECONNAISSANCE SURVEY

ANNEXURE 3.4: PHOTOS CAPTURED BY SURVEY TEAM DURING RECONNAISSANCE SURVEY

Photo 1: Murud Jetty at about 2.17km prior to Ch 0.0km (18°18'40.1"N, 72°57'45.5"E)

Photo 2: View of Light House at Ch 0.55km (18°17'50.4"N, 72°56'33.5"E)

Photo 3: Rajpuri Village at Ch 3.17km (18°18'07.7"N, 72°57'54.9"E)

Photo 4: Entrance of Janjira Fort at Ch 3.30km (18°18'02.0"N, 72°57'59.0"E)

Photo 5: Mouth of Rajpuri Creek on South of Dighi Bay at Ch 3.41km (18°17'51.6"N, 72°58'01.5"E)

Photo 6: Rajpuri Jetty at Ch 3.84km (18°17'02.0"N, 72°58'04.6"E)

Photo 7: Dighi Port Channel Buoy at Ch 4.07km (18°16'59.3"N, 72°58'13.5"E)

Photo 8: Dighi Port on North Bank of the River at Ch 4.25km (18°17'08.4"N, 72°58'30.2"E)

Photo 9: Dighi Port on South Bank of the River at Ch 5.07km (18°16′32.5″N, 72°58′35.5″E)

Photo 10: Agardanda Jetty at Ch 6.84km (18°15′55.4″N, 72°59′25.4″E)

Photo 11: Rocky Patch in river at Ch 26.02km (18°09'57.8"N, 73°04'58.95"E)

Photo 12: Mangroves flooded area East of Khargaon Village at Ch 28.99km (18°08'54.7"N, 73°06'04.2"E)

Photo 13: Mangroves flooded area West of Khargaon at Ch 29.08km (18°08'52.3"N, 73°06'06.0"E)

Photo 14: Large impounded water to the south of River at Ch 29.67km (18°08'33.9"N, 73°06'11.8"E)

Photo 15: Impounded water to the South of River at Ch 29.88km (18°08'29.7"N, 73°06'17.5"E)

Photo 16: Mhasala Village at Ch 30.27km (18°08'17.58"N, 73°06'22.2"E)

Photo 17: Telephone Tower at Ch 30.51km (18°08'13.2"N, 73°06'27.1"E)

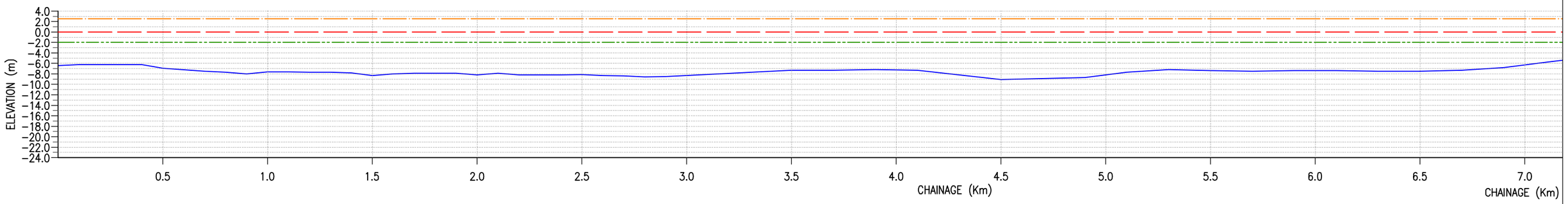
Photo 18: Landward side of the River at Ch 30.78km (18°08'16.7"N, 73°06'35.5"E)

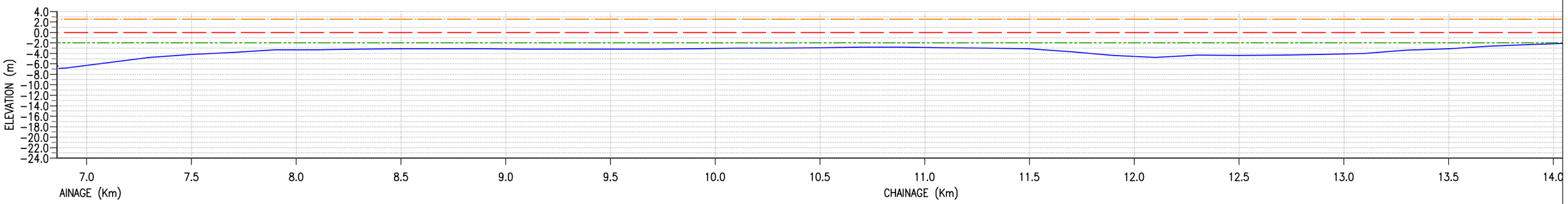
Photo 19: Bridge connecting Mhasala village to Khargaon at Ch 31.31km (18°08'11.7"N, 73°06'52.7"E)

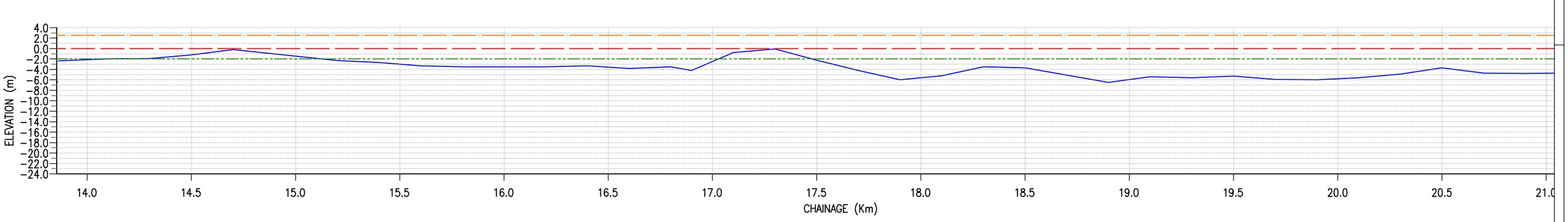
Photo 20: Seaward side of the River at Ch 31.33km (18°08'10.8"N, 73°06'53.1"E)

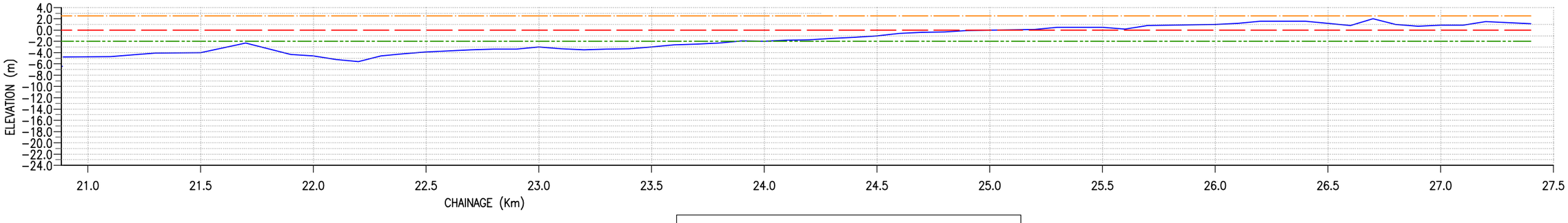
ANNEXURE 3.5

RAJPURI CREEK LONGITUDINAL BED PROFILE









LEGENDS

- HIGH TIDE
- CHART DATUM
- 2m DEPTH BELOW CHART DATUM
- RAJPURI CREEK BED PROFILE

ANNEXURE 3.5

RAJPURI CREEK LONGITUDINAL BED PROFILE

ANNEXURE 3.6

COMPILATION OF FIELD INFORMATION IN IWAI FORMAT

Annexure 3.6: Format for Submission of Initial Field Information Report

SL#	DESCRIPTION	DETAILS	REMARKS
	NAME OF THE FIRM	**Fugro Survey(India) Pvt Ltd.**	
	REGION / CLUSTER NO.	**Cluster-VII/ Stage-I/ Maharashtra**	
1	NAME OF THE WATERWAY	Rajpuri Creek	
2	LENGTH OF THE WATERWAY (km)	31	
3	WATERWAY IN THE STATES OF	Maharashtra	
4	FIELD WORK COMPLETED FOR THE LENGTH OF THE WATERWAY (km)	31 km (Data Acquisition done on 20 & 21.02.2016) based on Vessel Track	Data acquisition based on High Tide timings
TIDAL WATERWAYS			
5	Length of the waterway having tidal effects (km)	31	
6	Start & end location name having tidal effects	From Rajpuri to Mhasala	
7	Tidal variation (m)	-	Tide variation measurement scope is not in Stage-1, we have not carried out the same at site
DEPTH INFORMATION			
8	Length of the waterway, where depths more than 2m is observed	22.6 Km	
9	Length of the waterway, where depths more than 1.5m is observed	23.62 Km	
10	Length of the waterway, where depths more than 1.0 m is observed	24.06 Km	
11	Existing Water level (m)	0 to 9.1	The existing water level has been reckoned with respect to Chart Datum
12	Minimum Water Level (m)	0	
13	Highest Flood level (m)	-	We have not seen HFL marking in Bridge
CROSS-STRUCTURE INFORMATION			
14	Existing list of Dam, Barrages, Locks	Nil	
15	Existing Bridges (nos.)	1	Photographs captured
16	Minimum Vertical and Horizontal clearances (m) as per visual estimation	Mhasala to Khargaon Bridge -VC (4.0m) and HC (20m) - at Ch 31.31km from starting point	Vertical clearance above MHWS . Bridge located at the end of steady stretch.
17	High Tension lines	Nil	
NAVIGATIONAL OBSTRUCTION			
18	Rocks	On the South-East of Mithagar Village	approx. Ch 8.0km from Arabian Sea
19	Steep gradients	Nil	
ENVIRONMENTAL & OTHER ISSUES			
20	Details of wildlife /forest area	Nil	
21	Protected areas	Nil	
22	Security clearances	Nil	
CARGO AND OTHER DETAILS			
23	Availability of passenger ferry services along the waterway	04 Passenger Ferry Services	1) Agardanda to Rohini, 2) Agardanda to Dighi, 3) Rajpuri to Janjira, 4) Rajpuri to Dighi
24	Estimated cargo movement through proposed waterway, road and rail	0.79 MMTPA of cargo has been handled at Dighi Port in the year 2015-16	
25	Type of crops (in different seasons) and industries along the waterway	Crops: Rice, Nachni and Tur Pulse Industries:	
26	Availability of prominent towns / City along the waterway.	Murud, Dighi, Agardanda, Rajpuri, Roha, Tala, Mangaon, Mhasala, Srivardhan	
27	Historical and tourist places along waterway	Murud-Janjira Fort near mouth of Rajpuri Creek on the Arabian sea	
28	Existing water sport and recreational activities and future probability	-	
29	Existing Jetties and Terminals	15 jetties and 01 terminal	

ANNEXURE 4.1

LARGE SCALE INDUSTRIES IN RAJPURI CATCHMENT REGION

Annexure 4.1: Large scale Industries in Rajpuri catchment region

Sr. No.	COMPANY NAME	PRODUCTS	PROP_CAP	UNIT	TALUKA
1	WELSPUN MAXSTEEL LTD.	SPONGE IRON	27,50,000	MT	MURUD
2	WELSPUN MAXSTEEL LTD.	SPONGE IRON	27,50,000	MT	MURUD
3	RHODIA SPECIALTY CHEMICALS INDIA LTD(FORMALY ALBRIGHT & WILSON CHEMICALS INDIA LTD)	SYNTHETIC DETERGENTS AND ACTIVE DETERGENTS SULPHONATES	9,500	MT	ROHA
4	CALCHEM INDUSTRIES INDIA LTD	CALCIUM CARBONATE	18,000	MT	ROHA
5	CLARIANT CHEMICALS INDIA LTD	CHEMICAL PRODUCTS OR PREPARATIONS OF KIND USED IN TEXTILES LEATHER INDUSTRIES	17,850	MT	ROHA
6	HYDRIL JINDAL INTERNATIONAL PVT LTD	PREMIUM THIER CONNECTION LIKE COUPLED TUBING JOINTS COUPBLED CASING JOINTS & ACCESSORIES ENDS	2,00,000	PCS	ROHA
7	KISAN IRRIGATIONS LTD.	RIGID PVC PIPES & HDPE PIPES	3,000	MT	ROHA
8	LIME CHEMICALS LTD.	CALCIUM CARBONATE	32,000	MT	ROHA
9	MAHALAXMI SEAMLESS LTD.	COLD DRAWNSEAMLESS TUBE FROM MOTHER TUBE	5,000	MT	ROHA
10	MAHARAHSTRA SEAMLESS LTD	SEAMLESS STEEL,PIPES CASING,TUBING,DRILL PIPE AND LINE PIPE	25,000	MT	ROHA
11	RELIANCE INDUSTRIES LTD(IPCL)	PET CHIPS	1,00,000	MT	ROHA
12	ROHA DYCHEM PVT.LTD	DYES			ROHA
13	SUPREME PETROCHEM LTD	COMPOUNDS AND MASTER BATCHES OF POLYMERS	17,000	MT	ROHA
14	TRANSWORLD FURTICHEM PVT LTD	SULPHURIC ACID	90,750	MT	ROHA
15	WAMAN INDUSTRIAL CHEMICALS LTD.	OTHER SULPHIDES OF NON-METALS OR OF METALLOIDES	4,800	MT	ROHA
16	SUDARSHAN CHEMICAL INDUSTRIES LTD.	3.3 DCB			ROHA
17	POLYOLS INDIA PVT.LTD.	FORMALDEHYDE, THRITOL			ROHA
18	MAHARASHTRA SEAMLESS LTD	SEAMLESS STEEL PIPES CASTING,TUBING DRILLS KPIPE AND LINE PIPES	75000	MT	MIDC VILE-BHAGAD, TAL. .MANGAON
19	POSCO MAHARASHTRA STEEL				MANGAON
		TOTAL	**58,97,900**	**MT**	

Source: District Industries Centre, Raigarh District
Note: as per DIC office, the list is old and some companies may have closed. The data is to be verified.

ANNEXURE 4.2

MEETING AND DISCUSSIONS

Annexure 4.2: Meeting and Discussions

S.No	Department	Persons met
1.	Maharashtra Maritime Board	CEO, Port Superintendent, Traffic Department, Hydrographer
2.	Maharashtra Industrial Development Corporation	OSD
3.	Maharashtra Tourism Development Corporation Ltd.	Director of Tourism & Jt, MD, Manager Adventure Sports
4.	Indian Oil corporation Ltd.	GM, Consumer Sales
5.	Directorate of Industries, Government of Maharashtra (GOM)	Jt. Director
6.	Planning Department, GOM	Deputy Secretary
7.	Department of Agriculture, GOM	Jt. Secretary
8.	Cement Manufacturing Association	Sr. Deputy Secretary
9.	Collectorate & DM Office, Raigarh	District disaster Management officer
10.	Collectorate & DM Office, Raigarh	Superintendent of Agriculture
11.	District Industries Centre, Raigarh	GM
12.	Collectorate & DM Office, Ratnagiri	District disaster Management officer
13.	Collectorate & DM Office, Ratnagiri	Superintendent of Agriculture (Office)
14.	District Industries Centre, Ratnagiri	Manager
15.	JSW Dharamtar Port Pvt. Ltd.	CEO, Vice President
16.	PNP Port	Head Ports Operations
17	JSW Salav Jetty	Ports Office

DRAWINGS

P.009051-W-20201-A07 R0 (SHEET-1 TO 7): LAYOUT PLAN –

(RAJPURI CREEK)

53NW CLUSTER-7
STATE OF MAHARASTRA
RAJPURI CREEK

N
W E
S

एकदारा
Eakdara

JANGIRA

राजापुरी
Rajapuri

मुरुड जंजिरा किल्ला
Murud-Janjira Fort

FERRY LINE

RAJPURI SLOPE JETTY-2

जेट्टी वीच

RAJPURI KOLIVADA SLOPE JETTY

मजिरी मार्ग

CH 0.00

A1

A

CH 1.00

CH 2.00

CH 3.00

CH 4.00

CH 5.00

CH 6.00

CH 7.00

FERRY LINE

MATCH LINE

AGARDANDA TRANSPORT JETTY

हफीजखार
Haphijkhar

अगर्दंडा
Agardanda

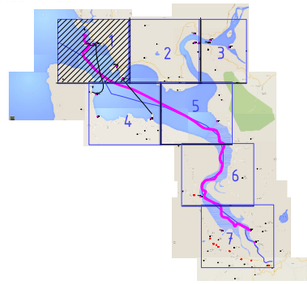
AGARDANDA SLOPE JETTY

दिघी पोर्ट
Dighi Port

नानावाली
Nanavali

MATCH LINE

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/SUB CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE
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A1	START POINT OF RECONNAISSANCE SURVEY FROM ARABIAN SEA RAJPURI LAT. 18°18'26.37", LONG. 72°57'47.42"
B	END POINT AT MHASALA AS PROVIDED BY IWAI LAT. 18°08'15.37" LON. 73°06'45.35"
B1	END POINT OF RECONNAISSANCE SURVEY AT MHASALA LAT. 18°09'39.19", LONG. 73°05'37.45"

PROPOSED WATERWAY LENGTH 31.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

REV.	DATE	SIGN	SIGN	SIGN	SIGN	
	REVISION	DRAWN	DESIGNED	CHECKED	APPROVED	SUBJECT OF REVISION
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TITLE
LAYOUT PLAN
RAJPURI CREEK

CLIENT
INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT
CONSULTANCY SERVICE FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 7 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 – FEASIBILITY REPORT

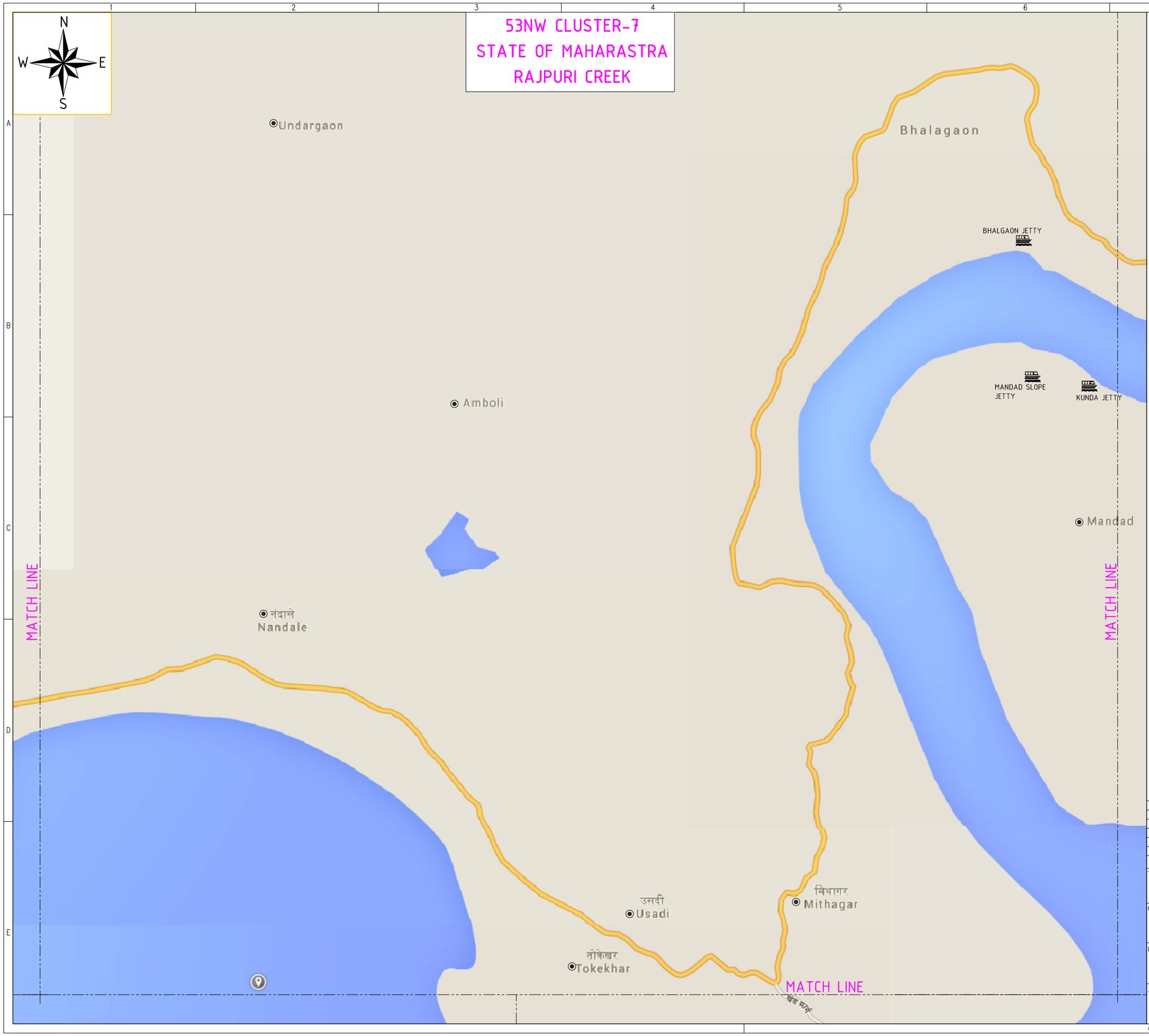
PROJECT NO. P.009051

SIZE: A3 | SCALE: 1:20000 | SHEET: 1–7

TRACTEBEL Engineering
GDF SUEZ

DRAWING NUMBER P.0090051–W–20201–A07 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
RAJPURI CREEK



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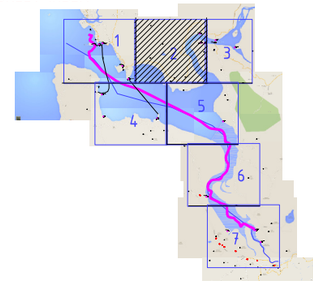

LEGEND

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	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
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SCALE 0 0.4 1.0KM

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REVISION		DRAWN	DESIGNED	CHECKED	APPROVED	

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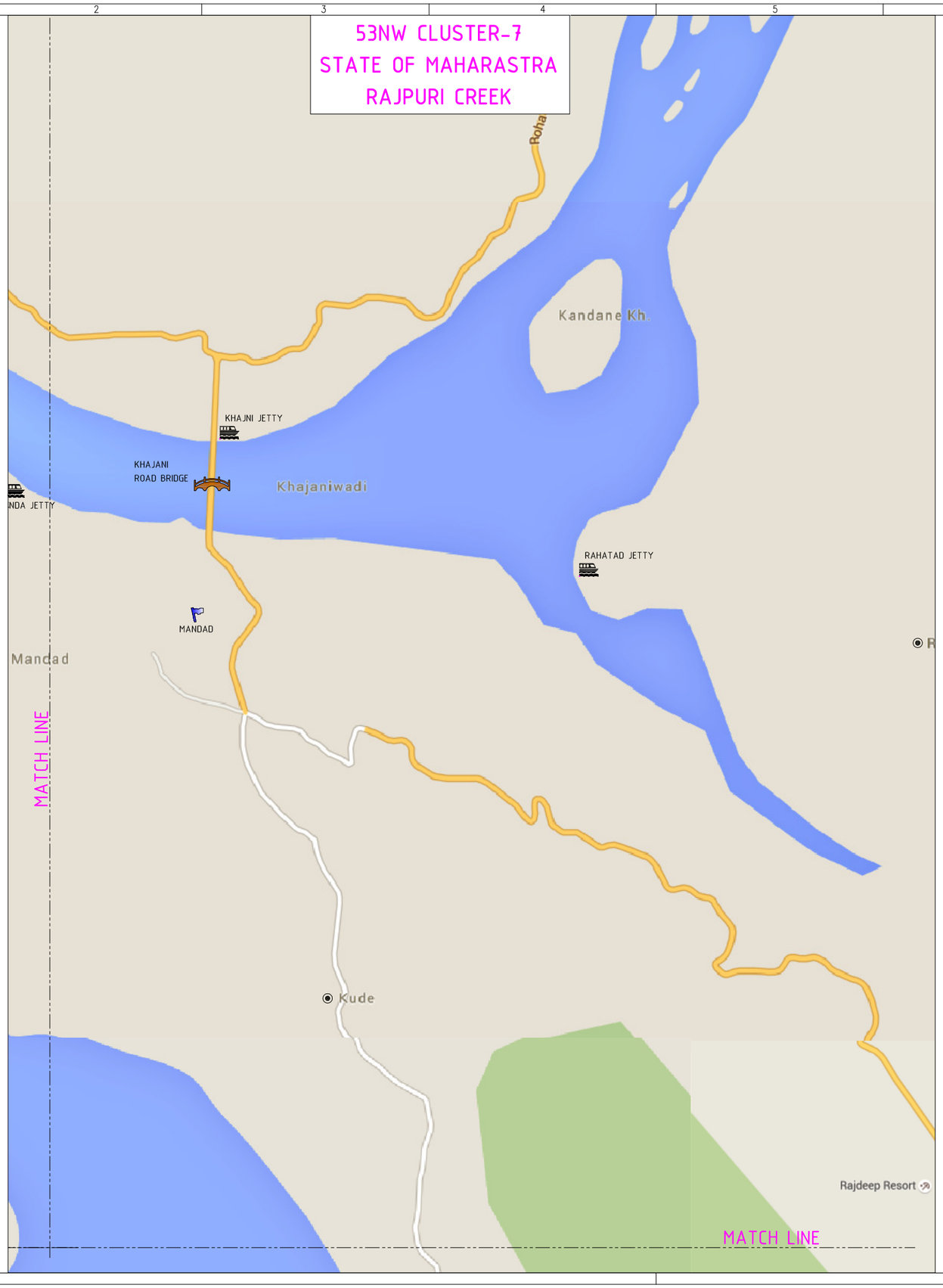
P.009051

TRACTEBEL Engineering
GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 2–7

DRAWING NUMBER
P.009051–W–20201–A07 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
RAJPURI CREEK



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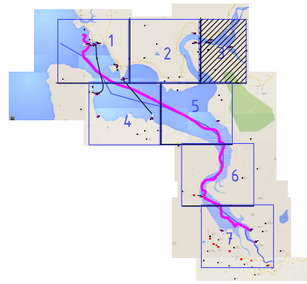

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	INDUSTRY
	RAILWAY STATION
	PLACE NAME
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SCALE 0 0.4 1.0KM

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P.009051

TRACTEBEL Engineering
GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 3-7

DRAWING NUMBER
P.009051-W-20201-A07 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
RAJPURI CREEK

MATCH LINE

CH 8.00

CH 9.00

CH 10.00

MATCH LINE

DIGHI

दीघि
Dighi

DIGGI MOHALLA
JETTY

KUDGAON
JETTY

कुदूओं
Kudgaon

हर्वित
Harvit

TRUMBADI
JETTY

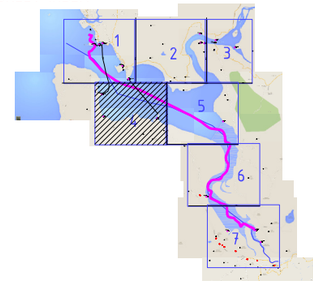
रोहिणी
Rohini

तुरुम्बदी
Turumbadi

आदि ठाकुर
Adi Thakur

रोहिनिकोंद
Rohinikond

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/SUB CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
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B1	END POINT OF RECONNAISSANCE SURVEY AT MHASALA LAT. 18°09'39.19", LONG. 73°05'37.45"

PROPOSED WATERWAY LENGTH 31.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

REV.	DATE	SIGN	SIGN	SIGN	SIGN	
REVISION		DRAWN	DESIGNED	CHECKED	APPROVED	SUBJECT OF REVISION
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TITLE
LAYOUT PLAN
RAJPURI CREEK

CLIENT
INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT
CONSULTANCY SERVICE FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 7 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 - FEASIBILITY REPORT

PROJECT NO.
P.009051

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 4–7

DRAWING NUMBER
P.009051–W–20201–A07 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
RAJPURI CREEK

N
W E
S

MATCH LINE

तोकेखर
okekhar

सवाली
Sawali

खंड
Khamde

रोवाला
Rowala

VASHI JETTY

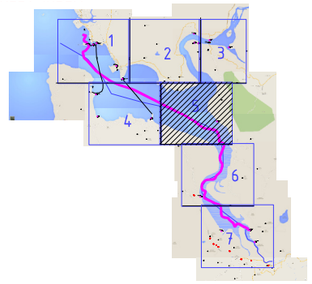
CH 11.00
CH 12.00
CH 13.00
CH 14.00
CH 15.00
CH 16.00
CH 17.00

MATCH LINE

तुरुम्बदी
urumbadi

MATCH LINE

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/SUB CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
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PROPOSED WATERWAY LENGTH 31.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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REVISION		DRAWN	DESIGNED	CHECKED	APPROVED	SUBJECT OF REVISION
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TITLE
LAYOUT PLAN
RAJPURI CREEK

CLIENT
INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT
CONSULTANCY SERVICE FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 7 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 - FEASIBILITY REPORT

PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 5-7

DRAWING NUMBER
P.0090511-W-20201-A07 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
RAJPURI CREEK

MATCH LINE

Washi Haveli

CH 18.00

CH 19.00

CH 20.00

CH 21.00

CH 22.00

CH 23.00

CH 24.00

वरल
Waral

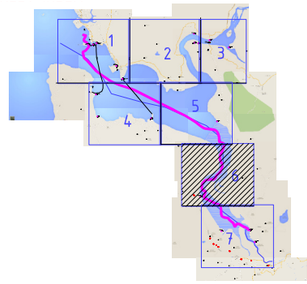
तम्हाने
तरफ टेल
Tamhane
Tarf Tale

मेंदादी
Mendadi

MENDADI JETTY

MATCH LINE

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
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	ROAD
	NALA/SUB CREEK/SMALL RIVER
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PROPOSED WATERWAY LENGTH 31.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

REV.	DATE	SIGN	SIGN	SIGN	SIGN	SUBJECT OF REVISION
	REVISION	DRAWN	DESIGNED	CHECKED	APPROVED	

TITLE
LAYOUT PLAN
RAJPURI CREEK

CLIENT
INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT
CONSULTANCY SERVICE FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 7 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 - FEASIBILITY REPORT

PROJECT NO.
P.009051

TRACTEBEL Engineering
GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 6-7

DRAWING NUMBER
P.0090051-W-202201-A07 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
RAJPURI CREEK

MATCH LINE

CH 24.00
CH 25.00
CH 26.00
CH 27.00
CH 28.00
CH 29.00
CH 30.00
CH 31.0

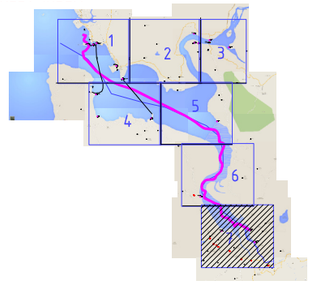
KHARSAI JETTY
PABHRE JETTY
KHARGOAN JETTY

निगडी
Nigadi
दगादधुम
Dagadghoom
पभारे
Pabhare
कोलीवाडा
KOLIWADA
खर्सी
Karsai
बनोती
Banoti
अगरवाडा
Agarwada
गणेश नगर
Ganesh Nagar
खरगोन बक
Khargaon Bk
रेवाली
Revali
पेधाम्बे
Pedhambe
वारावाटने
Waravatne
तोंदसुरे
Tondsure
खरगोन खुर्द
Khargaon Khurda
म्हासला
Mhasala
CHIRA

Mhasala Rd
म्हासला मार्ग
चिचोंदे मार्ग
नगरोली मार्ग

Google

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
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PROPOSED WATERWAY LENGTH 31.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

REV.	DATE	SIGN	SIGN	SIGN	SIGN	SUBJECT OF REVISION
REVISION		DRAWN	DESIGNED	CHECKED	APPROVED	
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TITLE: LAYOUT PLAN
RAJPURI CREEK

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT: CONSULTANCY SERVICE FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 7 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 - FEASIBILITY REPORT

PROJECT NO. P.009051

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 7–7

DRAWING NUMBER P.I.0.0.9.0.5.1.–.W.–.2.0.2.0.1.–.A.0.7 REV 0

MAP 4.1

MAP 4.1 – LAYOUT MAP SHOWING EXISTING JETTIES AND INDUSTRIES IN VICINITY OF RAJPURI CREEK)

MAP 4.1

LIST OF JETTIES		
SL.	DESCRIPTION	SYMB.
1	RAJPURI CREECK/AGARDANDA SLOPE JETTY	J1
2	RAJPURI CREECK/RAJPURI SLOPE JETTY	J2
3	RAJPURI CREECK/AGARDANDA TRANSPORT JETTY	J3
4	RAJPURI CREECK/RAJPURI KOLIVADASLOPE JETTY	J4
5	RAJPURI CREECK/RAJPURI KOLIVADA JETTY	J5
6	RAJPURI CREECK/MANDAD SLOPE JETTY	J6
7	RAJPURI CREECK/KHAJNI JETTY	J7
8	RAJPURI CREECK/KUNDA JETTY	J8
9	RAJPURI CREECK/BHALGAON JETTY	J9
10	RAJPURI CREECK/RAHATAD JETTY	J10
11	RAJPURI CREECK/VASHI JETTY	J11
12	RAJPURI CREECK/TRUMBADI JETTY	J12
13	RAJPURI CREECK/KHARGOAN JETTY	J13
14	RAJPURI CREECK/KHARSAI	J14
15	RAJPURI CREECK/PABHRE JETTY	J15
16	RAJPURI CREECK/MENDADI	J16
17	RAJPURI CREECK/KUDGAON JETTY	J17
18	RAJPURI CREECK/DIGGIMOHALLA JRTTY	J18
19	RAJPURI CREECK/DIGGI PORT LTD. JETTY	J19

LIST OF EXISTING INDUSTRY		
SL.	DESCRIPTION	SYMB.
1	AGARDANDA SHIPYARD	I1
2	MURUD FERRY POINT	I2
3	BEST HARDWARE	I3
4	HARDWORE STORE	I4
5	SOAT BARAH REAL ESTATE	I5
6	GOLDEN CERAMICS	I6
7	BHARAT PETROLEUM	I7
8	MEDHEKAR FOODS & BEVERAGES INDUSTRIES	I8
9	MIDC ROHA	I9

LIST OF PROPOSED INDUSTRIES/INDUSTRIAL AREAS EXPANSIONS		
SL.	DESCRIPTION	SYMB.
1	MIDC ROHA	IP1
	* TENTATIVE LOCATION	

(AROUND 20km FROM MANDAD, VIA ROHA MUSUD ROAD)

LEGEND

- BUS STOP
- HISTORICAL PLACE
- PORT
- EXISTING INDUSTRY
- PROPOSED INDUSTRY
- RAILWAY STATION
- PLACE NAME
- JETTY
- CHART DATUM
- ROAD BRIDGE
- NATIONAL HIGHWAY (Hwy)
- ROAD
- NALA/SUB CREEK/SMALL RIVER
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  LON. 73°06'45.35"
- (B1) END POINT OF RECONNAISSANCE SURVEY AT MHASALA
  LAT. 18°09'39.19", LONG. 73°05'37.45"

PROPOSED WATERWAY LENGTH 27.61Km

SCALE 0 2 5.0KM

TITLE: LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF RAJPURI (MAP 4.1)

CLIENT: INLAND WATERWAYS AUTHORITY OF INDIA
MINISTRY OF SHIPPING

PROJECT: CONSULTANCY SERVICE FOR PREPARATION OF TWO STAGE DETAILED PROJECT REPORT (DPR) OF CLUSTER 7 OF PROPOSED 53 NATIONAL WATERWAYS.
STAGE 1 - FEASIBILITY REPORT

PROJECT NO. P.009051

TRACTEBEL Engineering GDF SUEZ

At the helm of the Energy Transition, Tractebel provides a full range of engineering and consulting services throughout the life cycle of its clients' projects, including design and project management. As one of the world's largest engineering consultancy companies and with more than 150 years of experience, it's our mission to actively shape the world of tomorrow. With about 4,400 experts and offices in 33 countries, we are able to offer our customers multidisciplinary solutions in energy, water and infrastructure.

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