TRACTEBEL

ENGIE

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

FEASIBILITY REPORT-KALYAN-THANE-MUMBAI WATERWAY,VASAI CREEK AND ULHAS RIVER (145KM) - (NW-76)
Project No. P.009051
Document No. P.009051-W-10204-D06
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.02

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>Kalyan-Thane-Mumbai Waterway, Vasai Creek And Ulhas River(145km), NW-53</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>Kalyan-Thane-Mumbai via Ulhas River is Tidal from 0.00km to 67.78km. Waldhuni Creek of 3.31km length is Tidal. Vasai Creek is Tidal from 0.00km to 31.20km.
Tidal Variation is 4.42m / 0.32m</td></tr>
<tr><td>b)</td><td>LAD status (w.r.t.CD)
i) Survey period (12 to18,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>Kalyan-Thane-Ulhas River
<table>
<tr><th>Chainage (Km)</th><th><1m</th><th>1-1.5m</th><th>1.5-2.0m</th><th>>2m</th></tr>
<tr><td>0-5</td><td>-</td><td>-</td><td>-</td><td>4.93</td></tr>
<tr><td>5-9</td><td>-</td><td>-</td><td>-</td><td>4.04</td></tr>
<tr><td>9-17</td><td>-</td><td>-</td><td>0.89</td><td>7.09</td></tr>
<tr><td>17-21</td><td>-</td><td>-</td><td>0.00</td><td>4.03</td></tr>
<tr><td>21-25</td><td>2.76</td><td>0.10</td><td>0.30</td><td>0.20</td></tr>
<tr><td>25-29</td><td>1.92</td><td>1.69</td><td>1.01</td><td>-</td></tr>
<tr><td>29-33</td><td>0.93</td><td>2.51</td><td>0.55</td><td>-</td></tr>
<tr><td>33-37</td><td>2.99</td><td>0.10</td><td>0.78</td><td>-</td></tr>
<tr><td>37-43</td><td>1.00</td><td>0.49</td><td>0.50</td><td>4.17</td></tr>
<tr><td>43-47</td><td>-</td><td>-</td><td>-</td><td>3.99</td></tr>
<tr><td>47-50</td><td>-</td><td>-</td><td>-</td><td>3.00</td></tr>
<tr><td>50-55</td><td>-</td><td>0.20</td><td>-</td><td>4.79</td></tr>
<tr><td>55-59</td><td>-</td><td>-</td><td>0.40</td><td>3.57</td></tr>
<tr><td>59-64</td><td>-</td><td>-</td><td>0.20</td><td>4.80</td></tr>
<tr><td>64-69</td><td>0.10</td><td>1.57</td><td>0.81</td><td>2.56</td></tr>
<tr><td>69-75</td><td>3.97</td><td>1.41</td><td>-</td><td>-</td></tr>
<tr><td>75-79</td><td>4.39</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>79-84</td><td>3.51</td><td>1.40</td><td>-</td><td>-</td></tr>
<tr><td>84-87</td><td>2.06</td><td>0.94</td><td>-</td><td>-</td></tr>
<tr><td>87-90</td><td>2.19</td><td>1.10</td><td>-</td><td>-</td></tr>
<tr><td>90-94</td><td>2.88</td><td>1.13</td><td>-</td><td>-</td></tr>
<tr><td>94-100</td><td>3.52</td><td>2.09</td><td>-</td><td>-</td></tr>
<tr><td>100-104</td><td>3.92</td><td>0.40</td><td>-</td><td>-</td></tr>
<tr><td>104-107</td><td>2.57</td><td>0.52</td><td>-</td><td>-</td></tr>
<tr><td>107-111.2</td><td>3.45</td><td>0.78</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>42.16</td><td>16.43</td><td>5.44</td><td>47.17</td></tr>
</table>
Waldhuni River
<table>
<tr><th>Chainage (Km)</th><th><1m</th><th>1-1.5m</th><th>1.5-2.0m</th><th>>2m</th></tr>
<tr><td>0-0.71</td><td>0.71</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>0.71-3.31</td><td>1.27</td><td>1.17</td><td>-</td><td>0.16</td></tr>
<tr><td>Total</td><td>1.98</td><td>1.17</td><td>0.00</td><td>0.16</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Sl.No.</th><th>Particulars</th><th>Details</th></tr>
<tr><td></td><td></td><td>
Vasai Creek
<table>
<tr><th>Chainage (Km)</th><th><1m</th><th>1-1.5m</th><th>1.5-2.0m</th><th>>2m</th></tr>
<tr><td>0-4</td><td>0.20</td><td>0.70</td><td>0.30</td><td>2.80</td></tr>
<tr><td>4-8</td><td>0.20</td><td>0.30</td><td>0.20</td><td>3.30</td></tr>
<tr><td>8-11</td><td>-</td><td>-</td><td>-</td><td>3.00</td></tr>
<tr><td>11-15</td><td>-</td><td>-</td><td>-</td><td>4.00</td></tr>
<tr><td>15-19.5</td><td>-</td><td>-</td><td>-</td><td>4.50</td></tr>
<tr><td>19.5-24.5</td><td>-</td><td>-</td><td>-</td><td>5.00</td></tr>
<tr><td>24.5-29</td><td>-</td><td>-</td><td>-</td><td>4.50</td></tr>
<tr><td>29-31.163</td><td>-</td><td>-</td><td>-</td><td>2.16</td></tr>
<tr><td>Total</td><td>0.40</td><td>1.00</td><td>0.50</td><td>29.26</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) 2 no. barrage and 1 no. Check dam (no navigation lock)
ii) 40 no. of Bridges, HC: 8 m to 100 m , VC: 2.50 m to 15 m
22 no. HT line, VC : 6.0 m to 30.0 m
(VC are above MHWS / HFL)</td></tr>
<tr><td>d)</td><td>Avg. discharge & no. of days</td><td>Since the entire stretch (up to Ch145.00km) is tidal, discharge of the river is not relevant for navigability.</td></tr>
<tr><td>e)</td><td>Slope (1 in……)</td><td>Thane Creek & Vasai Creek are having a flat slope, but the Ulhas river is having a slope of 1 in 2347.</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, cargo, if any</td><td>Ferry Services Operational at Mora Group of Jetties</td></tr>
<tr><td>b)</td><td>Important industries within 50 km</td><td>Gharda Chemical Industries, Metropolitan Exichem Pvt. Ltd, Meghdoot Chemicals Pvt. Ltd. (For details Refer Annexure 4.1)</td></tr>
<tr><td>c)</td><td>Distance of Rail & Road from Industry</td><td>Most of the industries are located within 5 kms to road & rail</td></tr>
<tr><td>6.</td><td>Consultant’s recommendation for going ahead with Stage-II (DPR preparation)</td><td>Recommended for development as Class-III waterway for Ch 0.00 km to 66.80km in Kalyan-Thane-Ulhas River and for Ch 0.00km to Ch 31.20km in Vasai Creek, wherein the Waldhuni Creek is not recommended for navigability.</td></tr>
<tr><td>7.</td><td>Any other information/comment</td><td>A Check Dam exists at Ch 67.78km in Ulhas River.
MHWS – 4.42m, HTL— 4.42m, LTL— 0.32m, Average Tidal Variation—2.37m, Port Name: Apollo Bandar.</td></tr>
</table>

Date: 23-09-2016

Consultant signature

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

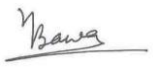
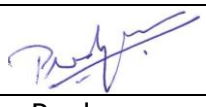
KALYAN-THANE-MUMBAI WATERWAY,

VASAI CREEK AND ULHAS RIVER

(NW-53)

CLUSTER - VII

GOA AND MAHARASHTRA, INDIA

					
02	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

NTPC 1980	National Transport Policy Committee, 1980
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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LIST OF MAPS

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LIST OF FIGURES

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, and 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 the 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 waterways to achieve navigation and to develop water transport facilities.

Sl No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River (NW-53)
2	State/ District through which river passes	Ulhas River with its tributaries Waldhuni river and Vasai Creek passes through the Raigad district of Maharastra.
3.	Study Stretch	145 km length of the waterway from Arabian Sea at Navi Mumbai via Ulhas river to bridge on state highway No.76 near Malegaon T. waredi From: 18°55'49.78"N, 72°53'21.67"E to: 19°2'38.20"N, 73°19'53.79"E Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan to Kalyan From: 19°14'6.39"N, 73°8'49.13"E to: 19°15'35.03"N, 73°9'27.77"E Vasai Creek to Kasheli From: 19°18'53.50"N, 72°47'30.18"E to: 19°13'22.84"N, 73°0'21.44"E
4	Length of the river / canal	The total length of Ulhas River from origin to its outfall is 161.00km and length of Waldhuni River is 31.8km. The index map of Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River showing proposed waterway stretch, topographic features and road networks is shown in Figure 1.1 & Figure1.2.
5.	Catchment Area	The total catchment area of Ulhas River basin is 4637 sqkm.

B. Methodology Adopted

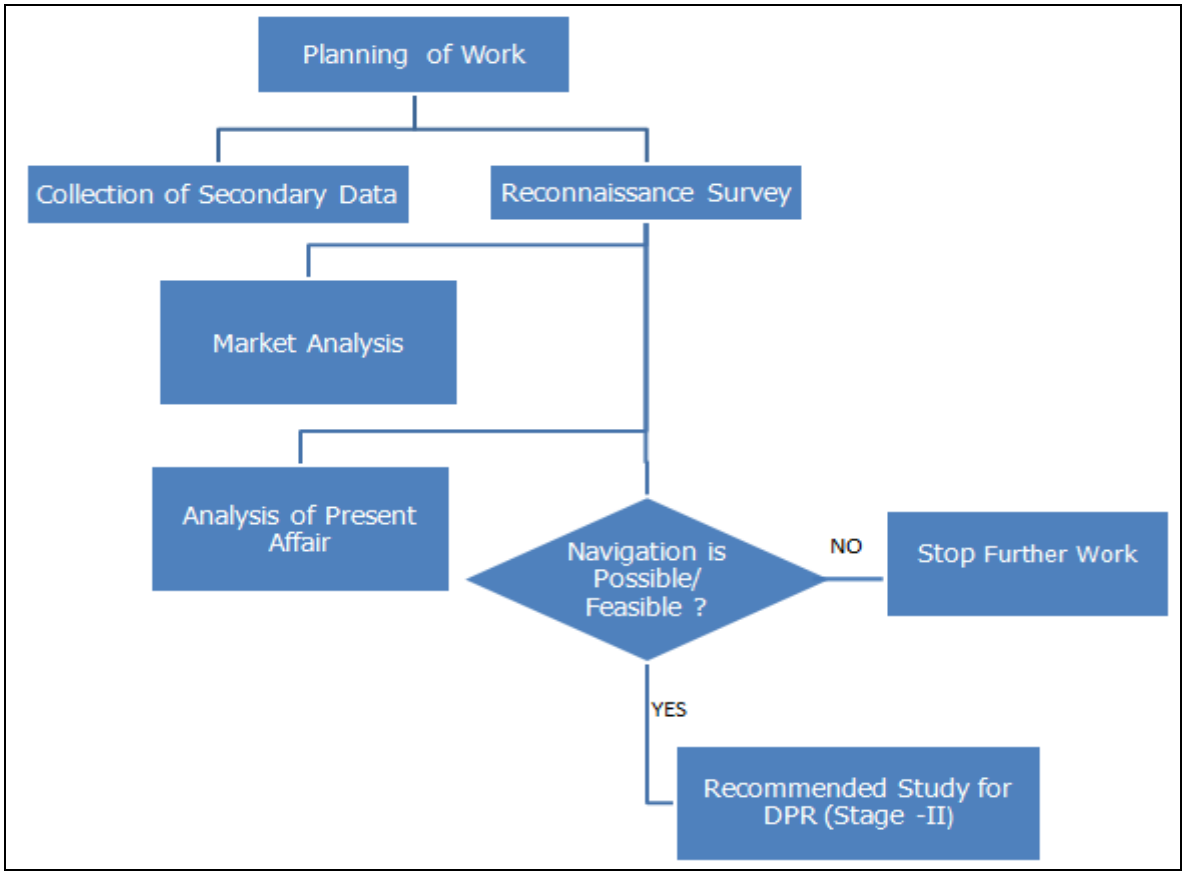
The feasibility of the navigation in the considered waterway has been examined from the following three perspectives:

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

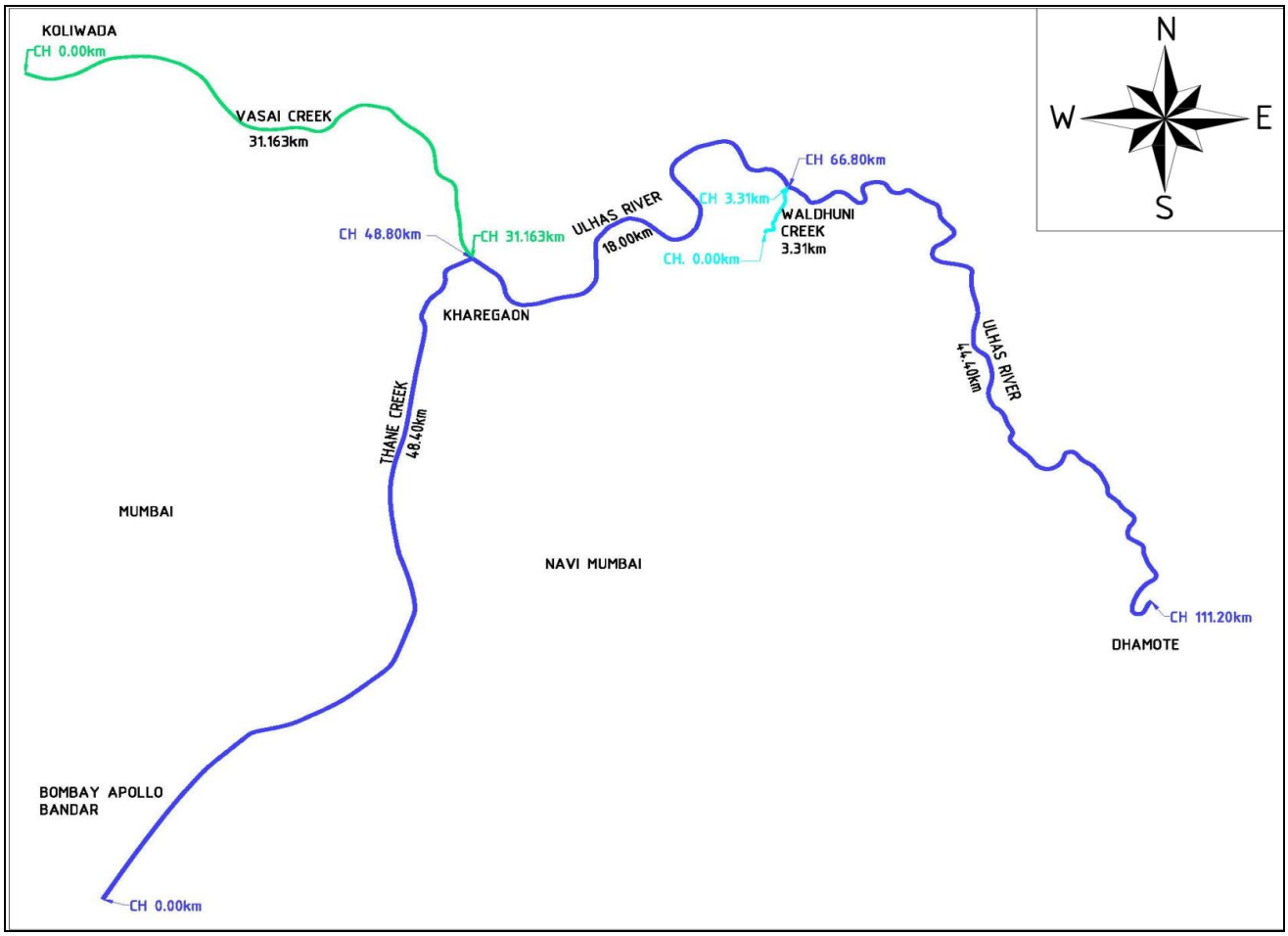
C. Collection of Data and Analysis

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, 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. Waterway Feasibility

The National Waterway NW-53 i.e., Kalyan-Thane- Mumbai Waterway, Vasai Creek and Ulhas River has been segregated into 3 parts and a line diagram (showing the same with the intermittent distance) has been placed herewith for reference.



Following conclusions have been derived for establishing the navigability of the proposed waterway;

1. The river length as given by IWAI is 145kms, whereas the total surveyed length to capture the thalweg is 111.2km along Kalyan-Thane-Mumbai Waterway and Ulhas River; 3.31kms along Waldhuni Creek and 31.163kms along Vasai Creek. (Total length is 145.673m). The deepest channel route has been reckoned

as 111.2km + 3.31km + 31.163Km. All inferences derived for identifying the navigable length have been derived with reference to the deepest channel length, as above.

2. The river is tidal affected for a majority of length under study especially in Thane Creek and Vasai Creek, wherein relevant chart datum have been used. In Thane Creek, with the presence of Check Dam at Ch 67.78km, navigation may have to be restricted at this location. 69.6% of the surveyed length of 67.78km in Thane Creek has water depth more than 2.0m, however not continuous (starting from 0.00km (confluence of river with Arabian Sea in the creek)). In Vasai Creek, 94% of the surveyed length of 31.163km has water depth more than 2.0m, however not continuous (starting from 0.00km (confluence of river with Arabian Sea in the creek)).
3. 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.
4. The lengths of the waterway, with a depth more than 2.0m, 1.5m and 1.0m with reference to Chart Datum have been compiled in the main report. This is given in Table 3.28 for Kalyan-Thane-Mumbai Stretch; Table 3.31 for Waldhuni Creek stretch and Table 3.40 for Vasai Creek stretch of the report and are being reproduced below:

Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 0.00km to Ch 111.20km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-5	15.20	10.3	4.93	-	-	-
5-9	18.20	10.0	4.04	-	-	-
9-17	12.70	1.60	7.09	0.89	-	-
17-21	7.50	3.00	4.03	-	-	-
21-25	3.00	0.30	0.20	0.30	0.10	2.76
25-29	1.80	0.10	-	1.01	1.69	1.92
29-33	1.90	0.00	-	0.55	2.51	0.93
33-37	1.80	0.10	-	0.78	0.10	2.99
37-43	16.20	0.20	4.17	0.50	0.49	1.00
43-47	16.00	6.00	3.99	-	-	-
47-50	14.40	6.30	3.00	-	-	-
50-55	12.00	1.20	4.79	-	0.20	-
55-59	11.50	1.70	3.57	0.40	0.00	-
59-64	7.90	1.70	4.80	0.20	0.00	-
64-69	5.00	0.10	2.56	0.81	1.57	0.10
69-75	1.20	0.40	-	-	1.41	3.97
75-79	0.80	0.30	-	-	0.00	4.39

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
79-84	1.40	0.20	-	-	1.40	3.51
84-87	1.20	0.20	-	-	0.94	2.06
87-90	1.40	0.30	-	-	1.10	2.19
90-94	1.20	0.20	-	-	1.13	2.88
94-100	1.20	0.20	-	-	2.09	3.52
100-104	1.20	0.10	-	-	0.40	3.92
104-107	1.20	0.10	-	-	0.52	2.57
107-111.2	1.20	0.00	-	-	0.78	3.45
Total			**47.17**	**5.44**	**16.43**	**42.16**

Maximum – Minimum Depth in Waldhuni Creek from Ch 0.00km to Ch 3.33km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-0.71	0.40	0.20	-	-	-	0.71
0.71-3.31	2.70	0.20	0.16	-	1.17	1.27
Total			**0.16**	**0.00**	**1.17**	**1.98**

Maximum – Minimum Depth in Vasai Creek from Ch 0.00km to Ch 31.163km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-4	16.50	0.70	2.80	0.30	0.70	0.20
4-8	6.20	1.00	3.30	0.20	0.30	0.20
8-11	7.20	3.60	3.00	-	-	-
11-15	36.70	5.70	4.00	-	-	-
15-19.5	39.40	4.60	4.50	-	-	-
19.5-24.5	12.60	4.60	5.00	-	-	-
24.5-29	15.30	5.80	4.50	-	-	-
29-31.163	10.40	5.80	2.16	-	-	-
Total			**29.26**	**0.50**	**1.00**	**0.40**

5. The inter connectivity of the stretches is before Ch 67.78km in Kalyan-Thane-Mumbai waterway and hence the navigability has been limited at Ch 67.78km. One Bridge @ Ch 30.00km may need to be modified, duly considering the single lane operation at the other cross structures. Two Railway Bridges in Vasai Creek may have to be maneuvered with partial raise in the structure and partial lowering the bed with lock type structure. Keeping in view the presence of Five Bridges in 3.31kms of Waldhuni Creek, the stretch may not be feasible.

6. One H. T. Line crossing the study stretch with the vertical clearance of 6m above MHWS, may have to be modified. The minimum vertical clearance required shall be 20.1m corresponding to 220kVA transmission line.

The description & classification of the waterway has been presented schematically based on the survey observation and duly keeping in view the river classification criteria in Table 3.59 to Table 3.61, as reproduced below.

Classification of Proposed Waterway for Kalyan-Thane-Mumbai via Ulhas River

Criteria	Classification																			
Length of waterway from start (km)	6	11	17	22	28	33	39	44	50	56	61	67	72	78	83	89	95	100	106	111
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	Class-V												Depth Not Available							
Raod Bridge Vert. Clearance	Class-III												Navigation Not Recommended							
Raod Bridge Hor. Clearance	All Class					Class-I														
HT Line Vert. Clearance	Class-II																			
Bend Radius	All Class																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

Classification of Proposed Waterway for Waldhuni Creek.

Criteria	Classification									
Length of waterway from start (km)	0	0.7	1.0	1.3	1.7	2.0	2.3	2.6	3.0	3.3
Chainage length in %	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Depth availble	Class-II									
Raod Bridge Vert. Clearance	Clearance not available for Navigation									
Raod Bridge Hor. Clearance	Clearance not available for Navigation									
LT Line Vert. Clearance	N/A									
Bend Radius	Class-II									
Index	All Class		Class-V		Class-IV		Class-III		Class-II	

Classification of Proposed Waterway for Vasai Creek.

Criteria	Classification																			
Length of waterway from start (km)	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	27	28	30	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	All Class																			
Raod Bridge Vert. Clearance	Class-I		Class-III																	
Raod Bridge Hor. Clearance	Class-III																			
HT Line Vert. Clearance	Class-III																			
Bend Radius	All Class																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

E. Cargo Feasibility

The Kalyan-Thane-Mumbai Waterway Stretch (including Vasai Creek and Ulhas River) is a long stretch in a region which is densely populated, industrialized and highly congested. As per preliminary estimation, the

potential to divert the cargo traffic to IWT is significant. As per preliminary estimation about 20 MMTPA of cargo can be moved in this Creek/River stretch. The details of the same are as follows:

- Ro-Ro vessels:
  - JNPT/MbPT-Thane Creek section: 0.3 million TEU and 1.6 million vehicles (19.5 MMTPA)
  - Thane-Vasai section: 0.07 million TEU and 0.6 million vehicles (6.8 MMTPA)
  - Thane-Kalyan section: 0.24 million TEU and 0.01 million vehicles (3.0 MMTPA)
- Cement: 1 MMTPA
- Passenger ferry services demand of 58 lakhs passengers annually is expected to grow at 8 – 10 percent per year. Passenger Ferry points may be provided across Vasai Creek.
- Tourism: Tourism potential exists at Vasai, Vashi, Thane and Panju island water front areas.

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. 69.6% of the surveyed length of 67.78km in Thane Creek has water depth more than 2.0m, however not continuous. In Vasai Creek, 94% of the surveyed length of 31.163km has water depth more than 2.0m, however not continuous.
2. The above depth availability of more than 2m in 47.17km of 67.78km in Kalyan-Thane stretch and in 29.26km of 31.163km is strength and certain patches may be required to be attended with a considerable conservancy activity involving dredging.
3. The Creek is tidal affected under the study stretch of 67.78kms + 31.163kms. The maximum water level fluctuation of 4.42m has been observed and this will strengthen the safe mobility of vessels in the waterway.
4. Approximately 220 lacs of population in the catchment area will have direct or indirect benefits from the IWT and related projects coming up in the area.
5. Two major Ports in the study stretch will be a thrust for IWT.
6. The Existing Cargo movement in the Trombay jetty / Bhivandi Jetty / Ambuja's Captive Jetty will have some influence in IWT, on its development. Further, a considerable cargo is divertible from / to hinterland, as per the preliminary study.
7. Eleven Industrial Clusters within the nearby locations of study stretch is a push for IWT development.
8. Two major Fertilizer plants within the nearby reach are having the production capacity of 5.6 Lac MTPA.

9. Two major Refinery Units in the vicinity are having the production capacity of 20.55 MMTPA.
10. Cement mobility through IWT is observed and having a potential for growth.
11. Possible divertible traffic to IWT through Ro-Ro is a significant strength for development of IWT in the study stretch.
12. Divertible cargo has been identified and this will be a major strength to go ahead with the IWT development.
13. Twenty Seven Ferry Points commuting 58 lacs of passenger mobility with an estimated 8 % growth rate is an indication of future growth for IWT.
14. The Tourism potential in the study stretch is a boost for IWT development.
15. Kalyan Railway yard within 3 kms is a scope for development of Rail / IWT hub. Further, the Rail Network in the study area will have advantage for creating inter modal connectivity.
16. The Road Network in the study stretch is well connected through Asian Highway AH-47, National Highway NH-4B, NH-4C, NH-66, Eastern Express Way, Mumbai Pune Express Way and providing a scope for development of Intermodal connectivity.

Weakness

1. The present IWT movement may have to be geared up by additional Infrastructure.
2. Policies are to be firmed up for mobility of Hazardous Goods through IWT.
3. Policies are to be firmed up for Decongestion of choked Mumbai City Roads with IWT divertible Traffic.
4. Ro – Ro operations are to be established with proper intermodal connectivity.
5. The existing cross structures in the study area and its clearances for IWT mobility are not amenable.

Opportunity

1. 69.6% of the surveyed length of 67.78km in Thane Creek and 94% of the surveyed length of 31.163km in Vasai Creek are having water depth more than 2.0 m, which is an opportunity for IWT.
2. The above depth availability for 47.17km in 67.78km in Kalyan-Thane stretch and 29.26km in 31.163km is advantageous and the shallow patches are amenable for Dredging.
3. The Creek is tidal affected under the study stretch of 67.78kms + 31.163kms. The tidal fluctuation of 4.1m is an opportunity for safe mobility of vessels in the waterway.
4. The existing Infra structure in the study area like two major Ports; Trombay jetty / Bhivandi Jetty / Ambuja's Captive Jetty and other jetties will be an opportunity for IWT development.
5. The presence of Eleven Industrial Clusters; Two major Fertilizer plants; Two major Refinery Units in the vicinity of study stretch will be an opportunity for IWT development, if well planned.
6. The present Cement mobility through IWT can be expanded.
7. Possible divertible traffic to IWT through Ro-Ro is an opportunity, if well planned and also will decongest the Mumbai City Roads.

8. Twenty Seven Ferry Points, commuting 58 lacs of passengers with an estimated 8 % growth rate is an opportunity for future growth through IWT.
9. 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.
10. Policies are to be firmed up for development of IWT in this stretch.
11. Tourism may flourish in the Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River, if developed in a planned way.

Threat

1. The present Road connectivity through Asian Highway AH-47, National Highway NH-4B, NH-4C, NH-66, Eastern Express Way, and Mumbai Pune Express Way in the study area may be competing modes of transport, especially with respect to cargo traffic for the proposed waterway.
2. The present rail network also may pose some threats as an alternative mode of transport.
3. The Pipe lines, which are the alternate mode for liquid cargo is a threat.
4. Traverse of Pipe line carrying inflammable liquid cargo in the thick habitant area is a threat.
5. The mangrove trees on the banks of the study stretch may involve some socio-environmental issues and may require statutory approvals and clearances to construct the jetties/ terminals/ ports/ intermodal connectivity structures.

G. Development Cost (Tentative)

The reconnaissance survey data with regard to physical constraints may have cost implications for making the river stretch navigable. Henceforth, 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 22.5km 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 Ro – Ro Terminal has been estimated @ INR 10.0 crore each for five such Ro – Ro Terminals. One no. Bridge may have to be modified with reconstruction at an estimated cost of INR 2.5 crores each amounting to INR 2.5 crores. HT line crossing shall need modification which shall require two towers at the bank of requisite height and the stringing over pair of poles crossing the Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River. The cost of transmission tower has been estimated to be INR 20.00 lacs each and the stringing cost across the towers shall be INR 4.0 lacs per pair of towers. The total estimated cost for modification to the one HT Line shall be INR 1 x 44.0 lacs = INR 44 lacs. Two Railway Bridges in the Vasai Creek may have to be

considered with a major semi Lock Type construction, which may be a capital expenditure in the order of INR 12 Crores. The cost of navigational aids for day/night navigation has been considered as INR 1060 lacs. 10% of the amount for dredging, terminal construction, tower / bridge modification, the Lock Structure and night navigational aids have been envisaged as unforeseen. The tentative total cost of development to make the river navigable round the year to achieve safe navigation for the required classification of vessel mobility has been estimated to INR 106 Crores. (As at Table 5.1).

Sl No.	Name of Waterway	Length of Waterway	Dredging Required (wrt. 2 m draft & 40.0m width)	Dredging Cost @ INR 230/ cum	No. of Ro – Ro Terminals Proposed /Cost @ INR 10 Cr each	Cost of Modification of Bridge / Transmission line	Lock Structure	Night Navigation	Total cost incld. 10% unforeseen
		(km)	(km)	(INR in Cr.)	(Nos)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)
1	Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River	145.673	22.5	20.70	5 / 50.00	2.94	12.00	10.60	106.00

H. Classification of Waterway

The 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 Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River (NW 53) of 98.943km (67.78km in Thane Creek + 31.163km of Vasai Creek) 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 river. The classification of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River is described below. (As at 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
0.0 – 67.78 (Thane Creek)	0.0	200.0	4.2 (Bridge) & 6.0 (H. T. Line)	20 (Bridge)	775	**Class – III**
0.0 – 31.163 (Vasai Creek)	0.7	200.0	3.43 (Bridge) & 10.0 (H. T. Line)	18.7 (Bridge)	690	**Class – III**

The study stretch of the waterway is amenable for development as Class III waterway as explained above. However, considerable Dredging may be required.

In order to consider the selected stretch as **Class III**, One Bridge and One HT Line are to be modified. Further, One Lock type structure may be required. The other cross structures is to be considered with single lane operation.

The above stretch of the waterway, hence, can be considered under Class III, which is navigable without any hindrance and shall be used for plying self-propelled vessel of carrying capacity up to 500 DWT (approximate size 58m overall length, 9m moulded breadth and 1.5m loaded draft) or one tug and two barges combination of 1000 DWT (approximate size 141m overall length, 9m breadth and 1.5m loaded draft).

I. Recommendation

The national waterway-53 of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River has been identified having potential for development as waterway of Class-III for a distance of 98.943km as described above. This stretch of the river 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-53 of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River is proposed for development as **Class III** waterway in the stretch of the waterway as depicted below (as at Table 3.62 to Table 3.64).

Stretch Name	Kalyan-Thane-Mumbai via Ulhas River		
River Stretch	0.00km	66.80km	111.20km
Classification			**NOT RECOMMENDED**
	Class III		
Horizontal clearance (m)	50		
Vertical clearnce (m)	7		
Minimum Depth(m)	1.7		
Bottom Width (m)	50		
Self Propelled Vessel			
Dead Weight Tonnage	500		
Vessel size (m)	(58 x 9 x 1.5)		
Tug + Barge			
Dead Weight Tonnage	1000		
Vessel size (m)	(141 x 9 x 1.5)		

Stretch Name	Waldhuni Creek	
River Stretch	0.00km	3.31km
Classification	**NOT RECOMMENDED**	
Horizontal clearance (m)		
Vertical clearnce (m)		
Minimum Depth(m)		
Bottom Width (m)		
Self Propelled Vessel		
Dead Weight Tonnage		
Vessel size (m)		
Tug + Barge		
Dead Weight Tonnage		
Vessel size (m)		

Stretch Name	Vasai Creek	
River Stretch	0.00km	31.20km
Classification		
	Class III	
Horizontal clearance (m)	50	
Vertical clearnce (m)	7	
Minimum Depth(m)	1.7	
Bottom Width (m)	50	
Self Propelled Vessel		
Dead Weight Tonnage	500	
Vessel size (m)	(58 x 9 x 1.5)	
Tug + Barge		
Dead Weight Tonnage	1000	
Vessel size (m)	(141 x 9 x 1.5)	

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.

Accordingly, the present Kalyan-Thane-Mumbai-waterway (Ch 0.00km to Ch 66.80km) and Vasai Creek (Ch 0.00km to Ch 31.20km) are navigable with **Class III** of waterway, wherein the Waldhuni Creek (Ch 0.00km to Ch 3.31km) is not recommended for navigability.

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. The depths have been reckoned in the tidal stretch with reference to the chart datum 2.515m at Apollo Bandar.
3. 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 underutilized 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, Kolkatta, Pakur, Farakka, Gaighat (Patna) & Allahabad.

Floating terminals = Kolkatta, 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 preparation 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 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.

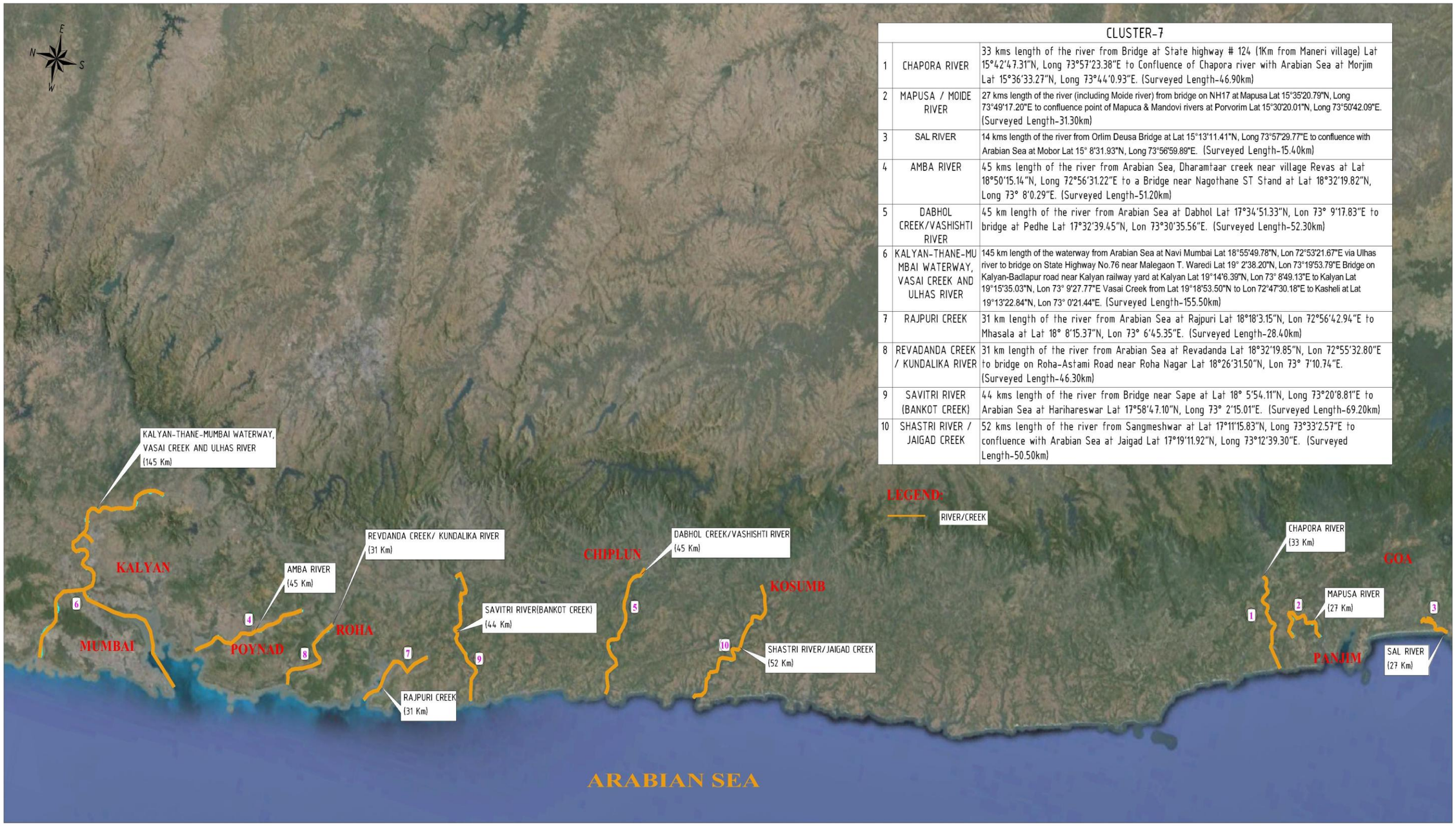
Feasibility study shall examine the viability of navigational routes and therefore potential to develop waterway transport facility is to be established. This shall be followed by preparation of Detailed Project Report (DPR) for those feasible waterways, which would include detailed hydrographic surveys 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 Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River 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

Sl No.	Name of Rivers/ Creeks	National Water Way (NW)	Length (km)	State
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 Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River are shown in **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

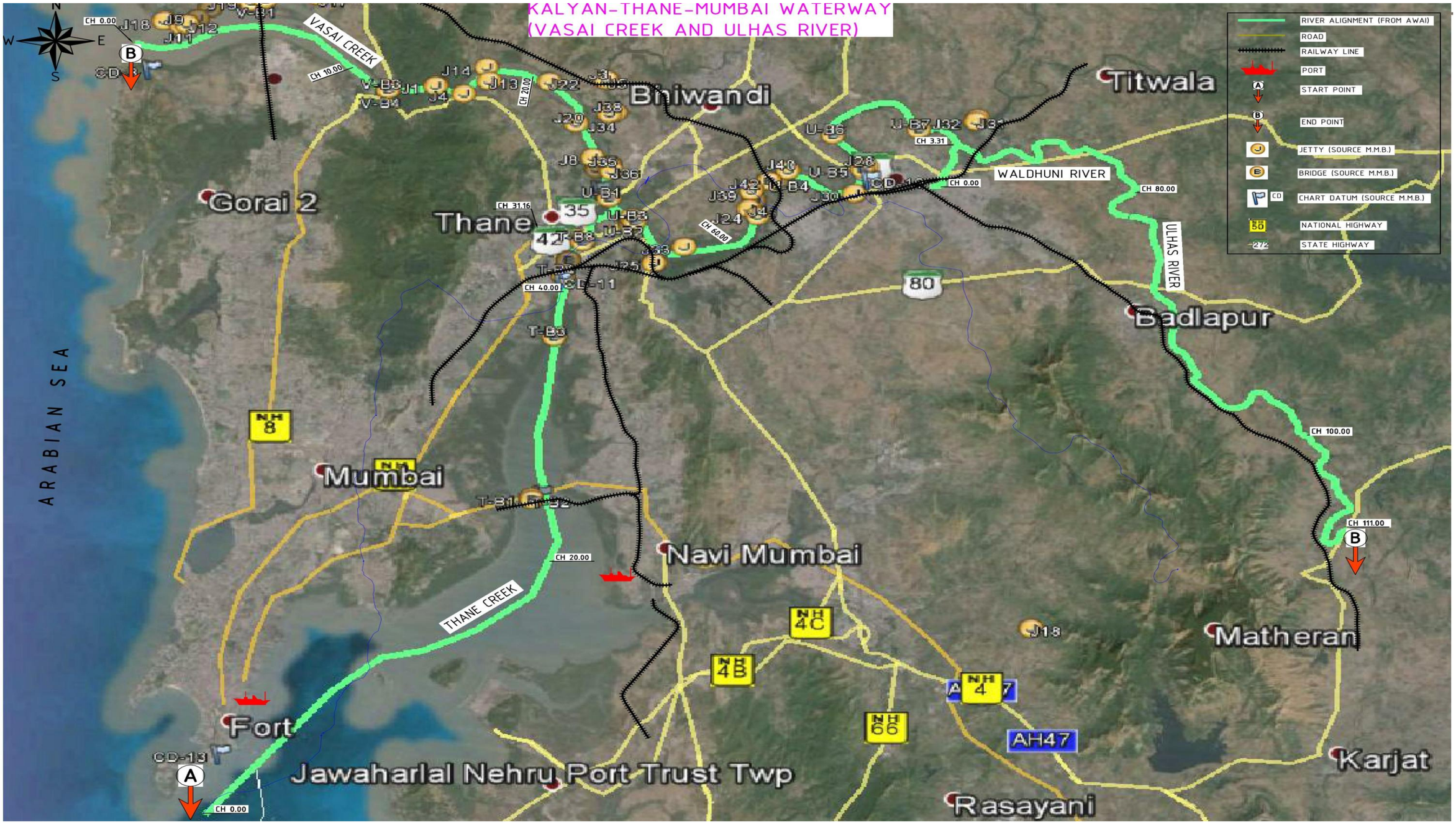


Figure 1.2: Index Map of Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River

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 2 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 **Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River** 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, draught 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). Such analysis is, therefore, proposed as one of the methods in stage I.

It should be pointed out, however, 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 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, an 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 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**.

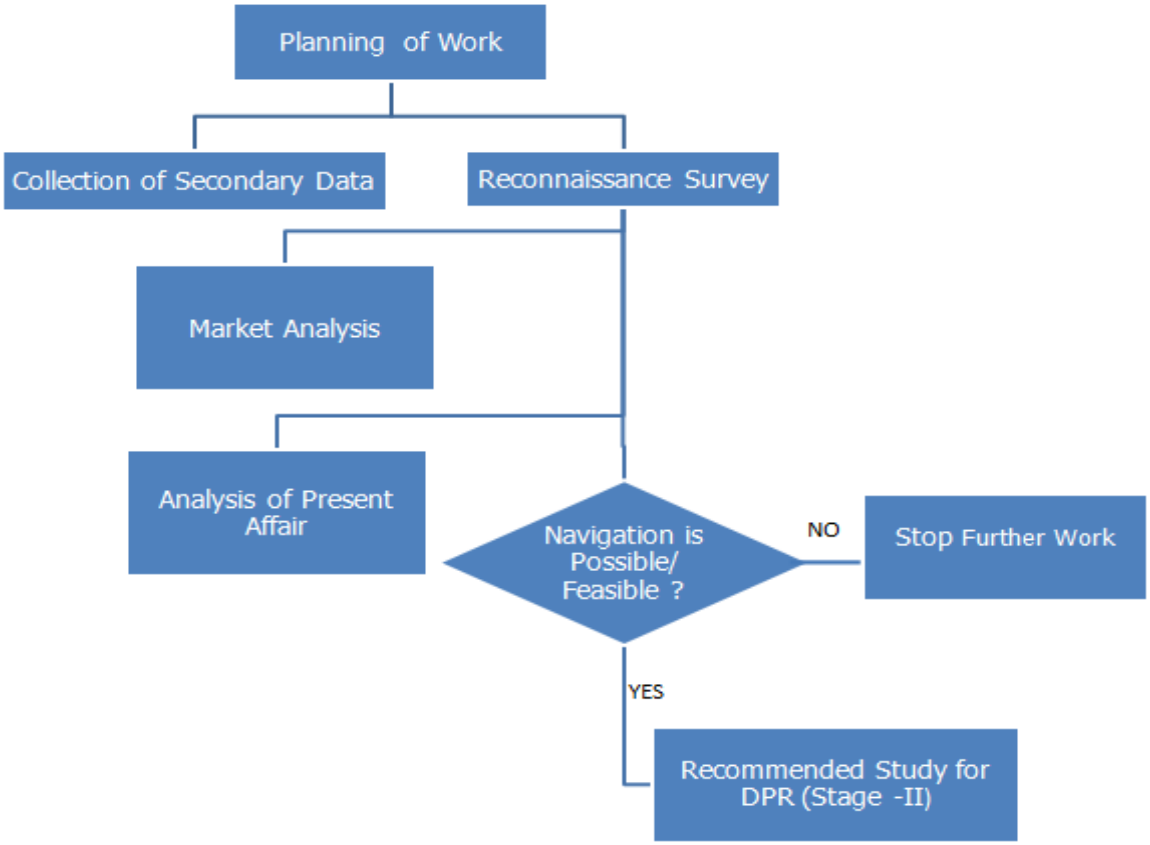


Figure 1.3: Execution Framework for Stage I

1.6 Collection of Data

For evaluating the feasibility of the waterway in Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River 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 and 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 sources available in public domain.

(i) Benchmark Data/ Chart Datum 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 draught) 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 Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River 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 have 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 to 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 Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River (NW-53)

Ulhas River

The Ulhas River originates in a valley north of the Rajmachi hills formed by mountain streams draining the northern slope of those hills which are part of the Sahyadri range of the Western Ghats in the Raigad district of Maharashtra at an altitude of 900m above mean sea level (AMSL). The total catchment area of Ulhas River basin is 4637 sqkm and the catchment receives an average annual rainfall of about 2,943 mm. The total length of the river from origin to its outfall in the Arabian Sea is about 161.00 km.

Waldhuni River

Waldhuni is a small river originating at Kakole Lake near Ambarnath and unites with Ulhas River near Kalyan and then flows down to the Thane creek, where it meets the Arabian Sea. Waldhuni River is a left bank tributary of Ulhas River. The river bank has maximum encroachment from Ulhasnagar on the east and Ashoknagar and Shivajinagar in Kalyan on the west of its bank. The total length of Waldhuni River is 31.8km.

Vasai Creek

Vasai Creek is an estuarine creek formed by one of the two main distributaries of the Ulhas River in Maharashtra state of western India. The Ulhas splits at the northeast corner of Salsette Island into its two main distributaries, Vasai Creek and Thane Creek. Vasai Creek forms the northern boundary of Salsette Island, and empties west into the Arabian Sea. Thane creek empties southwards into Bombay Harbour.

The detailed description of the river has been compiled in Table 1.2.

Table 1.2: Description of Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River (NW-53)

Sl No.	Introductory Consideration	Description of the River
1	Name of the river / canal	Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River (NW-53)
2	State/ District through which river passes	Ulhas River with its tributaries Waldhuni river and Vasai Creek passes through the Raigad district of Maharastra.
3	Length of the river / canal	The total length of Ulhas River from origin to its outfall is 161.00km and length of Waldhuni River is 31.8km.
4.	Study Stretch	145 km length of the waterway from Arabian Sea at Navi Mumbai via Ulhas river to bridge on state highway No.76 near Malegaon T. waredi From:

Sl No.	Introductory Consideration	Description of the River
		18°55'49.78"N, 72°53'21.67"E to: 19°2'38.20"N, 73°19'53.79"E Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan to Kalyan From: 19°14'6.39"N, 73°8'49.13"E to: 19°15'35.03"N, 73°9'27.77"E Vasai Creek to Kasheli From: 19°18'53.50"N, 72°47'30.18"E to: 19°13'22.84"N, 73°0'21.44"E
5,	Map	The index map of Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River showing proposed waterway stretch, topographic features and road networks is shown in Figure1.2. The section of the Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River under feasibility study for inland waterway showing reconnaissance survey routes is presented in Drawing No. P. 009051-W-20201-A06 R0 (Sheet – 1 to 24).
Characteristic of River		
6.	River Course	The Ulhas River originates in a valley north of the Rajmachi hills formed by mountain streams draining the northern slope of those hills which are part of the Sahyadri range of the Western Ghats in the Raigad district of Maharashtra.The total length of the river from origin to its outfall in the Arabian Sea is about 161.00 km. Waldhuni is a small river originating at Kakole Lake near Ambarnath and unites with Ulhas River near Kalyan and then flows down to the Thane creek, where it meets the Arabian Sea. The total length of Waldhuni River is 31.8km. Vasai Creek is an estuarine creek formed by one of the two main distributaries of the Ulhas River in Maharashtra state of western India. The Ulhas splits at the northeast corner of Salsette Island into its two main distributaries, Vasai Creek and Thane Creek. Vasai Creek forms the northern boundary of Salsette Island, and empties west into the Arabian Sea.
6	Tributaries / Network of Rivers / Basin	Major tributaries are Pej, Barvi, Bhivapuri, Murbari, and Kalu streams.
7	Catchment Area	The total catchment area of Ulhas River basin is 4637 sqkm.

1.9 Structure of the Feasibility Study Report (FSR)

The Feasibility Study Report for proposed Inland Waterways of **Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River** has been prepared and emphasized with stretches of proposed inland waterways

having the potential for navigation. Stage-II study for preparation of DPR shall be carried out only for those stretches of proposed inland waterways, 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, overview of the collected data followed by a description of the Present State of Affairs, Reconnaissance Survey, findings of Market Potential and observations & inferences thereof.

The executive summary concludes with Waterway Navigation Potential of the proposed waterway on Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River 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 Waterways 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 Waterways 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 waterways, 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 waterways 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 aspect 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 state of affairs as existing today along the proposed inland waterway on Kalyan-Thane-Mumbai waterway, Vasai creek and Ulhas River (NW-53) is studied. The waterway has been proposed along river Ulhas, Waldhuni Creek & Vasai creek. Out of total 161km length of the Ulhas River, 31.8km length of Waldhuni & 31km length of the Vasai creek, 111 km, 3 km & 31 km respectively along Ulhas, Waldhuni and Vasai have been proposed by IWAI for feasibility study. This chapter provides details 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 River Ulhas originates in the valley north of the Rajmachi hills formed by mountain streams draining through the northern slope of those hills which are part of the Sahyadri range of the Western Ghats in the Raigad district of Maharashtra at an altitude of 900m above mean sea level (MSL). Total length of the river from origin to sea mouth is 161 km. At chainage 74.87 km, a left bank tributary named Waldhuni river originating from Kakole Lake near Ambarnath joins the Ulhas River. The Ulhas splits at the northeast corner of Salsette Island into its two main distributaries, Vasai Creek and Thane Creek. Vasai Creek forms the northern boundary of Salsette Island, and empties west into the Arabian Sea. Thane creek empties southwards into Bombay Harbour.

There is Mumbai Port, Jawaharlal Nehru Port (JNPT), Bharti ship yard and few captive jetties among a total of 56 jetties are located along the River/Creeks. Cargo of 10,988 MT, 2900 MT & 64 MMTPA were handled at Trombay Jetty, Bhivandi Jetty and JNPT respectively in year 2015-2016.

Details of existing structures along and across Kalyan-Thane-Mumbai waterway, Vasai creek and Ulhas River (NW-53) are presented in the following sections.

2.2 Existing Waterway Structures

Existing waterway structures/ facilities in Kalyan-Thane-Mumbai waterway, Vasai creek and Ulhas River (NW-53) include Ports, Shipyards and Jetties. **Table 2.1** below provides the details of existing facilities along Kalyan-Thane-Mumbai waterway, Vasai creek and Ulhas River (NW-53) with current utilization status.

Table 2.1: Existing Facilities on Kalyan-Thane-Mumbai waterway, Vasai creek and Ulhas River (NW-53)

Sl. No.	Existing Facility	Chainage (km)	Coordinates DD MM SS	Current Utilization
	Thane Creek			
1.	Colaba Jetty	1.00	18 55 18.86 N 72 50 5.01 E	Appollo –Bunder-Mandwa Ferry route Elephanta –Mumbai Ferry
2.	Mumbai Port	3.40	18 56 10.41 N 72 50 33.42 E	Mumbai Port has three enclosed wet docks. Prince's Dock, Victoria Dock & Indira Dock. As of 2008, Prince's Dock has 8 berths, Victoria Dock, has 14 berths and Indira Dock has 21 berths.
3.	Bhaucha Jetty	6.00	18 57 27.25 N 72 51 0.16 E	Kandla – Mumbai Ferry Route Bhaucha-Dhakka- Mora Jetty
4.	Mora Jetty Ferry Terminal	6.00	18 54 52.6 N 72 55 40.2 E	MORA to Wharf and Mora to Sasoon dock, ferry service
5.	Karanja Jetty	6.00	18 55 01.7 N 72 54 41.3 E	Karanja to Revas ferry Jetty
6.	Jawahar Dweep Jetty 1	6.20	18 56 28.8 N 72 53 58.2 E	Handles Crude oil and Petroleum products
7.	Jawahar Dweep Jetty 2	6.40	18 57 15.2 N 72 54 28.6 E	
8.	Elephanta Ferry Uran Jetty	11.70	18 57 17.3 N 72 56 11.3 E	Elephanta Uran to Mumbai Ferry Service
9.	JNPT	11.70	18 56 46.1 N 72 56 21.2 E	The JNPT Container Terminal is operated by JNPT. It has a quay length of 680 metres with 3 berths. It can handle up to 15.6 million tons of cargo.
10.	Elephanta Jetty	11.70	18 58 19.3 N 72 55 48.7 E	Elephnata to Mumbai Ferry Service
11.	Nhavakhadi Boat Jetty	12.20	18 58 01.8 N 72 58 05.1 E	Local Transport
12.	Pipau Jetty	11.70	18 58 48.9 N 72 55 06.8 E	Mumbai Port's 1st Liquid Chemical Berth for Handling Specialised Grade of POL and Chemical Product
13.	Dhruva Jetty	12.10	18 59 56.9 N 72 55 22.4 E	Local Transport
14.	Trombay Koliwada Jetty	20.10	19 01 33.0 N 72 57 23.3 E	Ferry Service
15.	Yogayatan Port Jetty	24.10	19 03 24.8 N 72 57 40.8 E	Natural all-weather harbor port
16.	Thane Slope Jetty	37.50	19 10 50.3 N 72 58 59.9 E	Local transport
	Ulhas & Vasai Creek			
17.	Reti Bunder jetties	63.60 (Ulhas)	19 14 25.86 N 73 06 58.8 E	Local transport

Sl. No.	Existing Facility	Chainage (km)	Coordinates DD MM SS	Current Utilization
18.	Vasai/ Raangoan Jetty	0.00	19 21 40.45 N 72 46 17.38 E	Used for fishing/ local transport.
19.	Vasai/ panju bunder	2.12	19 19 39.42 N 72 48 18.79 E	Used for fishing/ local transport.
20.	vasai/Lage bunder slope Jetty-1	2.90	19 19 30.05 N 72 48 46.45 E	Used for fishing/ local transport.
21.	Vasai/Lage bunder-T-slope Jetty-2	3.08	19 19 32.39 N 72 48 51.55 E	Used for fishing/ local transport.
22.	Vasai/ Lage bunder slope Jetty-3	3.34	19 19 32.49 N 72 48 55.13 E	Used for fishing/ local transport.
23.	Vasai/ Lage bunder slope Jetty-4	3.42	19 19 32.99 N 72 48 56.62 E	Used for fishing/ local transport.
24.	Vasai/ Vasai Jetty	4.00	19 19 43.38 N 72 49 12.20 E	Used for fishing/ local transport.
25.	Vasai/ kochivade	4.57	19 20 04.32 N 72 49 31.85 E	Used for fishing/ local transport.
26.	Vasai/Naigon Slope step Jetty -1	5.50	19 20 26.98 N 72 50 13.06 E	Used for fishing/ local transport.
27.	Vasai/Naigon Slope Jetty-2	5.53	19 20 28.32 N 72 50 14.95 E	Used for fishing/ local transport.
28.	Vasai/ panju Jetty	6.00	19 20 17.84 N 72 50 37.58 E	Used for fishing/ local transport.
29.	Vasai/Naigon pravasi Jetty-3	8.84	19 19 41.81 N 72 52 42.03 E	Used for fishing/ local transport.
30.	Vasai/ Bharti Shipyard	13.50	19 17 17 .18 N 72 54 05.32 E	Shipyard
31.	Vasai/Ambvane jetty	15.90	19 17 30.10 N 72 55 33.71 E	Used for fishing/ local transport.
32.	Vasai/Gaimukh ghat	17.20	19 17 14.06 N 72 56 18.70 E	Used for fishing/ local transport.
33.	Vasai/ Nagla machhimari bunder	18.70	19 17 40.21 N 72 56 59.05 E	Used for fishing/ local transport.
34.	Vasai/Nagla Pravase Jetty	19.00	19 18 08.12 N 72 56 54.93 E	Used for fishing/ local transport.
35.	Vasai/ vat bunder Jetty	21.90	19 17 39.27 N 72 58 35.24 E	Used for fishing/ local transport.
36.	Vasai/Kharbav Jetty	24.50	19 17 43.61 N 73 00 05.59 E	Used for fishing/ local transport.
37.	Vasai/Dunge Jetty	24.50	19 17 41.49 N 73 00 08.80 E	Used for fishing/ local transport.
38.	Vasai/Kevni Jetty	24.50	19 16 37.37 N 73 00 20.34 E	Used for fishing/ local transport.
39.	Vasai/ Diva(kevni) Jetty	24.50	19 16 35.18 N 73 00 11.79 E	Used for fishing/ local transport.
40.	Vasai/vaghbil Ghat Jetty	24.90	19 16 15.28 N 72 59 18.28 E	Used for fishing/ local transport.
41.	Vasai/ kolshet Lal bati	27.20	19 15 06.59 N 72 59 45.02 E	Used for fishing/ local transport.

Sl. No.	Existing Facility	Chainage (km)	Coordinates DD MM SS	Current Utilization
42.	Vasai/ kolshet ghat	27.70	19 14 43.51 N 72 59 51.45 E	Used for fishing/ local transport.
43.	Vasai/Kalehar Machhimar boat Jetty-2	27.70	19 14 51.53 N 73 00 13.15 E	Used for fishing/ local transport.
44.	Vasai/Kalehar ghat	27.90	19 14 46.67 N 73 00 13.30 E	Used for fishing/ local transport.
45.	Vasai/Kalehar Machhimar boat Jetty-1	28.00	19 14 39.77 N 73 00 15.31 E	Used for fishing/ local transport.
46.	Vasai/Mumbra ganesh ghat	45.00	19 12 51.24 N 73 00 45.77 E	Used for fishing/ local transport.
47.	Vasai/Mumbra Jetty	47.20	19 11 33.91 N 73 01 24.73 E	Used for fishing/ local transport.
48.	Alimgarh Jetty	47.80	19 12 07.01 N 73 02 12.50 E	Used for fishing/ local transport.
49.	Domivali ganesh ghat	52.30	19 13 09.81 N 73 04 09.13 E	Used for fishing/ local transport.
50.	Surei Machhimar boat Jetty	52.80	19 13 24.45 N 73 03 55.36 E	Used for fishing/ local transport.
51.	Dombivali pravasi Jetty	53.40	19 13 40.84 N 73 04 04.21 E	Used for fishing/ local transport.
52.	Velhe Machhimar & pravasi jetty	54.00	19 14 00.42 N 73 03 58.73 E	Used for fishing/ local transport.
53.	Velhe jetty	54.50	19 14 02.33 N 73 04 00.79 E	Used for fishing/ local transport.
54.	Devi cha pada	55.40	19 14 19.21 N 73 04 39.22 E	Used for fishing/ local transport.
55.	Pinplan pravasi Jetty	56.00	19 14 41.84 N 73 04 57.50 E	Used for fishing/ local transport.
56.	Malag garh pravasi Jetty	59.30	19 13 55.64 N 73 06 43.29 E	Used for fishing/ local transport.
57.	Kalyan ganesh ghat	61.00	19 14 49.81 N 73 07 03.04 E	Used for fishing/ local transport.
58.	Devrang pravasi Jetty	70.24	19 16 28.07 N 73 09 59.89 E	Used for fishing/ local transport.
59.	Atalli pravasi Jetty	70.24	19 16 22.27 N 73 09 57.74 E	Used for fishing/ local transport.

Figures 2.1 to 2.3 show some of the above mentioned facilities.

Figure 2.1: Jetty on the Northern Bank of River at Chainage at Chainage 4.0 km (18°56'34.9"N 72°54'05.8"E)

Figure 2.2: JNPT Jetty on the Eastern Bank of River at Chainage 11.70 km (18°57'57.8"N 72°57'04.7"E)

Figure 2.3 : Slope Jetty on the Western Bank of the River at Chainage 37.50km (19°10'50.2"N 72°58'59.9"E)

2.3 Crossing Over Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River (NW-53)

Apart from the existing facilities on banks of the waterway as described in section 2.1.1 above, twenty six (26) bridges existing in the Ulhas and five (5) in Waldhuni and seven (7) in Vasai creek. The bridges across the study stretch are classified into road, rail and pipeline bridges. Further, two bridges are under construction in the study stretch of Ulhas River. **Table 2.2, 2.3 and Table 2.4** shows details of the existing and under construction bridges / structures across Ulhas, Waldhuni and Vasai Creek respectively.

Table 2.2: Details of Rail and Road Bridges across Ulhas River

Sl. No.	Name of Structure	Chainage (km)	Location	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
						Latitude	Longitude
1.	Vashi Rail bridge	19.52	Vashi	100.00	9.00	19°03'40.5" N	72°58'10.6" E
2.	Vashi Road bridge	19.52	Vashi	100.00	9.00	19°03'40.5" N	72°58'10.5 " E
3.	Vashi road bridge	19.56	Vashi	100.00	9.00	19°03'42.0" N	72°58'10.1" E
4.	Airoli road bridge	30.00	Airoli	30.00	4.20	19°09'02.3" N	72°58'48.3" E
5.	Thane Rail bridge	34.34	Thane	37.00	7.00	19°11'19.0" N	72°59'07.0" E
6.	Kalwa Old Road bridge	35.36	Kalwa	50.00	7.00	19°11'48.3" N	72°59'07.9" E
7.	Kalwa New Road bridge	35.36	Kalwa	50.00	9.00	19°11'48.3" N	72°59'07.9" E
8.	Kharegaon pipe line bridge	36.46	Kharegaon	15.00	9.00	19°12'15.0" N	72°59'31.5" E
9.	Kalwa pipe line bridge	37.03	Kalwa	50.00	11.00	19°12'30.0" N	72°59'42.0" E
10.	Thane - Kalwa Road bridge	37.10	Kalwa	40.00	12.00	19°12'32.5" N	72°59'42.6" E
11.	Nasik Express way pipe line bridge	40.19	Kalwa	75.00	8.00	19°13'04.2" N	73°00'45.9" E
12.	Bhiwandi - Dombivli rail bridge	50.70	Dombivli	40.00	11.00	19°14'18.1" N	73°04'28.3" E
13.	Kongaon old road bridge	56.14	Kongaon	30.00	11.00	19°14'42.9" N	73°06'58.0" E
14.	Kongaon new road bridge	56.20	Kongaon	50.00	10.00	19°14'45.0" N	73°06'58.3" E
15.	Thakurgaon pipe line bridge	58.77	Thakurgaon	20.00	10.00	19°15'53.7" N	73°06'10.8" E
16.	Kalyan Sape bridge	64.52	Kalyan	30.00	11.00	19°16'06.0" N	73°08'25.8" E
17.	Mohane Pipeline Bridge	67.39	Mohane	20.00	15.00	19°15'27.8" N	73° 9'44.1" E

Sl. No.	Name of Structure	Chainage (km)	Location	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
						Latitude	Longitude
18.	Mohane Pipeline Bridge	67.58	Mohane	20.00	15.00	19°15'23.42" N	73° 9'48.90" E
19.	Mohane Road Bridge	67.63	Mohane	10.00	15.00	19°15'22.36" N	73° 9'50.26" E
20.	Kalyan Rayate Bridge	75.77	Rayate	-	-	19°15'17.9" N	73°13'13.5" E
21.	Manjarligaon bridge	86.89	Manjarligaon	-	7.00	19°10'46.5" N	73°14'44.3" E
22.	Badlapur Foot Bridge	88.95	Badlapur	8.00	3.00	19°09'51.7" N	73°15'17.8" E
23.	Badlapur Bridge	89.07	Badlapur	8.00	12.00	19°09'47.0" N	73°15'14.8" E
24.	Broken Bridge	90.82	Badlapur	-	-	19°08'51.3" N	73°15'11.6" E
25.	Under Construction Bridge	97.93	Kudsavare	-	U/C	19°07'15.3" N	73°17'32.5" E
26.	Pashan Road Bridge	100.94	Vangani	10.00	13.00	19°06'05.2" N	73°18'32.4" E
27.	Under Construction Bridge	105.19	Shelu	-	2.50	19°04'20.8" N	73°19'32.5" E
28.	Malegaon Bridge	111.23	Malegaon	10.00	9.00	19°02'33.9" N	73°19'52.5" E

Table 2.3: Details of Bridges across Waldhuni Creek

Sl. No.	Name of Structure	Chainage (km)	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
					Latitude	Longitude
1	Kalyan Ambernath Bridge	0.40	10.00	6.00	19°14’06.4"N	73°08’49.1"E
2	Railway Bridge	1.00	8.00	3.00	19°14’24.2"N	73°09’02.5"E
3	Bhiwandi Murwad Road Bridge	1.33	8.00	4.00	19°14’34.3"N	73°09’06.3"E
4	Twin pipeline Bridge	2.94	20.00	5.00	19°15’24.6"N	73°09’23.4"E
5	Pipeline bridge towards Kalyan	3.16	20.00	8.00	19°15’30.9"N	73°09’26.9"E

Table 2.4: Details of Bridges across Vasai Creek

Sl. No.	Name of Structure	Chainage (km)	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
					Latitude	Longitude
1	Panju Island (Old Rly. Bridge) North Channel	3.38	18.70	3.91	19°19'07.34"N	72°51'07.32"E
2	Panju Island (New Rly. Bridge) North Channel	3.40	53.04	3.43	19°19'07.30"N	72°51'10.37"E
3	Mira Bhayandar old rail bridge	6.10	100.00	8.80	19°20'21.9"N	72°50'58.4"E
4	Mira Bhayandar new rail bridge	6.29	100.00	8.80	19°20'21.9"N	72°51'00.8"E
5	Mira Bhayandar Road bridge	13.51	100.00	8.80	19°17'23.9"N	72°54'19.3"E
6	Kasheli Road Bridge	29.97	50.00	8.80	19°13'48.3"N	73°00'16.7"E
7	Kasheli pipe line Bridge	30.31	50.00	6.80	19°13'46.0"N	73°00'16.9"E

Apart from bridges there are two barrages and one check dam across the waterway on Ulhas River. The details of dam and barrages across the Kalyan-Thane-Mumbai Waterway via Ulhas River are given below in Table 2.5.

Table 2.5: Dam and Barrages in Kalyan-Thane-Mumbai via Ulhas River

Sl. No.	Name of Structure	Location	Chainage (km)	Center Position	
				Latitude	Longitude
1	Check Dam	Kalyan	67.78	19°15'19.2" N	73°09'54.0" E
2	Barrage	Aapti	81.56	19°13'10.6"N	73°14'03.6" E
3	Barrage	Badlapur	90.37	19°09'6.02" N	73°15'10.0" E

2.4 Connectivity of Waterway

Proposed stretch of Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River (NW-53) waterway lies in the coastal area of Mumbai which is well connected with the surrounding districts, tehsils and villages through road and rail. **Figure 2.4** shows road and rail connectivity of the area adjacent to the Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River waterway.

Figure 2.4: View of Rail and Road Network around Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River (NW-53)

In **Figure 2.4**, Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River (NW-53) waterway is shown in blue color whereas yellow and black colors represent the road and rail network respectively around the waterway. The area under study is well connected with highway, rail and air network.

2.5 Important Places

Many important places of Mumbai district are situated in the vicinity of the waterway. These places are well connected with the waterway by road and rail transport. **Table 2.3** shows the distance of the waterway from nearby important places.

Table 2.6: List of Important Places in vicinity of Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River (NW-53) Waterway

Sl. No.	Important Places	Category	Distance from Creek/River	Bank
1.	Mumbai	State Capital	10 km	Right bank – Ulhas River Left Bank – Vasai Creek
2.	Colaba	Island, Part of Mumbai City – Lok Sabha Constituency	100 m from Ulhas	Right bank – Ulhas River Left Bank – Vasai Creek

Sl. No.	Important Places	Category	Distance from Creek/River	Bank
3.	Vasai	Tehsil	10 km	Right Bank – Vasai Creek
4.	Thane	City	2.5 km- Ulhas and 3 km from Vasai	Right Bank- Ulhas and Left Bank – Vasai Creek
5.	Kalyan	Tehsil	2.0 km	Left Bank- Ulhas River
6.	Mora	Town	150 m	Left Bank- Ulhas River
7.	Navi Mumbai	Township	5.0 km	Left Bank- Ulhas River

2.6 Road Connectivity

Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River in the study stretch is well connected with Asian Highway AH-47, National Highway NH-4B, NH-4C, NH-66, Eastern Express Way, Mumbai Pune Express Way and is surrounded by district road on right bank and left bank. The roads surrounding waterway connects to National Highway throughout the length of waterway.

2.7 Rail Connectivity

Railway transport in Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River catchment is developed under the Western Railways. The start and end point of study stretch of the river is connected to railway route. The nearest main railway station is at Mumbai Central railway station. Mumbai Central railway station is about 3.5 km from Ulhas River.

2.8 Status of Goods Transport

Status of goods transport through River / Waterway is detailed in **Chapter 4 on Market Analysis of this report**.

2.9 Conclusion

a) Kalyan-Thane and Vasai are among the important creeks in the coastal strip of Maharashtra located in Mumbai region.
b) There are two Major Ports in Mumbai namely JNPT (Jawaharlal Nehru Port Trust) and Mumbai port.
c) Bharti ship yard and few captive jetties among a total of 56 jetties are located along the River/Creek.
d) Twenty six (26) bridges exist in the Ulhas River, five (5) in Waldhuni and seven (7) in Vasai creeks. The bridges across the study stretch are classified into road, rail and pipeline bridges. Further, two bridges are under construction in the study stretch of Ulhas River.

e) Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River in the study stretch is well connected with Asian Highway AH-47, National Highway NH-4B, NH-4C, NH-66, Eastern Express Way, Mumbai Pune Express Way and is surrounded by district road on right bank and left bank.

f) Railway transport in Kalyan-Thane-Mumbai Waterway, Vasai creek and Ulhas River catchment is developed under the Western Railways. The nearest main railway station is at Mumbai Central railway station about 3.5 km from Ulhas River.

CHAPTER 3: RECONNAISSANCE SURVEY

3.1 River Profile

Ulhas River

The Ulhas River originates in a valley north of the Rajmachi hills formed by mountain streams draining the northern slope of those hills which are part of the Sahyadri range of the Western Ghats in the Raigad district of Maharashtra at an altitude of 900m above mean sea level (AMSL). The total catchment area of Ulhas River basin is 4637 sqkm and the catchment receives an average annual rainfall of about 2,943 mm. The total length of the river from origin to its outfall in the Arabian Sea is about 161.00 km. Beyond Kalyan the river, nearly flowing at sea level, merges with the creek waters and its flow affects by the tidal forces. From here on, it forms an estuary and also supports a mangrove forest near Diva-Dombivali. In rainy season and during low tide, the river continues to flow till Thane, where it splits into two branches one to west and another to south respectively, around Salsette Island, on which lies the metropolis of Mumbai. The main branch turns northwestward to Ghodbunder, where it opens into the estuary of Vasai Creek. The other branch flows south to empty into Bombay Harbour through Thane Creek. Ulhas River has a relatively large catchment area and its major tributaries are Pej, Barvi, Bhivapuri, Murbari, and Kalu streams. The river is used to supply drinking water to the cities of Badlapur and Navi Mumbai

Waldhuni Creek

Waldhuni is a small river originating at Kakole Lake near Ambarnath and unites with Ulhas River near Kalyan and then flows down to the Thane creek, where it meets the Arabian Sea. Waldhuni River is a left bank tributary of Ulhas River. The river bank has maximum encroachment from Ulhasnagar on the east and Ashoknagar and Shivajinagar in Kalyan on the west of its bank. The total length of Waldhuni River is 31.8km.

Vasai Creek

Vasai Creek is an estuarine creek formed by one of the two main distributaries of the Ulhas River in Maharashtra state of western India. The Ulhas splits at the northeast corner of Salsette Island into its two main distributaries, Vasai Creek and Thane Creek. Vasai Creek forms the northern boundary of Salsette Island, and empties west into the Arabian Sea. Thane creek empties southwards into Bombay Harbour.

A map showing Ulhas, Waldhuni, and Vasai Creek basin is shown in **Figure 3.1**.

Figure 3.1 indicates that the river flows close to the coastal region; thus the lower stretch of the river is expected to be tidal affected zone. Given the size and terrain of the river, lower reaches may have navigation

potential. IWAI expects the waterway 145.00km, shown in green, yellow and blue color in the Figure 3.1, to have potential for navigation and thus, the subject of study under this assignment.

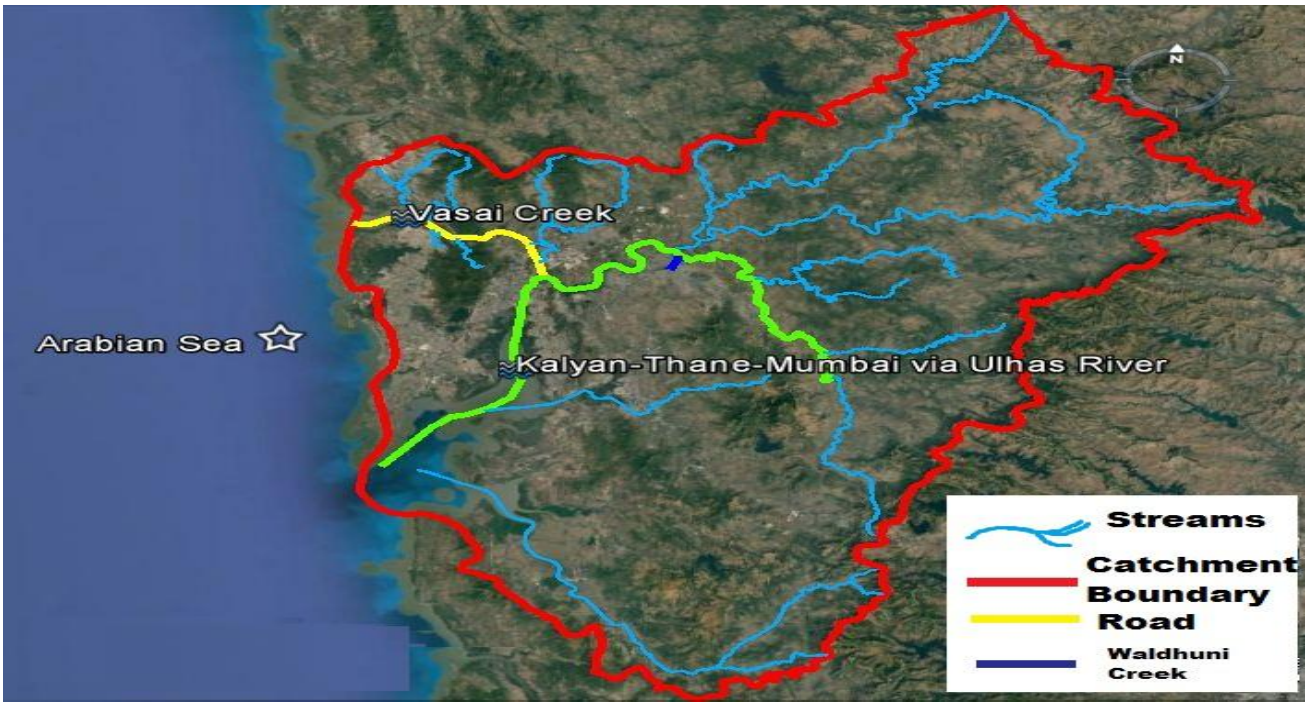


Figure 3.1: Catchment Area of Ulhas, Waldhuni, and Vasai Creek basin

The stretch of the Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River considered for assessment of navigation potential is defined as below:

145 km length of the waterway from Arabian Sea at Navi Mumbai via Ulhas river to bridge on state highway No.76 near Malegaon T. waredi	From: 18°55'49.78"N, 72°53'21.67"E	Up to: 19°2'38.20"N, 73°19'53.79"E	National Waterway: 53
Bridge on Kalyan-Badlapur road near Kalyan railway yard at Kalyan to Kalyan.	From: 19°14'6.39"N, 73°8'49.13"E	Up to: 19°15'35.03"N, 73°9'27.77"E	National Waterway: 53
Vasai Creek to Kasheli	From: 19°18'53.50"N, 72°47'30.18"E	Up to: 19°13'22.84"N, 73°0'21.44"E	National Waterway: 53

3.2 Reconnaissance Survey

This section presents a stretch-wise description about Kalyan-Thane-Mumbai Waterway via Ulhas River, Waldhuni Creek and Vasai Creek. It also covers the Hydrological analysis of collected data viz maximum and

minimum water depths. The route map of Kalyan-Thane-Mumbai Waterway via Ulhas River, Waldhuni Creek and Vasai Creek is in **Figure 3.2** below.

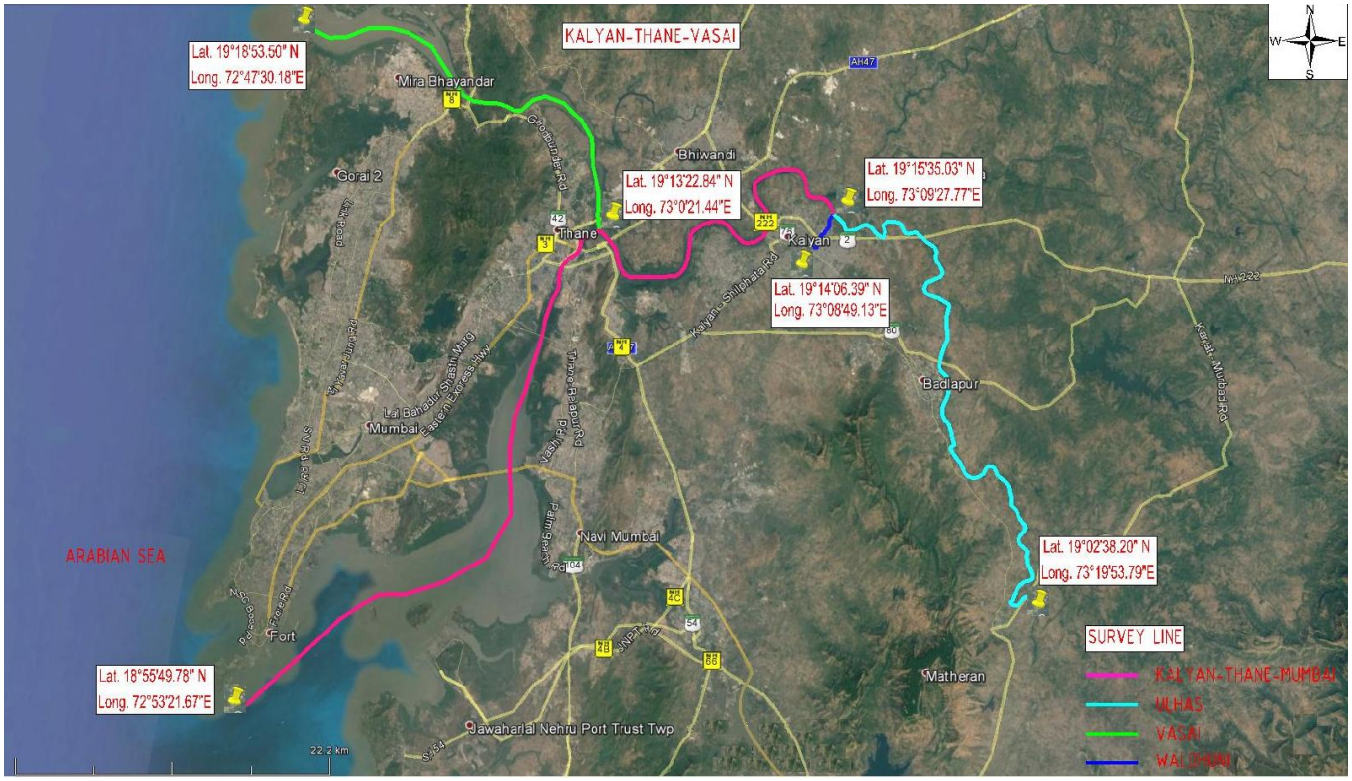


Figure 3.2: Route Map of Kalyan-Thane-Mumbai via Ulhas River, Waldhuni Creek, and Vasai Creek

3.2.1 Methodology of Survey

Single beam bathymetry survey was carried out to determine the 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.

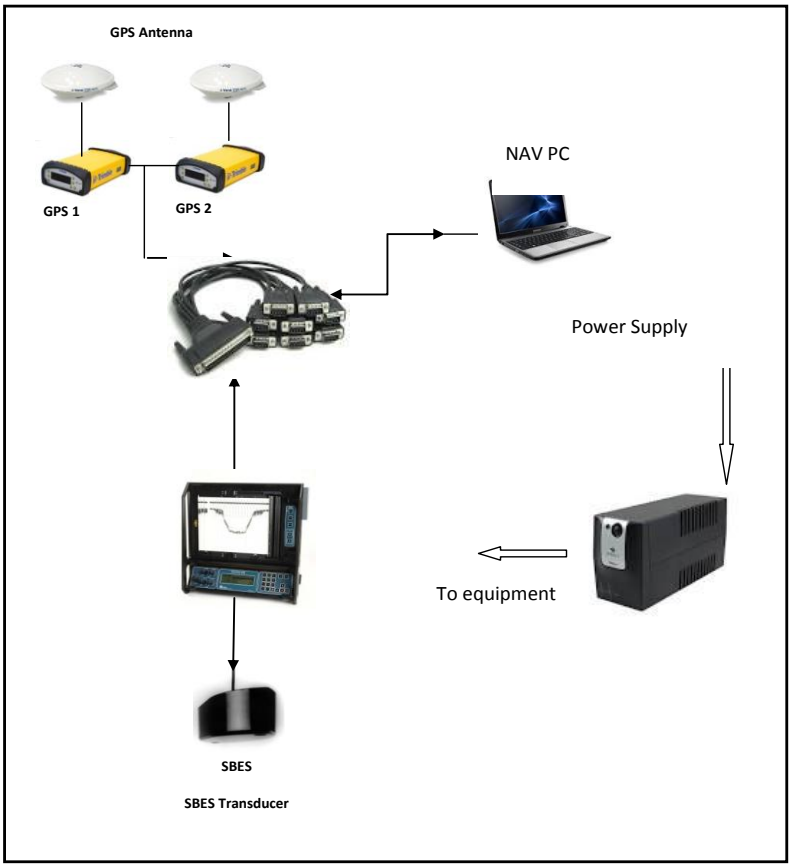


Figure 3.3: Equipment Diagram

Boat setup at site with equipment mounted on the boat is depicted in **Figure 3.4** as shown below.

Figure 3.4: Boat Setup with Equipment Mounted on the Boat

An overview chart for Kalyan-Thane-Mumbai Waterway via Ulhas River, Waldhuni Creek and Vasai 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 location with coordinates of Chart Datum obtained from MMB (**Annexure 3.2a** to **Annexure 3.2e**), 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	Vasai	19° 18'	72° 48'	2.530
2	**Bombay (Apollo Bandar)**	**18° 55′**	**72° 50′**	**2.510**
3	Kasheli Bridge	19° 14′	73° 00′	2.357
4	Thane Salt Bandar	19° 11′	72° 59′	2.819
5	Vashi Road bridge	19° 03′ 45″	72° 58′ 30″	2.942

**- 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.

3.2.3 Bathymetry and Site Data Collected for Kalyan-Thane-Mumbai waterway via Ulhas River

A. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 0.00km – Ch 5.00km)

Berthing jetties can be seen on either side of the stretch and Karanja jetty is present towards S.E direction in JNPT channel. Three ferry routes as shown in the Figure below are crisscrossing the JNPT Channel. The minimum water depth recorded in this section is 10.30m below CD at Ch 0.00km and maximum depth is 15.20m at Ch 4.73km. The same have been tabulated in **Table 3.3.** The stretch is shown in **Figure 3.5**.

Table 3.3: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 0.00km – Ch 5.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
0.00	5.00	15.20	10.30

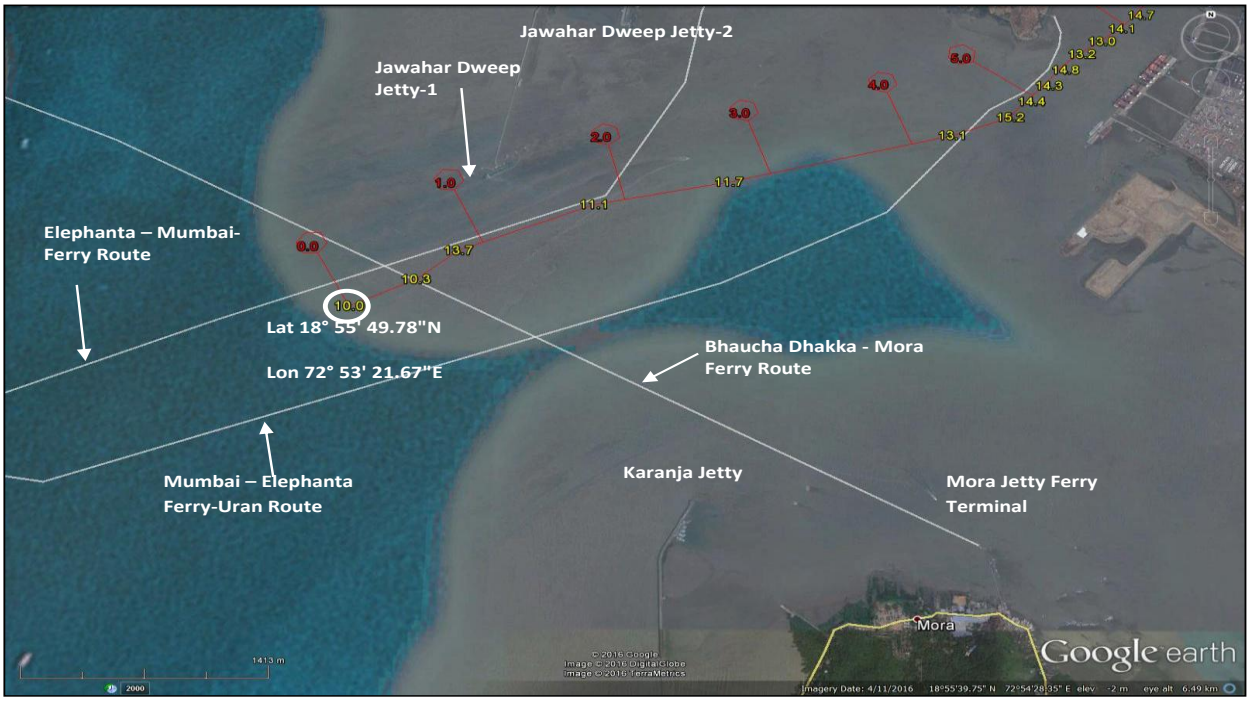


Figure 3.5: Route Chart of the Survey from Ch 0.00km to Ch 5.00km

B. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 5.00km – Ch 9.00km)

The Elephanta Ferry Jetty can be seen west (right) of Ch 5.70km, while the Jawaharlal Nehru Port Trust (JNPT) is seen east (left) of Ch 5.50km. (A small creek is seen in the east between JNPT and Nhava Supply Base). The Nhava ONGC supply base is seen in the east (left) near Ch 8.60km. The minimum depth recorded in this

section is 10.00m at Ch 8.67km and the maximum depth is 18.20m at Ch 7.03km and Ch 7.13km as tabulated in **Table 3.4**. The Stretch is shown in **Figure 3.6**.

Table 3.4: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 5.00km to Ch 9.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
5.00	**9.00**	18.20	10.00

Figure 3.6: Route Chart of the Survey from Ch 5.00km to Ch 9.00km

C. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 9.00km – Ch 17.00km)

The Pirpau Jetty at Ch 7.80km, Dhruva Jetty at Ch10.10km and Trombay Koliwada Jetty at Ch 14.50km are seen on the west (right) bank. Entrance to the Thane Creek is seen on the North part of the image beyond Trombay. The Panvel Creek and Seawoods are on the east (left) bank. The minimum depth recorded in this stretch is 1.60m at Ch 13.06km and the maximum depth is 12.70m at Ch 9.07km as tabulated in **Table 3.5.** The stretch is shown in **Figure 3.7**.

Table 3.5: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 9.00km to Ch 17.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w.r.t. Chart Datum	
From	To	Max	Min
9.00	**17.00**	12.70	1.60

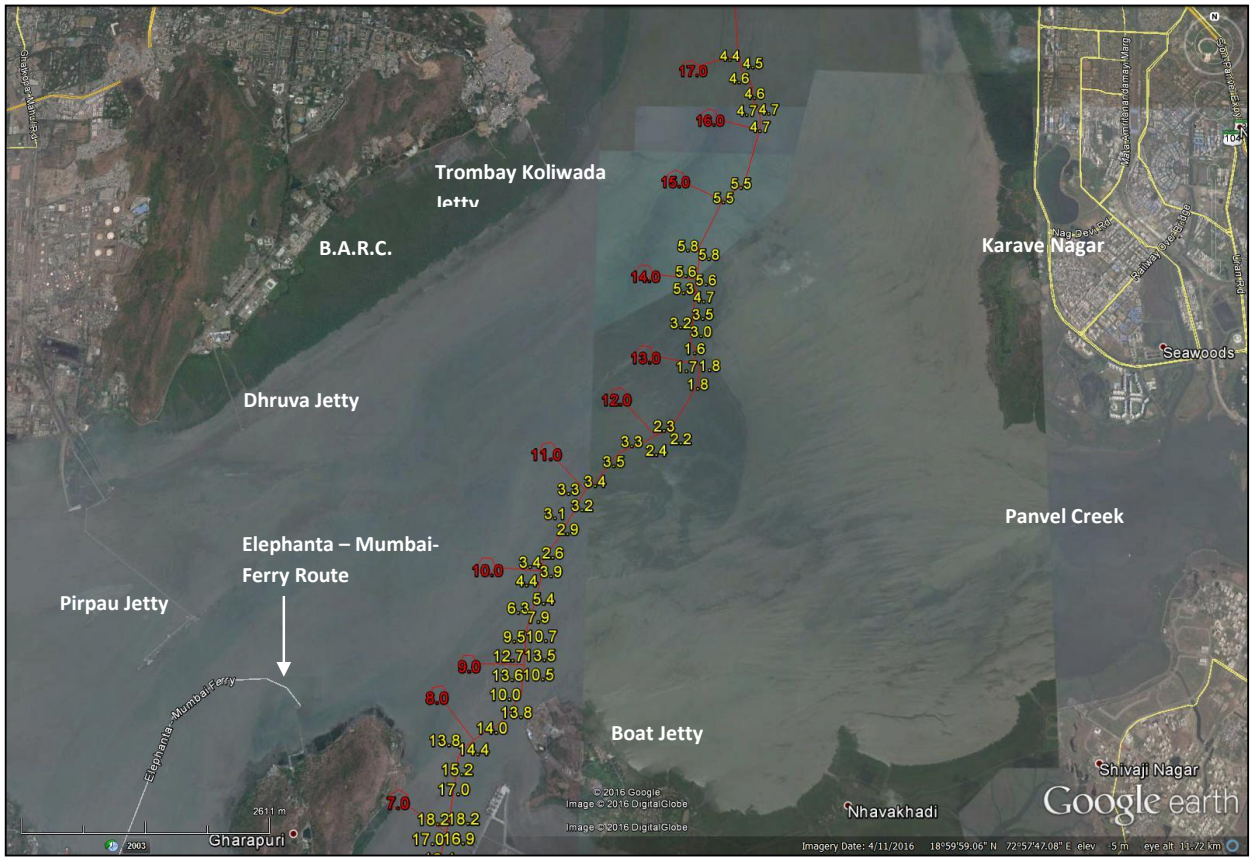


Figure 3.7: Route Chart of the Survey from Ch 9.00km to Ch 17.00km

D. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 17.00km – Ch 21.00Km)

The Mankhurd to Vashi Rail and Road Bridges cross the Thane Creek in this stretch. The HT lines are crossing the waterway at Ch 19.83km. The minimum water depth recorded in this section is 3.00m at Ch 20.98km and maximum depth is 7.50m at Ch 19.50km as tabulated in **Table 3.6.** The route chart has been displayed in **Figure 3.8**.

Table 3.6: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 17.00km to Ch 21.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
17.00	**21.00**	7.50	3.00

Figure 3.8: Route Chart of the Survey from Ch 17.00km to Ch 21.00km

E. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 21.0km – Ch 25.00Km)

Many small creeks can be seen on both sides of the banks of the Thane Creek, with dense mangroves along the banks. The minimum water depth recorded in this stretch is 0.30m at Ch 22.02km and Ch 22.13km and the maximum depth is 3.00m at Ch 21.08km as tabulated in **Table 3.7**. The stretch is shown in **Figure 3.9.**

Table 3.7: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 21.00km to Ch 25.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
21.00	**25.00**	3.00	0.30

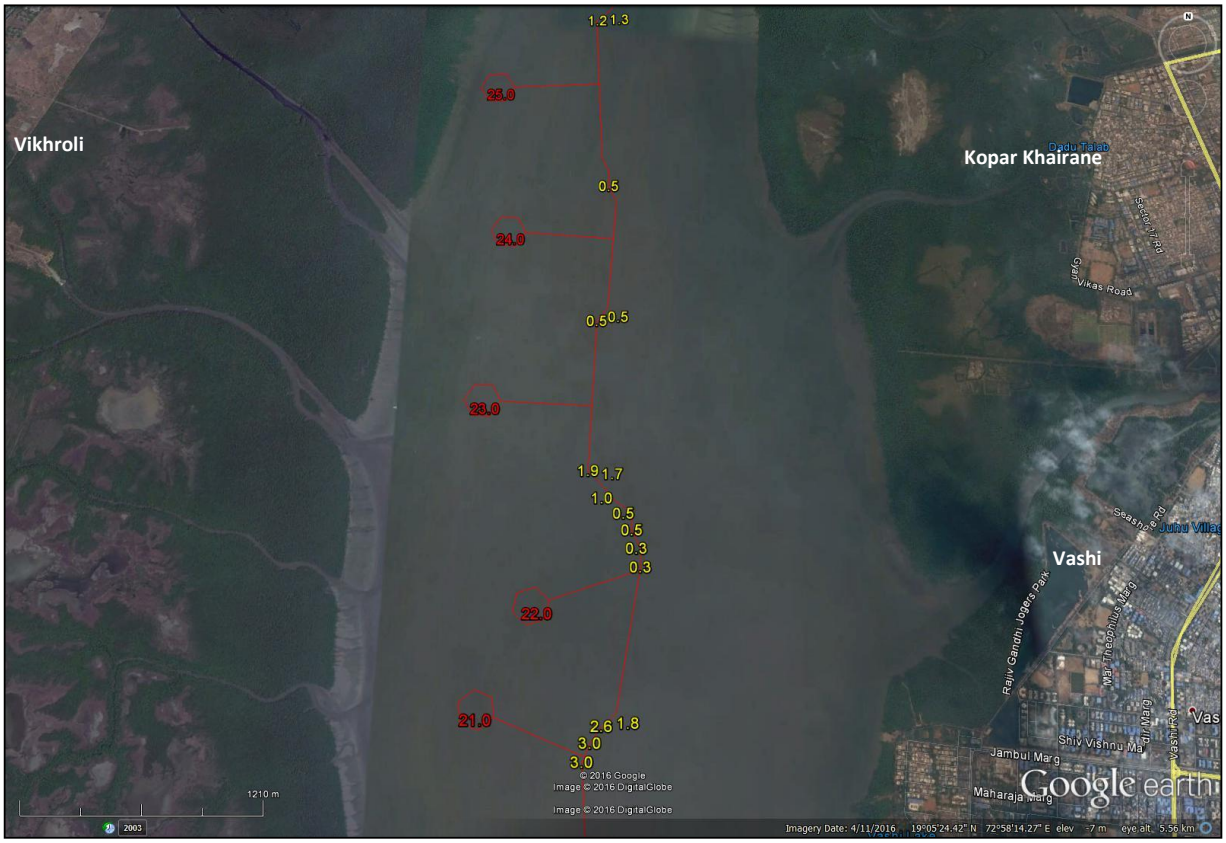


Figure 3.9: Route Chart of the Survey from Ch 21.00km to Ch 25.00km

F. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 25.00km – 29.00km)

Dense mangroves can be seen along both the banks of the river. Small creeks are joining on either side of the banks. The minimum depth recorded in this stretch is 0.10m at Ch 28.06km and the maximum depth is 1.80m at Ch 28.76km as tabulated in **Table 3.8.** The route chart has been displayed in **Figure 3.10**.

Table 3.8: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 25.00km to Ch 29.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
25.00	**29.00**	1.80	0.10

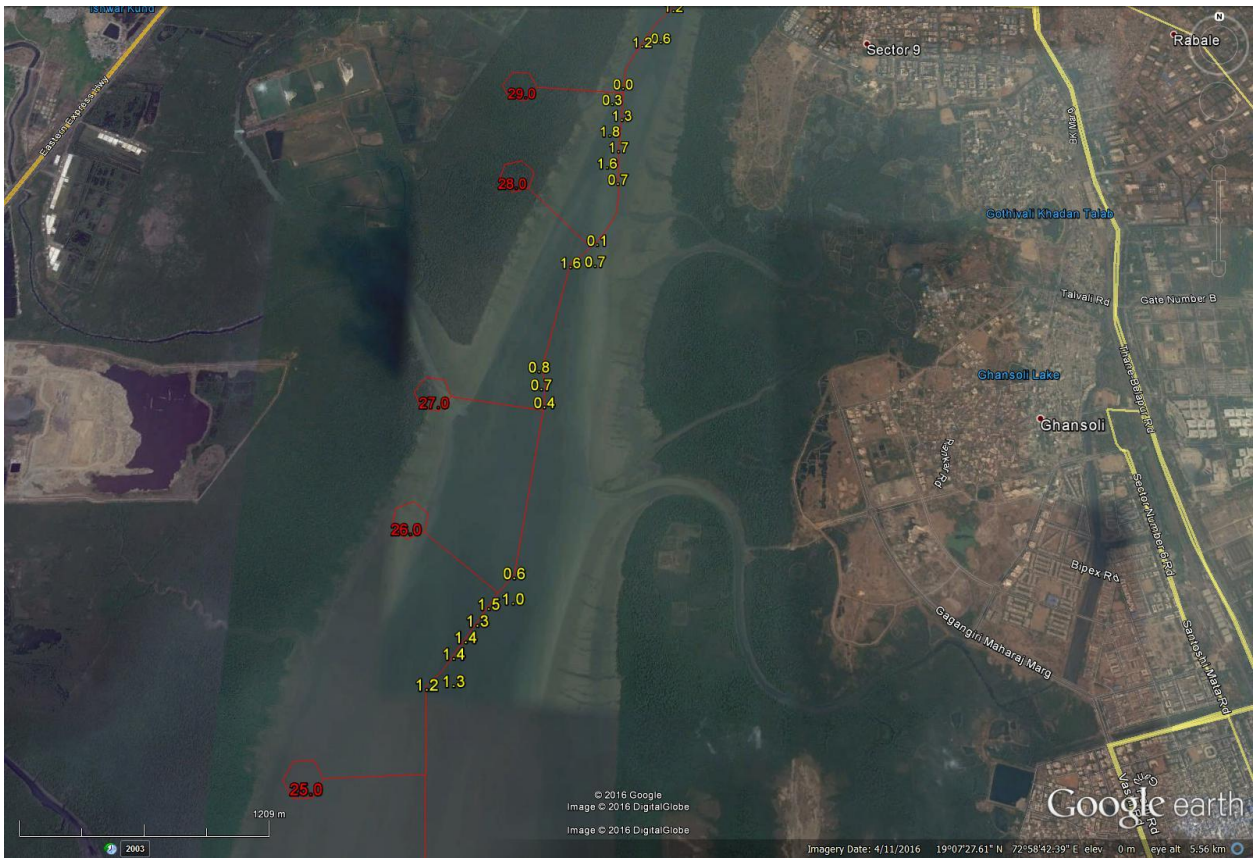


Figure 3.10: Route Chart of the Survey from Ch 25.00km to 29.00km

G. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 29.00km – 33.00km)

The Airoli to Mulund Road Bridge is crossing at Ch 30.00km. The HT line is crossing at Ch 31.93 km. There are many small creeks joining on both sides of the bank. Dense mangroves can be seen along the banks. The minimum water depth recorded in this section is 0.00m at Ch 29.06km and the maximum depth is 1.90m at Ch 32.58km as tabulated in **Table 3.9.** The route chart has been displayed in **Figure 3.11**.

Table 3.9: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 29.00km to Ch 33.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
29.00	33.00	1.90	0.00

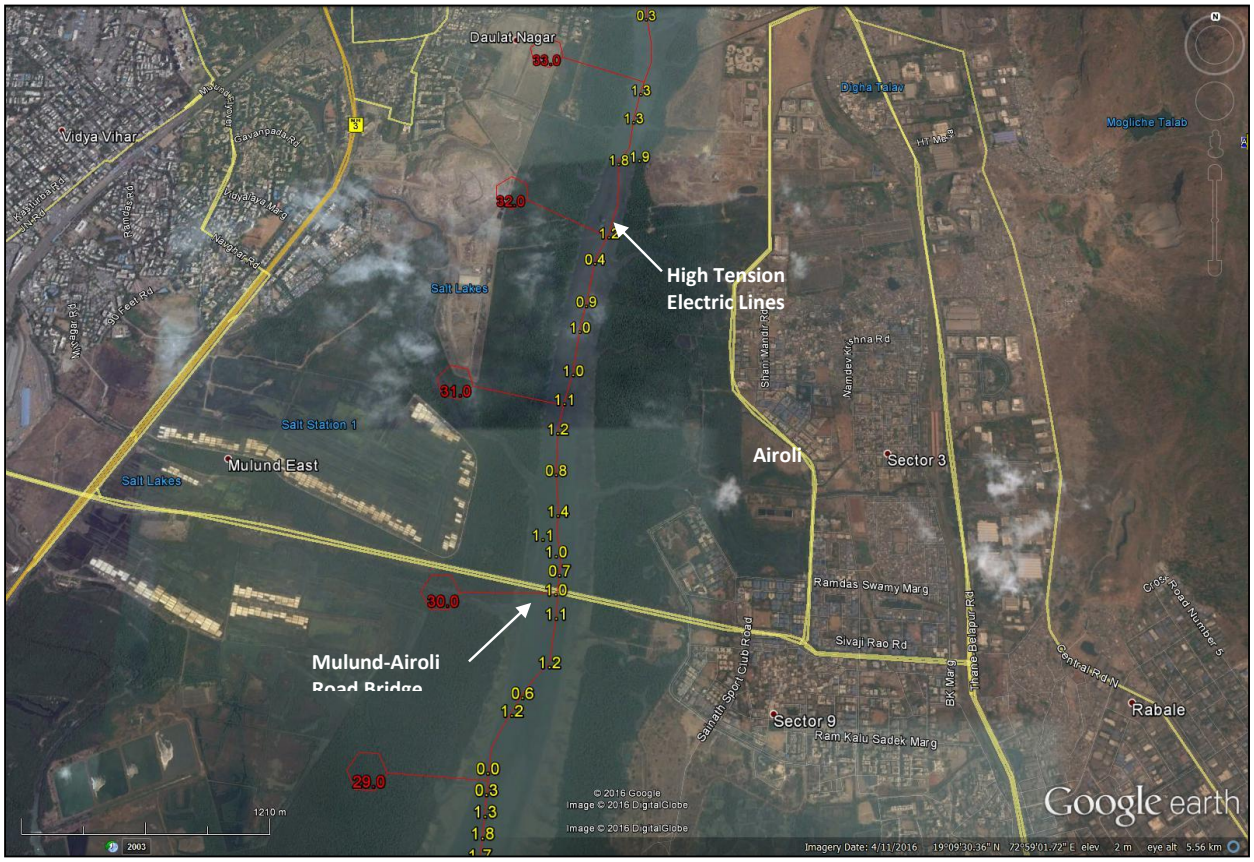


Figure 3.11: Route Chart of the Survey from Ch 29.00km to 33.00km

H. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 33.00km – 37.00km)

A slope jetty is present on the west bank at Ch 33.40km after which an exposed land covered with mangroves can be seen in the middle of the river between Ch 33.50km and Ch 34.00km. A HT line pole is present in the middle of the creek at Ch 33.77km. The Thane Rail Bridge can be seen at Ch 34.34km. The Kalwa Old Road Bridge is present at Ch 35.36km, Kalwa New Road Bridge is present at Ch 35.36km and Kharegaon Pipeline Bridge is present at Ch 36.46km. The minimum depth recorded in this section is 0.10m at Ch 34.25km and the maximum depth is 1.80m at Ch 35.03km as tabulated in **Table 3.10.** The route chart has been displayed in **Figure 3.12**.

Table 3.10: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 33.00km to Ch 37.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
33.00	37.00	1.80	0.10

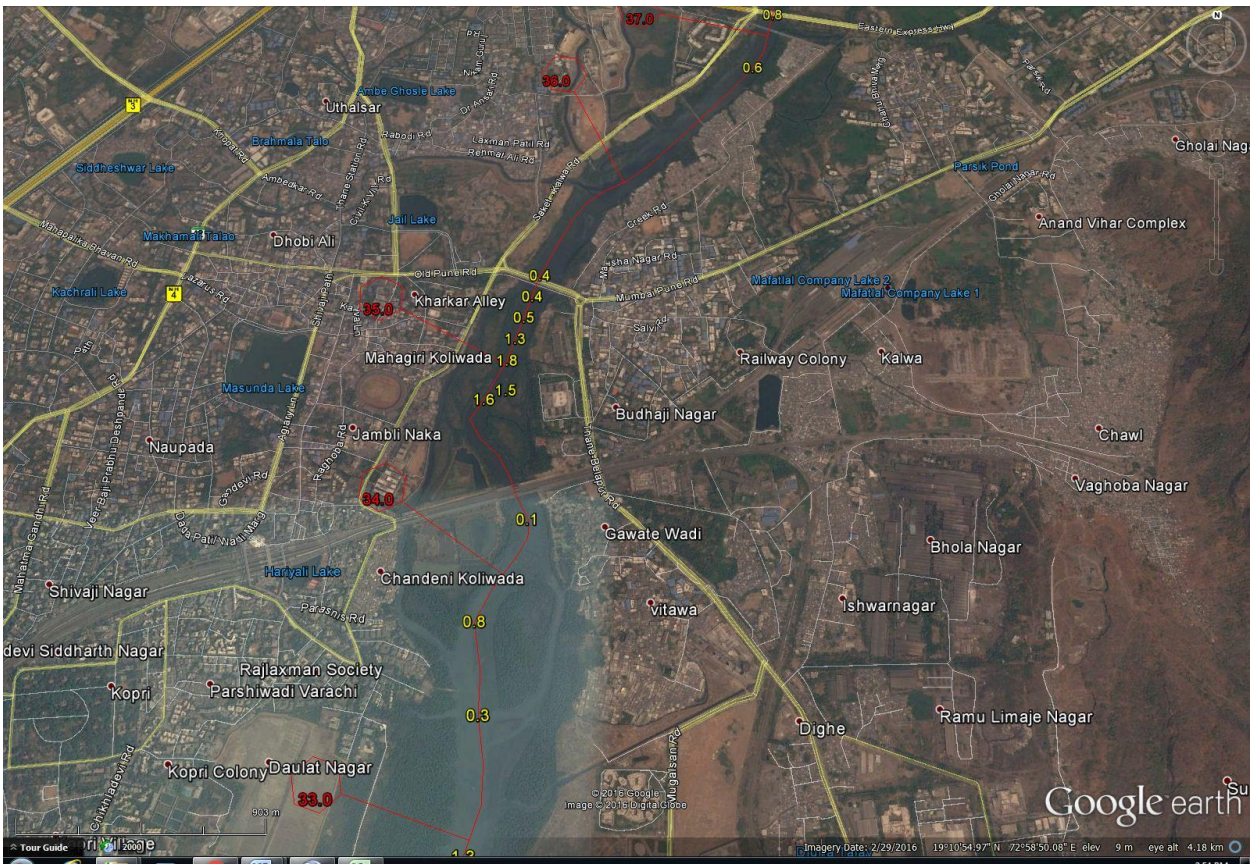


Figure 3.12: Route Chart of the Survey from Ch 33.00km to 37.00km

I. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 37.00km – 43.00km)

Kalwa Pipeline Bridge is present at Ch 37.03km and the Thane-Kalwa Road Bridge is present at Ch 37.10km. Mangroves can be seen with settlements on both sides of the bank. The confluence of this creek with the Vasai Creek can be seen at Ch 39.10km. The Thane to Dombivili stretch also known as Ulhas River, starts from this point. The Mumbai-Nasik Expressway Road Bridge goes across the Ulhas River at Ch 40.20km, while a pipeline bridge crosses at Ch 40.40km. Two HT lines with pole in the middle of the river are present at Ch 41.43km and Ch 42.40km. The minimum water depth recorded in this section is 0.20m at Ch 38.81km and the maximum water depth is 16.20m at Ch 42.38km as tabulated in **Table 3.11.** The route chart has been displayed in **Figure 3.13**.

Table 3.11: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 37.00km to Ch 43.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
37.00	**43.00**	16.20	0.20

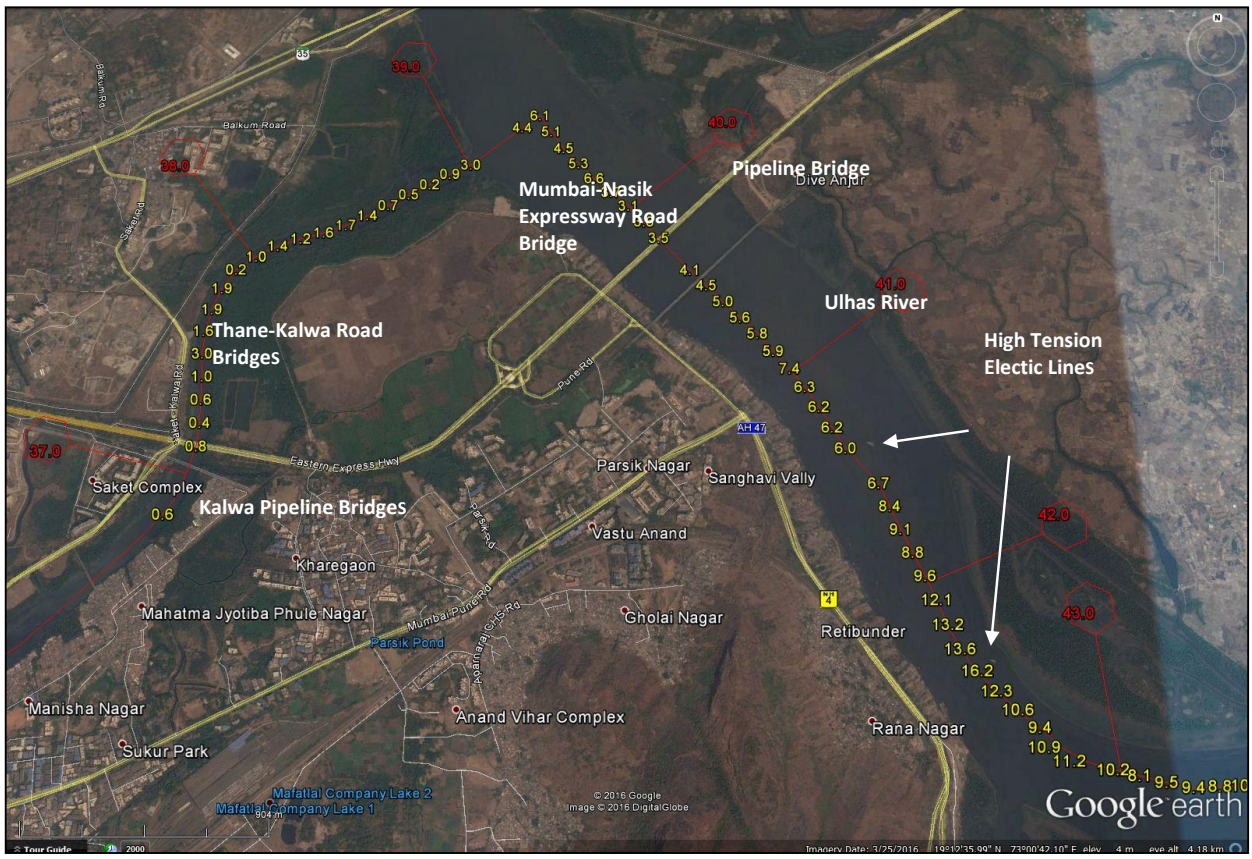


Figure 3.13: Route Chart of the Survey from Ch 37.00km to 43.00km

J. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 43.00km – 47.00km)

Marshy land is present along the south bank (left) where the river meanders and also on the west bank of the Desai Khadi where it meets with the Mumbra Jetty. The Alimgarh Jetty is seen on the north bank (right) at Ch 43.80km. The minimum water depth recorded in this section is 6.00m at Ch 46.77km and the maximum water depth is 16.00m at Ch 45.87km as tabulated in **Table 3.12.** The route chart has been displayed in **Figure 3.14**.

Table 3.12: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 43.00km to Ch 47.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
43.00	**47.00**	16.00	6.00

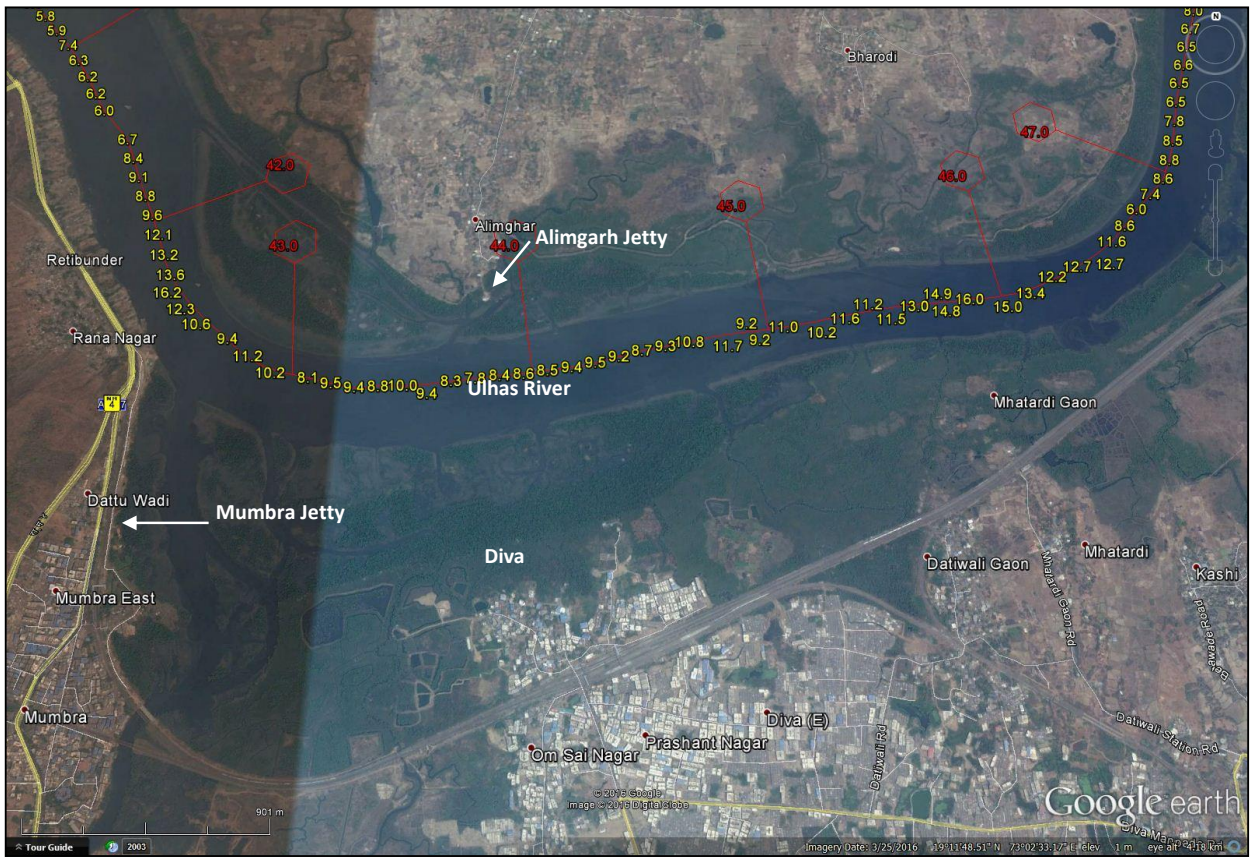


Figure 3.14: Route Chart of the Survey from Ch 43.00km to 47.00km

K. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 47.00km – 50.00km)

The river meanders towards the north in this section with mangroves seen in both the banks and the Surei Boat Jetty is seen on the west bank (right) at Ch 48.70km. There are few small boats docked along the east bank(left) near Pravasi Jetty. Few small boats are docked on the north bank (right) at Velhe Jetty at Ch 49.8km. The minimum water depth recorded in this section is 6.30m at Ch 49.57km and the maximum water depth is 14.40m at Ch 49.17km as tabulated in **Table 3.13.** The route chart has been displayed in **Figure 3.15**.

Table 3.13: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 47.00km to Ch 50.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
47.00	**50.00**	14.40	6.30

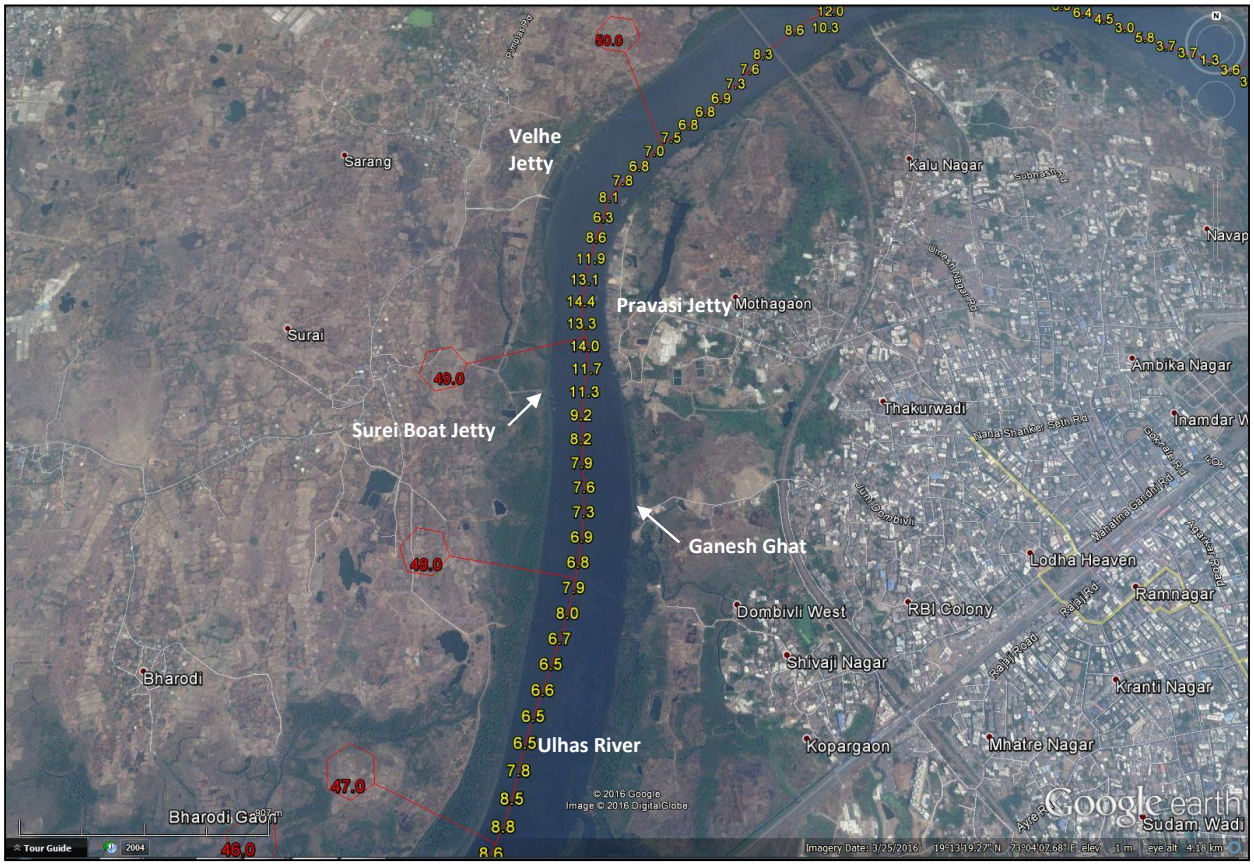


Figure 3.15: Route Chart of the Survey from Ch 47.00km to 50.00km

L. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 50.00km – 55.00km)

The Bhiwandi-Dombivli Rail Bridge goes across the river at Ch 50.70km. Few small boats are docked on the north bank(right) at Pimplas Jetty at Ch 51.70km. Shallow patches from the middle of the river to the south bank (left) at Ch 54.20km to Ch 55.00km can be seen. The Malagarh Jetty is seen in the south bank (left) at Ch 54.80km.The minimum water depth recorded in this section is 1.20m at Ch 54.96km and the maximum water depth is 12.0m at Ch 51.06km as tabulated in **Table 3.14.** The route chart has been displayed in **Figure 3.16**.

Table 3.14: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 50.00km to Ch 55.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
50.00	55.00	12.00	1.20

Figure 3.16: Route Chart of the Survey from Ch 50.00km to 55.00km

M. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 55.00km – 59.00km)

Two high tension electric lines are seen passing across the river at Ch 55.17km and Ch 57.89km. There are many small boats docked along the east bank starting from Ch 55.70km. This can be seen along the Reti Bunder up to the old Kongaon Road Bridge at Ch 56.14km and the new Kongaon Road Bridge at Ch 56.20km. Few small boats are docked on the west bank near the old Kongaon Road Bridge surrounded by settlements. The Thakurgaon pipeline bridge crosses the river at Ch 58.77km. The minimum water depth recorded in this section is 1.70m at Ch 57.55km and Ch 57.65km and the maximum water depth is 11.5m at Ch 55.96 as tabulated in **Table 3.15.** The route chart has been displayed in **Figure 3.17**.

Table 3.15: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 55.00km to Ch 59.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
55.00	**59.00**	11.50	1.70

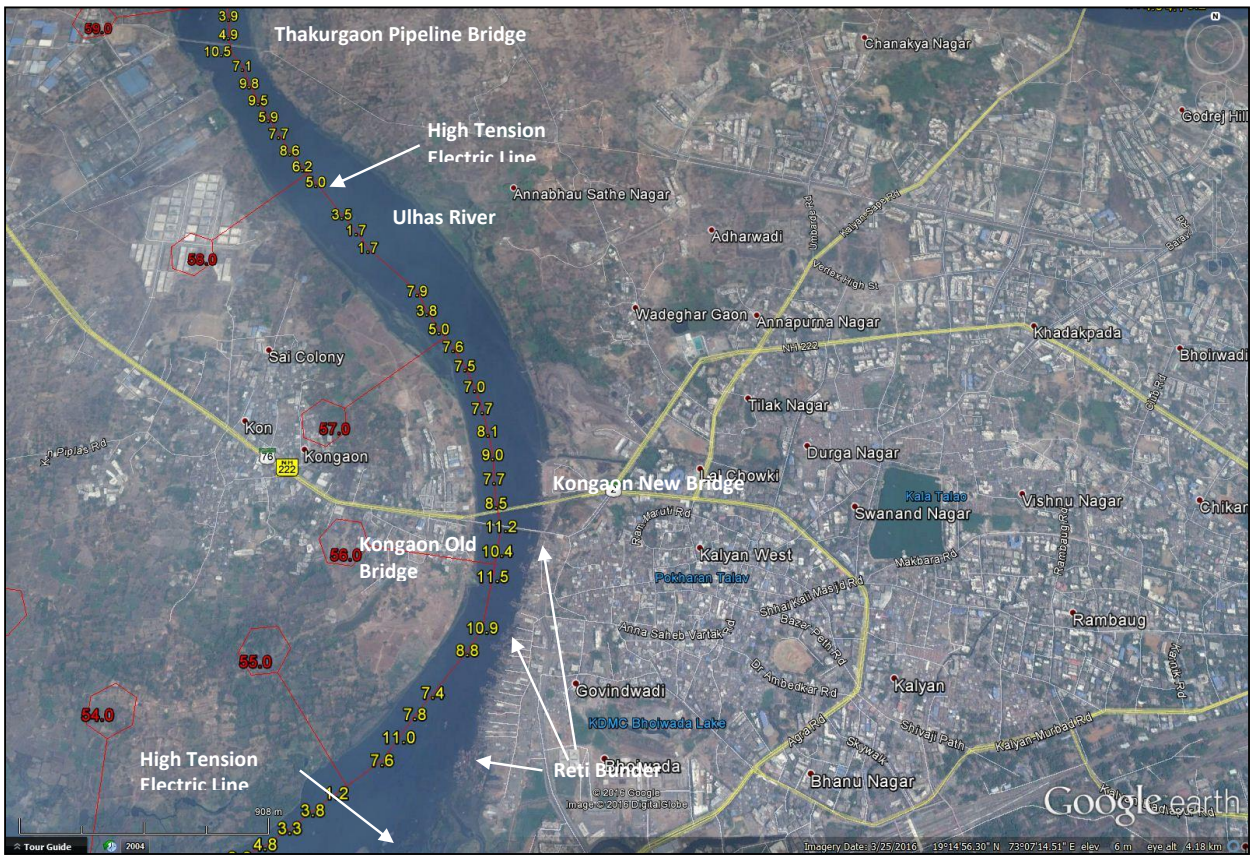


Figure 3.17: Route Chart of the Survey from Ch 55.00km to 59.00km

N. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 59.00km – 64.00km)

Vegetation can be seen along the banks in this section. There are few shallow patches in the middle of the river from Ch 58.90km to Ch 59.80km. A high tension electric line passes across the river at Ch 62.99km. The minimum water depth recorded in this section is 1.70m at Ch 59.53km and the maximum water depth is 7.90m at Ch 61.23km as tabulated in **Table 3.16.** The route chart has been displayed in **Figure 3.18**.

Table 3.16: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 59.00km to Ch 64.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
59.00	**64.00**	7.90	1.70

Figure 3.18: Route Chart of the Survey from Ch 59.00km to 64.00km

O. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 64.00km – 69.00km)

The Kalyan-Sape Road Bridge crosses the river at Ch 64.52km. Thereafter, the Kalu River branches off at Ch 65.40km, while the Ulhas River branches off and flow southwards at Ch 66.89km. A high tension electric line crosses above the river at Ch 66.35km. Beyond this point, the River becomes very shallow and two pipeline bridges at Ch 67.39km and Ch 67.58km crosses the river before the Mohane Road Bridge at Ch 67.63km. The minimum water depth recorded in this section is 0.10m at Ch 65.99km and the maximum water depth is 5.00m at Ch 64.63km as tabulated in **Table 3.17.** The route chart has been displayed in **Figure 3.19**.

Table 3.17: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 64.00km to Ch 69.00km

Maximum –Minimum Depth			
Chainage (km)		**Reduced Water Depth (m) w. r. t. Chart Datum**	
From	**To**	**Max**	**Min**
64.00	**69.00**	5.00	0.10

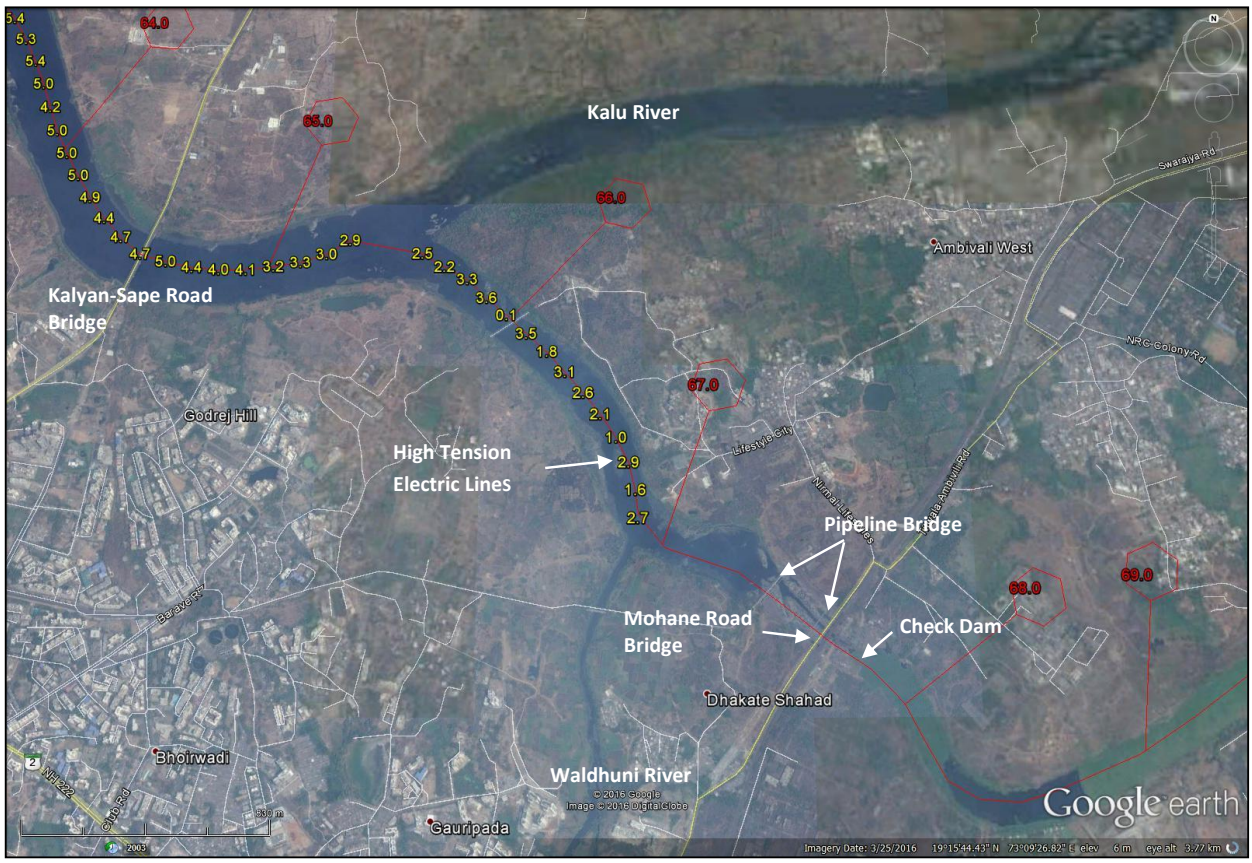


Figure 3.19: Route Chart of the Survey from Ch 64.00km to 69.00km

Due to the Check dam at Ch 67.78km, bathymetry survey could not be continued beyond this point.

P. Kalyan-Thane-Mumbai waterway via Ulhas River (Ch 69.00km – 75.00km)

The rest of the waterway up to Malegaon T. Waredi at Ch 111.20km was not navigable using a survey boat. Hence, topographic survey was undertaken to the extent possible, along the dry portions of land on the River banks from Ch 68.00km till Ch 111.20km.

A temple with an adjoining jetty can be seen on the north bank (right) at Ch 79.40km. A set of high tension electric lines crosses the river at Ch 69.82km and Ch 73.39km. The minimum water depth recorded in this section is 0.40m at Ch 72.23km and the maximum water depth is 1.20m at Ch 68.97km, Ch 69.27km, Ch 69.60km, and Ch 71.71km as tabulated in **Table 3.18.** The route chart has been displayed in **Figure 3.20**.

Table 3.18: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 69.00km to Ch 75.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
69.00	75.00	1.20	0.40

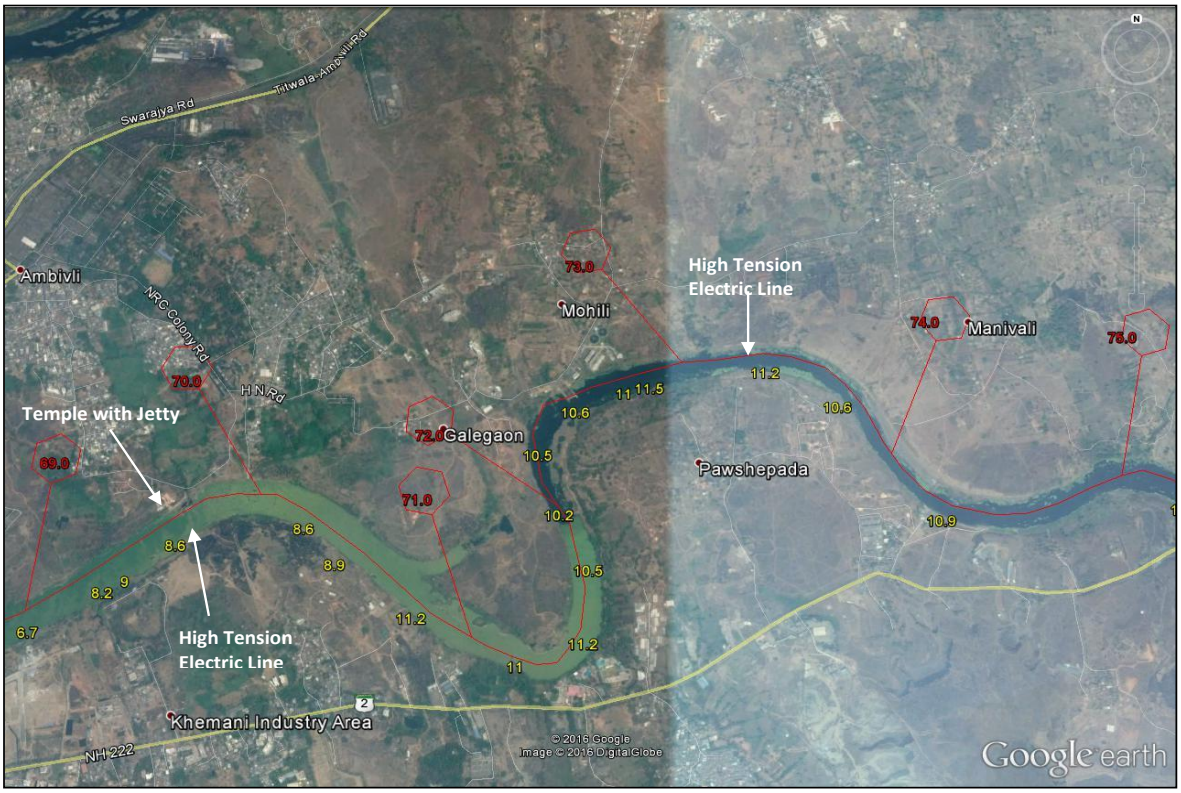


Figure 3.20: Route Chart of the Survey from Ch 69.00km to 75.00km

Q. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 75.00km – 79.00km)

The Kalyan-Rayate Road Bridge crosses the river at Ch 75.77km. A set of high tension electric lines go across the river at Ch 78.24km and Ch 78.75km. The minimum water depth recorded in this section is 0.30m at Ch 77.66km and the maximum water depth is 0.80m at Ch 74.35km, Ch 76.43km, and Ch 79.02km as tabulated in **Table 3.19.** The route chart has been displayed in **Figure 3.21**.

Table 3.19: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 75.00km to Ch 79.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
75.00	79.00	0.80	0.30

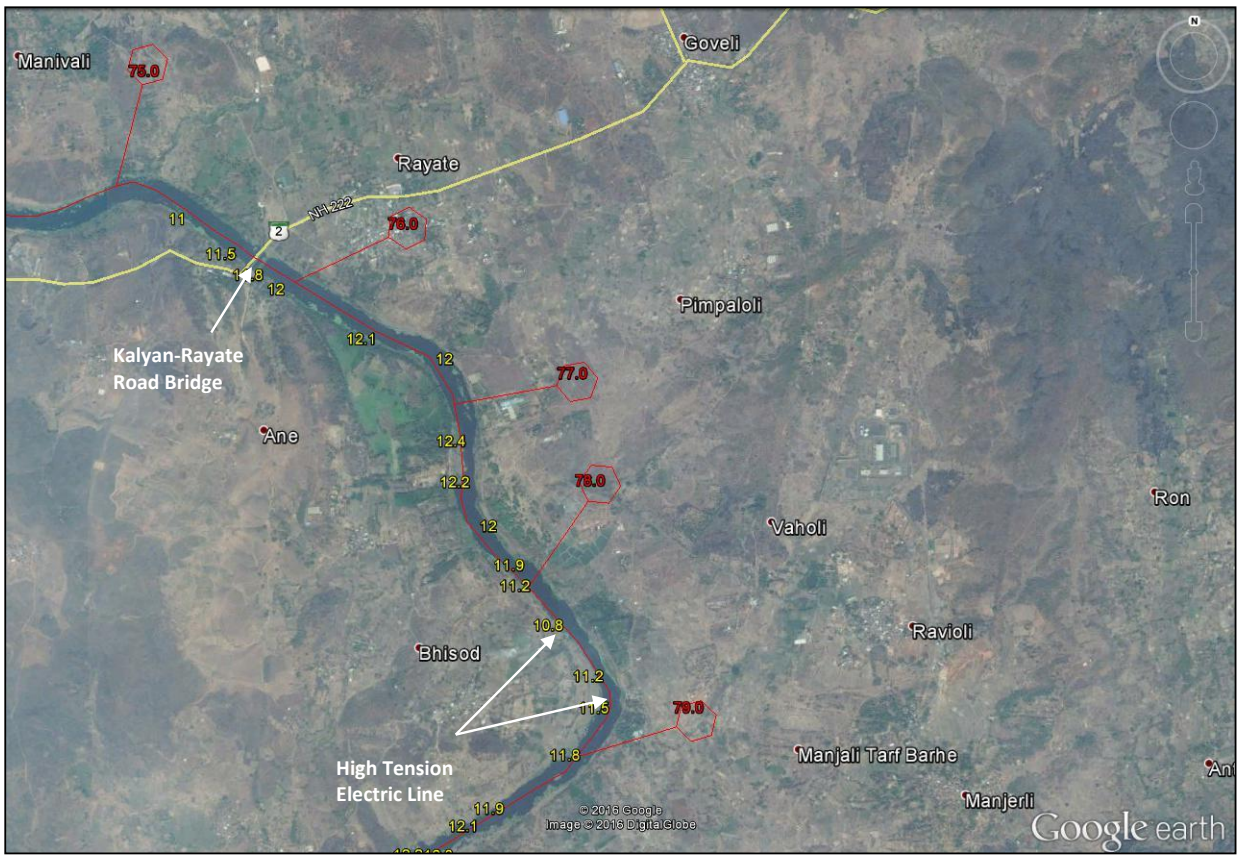


Figure 3.21: Route Chart of the Survey from Ch 75.00km to 79.00km

R. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 79.00km – 84.00km)

A set of high tension electric lines are seen going across the river at Ch 79.49km and Ch 81.51km. A barrage is seen holding the water at Ch 81.56km. The confluence of Barvi River is at Ch 82.60km where the Vasat Village Hindu Crematorium can be seen along the west bank of river. The minimum water depth recorded in this section is 0.20m at Ch 80.26km and the maximum water depth is 1.40m at Ch 82.77km as tabulated in **Table 3.20.** The route chart has been displayed in **Figure 3.22**.

Table 3.20: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 79.00km to Ch 84.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
79.00	**84.00**	1.40	0.20

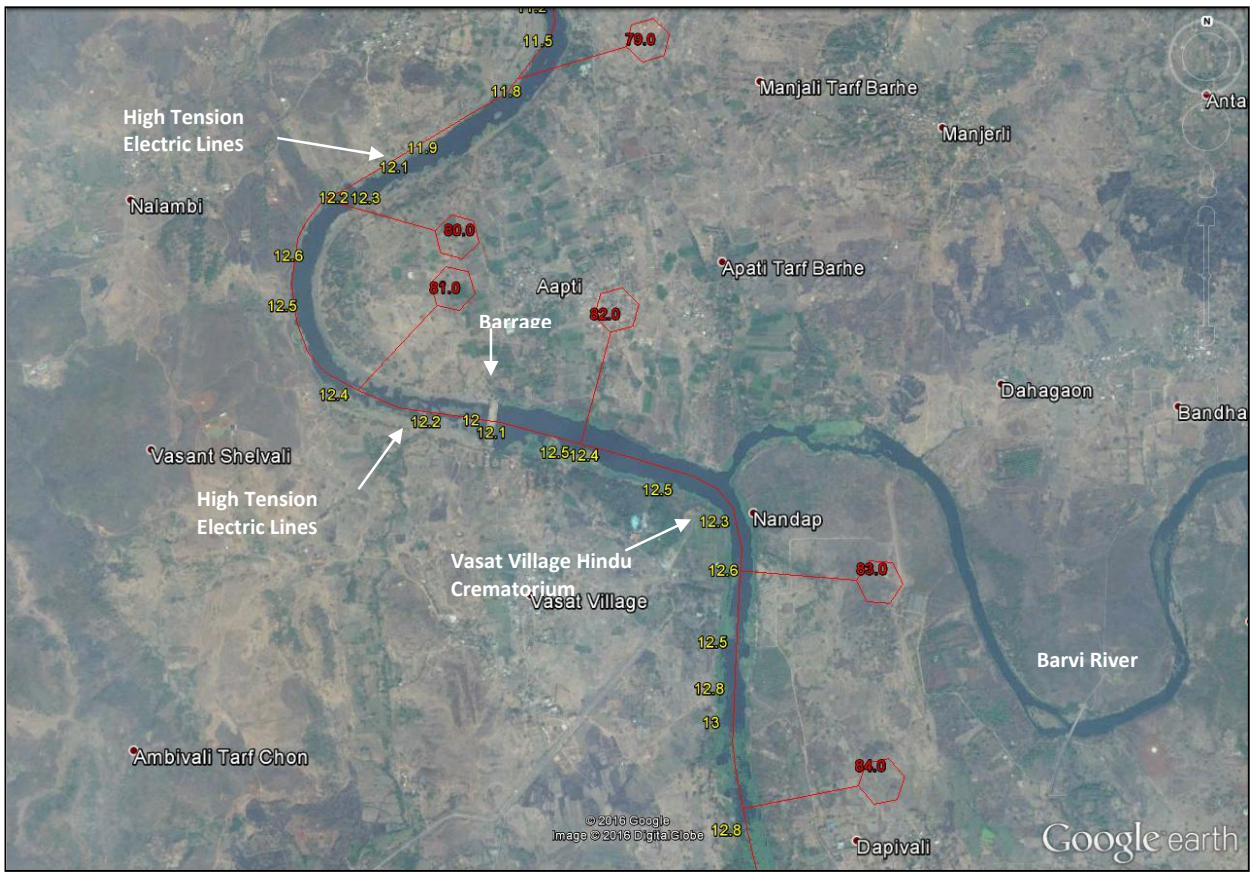


Figure 3.22: Route Chart of the Survey from Ch 79.00km to 84.00km

S. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 84.00km – 87.00km)

A Shiv Mandir is located on the east bank near Ch 84.60km. The Manjarligaon Bridge is located at Ch 86.89km. The minimum water depth recorded in this section is 0.20m at Ch 85.87km and the maximum water depth is 1.20m at Ch 85.57km as tabulated in **Table 3.21.** The route chart has been displayed in **Figure 3.23**.

Table 3.21: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 84.00km to Ch 87.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
84.00	87.00	1.20	0.20

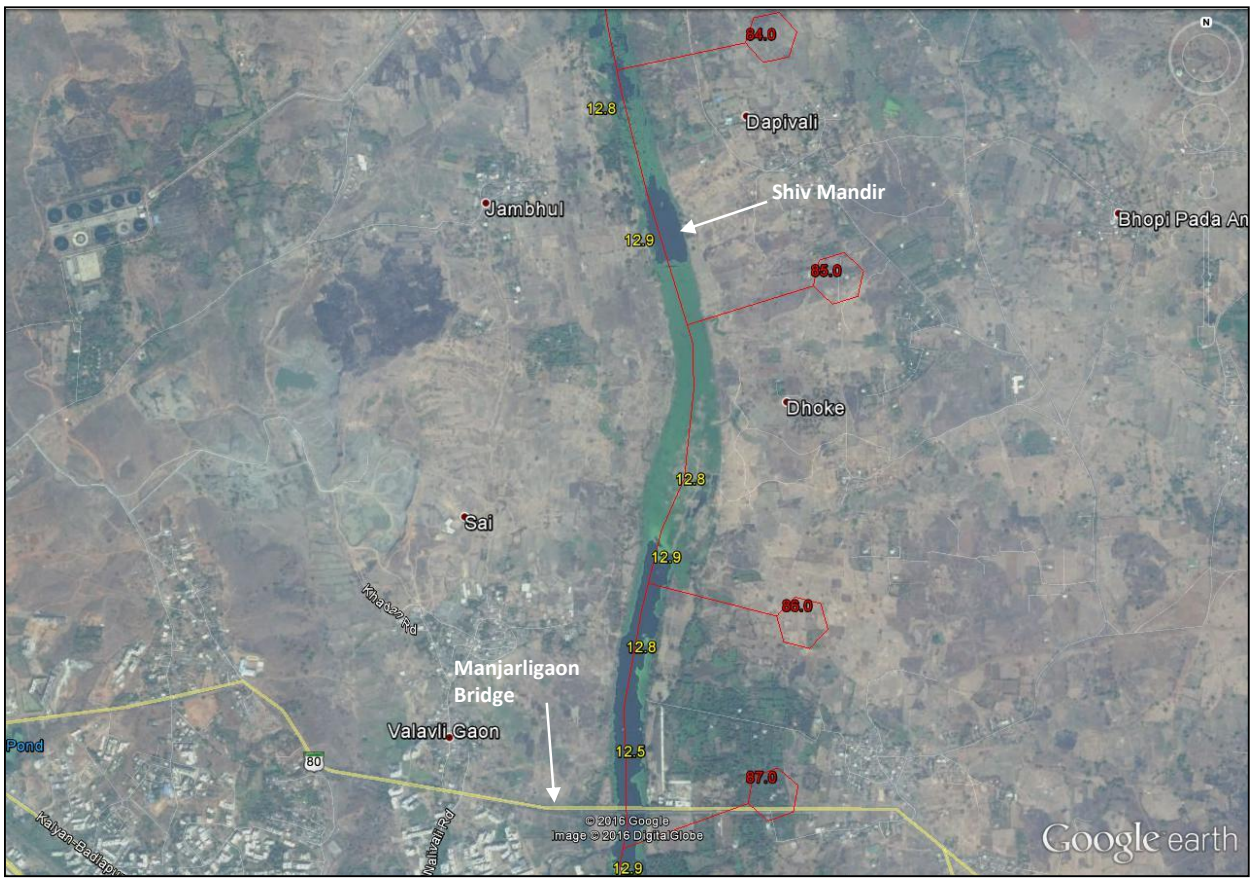


Figure 3.23: Route Chart of the Survey from Ch 84.00km to 87.00km

T. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 87.00km – 90.00km)

There are two bridges, a low clearance foot bridge at Badlapur at Ch 88.95km and the Badlapur Road Bridge at Ch 89.07km, which go across the river in this section. The minimum water depth recorded in this section is 0.30m at Ch 87.67km and the maximum water depth is 1.40m at Ch 89.07km as tabulated in **Table 3.22.** The route chart has been displayed in **Figure 3.24**.

Table 3.22: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 87.00km to Ch 90.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
87.00	**90.00**	1.40	0.30

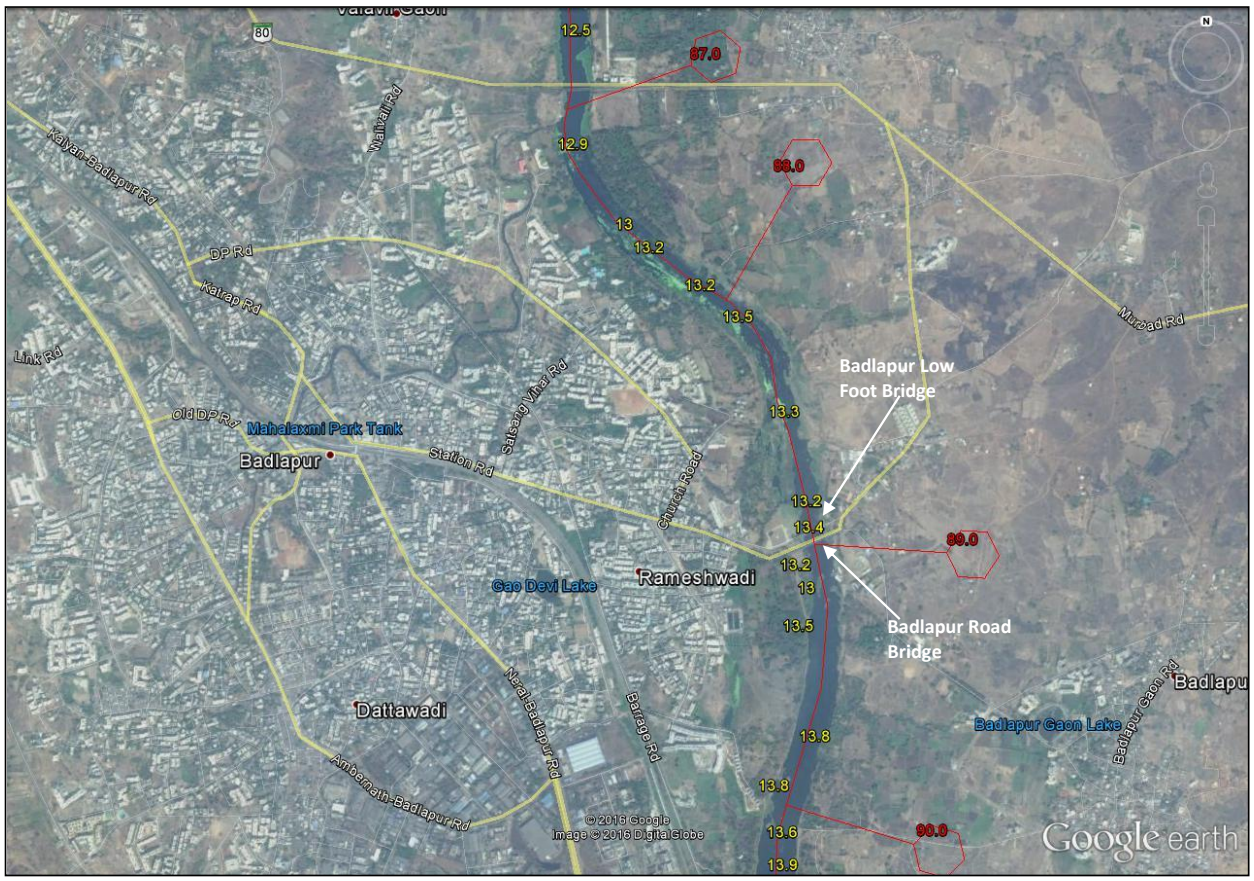


Figure 3.24: Route Chart of the Survey from Ch 87.00km to 90.00km

U. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 90.00km – 94.00km)

There is a Barrage across the river at Ch 90.37km while there are pillars of old broken bridge near Ch 90.82km. A water treatment plant is on the east bank near the broken bridge. The minimum water depth recorded in this section is 0.20m at Ch 93.51km and the maximum water depth is 1.20m at Ch 90.10km as tabulated in **Table 3.23.** The route chart has been displayed in **Figure 3.25**.

Table 3.23: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 90.00km to Ch 94.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
90.00	**94.00**	1.20	0.20

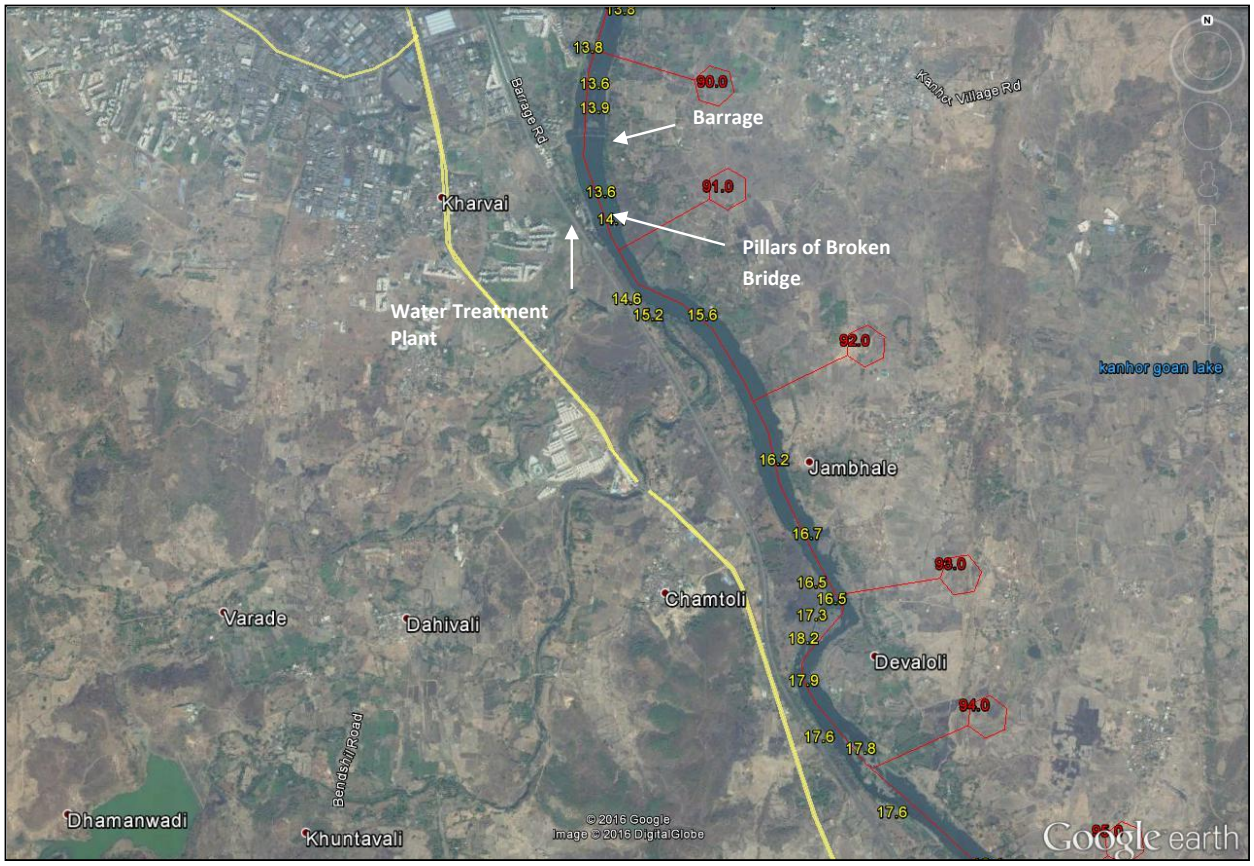


Figure 3.25: Route Chart of the Survey from Ch 90.00km to 94.00km

V. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 94.00km – 100.00km)

There is a bridge being constructed across the river near Ch 97.93km The minimum water depth recorded in this section is 0.20m at Ch 99.56km and the maximum water depth is 1.20m at Ch 95.36km and Ch 96.74km as tabulated in **Table 3.24.** The route chart has been displayed in **Figure 3.26**.

Table 3.24: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 94.00km to Ch 100.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
94.00	**100.00**	1.20	0.20

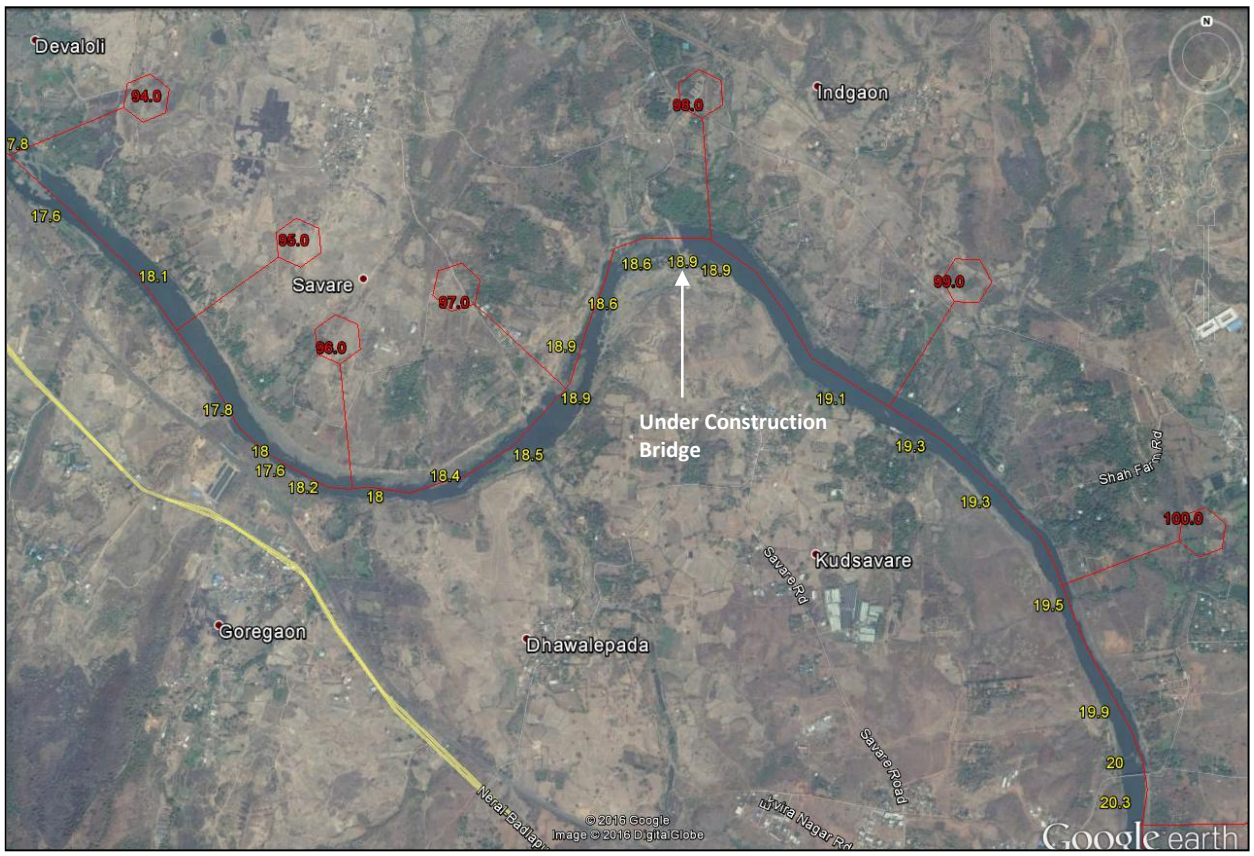


Figure 3.26: Route Chart of the Survey from Ch 94.00km to 100.00km

W. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 100.00km – 104.00km)

The Pashan Road Bridge goes across at Ch 100.94km. The minimum water depth recorded in this section is 0.10m at Ch 100.75km and Ch 103.33km and the maximum water depth is 1.20m at Ch 101.13km as tabulated in **Table 3.25.** The route chart has been displayed in **Figure 3.27**.

Table 3.25: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 100.00km to Ch 104.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
100.00	**104.00**	1.20	0.10

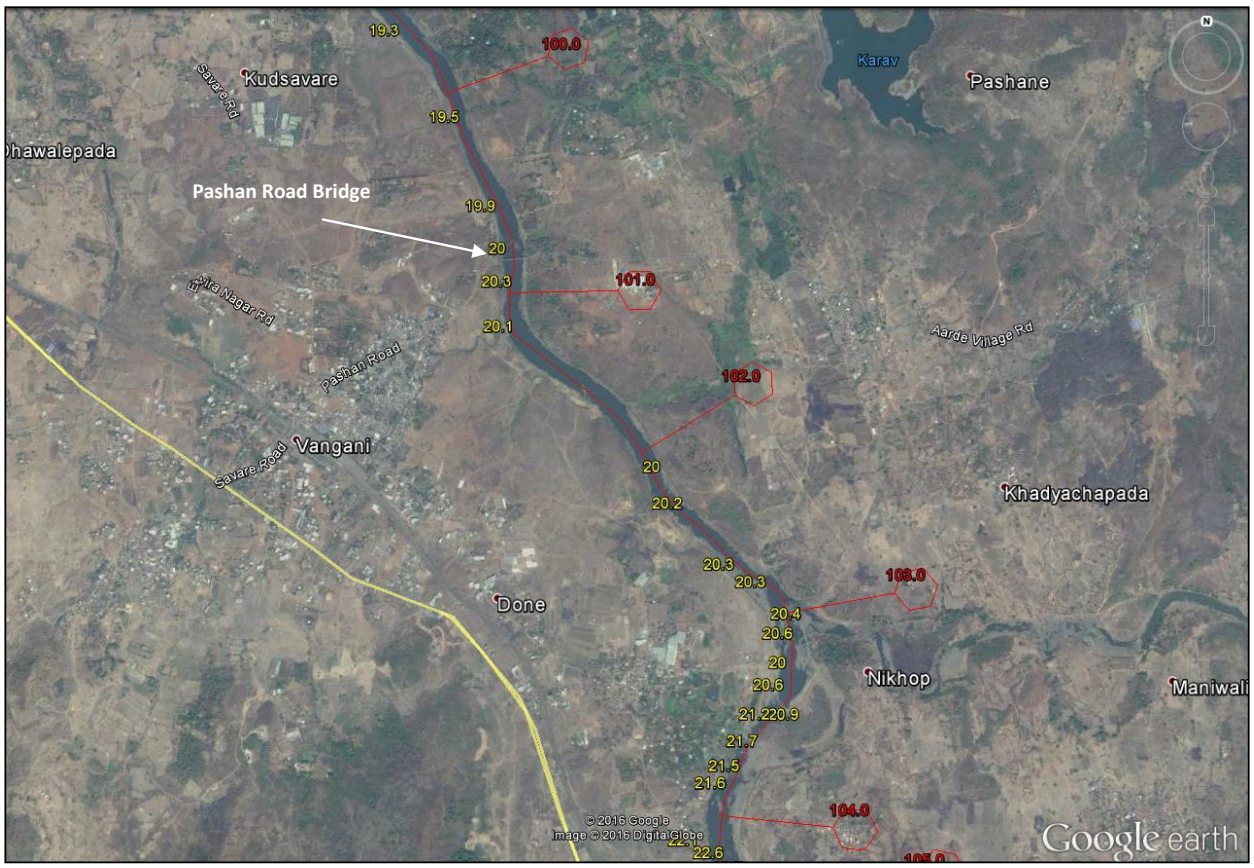


Figure 3.27: Route Chart of the Survey from Ch 100.00km to 104.00km

X. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 104.00km – 107.00km)

A small bridge is under construction across the river near Ch 105.19km. There are few boulders arranged across the river near Ch 106.50km as well as a high tension electric line above the river. The minimum depth recorded in this section is 0.00m at Ch 110.76km, Ch 111.07km and Ch 111.20km and maximum depth is 1.20m at Ch 107.62km as tabulated in **Table 3.26.** The route chart has been displayed in **Figure 3.28**.

Table 3.26: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 104.00km to Ch 107.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
104.00	**107.00**	1.20	0.00

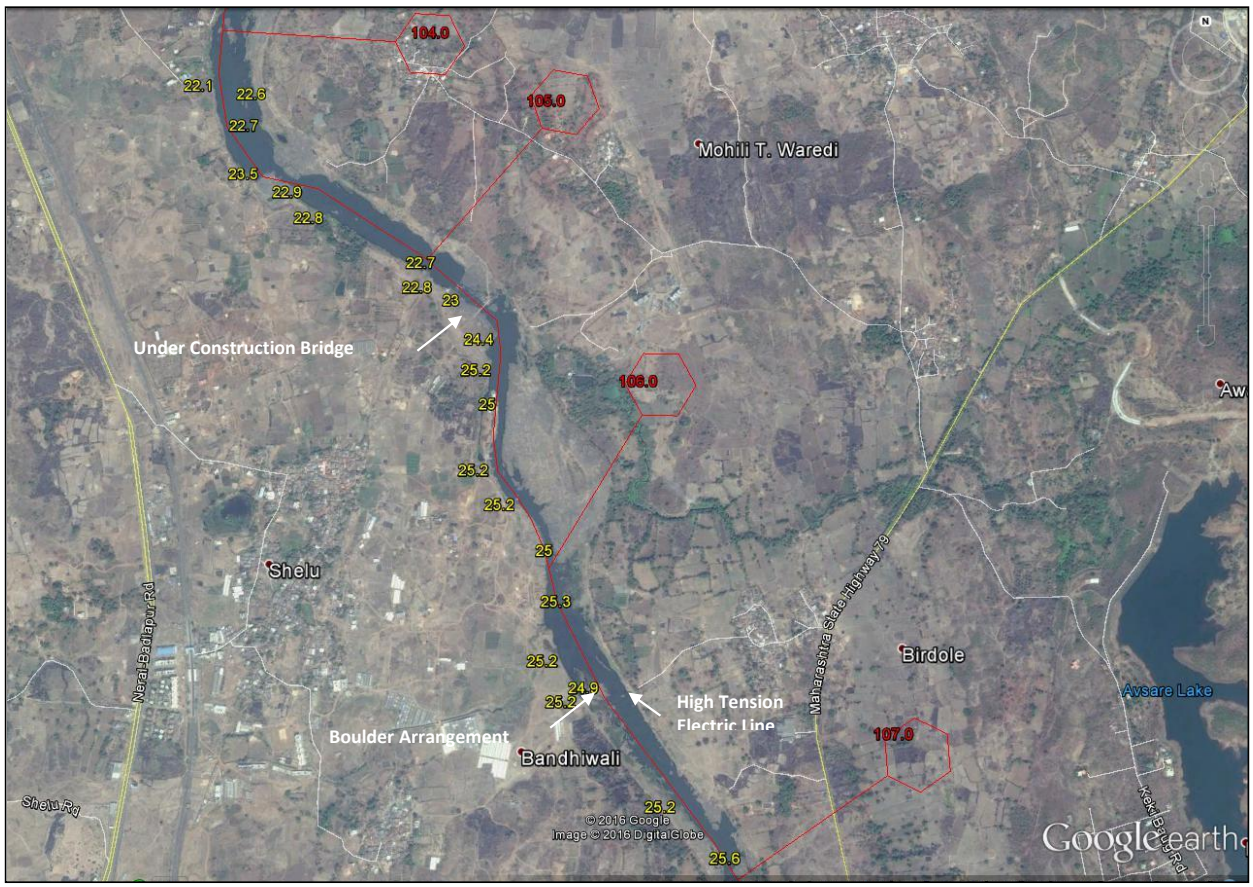


Figure 3.28: Route Chart of the Survey from Ch 104.00km to 107.00km

Y. Kalyan-Thane-Mumbai waterway via Ulhas River(Ch 107.00km – 111.20km)

There are many shallow rocky patches in this section. The proposed waterway route ends near the Malegaon Bridge at Lat. 19° 02′ 38.20″ N, Long. 73° 19′ 53.79″ E. The survey route ends at this point. The minimum depth recorded in this section is 0.00m at Ch 110.76km, Ch 111.07km and Ch 111.20km and maximum depth is 1.20m at Ch 107.62km as tabulated in **Table 3.27.** The route chart has been displayed in **Figure 3.29**.

Table 3.27: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 107.00km to Ch 111.20km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
107.00	**111.20**	1.20	0.00

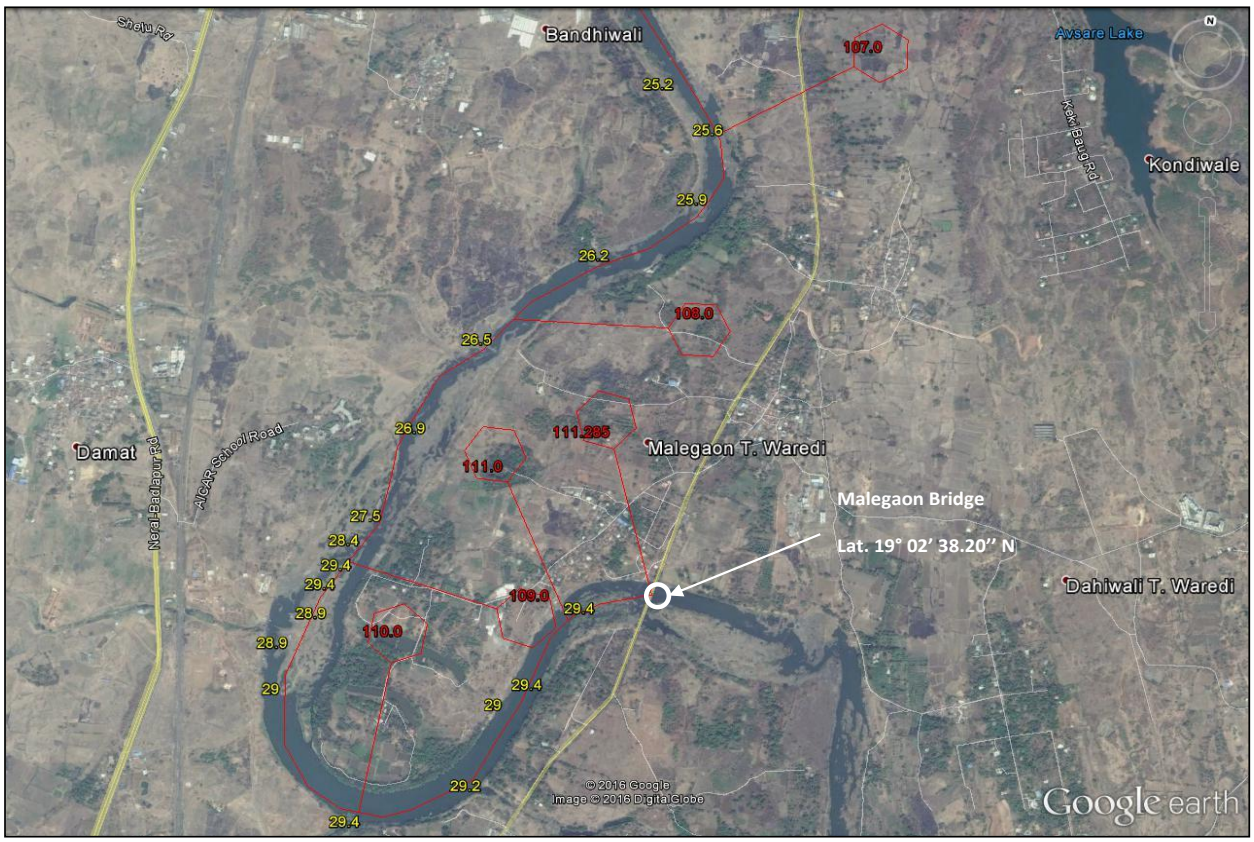


Figure 3.29: Route Chart of the Survey from Ch 107.00km to 111.20km

The maximum and minimum depths with reference to the Chart Datum in the small intervals have been summarized in **Table 3.28** describing the length of stretch showing various ranges of water depth available.

Table 3.28: Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 0.00km to Ch 111.20km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-5	15.20	10.30	4.93	-	-	-
5-9	18.20	10.00	4.04	-	-	-
9-17	12.70	1.60	7.09	0.89	-	-
17-21	7.50	3.00	4.03	-	-	-
21-25	3.00	0.30	0.20	0.30	0.10	2.76
25-29	1.80	0.10	-	1.01	1.69	1.92
29-33	1.90	0.00	-	0.55	2.51	0.93
33-37	1.80	0.10	-	0.78	0.10	2.99
37-43	16.20	0.20	4.17	0.50	0.49	1.00
43-47	16.00	6.00	3.99	-	-	-
47-50	14.40	6.30	3.00	-	-	-
50-55	12.00	1.20	4.79	-	0.20	0.00

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
55-59	11.50	1.70	3.57	0.40	-	-
59-64	7.90	1.70	4.80	0.20	-	-
64-69	5.00	0.10	2.56	0.81	1.57	0.10
69-75	1.20	0.40	-	-	1.41	3.97
75-79	0.80	0.30	-	-	0.00	4.39
79-84	1.40	0.20	-	-	1.40	3.51
84-87	1.20	0.20	-	-	0.94	2.06
87-90	1.40	0.30	-	-	1.10	2.19
90-94	1.20	0.20	-	-	1.13	2.88
94-100	1.20	0.20	-	-	2.09	3.52
100-104	1.20	0.10	-	-	0.40	3.92
104-107	1.20	0.10	-	-	0.52	2.57
107-111.2	1.20	0.00	-	-	0.78	3.45
Total			**47.17**	**5.44**	**16.43**	**42.16**

The above data indicates that water depth of 2.0m and above is available up to 47.17km of the waterway under study. It may be noted that the above depths have been reckoned with CD. Since the entire study stretch of Kalyan-Thane-Mumbai waterway via Ulhas River is under tidal influence, the available effective depths would be more than 2.37m (average tide height) which will be advantageous for safe navigation. It confirms the availability of 2.0m and above water in 42.4% of river in the proposed stretch under study. The detailed hydrographic survey information indicating location, observed water depth at each point of data reading has been given in **Annexure 3.3a.**

3.2.4 Bathymetry and Site Data Collected for Waldhuni Creek

A. Waldhuni Creek (Ch 0.00km – 0.71km)

This Waldhuni creek branches away from the Ulhas River at a point north of Gauripada near Ch 75.00km and traverses south west wards. In this stretch no bathymetry survey was possible due to very shallow water and marshy creek bed. This kind of marshy terrain restricted the surveyor from setting his foot anywhere within the creek bed. Hence, topographic survey was undertaken from Ch 0.00km to the point at Ch 2.51km, to the extent possible, on the river banks. The minimum water depth recorded in this section is 0.20m at various chainages and the maximum water depth is 0.40m at different chainages at the confluence with the Ulhas River as tabulated in **Table 3.29.** The route chart has been displayed in **Figure 3.30**.

Table 3.29: Maximum – Minimum Depth in Waldhuni Creek from Ch 0.00km to Ch 0.71km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
0.00	**0.71**	0.40	0.20

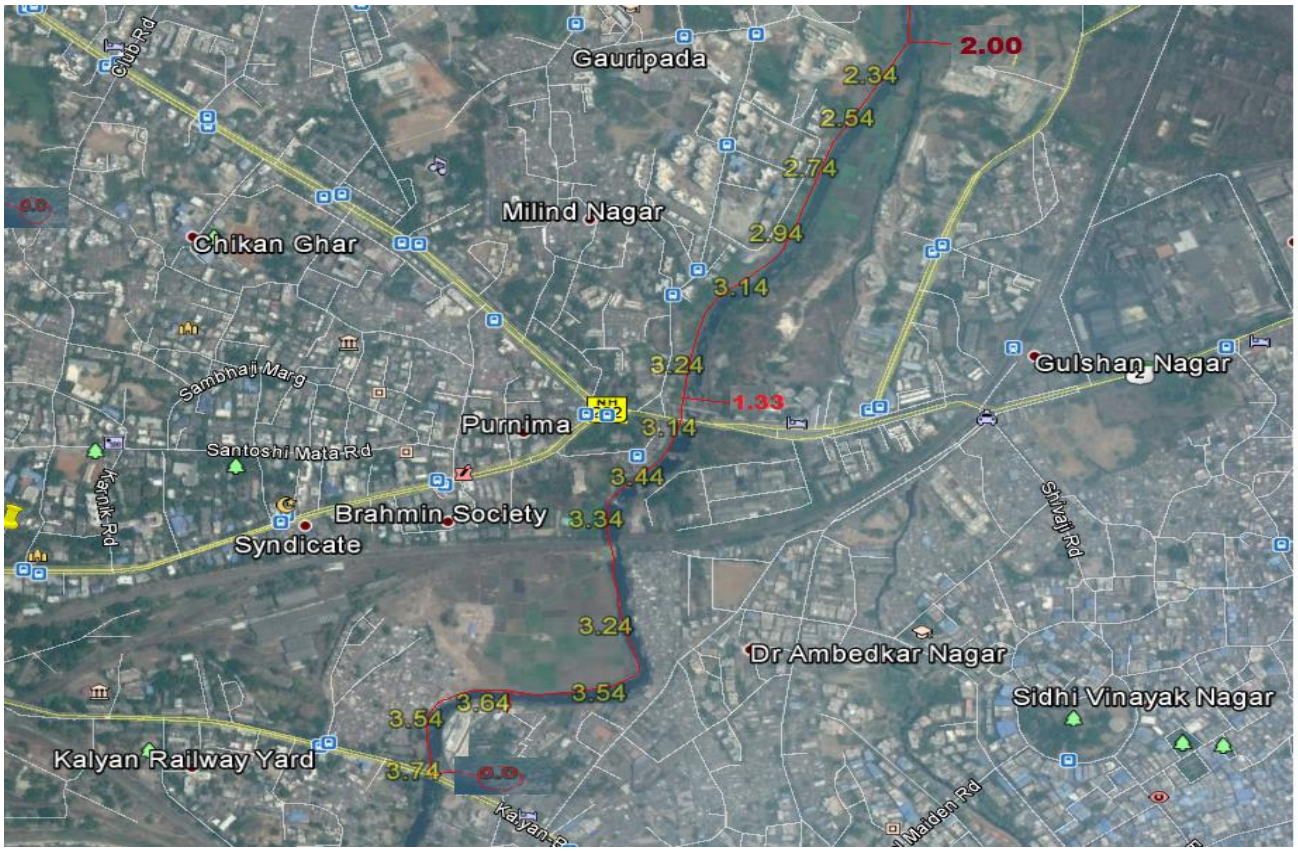


Figure 3.30: Route Chart of the Survey from Ch 0.00km to 0.71km

B. Waldhuni Creek (Ch 0.71km – 3.31km)

Beyond this point at Ch 0.80km from Gauripada, Salt pans and Agricultural fields have been noticed on both the sides of the creek in the stretch. Some settlements are seen at Gauripada at Ch 2.21km. A twin pipeline bridge crosses the river at Ch 2.98km. The minimum water depth recorded in this section is 0.30m at various chainage and the maximum water depth is 2.70m at different chainages and tabulated in **Table 3.30.** The route chart has been displayed in **Figure 3.31**.

Table 3.30: Maximum – Minimum Depth in Waldhuni Creek from Ch 0.71km to Ch 3.31km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
0.71	**3.31**	2.70	0.30

Figure 3.31: Route Chart of the Survey from Ch 0.71km to 3.31km

The maximum and minimum depths with reference to the Chart Datum in the small intervals have been summarized in **Table 3.31** describing the length of stretch showing various ranges of water depth available.

Table 3.31: Maximum – Minimum Depth in Waldhuni Creek from Ch 0.00km to Ch 3.33km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-0.71	0.40	0.20	-	-	-	0.71
0.71-3.31	2.70	0.20	0.16	-	1.17	1.27
Total			**0.16**	**0.00**	**1.17**	**1.98**

The above data indicates that water depth of 2.0m and above is available in 0.16km of the waterway under study. It may be noted that the above depths have been reckoned with CD. Since the entire study stretch of

Waldhuni Creek is under tidal influence, the available effective depths would be more than 2.37m (average tide height) which will be advantageous for safe navigation. It confirms the availability of 2.0m and above water in 4.83% of river in the proposed stretch under study. The detailed hydrographic survey information indicating location, observed water depth at each point of data reading has been given in **Annexure 3.3b.**

3.2.5 Bathymetry and Site Data Collected for Vasai Creek

A. Vasai Creek (Ch 0.00km – 4.00km)

Vasai Creek starts from the Arabian Sea (Lat. 19°18'53.50" N Long. 72°47'30.18" E), with Vasai Beach in the north and Uttan-Pali Jetty on the south bank (left), where there is a shallow delta formed near the mouth of the river. Dense mangroves are observed on South side of the river. Various jetties are seen on the North-bank of the Vasai Creek, behind which there are settlements observed along the banks. Sand bars are seen in the center of the creek at the point it meets the sea. Panju island old Rly. Bridge is present at Ch 3.38km and Panju Island New Rly Bridge is present at Ch 3.40km. The minimum water depth recorded in this stretch is 0.70m at Ch 4.00km and the maximum water depth is 16.50m at Ch 0.30km as tabulated in **Table 3.32.** The route chart has been displayed in **Figure 3.32**.

Table 3.32: Maximum – Minimum Depth in Vasai Creek from Ch 0.00km to Ch 4.00km

Maximum –Minimum Depth			
Chainage (km)		**Reduced Water Depth (m) w. r. t. Chart Datum**	
From	**To**	**Max**	**Min**
0.00	**4.00**	16.50	0.70

Figure 3.32: Route Chart of the Survey from Ch 0.00km to 4.00km

B. Vasai Creek (Ch 4.00km – 8.00km)

Settlements are seen on the North bank (right) of the river with the Vasai Jetty, Khochiwade Jetty and Naigaon jetties. Dense mangroves are observed along South bank (left) of the river. At Ch 6.10km, a rail bridge crosses the river joining Bhayandar to Naigaon (on the north bank, right). Panju Island is located in the middle of the creek, extending from Ch 5.00km to Ch 9.00km connected through a ferry route between Naigaon and Panju Island. A road and rail bridge are crossing the creek from Mira Bhayandar to Naigaon West. The minimum depth recorded in this section is 1.00m at Ch 5.10km and the maximum water depth is 6.20m at Ch 7.20km as tabulated in **Table 3.33.** The route chart has been displayed in **Figure 3.33**.

Table 3.33: Maximum – Minimum Depth in Vasai Creek from Ch 4.00km to Ch 8.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
4.00	**8.00**	6.20	1.00

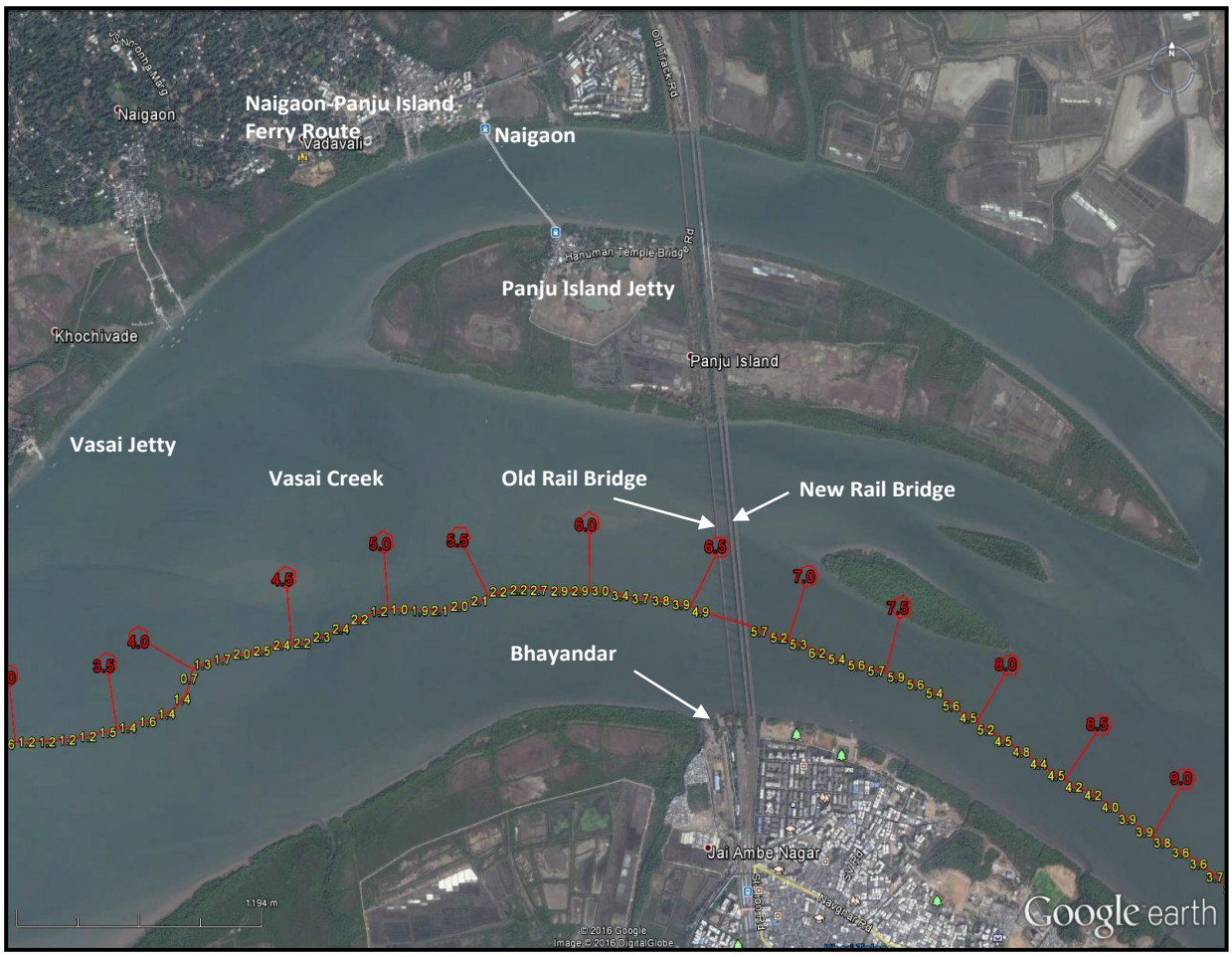


Figure 3.33: Route Chart of the Survey from Ch 4.00km to 8.00km

C. Vasai Creek (Ch 8.00km – 11.00km)

Dense mangroves are observed along both the banks of the Vasai Creek. One tributary can be seen towards the east bank at Ch 8.50km. Beyond the mangroves, the east bank has open fields while the West bank has settlements. High tension lines crosses the river with pair of pylons located in the middle of the river at Ch 10.31km and Ch 10.51km. The minimum water depth recorded in this stretch is 3.60m at Ch 9.20km and the maximum water depth is 7.20m at Ch 11.00km as tabulated in **Table 3.34.** The route chart has been displayed in **Figure 3.34**.

Table 3.34: Maximum – Minimum Depth in Vasai Creek from Ch 8.00km to Ch 11.00km

Maximum –Minimum Depth			
Chainage (km)		**Reduced Water Depth (m) w. r. t. Chart Datum**	
From	**To**	**Max**	**Min**
8.00	**11.00**	7.20	3.60

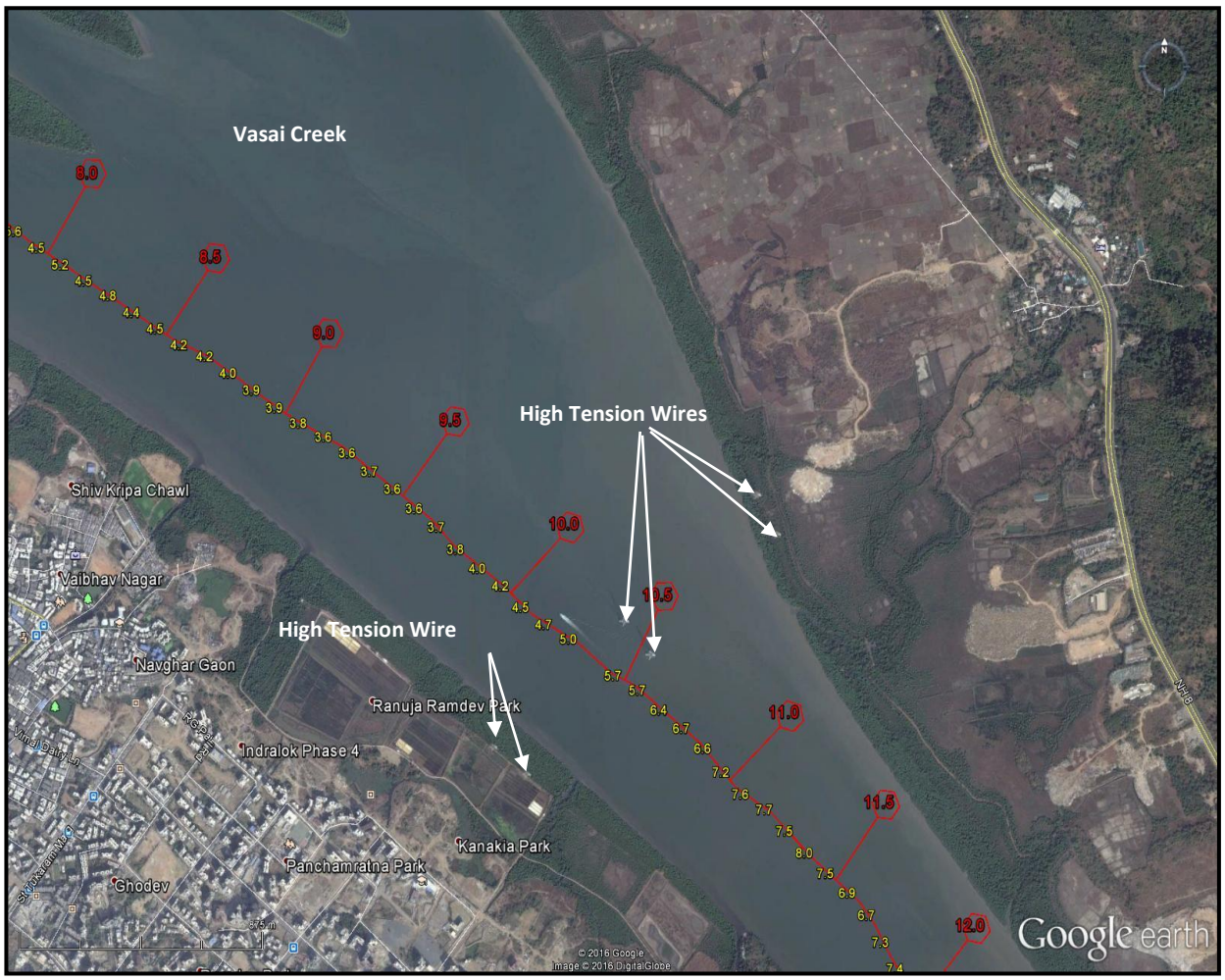


Figure 3.34: Route Chart of the Survey from Ch 8.00km to 11.00km

D. Vasai Creek (Ch 11.00km – 15.00km)

Mangroves have been observed along the North bank (right) of the Vasai Creek beyond which there are open fields. One tributary can be seen on the west bank at Ch 11.50km. The Sasunavghar Jetty is on the north bank (right) near Ch 13.20km and few boats are seen docked at Reti Bunder on the south bank (left) from Ch 11.90km to Ch 13.40km. Two GodhBunder Road bridges cross the river at Ch 13.51km. High Tension line has been observed crossing the river at Ch 14.20km. The minimum water depth recorded in this section is 5.70m at Ch 12.40km and the maximum water depth is 36.70m at Ch 14.60km as tabulated in **Table 3.35.** The route chart has been displayed in **Figure 3.35**.

Table 3.35: Maximum – Minimum Depth in Vasai Creek from Ch 11.00km to Ch 15.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
11.00	**15.00**	36.70	5.70

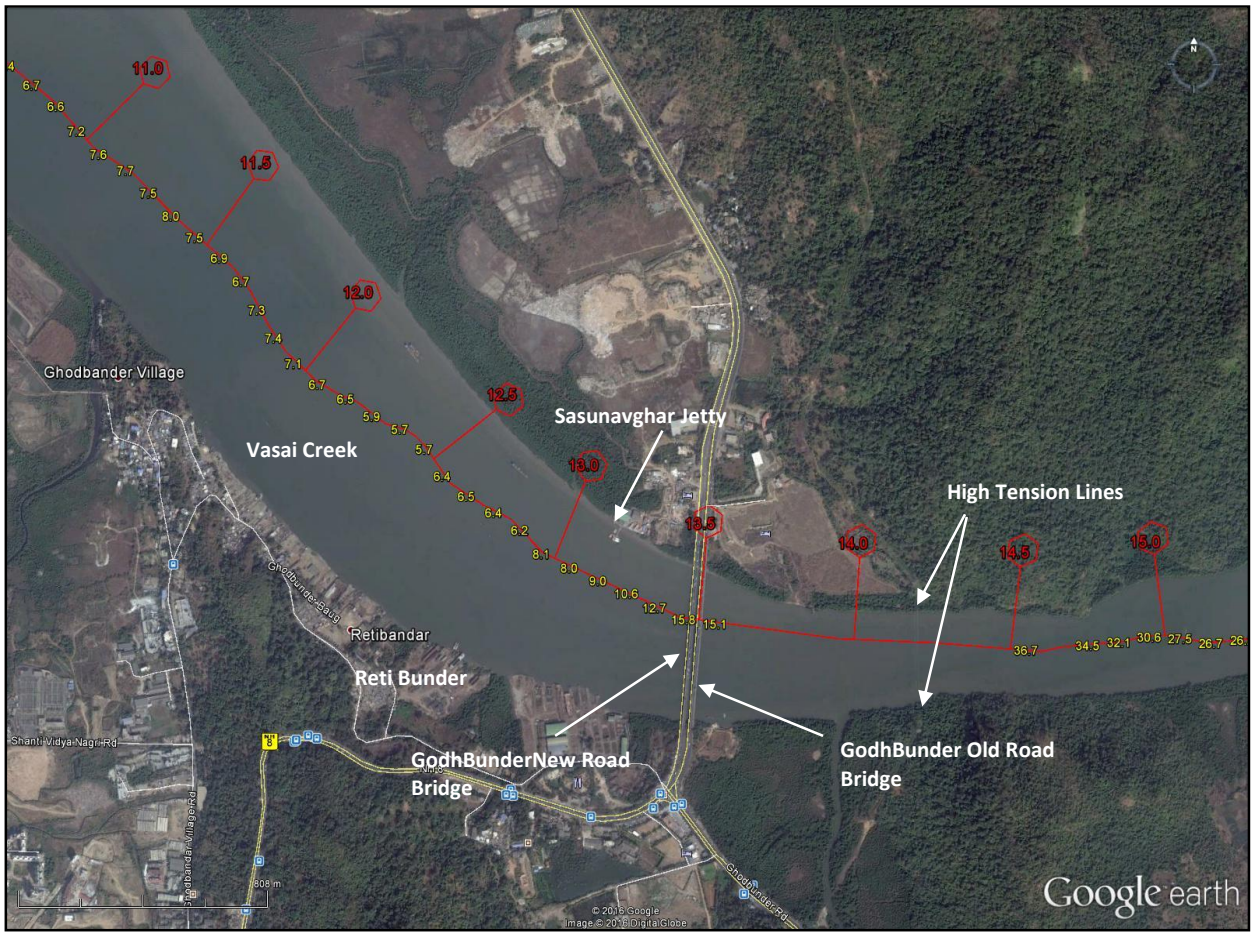


Figure 3.35: Route Chart of the Survey from Ch 11.00km to 15.00km

E. Vasai Creek (Ch 15.00km – 19.50km)

Mangroves were observed along the banks of the river. Some settlements are seen on the South bank (left) from Ch 16.50km to Ch 18.50km with small boats docked along the bank from Gaimukh Bunder to Nagla Fishing Bunder. The Nagla Ferry Jetty is on the north bank (right) at Ch 18.80km. The minimum water depth recorded in this stretch is 4.60m at Ch 19.40km and the maximum water depth is 39.40m at Ch 16.50km as tabulated in **Table 3.36.** The route chart has been displayed in **Figure 3.36**.

Table 3.36: Maximum – Minimum Depth in Vasai Creek from Ch 15.00km to Ch 19.50km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
15.00	**19.50**	39.40	4.60

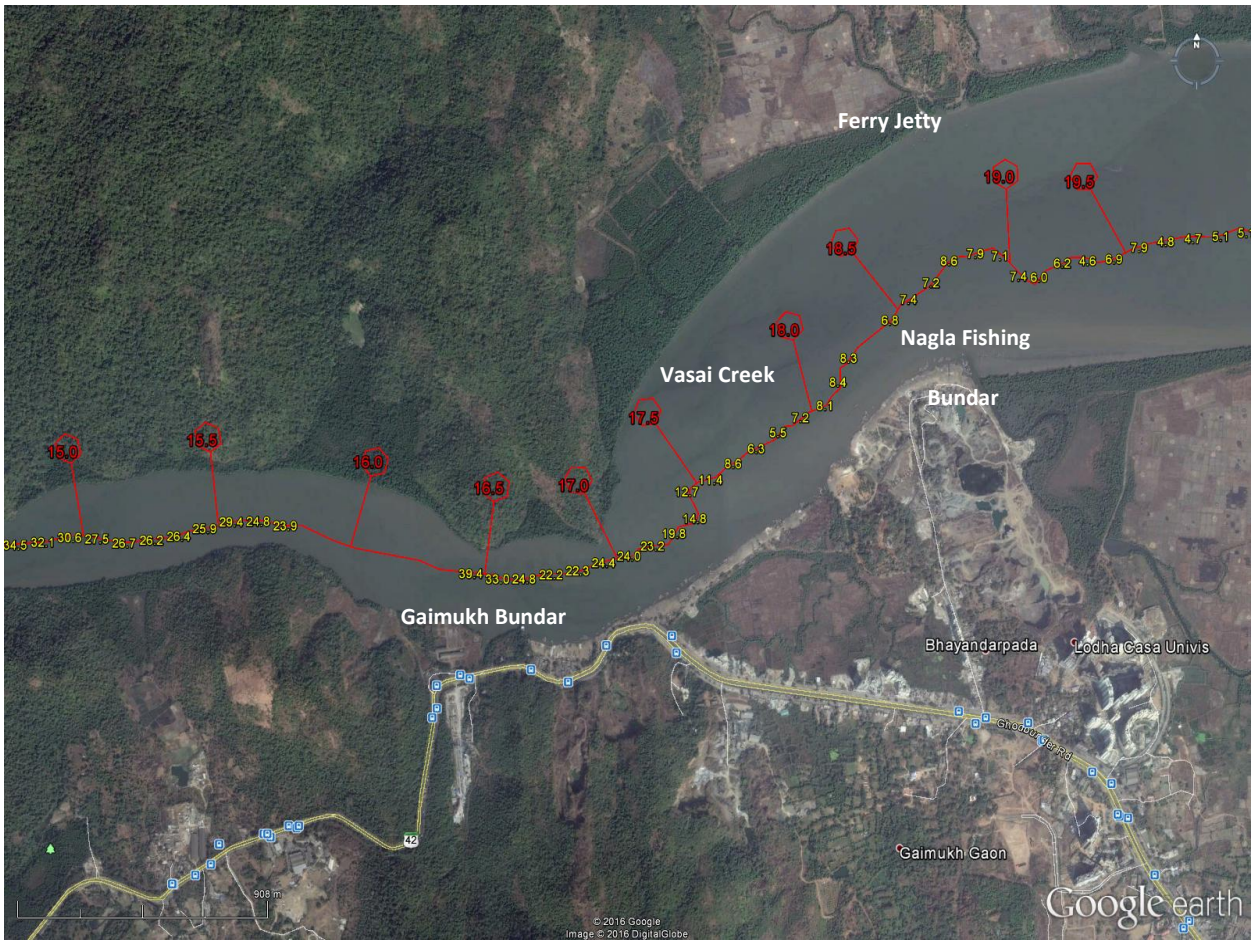


Figure 3.36: Route Chart of the Survey from Ch 15.00km to 19.50km

F. Vasai Creek (Ch 19.50km – 24.50km)

Mangroves were observed along the banks of the river. Beyond the mangroves, open fields have been observed. A High tension line crosses the river at Ch 22.06km with the Vat Bunder Jetty on the north bank (right). A tributary meets the river at Ch 24.30km on the East bank. The minimum water depth recorded in this stretch is 4.60m at Ch 20.5km and the maximum water depth is 12.6m at Ch 21.90km as tabulated in **Table 3.37.** The route chart has been displayed in **Figure 3.37**.

Table 3.37: Maximum – Minimum Depth in Vasai Creek from Ch 19.50km to Ch 24.50km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
19.50	**24.50**	12.6	4.60

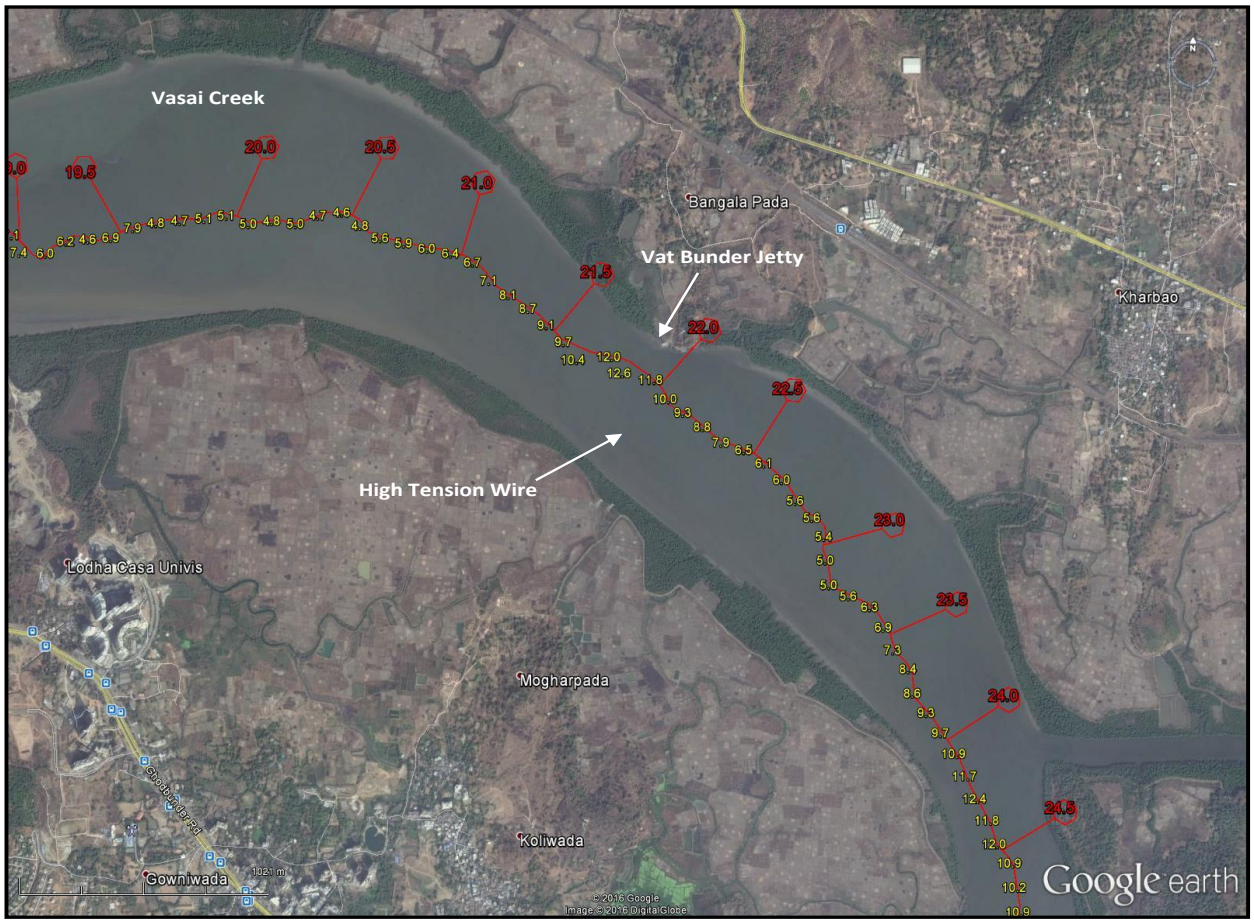


Figure 3.37: Route Chart of the Survey from Ch 19.50km to 24.50km

G. Vasai Creek (Ch 24.50km – 29.00km)

Mangroves were observed along the banks of the river. Waghbil Ghat Jetty is on the west bank at Ch 25.10km. An island splits the river between Ch 26.00km and Ch 27.00km. The Kolshet to Kalher Ferry line operates between the East bank and West bank at Ch 28.3km. The minimum depth recorded in this stretch is 5.8m at Ch 27.10km and the maximum depth is 15.3m at Ch 25.70km as tabulated in **Table 3.38.** The route chart has been displayed in **Figure 3.38**.

Table 3.38: Maximum – Minimum Depth in Vasai Creek from Ch 24.50km to Ch 29.00km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
24.50	29.00	15.3	5.8

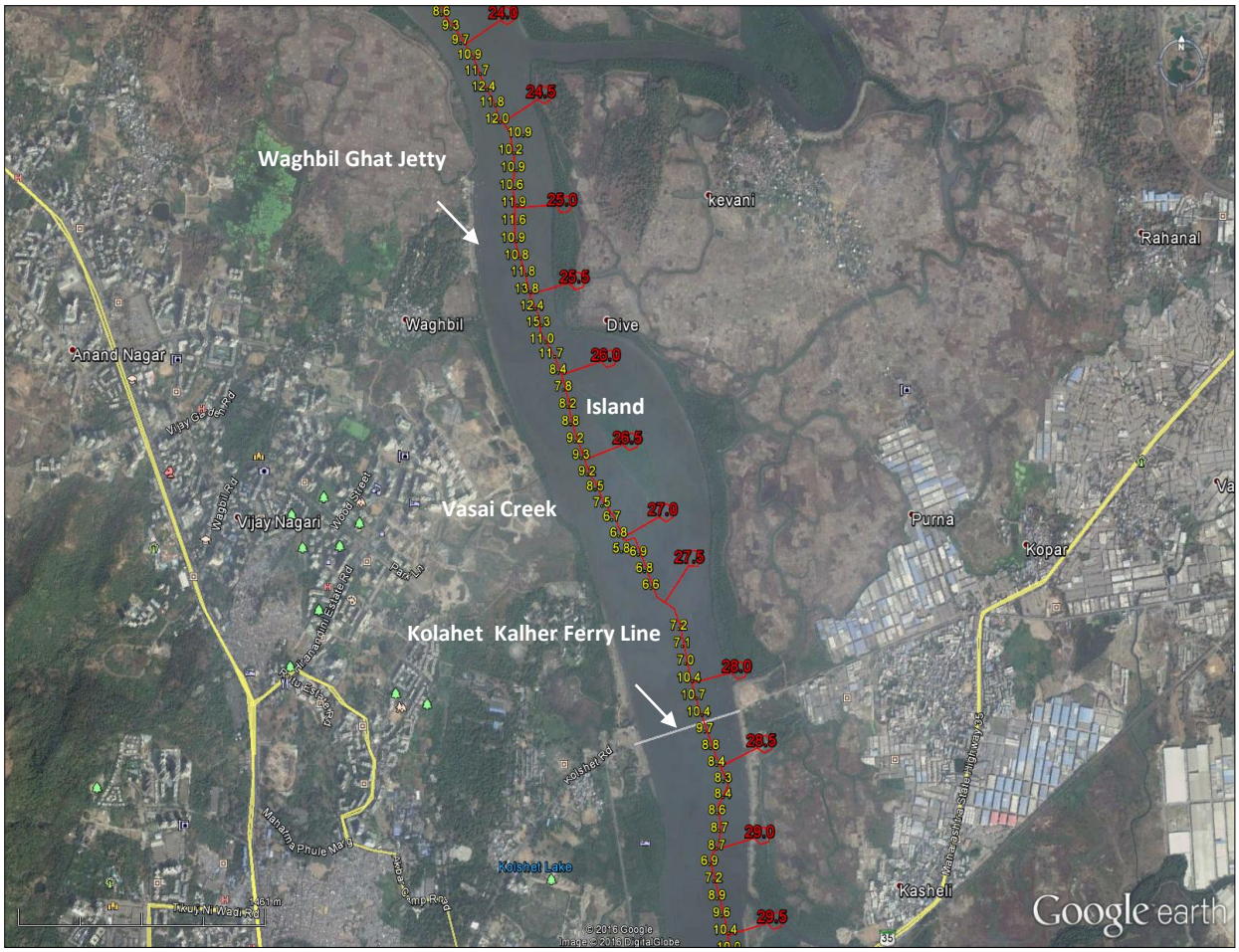


Figure 3.38: Route Chart of the Survey from Ch 24.50km to 29.00km

H. Vasai Creek (Ch 29.00km – 31.163km)

Mangroves were observed along the banks of the river. One tributary is meeting the river at Ch 29.3km on the East Bank. The Kasheli Road Bridge crosses the river at Ch 29.97km. A High tension line crosses the river at Ch 30.52km. The Vasai Creek ends at Ch 31.16km (Lat 19° 13′ 22.84″ N, Lon 73° 00′ 21.44″ E). From here on, the waterway is known as Thane-Kalyan Ulhas River. The minimum water depth below CD in this stretch is 5.80m at Ch 30.3km and the maximum water depth is 10.40m at Ch 29.50km as tabulated in **Table 3.39.** The route chart has been displayed in **Figure 3.39**.

Table 3.39: Maximum – Minimum Depth in Vasai Creek from Ch 29.00km to Ch 31.163km

Maximum –Minimum Depth			
Chainage (km)		Reduced Water Depth (m) w. r. t. Chart Datum	
From	To	Max	Min
29.00	**31.163**	10.40	5.80

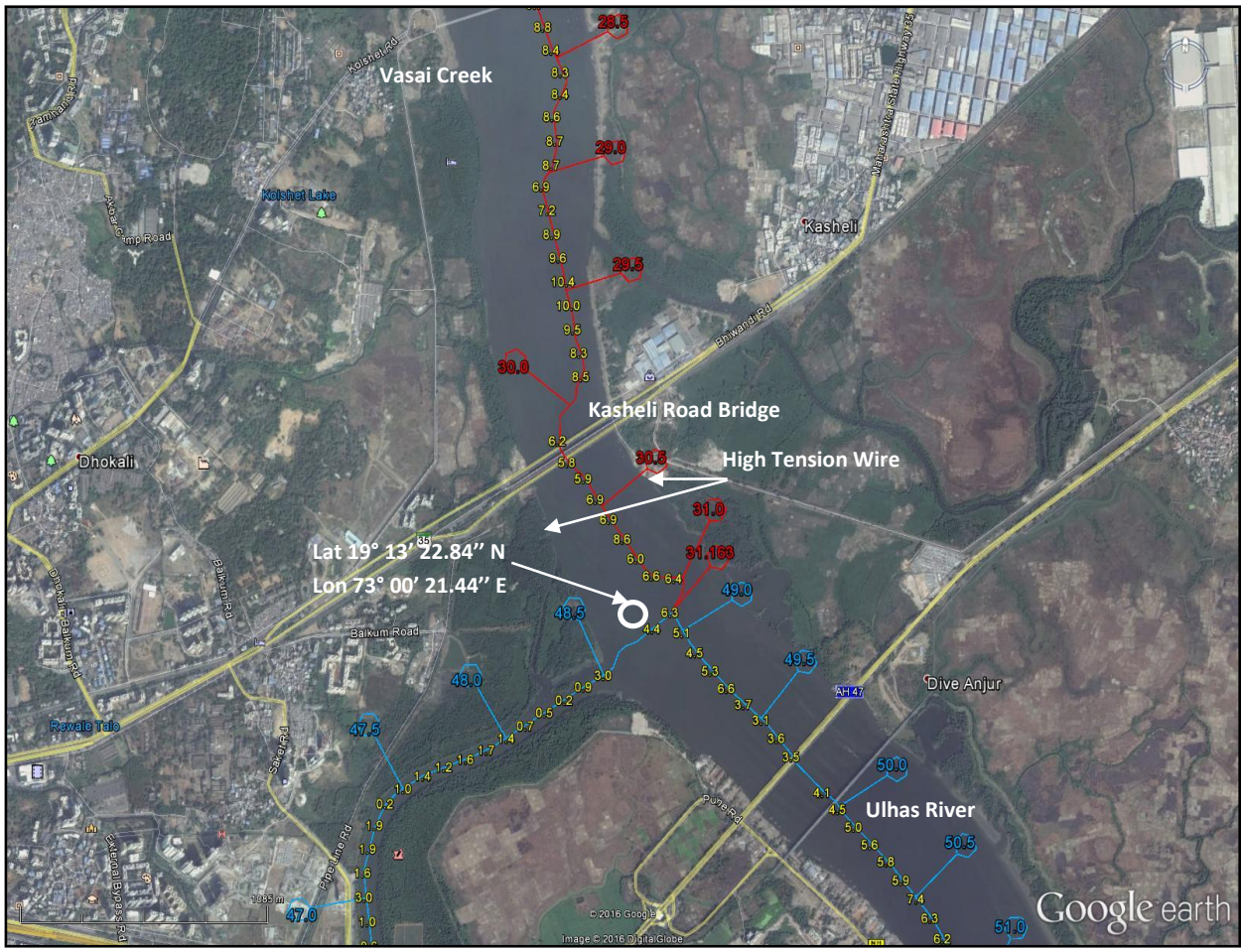


Figure 3.39: Route Chart of the Survey from Ch 29.00km to 31.163km

The maximum and minimum depths with reference to the Chart Datum in the small intervals have been summarized in **Table 3.40** describing the length of stretch showing various ranges of water depth available.

Table 3.40: Maximum – Minimum Depth in Vasai Creek from Ch 0.00km to Ch 31.163km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-4	16.50	0.70	2.80	0.30	0.70	0.20
4-8	6.20	1.00	3.30	0.20	0.30	0.20

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
8-11	7.20	3.60	3.00	-	-	-
11-15	36.70	5.70	4.00	-	-	-
15-19.5	39.40	4.60	4.50	-	-	-
19.5-24.5	12.60	4.60	5.00	-	-	-
24.5-29	15.30	5.80	4.50	-	-	-
29-31.163	10.40	5.80	2.16	-	-	-
Total			**29.26**	**0.50**	**1.00**	**0.40**

The above data indicates that water depth of 2.0m and above is available up to 29.26km of the waterway under study. It may be noted that the above depths have been reckoned with CD. Since the entire study stretch of Vasai Creek is under tidal influence, the available effective depths would be more than 2.37m (average tide height) which will be advantageous for safe navigation. It confirms the availability of 2.0m and above water in 93.90% of river in the proposed stretch under study. The detailed hydrographic survey information indicating location, observed water depth at each point of data reading has been given in **Annexure 3.3c.**

3.2.6 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 3.41**, **Table 3.42**, and **Table 3.43.**

Table 3.41: Soil Texture in Kalyan-Thane-Mumbai waterway via Ulhas Riverat 10.0km Interval

Chainage (Km)	Latitude	Longitude	Depth (m)	Soil Texture
0.00	18°55'51.472"N	72°53'28.156"E	10.30	silty sandy clay
10.00	18°56'15.263"N	72°56'05.721"E	2.58	silty sandy clay
20.00	19°00'41.828"N	72°58'11.307"E	4.40	silty sandy clay
30.00	19°05'10.674"N	72°58'14.606"E	1.05	silty sandy clay
40.00	19°09'37.916"N	72°58'52.473"E	3.20	silty sandy clay
50.00	19°12'57.228"N	73°00'52.899"E	7.20	silty sandy clay
60.00	19°14'11.980"N	73°04'23.022"E	3.00	silty sandy clay
66.90	19°15'15.441"N	73°06'43.801"E	2.70	silty sandy clay

Table 3.42: Soil Texture in Waldhuni Creek at 10.0km Interval

Chainage (Km)	Latitude	Longitude	Depth (m)	Soil Texture
0.00	19°14'07.40"N	73°08'49.12"E	4.49	silty sandy clay
3.31	19°15'32.20"N	73°09'27.57"E	0.2	silty sandy clay

Table 3.43: Soil Texture in Vasai Creek at 10.0km Interval

Chainage (Km)	Latitude	Longitude	Depth (m)	Soil Texture
0.10	19°18'42.826"N	72°47'30.009"E	13.40	Sand with shell fragments

Chainage (Km)	Latitude	Longitude	Depth (m)	Soil Texture
10.00	19°18'31.471"N	72°52'44.041"E	8.10	Sand with shell fragments
20.00	19°17'55.982"N	72°57'34.509"E	8.40	Sand with shell fragments
31.20	19°13'23.215"N	73°00'27.668"E	8.00	silty clay

From the above table it is observed that silty sandy clayey soil is present in most parts of the Kalyan-Thane-Mumbai waterway via Ulhas River and Waldhuni Creek under study stretch whereas Sand with shell fragments is present in most part of Vasai Creek under study stretch.

3.3 Classification of Waterways

The 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 2000tonne Dead Weight Tonnage (DWT) and tug-barge formation in push-tug units of carrying capacity up to 8000tonne (Ref: IWAI, Gazette Notification 2006). The classification criteria of waterways are mentioned in **Table 3.44** for Rivers and in **Table 3.45** for canals.

Table 3.44: 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 3.45: 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
V	-	-	-	-	-
VI	3.5	60	900	10	60
VII	-	-	-	-	-

The vessel sizes for self propelled or tug and barge combination for different classes of waterways is described in **Table 3.46**.

Table 3.46: 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 Kalyan-Thane-Mumbai Waterway via Ulhas River, Waldhuni Creek and Vasai Creek falls into. Furthermore, it is to be determined whether the entire 145km 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

The details of High Tension lines, Bridges, and Barrages crossing the Kalyan-Thane-Mumbai Waterway via Ulhas River, Waldhuni Creek and Vasai River are given below from **Table 3.47** to **Table 3.51.**

Table 3.47: Details of High Tension Lines across Kalyan-Thane-Mumbai Waterway via Ulhas River

Sl. No.	Cross-Structure Name	Chainage (km)	Location	Position (Above vessel track)		Vertical Clearance above MHWS (m)
				Latitude	Longitude	
1	HT Line	19.83	Vashi	19°03'50.1" N	72°58'15.5" E	6.00
2	HT Line	31.93	Airoli	19°10'04.2" N	72°58'56.4" E	11.00
3	HT Line	33.77	Vitawa	19°11'02.7" N	72°59'03.6" E	15.00
4	HT Line	41.43	Kalwa	19°12'33.3" N	73°01'13.1" E	21.00
5	HT Line	42.40	Mumbra	19°12'05.9" N	73°01'29.0" E	21.00
6	HT Line	55.17	Bhoiwada	19°14'14.7" N	73°06'45.1" E	14.00
7	HT Line	57.89	Govana	19°15'30.6" N	73°06'28.3" E	14.00
8	HT Line	62.99	Bapgaon	19°16'48.0" N	73°07'58.8" E	9.00
9	HT Line	66.35	Kalyan	19°15'49.9" N	73°09'20.7" E	9.00
10	HT Line	69.82	Ambivali	19°15'20.5" N	73°10'50.9" E	9.00
11	HT Line	73.39	Pawshepeda	19°15'39.5" N	73°12'04.7" E	16.00
12	HT Line	78.24	Raita	19°14'18.7" N	73°14'03.3" E	16.00
13	HT Line	78.75	Raita	19°14'06.3" N	73°14'10.9" E	11.00
14	HT Line	79.49	Raita	19°13'50.2" N	73°13'53.6" E	9.00
15	HT Line	81.51	Aapti	19°13'10.8" N	73°14'01.7" E	19.00
16	HT Line	100.82	Pashan Road	19°06'08.6" N	73°18'33.5" E	7.50
17	HT Line	106.46	Bandhiwali	19°03'42.7" N	73°19'45.2" E	8.00

Table 3.48: Details of Bridges across Kalyan-Thane-Mumbai Waterway via Ulhas River

Sl. No.	Name of Structure	Chainage (km)	Location	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
						Latitude	Longitude
1	Vashi Rail bridge	19.52	Vashi	100.00	9.00	19°03'40.5" N	72°58'10.6" E
2	Vashi Road bridge	19.52	Vashi	100.00	9.00	19°03'40.5" N	72°58'10.5 " E
3	Vashi road bridge	19.56	Vashi	100.00	9.00	19°03'42.0" N	72°58'10.1" E

Sl. No.	Name of Structure	Chainage (km)	Location	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
						Latitude	Longitude
4	Airoli road bridge	30.00	Airoli	50.00	4.20	19°09'02.3" N	72°58'48.3" E
5	Thane Rail bridge	34.34	Thane	37.00	7.00	19°11'19.0" N	72°59'07.0" E
6	Kalwa Old Road bridge	35.36	Kalwa	50.00	7.00	19°11'48.3" N	72°59'07.9" E
7	Kalwa New Road bridge	35.36	Kalwa	50.00	9.00	19°11'48.3" N	72°59'07.9" E
8	Kharegaon pipe line bridge	36.46	Kharegaon	15.00	9.00	19°12'15.0" N	72°59'31.5" E
9	Kalwa pipe line bridge	37.03	Kalwa	50.00	11.00	19°12'30.0" N	72°59'42.0" E
10	Thane - Kalwa Road bridge	37.10	Kalwa	40.00	12.00	19°12'32.5" N	72°59'42.6" E
11	Nasik Express way pipe line bridge	40.19	Kalwa	75.00	8.00	19°13'04.2" N	73°00'45.9" E
12	Bhiwandi - Dombivli rail bridge	50.70	Dombivli	40.00	11.00	19°14'18.1" N	73°04'28.3" E
13	Kongaon old road bridge	56.14	Kongaon	30.00	11.00	19°14'42.9" N	73°06'58.0" E
14	Kongaon new road bridge	56.20	Kongaon	50.00	10.00	19°14'45.0" N	73°06'58.3" E
15	Thakurgaon pipe line bridge	58.77	Thakurgaon	20.00	10.00	19°15'53.7" N	73°06'10.8" E
16	Kalyan Sape bridge	64.52	Kalyan	30.00	11.00	19°16'06.0" N	73°08'25.8" E
17	Mohane Pipeline Bridge	67.39	Mohane	20.00	15.00	19°15'27.8" N	73° 9'44.1" E
18	Mohane Pipeline Bridge	67.58	Mohane	20.00	15.00	19°15'23.42" N	73° 9'48.90" E
19	Mohane Road Bridge	67.63	Mohane	10.00	15.00	19°15'22.36" N	73° 9'50.26" E
20	Kalyan Rayate Bridge	75.77	Rayate	-	-	19°15'17.9" N	73°13'13.5" E
21	Manjarligaon bridge	86.89	Manjarligaon	-	7.00	19°10'46.5" N	73°14'44.3" E

Sl. No.	Name of Structure	Chainage (km)	Location	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
						Latitude	Longitude
22	Badlapur Foot Bridge	88.95	Badlapur	8.00	3.00	19°09'51.7" N	73°15'17.8" E
23	Badlapur Bridge	89.07	Badlapur	8.00	12.00	19°09'47.0" N	73°15'14.8" E
24	Broken Bridge	90.82	Badlapur	-	-	19°08'51.3" N	73°15'11.6" E
25	Under Construction Bridge	97.93	Kudsavare	-	U/C	19°07'15.3" N	73°17'32.5" E
26	Pashan Road Bridge	100.94	Vangani	10.00	13.00	19°06'05.2" N	73°18'32.4" E
27	Under Construction Bridge	105.19	Shelu	-	2.50	19°04'20.8" N	73°19'32.5" E
28	Malegaon Bridge	111.23	Malegaon	10.00	9.00	19°02'33.9" N	73°19'52.5" E

No Power cable is crossing the study stretch of Waldhuni Creek.

Table 3.49: Details of Bridges across Waldhuni Creek

Sl. No.	Name of Structure	Chainage (km)	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
					Latitude	Longitude
1	Kalyan Ambernath Bridge	0.40	10.00	6.00	19°14’06.4"N	73°08’49.1"E
2	Railway Bridge	1.00	8.00	3.00	19°14’24.2"N	73°09’02.5"E
3	Bhiwandi Murwad Road Bridge	1.33	8.00	4.00	19°14’34.3"N	73°09’06.3"E
4	Twin pipeline Bridge	2.94	20.00	5.00	19°15’24.6"N	73°09’23.4"E
5	Pipeline bridge towards Kalyan	3.16	20.00	8.00	19°15’30.9"N	73°09’26.9"E

Table 3.50: Details of High Tension Lines across Vasai Creek

Sl. No.	Cross-Structure Name	Chainage (km)	Location	Position (Above vessel track)		Vertical Clearance above MHWS (m)
				Latitude	Longitude	
1	HT Line	10.31	Mira Bhayandar	19°18'23.8" "N	72°52'53.2"E	14
2	HT Line	10.51	Mira Bhayandar	19°18'21.5"N	72°52'59.5"E	14

Sl. No.	Cross-Structure Name	Chainage (km)	Location	Position (Above vessel track)		Vertical Clearance above MHWS (m)
				Latitude	Longitude	
3	HT Line	13.51	Ghodbundar	19°17'23.9"N	72°54'19.3"E	10
4	HT Line	22.06	-	19°17'32.1"N	72°58'37.0"E	14
5	HT Line	30.52	Kasheli	19°13'36.2"N	73°00'17.2"E	21

Table 3.51: Details of Bridges across Vasai Creek

Sl. No.	Name of Structure	Chainage (km)	Horizontal Clearance (m)	Vertical Clearance above MHWS (m)	Center Position	
					Latitude	Longitude
1	Panju Island (Old Rly. Bridge) North Channel	3.38	18.70	3.91	19°19'07.34"N	72°51'07.32"E
2	Panju Island (New Rly. Bridge) North Channel	3.40	53.04	3.43	19°19'07.30"N	72°51'10.37"E
3	Mira Bhayandar old rail bridge	6.10	100.00	8.80	19°20'21.9"N	72°50'58.4"E
4	Mira Bhayandar new rail bridge	6.29	100.00	8.80	19°20'21.9"N	72°51'00.8"E
5	Mira Bhayandar Road bridge	13.51	100.00	8.80	19°17'23.9"N	72°54'19.3"E
6	Kasheli Road Bridge	29.97	50.00	8.80	19°13'48.3"N	73°00'16.7"E
7	Kasheli pipe line Bridge	30.31	50.00	6.80	19°13'46.0"N	73°00'16.9"E

From the above information, Kalyan-Thane-Mumbai-Ulhas River Waterway from Ch 0.00km to Ch 111.20km, vertical clearance is available from most of the HT line but support base of some HT line will have to be raised in the range of 1.0m to 4.0m in order to get the required clearance.

The vertical clearance at the bridges fulfills the criteria for Class III. Airoli Road Bridge is located at Ch 30.00km. Prior to this bridge, the stretch can be classified for all classes. Thereafter, from Ch 34.34km to Ch 36.46km the vertical clearance at bridges is falling in **Class III** and from Ch 37.03km to Ch 64.52km the stretch can be classified for all classes. Thereafter, no vertical clearance is available for navigation from Mohane Bridge (Ch 64.52km) to the Malegaon Bridge (Ch 111.23km).

For Waldhuni Creek waterway, the vertical clearance at the bridges fulfills the criteria for Class II as shown above in Table 3.50.

For Vasai Creek from Ch 0.00km to Ch 30.52km, the sufficient vertical clearance is available for most of the HT lines fulfilling the required clearance as shown above in Table 3.51.

The vertical clearance at the bridges fulfills the criteria for **Class I** upto Ch 6.29km. The stretch between Ch 6.29km and ch 13.51km can be classified under class III. Thereafter, From Ch 13.51km to the end the stretch can be classified for all classes as shown above in Table 3.52.

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

3.3.2 Dams, Barrages and Reservoirs

One Check dam at Ch 67.78km near Kalyan is present and two barrages can be seen at Ch 81.567 km at Aapti and Ch 90.372km at Badlapur in the Kalyan-Thane-Mumbai waterway via Ulhas River. No reservoirs exist along the surveyed route.

No dams, barrage and reservoir exist along the route of waldhuni River and Vasai Creek. The details of dam and barrages across the Kalyan-Thane-Mumbai Waterway via Ulhas River is given below in **Table 3.52.**

Table 3.52: Dam and Barrages in Kalyan-Thane-Mumbai via Ulhas River

Sl. No.	Name of Structure	Location	Chainage (km)	Center Position	
				Latitude	Longitude
1	Check Dam	Kalyan	67.78	19°15'19.2" N	73°09'54.0" E
2	Barrage	Aapti	81.56	19°13'10.6"N	73°14'03.6" E
3	Barrage	Badlapur	90.37	19°09'6.02" N	73°15'10.0" E

3.3.3 Bends along the Route

On the proposed waterway route, there are many bends in Kalyan-Thane-Ulhas River,Waldhuni Creek and Vasai Creek which are given below in **Table 3.53** to **Table 3.55.**

Table 3.53: River Bend Radius in Kalyan-Thane-Mumbai via Ulhas River

Sl. No.	Chainage (Km)	Radius (m)	Sl. No.	Chainage (Km)	Radius (m)
1	39.65	860	11	57.57	1360
2	40.00	450	12	60.00	1150
3	41.05	3060	13	62.65	1130
4	41.76	1850	14	65.35	930
5	42.60	1060	15	67.00	1915
6	43.50	800	16	68.83	810
7	45.00	600	17	70.87	775
8	48.00	1250	18	72.40	1380

Sl. No.	Chainage (Km)	Radius (m)	Sl. No.	Chainage (Km)	Radius (m)
9	52.29	1440			
10	55.27	1070			

Table 3.54: River Bend Radius in Waldhuni Creek

Sl. No.	Chainage (Km)	Radius (m)
1	0.08	385
2	0.26	1030
3	0.45	285
4	0.65	1150
5	1.28	165
6	1.50	340
7	1.72	650
8	2.00	295
9	2.68	495
10	3.10	272

Table 3.55: River Bend Radius in Vasai Creek

Sl. No.	Chainage (Km)	Radius (m)
1	1.24	2350
2	12.80	1940
3	15.45	1412
4	16.65	690
5	19.40	2385
6	23.70	2200
7	27.65	2960
8	29.55	1890

In Kalyan-Thane-Mumbai via Ulhas River stretch, it needs smoothening of bends at some locations. In the study stretch based on the river radius criteria it may be fit for **All class** vessels with depth improvement at some locations and by smoothening of the bends, however on confirmation of cargo.

Thereafter, in Waldhuni creek based on the river radius criteria, it may be fit for **Class II** vessels. However, it may be developed for Class III by smoothening of the bends at some locations, however on confirmation of cargo.Vasai Creek may be fit for **All class** vessels with minor smoothening of bends at one or two locations.

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-A06 R0** (Sheet 1 to 24). Drawing also depicts various information such as Jetties, Rail and Road location along the waterway.

3.3.4 Gauge & Discharge data

In the Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River catchment, Central Water Commission (CWC) has hydrological observatory station at Badlapur, which is located within the study area. Long term data on daily basis for the period of 12 years (January, 2000 to May, 2012) of Badlapur Gauge and Discharge site have been provided by IWAI as given in **Annexure 3.5**. The details of Gauge station are presented in **Table 3.56** below.

Table 3.56: Details of Badlapur Gauge Station

General Details	
Station Name	Badlapur
Station Code	WU000P8
Operational Status	Existing
Activity	HO
Station Type (Current)	GDQ
Tehsil/Taluk	Ulhasnagar
District	Thane
State	Maharastra
Latitude (DMS)	19°09’51” N
Longitude (DMS)	73°15’16” E
Altitude (m)	9.02
Distance to Outlet (km)	0
Topo Sheet No.	---
Catchment Area (sq. Km)	785
Basin	West Flowing River (WFR) from Tapi to Tadri
Independent River	Ulhas
Type of River	Perenial
Station Bank	Left
Method of Discharge Obs.	Bridge and Wading
Zero of Gauge (m)	9.02
U/S Gauge Line Dist. (m)	150
D/S Gauge Line Dist. (m)	150

Based on the observed daily data, the maximum and minimum water level at Badlapur site in each year is given in **Table 3.57** below. Observed data for the year 2012 is available till 31st May.

Table 3.57: Summary of Badlapur Gauge and Discharge Data (2000-2012)

Year	Data Type (HZS=Absolute Gauge; HHS=With M.S.L.)	Mean Gauge (m)	
		Minimum	Maximum
2000	HZS	1.02	6.50
2001	HZS	0.94	4.60
2002	HZS	0.98	8.21
2003	HZS	0.94	8.51
2004	HZS	0.95	7.65
2005	HZS	0.90	12.08
2006	HZS	0.85	7.71
2007	HZS	0.81	5.82
2008	HZS	0.98	6.65
2009	HZS	1.03	6.40
2010	HZS	1.00	5.53
2011	HZS	0.97	6.10
2012	HZS	0.88	1.41
	Average	0.94	6.71
	Minimum	0.81	1.41
	Maximum	1.03	12.08
	Avg. (last six yrs.)	0.94	

Minimum mean gauge of 0.81m and maximum mean gauge of 12.08m were observed. The average of minimum mean gauge from each year is 0.94m. As suggested by the IWAI, the average minimum mean gauge of last six years (yr 2006 to yr 2011) (*since the data available is upto May 2012, Yr 2011 has been taken as last year*) can be considered as Chart datum for the free surface flow river stretch. Based on the data available at this stage of study, minimum water depth of **0.94m** may be available every time for navigation.

3.3.5 Bed Profile of Waterway

All soundings were reduced to Chart Datum in the area. Tidal heights are predicted using Mumbai (Apollo Bandar) data to reduce the raw water depths to Chart Datum. The observed bed profile of Kalyan-Thane-Mumbai via Ulhas River waterways is shown below in **Figure 3.40** and presented in **Annexure 3.6**.

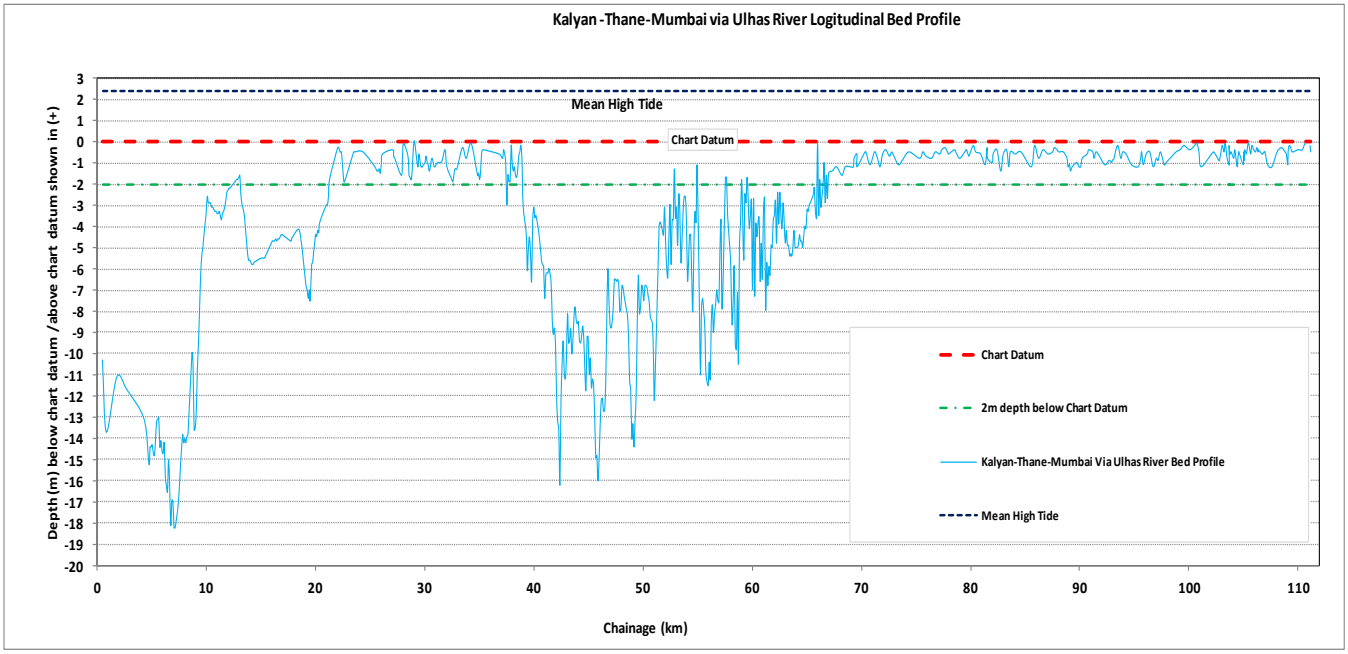


Figure 3.40: Longitudinal River Bed Depth Profile of Kalyan-Thane-Mumbai Waterway via Ulhas River from Ch 0.00km to Ch 111.20km

Figure 3.40 also shows the Chart Datum line, 2m below the Chart Datum line and means high tide 2.37m above Chart Datum. However, high 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 3.40:

A. The tidal effect of the Arabian Sea in the Kalyan-Thane-Ulhas River is affected upto Check dam site at Ch 67.73km.

B. As observed at the site, the study stretch generally has the soil texture as silty sandy clayey soil.

C. Almost the full river stretch from the mouth to the end is flatter.

D. Water depth of 2m is available naturally for up to 21.00km with minimum dredging requirement at some places.

E. With some moderate dredging between 21.28km and 38.41km (17.13km stretch) and between Ch 66.19km and Ch 111.20km (45.01km stretch) a minimum draft of 2.0m may be achieved.

The observed bed profile of Waldhuni Creek waterways is shown below in **Figure 3.41** and presented in **Annexure 3.7**.

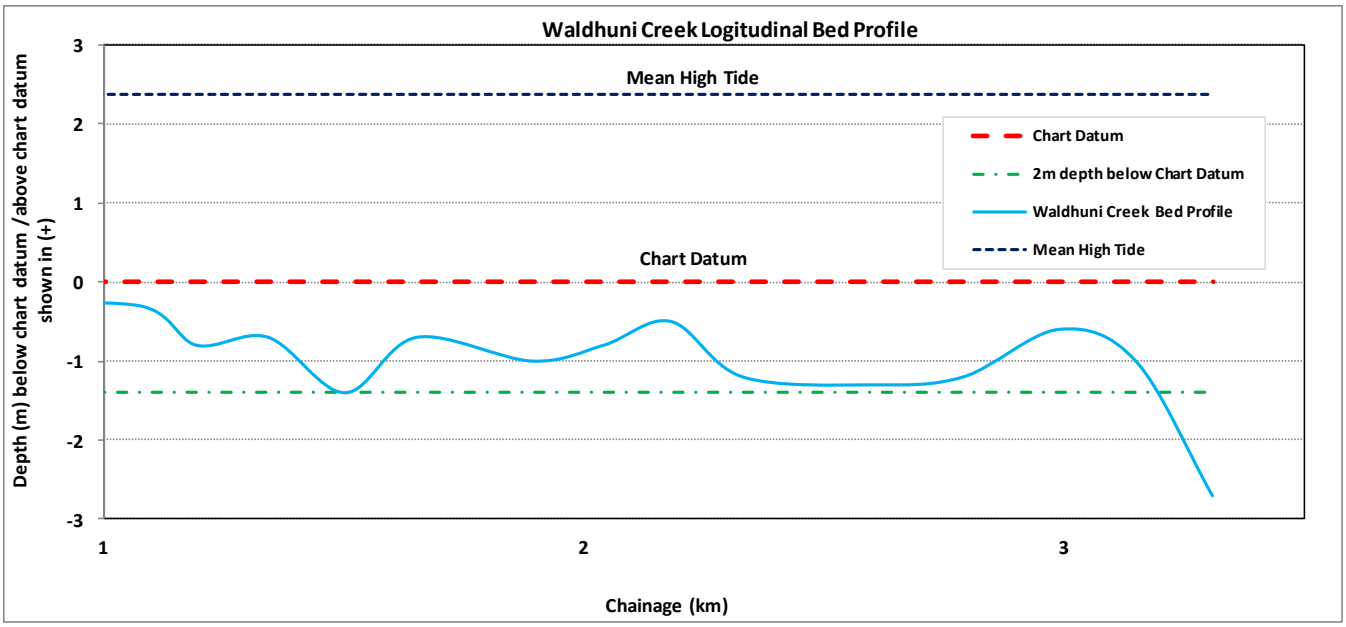


Figure 3.41: Longitudinal River Bed Depth Profile of Waldhuni Creek from Ch 0.00km to Ch 3.31km

Figure 3.41 shows the Chart Datum line, 1.4m below the Chart Datum line, and means high tide 2.37m above Chart Datum. However, high 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 3.41**:

(i) The Waldhuni Creek is fully tidal affected.
(ii) As observed at the site, the study stretch generally has the soil texture as silty sandy clayey soil.
(iii) Almost the full river stretch from the mouth to the end is flatter.
(iv) With extreme dredging between 0.00km and 3.31km (3.31km stretch), a minimum draft of 1.4m may be achieved.

The observed bed profile of Vasai Creek waterways is shown below in **Figure 3.42** and presented in **Annexure 3.8**.

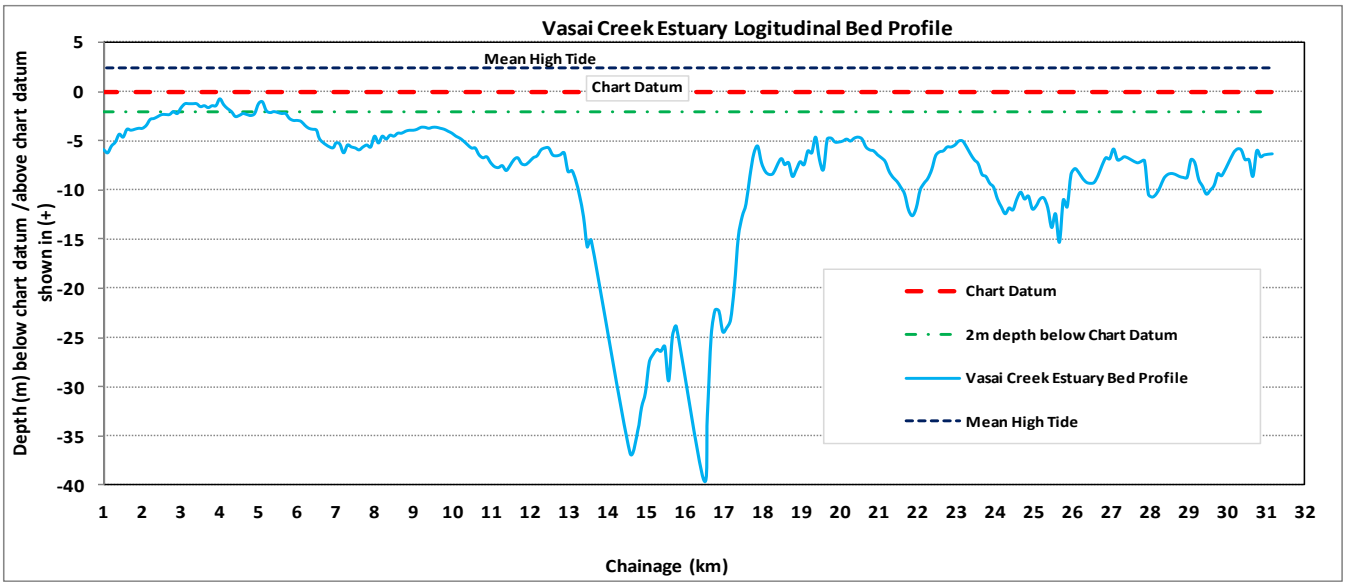


Figure 3.42: Longitudinal River Bed Depth Profile of Vasai Creek from Ch 0.00km to Ch 31.20km

Figure 3.42 also shows the Chart Datum line, 2m below the Chart Datum line and means high tide 2.37m above Chart Datum. However, high 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 3.42**:

(i) The Vasai Creek is fully tidal affected.

(ii) As observed at the site, the study stretch generally has the soil texture as Sand with Shell Fragments in the initial stretch and silty clay at the end of the stretch.

(iii) Almost the full river stretch from the mouth to the end is flatter.

(iv) Water depth of 2m is available naturally for up to 31.20km with minimum dredging requirement at some places.

3.4 Tidal Effect on Navigability of Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River

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 these rivers and creeks 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, movements of the Vessels through the river depend upon the draft available which is affected by the tide.

3.5 Present Usability of Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River

With the information gathered during the reconnaissance survey, presently, vessels are plying upstream up to Godrej-Boyce MMB Jetty in Kalyan-Thane Creek. No vessels are plying in Vasai Creek with considerable size. Tide dependent water level in the Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River can be used advantageously for the smooth movement of the Vessels in the study stretch.

3.5.1 Chart Datum & Variation in Navigation Draft

The draft variation in the Kalyan-Thane-Mumbai Waterway via Ulhas River has been established from 0.00m to 18.20m, in Waldhuni Creek it has been established from 0.20m to 2.70m and for Vasai Creek it is 0.70m to 39.40m 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 of the order of 2.37m with its maximum depth of 4.42m in Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River 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 Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River 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 for unloading the material and the 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.

3.5.2 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.

3.6 Agencies to be approached for Clearances, if any

Based on the 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-53 (Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River) has been given in **Table 3.58**.

Table 3.58: List of Clearances and Approvals Required

Environment 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	√	√	√	√

3.6.1 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 Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River. The consolidated data shall be useful in deriving basic information about each of the waterway in IWAI format as enclosed as **Annexure 3.8**.

3.7 Conclusion

Based on the survey observation, the classification of proposed waterways based on various criteria has been summarized in below **Table 3.59** to **Table 3.61.**

Table 3.59: Classification of Proposed Waterway for Kalyan-Thane-Mumbai via Ulhas River

Criteria	Classification																			
Length of waterway from start (km)	6	11	17	22	28	33	39	44	50	56	61	67	72	78	83	89	95	100	106	111
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	Class-V												Depth Not Available							
Raod Bridge Vert. Clearance	Class-III												Navigation Not Recommended							
Raod Bridge Hor. Clearance	All Class								Class-I											
HT Line Vert. Clearance	Class-II																			
Bend Radius	All Class																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

Table 3.60: Classification of Proposed Waterway for Waldhuni Creek

Criteria	Classification									
Length of waterway from start (km)	0	0.7	1.0	1.3	1.7	2.0	2.3	2.6	3.0	3.3
Chainage length in %	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Depth availble	Class-II									
Raod Bridge Vert. Clearance	Clearance not available for Navigation									
Raod Bridge Hor. Clearance	Clearance not available for Navigation									
LT Line Vert. Clearance	N/A									
Bend Radius	Class-II									
Index	All Class		Class-V		Class-IV		Class-III		Class-II	

Table 3.61: Classification of Proposed Waterway for Vasai Creek.

Criteria	Classification																			
Length of waterway from start (km)	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	27	28	30	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	All Class																			
Raod Bridge Vert. Clearance	Class-I		Class-III																	
Raod Bridge Hor. Clearance	Class-III																			
HT Line Vert. Clearance	Class-III																			
Bend Radius	All Class																			
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 Kalyan-Thane-Mumbai Waterway, Vasai Creek and Ulhas River Waterway in light of technical navigability may be adopted as shown in **Table 3.62** to **Table 3.64** below:

Table 3.62: Final Conclusion for Possible Navigation for Kalyan-Thane via Ulhas River

Stretch Name	Kalyan-Thane-Mumbai via Ulhas River		
River Stretch	0.00km	66.80km	111.20km
Classification			**NOT RECOMMENDED**
	Class III		
Horizontal clearance (m)	50		
Vertical clearnce (m)	7		
Minimum Depth(m)	1.7		
Bottom Width (m)	50		
Self Propelled Vessel			
Dead Weight Tonnage	500		
Vessel size (m)	(58 x 9 x 1.5)		
Tug + Barge			
Dead Weight Tonnage	1000		
Vessel size (m)	(141 x 9 x 1.5)		

Table 3.63: Final Conclusion for Possible Navigation for Waldhuni Creek

Stretch Name	Waldhuni Creek	
River Stretch	0.00km	3.31km
Classification	**NOT RECOMMENDED**	
Horizontal clearance (m)		
Vertical clearnce (m)		
Minimum Depth(m)		
Bottom Width (m)		
Self Propelled Vessel		
Dead Weight Tonnage		
Vessel size (m)		
Tug + Barge		
Dead Weight Tonnage		
Vessel size (m)		

Table 3.64: Final Conclusion for Possible Navigation for Vasai Creek

Stretch Name	Vasai Creek	
River Stretch	0.00km	31.20km
Classification		
	Class III	
Horizontal clearance (m)	50	
Vertical clearnce (m)	7	
Minimum Depth(m)	1.7	
Bottom Width (m)	50	
Self Propelled Vessel		
Dead Weight Tonnage	500	
Vessel size (m)	(58 x 9 x 1.5)	
Tug + Barge		
Dead Weight Tonnage	1000	
Vessel size (m)	(141 x 9 x 1.5)	

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.

Accordingly, the present Kalyan-Thane-Mumbai-waterway (Ch 0.00km to Ch 66.80km) and Vasai Creek (Ch 0.00km to Ch 31.20km) are navigable with **Class III** of waterway, wherein the Waldhuni Creek (Ch 0.00km to Ch 3.31km) is not recommended for navigability.

CHAPTER 4: MARKET ANALYSIS

4.1 Background

Kalyan-Thane-Mumbai Waterway (including Vasai Creek & Ulhas River) has been declared as National Waterway (**NW 53**). Kalyan-Thane and Vasai creeks located in Mumbai region are among the important creeks in the coastal strip of Maharashtra, and a brief introduction of these creeks/rivers is as follows:

- Ulhas River is approx. 161 km long; it rises in proximity to Bhor Ghat near Karjat and is bound by steep canyons of Sahyadri and Matheran ridge. It flows northwards after leaping over a depth of 90 m in two water-falls one below the other. The valley opens out steadily as the River flows past Karjat towards the north. After its confluence with Kalu and Bhatsai, on the east of Kalyan, the River turns west and flows through Mumbra ridge, later it turns northwards to flows through the picturesquely forest clad country and then turning west again to develop an estuary, about 3 km wide, joining the Arabian sea south of Vasai. An island named Panju islands, just east of estuary on the River is used by Western Railways for connecting Salsette with Vasai. The River is tidal till Kalyan.

- Thane Creek (amongst largest marine bodies in an enclosed area in India) and Ulhas River (an estuary located adjacent to the cities of Mumbai), and Thane are connected through a narrow and shallow channel. It separates Mumbai and part of Thane city from the main land of India.

The boundaries of Kalyan-Thane-Mumbai Waterway (including Vasai Creek & Ulhas River) include, parts of Raigarh District (Uran, Panvel, Karjat Talukas), Thane District (Thane, Kalyan, Bhivandi, Ulhas Nagar and Vasai Talukas), Mumbai Suburban District, and Greater Mumbai District.

The navigable length of the Kalyan Thane Mumbai waterway (including Vasai Creek and Ulhas River) creeks is about 145 km and based on the deepest bathymetry single line survey carried out during the study and as per the classification of "Inland water ways" by Ministry of Shipping, Govt. of India notification, it can be classified as Class III, due to the restrictions of cross structures in the city area.

Mumbai Port, JNPT and a few captive jetties among total of 42 are located along the River/Creeks (**Map 4.1**).

4.2 Existing Traffic

The existing cargo (**Table 4.1**) and passenger movement (**Table 4.2)** on and along the waterway are as follows:

- **Cargo:** As per the Maharashtra Maritime Board (MMB) data, small amount of project cargo is moving in the waterway from the MMB/captive jetties. The same is discussed as follows:
  - Trombay (Godrej Boyce Co. Jetty): Project cargo (over dimensional cargo) of 6,097 MT in 2013-14, 6,661 MT in 2014-15, and 10,988 MT in 2015-16 was handled at this MMB Jetty.

- Bhivandi Jetty: There was no cargo handled from 2013-15, however, in 2015-16, 2,900 MT of cargo was handled (Transformer, Diesel Engine) at this MMB Jetty.

Traffic handled in vicinity of the waterway is as follows:

- Ambuja Jetty (Ulwa – Belapur): This is a captive jetty of Ambuja cement located at Ulwa-Belapur. Approximately 1.18 MMTPA, 1.62 MMTPA and 1.6 MMTPA cargo has been handled at this jetty in last three years from 2013-14 to 2015-16.
- Mumbai Port Trust: At Mumbai Port trust, 59.2 MMTPA, 61.7 MMTPA and 61.1 MMTPA were handled in last three years from 2012-14 to 2015-16.
- Jawaharlal Nehru Port Trust (JNPT): 62.3 MMTPA, 63.8 MMTPA and 64.0 MMTPA cargo has been handled at JNPT in last three years from 2013-14 to 2015-16.
- Vasai Creek: There is a small size ship yard located along Vasai Creek.

Table 4.1: Traffic Handled along Kalyan Thane Mumbai waterway (including Vasai Creek and Ulhas River)

Sl. No.	Jetty/Port	YEAR		
		2013-14	2014-15	2015-16
In MTPA				
1	Trombay	6,097	6,661	10,988
2	Bhivandi	0	0	2,900
In MMTPA				
3	Ulwa Belapur	1.18	1.62	1.6
4	MbPT	59.2	61.7	61.1
5	JNPT	62.3	63.8	64.0

Source: MMB, Major Ports Statistics of India

- **Passengers:** At present, about 58 lakh (**Table 4.2**) passengers use the passenger ferry services every year. These ferry services are available on 27 routes in the vicinity of Kalyan Thane Mumbai waterway (including Vasai Creek and Ulhas River). In the year 2013-14, the total passengers handled stood at 37.8 lakhs and in 2014-15, it grew to 53.7 lakhs.

Table 4.2: Passengers handled at Mora group of Jetties in 2015-16

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	NEW FERRY WHARF TO MORA (R.N.Shipping)	19,238	-	19,238
2	BASSESIN(VASAI)	5,352	100,540	105,892
3	BHIWANDI	-	-	-
4	DHARAMTAR	-	-	-
5	ELEPHANTA	2,124,916	-	2,124,916
6	FERRY WHARF TO ELEPHANTA	782	-	782
7	FERRY WHARF TO MORA	406,023	-	406,023
8	FERRY WHARF TO MORA (R.N.Shipping)	183,408	-	183,408
9	FERRY WHARF TO REWAS	133,329	-	133,329
10	KALYAN	12,308	-	12,308
11	KARANJA	53,949	-	53,949
12	KARANJA TO REWAS	278,288	-	278,288
13	MANDWA	1,398,177	-	1,398,177
14	MORA	8,078	-	8,078
15	MORA TO NEW FERRY WHARF	405,923	-	405,923
16	MORA TO NEW FERRY WHARF (R.N.Shipping)	19,238		19,238
17	MORA TO NEW FERRY WHARF (R.N.Shipping)	183,408	-	183,408
18	MORA TO SASOON DOCK	77,926	-	77,926
19	NEW FERRY	-	-	-
20	NEW FERRY WHARF TO ELEPHANTA	-	-	-
21	PANVEL	-	-	-
22	REWAS	-	-	-
23	REWAS TO KARANJA	332,237	-	332,237
24	REWAS TO NEW FERRY WHARF	133,333	-	133,333
25	THANE	-	-	-
26	TROMBAY	-	-	-
27	ULWA-BELAPUR	2,448	-	2,448
Total		**5,778,361**	**1,00,540**	**5,878,901**

Source: MMB

4.3 Future Traffic Potential

Based on the review of secondary data and discussions with stakeholders, preliminary assessment of cargo potential on this River/Creek stretch is summarized as follows:

- **MMB Jetties:** MMB jetties at Trombay (Godrej Boyce company ltd.) and at Bhivandi are handling project related cargo and same amount of cargo about 10,000 -15,000 MTPA is expected to continue at these jetties in future years as well.

- **Industrial clusters:** There are 11 industrial clusters around the Kalyan-Thane-Vasai-Ulhas waterway adding up to 2064 Ha of Land (**Annexure 4.1 & Map 4.1**). The clusters are at Marol, Dombivali, Mira, Wagle, Kalyan Bhivandi, Ambernath, Badlapur and Murbad areas. These clusters are generating significant amount of traffic in the River/Catchment region. (**Figure 4.1**).

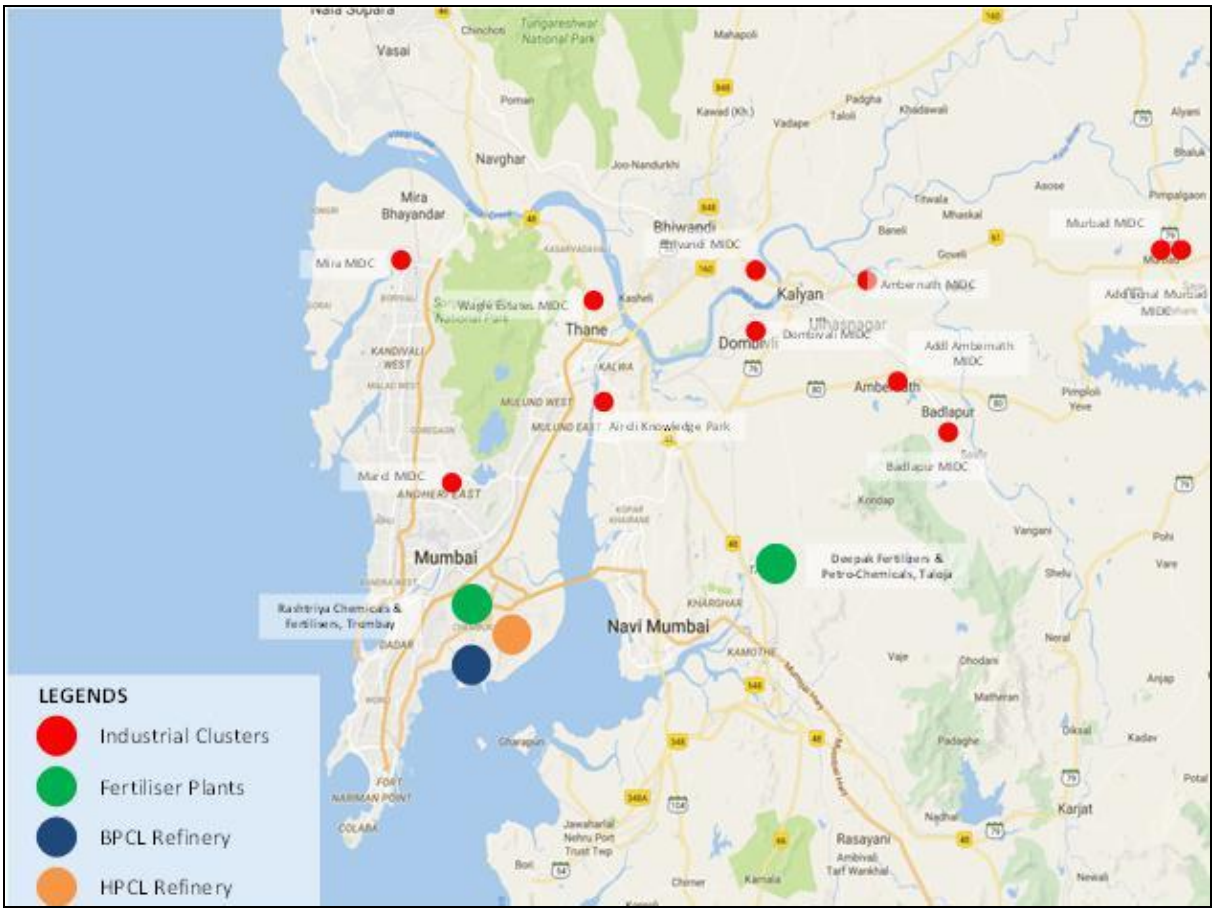


Figure 4.1: Industrial Clusters, Refineries and Fertilizer Plants in Mumbai region

- **Fertilizer Plants**: Though the Fertilizer requirements in this River/Creek catchment region are limited; two major Fertilizer Plants, Rashtriya Chemicals & Fertilizers Ltd. (RCF) and Deepak Fertilizers having a combined production capacity of 5.6 Lakh MTPA (**Table 4.3**) falls in this River/Creek catchment area. There is a possibility to divert the traffic generated from RCF plant to Kalyan-Thane- Vasai and Ulhas River waterway and south bound traffic from Deepak Fertilizers can move through Panvel creek to Arabian Sea and thereafter to its respective locations in the coastal Rivers of Maharashtra.

Table 4.3: Fertilizer units in Mumbai region

Sl. No.	Manufacturing Unit	Production Unit	Location	Manufacturing Capacity (MTPA)
1	RCF	Urea	Trombay	3,30,000
2	DFCL	NPK	Taloja	2,29,000

Source: Fertilizer Management Systems, GOI

- **POL Products:** In addition, there are two major petroleum refineries BPCL and HPCL with combined production capacity of 20.55 MMTPA (**Table 4.4**) near Trombay area in Mumbai. Though major part of it; 10.3 MMTPA (**Table 4.5**) is moving through pipeline and new pipelines are also under construction, still a significant amount is also transported through Road and Rail and the road movement is in catchment area of the study stretch.

Table 4.4: Refineries in Mumbai Region

Sl. No.	Refinery Name	Production Capacity (MMTPA)
1	HPCL, Mumbai	7.75
2	BPCL, Mumbai	12.8

Source: BPCL & HPCL

Table 4.5: Pipelines in Mumbai Region

Sl. No.	Pipeline Details	Operating Entity	Capacity (MMTPA)	Length (km)
1	Mumbai Pune Solapur Pipeline	HPCL	4.3	508
2	Uran-Chakan/Shikrapur LPG Pipeline (Under Construction)	HPCL	1	165
3	Mumbai-Manmad-Bijwasan	BPCL		
	3a Mumbai-Manmad		6	252
	3b Manmad-Manglya		3.5	358
	3c Manglya-Piyala		2.2	722
	3d Piyala-Bijwasan		1	57

Source: BPCL & HPCL

- **Mumbai Port (MbPT) Traffic:** MbPT is handling 61.1MMTPA (**Table 4.6**) of cargo traffic out of which Non POL related traffic is 24.84 MMTPA and POL products is 36.27 MMPTA. Major commodities excluding crude oil include POL products (11.2 %), Iron & Steel (9.8%) and Chemicals (4%). The container movement is declining from 72,000 TEUs in 2010-11 to 42,000 TEU (0.53 MMTPA) in 2015-16, but still, it is a sizable component and part of it is moving by Road and creating congestion in the Mumbai city region. This cargo movement is falling in the River/Catchment region and has potential to be diverted to IWT.

Table 4.6: Cargo handled at Mumbai port from 2010-11 to 2015-16

Sl. No.	Commodity	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
A. Imports (in '000 MTPA)							
1	Crude Oil	12,380	14,492	15,479	14,009	13,385	14,063
2	POL Products	4,436	3,541	3,238	3,521	3,234	3,409
3	Bulk Chemicals	1,291	1,444	1,507	1,641	1,928	2,173
4	Fertilizers	159	230	156	151	172	148
5	Rock Phosphate	315	163	272	128	276	291
6	Sulphur	20	11	83	23	-	-
7	Iron & Steel	4,105	3,505	2,941	1,886	4,102	5,643
8	Vegetable Oil	161	192	239	268	220	173
9	Pulses	703	850	834	720	683	961
10	Coal	3,869	4,321	4,018	4,221	4,304	3,451
11	Containerized Cargo	566	498	653	440	534	445
12	Stream cargo	7,033	7,961	9,067	9,495	9,516	8,951
13	Miscellaneous	1,718	1,664	1,573	2,447	2,262	1,586
Total Import		36,756	38,872	40,060	38,950	40,616	41,294
Containers (TEU's) under Import		60,864	50,811	46,680	36,281	41,457	37,709
B. Exports (in '000 MTPA)							
1	Crude Oil	2,976	2,731	4,552	3,462	3,069	2,558
2	Crude Oil - Pipeline	6,456	6,073	5,149	8,721	9,211	9,470
3	POL Products	3,604	3,647	3,718	3,607	4,072	3,451
4	POL Products - Pipeline	3,316	2,831	2,615	2,660	3,314	3,323
5	Bulk Chemicals	86	143	186	121	74	47
6	Sugar	12	162	163	153	97	5
7	Food grains	-	53	30	-	-	-
8	Iron & Steel	505	721	741	1,040	610	342
9	Oil Cakes	-	-	6	-	-	-
10	Vegetable Oil	13	7	15	-	3	-
11	Motor Vehicles	197	222	177	201	286	314
12	Molasses	106	63	49	-	16	13
13	Containerized Cargo	86	53	177	11	10	92
14	Stream Cargo	244	251	192	107	73	58
15	Miscellaneous	229	357	208	152	209	143
Total Exports		17,830	17,314	17,978	20,235	21,044	19,816
Containers (TEU's) under Export		11,608	6,949	10,993	4,455	4,021	5,111
Total Traffic		54,586	56,186	58,038	59,185	61,660	61,110
Total TEU's (Import + Export)		72,472	57,760	57,673	40,736	45,478	42,820

Sl. No.	Commodity	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
POL		33,168	33,315	34,751	35,980	36,285	36,274
Non-POL		21,418	22,871	23,287	23,205	25,375	24,836
Total		54,586	56,186	58,038	59,185	61,660	61,110

Source: MbPT

- **Jawaharlal Nehru Port (JNPT) Traffic:** JNPT handled 4.49 million TEUs (**Table 4.7**) of container traffic during year 2015-16 and 7.24 MMTPA of bulk traffic (**Table 4.8**). This trend is increasing and a part of it, specially the northward movement by Road has potential for diversion to IWT.

Table 4.7: Container Traffic handled at JNPT from 2014-15 to 2015-16 (TEU'S)

Container traffic	2014-15			2015-16			
	JNPCT	NSICT	APMT	JNPCT	NSICT	APMT	NSIGT
Import	643,849	527,764	1,086,464	706,601	449,627	1,000,550	114,429
Export	615,413	620,885	914,625	698,106	532,482	852,663	85,818
Trans-shipment	34,740	11,571	11,385	24,570	17,571	7,070	2,081
Total of Terminal	1,294,002	1,160,220	2,012,474	1,429,277	999,680	1,860,283	202,328
Total	**4,466,696**			**4,491,568**			

Table 4.8: Bulk Traffic handled at JNPT from 2014-15 to 2015-16 (MTPA)

Commodity	2014-15	2015-16	% Variation over previous year
Liquid Bulk	6,189,644	6,504,656	5.09
Cement & Other Dry Bulk Cargo	652,584	674,064	3.29
Break Bulk	25,709	58,109	126.03
Total Bulk	**6,867,937**	**7,236,829**	5.37

Most of traffic generated from Industries, Fertilizer plants, Refineries, Ports (as described above) is carried by Roads and some component of the same is carried by Railways. The vehicular traffic in the city is increasing at an alarming rate resulting in congestion and air pollution. Geographically the city is linear, with limited land width and limited road system (Western Expressway towards NH-8; Eastern Expressway towards NH-3 and Sion Panvel Highway towards NH-4); possibility of diverting city traffic through Ro-Ro vessels to IWT is the need of the hour. Several studies have been carried out in the past, the "Techno Economic Feasibility study to decongest Mumbai city through Inland Water Transport and Coastal shipping, 2006" carried by IWAI was a detailed one. As a part of the study, traffic counts and origin & destination surveys were carried out at all the entry points in Mumbai and at major cargo generation nodes i.e. at MbPT and at JNPT. The quantum of freight traffic was estimated, its movement pattern on roads was studied and routes (**Figure 4.2**) falling in the catchment area of IWT River/Creek and traffic which could be diverted to IWT was estimated. The salient observations of the study modified to current situation are:

- **Diversion of Freight Traffic to IWT in the city**: As per estimates, more than 26,000 vehicles (0.26 MT) (**Table 4.9**), are moving along in the catchment area of the River/Creek. Nearly 10-15 percent of the traffic was of Chemical origin (daily 2,600 vehicles, 26,000 MT), annually (949,000 vehicles, 9.5 MMTPA) could be considered for diversion to Inland waterways. Traffic in this region is growing at the rate of 7 percent per annum and therefore the potential traffic is expected to double in 10 years time (1.9 million vehicles, 19 MMTPA). About 35 percent of these vehicles (from Vasai Creek – South Mumbai) will have two options to move either (a) through Arabian Sea and or (b) through Vasai-Kalyan-Thane inland waterway. This offers a large potential for development of waterway, but there are Railway bridges at Vasai and at Thane, the vertical clearances, availability of draft among other limitations for the same needs to be studied in detail.

Table 4.9: Possible Divertible Freight Traffic to IWT (vehicles per day)

Route	Node A	Node B	Down	Up	Total (vehicles per Day)	Total (MT per day)	Commodity Type
1	Vasai	JNPT	1,280	2,066	3,346	46,150	Containerized, Building material and Engineering goods
2	Vasai	Vashi	830	548	1,378	14,269	Building material
3	Vasai	MbPT	884	274	1,158	11,452	Chemicals, Groceries
4	Vasai	Alibaug	648	249	897	10,297	Chemicals, Engineering Goods
5	Dahisar	MbPT	1,388	1,424	2,812	17,008	Chemicals, Groceries
6	Thane	MbPT	3,501	105	3,606	47,281	Engineering goods, Grocery, Building material
7	Thane	Alibaugh	321	691	1,012	14,773	Chemicals
8	Vashi	MbPT	3,760	2,802	6,562	21,258	Grocery, engineering Goods, Building material
9	JNPT	MbPT	1,310	2,052	3,362	53,962	Others, Grocery, Building material
10	Alibagh	MbPT	1,054	1,478	2,532	28,517	Chemicals, Building materials
		Total	14,976	11,688	26,664	264,966	

Source: Techno Economic Feasibility study to decongest Mumbai, IWAI

Figure 4.2 shows the potential divertable freight traffic routes in the catchment of the waterway.

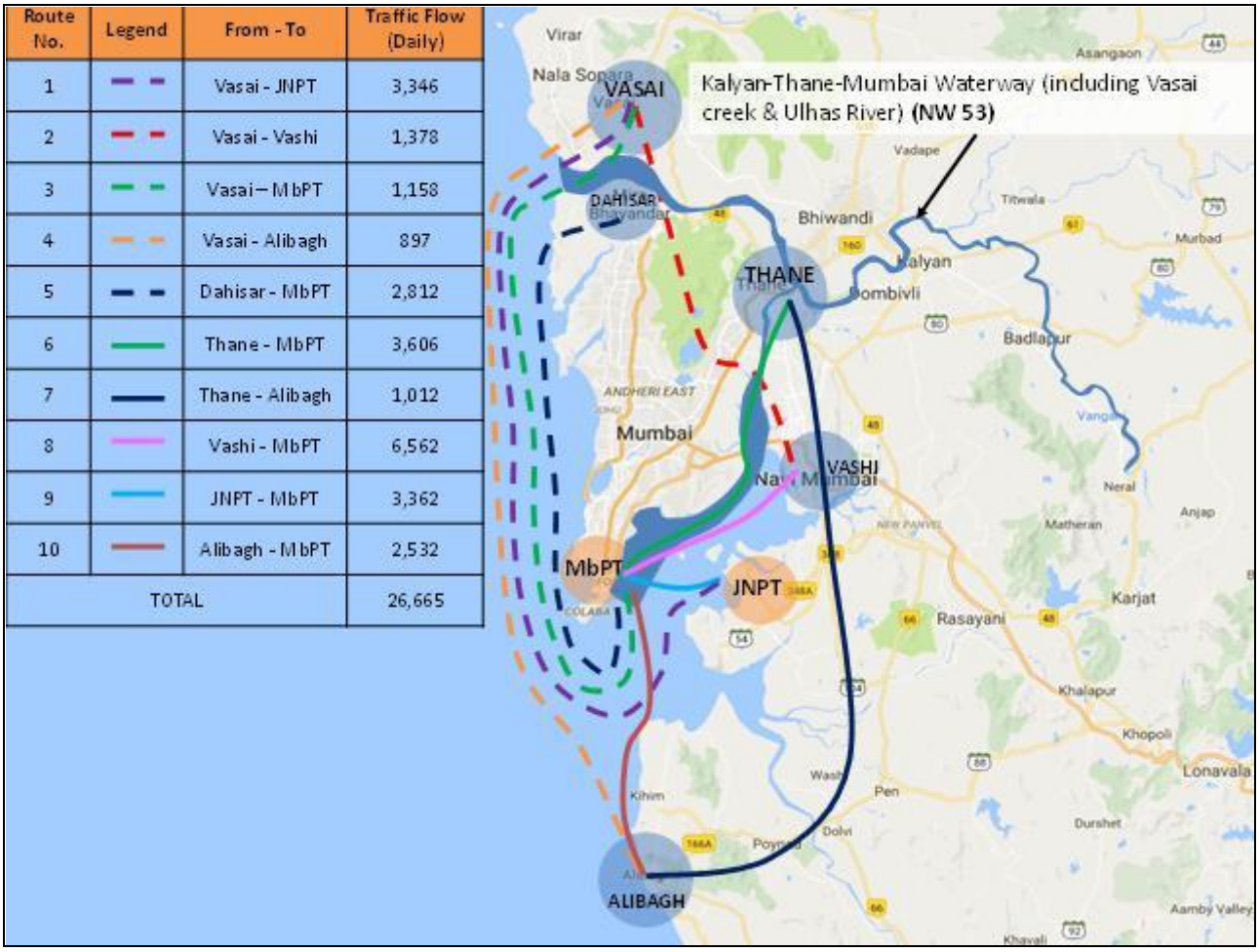


Figure 4.2: Possible divertible freight traffic routes at Kalyan-Thane-Mumbai waterway

- **Diversion of MbPT traffic to IWT:** Separate assessment of traffic originating from MbPT was carried out in the study, by first counting inbound and outbound traffic at MbPT and identifying major traffic generating points (MOD Kurla, CWC Kalamboli and Vasai) and then conducting origin destination surveys at these points. A total of 966 vehicles per day (**Table 4.10**), (3.5 MMTPA) originating from MbPT was estimated. At a growth rate of 7% per year, this will double to about 7 MMTPA. It is not clear from the study that if this traffic is already captured in the counts conducted **(Table 4.3)**; therefore it is not included as a part of preliminary estimation.

Table 4.10: Possible Divertible Freight Traffic to IWT from MbPT (vehicles per day)

Route	Node A	Node B	Total (vehicles per Day)
1	MbPT	Vasai & above	83
		MOD Kurla	384
		CWC Kalamboli	138

Route	Node A	Node B	Total (vehicles per Day)
		Total	605
2	CWC Kalamboli	North India	81
		Dahisar	36
		Thane-Belapur	107
		Rest of Maharashtra	25
		Uran	46
		MbPT	295
3	MOD Kurla	North India	92
		Dahisar	51
		Thane Belapur	92
		Vashi	71
		Rest of Maharashtra	92
		Mumbai Port	397
Final	MbPT	Dahisar	51
		Vasai	41
		North India	249
		Thane Belapur	203
		Vashi	86
		JNPT	92
		Rest of Maharashtra	244
		Total	**966**

Source: Techno Economic Feasibility study to decongest Mumbai, IWAI

- **Evacuation of containers from MbPT and JNPT:** Assessment for evacuation of container traffic originating from MbPT and JNPT has also been conducted. It was estimated that about 40,357 TEUS from MbPT and 1.27 million TEU's (**Table 4.11**) falls in the catchment area of Kalyan Thane waterway (**Figure 4.3**). The container traffic has declined at MbPT from 144,000 MTPA in 2006 to 42,000 TEU in 2015-16 and has increased at JNPT from 1.8 million TEU in 2006 to 4.5 million TEU's in 2015-16; so the adjusted TEU traffic would be (about 12,000 TEUs from MbPT) and about 3 million TEU's from JNPT totaling to 35

MMTPA. There are two options for containers to move i.e. (a) through Arabian Sea or (b) through the waterway.

Table 4.11: Possible Divertible container Traffic to IWT (TEU's annually)

Route	Node A	Node B	Total (Containers per year)	Percent Share (%)
1	MbPT	NH8	7,495	5.2%
2		City	1,03,774	72.0%
3		NH4	31,133	21.6%
4		NH3	1,729	1.2%
Total			1,44,131	100%
Total (without city)			**40,357**	
1	JNPT	NH8	2,86,891	16%
2		City	1,61,376	9%
3		NH4	3,58,614	20%
4		NH3	9,86,193	55%
Total			1,793,074	100%
Total (without city and NH4)			**12,73,084**	

Source: Techno Economic Feasibility study to decongest Mumbai, IWAI

Port	From - To	Container Flow (yearly)
MbPT	MbPT – NH-8	7,495
	MbPT – City	1,03,774
	MbPT – NH-4	31,133
	MbPT – NH-3	1,729
JNPT	JNPT – NH-8	2,86,891
	JNPT – City	1,61,376
	JNPT – NH-4	3,58,614
	JNPT – NH-3	9,86,193
Total		19,37,205

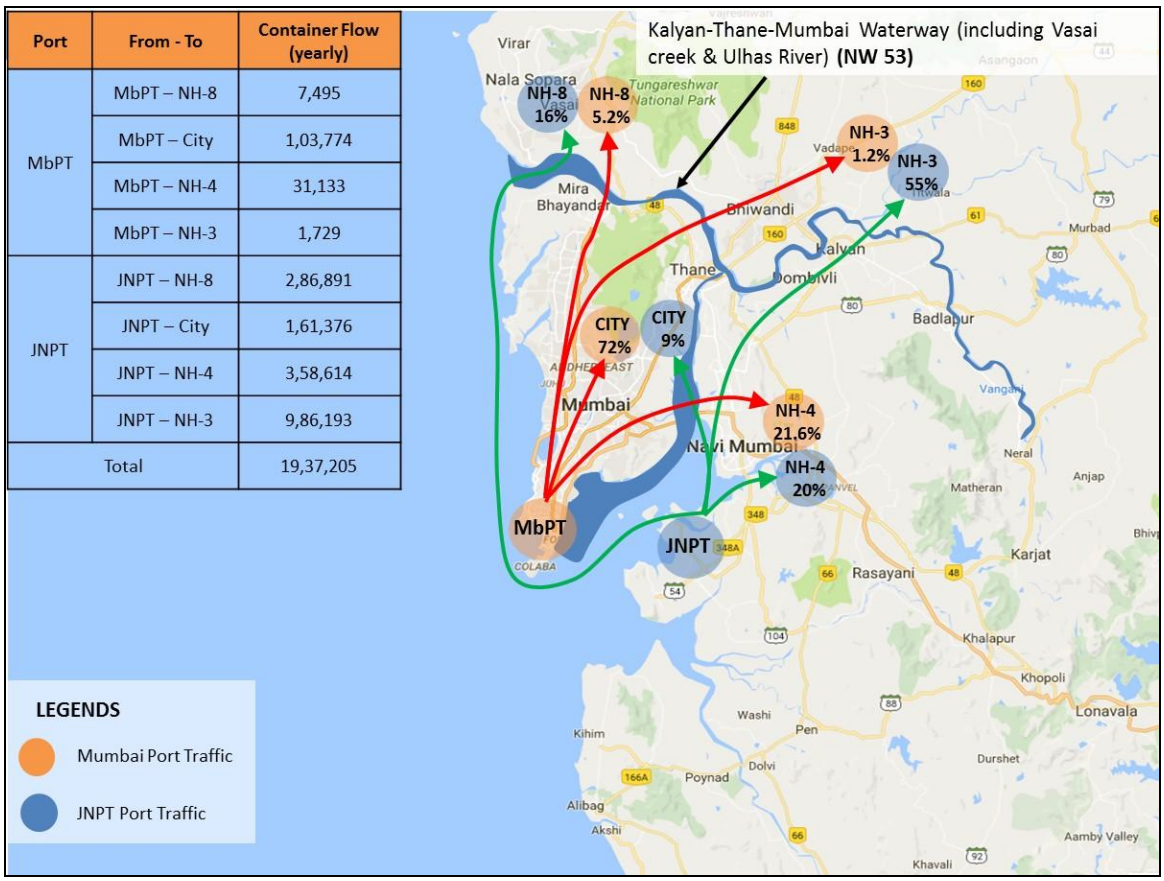


Figure 4.3: Possible divertible container traffic to Kalyan Thane Mumbai waterway

Based on the preliminary estimation the potential of container traffic is estimated at 10% of total traffic as follows:

- JNPT/MbPT-Thane Creek section: 0.3 million TEU (3.5 MMTPA)
- Thane-Vasai section: 0.07 million TEU (0.8 MMTPA)
- Thane-Kalyan section: 0.24 million TEU (2.9 MMTPA)

The potential of freight traffic is estimated by subtracting the container traffic from total traffic generated as follows:

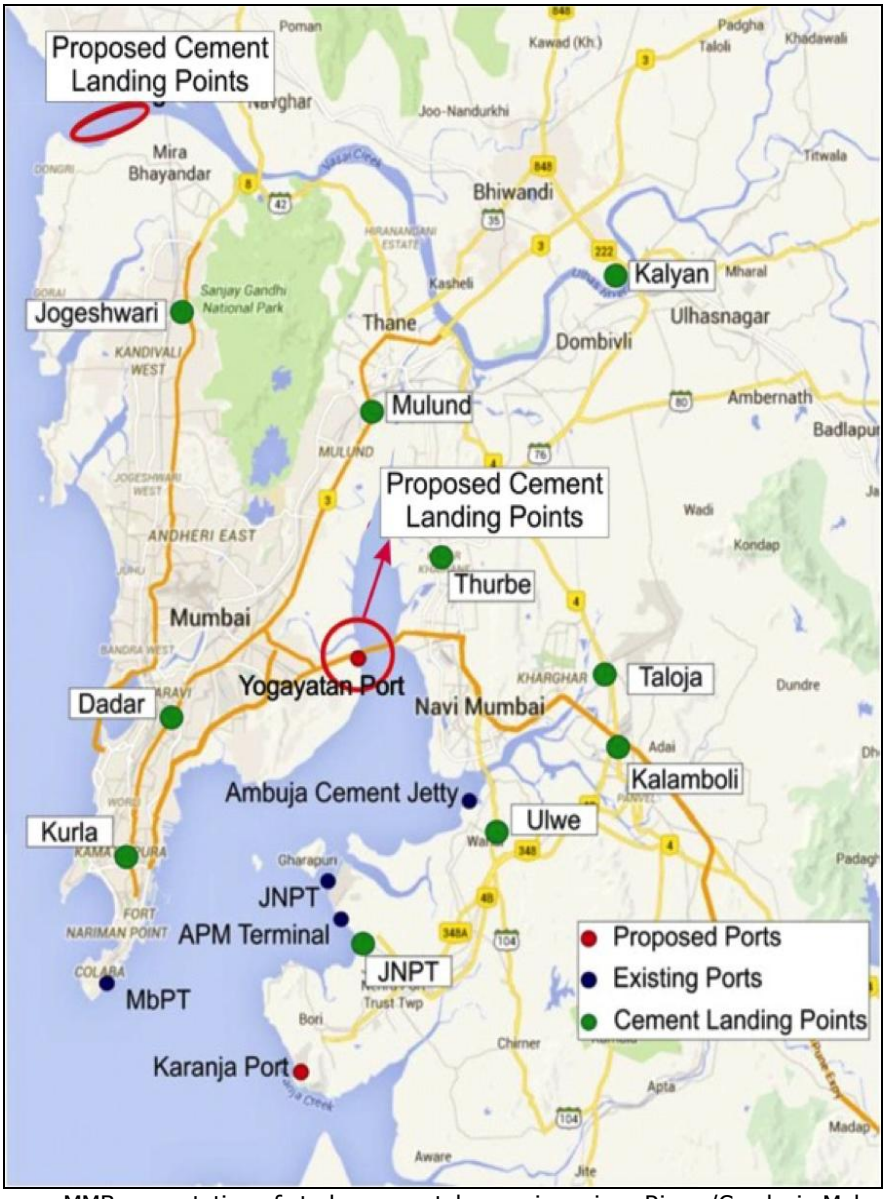
- JNPT/MbPT-Thane Creek section: 1.6 million vehicles (16.0 MMTPA)
- Thane-Vasai section: 0.6 million vehicles (6 MMTPA)
- Thane-Kalyan section: 0.01 million vehicles (0.1 MMTPA)

These are very preliminary estimates and will be studied in detail at the stage of DPR.

Other cargo apart from Ro-Ro vessel estimation is as follows:

- **Cement:** Significant amount of cement is required in the Mumbai region for construction activities and there are ten cement landing points in the city (**Figure 4.4**). Cement is unloaded at two ports namely,

Ulwe Belapur (1.6 MMTPA) and at JNPT (0.67 MMTPA). As the requirements for cement in Mumbai region is very large, there is a possibility to create a cement packaging plant near Yogayatan port and move 1.0 MMTPA of cement from Gujarat. This is to be discussed with the Industries and finalized.



(Source MMB presentation of study on coastal cargo in various Rivers/Creeks in Maharashtra)

Figure 4.4: Cement Landing Points in Mumbai

- **Agriculture:** The food grains production in the region is 0.74 MMTPA (**Table 4.12**), however the production areas are further away from the River/Creek catchment areas and it may not have potential to move through the IWT except for the vehicles which are moving along the River/Creek catchment areas.

Table 4.12: Food Grain Production in River/Creek catchment Region (2013-14)

Sl. No.	District	Cereals		Pulses		Total	
		Area (Ha)	Production(T)	Area (Ha)	Production(T)	Area (Ha)	Production (T)
1	Thane	162,600	351,100	15,300	10,600	177,900	361,700
2	Raigarh	139,600	375,600	8,100	4,000	147,700	379,600
3	Brihan Mumbai	-	-	-	-	-	-
	Total	**302,200**	**726,700**	**23,400**	**14,600**	**325,600**	**741,300**

Source: Handbook of Basic Statistics of Maharashtra, 2014

- **Fisheries:** The fish production in the region is about 3 lakh Tonnes per year (**Table 4.13**) and may not have potential to move through IWT, except for the truck movement which is falling in the River/Creek catchment area.

Table 4.13: Fish Production in River/Creek catchment region (2013-14)

Sl. No.	District	Fish Production (MT)
1	Thane	120,924
2	Raigarh	42,825
3	Brihan Mumbai	169,574
Total		**333,323**

- **Minerals:** Major Bauxite reserves are in Raigarh district (**Table 4.14**) and are already moving through ports in Maharashtra coastal region and may not move through the study River/Creek.

Table 4.14: Minerals in River/Creek catchment region

Sl. No.	District	Mineral Reserves (Million Tonnes)	
		Bauxite	Clay
1	Thane	2.3	0.065
2	Raigad	12.39	
3	Brihan Mumbai	0	0
Total		**14.69**	**0.065**

- **Passengers:** A significant amount of passengers (58 lakh) are using the Ferry services at 27 Ferry points. This traffic has grown at the rate of 8 percent per year since last year and is expected to grow as the population in the region is more than 2.2 Crores (**Table 4.15**) and is growing.

Table 4.15: Population in River/Creek catchment region

Sl. No.	District/Sub District	Taluka/Tehsil	Population	
			2001	2011
1	Mumbai Sub Urban District	Andheri	8,640,419	9,356,962

Sl. No.	District/Sub District	Taluka/Tehsil	Population	
		Borivali		
		Kurla		
2	Mumbai City	Mumbai City	3,338,031	3,085,411
3	Thane	Thane Tehsil	2,486,941	3,787,036
		Bhiwandi	945,582	1,141,386
		Vasai	795,863	1,343,402
		Kalyan	1,276,614	1,565,417
		Ulhasnagar	473,731	506,098
		Shahapur	273,304	314,103
		Murbad	170,267	190,652
		Ambarnath	366,501	565,340
4	Raigarh	Panvel	422,522	750,236
		Karjat	184,420	212,051
		Total	19,374,195	22,818,094

Source: Office of the Registrar General & Census Commissioner, India

There is a possibility of developing an additional Passenger and Ro-Ro facility across Vasai Creek (**Figure 4.5**) to connect Vasai - Virar and Mira-Bhaynder as distance through road is longer and about 8 lakh people live in the catchment area. The possibility of Ferry services from Vashi to South Mumbai also exists. The same was operational in the past and will be re-examined at DPR stage.

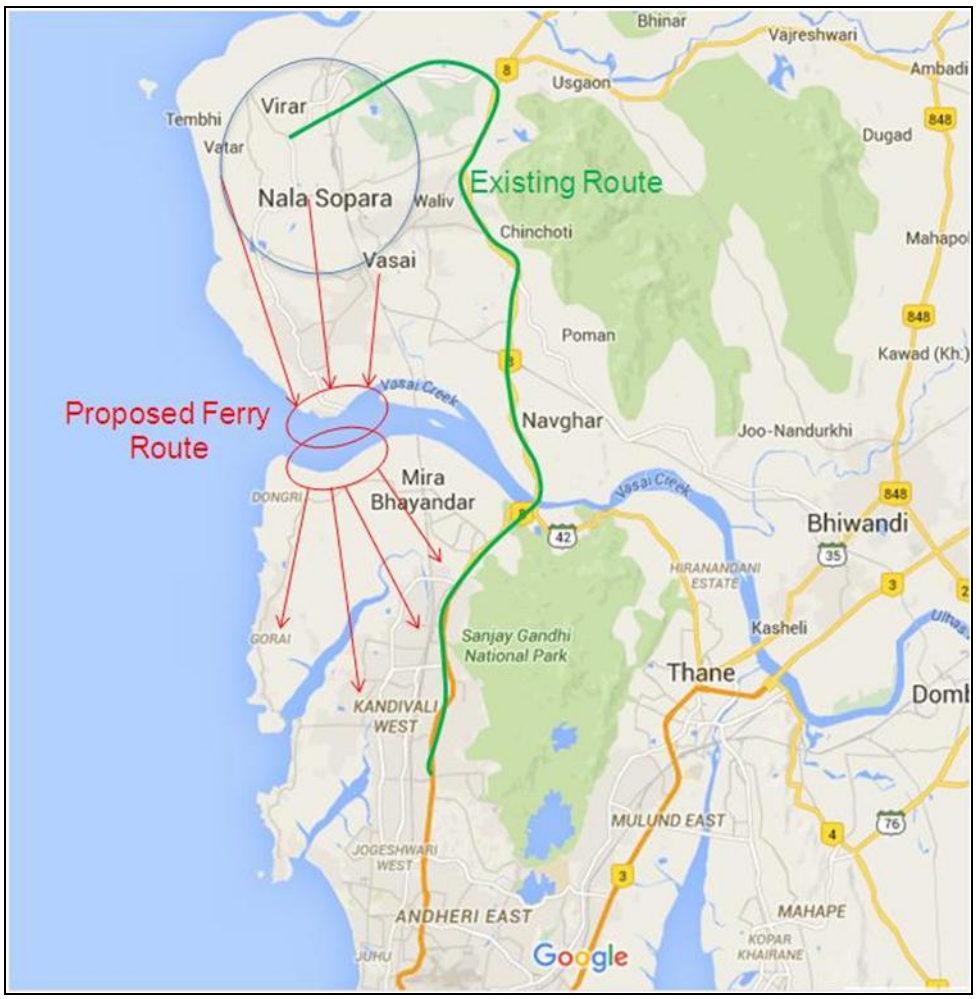


Figure 4.5: Proposed Passenger Ferry Services in River/Creek region

- **Tourism:** Maharashtra has beautiful landscape and Tourism facilities exist at following locations in the River/Creek region:

  - Panju Islands: Outdoor, indoor and Water front activities:
  - Vasai Creek: Water front activities and indoor activities
  - Vashi Creek: Water front activities
  - Thane Creek : Water front activities

Figure 4.6: Tourism potential in Vasai Creek

This will be examined in detail at DPR stage.

4.4 Conclusion

The Thane-Kalyan-Mumbai Waterway Stretch (including Vasai Creek and Ulhas River) is a long stretch in a region which is densely populated, industrialized and highly congested. As per preliminary estimation, the potential to divert the cargo traffic to IWT is significant. As per preliminary estimation about 20 MMTPA of cargo can be moved in this Creek/River stretch. The details of the same are as follows:

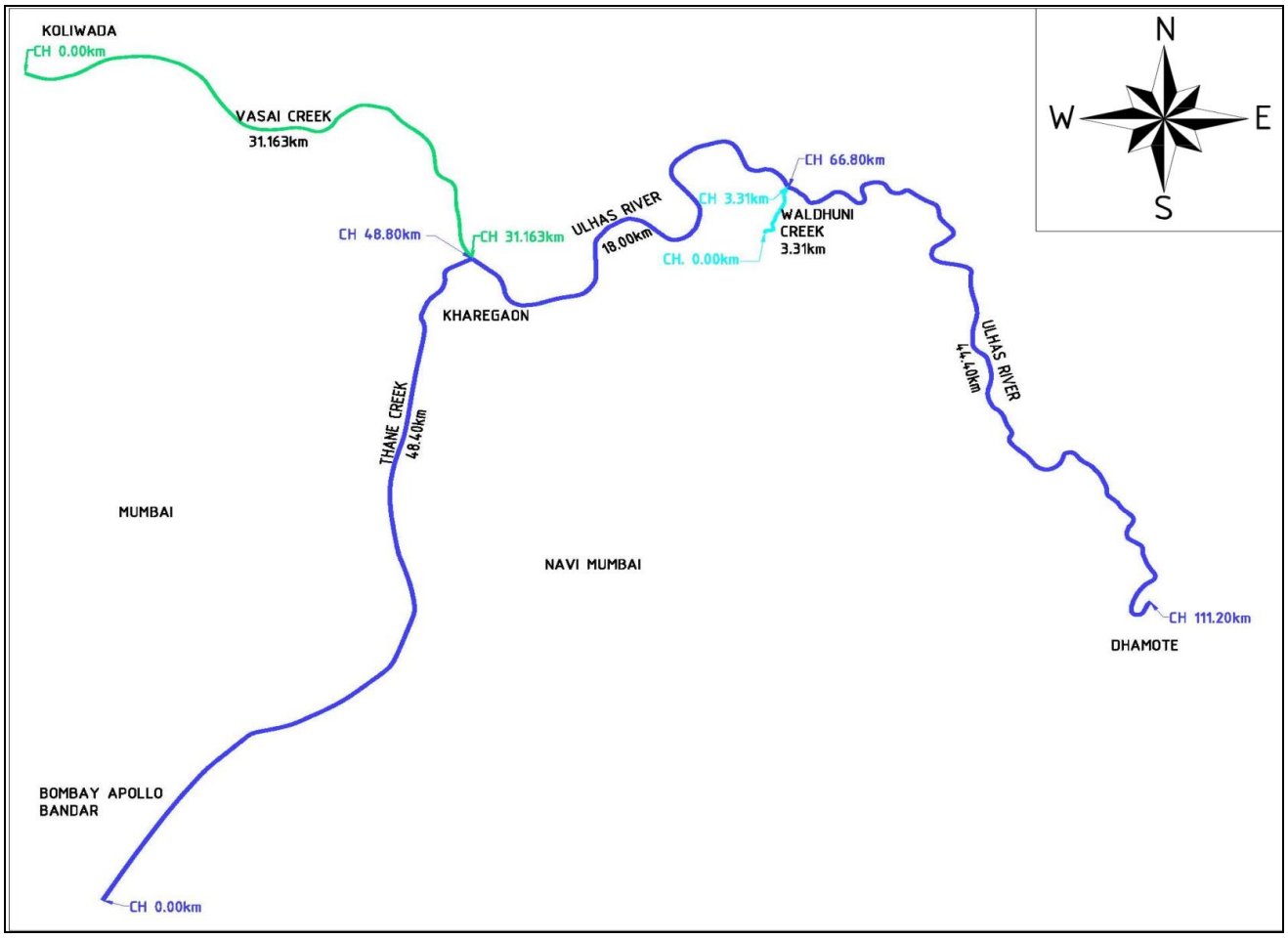
- Ro-Ro vessels:
  - JNPT/MbPT-Thane Creek section: 0.3 million TEU and 1.6 million vehicles (19.5 MMTPA)
  - Thane-Vasai section: 0.07 million TEU and 0.6 million vehicles (6.8 MMTPA)
  - Thane-Kalyan section: 0.24 million TEU and 0.01 million vehicles (3.0 MMTPA)
- Cement: 1 MMTPA
- Passenger ferry services demand of 58 lakhs passengers annually is expected to grow at 8 – 10 percent per year. Passenger Ferry points may be provided across Vasai Creek.
- Tourism: Tourism potential exists at Vasai, Vashi, Thane and Panju island water front areas.

There are limitations also on availability of Draft, limitations of moving cargo in city area, vertical clearances at few Railway and road bridges. The same have to be studied in detail. The modifications of Bridges may be very expensive, yet the returns on these investments over a longer period and savings in pollution, accidents and other benefits also need to be examined. This will be carried out at the DPR stage.

CHAPTER 5: OBSERVATIONS AND INFERENCES

5.1 Waterway Feasibility

The National Waterway NW-53 i.e., Kalyan-Thane- Mumbai Waterway, Vasai Creek and Ulhas River has been segregated into 3 parts and a line diagram (showing the same with the intermittent distance) has been placed herewith for reference.



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

1. The river length as given by IWAI is 145kms, whereas the total surveyed length to capture the thalweg is 111.2km along Kalyan-Thane-Mumbai Waterway and Ulhas River; 3.31kms along Waldhuni Creek and 31.163kms along Vasai Creek. (Total length is 145.673m). The deepest channel route has been reckoned

as 111.2km + 3.31km + 31.163Km. All inferences derived for identifying the navigable length have been derived with reference to the deepest channel length, as above.

7. The river is tidal affected for a majority of length under study especially in Thane Creek and Vasai Creek, wherein relevant chart datum have been used. In Thane Creek, with the presence of Check Dam at Ch 67.78km, navigation may have to be restricted at this location. 69.6% of the surveyed length of 67.78km in Thane Creek has water depth more than 2.0m, however not continuous (starting from 0.00km (confluence of river with Arabian Sea in the creek)). In Vasai Creek, 94% of the surveyed length of 31.163km has water depth more than 2.0m, however not continuous (starting from 0.00km (confluence of river with Arabian Sea in the creek)).
2. 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. The lengths of the waterway, with a depth more than 2.0m, 1.5m and 1.0m with reference to Chart Datum have been compiled in the main report. This is given in Table 3.29 for Kalyan-Thane-Mumbai Stretch; Table 3.31 for Waldhuni Creek stretch and Table 3.40 for Vasai Creek stretch of the report and are being reproduced below.

Maximum – Minimum Depth in Kalyan-Thane-Mumbai waterway via Ulhas River from Ch 0.00km to Ch 111.20km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-5	15.20	10.30	4.93	-	-	-
5-9	18.20	10.00	4.04	-	-	-
9-17	12.70	1.60	7.09	0.89	-	-
17-21	7.50	3.00	4.03	-	-	-
21-25	3.00	0.30	0.20	0.30	0.10	2.76
25-29	1.80	0.10	-	1.01	1.69	1.92
29-33	1.90	0.00	-	0.55	2.51	0.93
33-37	1.80	0.10	-	0.78	0.10	2.99
37-43	16.20	0.20	4.17	0.50	0.49	1.00
43-47	16.00	6.00	3.99	-	-	-
47-50	14.40	6.30	3.00	-	-	-
50-55	12.00	1.20	4.79	-	0.20	-
55-59	11.50	1.70	3.57	0.40	-	-
59-64	7.90	1.70	4.80	0.20	-	-
64-69	5.00	0.10	2.56	0.81	1.57	0.10
69-75	1.20	0.40	-	-	1.41	3.97
75-79	0.80	0.30	-	-	-	4.39

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
79-84	1.40	0.20	-	-	1.40	3.51
84-87	1.20	0.20	-	-	0.94	2.06
87-90	1.40	0.30	-	-	1.10	2.19
90-94	1.20	0.20	-	-	1.13	2.88
94-100	1.20	0.20	-	-	2.09	3.52
100-104	1.20	0.10	-	-	0.40	3.92
104-107	1.20	0.10	-	-	0.52	2.57
107-111.2	1.20	0.00	-	-	0.78	3.45
Total			**47.17**	**5.44**	**16.43**	**42.16**

Maximum – Minimum Depth in Waldhuni Creek from Ch 0.00km to Ch 3.33km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-0.71	0.40	0.20	-	-	-	0.71
0.71-3.31	2.70	0.20	0.16	-	1.17	1.27
Total			**0.16**	**0.00**	**1.17**	**1.98**

Maximum – Minimum Depth in Vasai Creek from Ch 0.00km to Ch 31.163km

Chainage (Km)	Depth Available		Length of River (Km)			
	Max. (m)	Min. (m)	>2m	1.5-2.0m	1-1.5m	<1m
0-4	16.50	0.70	2.80	0.30	0.70	0.20
4-8	6.20	1.00	3.30	0.20	0.30	0.20
8-11	7.20	3.60	3.00	-	-	-
11-15	36.70	5.70	4.00	-	-	-
15-19.5	39.40	4.60	4.50	-	-	-
19.5-24.5	12.60	4.60	5.00	-	-	-
24.5-29	15.30	5.80	4.50	-	-	-
29-31.163	10.40	5.80	2.16	-	-	-
Total			**29.26**	**0.50**	**1.00**	**0.40**

4. The inter connectivity of the stretches is before Ch 67.78km in Kalyan-Thane-Mumbai waterway and hence the navigability has been limited at Ch 67.78km. One Bridge @ Ch 30.00km may need to be modified, duly considering the single lane operation at the other cross structures. Two Railway Bridges in Vasai Creek may have to be maneuvered with partial raise in the structure and partial lowering the bed with lock type structure. Keeping in view the presence of Five Bridges in 3.31kms of Waldhuni Creek, the stretch may not be feasible.

5. One H. T. Line crossing the study stretch with the vertical clearance of 6m above MHWS, may have to be modified. The minimum vertical clearance required shall be 20.1m corresponding to 220kVA transmission line.

The description & classification of the waterway has been presented schematically based on the survey observation and duly keeping in view the river classification criteria in Table 3.59 to Table 3.61, as reproduced below.

Classification of Proposed Waterway for Kalyan-Thane-Mumbai via Ulhas River

Criteria	Classification																			
Length of waterway from start (km)	6	11	17	22	28	33	39	44	50	56	61	67	72	78	83	89	95	100	106	111
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	Class-V												Depth Not Available							
Raod Bridge Vert. Clearance	Class-III												Navigation Not Recommended							
Raod Bridge Hor. Clearance	All Class					Class-I														
HT Line Vert. Clearance	Class-II																			
Bend Radius	All Class																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

Classification of Proposed Waterway for Waldhuni Creek

Criteria	Classification									
Length of waterway from start (km)	0	0.7	1.0	1.3	1.7	2.0	2.3	2.6	3.0	3.3
Chainage length in %	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Depth availble	Class-II									
Raod Bridge Vert. Clearance	Clearance not available for Navigation									
Raod Bridge Hor. Clearance	Clearance not available for Navigation									
LT Line Vert. Clearance	N/A									
Bend Radius	Class-II									
Index	All Class		Class-V		Class-IV		Class-III		Class-II	

Classification of Proposed Waterway for Vasai Creek

Criteria	Classification																			
Length of waterway from start (km)	2	3	5	6	8	9	11	12	14	16	17	19	20	22	23	25	27	28	30	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	All Class																			
Raod Bridge Vert. Clearance	Class-I		Class-III																	
Raod Bridge Hor. Clearance	Class-III																			
HT Line Vert. Clearance	Class-III																			
Bend Radius	All Class																			
Index	All Class		Class-V		Class-IV		Class-III		Class-II		Class-I									

5.2 Cargo Feasibility

The Kalyan-Thane-Mumbai Waterway Stretch (including Vasai Creek and Ulhas River) is a long stretch in a region which is densely populated, industrialized and highly congested. As per preliminary estimation, the potential to divert the cargo traffic to IWT is significant. As per preliminary estimation about 20 MMTPA of cargo can be moved in this Creek/River stretch. The details of the same are as follows:

- Ro-Ro vessels:
    - JNPT/MbPT-Thane Creek section: 0.3 million TEU and 1.6 million vehicles (19.5 MMTPA)
    - Thane-Vasai section: 0.07 million TEU and 0.6 million vehicles (6.8 MMTPA)
    - Thane-Kalyan section: 0.24 million TEU and 0.01 million vehicles (3.0 MMTPA)
- Cement: 1 MMTPA
- Passenger ferry services demand of 58 lakhs passengers annually is expected to grow at 8 – 10 percent per year. Passenger Ferry points may be provided across Vasai Creek.
- Tourism: Tourism potential exists at Vasai, Vashi, Thane and Panju island water front areas.

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. 69.6% of the surveyed length of 67.78km in Thane Creek has water depth more than 2.0m, however not continuous. In Vasai Creek, 94% of the surveyed length of 31.163km has water depth more than 2.0m, however not continuous.
2. The above depth availability of more than 2m in 47.17km of 67.78km in Kalyan-Thane stretch and in 29.26km of 31.163km is strength and certain patches may be required to be attended with a considerable conservancy activity involving dredging.
3. The Creek is tidal affected under the study stretch of 67.78kms + 31.163kms. The maximum water level fluctuation of 4m has been observed and this will strengthen the safe mobility of vessels in the waterway.
4. Approximately 220 lacs of population in the catchment area will have direct or indirect benefits from the IWT and related projects coming up in the area.
5. Two major Ports in the study stretch will be a thrust for IWT.
6. The Existing Cargo movement in the Trombay jetty / Bhivandi Jetty / Ambuja's Captive Jetty will have some influence in IWT, on its development. Further, a considerable cargo is divertible from / to hinterland, as per the preliminary study.
7. Eleven Industrial Clusters within the nearby locations of study stretch is a push for IWT development.

8. Two major Fertilizer plants within the nearby reach are having the production capacity of 5.6 Lac MTPA.
9. Two major Refinery Units in the vicinity are having the production capacity of 20.55 MMTPA.
10. Cement mobility through IWT is observed and having a potential for growth.
11. Possible divertible traffic to IWT through Ro-Ro is a significant strength for development of IWT in the study stretch.
12. Divertible cargo has been identified and this will be a major strength to go ahead with the IWT development.
13. Twenty Seven Ferry Points commuting 58 lacs of passenger mobility with an estimated 8 % growth rate is an indication of future growth for IWT.
14. The Tourism potential in the study stretch is a boost for IWT development.
15. Kalyan Railway yard within 3 kms is a scope for development of Rail / IWT hub. Further, the Rail Network in the study area will have advantage for creating inter modal connectivity.
16. The Road Network in the study stretch is well connected through Asian Highway AH-47, National Highway NH-4B, NH-4C, NH-66, Eastern Express Way, Mumbai Pune Express Way and providing a scope for development of Intermodal connectivity.

Weakness

1. The present IWT movement may have to be geared up by additional Infrastructure.
2. Policies are to be firmed up for mobility of Hazardous Goods through IWT.
3. Policies are to be firmed up for Decongestion of choked Mumbai City Roads with IWT divertible Traffic.
4. Ro – Ro operations are to be established with proper intermodal connectivity.
5. The existing cross structures in the study area and its clearances for IWT mobility are not amenable.

Opportunity

1. 69.6% of the surveyed length of 67.78km in Thane Creek and 94% of the surveyed length of 31.163km in Vasai Creek are having water depth more than 2.0 m, which is an opportunity for IWT.
2. The above depth availability for 47.17km in 67.78km in Kalyan-Thane stretch and 29.26km in 31.163km is advantageous and the shallow patches are amenable for Dredging.
3. The Creek is tidal affected under the study stretch of 67.78kms + 31.163kms. The tidal fluctuation of 4.42m is an opportunity for safe mobility of vessels in the waterway.
4. The existing Infra structure in the study area like two major Ports; Trombay jetty / Bhivandi Jetty / Ambuja's Captive Jetty and other jetties will be an opportunity for IWT development.
5. The presence of Eleven Industrial Clusters; Two major Fertilizer plants; Two major Refinery Units in the vicinity of study stretch will be an opportunity for IWT development, if well planned.
6. The present Cement mobility through IWT can be expanded.
7. Possible divertible traffic to IWT through Ro-Ro is an opportunity, if well planned and also will decongest the Mumbai City Roads.

8. Twenty Seven Ferry Points, commuting 58 lacs of passengers with an estimated 8 % growth rate is an opportunity for future growth through IWT.
9. 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.
10. Policies are to be firmed up for development of IWT in this stretch.
11. Tourism may flourish in the Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River, if developed in a planned way.

Threat

1. The present Road connectivity through Asian Highway AH-47, National Highway NH-4B, NH-4C, NH-66, Eastern Express Way, and Mumbai Pune Express Way in the study area may be competing modes of transport, especially with respect to cargo traffic for the proposed waterway.
2. The present rail network also may pose some threats as an alternative mode of transport.
3. The Pipe lines, which are the alternate mode for liquid cargo is a threat.
4. Traverse of Pipe line carrying inflammable liquid cargo in the thick habitant area is a threat.
5. The mangrove trees on the banks of the study stretch may involve some socio-environmental issues and may require statutory approvals and clearances to construct the jetties/ terminals/ ports/ intermodal connectivity structures.

5.4 Development Cost (Tentative)

The reconnaissance survey data with regard to physical constraints may have cost implications for making the river stretch navigable. Henceforth, 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 22.5km 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 Ro – Ro Terminal has been estimated @ INR 10.0 crore each for five such Ro – Ro Terminals. One no. Bridge may have to be modified with reconstruction at an estimated cost of INR 2.5 crores each amounting to INR 2.5 crores. HT line crossing shall need modification which shall require two towers at the bank of requisite height and the stringing over pair of poles crossing the Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River. The cost of transmission tower has been estimated to be INR 20.00 lacs each and the stringing cost across the towers shall be INR 4.0 lacs per pair of towers. The total estimated cost for modification to the one HT Line shall be INR 1 x 44.0 lacs = INR 44 lacs. Two Railway Bridges in the Vasai Creek may have to be considered with a major semi Lock Type construction, which may be a capital expenditure in the order of INR 12 Crores. The cost of navigational aids for day/night navigation has been considered as INR 1060 lacs. 10% of the amount for

dredging, terminal construction, tower / bridge modification, the Lock Structure and night navigational aids have been envisaged as unforeseen. The tentative total cost of development to make the river navigable round the year to achieve safe navigation for the required classification of vessel mobility has been estimated to INR 106 Crores.

Table 5.1: Tentative Development Cost of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River (NW 53)

Sl No.	Name of Waterway	Length of Waterway	Dredging Required (wrt. 2 m draft & 40.0m width)	Dredging Cost @ INR 230/ cum	No. of Ro – Ro Terminals Proposed /Cost @ INR 10 Cr each	Cost of Modification of Bridge / Transmission line	Lock Structure	Night Navigation	Total cost incld. 10% unforeseen
		(km)	(km)	(INR in Cr.)	(Nos)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)	(INR in Cr.)
1	Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River	145.673	22.5	20.70	5 / 50.00	2.94	12.00	10.60	106.00

5.5 Classification of Waterway

The 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 Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River (NW 53) of 98.943km (67.78km in Thane Creek + 31.163km of Vasai Creek) 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 river. The classification of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River is described below.

Table 5.2: Classification of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River / (NW 53)

Chainage (km)	Minimum Depth (m)	Bottom Width (m)	Minimum Vertical Clearance (m)	Minimum Horizontal Clearance (m)	Bend Radius (m)	Classification of Waterway
0.0 – 67.78 (Thane Creek)	0.0	200.0	4.2 (Bridge) & 6.0 (H. T. Line)	20 (Bridge)	775	**Class – III**
0.0 – 31.163 (Vasai Creek)	0.7	200.0	3.43 (Bridge) & 10.0 (H. T. Line)	18.7 (Bridge)	690	**Class – III**

The study stretch of the waterway is amenable for development as Class III waterway as explained above. However, considerable Dredging may be required.

In order to consider the selected stretch as **Class III**, One Bridge and One HT Line are to be modified. Further, One Lock type structure may be required. The other cross structures is to be considered with single lane operation.

The above stretch of the waterway, hence, can be considered under Class III, which is navigable without any hindrance and shall be used for plying self-propelled vessel of carrying capacity up to 500 DWT (approximate size 58m overall length, 9m moulded breadth and 1.5m loaded draft) or one tug and two barges combination of 1000 DWT (approximate size 141m overall length, 9m breadth and 1.5m loaded draft).

5.6 Recommendation

The national waterway-53 of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River has been identified having potential for development as waterway of Class-III for a distance of 98.943km as described above. This stretch of the river 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-53 of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River is proposed for development as **Class III** waterway in the stretch of the waterway as depicted below (as at Table 3.62 to Table 3.64).

Stretch Name	Kalyan-Thane-Mumbai via Ulhas River		
River Stretch	0.00km	66.80km	111.20km
Classification			**NOT RECOMMENDED**
	Class III		
Horizontal clearance (m)	50		
Vertical clearnce (m)	7		
Minimum Depth(m)	1.7		
Bottom Width (m)	50		
Self Propelled Vessel			
Dead Weight Tonnage	500		
Vessel size (m)	(58 x 9 x 1.5)		
Tug + Barge			
Dead Weight Tonnage	1000		
Vessel size (m)	(141 x 9 x 1.5)		

Stretch Name	Waldhuni Creek	
River Stretch	0.00km	3.31km
Classification	**NOT RECOMMENDED**	
Horizontal clearance (m)		
Vertical clearnce (m)		
Minimum Depth(m)		
Bottom Width (m)		
Self Propelled Vessel		
Dead Weight Tonnage		
Vessel size (m)		
Tug + Barge		
Dead Weight Tonnage		
Vessel size (m)		

Stretch Name	Vasai Creek	
River Stretch	0.00km	31.20km
Classification		
	Class III	
Horizontal clearance (m)	50	
Vertical clearnce (m)	7	
Minimum Depth(m)	1.7	
Bottom Width (m)	50	
Self Propelled Vessel		
Dead Weight Tonnage	500	
Vessel size (m)	(58 x 9 x 1.5)	
Tug + Barge		
Dead Weight Tonnage	1000	
Vessel size (m)	(141 x 9 x 1.5)	

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.

Accordingly, the present Kalyan-Thane-Mumbai-waterway (Ch 0.00km to Ch 66.80km) and Vasai Creek (Ch 0.00km to Ch 31.20km) are navigable with **Class III** of waterway, wherein the Waldhuni Creek (Ch 0.00km to Ch 3.31km) is not recommended for navigability.

ANNEXURE 1.1

DATA COLLECTION & SOURCE OF DATA

Annexure 1.1: Data Collection 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

Annexure 1.1: Data Collection Source of Data

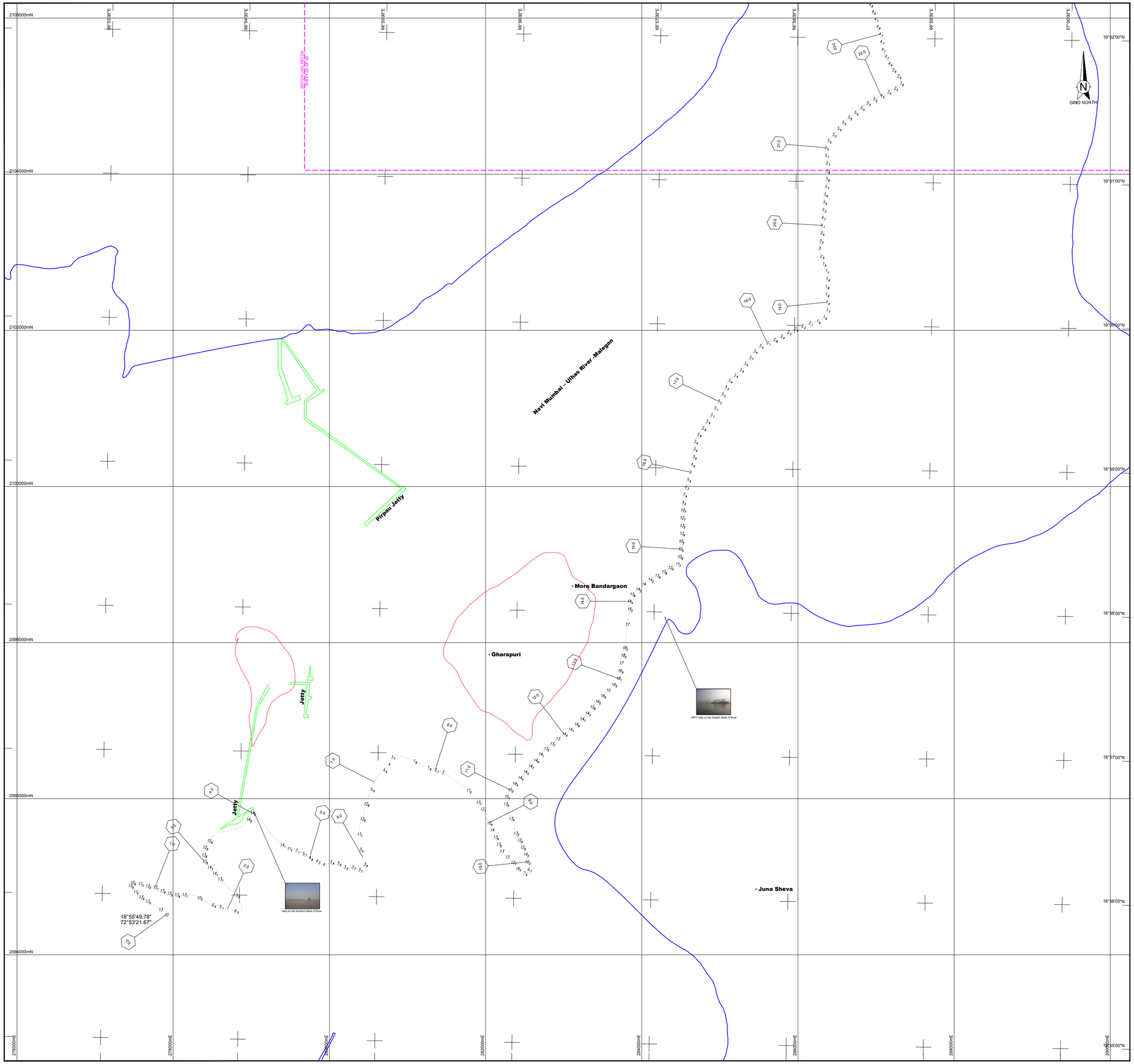
(Cluster-7)

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 KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER BATHYMETRY

BATHYMETRY



LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG VESSEL TRACK

BATHYMETRY

- 4_7 DEPTHS IN METRES BELOW CHART DATUM
- $\underline{1}_7$ HEIGHTS IN METRES ABOVE CHART DATUM

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHOAL/BAR/ISLAND
- BRIDGE
- BUOY

NOTES:

1) SURVEY VESSEL HEMAVATI 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.

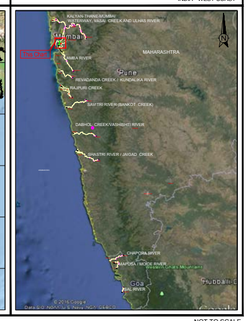
REFERENCE DRAWINGS

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
MUMBAI - 400 706, INDIA
TEL : +91 22 2762 9500 FAX : +91 22 2762 9140
(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

ANNEXURE 3.1
OVERVIEW CHART FOR NAVI MUMBAI - ULHAS RIVER - MALEGAON
RIVER BATHYMETRY
SHEET 01 OF 06

HORIZONTAL SCALE 1 : 20,000

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

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

Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	07/04/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No: 7451-01R0

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/01/7451

Encl: 01 OF 06

BATHYMETRY

Navi Mumbai - Ulhas River -Malegaon

*Ghansoli

*Vashi

*Mandala

*Navi Mumbai

MATCH LINE REFER SHEET 03 OF 06

MATCH LINE REFER SHEET 01 OF 06

Vashi Road bridge

High Tension line crossing River

Vashi Rail bridge

73°05'59"E 73°06'59"E 73°07'59"E 73°08'59"E 73°09'59"E 73°10'59"E 73°12'00"E

19°08'00"N 19°07'00"N 19°06'00"N 19°05'00"N 19°04'00"N 19°03'00"N 19°02'00"N

2116000mN 2114000mN 2112000mN 2110000mN 2108000mN 2106000mE

260000mE 262000mE 264000mE 266000mE 268000mE 270000mE 272000mE 274000mE

GRID NORTH

LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG VESSEL TRACK

BATHYMETRY

- 4₇ DEPTHS IN METRES BELOW CHART DATUM
- 1₃ HEIGHTS IN METRES ABOVE CHART DATUM

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHOAL/BAR/ISLAND
- BRIDGE
- BUOY

NOTES:

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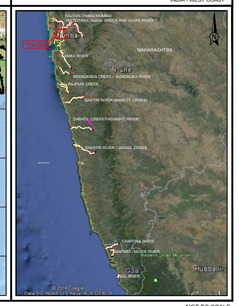
REFERENCE DRAWINGS

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,
DLF CYBER CITY,
GURGAON - 122002
HARYANA (INDIA)

SURVEY CONTRACTOR

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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

ANNEXURE 3.1
OVERVIEW CHART FOR NAVI MUMBAI - ULHAS RIVER - MALEGAON
RIVER BATHYMETRY
SHEET 02 OF 06

HORIZONTAL SCALE 1 : 20,000

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

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

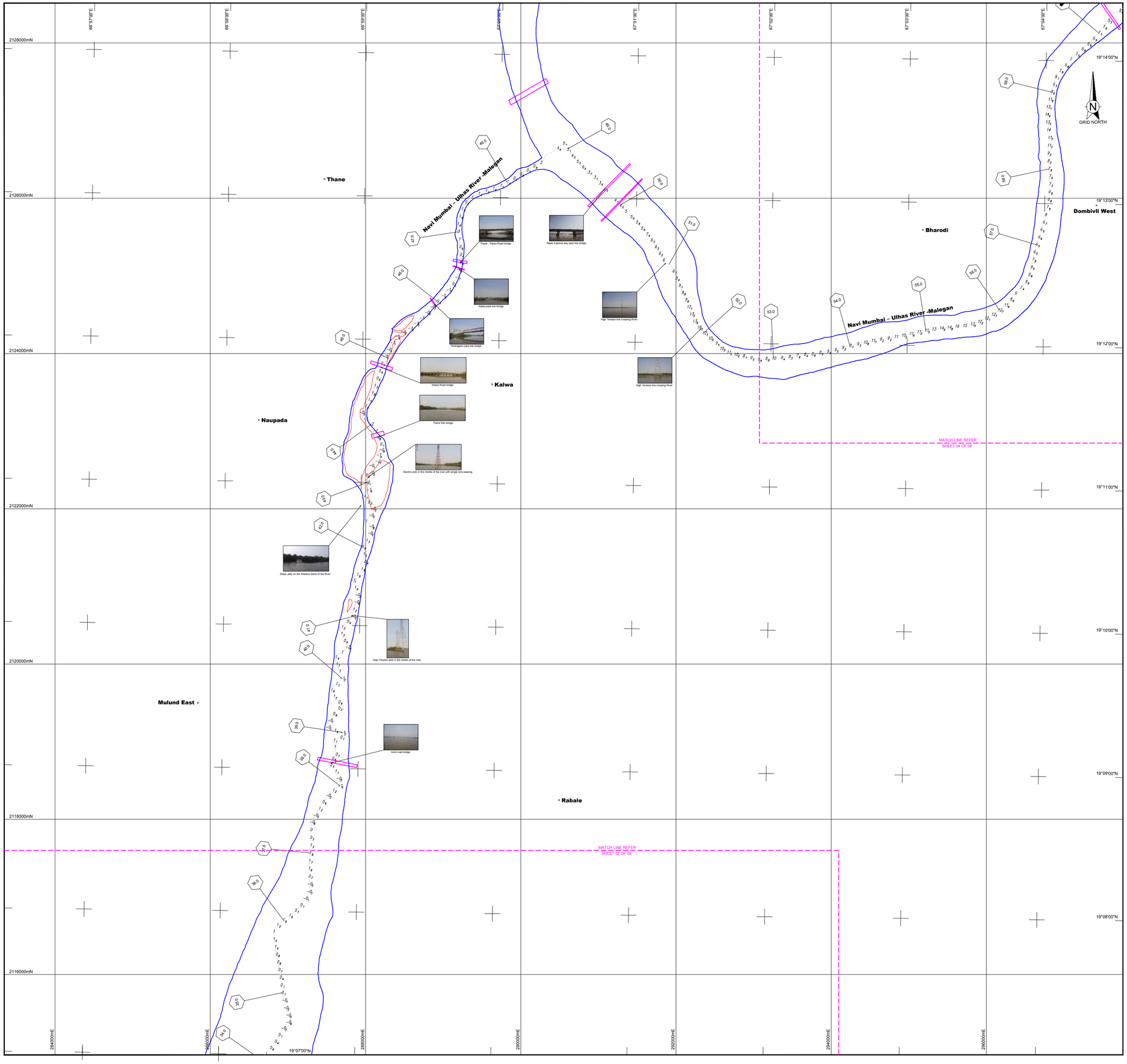
Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	07/04/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No: 7451-02R0

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/02/7451

Encl: 02 OF 06

BATHYMETRY



LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG VESSEL TRACK

BATHYMETRY

- 4₇ DEPTHS IN METRES BELOW CHART DATUM
- 1₇ HEIGHTS IN METRES ABOVE CHART DATUM

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHOAL/BAR/ISLAND
- BRIDGE
- BUOY

NOTES:

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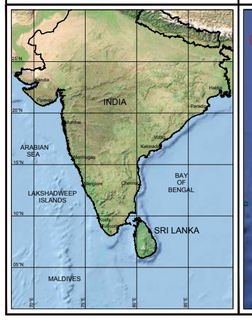
REFERENCE DRAWINGS

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

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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

ANNEXURE 3.1
OVERVIEW CHART FOR NAVI MUMBAI - ULHAS RIVER - MALEGAON
RIVER BATHYMETRY
SHEET 03 OF 06

HORIZONTAL SCALE 1 : 20,000

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

Vessel:- | Project Ref: J-MAR-16-012

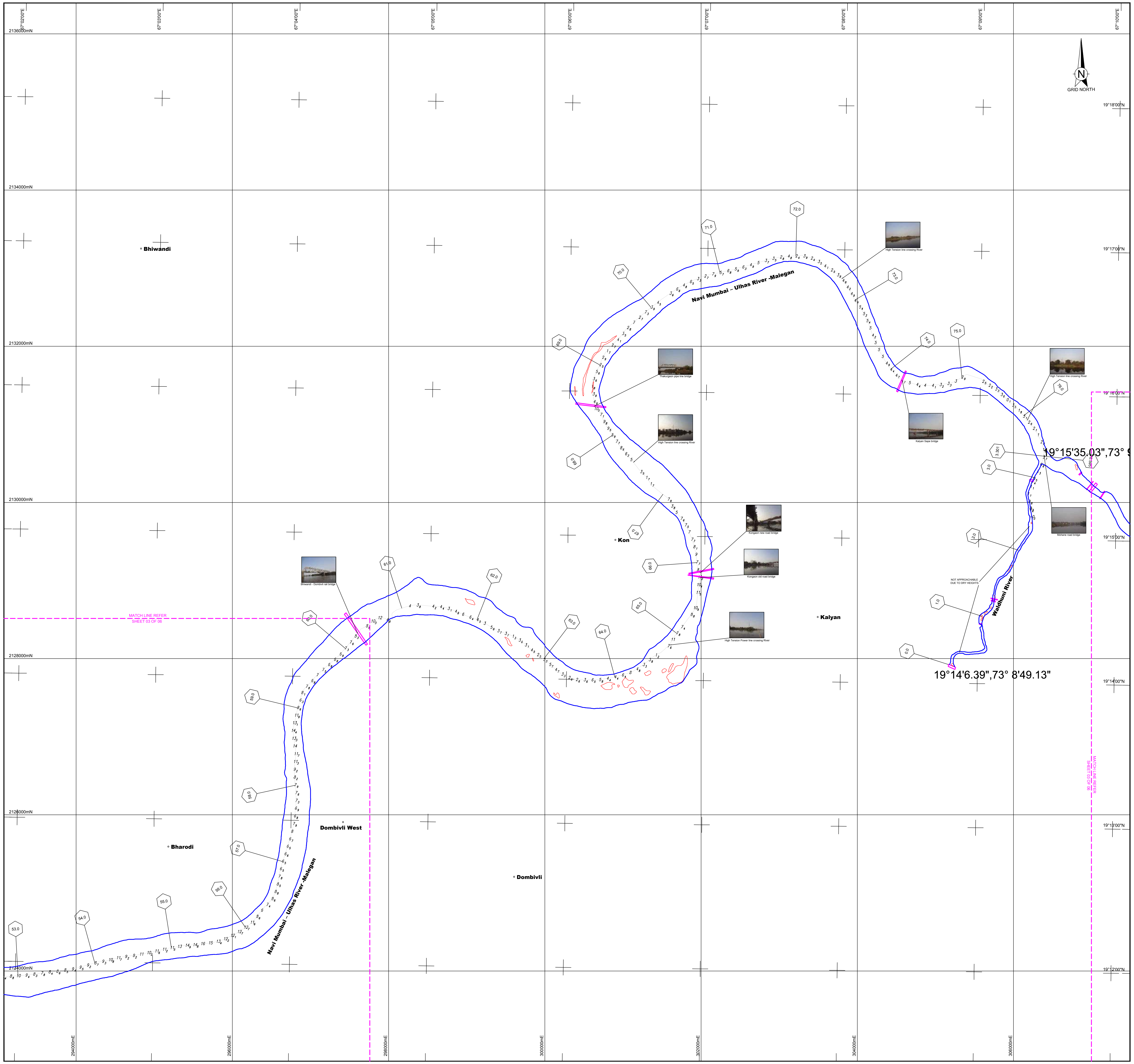
Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	07/04/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No: 7451-03R0

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/03/7451

Encl: 03 OF 06

BATHYMETRY



LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG VESSEL TRACK

BATHYMETRY

- 4_7 DEPTHS IN METRES BELOW CHART DATUM
- $\underline{1}_7$ HEIGHTS IN METRES ABOVE CHART DATUM

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHOAL/BAR/ISLAND
- BRIDGE
- BUOY

NOTES:

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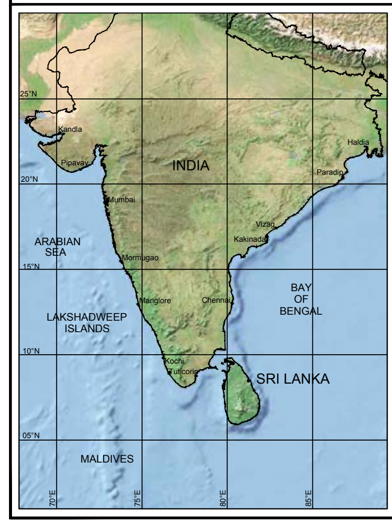
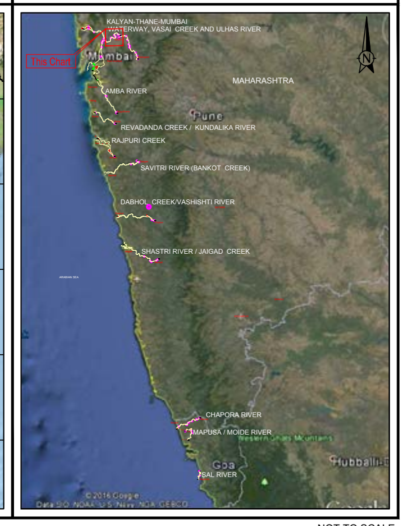
REFERENCE DRAWINGS

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

OVERVIEW PLAN



LAYOUT PLAN INDIA - WEST COAST



NOT TO SCALE

CLIENT

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PROJECT TITLE

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

FEBRUARY 2016

CHART SHOWING

ANNEXURE 3.1
OVERVIEW CHART FOR NAVI MUMBAI - ULHAS RIVER - MALEGAON AND WALDHUNI RIVER
RIVER BATHYMETRY
SHEET 04 OF 06

HORIZONTAL SCALE 1 : 20,000

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

Vessel:- | Project Ref: J-MAR-16-012

Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	07/04/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No:	Drawing No:	Encl:
7451-04R0	J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/04/7451	04 OF 06

BATHYMETRY

73°10'00"E
73°11'00"E
73°12'00"E
73°13'00"E
73°14'00"E
73°15'00"E
73°16'00"E
73°17'00"E
73°18'00"E

19°16'00"N
19°15'00"N
19°14'00"N
19°13'00"N
19°12'00"N
19°11'00"N
19°10'00"N
19°09'00"N

2130000mN
2128000mN
2126000mN
2124000mN
2122000mN
2120000mN
2118000mN

30000mE
31000mE
32000mE

GRID NORTH

* Goveli
* Kamba
* Dapivali
* Dhoke
* Badlapur

High tension wire crossing river
Three sets of high tension wire crossing river
Kalyan Rayatta Bridge
Temple with jetty on the right side
High Tension line crossing river
High Tension line crossing river
High Tension line crossing river
High Tension line crossing river
Upstream of the river from middle of the barrage
NOT APPROACHABLE DUE TO DRY HEIGHTS
Mahajangaon bridge
Badlapur Bridge and adjacent bridge
Badlapur bridge
Old broken barrage

MATCH LINE REFER SHEET 04 OF 06

MATCH LINE REFER SHEET 06 OF 06

LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

GEOGRAPHICAL GRATICULE INTERSECTION

CHAINAGE ALONG VESSEL TRACK

BATHYMETRY

DEPTHS IN METRES BELOW CHART DATUM

HEIGHTS IN METRES ABOVE CHART DATUM

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

RIVER BOUNDARY (DRAWN FROM GOOGLE)

SHOAL/BAR/ISLAND

BRIDGE

BUOY

NOTES:

1) SURVEY VESSEL HEMAVATI WAS DEPLOYED FOR THIS SURVEY IN FEBRUARY 2016.
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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

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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

ANNEXURE 3.1
OVERVIEW CHART FOR NAVI MUMBAI - ULHAS RIVER - MALEGAON
RIVER BATHYMETRY
SHEET 05 OF 06

HORIZONTAL SCALE 1 : 20,000

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

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

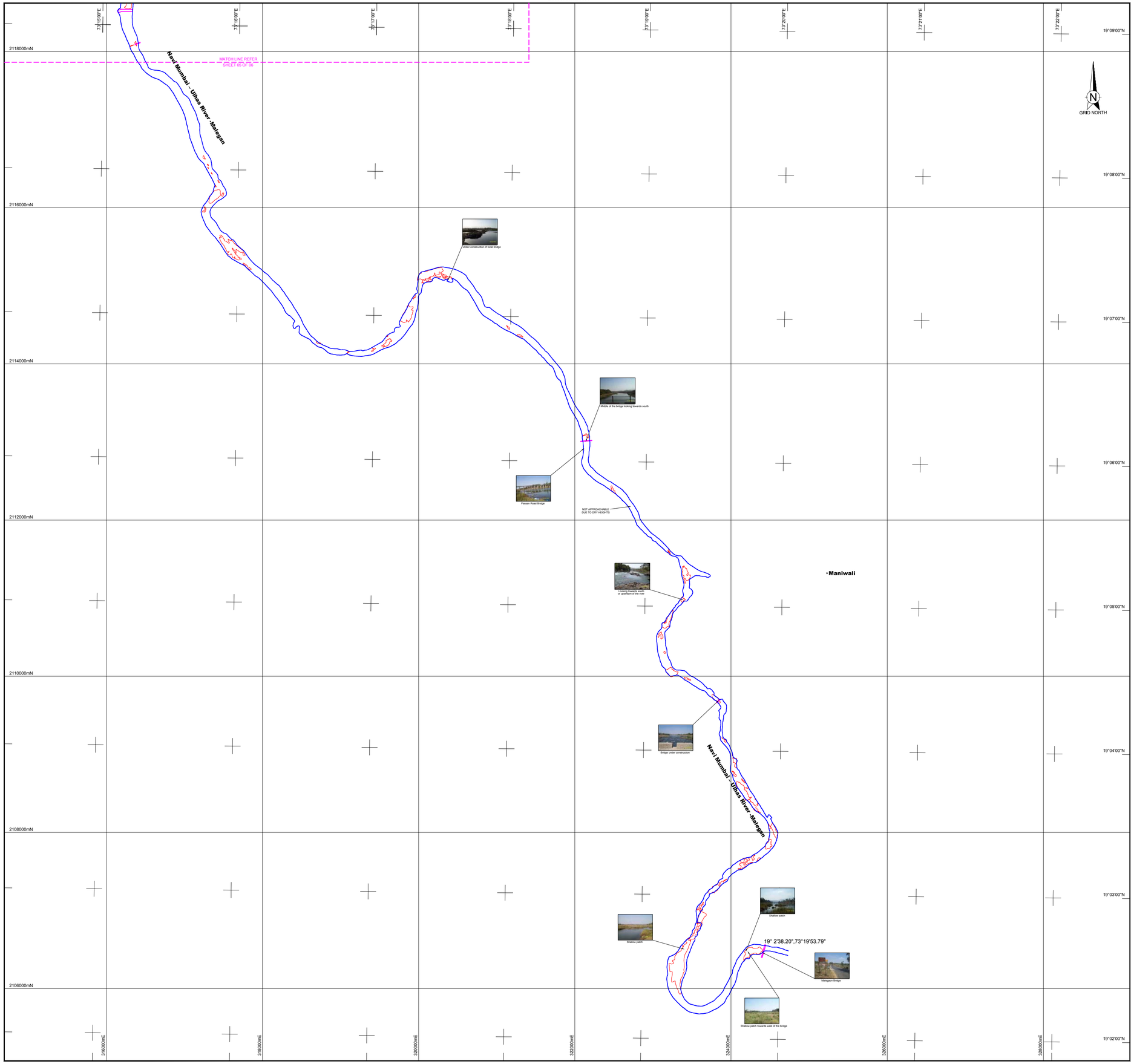
Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	07/04/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No: 7451-05R0

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/05/7451

Encl: 05 OF 06

BATHYMETRY



LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG VESSEL TRACK

BATHYMETRY

- DEPTHS IN METRES BELOW CHART DATUM
- HEIGHTS IN METRES ABOVE CHART DATUM

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHOAL/BAR/ISLAND
- BRIDGE
- BUOY

NOTES:

1) SURVEY VESSEL HEMAVATI 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
MUMBAI - 400 706, INDIA
TEL : +91 22 2762 9500 FAX : +91 22 2762 9140
(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

ANNEXURE 3.1
OVERVIEW CHART FOR NAVI MUMBAI - ULHAS RIVER - MALEGAON
RIVER BATHYMETRY
SHEET 06 OF 06

HORIZONTAL SCALE 1 : 20,000

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

Vessel:- | Project Ref: J-MAR-16-012

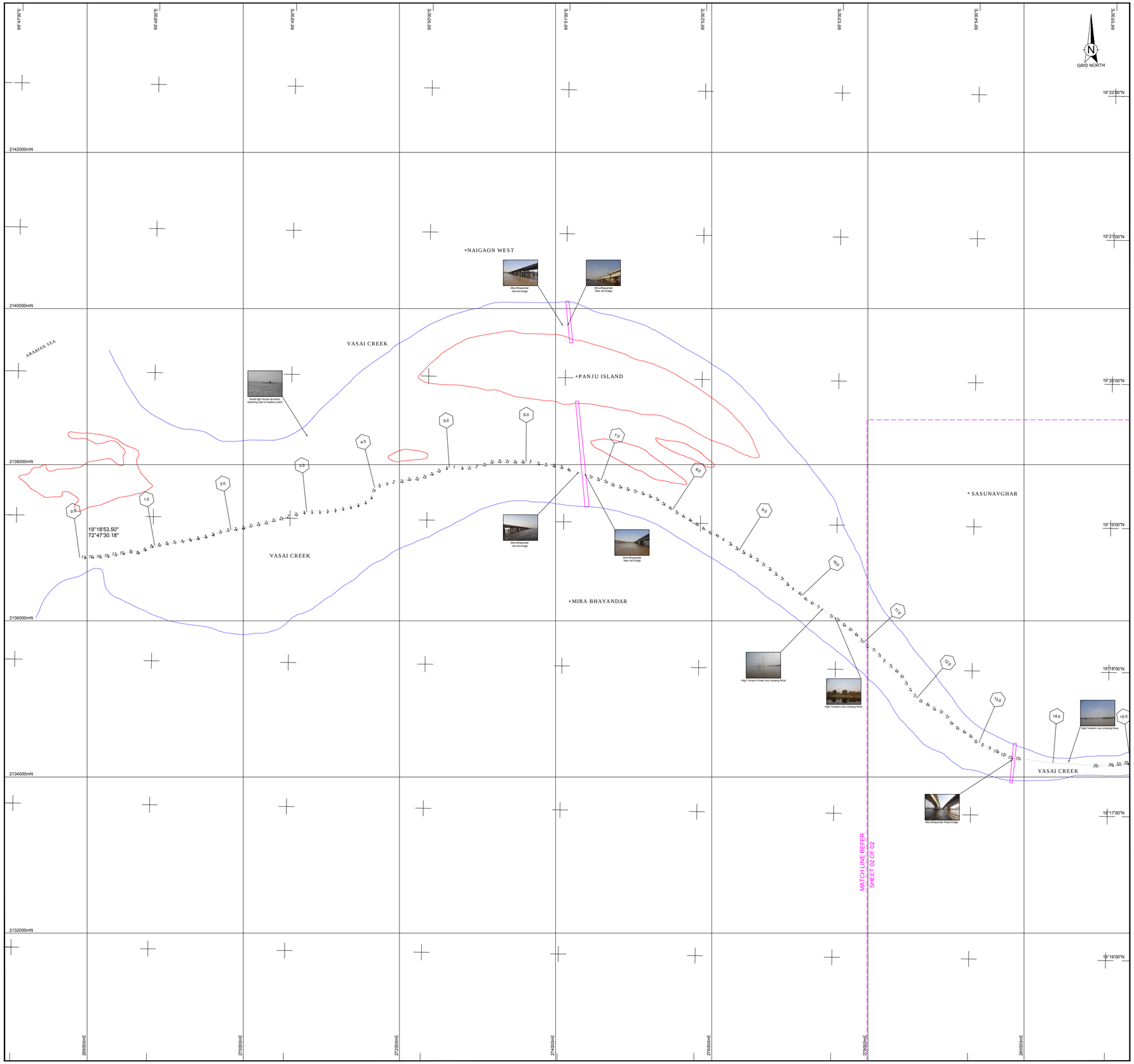
Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	07/04/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No: 7451-06R0

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/06/7451

Encl: 06 OF 06

BATHYMETRY



LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG CENTER LINE

BATHYMETRY

- 4.2 DEPTHS IN METRES BELOW CHART DATUM
- 1.2 HEIGHTS IN METRES ABOVE CHART DATUM
- 1.52 SPOT HEIGHTS W.R.T MSL

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHOAL / BAR / ISLAND
- BRIDGE
- BUOY
- JETTY

NOTES:

1) SURVEY VESSEL HEMAVATI WAS DEPLOYED FOR THIS SURVEY IN FEBRUARY 2016.
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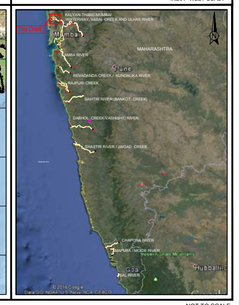
REFERENCE DRAWINGS

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

OVERVIEW PLAN

LAYOUT PLAN — INDIA - WEST COAST



NOT TO SCALE

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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

ANNEXURE 3.1
OVERVIEW CHART OF VASAI CREEK
RIVER BATHYMETRY
SHEET 01 OF 02

HORIZONTAL SCALE 1 : 20,000

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

Vessel:- | Project Ref: J-MAR-16-012

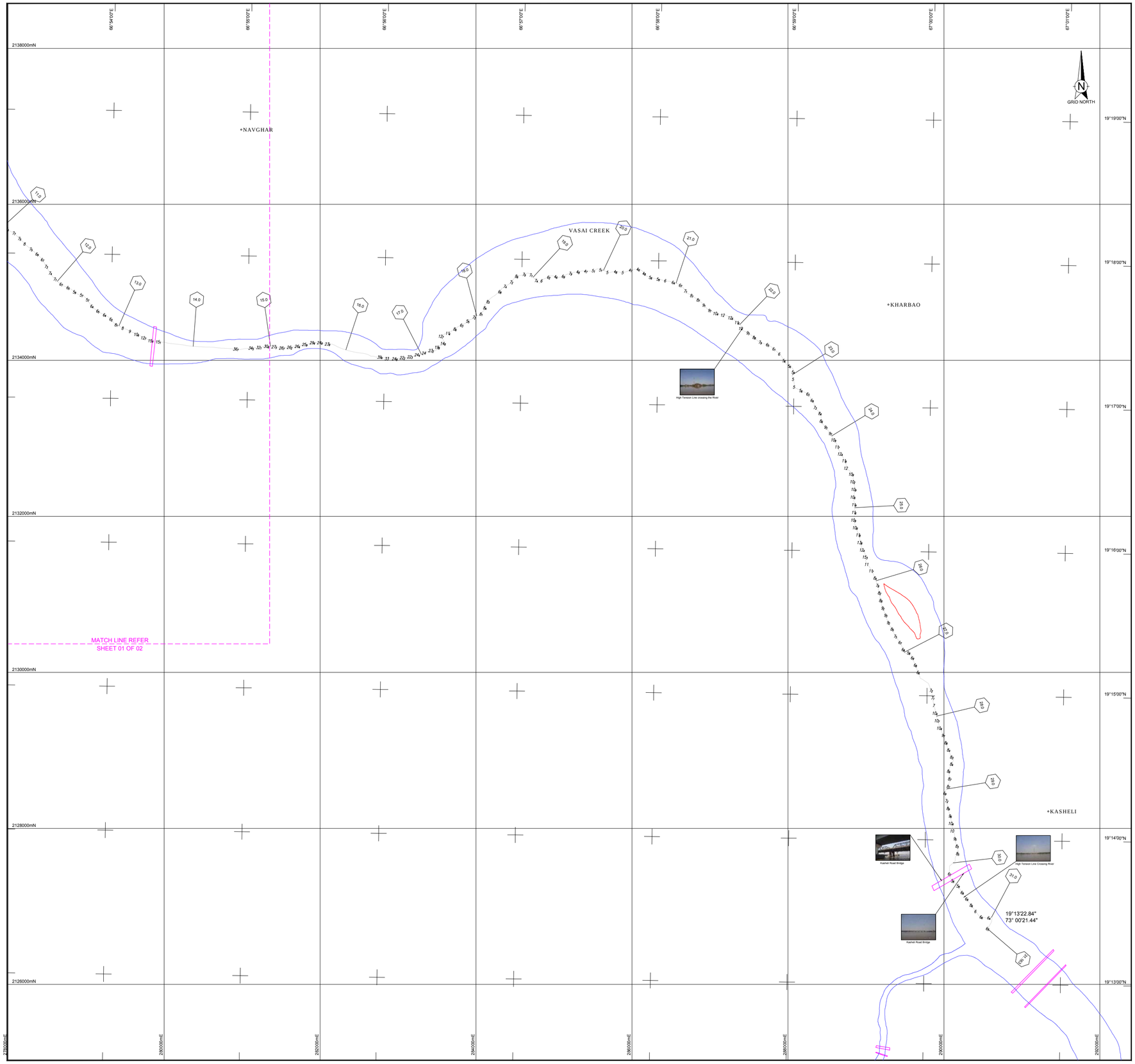
Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	22/07/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No: 7450-01R1

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B/01/7450

Encl: 19 OF 26

BATHYMETRY



LEGEND:

FEATURES IDENTIFIED FROM CURRENT SURVEY

GENERAL

- GEOGRAPHICAL GRATICULE INTERSECTION
- CHAINAGE ALONG CENTER LINE

BATHYMETRY

- DEPTHS IN METRES BELOW CHART DATUM
- HEIGHTS IN METRES ABOVE CHART DATUM
- 1.52 SPOT HEIGHTS W.R.T MSL

FEATURES OBTAINED FROM OTHER SOURCES (AS INDICATED)

- RIVER BOUNDARY (DRAWN FROM GOOGLE)
- SHOAL / BAR / ISLAND
- BRIDGE
- BUOY
- JETTY

NOTES:

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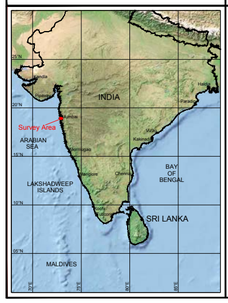
REFERENCE DRAWINGS

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

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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

ANNEXURE 3.1
OVERVIEW CHART OF VASAI CREEK
RIVER BATHYMETRY
SHEET 02 OF 02

HORIZONTAL SCALE 1 : 20,000

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

Vessel:- | Project Ref: J-MAR-16-012

Rev. No:	Date:	Description:	Surveyed :	Interpr:	Drawn:	Chkd:	Appr:
0	22/07/2016	ISSUED FOR APPROVAL	SD	--	RP/SG	KS/PM	MI

Drawing File No: 7450-02R1

Drawing No: J-MAR-16-012/TRACTEBELENGINEERING/MAHA/B/B-02/7450

Encl: 20 OF 26

ANNEXURE 3.2

CHART DATUM OF KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER FROM MMB

Vasai creek

3 Tid. Anal.

SURVEY OF INDIA

List of Harmonic Tidal Constants

Place Vasai (Bassein)

Latitude	Longitude L	Standard time S	Observational data	
			Length	Central day
19° 18' N	72° 48' E	I.S.T.	29 days	16. 3. 1948.

Notes :—

(1) Description of the tide-gauge site : At the junction of stream and Vasai (Bassein) Creek about 46 metres E of the Custom House.

(2) B.M. of reference : Flag stone second step leading to the main entrance of the Custom House.

(3) Height of chart datum { (a) below B.M. of reference 5.825 ft. m ; (b) above Zero of tide-gauge −0.501 ft. m }

	H	g		H	g		H	g		H	g
	ft. m	°		ft. m	°		ft. m	°		ft. m	°
S_o *	2.029	—	$2Q_1$			OQ_2			MO_3	0.013	105.6
Z_o †	2.530	—	σ_1			MNS_2			M_3	0.015	57.3
			Q_1	0.049	16.8	$2N_2$	0.037	304.0	SO_3		
Sa	0.037	284.9	ρ_1			μ_2	0.048	324.2	MK_3	0.008	293.0
Ssa	0.040	193.5	O_1	0.214	50.3	N_2	0.259	346.8	SK_3		
Mm	0.074	93.8	MP_1			ν_2	0.050	299.5			
Msf	0.032	356.6	M_1			OP_2			MN_4	0.028	283.4
Mf			χ_1			M_2	1.200	6.4	M_4	0.085	305.7
			π_1			MKS_2			SN_4		
			P_1	0.157	58.8	λ_2			MS_4	0.059	17.1
			S_1	0.003	59.6	L_2	0.018	141.2	MK_4	0.016	20.2
			K_1	0.481	59.5	T_2	0.026	43.3	S_4		
			ψ_1			S_2	0.440	44.8	SK_4		
			ϕ_1			R_2					
			θ_1			K_2	0.119	47.9	$2MN_6$	0.005	39.4
			J_1	0.028	53.6	MSN_2			M_6	0.005	102.5
			SO_1			KJ_2			MSN_6		
			OO_1			$2SM_2$	0.008	228.0	$2MS_6$	0.008	57.7
									$2MK_6$		
									$2SM_6$	0.003	96.0
									MSK_6		

SURVEY OF INDIA

List of Harmonic Tidal Constants

Place Bombay (Apollo Bandar)

Latitude			Longitude L			Standard time S	Observational data	
°	′	″	°	′	″		Length	Central day
18	55	N	72	50	E	I.S.T.	One year	1st July 1952

Notes :—

(1) Description of the tide-gauge site :

(2) B.M. of reference : A.D. 1877 G.T.S. □ M.B. Cut on one of the stone flags, forming the pavem^nt round a circular well at the N E Corner of the Bandar, a few inches ~~to~~ north of the parapet well.

(3) Height of chart datum
(a) below B.M. of reference 6.684 ft. ~~m~~
(b) above Zero of tide-gauge 0.609 ft. ~~m~~

Lowest Astronomical Tide - Bombay = -0.25 meters below C.D.
as per [illegible] letter No. ~~[illegible]~~
B66/42-E-2/Tidal dtd 9/4/56.

	H	g		H	g		H	g		H	g
	ft. ~~m~~	°		~~ft.~~ m	°		ft. ~~m~~	°		ft. ~~m~~	°
S_0 *	3.124	–	$2Q_1$	0.006	33.4	OQ_2	0.009	121.2	MO_3	0.016	99.6
Z_0 †	2.515	–	σ_1	0.013	78.8	MNS_2	0.012	279.8	M_3	0.020	45.5
			Q_1	0.041	58.0	$2N_2$	0.054	280.8	SO_3	0.011	200.7
Sa	0.043	33.1	ρ_1	0.008	55.9	μ_2	0.062	319.1	MK_3	0.008	191.0
Ssa	0.036	187.4	O_1	0.201	51.8	N_2	0.287	326.5	SK_3	0.031	241.7
Mm	0.017	145.7	MP_1	0.009	79.4	ν_2	0.053	318.2			
Msf	0.009	184.5	M_1	0.014	49.9	OP_2	0.015	103.7	MN_4	0.007	296.1
Mf	0.016	28.0	χ_1	0.006	32.9	M_2	1.227	345.4	M_4	0.035	331.6
			π_1	0.011	45.2	MKS_2	0.018	253.6	SN_4	0.001	1.7
			P_1	0.118	55.7	λ_2	0.005	13.8	MS_4	0.032	42.6
			S_1	0.021	183.9	L_2	0.029	328.2	MK_4	0.009	4.6
			K_1	0.425	55.5	T_2	0.030	43.9	S_4	0.006	297.3
			ψ_1	0.003	104.8	S_2	0.479	24.6	SK_4	0.003	210.5
			ϕ_1	0.009	52.1	R_2	0.012	327.6			
			θ_1	0.003	25.3	K_2	0.130	14.1	$2MN_6$	0.007	48.9
			J_1	0.033	78.5	MSN_2	0.013	74.0	M_6	0.007	61.7
			SO_1	0.008	172.9	KJ_2	0.009	166.5	MSN_6	0.002	95.5
			OO_1	0.022	97.8	$2SM_2$	0.014	139.1	$2MS_6$	0.007	68.6
									$2MK_6$	0.006	66.5
									$2SM_6$	0.002	164.7
									MSK_6	0.002	69.2

* S_0 = Height of mean-sea-level above Zero of tide-gauge.

3 Tid. Anal.

SURVEY OF INDIA

List of Harmonic Tidal Constants

Place Kasheli Bridge

Latitude	Longitude L	Standard time S	Observational data: Length	Observational data: Central day
19 14 N	73 00 E	I.S.T.	29 days	15.4.1967

Notes :—

(1) Description of the tide-gauge site: On the second concrete pile from West of Kasheli Bridge on Thāna-Bhivandi Road carrying water pipe lines from Thāna lake.

(2) B.M. of reference: G.T.S. Bom — on concrete plinth N. of a concrete watch post on S. end of the Kasheli Bridge over Ulhās River on Thāna-Bhivandi Road, towards W. side of the bridge and 2.3 metres W. of the W. abutment of the bridge.

(3) Height of chart datum: (a) below B.M. of reference 6.083 m.; (b) above Zero of tide-gauge 0.369 m.

	H	g		H	g		H	g		H	g
	ft. m	°		ft. m	°		ft. m	°		ft. m	°
S_0 *	2.726		$2Q_1$	0.004	32.7	OQ_2			MO_3	0.033	142.6
Z_0 †	2.357		σ_1	0.001	32.7	MNS_2			M_3	0.011	133.6
			Q_1	0.033	43.1	$2N_2$	0.034	1.8	SO_3		
Sa			ρ_1			μ_2	0.050	90.3	MK_3	0.052	45.7
Ssa			O_1	0.169	53.5	N_2	0.256	18.9	SK_3		
Mm	0.158	326.7	MP_1			ν_2	0.050	18.9			
Msf	0.129	32.3	M_1	0.014	112.0	OP_2			MN_4	0.061	324.7
Mf			χ_1			M_2	1.165	36.0	M_4	0.133	347.8
			π_1	0.008	84.7	MKS_2			SN_4	0.022	26.0
			P_1	0.141	84.7	λ_2			MS_4	0.092	32.0
			S_1			L_2	0.149	317.0	MK_4		
			K_1	0.426	84.7	T_2	0.023	78.8	S_4		
			ψ_1	0.003	84.7	S_2	0.386	78.8	SK_4		
			ϕ_1	0.006	84.7	R_2					
			θ_1			K_2	0.105	78.8	$2MN_6$	0.016	183.5
			J_1	0.020	147.6	MSN_2			M_6	0.020	200.1
			SO_1			KJ_2			MSN_6	0.010	258.3
			OO_1	0.015	230.6	$2SM_2$	0.025	262.7	$2MS_6$	0.019	209.7
									$2MK_6$		
									$2SM_6$	0.008	236.8
									MSK_6		

* S_0 = Height of mean-sea-level above Zero of tide-gauge.

Thana 1968 54

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3 Tid. Anal.

SURVEY OF INDIA

List of Harmonic Tidal Constants

Place Thana Salt Bandar

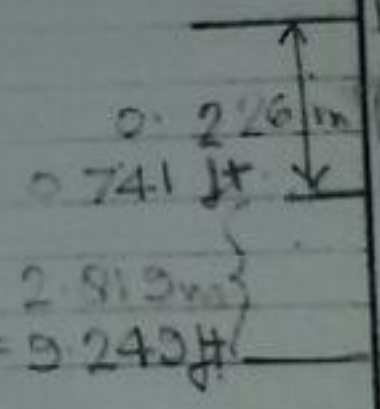
Latitude	Longitude L	Standard time S	Observational data: Length	Observational data: Central day
19 11 N	72 59 E	I.S.T	29 days	15.4.1967

Notes :—

(1) Description of the tide-gauge site : On E. side of the northern most sloping jetties at Salt Bandar Thāna.

(2) B.M. of reference : BM 0 on slope on S. side of the northern most sloping jetty, 50 cms E. of the NE. Corner of the wharf at Salt Bandar Thāna.

(3) Height of chart datum
(a) below B.M. of reference 3.045 m
(b) above Zero of tide-gauge 0.432 m



	H	g		H	g		H	g		H	g
	ft. m	°		ft. m	°		ft. m	°		ft. m	°
S_o *	3.251		$2Q_1$	0.004	39.3	OQ_2			MO_3	0.048	108.4
Z_o †	2.819		σ_1	0.001	39.3	MNS_2			M_3	0.018	136.6
			Q_1	0.034	45.3	$2N_2$	0.042	320.8	SO_3		
Sa			ρ_1			μ_2	0.088	6.6	MK_3	0.042	315.8
Ssa			O_1	0.175	51.3	N_2	0.315	339.2	SK_3		
Mm	0.156	307.2	MP_1			ν_2	0.061	339.2			
Msf	0.083	33.4	M_1	0.015	74.2	OP_2			MN_4	0.021	221.0
Mf			χ_1			M_2	1.407	357.6	M_4	0.021	256.9
			π_1	0.008	69.8	MKS_2			SN_4	0.022	284.3
			P_1	0.151	69.8	λ_2			MS_4	0.008	100.2
			S_1			L_2	0.094	323.2	MK_4		
			K_1	0.456	69.8	T_2	0.032	38.4	S_4		
			ψ_1	0.004	69.8	S_2	0.542	38.4	SK_4		
			ϕ_1	0.006	69.8	R_2					
			θ_1			K_2	0.148	38.4	$2MN_6$	0.010	331.4
			J_1	0.021	123.7	MSN_2			M_6	0.029	20.6
			SO_1			KJ_2			MSN_6	0.021	65.9
			OO_1	0.025	165.8	$2SM_2$	0.031	184.9	$2MS_6$	0.039	34.8
			Σ			Σ			$2MK_6$		
									$2SM_6$	0.014	91.7
									MSK_6		

* S_o = Height of mean-sea-level above Zero of tide-gauge.
† Z_o = " " " chart datum.

Copied by:-

Thane creek

3 ज्वार विश्लेषण
3 Tid. Anal.

भारतीय सर्वेक्षण विभाग
SURVEY OF INDIA

पृष्ठ
Page 101

सं० पार्टी ( ) सीजन 19
No. 66 (Tidal) Party (GBRB) Season 1992 93

प्रसंवादी ज्वारीय स्थिरांकों की सूची
List of Harmonic Tidal Constants

स्थान
Place VASHI ROAD BRIDGE BOMBAY.

अक्षांश Latitude	रेखांश Longitude L	मानक समय Standard time S	प्रेक्षण सामग्री Observational data	
			लम्बाई Length	मध्यवर्ती दिन Central day
19° 03' 45"	72° 58' 30"	I.S.T.	32 days	23 11 92

टिप्पणियां
Notes :—

(1) ज्वार-माप स्थल का विवरण : TP sites at Thana Creek Bridge, Vashi New Bombay.
Description of the tide-gauge site:

(2) सन्दर्भ का त० चि० B.M. of reference : BOM Engraved on centre of R.C.C. plateform under the east abutment at Thane creek old road bridge at VASHI.

(3) आधार चार्ट की ऊंचाई Height of chart datum
(क) सन्दर्भ के तल चि० से नीचे मी
(a) below B.M. of reference + 2.658 m.
(ख) ज्वार माप के शून्य के ऊपर मी
(b) above Zero of tide-gauge m
C.D. = 0.000 m

	H	g		H	g		H	g		H	g
S_o *	m 2.076	°	$2Q_1$	m 0.050	° 35.16	OQ_2	m	°	MO_3	m 0.027	° 24.47
Z_o †	2.9420		σ_1	0.0014	35.16	MNS_2			M_3	0.0276	47.65
			Q_1	0.0446	47.52	$2N_2$	0.0444	322.60	SO_3		
Sa	0.0490	349.21	ρ_1			μ_2	0.0663	352.80	MK_3	0.0111	141.11
Ssa	0.0350	246.90	O_1	0.2004	59.28	N_2	0.3340	335.87	SK_3		
Mm	0.0618	211.31	MP_1			ν_2	0.0648	335.69			
Msf	0.0064	219.16	M_1	0.0093	79.22	OP_2			MN_4	0.0133	128.25
Mf			χ_1			M_2	1.3274	341.35	M_4	0.0246	38.29
			π_1	0.0078	57.04	MKS_2			SN_4	0.0132	151.04
			P_1	0.1365	57.04	λ_2			MS_4	0.0303	116.28
			S_1			L_2	0.0210	332.69	MK_4		
			K_1	0.4124	57.04	T_2	0.0317	31.01	S_4		
			ϕ_1	0.0033	57.04	S_2	0.3379	31.01	SK_4		
			ψ_1	0.0038	57.04	R_2					
			θ_1			K_2	0.1463	31.01	$2MN_6$	0.0180	297.00
			J_1	0.0279	107.43	MSN_2			M_6	0.0330	288.91
			SO_1			KJ_2			MSN_6	0.0203	311.42
			OO_1	0.0092	86.65	$2SM_2$	0.0267	148.76	$2MS_6$	0.0352	358.92
									$2MK_6$		
									$2SM_6$	0.0195	37.54
									MSK_6		

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

Contd

ANNEXURE 3.3

DIGITAL DATA, CHAINAGE VS WATER DEPTH, TOPOGRAPHIC SURVEY

Annexure 3.3a: Digital Data, Chainage vs Water Depth, Bathymetric Survey of Kalyan-Thane-Ulhas River

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
0.47	2094731.20	278330.63	13.10	10.30
0.83	2094972.20	278596.26	16.38	13.70
1.79	2095359.19	279480.24	13.47	11.10
2.71	2095548.44	280376.32	13.72	11.70
4.29	2095954.59	281904.34	14.83	13.10
4.73	2096116.59	282312.38	16.62	15.20
4.83	2096196.23	282371.97	15.82	14.40
4.93	2096268.53	282441.03	15.85	14.40
5.03	2096343.25	282507.48	15.75	14.30
5.13	2096418.00	282573.86	16.19	14.70
5.23	2096493.41	282639.49	16.30	14.80
5.33	2096570.08	282703.66	15.60	14.10
5.43	2096644.31	282770.62	14.75	13.20
5.53	2096705.13	282849.76	14.63	13.10
5.63	2096768.72	282926.81	14.58	13.00
5.73	2096831.09	283004.70	16.00	14.40
5.83	2096890.52	283085.05	15.76	14.10
5.93	2096954.42	283161.82	16.23	14.60
6.03	2097022.40	283235.04	16.37	14.70
6.13	2097096.16	283302.25	15.83	14.20
6.23	2097175.04	283363.42	17.54	15.80
6.33	2097247.23	283432.57	17.93	16.20
6.43	2097321.09	283499.86	18.24	16.50
6.53	2097390.06	283572.16	16.72	15.00
6.63	2097464.51	283638.86	18.03	16.30
6.73	2097543.21	283699.69	19.86	18.10
6.83	2097640.90	283720.50	18.71	16.90
6.93	2097739.28	283738.31	18.78	17.00
7.03	2097837.06	283759.19	20.04	18.20
7.13	2097934.86	283780.05	20.03	18.20
7.43	2098232.67	283813.91	18.84	17.00
7.63	2098430.75	283840.70	17.06	15.20
7.73	2098530.39	283842.19	16.33	14.40
7.82	2098621.23	283873.45	15.75	13.80
7.91	2098684.70	283950.66	16.12	14.20
8.01	2098749.61	284026.64	15.93	14.00
8.11	2098807.08	284108.42	16.25	14.20
8.21	2098858.30	284194.17	15.95	13.90
8.31	2098910.99	284279.13	15.83	13.80
8.67	2099200.03	284492.08	12.14	10.00
8.77	2099299.69	284500.13	12.59	10.50
8.87	2099399.09	284510.36	15.74	13.60
8.97	2099499.05	284512.65	15.72	13.50
9.07	2099599.03	284514.62	14.91	12.70
9.17	2099698.65	284522.62	12.96	10.70
9.27	2099798.58	284525.07	11.72	9.50
9.37	2099897.88	284536.13	10.19	7.90
9.47	2099994.44	284561.37	8.62	6.30
9.57	2100090.36	284589.42	7.73	5.40
9.67	2100185.09	284621.26	7.31	5.00
9.77	2100283.29	284639.88	6.76	4.40
9.87	2100381.06	284660.81	6.28	3.90

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
9.97	2100480.30	284671.08	5.80	3.40
10.07	2100579.13	284678.60	5.05	2.60
10.17	2100669.00	284721.69	5.31	2.90
10.27	2100749.92	284780.40	5.35	2.90
10.37	2100834.83	284833.19	5.42	2.90
10.47	2100917.87	284888.83	5.57	3.10
10.57	2101005.92	284935.23	5.65	3.10
10.67	2101094.36	284981.81	5.77	3.20
10.77	2101182.26	285029.35	5.86	3.30
10.87	2101272.03	285073.17	5.95	3.30
10.97	2101358.72	285119.91	6.03	3.40
11.07	2101428.26	285191.32	6.04	3.40
11.17	2101496.98	285263.73	5.97	3.30
11.27	2101578.44	285320.63	6.18	3.50
11.37	2101653.97	285385.46	6.40	3.70
11.47	2101736.60	285441.21	6.13	3.40
11.57	2101801.71	285515.32	6.08	3.30
11.67	2101841.51	285607.04	5.87	3.10
11.77	2101881.84	285698.53	5.58	2.80
11.87	2101924.81	285788.69	5.23	2.40
11.97	2101977.32	285873.78	5.14	2.30
12.07	2102019.87	285964.01	5.11	2.20
12.17	2102056.38	286057.06	5.16	2.20
12.76	2102562.98	286360.30	4.90	1.80
12.86	2102662.61	286367.79	4.89	1.80
12.96	2102760.59	286356.86	4.80	1.70
13.06	2102854.83	286323.45	4.77	1.60
13.15	2102950.88	286296.08	5.70	2.50
13.27	2103048.73	286275.97	6.18	3.00
13.37	2103147.71	286286.18	6.49	3.20
13.47	2103246.98	286295.96	6.75	3.50
13.57	2103346.77	286301.84	7.39	4.10
13.67	2103446.35	286310.61	8.00	4.70
13.77	2103545.76	286321.06	8.61	5.30
13.87	2103645.11	286332.20	8.92	5.60
13.97	2103744.53	286342.76	9.02	5.60
14.07	2103843.80	286354.69	9.10	5.70
14.17	2103943.14	286364.67	9.18	5.80
14.27	2104043.05	286367.75	9.19	5.80
14.37	2104143.00	286368.37	9.20	5.70
15.02	2104730.35	286652.33	9.14	5.50
15.12	2104791.02	286731.80	9.17	5.50
15.22	2104850.51	286812.17	9.12	5.50
15.32	2104912.47	286890.57	9.16	5.50
16.03	2105598.07	287078.38	8.60	4.70
16.13	2105696.56	287061.90	8.58	4.70
16.23	2105795.17	287046.34	8.56	4.70
16.34	2105890.48	287016.15	8.51	4.60
16.44	2105986.47	286988.17	8.58	4.70
16.54	2106080.89	286955.40	8.56	4.60
16.65	2106174.49	286920.99	8.55	4.60
16.75	2106265.90	286880.53	8.44	4.50
16.85	2106360.11	286847.05	8.40	4.40
16.95	2106455.52	286817.17	8.38	4.40

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
17.71	2107214.58	286775.03	8.86	4.70
17.80	2107307.55	286811.70	8.80	4.60
17.90	2107400.23	286849.18	8.70	4.50
18.52	2107986.88	286800.57	8.46	4.20
19.12	2108461.10	286431.02	11.11	6.80
19.23	2108558.88	286410.10	11.38	7.00
19.33	2108655.97	286386.26	11.81	7.40
19.43	2108751.48	286359.48	11.37	7.00
19.50	2108811.11	286399.01	11.87	7.50
19.64	2108945.88	286414.04	10.17	5.80
19.73	2109041.19	286422.95	10.10	5.70
19.99	2109300.58	286469.59	8.81	4.40
20.09	2109398.98	286452.48	8.91	4.50
20.19	2109497.48	286435.42	8.68	4.20
20.29	2109595.77	286417.20	8.72	4.30
20.39	2109690.70	286385.91	8.32	3.80
20.98	2110274.16	286354.71	7.54	3.00
21.08	2110365.95	286393.89	7.54	3.00
21.18	2110447.88	286451.04	7.09	2.60
21.28	2110514.09	286525.69	6.32	1.80
22.02	2111249.86	286644.38	4.85	0.30
22.13	2111347.35	286622.70	4.81	0.30
22.23	2111444.07	286597.39	5.05	0.50
22.35	2111531.66	286551.99	5.08	0.50
22.45	2111612.93	286493.93	5.57	1.00
22.55	2111689.79	286430.01	6.26	1.70
22.65	2111759.27	286358.18	6.40	1.90
23.49	2112604.80	286391.54	5.03	0.50
23.59	2112684.76	286451.42	5.03	0.50
24.34	2113420.94	286446.75	5.10	0.50
25.43	2114501.03	286362.25	5.79	1.20
25.53	2114569.94	286434.25	5.91	1.30
25.63	2114653.48	286489.10	6.05	1.40
25.73	2114736.05	286545.43	6.07	1.40
25.83	2114818.56	286601.86	5.90	1.30
25.93	2114902.88	286655.50	6.10	1.50
26.03	2114982.05	286716.58	5.70	1.00
26.13	2115059.83	286779.40	5.23	0.60
27.05	2115966.39	286904.67	5.02	0.40
27.15	2116064.60	286885.86	5.31	0.70
27.25	2116163.32	286870.19	5.43	0.80
27.86	2116764.44	287021.97	6.20	1.60
27.96	2116827.70	287099.39	5.33	0.70
28.06	2116898.40	287169.61	4.67	0.10
28.46	2117268.51	287277.95	5.28	0.70
28.56	2117368.27	287272.02	6.19	1.60
28.66	2117468.11	287276.81	6.26	1.70
28.76	2117567.64	287285.43	6.33	1.80
28.86	2117667.29	287293.59	5.84	1.30
28.96	2117767.27	287295.61	4.88	0.30
29.06	2117867.23	287298.37	4.50	0.00
29.36	2118141.99	287404.13	5.68	1.20
29.46	2118227.94	287455.22	5.09	0.60
29.66	2118379.17	287585.02	5.69	1.20

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
29.90	2118620.04	287613.63	5.61	1.10
30.02	2118741.53	287607.36	5.40	1.00
30.12	2118838.16	287624.16	5.18	0.70
30.22	2118935.71	287603.09	5.42	1.00
30.31	2119021.77	287592.80	5.53	1.10
30.43	2119146.72	287606.03	5.77	1.40
30.65	2119362.02	287591.27	5.11	0.80
30.87	2119585.74	287592.18	5.55	1.20
31.04	2119747.91	287625.05	5.42	1.10
31.20	2119909.27	287666.49	5.21	1.00
31.45	2120154.70	287696.74	5.20	1.00
31.60	2120303.04	287729.49	5.09	0.90
31.86	2120551.96	287771.02	4.57	0.40
32.03	2120708.09	287845.08	5.27	1.20
32.48	2121153.60	287893.75	5.77	1.80
32.58	2121233.34	287951.64	5.86	1.90
32.76	2121417.86	287975.51	5.28	1.30
32.95	2121597.73	288014.76	5.27	1.30
33.45	2122088.84	288042.54	4.12	0.30
33.80	2122433.44	288010.91	4.48	0.80
34.25	2122833.27	288198.01	3.71	0.10
34.84	2123325.41	288000.35	5.05	1.60
34.93	2123406.96	288040.91	4.94	1.50
35.03	2123494.25	288087.49	5.26	1.80
35.13	2123589.66	288117.27	4.67	1.30
35.22	2123683.97	288150.32	3.91	0.50
35.32	2123779.23	288180.56	3.81	0.40
35.42	2123874.53	288209.36	3.74	0.40
36.82	2124898.89	289126.52	4.09	0.60
37.12	2125177.66	289223.71	4.14	0.80
37.22	2125276.02	289225.08	3.72	0.40
37.32	2125375.07	289217.19	3.92	0.60
37.42	2125474.63	289208.10	4.25	1.00
37.52	2125573.97	289197.22	6.29	3.00
37.62	2125673.49	289188.61	4.88	1.60
37.72	2125770.40	289212.73	5.07	1.90
37.82	2125865.44	289243.74	5.12	1.90
37.92	2125951.81	289293.08	3.37	0.20
38.01	2126012.58	289371.46	4.15	1.00
38.11	2126063.41	289457.55	4.49	1.40
38.21	2126098.27	289551.19	4.24	1.20
38.31	2126128.46	289646.52	4.69	1.60
38.41	2126165.04	289739.44	4.73	1.70
38.51	2126211.90	289827.66	4.48	1.40
38.61	2126260.78	289914.88	3.76	0.70
38.71	2126314.04	289999.43	3.56	0.50
38.81	2126363.67	290086.20	3.25	0.20
38.91	2126416.22	290171.20	3.90	0.90
39.01	2126462.51	290259.75	5.95	3.00
39.30	2126649.45	290476.98	7.39	4.40
39.40	2126711.18	290554.93	7.01	6.10
39.49	2126631.63	290606.78	5.91	5.10
39.59	2126549.48	290663.61	5.37	4.50
39.69	2126475.21	290730.54	6.20	5.30

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
39.79	2126403.68	290800.36	7.44	6.60
39.89	2126337.37	290875.15	4.60	3.70
39.99	2126273.09	290951.74	4.01	3.10
40.09	2126198.56	291018.19	4.48	3.60
40.19	2126122.41	291082.87	4.38	3.50
40.39	2125976.08	291217.19	4.99	4.10
40.49	2125906.70	291284.81	5.36	4.50
40.59	2125834.55	291353.86	5.94	5.00
40.69	2125762.83	291423.50	6.56	5.60
40.79	2125692.93	291494.96	6.71	5.80
40.89	2125616.34	291559.20	6.81	5.90
40.99	2125540.37	291624.16	8.34	7.40
41.09	2125461.58	291685.69	7.28	6.30
41.19	2125377.23	291739.32	7.16	6.20
41.29	2125290.74	291789.50	7.14	6.20
41.39	2125204.88	291840.64	6.99	6.00
41.58	2125062.06	291966.27	7.67	6.70
41.68	2124969.60	292004.31	9.35	8.40
41.78	2124877.35	292042.83	10.07	9.10
41.88	2124786.41	292084.38	9.76	8.80
41.98	2124695.67	292126.39	10.56	9.60
42.08	2124603.87	292165.69	13.07	12.10
42.18	2124510.24	292200.70	14.17	13.20
42.28	2124418.89	292241.24	14.59	13.60
42.38	2124338.65	292299.88	17.18	16.20
42.48	2124265.13	292367.59	13.27	12.30
42.58	2124198.08	292441.22	11.66	10.60
42.68	2124135.11	292518.79	10.45	9.40
42.78	2124065.93	292590.46	11.89	10.90
42.88	2124018.10	292678.10	12.21	11.20
42.98	2123988.99	292773.63	11.28	10.20
43.08	2123969.61	292871.72	9.17	8.10
43.18	2123947.26	292967.08	10.60	9.50
43.27	2123930.51	293064.08	10.51	9.40
43.37	2123936.29	293162.55	9.83	8.80
43.47	2123940.28	293262.43	11.06	10.00
43.57	2123949.00	293361.97	10.48	9.40
43.67	2123962.31	293461.06	9.34	8.30
43.77	2123975.65	293560.12	8.93	7.80
43.87	2123990.39	293659.02	9.51	8.40
43.97	2123997.72	293757.92	9.69	8.60
44.07	2124013.44	293856.66	9.64	8.50
44.17	2124028.70	293955.48	10.51	9.40
44.27	2124050.15	294053.12	10.58	9.50
44.37	2124078.22	294149.02	10.38	9.20
44.47	2124105.51	294245.22	9.88	8.70
44.57	2124125.86	294343.03	10.42	9.30
44.67	2124145.53	294441.01	11.99	10.80
44.77	2124170.17	294537.91	12.88	11.70
44.87	2124187.20	294636.43	10.34	9.20
44.97	2124200.25	294735.56	10.34	9.20
45.07	2124216.94	294833.99	12.16	11.00
45.17	2124235.84	294932.15	11.37	10.20
45.27	2124257.33	295029.81	12.80	11.60

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
45.37	2124279.65	295127.28	12.37	11.20
45.47	2124299.68	295225.22	12.72	11.50
45.57	2124316.23	295323.81	14.19	13.00
45.67	2124330.21	295422.73	16.11	14.90
45.77	2124338.64	295522.36	16.05	14.80
45.87	2124351.63	295621.45	17.26	16.00
45.97	2124361.35	295720.92	16.24	15.00
46.07	2124381.25	295818.83	14.68	13.40
46.17	2124414.24	295913.11	13.51	12.20
46.27	2124457.93	296003.06	13.34	12.10
46.37	2124506.11	296090.64	13.95	12.70
46.47	2124562.25	296173.39	13.96	12.70
46.57	2124625.07	296250.88	12.89	11.60
46.67	2124700.57	296316.21	9.92	8.60
46.77	2124779.41	296377.67	7.30	6.00
46.87	2124852.70	296445.44	8.72	7.40
46.97	2124928.15	296510.74	9.90	8.60
47.07	2125019.41	296550.58	10.16	8.80
47.17	2125115.38	296578.37	9.82	8.50
47.27	2125213.29	296598.45	9.17	7.80
47.37	2125311.05	296619.02	7.87	6.50
47.47	2125407.32	296645.81	7.81	6.50
47.57	2125502.08	296677.58	7.98	6.60
47.67	2125597.95	296705.85	7.91	6.50
47.77	2125693.14	296736.47	8.05	6.70
47.87	2125789.61	296762.73	9.33	8.00
47.97	2125887.40	296783.55	9.33	7.90
48.07	2125986.08	296799.18	8.15	6.80
48.17	2126085.37	296810.67	8.35	6.90
48.27	2126185.10	296815.54	8.70	7.30
48.37	2126285.08	296814.20	9.05	7.60
48.47	2126384.15	296802.82	9.36	7.90
48.57	2126483.88	296795.91	9.63	8.20
48.67	2126583.86	296794.28	10.67	9.20
48.77	2126683.18	296805.02	12.78	11.30
48.87	2126782.82	296812.11	13.16	11.70
48.97	2126882.12	296801.83	15.47	14.00
49.07	2126981.02	296787.10	14.73	13.30
49.17	2127080.71	296780.45	15.90	14.40
49.27	2127179.26	296795.26	14.62	13.10
49.37	2127276.76	296817.32	13.38	11.90
49.47	2127374.33	296839.15	10.08	8.60
49.57	2127469.77	296868.75	7.79	6.30
49.67	2127566.20	296892.21	9.64	8.10
49.77	2127647.00	296950.20	9.27	7.80
49.87	2127717.81	297020.65	8.30	6.80
49.97	2127793.23	297086.05	8.55	7.00
50.07	2127860.43	297160.05	9.08	7.50
50.17	2127924.82	297236.55	8.32	6.80
50.27	2127990.97	297311.47	8.32	6.80
50.37	2128060.49	297383.14	8.40	6.90
50.47	2128136.32	297448.30	8.88	7.30
50.57	2128212.78	297512.70	9.11	7.60
50.67	2128290.96	297575.03	9.90	8.30

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
50.86	2128420.17	297721.15	10.19	8.60
50.96	2128481.34	297800.23	11.86	10.30
51.06	2128524.54	297888.97	13.56	12.00
51.47	2128675.84	298270.94	5.58	4.00
51.57	2128687.87	298369.99	5.40	3.80
51.77	2128671.78	298569.26	5.81	4.20
51.87	2128664.78	298668.94	6.01	4.40
51.97	2128642.96	298766.36	4.76	3.10
52.07	2128607.67	298859.90	6.44	4.80
52.17	2128568.15	298951.75	7.65	6.00
52.27	2128531.67	299044.67	8.05	6.40
52.37	2128498.28	299138.90	6.20	4.50
52.47	2128453.61	299228.29	4.71	3.00
52.57	2128402.11	299313.77	7.45	5.80
52.67	2128358.10	299403.40	5.38	3.70
52.77	2128323.85	299497.09	5.39	3.70
52.87	2128287.71	299590.10	2.97	1.30
52.97	2128237.81	299676.56	5.33	3.60
53.07	2128177.25	299756.02	4.79	3.10
53.17	2128111.79	299831.53	6.61	4.90
53.27	2128051.07	299910.79	4.16	2.50
53.37	2127990.59	299990.32	5.06	3.30
53.47	2127925.40	300066.04	7.37	5.70
53.57	2127860.41	300141.87	6.38	4.70
53.67	2127801.37	300222.39	5.05	3.30
53.77	2127758.59	300312.60	4.38	2.60
53.87	2127733.34	300408.44	4.37	2.60
53.97	2127729.83	300508.36	5.35	3.60
54.07	2127729.21	300608.33	8.24	6.50
54.16	2127731.82	300705.29	7.58	5.80
54.26	2127747.67	300802.98	6.19	4.40
54.36	2127768.21	300900.76	6.15	4.40
54.46	2127791.89	300997.68	8.18	6.40
54.56	2127822.56	301092.69	9.76	8.00
54.66	2127869.20	301180.93	6.64	4.80
54.76	2127925.06	301263.81	5.11	3.30
54.86	2127987.22	301342.01	5.59	3.80
54.96	2128047.17	301421.95	3.03	1.20
55.16	2128164.19	301581.01	9.44	7.60
55.26	2128246.39	301637.12	12.83	11.00
55.36	2128329.72	301692.20	9.63	7.80
55.46	2128408.34	301753.83	9.27	7.40
55.66	2128566.28	301876.00	10.66	8.80
55.76	2128651.64	301927.27	12.76	10.90
55.96	2128848.44	301957.76	13.32	11.50
56.06	2128947.56	301970.68	12.25	10.40
56.16	2129045.59	301980.71	13.03	11.20
56.25	2129138.11	301958.11	10.34	8.50
56.35	2129237.12	301945.03	9.56	7.70
56.45	2129336.45	301934.59	10.90	9.00
56.55	2129433.64	301911.20	10.02	8.10
56.65	2129529.30	301882.46	9.59	7.70
56.75	2129622.43	301846.07	8.89	7.00
56.85	2129711.84	301801.35	9.45	7.50

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
56.95	2129795.76	301747.02	9.53	7.60
57.05	2129873.11	301683.85	6.89	5.00
57.15	2129954.50	301627.68	5.68	3.80
57.25	2130042.59	301581.27	9.88	7.90
57.55	2130239.26	301356.25	3.64	1.70
57.65	2130320.79	301298.93	3.66	1.70
57.75	2130394.65	301231.59	5.50	3.50
57.95	2130548.53	301104.13	6.97	5.00
58.05	2130623.50	301038.01	8.15	6.20
58.15	2130700.61	300974.40	10.61	8.60
58.25	2130782.77	300917.45	9.64	7.70
58.35	2130866.29	300862.52	7.85	5.90
58.45	2130949.94	300807.82	11.46	9.50
58.55	2131036.26	300757.83	11.78	9.80
58.65	2131126.72	300717.33	9.13	7.10
58.74	2131201.94	300656.79	12.56	10.50
58.83	2131290.68	300633.64	6.90	4.90
58.93	2131389.74	300621.88	5.96	3.90
59.03	2131487.51	300602.88	3.83	1.80
59.13	2131584.20	300625.56	5.70	3.60
59.23	2131677.17	300662.19	7.65	5.60
59.33	2131764.97	300709.51	4.60	2.50
59.43	2131858.93	300742.78	4.12	2.90
59.53	2131942.46	300796.93	2.92	1.70
59.63	2132015.92	300864.61	3.90	2.70
59.73	2132086.65	300935.13	5.32	4.10
59.83	2132163.23	300999.04	4.73	3.50
59.93	2132240.08	301062.54	4.04	2.80
60.03	2132305.62	301137.97	8.28	7.00
60.13	2132371.65	301213.03	4.00	2.70
60.23	2132437.99	301287.75	8.63	7.30
60.33	2132501.02	301365.34	5.18	3.90
60.43	2132560.91	301445.38	5.80	4.50
60.63	2132678.29	301607.11	4.92	3.60
60.73	2132732.24	301691.27	7.92	6.60
60.83	2132783.29	301777.14	6.10	4.80
60.93	2132827.62	301866.75	7.83	6.50
61.03	2132866.25	301958.80	4.68	3.30
61.13	2132899.99	302052.80	4.05	2.70
61.23	2132924.85	302149.50	9.25	7.90
61.33	2132944.71	302247.46	7.05	5.70
61.43	2132967.04	302344.86	8.16	6.80
61.53	2132990.56	302441.74	7.28	5.90
61.63	2133015.51	302538.48	7.66	6.30
61.73	2133043.40	302634.48	6.30	4.90
61.83	2133070.07	302730.82	6.46	5.00
61.93	2133098.32	302826.72	5.12	3.70
62.03	2133125.63	302922.72	4.94	3.50
62.13	2133143.45	303021.09	4.20	2.80
62.23	2133153.72	303120.50	6.22	4.80
62.33	2133156.37	303220.40	3.85	2.40
62.43	2133157.49	303319.93	5.36	3.90
62.53	2133129.27	303415.78	3.83	2.40
62.63	2133085.45	303505.33	4.98	3.50

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
62.73	2133028.16	303587.23	5.61	4.10
62.83	2132977.19	303673.05	4.35	2.90
62.93	2132914.53	303750.90	5.28	3.80
63.03	2132841.89	303819.31	6.29	4.80
63.13	2132758.20	303873.99	5.74	4.20
63.23	2132672.46	303925.39	6.39	4.90
63.33	2132584.82	303973.42	6.41	4.90
63.43	2132503.77	304031.92	6.92	5.40
63.53	2132417.83	304082.70	6.82	5.30
63.63	2132327.72	304125.95	6.96	5.40
63.73	2132235.48	304164.30	6.53	5.00
63.83	2132141.14	304197.40	5.78	4.20
63.93	2132047.21	304231.35	6.53	5.00
64.03	2131957.21	304274.82	6.55	5.00
64.13	2131870.05	304323.79	6.55	5.00
64.23	2131783.54	304373.95	6.50	4.90
64.33	2131702.19	304431.96	6.05	4.40
64.43	2131628.11	304499.03	6.28	4.70
64.53	2131563.06	304574.24	6.34	4.70
64.63	2131533.92	304669.05	6.69	5.00
64.73	2131510.23	304766.07	6.06	4.40
64.83	2131500.20	304865.52	5.64	4.00
64.93	2131498.47	304965.29	5.74	4.10
65.03	2131509.30	305064.65	4.92	3.20
65.13	2131524.25	305163.52	5.03	3.30
65.22	2131554.74	305257.97	4.76	3.00
65.32	2131606.39	305343.47	4.60	2.90
65.60	2131551.84	305610.25	4.26	2.50
65.69	2131499.94	305691.63	3.90	2.20
65.79	2131452.73	305775.46	5.03	3.30
65.89	2131382.30	305846.06	5.34	3.60
65.99	2131315.62	305920.50	1.84	0.10
66.09	2131245.93	305992.09	5.26	3.50
66.19	2131179.11	306065.49	3.61	1.80
66.29	2131104.38	306131.75	4.85	3.10
66.39	2131028.02	306196.24	4.44	2.60
66.49	2130949.67	306258.35	3.94	2.10
66.59	2130865.51	306311.97	2.81	1.00
66.69	2130776.25	306356.49	4.69	2.90
66.79	2130678.74	306377.75	3.44	1.60
66.89	2130579.95	306386.76	4.55	2.70
67.01	2130467.37	306467.96	-	1.50
67.34	2130309.39	306750.17	-	1.40
67.73	2130139.57	307105.85	-	1.20
Check Dam At Ch 67.80km				
68.22	2129770.72	307438.42	-	1.60
68.52	2129558.29	307635.95	-	1.20
68.97	2129697.44	308089.54	-	1.20
69.27	2129849.54	308364.51	-	1.20
69.34	2129893.16	308428.06	-	0.80
69.60	2130034.85	308639.83	-	0.60
69.60	2130046.03	308629.43	-	1.20
70.23	2130096.10	309134.63	-	0.60
70.41	2129950.88	309259.29	-	0.50

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
70.80	2129737.26	309572.48	-	1.10
71.21	2129545.14	309949.00	-	0.50
71.48	2129630.74	310233.78	-	0.80
71.71	2129918.33	310257.79	-	1.20
71.95	2130140.92	310144.45	-	0.60
72.23	2130385.32	310062.88	-	0.40
72.58	2130560.90	310211.90	-	0.70
72.77	2130636.64	310380.91	-	0.50
72.90	2130657.47	310507.29	-	0.60
73.39	2130719.09	310970.53	-	1.10
73.75	2130572.25	311252.88	-	0.90
74.35	2130103.32	311637.05	-	0.50
75.33	2130138.29	312541.61	-	0.80
75.63	2129969.77	312781.70	-	0.50
75.79	2129868.74	312917.35	-	0.60
75.93	2129801.14	313032.31	-	0.70
76.43	2129564.17	313471.48	-	0.80
76.78	2129471.65	313859.56	-	0.50
77.17	2129072.51	313918.58	-	0.60
77.37	2128873.05	313937.57	-	0.40
77.66	2128661.24	314082.62	-	0.30
77.89	2128471.77	314206.87	-	0.50
77.98	2128371.83	314237.40	-	0.60
78.23	2128181.94	314403.71	-	0.50
78.55	2127936.39	314601.00	-	0.40
78.74	2127781.11	314630.97	-	0.60
79.02	2127550.04	314491.93	-	0.80
79.48	2127288.12	314121.23	-	0.50
79.63	2127200.85	313994.16	-	0.40
79.84	2127103.15	313803.88	-	0.70
79.93	2127059.62	313729.83	-	0.60
80.26	2126795.89	313537.86	-	0.20
80.48	2126574.72	313514.57	-	0.50
80.93	2126184.83	313752.47	-	0.60
81.34	2126069.97	314161.43	-	1.10
81.52	2126079.22	314340.29	-	0.30
81.56	2126067.73	314382.24	-	0.80
82.00	2125941.70	314801.61	-	1.00
82.07	2125930.00	314864.59	-	0.60
82.42	2125782.80	315189.10	-	0.40
82.77	2125647.42	315440.13	-	1.40
83.00	2125436.69	315480.07	-	0.60
83.31	2125127.17	315434.88	-	0.40
83.51	2124928.04	315422.35	-	1.20
83.65	2124784.24	315410.39	-	0.50
84.10	2124329.45	315500.45	-	0.60
84.63	2123818.79	315642.55	-	0.50
85.57	2122898.05	315833.12	-	1.20
85.87	2122600.13	315735.47	-	0.20
86.24	2122257.94	315637.36	-	0.80
86.65	2121859.88	315591.28	-	0.40
87.10	2121417.22	315576.31	-	0.60
87.52	2121105.49	315752.00	-	0.50
87.67	2121015.78	315866.80	-	0.30

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
87.92	2120869.87	316065.20	-	0.40
88.10	2120746.64	316211.23	-	0.50
88.50	2120379.57	316386.38	-	0.50
88.84	2120035.58	316467.09	-	0.80
88.94	2119935.86	316476.62	-	1.20
89.07	2119792.49	316422.58	-	1.10
89.16	2119703.72	316442.74	-	1.40
89.32	2119559.93	316430.78	-	1.20
89.72	2119138.68	316489.68	-	1.00
89.94	2118952.08	316330.02	-	1.20
90.10	2118774.66	316359.80	-	1.20
90.24	2118652.90	316358.58	-	0.80
90.69	2118243.03	316386.05	-	0.60
90.83	2118109.68	316437.32	-	0.40
91.20	2117721.53	316507.08	-	0.50
91.33	2117643.00	316611.51	-	0.80
91.55	2117640.37	316874.50	-	0.50
92.30	2116939.57	317214.71	-	1.10
92.70	2116583.79	317369.00	-	0.90
92.92	2116351.14	317387.73	-	1.00
93.00	2116273.44	317408.00	-	0.90
93.16	2116196.17	317386.19	-	0.80
93.27	2116085.90	317343.01	-	0.50
93.51	2115886.66	317341.03	-	0.20
93.77	2115620.27	317412.03	-	0.80
93.95	2115562.94	317611.38	-	0.50
94.26	2115262.62	317755.71	-	0.60
94.75	2115014.63	318205.71	-	1.10
95.36	2114469.45	318484.43	-	1.20
95.59	2114301.86	318640.62	-	0.80
95.68	2114223.75	318702.99	-	0.50
95.83	2114155.99	318839.11	-	1.10
96.10	2114120.10	319112.35	-	0.60
96.42	2114205.65	319418.35	-	0.50
96.74	2114290.90	319755.90	-	1.20
97.02	2114521.49	319947.57	-	0.80
97.19	2114732.42	319886.50	-	0.90
97.41	2114907.87	320056.57	-	0.50
97.74	2115072.56	320194.97	-	1.10
97.93	2115081.78	320384.46	-	1.00
98.11	2115047.24	320520.91	-	0.90
98.83	2114522.40	320989.29	-	0.50
99.20	2114331.06	321313.63	-	0.40
99.56	2114107.13	321574.51	-	0.20
100.08	2113694.73	321865.15	-	0.40
100.53	2113272.39	322039.96	-	0.20
100.75	2113072.54	322101.17	-	0.10
100.93	2112917.38	322120.71	-	0.50
101.13	2112706.97	322129.20	-	1.20
102.08	2112058.19	322828.02	-	0.60
102.28	2111891.25	322921.13	-	0.50
102.65	2111612.21	323160.50	-	0.80
102.81	2111533.31	323307.08	-	0.90
103.04	2111344.24	323399.98	-	0.20

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
103.09	2111299.66	323431.13	-	0.20
103.23	2111167.04	323408.81	-	0.50
103.33	2111067.62	323386.81	-	0.10
103.44	2110979.08	323385.96	-	0.50
103.51	2110935.41	323322.39	-	0.80
103.71	2110770.59	323194.52	-	1.10
103.68	2110792.42	323226.30	-	0.20
103.78	2110704.28	323183.36	-	0.60
103.88	2110627.40	323119.48	-	0.50
104.12	2110373.33	323064.42	-	0.80
104.19	2110316.87	323179.64	-	0.40
104.26	2110250.26	323200.06	-	0.50
104.39	2110095.70	323156.47	-	1.10
104.43	2110105.96	323240.77	-	1.00
104.44	2110094.90	323240.66	-	1.20
104.56	2110049.81	323324.43	-	0.50
104.65	2109971.73	323386.83	-	0.60
104.99	2109802.98	323669.39	-	1.10
105.04	2109758.40	323700.54	-	0.50
105.08	2109746.83	323753.05	-	0.90
105.10	2109735.66	323763.47	-	0.50
105.14	2109724.19	323805.46	-	0.40
105.29	2109601.73	323877.96	-	0.60
105.49	2109413.57	323876.17	-	0.10
105.67	2109225.60	323853.32	-	0.60
105.78	2109125.28	323926.04	-	0.20
105.95	2108991.45	324030.02	-	0.40
106.11	2108847.06	324081.27	-	0.50
106.24	2108681.43	324037.59	-	0.30
106.36	2108591.98	324131.46	-	0.50
106.36	2108602.85	324152.62	-	0.40
106.75	2108268.79	324359.95	-	0.60
106.97	2108123.20	324537.50	-	0.50
107.22	2107879.99	324503.61	-	1.10
107.62	2107661.52	324196.28	-	1.20
108.09	2107343.94	323835.36	-	0.50
108.48	2107024.76	323642.84	-	0.30
108.82	2106715.95	323524.10	-	0.50
108.94	2106628.00	323460.10	-	0.60
109.07	2106506.85	323395.78	-	1.10
109.10	2106473.64	323395.46	-	0.50
109.20	2106374.23	323373.46	-	0.20
109.34	2106264.65	323256.62	-	0.30
109.48	2106109.79	323244.61	-	0.50
110.00	2105686.27	323545.85	-	0.40
110.39	2105837.61	323926.27	-	0.40
110.63	2106113.93	323971.01	-	0.10
110.76	2106190.20	324098.06	-	-
111.06	2106488.15	324195.64	-	0.20
111.07	2106465.81	324216.48	-	-
111.11	2106465.31	324269.11	-	0.20
111.17	2106464.81	324321.74	-	0.50
111.20	2106464.51	324353.31	-	-

Note: Reduced depth has been reckoned by applying tide variation Min 0.81m & Max 4.70m

Annexure 3.3b: Digital Data, Chainage vs Water Depth, Bathymetric Survey for Waldhuni Creek

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
0.01	2127901.70	305236.56	4.49	0.20
0.06	2128039.23	305251.05	2.83	0.30
0.11	2128065.77	305389.86	2.47	0.30
0.16	2128077.24	305602.19	3.07	0.20
0.21	2128507.13	305605.10	3.14	0.20
0.26	2128247.49	305629.94	3.06	0.20
0.31	2128602.89	305697.23	2.36	0.30
0.36	2128732.43	305762.09	2.68	0.40
0.41	2128880.14	305781.65	2.87	0.20
0.71	2129064.27	305907.49	2.19	0.20
0.66	2129195.14	305985.95	2.15	0.40
0.61	2129344.47	306048.20	2.74	0.40
0.46	2129465.11	306120.00	2.55	0.40
0.56	2129574.31	306184.80	2.62	0.30
0.51	2130117.06	306192.25	3.25	0.30
1.07	2130067.27	306193.36	-	0.30
1.19	2130164.32	306202.09	-	0.80
1.34	2130018.61	306209.33	-	0.70
1.50	2129969.75	306217.67	-	1.40
1.65	2129920.31	306221.89	-	0.70
1.89	2130210.66	306222.90	-	1.00
2.04	2130257.30	306242.34	-	0.80
2.18	2130303.13	306267.08	-	0.50
2.60	2130347.79	306293.49	-	1.20
2.33	2130392.15	306319.04	-	1.30
2.79	2130435.84	306338.73	-	1.20
2.99	2130481.44	306367.68	-	0.60
3.15	2130527.01	306373.45	-	1.00
3.31	2130574.11	306401.32	-	2.70

Note: Reduced depth has been reckoned by applying tide variation Min 1.79m & Max 4.29m

Annexure 3.3c: Digital Data, Chainage vs Water Depth, Bathymetric Survey for Vasai Creek

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
0.10	2136818.01	267964.72	13.40	11.80
0.20	2136822.48	268064.58	18.00	16.40
0.30	2136826.03	268164.49	18.20	16.50
0.40	2136835.59	268263.98	17.20	15.50
0.50	2136854.07	268362.23	14.90	13.30
0.60	2136869.93	268460.95	12.10	10.40
0.70	2136890.43	268558.80	9.90	8.20
0.80	2136876.71	268648.49	10.60	8.90
0.90	2136917.97	268737.89	7.50	5.80
1.00	2136960.08	268825.86	7.70	5.90
1.10	2136976.58	268924.43	9.30	6.20
1.20	2136994.68	269022.60	8.60	5.50
1.30	2137009.03	269121.47	8.30	5.10
1.40	2137023.73	269220.29	7.50	4.30
1.50	2137042.33	269318.51	7.80	4.60
1.60	2137061.01	269416.65	7.00	3.80
1.70	2137081.48	269514.50	7.10	3.90
1.80	2137109.90	269609.91	7.00	3.80
1.90	2137140.69	269704.61	6.90	3.70
2.00	2137162.27	269802.13	6.90	3.70
2.10	2137177.64	269900.85	6.60	3.40
2.20	2137195.25	269999.23	6.00	2.80
2.30	2137220.68	270095.82	6.00	2.70
2.40	2137240.24	270193.77	5.80	2.50
2.50	2137261.25	270291.48	5.60	2.30
2.60	2137290.94	270386.83	5.60	2.30
2.70	2137314.74	270483.67	5.60	2.30
2.80	2137339.32	270580.54	5.40	2.00
2.90	2137368.25	270676.17	5.50	2.20
3.00	2137390.55	270773.58	5.00	1.60
3.10	2137398.90	270873.05	4.60	1.20
3.20	2137398.43	270973.02	4.60	1.20
3.30	2137406.30	271072.69	4.60	1.20
3.40	2137419.63	271171.75	4.70	1.20
3.50	2137437.42	271270.12	4.90	1.50
3.60	2137457.22	271368.07	4.80	1.40
3.70	2137482.84	271464.68	5.00	1.60
3.80	2137516.70	271558.51	4.90	1.40
3.90	2137581.67	271633.68	4.90	1.40
4.00	2137672.55	271671.83	4.20	0.70
4.10	2137735.47	271735.25	4.80	1.30
4.20	2137756.59	271832.71	5.20	1.70
4.30	2137779.20	271930.05	5.60	2.00
4.40	2137791.39	272029.08	6.00	2.50
4.50	2137816.53	272125.28	5.90	2.40
4.60	2137824.14	272224.57	5.80	2.20
4.70	2137850.02	272321.05	5.80	2.30
4.80	2137885.27	272414.47	6.00	2.40
4.90	2137926.54	272505.33	5.80	2.20
5.00	2137960.88	272598.27	4.80	1.20
5.10	2137967.87	272697.66	4.70	1.00
5.20	2137961.86	272797.17	5.50	1.90

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
5.30	2137960.91	272896.84	5.70	2.10
5.40	2137979.20	272994.61	5.70	2.00
5.50	2138002.03	273091.79	5.80	2.10
5.60	2138040.64	273183.91	5.80	2.20
5.70	2138048.49	273282.89	5.80	2.20
5.80	2138045.12	273381.97	6.40	2.70
5.90	2138040.59	273481.82	6.60	2.90
6.00	2138040.30	273581.47	6.60	2.90
6.10	2138038.96	273681.35	6.70	3.00
6.20	2138016.47	273778.41	7.10	3.40
6.30	2138001.61	273877.12	7.40	3.70
6.40	2137991.29	273976.43	7.50	3.80
6.50	2137972.68	274074.53	7.60	3.90
6.60	2137939.61	274168.66	8.60	4.90
6.90	2137847.44	274453.39	9.50	5.70
7.00	2137818.59	274548.65	9.00	5.20
7.10	2137788.00	274643.53	9.10	5.30
7.20	2137748.47	274734.67	10.00	6.20
7.30	2137719.85	274829.73	9.20	5.40
7.40	2137691.15	274925.44	9.40	5.60
7.50	2137664.77	275021.83	9.50	5.70
7.60	2137636.19	275117.60	9.70	5.90
7.70	2137601.66	275211.41	9.50	5.60
7.80	2137562.09	275303.13	9.30	5.40
7.90	2137503.56	275384.04	9.40	5.60
8.00	2137449.80	275468.21	8.30	4.50
8.10	2137395.09	275551.91	9.10	5.20
8.20	2137342.89	275637.18	8.30	4.50
8.30	2137294.62	275724.73	8.60	4.80
8.40	2137240.15	275808.56	8.30	4.40
8.50	2137187.29	275893.43	8.40	4.50
8.60	2137134.93	275978.41	8.10	4.20
8.70	2137097.21	276070.87	8.10	4.20
8.80	2137043.03	276154.88	7.90	4.00
8.90	2136987.66	276238.12	7.80	3.90
9.00	2136930.54	276320.09	7.80	3.90
9.10	2136880.86	276406.48	7.80	3.80
9.20	2136835.81	276495.66	7.50	3.60
9.30	2136783.99	276581.03	7.50	3.60
9.40	2136724.18	276661.12	7.60	3.70
9.50	2136667.22	276743.22	7.50	3.60
9.60	2136604.19	276820.52	7.50	3.60
9.70	2136544.09	276900.22	7.60	3.70
9.80	2136472.53	276968.61	7.80	3.80
9.90	2136410.89	277047.16	7.90	4.00
10.00	2136354.19	277129.40	8.10	4.20
10.10	2136285.43	277201.89	8.40	4.50
10.20	2136229.63	277284.56	8.70	4.70
10.30	2136182.05	277372.46	9.00	5.00
10.50	2136063.96	277532.31	9.70	5.70
10.60	2136016.49	277619.87	9.70	5.70
10.70	2135952.52	277696.64	10.30	6.40
10.80	2135893.27	277776.99	10.60	6.70
10.90	2135828.35	277853.03	10.50	6.60

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
11.00	2135752.24	277917.50	11.10	7.20
11.10	2135681.25	277987.21	11.50	7.60
11.20	2135631.09	278073.43	11.60	7.70
11.30	2135561.98	278145.30	11.40	7.50
11.40	2135491.61	278216.29	11.90	8.00
11.50	2135425.43	278291.21	11.40	7.50
11.60	2135362.75	278369.10	10.80	6.90
11.70	2135290.87	278437.92	10.70	6.70
11.80	2135204.19	278487.15	11.20	7.30
11.90	2135118.87	278539.21	11.30	7.40
12.00	2135040.72	278601.07	11.00	7.10
12.10	2134976.56	278677.63	10.60	6.70
12.20	2134931.94	278766.73	10.40	6.50
12.30	2134877.81	278849.42	9.90	5.90
12.40	2134837.78	278939.03	9.60	5.70
12.50	2134776.83	279015.97	9.60	5.70
12.60	2134694.43	279072.30	10.30	6.40
12.70	2134632.57	279148.42	10.30	6.50
12.80	2134582.29	279234.65	10.30	6.40
12.90	2134528.20	279317.23	10.10	6.20
13.00	2134455.34	279384.86	12.00	8.10
13.10	2134411.96	279474.19	11.90	8.00
13.20	2134371.99	279565.18	12.90	9.00
13.30	2134332.35	279656.85	14.40	10.60
13.40	2134288.11	279746.45	16.60	12.70
13.50	2134251.54	279838.92	19.60	15.80
13.60	2134237.14	279937.83	18.90	15.10
14.60	2134145.61	280931.87	40.50	36.70
14.80	2134157.20	281129.00	38.30	34.50
14.90	2134165.43	281228.17	35.90	32.10
15.00	2134180.26	281325.45	34.40	30.60
15.10	2134174.27	281424.52	31.30	27.50
15.20	2134159.05	281522.41	30.50	26.70
15.30	2134167.56	281622.00	30.00	26.20
15.40	2134179.62	281721.06	30.20	26.40
15.50	2134204.42	281816.09	29.70	25.90
15.60	2134226.15	281912.97	33.20	29.40
15.70	2134227.03	282010.60	28.50	24.80
15.80	2134210.67	282107.93	27.60	23.90
16.50	2134040.69	282778.28	43.10	39.40
16.60	2134021.30	282874.82	36.70	33.00
16.70	2134020.33	282970.93	28.50	24.80
16.80	2134033.50	283068.75	25.90	22.20
16.90	2134045.55	283165.14	25.90	22.30
17.00	2134071.50	283259.66	28.10	24.40
17.10	2134092.87	283352.00	27.60	24.00
17.20	2134125.88	283436.89	26.80	23.20
17.30	2134167.24	283512.94	23.40	19.80
17.40	2134216.76	283589.05	18.50	14.80
17.50	2134308.40	283561.41	16.30	12.70
17.60	2134347.67	283646.97	15.00	11.40
17.70	2134401.38	283728.77	12.20	8.60
17.80	2134450.94	283813.80	9.90	6.30
17.90	2134504.41	283893.15	9.10	5.50

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
18.00	2134554.12	283974.46	10.80	7.20
18.10	2134593.77	284063.81	11.70	8.10
18.20	2134672.94	284112.27	12.00	8.40
18.30	2134753.59	284152.20	11.90	8.30
18.50	2134880.34	284303.56	10.30	6.80
18.60	2134949.75	284371.36	11.00	7.40
18.70	2135005.01	284453.01	10.70	7.20
18.80	2135078.87	284519.46	12.10	8.60
18.90	2135102.20	284615.26	11.40	7.90
19.00	2135093.53	284703.64	10.50	7.10
19.10	2135023.61	284771.00	10.80	7.40
19.20	2135018.98	284845.66	9.40	6.00
19.30	2135066.03	284930.09	9.60	6.20
19.40	2135072.84	285022.09	8.00	4.60
19.50	2135077.62	285118.04	10.30	6.90
19.60	2135115.44	285209.23	11.20	7.90
19.70	2135134.80	285306.81	8.10	4.80
19.80	2135143.15	285405.34	8.10	4.70
19.90	2135149.76	285504.59	8.40	5.10
20.00	2135160.94	285597.31	8.40	5.10
20.10	2135126.70	285689.47	8.20	5.00
20.20	2135137.18	285787.68	8.10	4.80
20.30	2135124.78	285885.44	8.20	5.00
20.40	2135156.74	285979.74	7.90	4.70
20.50	2135167.93	286078.40	7.80	4.60
20.60	2135113.57	286154.48	8.00	4.80
20.70	2135063.77	286236.36	8.70	5.60
20.80	2135041.83	286333.83	9.00	5.90
20.90	2135019.71	286430.94	9.10	6.00
21.00	2134999.26	286528.18	9.50	6.40
21.10	2134962.24	286619.76	9.80	6.70
21.20	2134888.55	286685.45	10.20	7.10
21.30	2134830.37	286765.17	11.10	8.10
21.40	2134774.78	286847.59	11.70	8.70
21.50	2134708.47	286921.39	12.10	9.10
21.60	2134640.81	286993.37	12.60	9.70
21.70	2134600.53	287084.84	13.40	10.40
21.80	2134578.87	287181.92	14.90	12.00
21.90	2134545.38	287274.44	15.50	12.60
22.00	2134485.15	287353.38	14.70	11.80
22.10	2134407.93	287413.73	12.90	10.00
22.20	2134353.08	287485.56	12.20	9.30
22.30	2134294.76	287565.95	11.70	8.80
22.40	2134232.40	287642.59	10.70	7.90
22.50	2134201.04	287737.01	9.30	6.50
22.60	2134147.10	287819.64	8.90	6.10
22.70	2134080.06	287893.46	8.70	6.00
22.80	2133996.78	287947.76	8.40	5.60
22.90	2133927.34	288016.19	8.40	5.60
23.00	2133851.82	288065.50	8.10	5.40
23.10	2133757.25	288070.54	7.70	5.00
23.20	2133658.48	288083.67	7.60	5.00
23.30	2133613.72	288164.22	8.20	5.60
23.40	2133568.63	288253.12	8.90	6.30

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
23.50	2133486.76	288308.44	9.40	6.90
23.60	2133395.94	288346.44	9.90	7.30
23.70	2133319.41	288409.38	10.90	8.40
23.80	2133222.56	288425.52	11.10	8.60
23.90	2133144.07	288482.62	11.70	9.30
24.00	2133062.85	288540.82	12.20	9.70
24.10	2132979.45	288595.94	13.30	10.90
24.20	2132889.63	288638.47	14.10	11.70
24.30	2132799.20	288680.53	14.80	12.40
24.40	2132712.23	288729.75	14.10	11.80
24.50	2132617.65	288760.58	14.40	12.00
24.60	2132540.48	288822.46	13.20	10.90
24.70	2132443.79	288840.54	12.50	10.20
24.80	2132345.54	288854.98	13.10	10.90
24.90	2132246.80	288843.36	12.80	10.60
25.00	2132150.09	288855.66	14.00	11.90
25.10	2132050.78	288854.88	13.70	11.60
25.20	2131951.20	288851.14	13.00	10.90
25.30	2131854.41	288872.40	12.90	10.80
25.40	2131761.38	288908.68	13.90	11.80
25.50	2131664.00	288931.27	15.80	13.80
25.60	2131569.22	288961.60	14.40	12.40
25.70	2131478.03	288999.66	17.20	15.30
25.80	2131383.55	289019.04	12.90	11.00
25.90	2131300.83	289074.37	13.60	11.70
26.00	2131210.08	289115.88	10.30	8.40
26.10	2131115.37	289147.38	9.70	7.80
26.20	2131018.86	289172.40	10.10	8.20
26.30	2130921.11	289189.08	10.60	8.80
26.40	2130824.76	289214.98	11.10	9.20
26.50	2130732.26	289251.33	11.10	9.30
26.60	2130638.74	289286.10	10.90	9.20
26.70	2130554.22	289335.42	10.30	8.50
26.80	2130462.94	289375.88	9.20	7.50
26.90	2130383.56	289435.93	8.40	6.70
27.00	2130292.51	289476.20	8.50	6.80
27.10	2130250.79	289545.34	7.50	5.80
27.20	2130185.85	289595.17	8.50	6.90
27.30	2130092.73	289631.60	8.40	6.80
27.40	2129999.92	289668.77	8.20	6.60
27.70	2129769.45	289834.90	8.80	7.20
27.80	2129671.84	289856.39	8.70	7.10
27.90	2129574.04	289875.49	8.60	7.00
28.00	2129476.15	289895.69	12.30	10.40
28.10	2129379.92	289922.15	12.60	10.70
28.20	2129284.70	289952.26	12.20	10.40
28.30	2129191.97	289989.01	11.40	9.70
28.40	2129098.36	290023.75	10.50	8.80
28.50	2129004.76	290058.60	10.00	8.40
28.60	2128913.12	290098.55	9.90	8.30
28.70	2128824.60	290096.77	10.10	8.40
28.80	2128733.76	290059.03	10.20	8.60
28.90	2128634.74	290072.05	10.30	8.70
29.00	2128536.81	290054.89	10.30	8.70

Chainage (km)	Northing(m)	Easting(m)	Raw Depth(m)	Reduced Depth w.r.t CD (m)
29.10	2128450.07	290009.33	8.50	6.90
29.20	2128353.86	290033.63	8.80	7.20
29.30	2128256.03	290053.46	10.60	8.90
29.40	2128159.52	290079.31	11.30	9.60
29.50	2128062.92	290101.84	12.10	10.40
29.60	2127966.08	290123.76	11.80	10.00
29.70	2127867.87	290140.52	11.20	9.50
29.80	2127772.26	290167.44	10.00	8.30
29.90	2127676.20	290174.66	10.20	8.50
30.20	2127416.49	290068.93	8.00	6.20
30.30	2127328.72	290109.41	7.50	5.80
30.40	2127261.94	290180.39	7.60	5.90
30.50	2127177.28	290233.10	8.60	6.90
30.60	2127095.37	290290.38	8.70	6.90
30.70	2127014.59	290349.30	10.30	8.60
30.80	2126934.45	290409.06	7.70	6.00
30.90	2126863.44	290476.35	8.20	6.60
31.00	2126852.20	290574.51	8.10	6.40
31.20	2126714.26	290556.91	8.00	6.30

Note: Reduced depth has been reckoned by applying tide variation Min 1.60m & Max 4.00m

ANNEXURE 3.4

PHOTOS CAPTURED BY SURVEY TEAM DURING RECONNAISSANCE SURVEY

ANNEXURE 3.4: PHOTOS CAPTURED BY SURVEY TEAM DURING RECONNAISSANCE SURVEY

Kalyan-Thane-Ulhas River

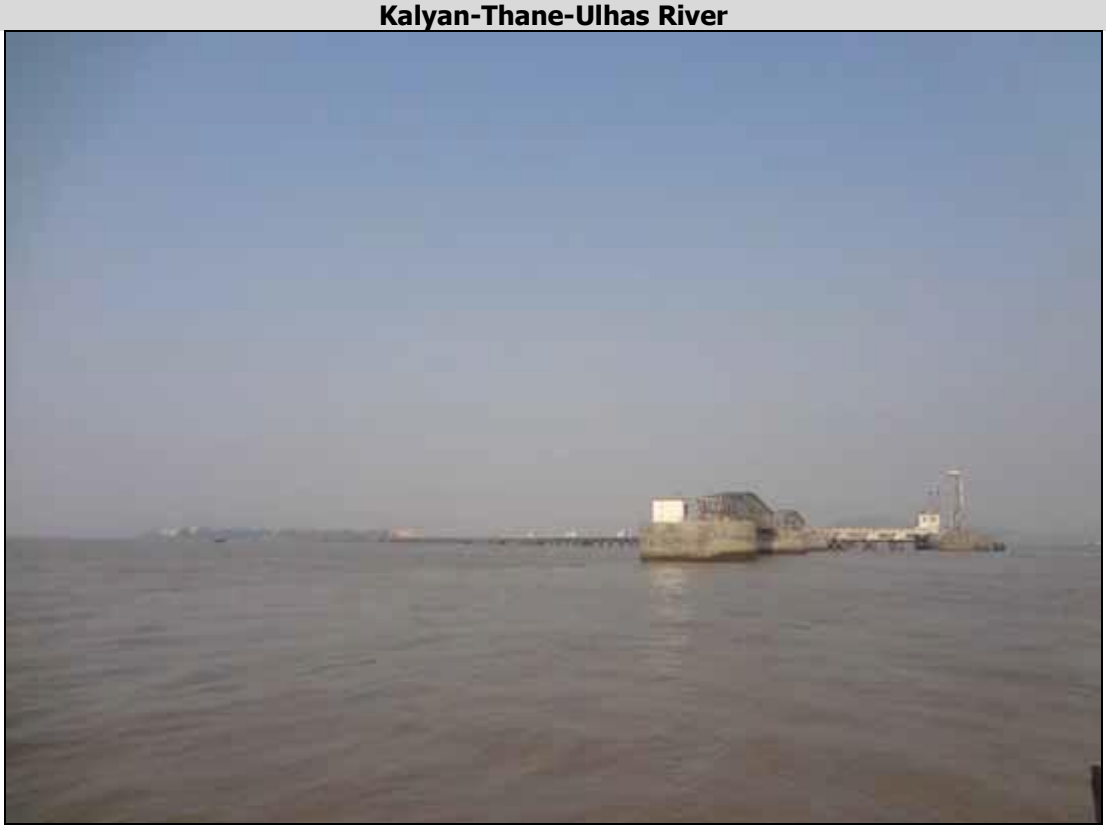


Photo 1: **Jetty on the Northern Bank of River at Ch 4.00 km**

Photo 2: **JNPT Jetty on the Eastern Bank of River at Ch 11.70 km**

Photo 3: Vashi Rail bridge at Ch 19.52 km

Photo 4: Vashi Road bridge at Ch 19.52km

Photo 5: Vashi road bridge at Ch 19.56km

Photo 6: High Tension line crossing River at Ch 19.83km

Photo 7: Airoli Road Bridge at Ch 30.00km

Photo 8: High Tension Power Line crossing River at Ch 31.93 km

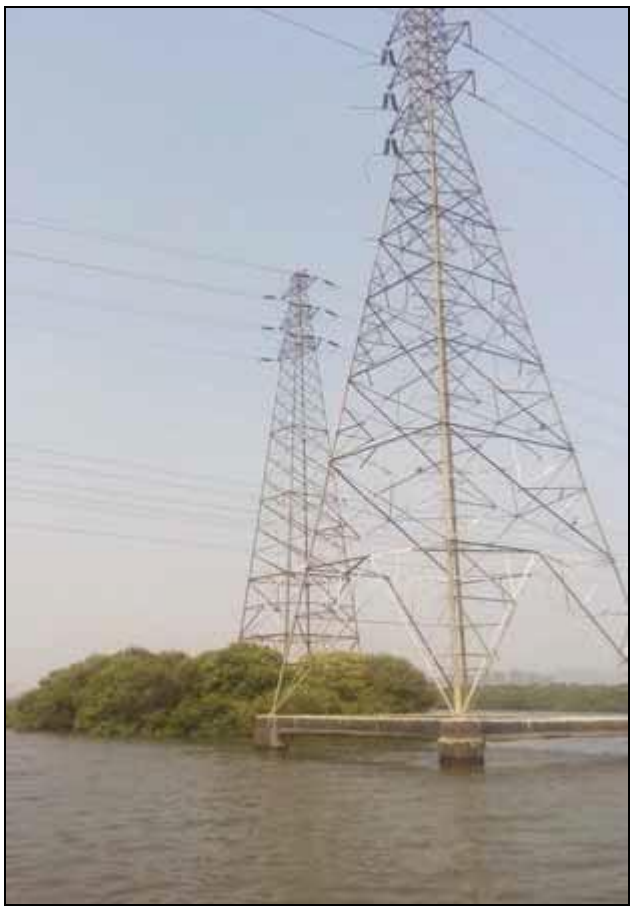


Photo 9: High Tension pole in the centre of the river at Ch 33.77km

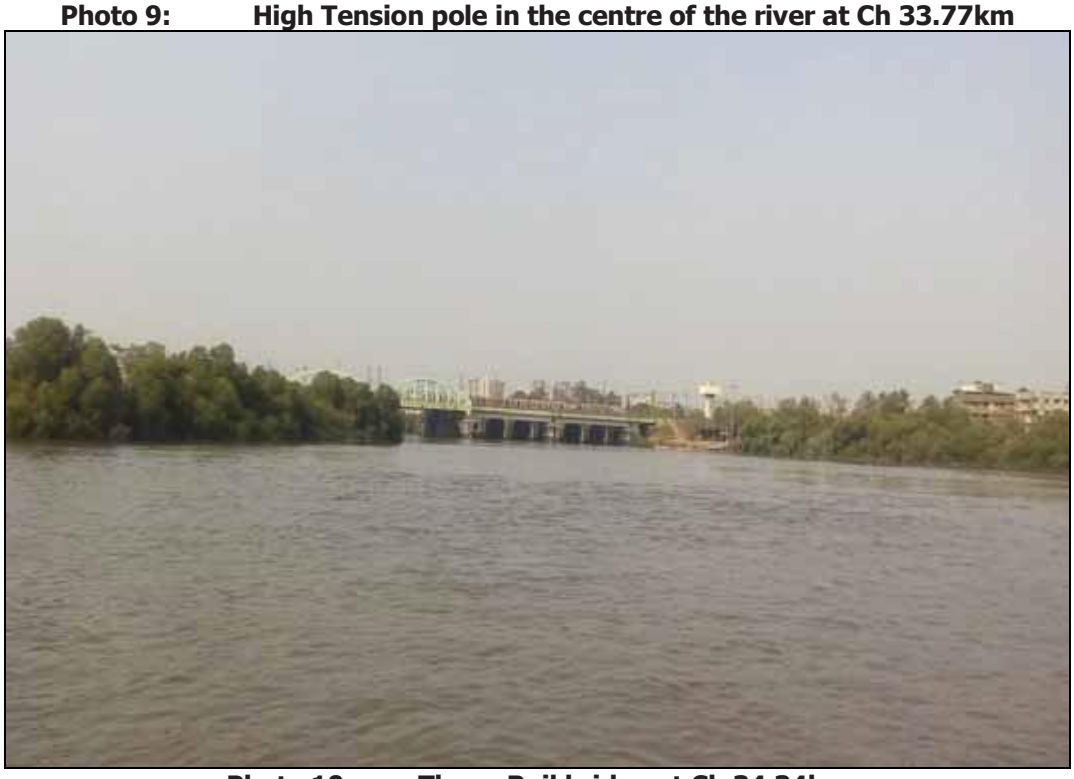


Photo 10: Thane Rail bridge at Ch 34.34km

Photo 11: Kalwa Road bridge at Ch 35.36km

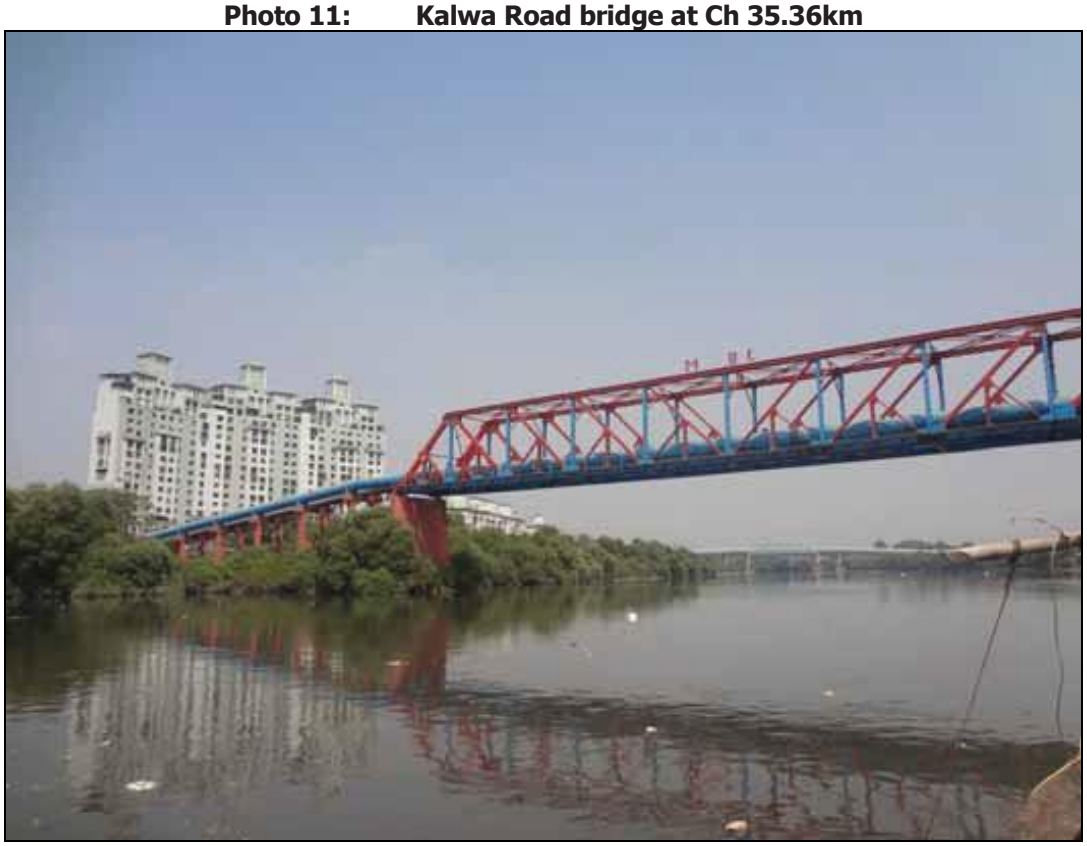


Photo 12: Kharegaon pipe line bridge at Ch 36.46km

Photo 13: Kalwa pipe line bridge at Ch 37.03km

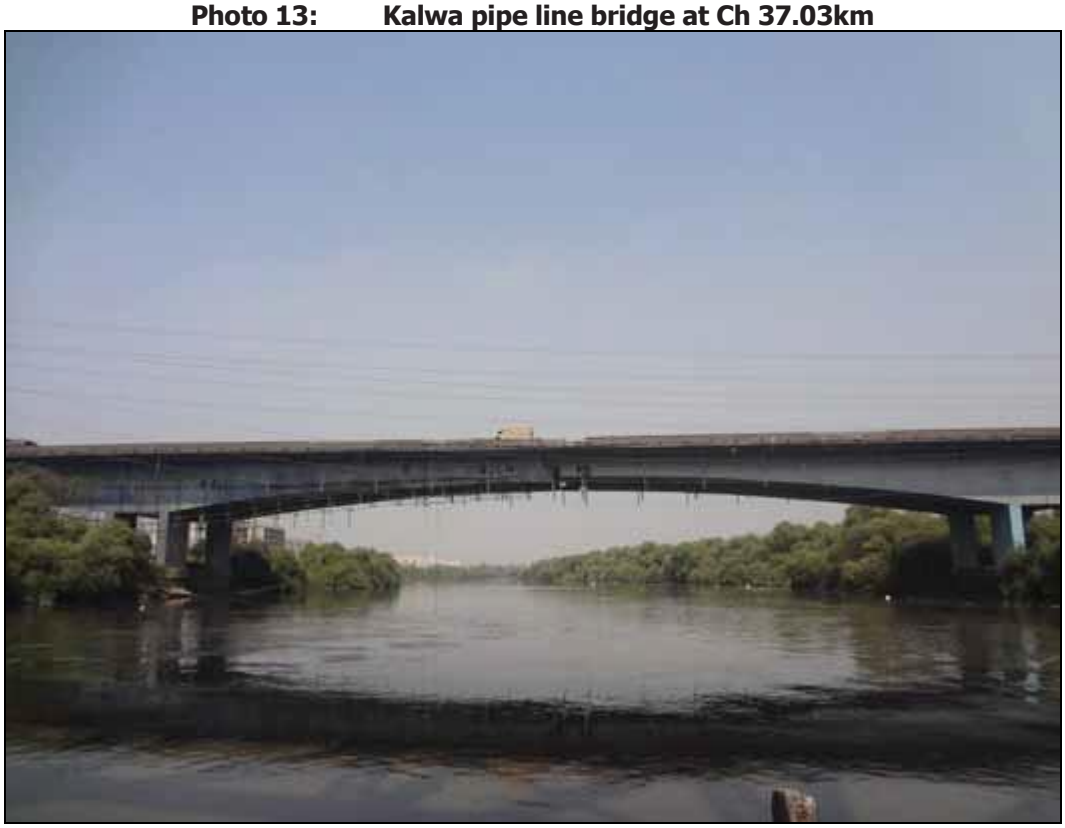


Photo 14: Kalwa Road bridge at Ch 37.10km

Photo 15: Slope Jetty on the Western Bank of the River at Ch 37.50km

Photo 16: Nasik Expressway pipe Line Bridge at Ch 40.19km

Photo 17: Electric pole in the middle of the river, at Ch 41.43km

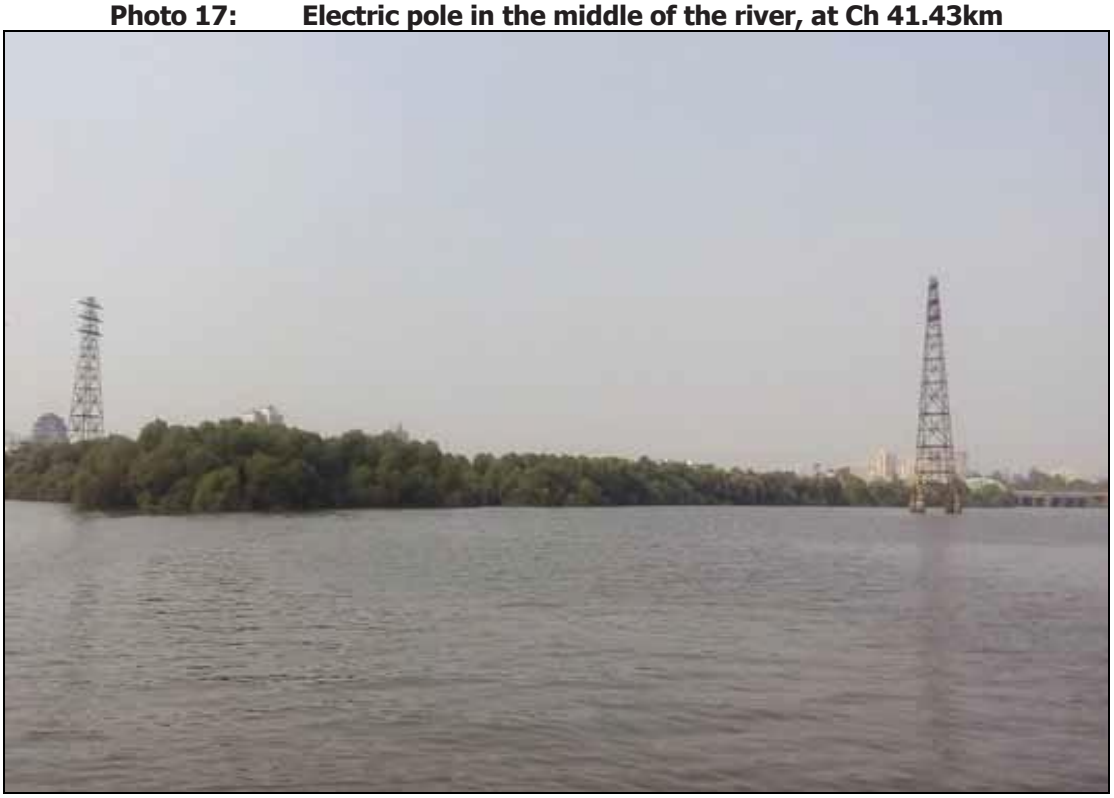


Photo 18: Electric pole in the middle of the river with single Wire passing at Ch 42.40km

Photo 19: Bhiwandi - Dombivli Rail Bridge at Ch 50.70km

Photo 20: High Tension line at Ch 55.17km

Photo 21: Kongaon old road bridge at Ch 56.14km

Photo 22: Kongaon new road bridge at Ch 56.20km

Photo 23: High Tension line at Ch 57.89km

Photo 24: Thakurgaon pipe line bridge at Ch 58.77km

Photo 25: High Tension line at Ch 62.99km

Photo 26: Kalyan Sape bridge at Ch 64.52km

Photo 27: High Tension line crossing river at Ch 66.35km

Photo 28: Mohane road bridge at Ch 67.63km

Photo 29: High Tension line crossing the River at Ch 69.82km

Photo 30: High Tension line crossing the River at Ch 73.39km

Photo 31: Downstream of the river from middle of the Kalyan-Rayate Bridge at Ch 75.77km

Photo 32: High Tension line crossing River at Ch 78.24km

Photo 33: High tension wire crossing river at Ch 79.49km

Photo 34: Three sets of high tension wire Crossing River at Ch 81.51km

Photo 35: Upstream of the bridge from centre of Manjarligaon bridge at Ch 86.89km

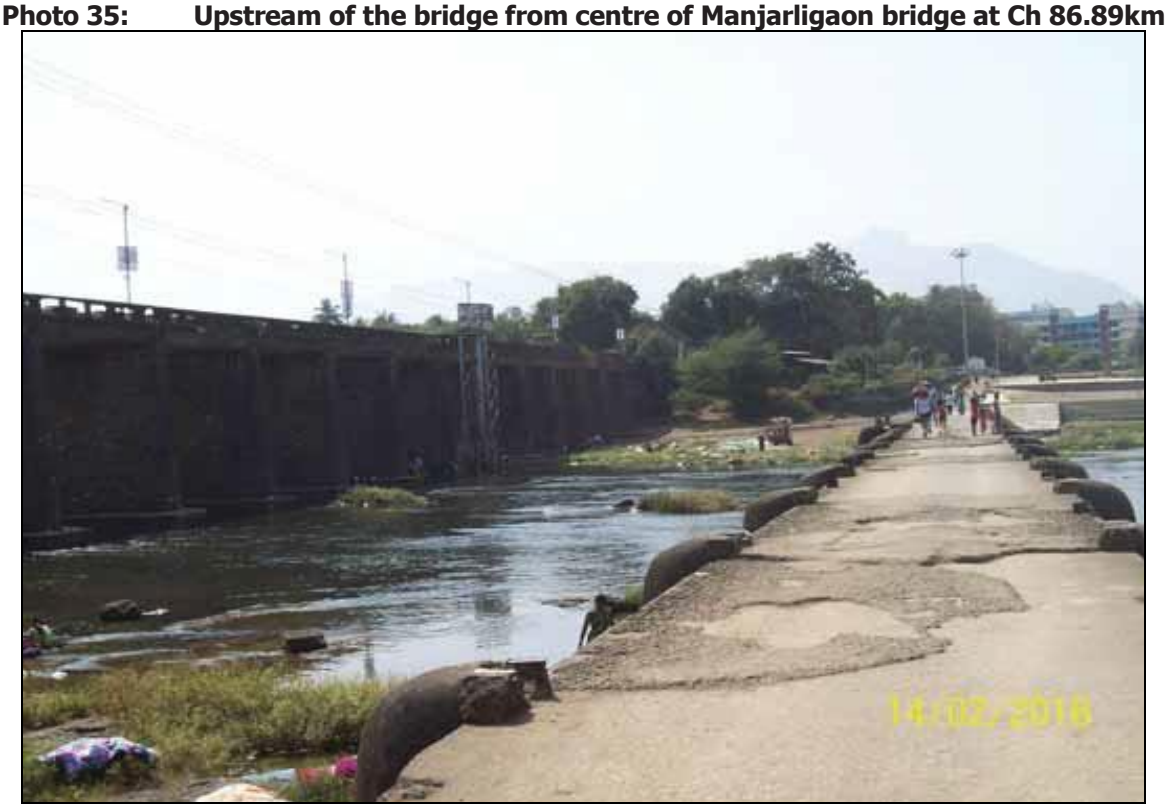


Photo 36: Badlapur Bridge and adjacent bridge at Ch 88.95km

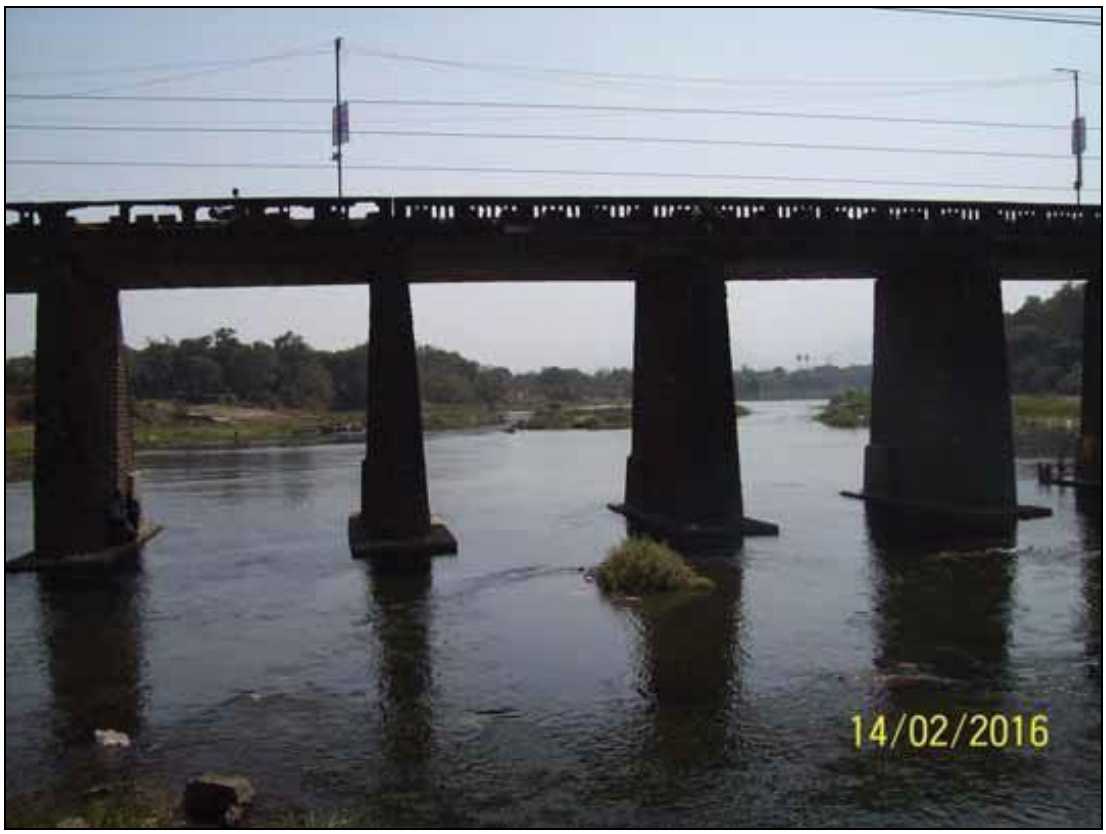


Photo 37: Badlapur Bridge from the centre of a second bridge 60 m downstream on the river at Ch 89.07km

Photo 38: Badlapur Bridge at Ch 89.07km

Photo 39: Barrage 300 m upstream and high tension line crossing river near Ch 90.37km

Photo 40: Upstream of the river from middle of the barrage at Ch 90.37km

Photo 41: Water treatment plant and broken bridge at Ch 90.82km

Photo 42: High Tension line crossing river at Ch 100.82km

Photo 43: Pashan Road Bridge from Ch 100.94km

Photo 44: East bank and an electric pole from where electric cable crossing river from Ch 106.46km

Photo 45: North of the bridge towards Malegaon at Ch 111.23km

Waldhuni River

Photo 46: Showing towards north from centre of the Kalyan Ambernath Bridge at Ch 0.40 km

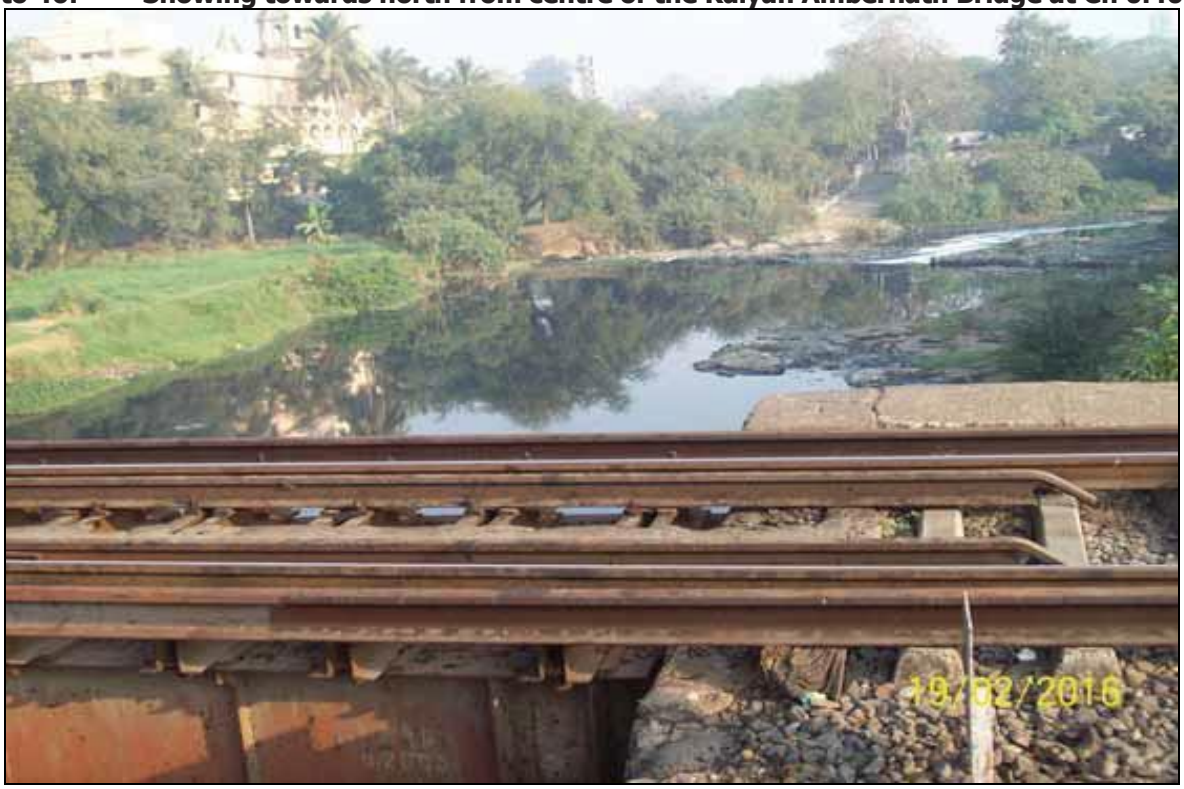


Photo 47: Showing towards north of river from Railway Bridge at Ch 1.00km

Photo 48: Showing towards east of the Bhiwandi Murwad Road Bridge at Ch 1.33km. Foot over bridge is at 50m north of this bridge

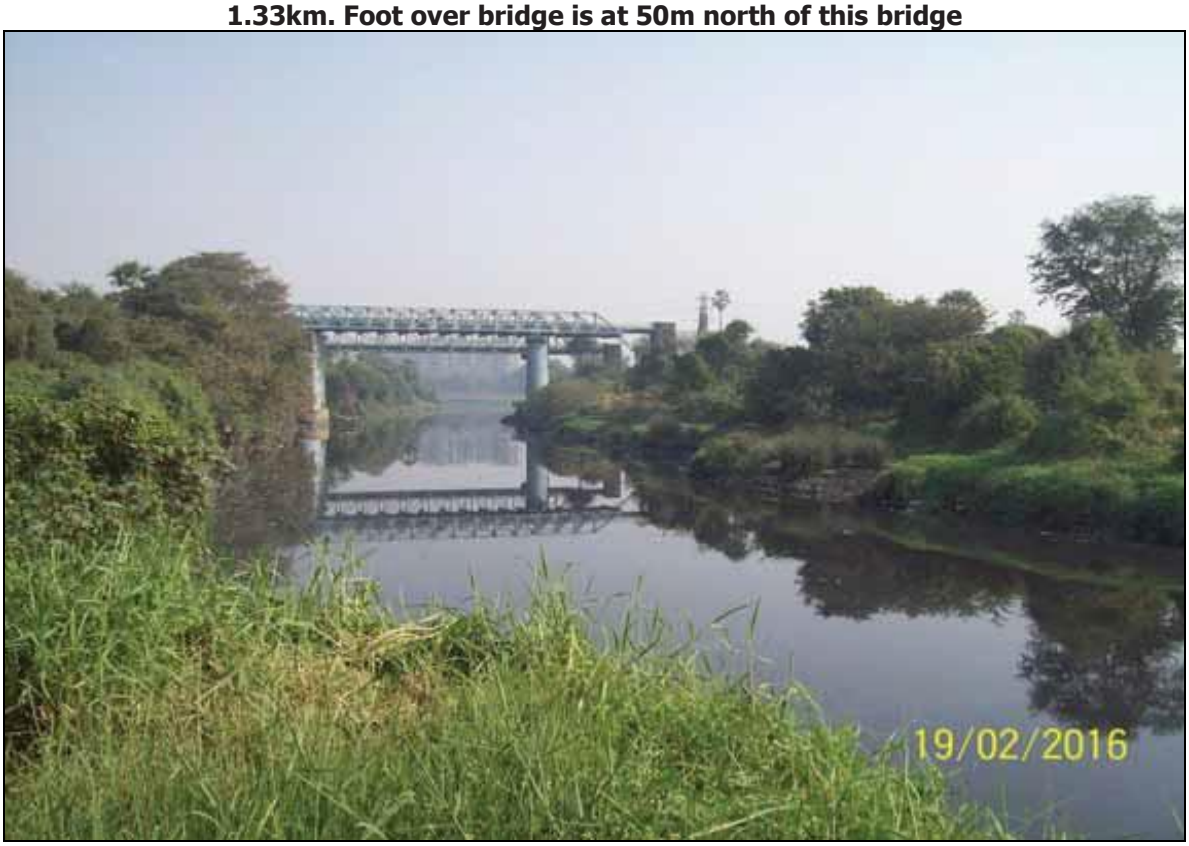


Photo 49: Showing towards north of the river at Ch 2.75km. 50m north there are two adjacent pipeline bridges

Photo 50: Showing twin pipeline bridge at Ch 2.94km

Photo 51: Pipeline bridge towards Kalyan at Ch 3.16km

Vasai Creek

Photo 52: Small light house structure, depicting start of shallow patch at Ch 3.037 km

Photo 53: Mira Bhayandar old rail bridge at Ch 6.10km

Photo 54: Mira Bhayandar new rail bridge at Ch 6.29km

Photo 55: Mira Bhayandar old rail bridge at Ch 6.68km

Photo 56: Mira Bhayandar new rail bridge at Ch 6.29km

Photo 57: High Tension Power line crossing River. at Approx. Ch 10.31km

Photo 58: High Tension Line crossing River at Approx. Ch 10.51km

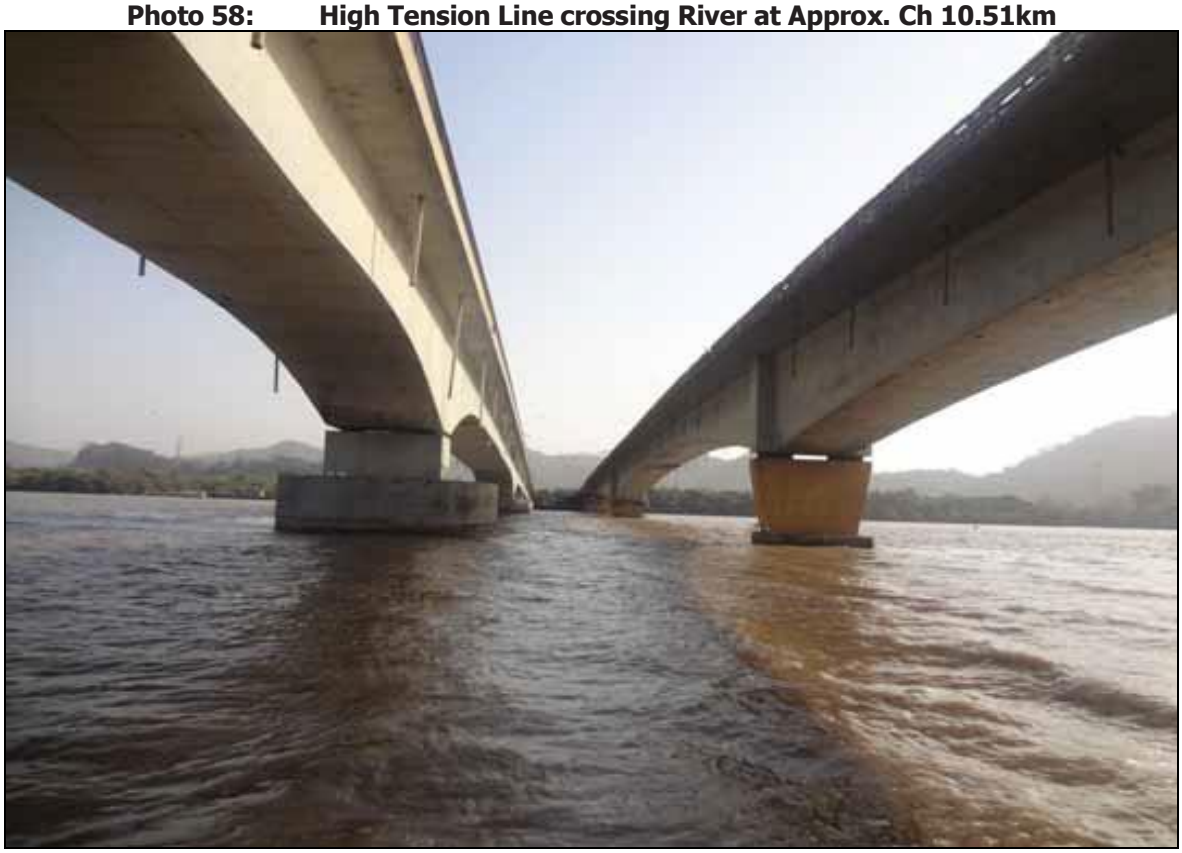


Photo 59: Mira Bhayandar Road bridge at Ch 13.51km

Photo 60: High Tension Line crossing the River Ch 13.51km

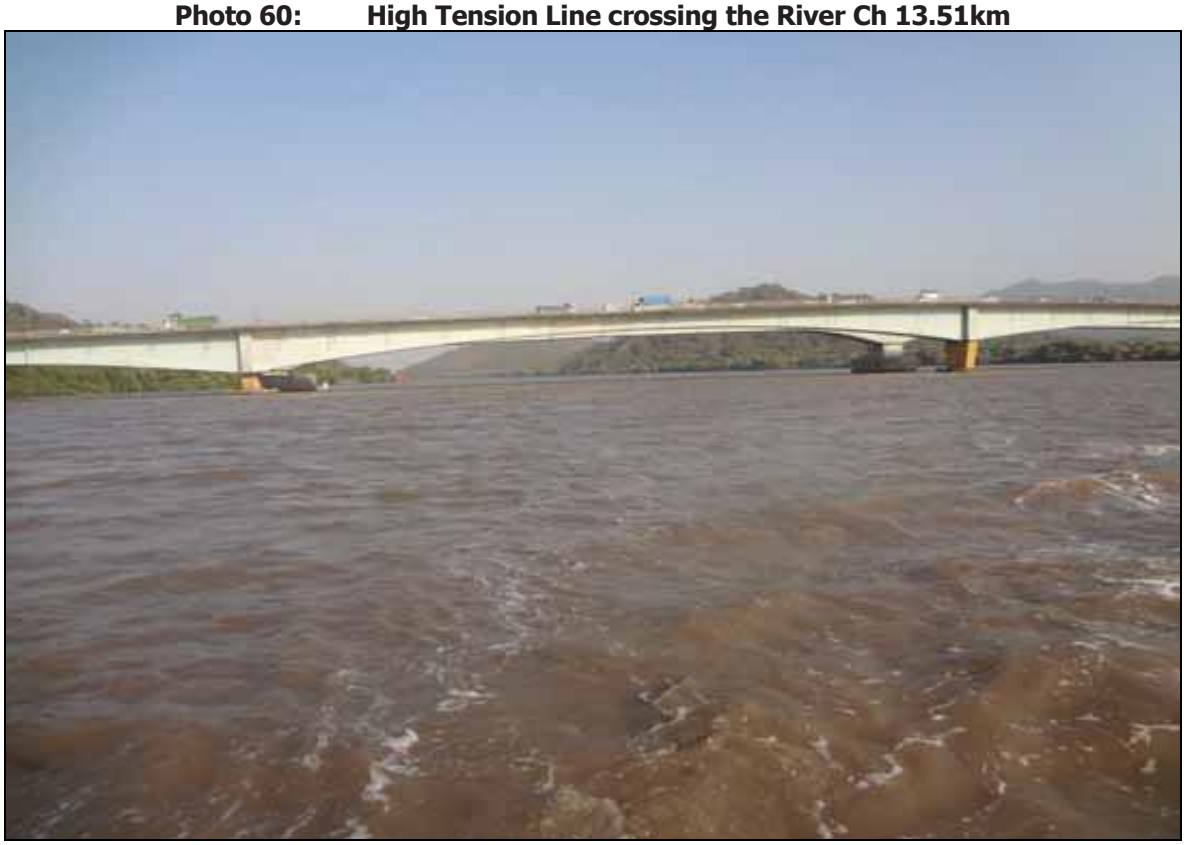


Photo 61: Mira Bhayandar Road bridge Ch 14.198 km

Photo 62: Coast on the Northern bank of the River at Ch 16.05km

Photo 63: High tension line crossing the River at Ch 22.06km

Photo 64: View of Western Bank of River at Ch 26.58km

Photo 65: Kasheli road Bridge at Ch 29.97km

Photo 66: Kasheli Road Bridge at Ch 29.969 km

Photo 67: Kasheli pipe line Bridge at Ch 30.31km

Photo 68: High Tension Line Crossing River at Ch 30.52km

ANNEXURE 3.5

BADLAPUR GAUGE AND DISCHARGE DATA

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2000 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.08	5.132	O	1	1.18	8.855	O	1	1.2	9.311	O	1	1.25	11.16	O	1	1.16	7.74	O	1	1.3	12.88	O
2	1.06	4.5	C	2	1.165	8.084	O	2	1.19	8.866	O	2	1.26	12	C	2	1.15	7.5	C	2	2.1	115	O
3	1.06	4.7	C	3	1.15	7.735	O	3	1.19	8.575	O	3	1.11	6.47	O	3	1.12	6.414	O	3	1.55	37	O
4	1.06	4.7	C	4	1.2	9.823	O	4	1.18	8.045	O	4	1.3	12.972	O	4	1.13	6.639	O	4	1.9	82	O
5	1.07	4.85	C	5	1.14	7.2	O	5	1.19	9	C	5	1.27	12.3	C	5	1.17	8.437	O	5	1.45	20.71	O
6	1.08	5.179	O	6	1.2	9.45	C	6	1.2	9.45	C	6	1.15	7.571	O	6	1.18	8.936	O	6	1.37	17.69	O
7	1.08	4.914	O	7	1.14	7.043	O	7	1.21	9.6	C	7	1.16	7.7	C	7	1.15	7.5	C	7	2.72	263.7	O
8	1.1	5.669	O	8	1.28	13.068	O	8	1.21	9.6	C	8	1.22	10.2	C	8	1.15	7.5	C	8	2.39	185.6	O
9	1.08	5.25	C	9	1.26	12.411	O	9	1.2	9.222	O	9	1.2	9.45	C	9	1.15	7.5	C	9	2.05	96.63	O
10	1.08	5.25	C	10	1.26	13.703	O	10	1.25	11.458	O	10	1.14	7.2	C	10	1.18	8.6	C	10	1.78	61.75	O
11	1.07	5.121	O	11	1.28	13.129	O	11	1.27	12.668	O	11	1.25	11.171	O	11	1.24	10.85	C	11	1.91	84	O
12	1.11	6.485	O	12	1.28	13.517	O	12	1.28	12.6	C	12	1.25	10.726	O	12	1.21	9.6	C	12	1.57	38.68	O
13	1.11	6.3	C	13	1.26	12	C	13	1.27	12.749	O	13	1.19	8.172	O	13	1.2	9.45	C	13	1.63	44.83	O
14	1.125	6.6	C	14	1.2	9.407	O	14	1.26	12	C	14	1.28	12.277	O	14	1.25	11.6	C	14	1.66	49.15	O
15	1.11	6.428	O	15	1.26	12.021	O	15	1.26	12	C	15	1.25	11.6	C	15	1.15	7.5	C	15	1.82	70	O
16	1.14	6.45	C	16	1.19	8.799	O	16	1.24	10.85	C	16	1.26	12	C	16	1.34	14.6	C	16	1.75	60.06	O
17	1.12	6.45	C	17	1.155	7.336	O	17	1.19	9	C	17	1.29	12.36	O	17	1.35	15	C	17	1.5	32	O
18	1.12	6.45	C	18	1.27	12.728	O	18	1.18	8.5	C	18	1.38	16.7	C	18	1.38	17	C	18	1.42	24	O
19	1.12	6.45	C	19	1.23	10.527	O	19	1.17	8.25	C	19	1.39	16.768	O	19	1.6	50	C	19	1.3	15	O
20	1.12	6.45	C	20	1.2	9.45	C	20	1.1	5.85	C	20	1.35	15.273	O	20	1.5	38	C	20	1.45	24	O
21	1.125	6.359	O	21	1.14	7.142	O	21	1.02	3.5	C	21	1.34	14.6	C	21	1.41	18	C	21	1.42	24	O
22	1.135	6.667	O	22	1.26	12.034	O	22	1.08	5.25	C	22	1.35	15	C	22	1.2	9.159	O	22	1.22	9.647	O
23	1.13	6.75	C	23	1.225	10.495	O	23	1.24	10.85	C	23	1.34	14.6	C	23	1.38	16.431	O	23	1.3	12.68	O
24	1.13	6.522	O	24	1.27	12.3	C	24	1.26	12.039	O	24	1.35	15.359	O	24	1.31	13.354	O	24	1.48	30	O
25	1.14	7.39	O	25	1.26	12	C	25	1.26	11.879	O	25	1.37	17.572	O	25	1.29	12.335	O	25	1.95	90	O
26	1.14	7.2	C	26	1.25	11.409	O	26	1.25	11.6	C	26	1.37	16.777	O	26	1.32	13.315	O	26	1.85	75	O
27	1.13	6.473	O	27	1.27	12.3	C	27	1.23	11.846	O	27	1.355	15.227	O	27	1.33	13.996	O	27	1.91	84	O
28	1.095	5.347	O	28	1.26	12.199	O	28	1.27	12.79	O	28	1.22	8.573	O	28	1.32	13.8	C	28	1.95	90	O
29	1.13	6.708	O	29	1.23	10.904	O	29	1.26	12	C	29	1.19	8.294	O	29	1.28	12.14	O	29	1.71	56	O
30	1.13	6.75	C					30	1.26	12.071	O	30	1.16	7.7	C	30	1.18	8.782	O	30	1.95	90	O
31	1.125	6.432	O					31	1.26	11.796	O					31	1.23	10.796	O				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.92	85	O	1	1.59	47.36	O	1	2.77	310	O	1	1.54	36	O	1	1.13	5.5	O	1	1.16	6.513	O
2	1.7	55	O	2	1.56	41.3	O	2	2.97	414.5	O	2	1.42	24	O	2	1.21	9.5	O	2	1.155	6.752	O
3	2	97	O	3	1.48	37.64	O	3	2.48	210	O	3	1.52	42.37	O	3	1.25	11.5	O	3	1.19	8.6	C
4	2.24	128.1	O	4	1.46	33.35	O	4	2.25	159.2	O	4	1.54	40.71	O	4	1.26	12	O	4	1.12	5.391	O
5	2.2	127.5	O	5	1.42	24.01	O	5	2.06	114.9	O	5	1.5	32.62	O	5	1.27	13	O	5	1.1	4.939	O
6	2.82	309.4	O	6	1.4	22.5	O	6	2.1	117.8	O	6	1.57	43.36	O	6	1.11	5.5	O	6	1.1	5.633	O
7	4.52	1199	O	7	1.37	20.71	O	7	1.95	96.75	O	7	1.49	31	O	7	1.105	5.371	O	7	1.15	6.8	C
8	3.92	740.9	O	8	1.28	15.4	O	8	1.86	68.48	O	8	1.44	26	O	8	1.22	9.482	O	8	1.16	6.794	O
9	3.89	760	O	9	1.98	92.3	O	9	1.76	58.71	O	9	1.77	60.5	O	9	1.29	12.88	O	9	1.13	6.002	O
10	4.84	886.2	O	10	2.6	321.7	O	10	1.68	52	O	10	1.62	41.97	O	10	1.24	10.8	O	10	1.1	5.3	C
11	4.6	1101	O	11	3.58	606	O	11	1.6	42.83	O	11	1.61	40.27	O	11	1.17	8	O	11	1.14	6.5	C
12	4.15	1010	O	12	2.84	366.9	O	12	1.54	37.75	O	12	1.62	52.1	O	12	1.19	9	O	12	1.13	5.902	O
13	6.5	2450	O	13	2.95	380	O	13	1.5	32.27	O	13	1.62	45.28	O	13	1.2	8.723	O	13	1.03	3.366	O
14	3.6	627.7	O	14	2.47	209.4	O	14	1.45	29.37	O	14	1.54	37.98	O	14	1.16	7.574	O	14	1.13	6.34	O
15	3.06	458.5	O	15	2.22	142	O	15	1.39	20.89	O	15	1.34	18	O	15	1.22	10.05	O	15	1.07	3.994	O
16	2.61	250	O	16	2.1	117.9	O	16	1.35	17.36	O	16	1.31	15.15	O	16	1.16	7.141	O	16	1.1	4.798	O
17	2.45	192.9	O	17	1.99	101.5	O	17	1.32	16	O	17	1.41	23.5	O	17	1.19	8.553	O	17	1.12	6	C
18	2.4	193	O	18	2.08	112.3	O	18	1.29	13.84	O	18	1.42	24	O	18	1.21	9.104	O	18	1.045	3.381	O
19	2.53	238.9	O	19	2.14	120.5	O	19	1.27	13.84	O	19	1.42	19.64	O	19	1.17	3.341	O	19	1.03	3.082	O
20	2.52	247.1	O	20	2.25	150	O	20	1.24	12.14	O	20	1.37	18.54	O	20	1.12	6.028	O	20	1.05	3.198	O
21	2.35	176.3	O	21	2.34	165.3	O	21	1.38	19.52	O	21	1.35	17.99	O	21	1.11	5.216	O	21	1.1	4.97	O
22	2.1	118.5	O	22	2.59	241.7	O	22	1.54	41.41	O	22	1.25	11.5	O	22	1.11	5.314	O	22	1.12	5.383	O
23	1.98	94	O	23	2.62	250.7	O	23	1.78	62.46	O	23	1.18	9.162	O	23	1.12	5.831	O	23	1.115	5.38	O
24	1.87	76.56	O	24	2.35	170.4	O	24	1.85	75	O	24	1.15	6.5	O	24	1.13	5.938	O	24	1.15	6.8	C
25	2.02	96.83	O	25	3.8	744.8	O	25	1.44	23.08	O	25	1.38	21	O	25	1.15	6.765	O	25	1.05	3.6	C
26	1.9	81.75	O	26	2.57	213.5	O	26	1.45	25.22	O	26	1.38	21	O	26	1.15	3.015	O	26	1.03	2.765	O
27	1.18	61.27	O	27	2.41	191	O	27	1.72	58.91	O	27	1.16	7.5	O	27	1.12	6.393	O	27	1.03	2.777	O
28	1.73	53.37	O	28	3.1	417.9	O	28	1.9	78.52	O	28	1.14	6	O	28	1.1	5.325	O	28	1.15	6.8	C
29	1.61	35.27	O	29	3.44	525	O	29	1.85	70.92	O	29	1.13	5.5	O	29	1.11	5	O	29	1.06	3.8	C
30	1.58	40	O	30	3.12	441.2	O	30	1.65	49	O	30	1.12	5	O	30	1.12	5	O	30	1.09	5.1	C
31	1.49	29.38	O	31	2.78	331.1	O					31	1.08	5.716	O					31	1.06	3.8	C

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2001 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.1	4.966	O	1	1.08	4.028	O	1	1.08	4.101	O	1	1.105	4.9	C	1	1.12	4.6	C	1	1.37	16.49	O
2	1.12	5.962	O	2	1.08	4.3	C	2	1.11	5.115	O	2	1.105	4.631	O	2	1.11	4.3	C	2	1.38	16.91	O
3	1.12	6.124	O	3	1.08	4.3	C	3	1.11	5.096	O	3	1.095	3.989	O	3	1.12	4.6	C	3	1.37	18	O
4	1.08	4.08	O	4	1.09	4.5	C	4	1.1	5	C	4	1.1	4.8	C	4	1.1	4	C	4	1.2	6.585	O
5	1.09	4.372	O	5	1.08	4.3	C	5	1.1	4.832	O	5	1.01	2.5	C	5	1.11	4.3	C	5	1.24	12	O
6	1.1	4.667	O	6	1.08	4.3	C	6	1.1	5	C	6	1.02	2.7	C	6	1.19	8.4	C	6	1.27	10.89	O
7	1.09	4.7	C	7	1.09	4.5	C	7	1.1	4.629	O	7	1.06	2.998	O	7	1.19	8.4	C	7	1.39	15.73	O
8	1.08	4.03	O	8	1.09	4.5	C	8	1.11	5.057	O	8	1.1	4.8	C	8	1.18	8.1	C	8	1.4	16.44	O
9	1.12	5.16	O	9	1.09	4.5	C	9	1.05	3.293	O	9	1.09	4.2	C	9	1.12	4.6	C	9	1.37	18	O
10	1.105	5.338	O	10	1.08	4.3	C	10	1.164	7.5	C	10	1.07	3.6	C	10	1.26	10.4	C	10	1.28	13	O
11	1.1	4.703	O	11	1.08	4.2	C	11	1.09	4.6	C	11	1.08	3.9	C	11	1.21	8.8	C	11	1.21	6.871	O
12	1.11	4.787	O	12	1.07	3.92	O	12	1.05	3.343	O	12	1.07	3.48	O	12	1.21	8.8	C	12	1.285	10.42	O
13	1.11	5	C	13	1.06	4	C	13	1.07	3.867	O	13	1.08	3.9	C	13	1.18	8.1	C	13	1.28	9.751	O
14	1.12	5.3	C	14	1.08	4.064	O	14	1.05	4	O	14	1.09	4.2	C	14	1.14	5.75	O	14	1.44	27.02	O
15	1.09	4.182	O	15	1.08	4.057	O	15	1.11	4.533	O	15	1.07	3.6	C	15	1.13	5.277	O	15	2.65	257.7	O
16	1.11	5.378	O	16	1.13	5.765	O	16	1.11	4.623	O	16	1.07	3.131	O	16	1.15	5.934	O	16	2.22	114.4	O
17	1.12	5.629	O	17	1.08	4.062	O	17	1.1	4.559	O	17	1.07	3.063	O	17	1.24	8.606	O	17	3.22	500	O
18	1.12	5.656	O	18	1.08	4.2	C	18	1.11	5	C	18	1.12	4.215	O	18	1.25	8.768	O	18	2.85	384.7	O
19	1.13	6	C	19	1.06	3.778	O	19	1.105	4.52	O	19	1.1	4.5	C	19	1.25	8.783	O	19	2.17	113.7	O
24	1.11	5.5	C	20	1.05	4.367	O	20	1.1	4.415	O	20	1.09	4.2	C	20	1.24	9	C	20	2	89.73	O
25	1.12	5.7	C	21	1.06	3.8	C	21	1.095	4.005	O	21	1.12	4.6	C	21	1.135	4.348	O	21	1.88	70.56	O
26	1.15	6.7	C	22	1.08	4.045	O	22	1.09	3.997	O	22	1.1	4	C	22	1.14	4.618	O	22	1.69	44.36	O
27	1.05	3.8	C	23	1.1	4.703	O	23	1.095	4.284	O	23	1.095	3.413	O	23	1.25	8.807	O	23	1.54	38.07	O
28	1.12	5.7	C	24	1.09	4.415	O	24	1.09	3.985	O	24	1.08	3.203	O	24	1.31	13.625	O	24	1.4	21	O
29	1.1	4.8	C	25	1.09	4.6	C	25	1.11	5	C	25	1.1	3.487	O	25	1.32	14.004	O	25	1.33	13.35	O
30	1.08	3.992	O	26	1.12	5.591	O	26	1.105	4.9	C	26	1.11	4.05	O	26	1.33	14.455	O	26	1.31	11.83	O
31	1.09	4.051	O	27	1.07	3.756	O	27	1.1	4.426	O	27	1.12	4.279	O	27	1.39	18	C	27	1.85	73.14	O
				28	1.09	4.372	O	28	1.105	4.598	O	28	1.11	4.3	C	28	1.28	10.498	O	28	2.49	180.9	O
								29	1.105	4.582	O	29	1.12	4.6	C	29	1.37	16.323	O	29	2.17	114.1	O
								30	1.1	4.107	O	30	1.1	4	C	30	1.38	16.786	O	30	2	85.87	O
								31	1.105	4.621	O					31	1.38	16.57	O				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.85	75	O	1	2.48	209	O	1	1.77	63.28	O	1	1.55	44.96	O	1	1.22	9.033	O	2	1.08	7.14	O
2	2.28	132.9	O	2	2.25	147.4	O	2	1.63	45	O	2	1.57	40	O	2	1.16	6.484	O	3	1.07	8.6	O
3	3.07	418.8	O	3	2.01	109.6	O	3	1.91	85	O	3	1.41	21.56	O	3	1.17	6.594	O	4	1.065	5.793	O
4	3.98	890.4	O	4	2	109.4	O	4	1.84	79.58	O	4	1.49	39.55	O	4	1.14	4	O	5	1.055	5.311	O
5	3.51	580.3	O	5	2.32	170	O	5	1.67	57.14	O	5	1.44	21.59	O	5	1.15	4.5	O	6	1.065	5.92	O
6	2.64	275.2	O	6	2.63	258.9	O	6	1.62	48.22	O	6	1.61	51.92	O	6	1.15	4.5	O	7	1.17	6.8	O
7	2.65	283.5	O	7	2.37	182	O	7	1.53	36.17	O	7	2.13	140	O	7	1.15	4.5	O	8	1.16	7.195	O
8	2.35	177	O	8	2.46	202.7	O	8	1.46	27	O	8	1.93	88.48	O	8	1.18	7.019	O	9	1.09	6.368	O
9	3.54	771.8	O	9	2.8	331.3	O	9	1.39	21	O	9	2.37	179.2	O	9	1.17	6.5	O	10	1.11	5.3	O
10	4.6	1103	O	10	3	419.6	O	10	1.37	19.19	O	10	2.01	101.4	O	10	1.15	4.5	O	11	1.21	6.5	O
11	2.95	384.6	O	11	2.94	374.7	O	11	1.37	19.08	O	11	1.8	65.07	O	11	1.15	4.5	O	12	1.15	6.266	O
12	2.73	320.8	O	12	3.1	420	O	12	1.47	33.92	O	12	1.82	66.05	O	12	1.15	5.45	O	13	1.2	3.692	O
13	2.57	256.4	O	13	2.65	272.4	O	13	1.37	19.1	O	13	1.75	62	O	13	1.14	4.367	O	14	1.12	6.708	O
14	2.58	247.5	O	14	2.99	370.6	O	14	1.26	10.84	O	14	1.88	78	O	14	1.1	3.662	O	15	1.13	4.225	O
15	2.58	240	O	15	3.5	620	O	15	1.23	9.947	O	15	1.53	39.24	O	15	1.11	3.892	O	16	1.1	5.033	O
16	2.68	278.8	O	16	3.9	757	O	16	1.21	8.6	O	16	1.59	49.32	O	16	1.1	3.662	O	17	1.1	6	O
17	2.33	174	O	17	3.55	601.2	O	17	1.21	8.595	O	17	1.52	38.04	O	17	1.1	3.74	O	18	1.08	3.645	O
18	2.16	127.4	O	18	2.9	341.8	O	18	1.2	7.766	O	18	1.5	35.8	O	18	1.09	3.5	O	19	1.08	3.325	O
19	2.21	143.8	O	19	2.62	270	O	19	1.56	44.54	O	19	1.45	25.66	O	19	1.09	3.455	O	20	1.085	3.439	O
20	2.61	256.4	O	20	2.26	144.6	O	20	2.24	141.9	O	20	1.43	22.75	O	20	1.06	2.402	O	21	1.08	5.34	O
21	2.56	247.4	O	21	2.11	117.1	O	21	2.68	286.2	O	21	1.38	19.5	O	21	1.28	13.2	O	22	1.085	5.699	O
22	2.46	210	O	22	2.06	112	O	22	2.62	270	O	22	1.38	18.22	O	22	1.135	4.899	O	23	1.085	5.616	O
23	3.1	462.5	O	23	1.91	80.88	O	23	1.97	95	O	23	1.31	13.48	O	23	1.09	3.441	O	24	1.08	6.8	O
24	2.88	401.5	O	24	1.95	89.15	O	24	1.75	64.97	O	24	1.37	18.55	O	24	1.07	3.21	O	25	1.075	3.6	O
25	2.5	213.3	O	25	2.08	129	O	25	2.04	99.46	O	25	1.28	12.8	O	25	1.065	3.1	O	26	0.95	3.001	O
26	2.44	201.8	O	26	1.98	97	O	26	2.37	176.2	O	26	1.19	7.5	O	26	1.09	3.484	O	27	0.95	3.001	O
27	2.37	184	O	27	1.81	59.57	O	27	2.21	140	O	27	1.17	6.889	O	27	1.07	3.25	O	28	0.94	6.8	O
28	2.52	241.5	O	28	2.04	112.8	O	28	1.85	70.68	O	28	1.36	18.5	O	28	1.07	3.261	O	29	0.97	3.8	O
29	2.52	230	O	29	2.04	100.6	O	29	1.79	65.07	O	29	1.3	13.52	O	29	1.17	5.83	O	30	1.025	5.1	O
30	2.35	171.9	O	30	1.91	83.72	O	30	1.63	45	O	30	1.24	11.31	O	30	1.11	3.441	O	31	1.04	3.8	O
31	2.46	202.9	O	31	1.78	62.03	O					31	1.18	7.753	O	36903	1.085	6.884	O				

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2002 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	0.98	0.24	O	1	1.24	1.285	O	1	1.17	4.34	C	1	1.12	4.9	O	1	1.2	4.6	C	1	1.26	10.04	C
2	1.055	0.442	O	2	1.2	4.2	C	2	1.14	5.268	C	2	1.06	4.876	O	2	1.18	0.851	O	2	1.26	10.04	C
3	1.06	6.502	C	3	1.25	4.3	C	3	1.12	5.347	C	3	1.05	3.975	O	3	1.2	0.871	O	3	1.25	9.57	C
4	1.08	4.325	C	4	1.23	4.5	C	4	1.12	5	C	4	1.195	4.8	O	4	1.24	0.887	O	4	1.21	7.89	C
5	1.08	4.606	C	5	1.3	4.3	C	5	1.18	5.084	C	5	1.17	2.5	O	5	1.33	4.3	C	5	1.2	7.52	C
6	1.05	4.895	C	6	1.3	4.3	C	6	1.26	1.314	O	6	1.14	2.7	O	6	1.295	1.235	O	6	1.215	7.132	O
7	1.05	4.7	C	7	1.3	4.5	C	7	1.2	0.902	O	7	1.15	3.244	O	7	1.22	0.909	O	7	1.23	7.678	O
8	1.04	4.279	C	8	1.28	4.5	C	8	1.165	0.892	O	8	1.115	4.8	O	8	1.26	8.1	C	8	1.25	9.57	C
9	1.05	5.403	C	9	1.27	4.5	C	9	1.165	0.82	O	9	1.15	4.2	O	9	1.305	1.402	O	9	1.245	9.57	C
10	1.05	5.564	C	10	1.28	4.3	C	10	1.14	7.5	C	10	1.14	3.6	O	10	1.3	1.322	O	10	1.215	7.446	O
11	1.13	4.958	C	11	1.22	4.2	C	11	1.105	0.576	O	11	1.16	3.9	O	11	1.34	8.8	C	11	1.195	6.908	O
12	1.16	5.041	C	12	1.18	4.156	C	12	1.18	3.648	C	12	1.16	3.731	O	12	1.26	8.8	C	12	1.205	7.127	O
13	1.07	5	C	13	1.26	4	C	13	1.295	1.497	O	13	1.15	3.9	O	13	1.2	8.1	C	13	1.205	7.622	O
14	1.05	0.453	O	14	1.28	4.312	C	14	1.265	1.347	O	14	1.16	4.2	O	14	1.205	6.134	C	14	1.215	7.858	O
15	1.05	0.448	O	15	1.23	4.305	C	15	1.15	0.772	O	15	1.15	3.6	O	15	1.31	5.522	C	15	1.205	7.89	C
16	1.155	0.746	O	16	1.35	5.993	C	16	1.13	0.653	O	16	1.14	3.404	O	16	1.36	6.321	C	16	1.21	7.9	C
17	1.16	0.826	O	17	1.36	4.294	C	17	1.12	4.823	C	17	1.23	3.345	O	17	1.22	9.033	C	17	1.195	6.891	O
18	1.17	0.845	O	18	1.25	4.2	C	18	1.105	0.519	O	18	1.24	4.51	O	18	1.35	9.189	C	18	1.175	6.005	O
19	1.205	1.048	O	19	1.34	3.768	C	19	1.09	0.494	O	19	1.24	4.5	O	19	1.24	9.204	C	19	1.2	7.113	O
20	1.18	0	C	20	1.32	1.504	O	20	1.1	0.515	O	20	1.22	4.2	O	20	1.24	9	C	20	1.215	7.763	O
21	1.12	0.589	O	21	1.3	1.342	O	21	1.22	0.946	O	21	1.21	4.6	O	21	1.21	0.702	O	21	1.25	8.85	O
22	1.21	1.029	O	22	1.235	1.086	O	22	1.18	0.885	O	22	1.16	4	O	22	1.24	7.694	O	22	1.21	7.147	O
23	1.2	0.983	O	23	1.21	4.958	C	23	1.135	0.681	O	23	1.15	3.689	O	23	1.28	471.13	O	23	1.085	4.25	C
24	1.23	1.095	O	24	1.15	4.646	C	24	1.145	4.226	C	24	1.205	3.487	O	24	1.33	13.92	C	24	2.5	247.615	O
25	1.27	1.402	O	25	1.09	0.494	O	25	1.12	5	C	25	1.22	3.761	O	25	1.3	14.29	C	25	2.08	134.043	O
26	1.19	6.7	C	26	1.08	0.452	O	26	1.12	0.646	O	26	1.18	4.316	O	26	1.23	14.75	C	26	2.32	2946.158	O
27	1.1	3.8	C	27	1.12	4.052	C	27	1.12	0.652	O	27	1.185	4.563	O	27	1.24	18	C	27	4.69	1121.033	O
28	1.12	0.564	O	28	1.14	4.605	C	28	1.12	0.633	O	28	1.19	4.3	O	28	1.2	10.88	O	28	2.84	317.151	O
29	1.21	1.037	O					29	1.15	4.852	C	29	1.17	4.6	O	29	1.21	16.69	C	29	2.6	242.04	C
30	1.25	1.276	O					30	1.13	0.688	O	30	1.16	4	O	30	1.31	10.81	O	30	2.73	285.69	C
31	1.2	1.029	O					31	1.14	4.888	C					31	1.32	11.046	O				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	2	127.562	O	1	1.75	63.03	C	1	2.49	208.97	C	1	1.46	21.487	O	1	1.18	7.874	O	1	1.25	8.72	C
2	1.93	109.529	O	2	1.7	59.35	C	2	2.64	318.395	O	2	1.4	18.76	C	2	1.1	4.48	C	2	1.1	4.886	O
3	1.81	84.215	O	3	1.8	69.37	C	3	2.88	441.597	O	3	1.36	15.79	C	3	1.1	4.48	C	3	1.06	3.593	O
4	1.73	60.62	C	4	1.83	73.37	C	4	3.41	708.421	O	4	1.38	17.393	O	4	1.13	5.26	C	4	1.12	5.417	O
5	1.66	51.53	C	5	2.85	396.111	O	5	3.67	697.47	C	5	1.38	17.22	C	5	1.06	3.81	O	5	1.2	7.15	C
6	1.44	22.17	C	6	2.84	376.075	O	6	2.75	336.897	O	6	1.42	4.699	C	6	1.1	4.621	O	6	1.18	8.027	O
7	1.41	19.57	C	7	8.21	2323.403	O	7	2.32	197.691	O	7	1.42	18.917	O	7	1.1	4.713	O	7	1.13	5.34	C
8	1.34	14.46	C	8	4.65	1335.785	O	8	2.12	120.96	C	8	1.38	17.698	O	8	1.1	4.736	O	8	1.15	5.82	C
9	1.34	13.83	C	9	4	822.88	C	9	1.9	103.252	O	9	1.35	15.618	O	9	1.18	6.8	C	9	1.09	4.48	C
10	1.33	14.72	O	10	3.85	764.64	C	10	1.86	78.97	C	10	1.27	10.52	C	10	1.12	4.99	C	10	1.1	4.69	C
11	1.54	47.881	O	11	3.39	598.87	C	11	1.72	67.835	O	11	1.26	10.04	C	11	1.09	4.429	O	11	1.09	4.48	C
12	1.68	49.72	C	12	3.93	1002.473	O	12	1.67	53.4	C	12	1.26	10.04	C	12	1.03	2.917	O	12	1.15	5.82	C
13	1.65	49.72	C	13	3.28	602.448	O	13	1.63	46.25	C	13	1.26	10.04	C	13	1.09	4.566	O	13	1.175	6.59	C
14	1.59	39.91	C	14	2.62	296.785	O	14	1.65	49.72	C	14	1.22	8.644	O	14	1.19	8.516	O	14	1.17	6.33	C
15	1.77	75.95	O	15	2.34	169.19	C	15	1.52	30.55	C	15	1.19	7.15	C	15	1.25	9.57	C	15	1.1	4.69	C
16	2.21	354.749	O	16	2.26	150.33	C	16	1.4	17.891	O	16	1.055	3.84	O	16	1.165	6.47	C	16	1.08	4.29	C
17	2.23	180.791	O	17	2.28	179.22	C	17	1.395	17.671	O	17	1.175	7.312	O	17	1.17	6.47	C	17	1.07	3.736	O
18	2.85	330.67	C	18	2.41	187.02	C	18	1.54	47.266	O	18	1.33	13.83	C	18	1.11	5.05	O	18	1.12	5.51	O
19	2.68	355.069	O	19	2.4	230.077	O	19	1.55	34.31	C	19	1.26	10.04	C	19	1.17	6.47	C	19	1.16	7.258	O
20	2.7	275.16	C	20	2.32	193.606	O	20	1.46	24.06	C	20	1.25	9.57	C	20	1.17	6.47	C	20	1.1	4.891	O
21	2.37	176.68	C	21	2.05	134.416	O	21	1.3	12.08	C	21	1.12	4.99	C	21	1.22	8.29	C	21	1.09	3.845	O
22	2.47	220.752	O	22	1.88	80.41	C	22	1.38	17.22	C	22	1.35	15.12	C	22	1.19	8.509	O	22	1.11	4.977	C
23	3.09	468.943	O	23	1.81	70.68	C	23	1.4	19.529	O	23	1.25	9.57	C	23	1.27	11.016	O	23	1.105	4.76	O
24	2.88	420.054	O	24	1.84	74.75	C	24	1.51	30.942	O	24	1.23	8.7	C	24	1.29	11.54	C	24	1.05	3.74	C
25	3.01	398.11	C	25	2.1	117.13	C	25	1.48	29.896	O	25	1.15	5.84	C	25	1.3	11.698	O	25	1.11	4.9	C
26	2.77	300.17	C	26	2.76	346.16	O	26	1.47	25.05	C	26	1.17	6.47	C	26	1.33	13.83	C	26	1.11	5.327	O
27	2.5	211.84	C	27	2.37	207.081	O	27	1.3	12.08	C	27	1.18	6.8	C	27	1.28	11.373	O	27	1.1	4.69	C
28	2.3	159.56	C	28	2.02	118.901	O	28	1.34	14.46	C	28	1.1	4.871	O	28	1.29	11.566	O	28	1.15	5.82	C
29	2.03	123.609	O	29	1.88	78.97	C	29	1.27	10.52	C	29	1.07	4.052	O	29	1.19	7.15	C	29	1.16	6.07	C
30	1.92	95.725	O	30	2.28	154.9	C	30	1.245	9.57	C	30	1.11	4.73	C	30	1.24	9.68	O	30	1.17	6.783	O
31	1.83	77.755	O	31	2.12	120.96	C					31	1.23	9.476	O					31	1.145	5.82	C

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2003 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.17	7.503	O	1	1.21	6.791	O	1	1.165		null	1	1.11	3.705	O	1	1.105		null	1	1.19		null
2	1.11	5.349	O	2	1.225		null	2	1.16		null	2	1.156		null	2	1.115		null	2	1.1		null
3	1.11	4.276	O	3	1.24		null	3	1.175	3.673	O	3	1.12	3.673	O	3	1.065		null	3	1.075		null
4	1.1	4.632	O	4	1.26		null	4	1.15		null	4	1.105	3.602	O	4	1.065		null	4	1.13	3.763	O
5	1.11		null	5	1.25	9.044	O	5	1.21		null	5	1.105	3.597	O	5	1.085	3.692	O	5	1.2	5.967	O
6	1.11	4.352	O	6	1.27	9.899	O	6	1.23		null	6	1.11		null	6	1.065	3.749	O	6	1.2	5.837	O
7	1.13	5.72	O	7	1.24	8.235	O	7	1.255		null	7	1.12	4.009	O	7	1.095	3.99	O	7	1.22	6.81	O
8	1.12		null	8	1.25	8.748	O	8	1.265		null	8	1.1	3.499	O	8	1.13	4.574	O	8	1.155		null
9	1.11		null	9	1.26		null	9	1.25		null	9	1.11		null	9	1.15	5.162	O	9	1.11	3.242	O
10	1.1	4.591	O	10	1.105	5.239	O	10	1.18	5.938	O	10	1.125	4.15	O	10	1.165		null	10	1.08	2.837	O
11	1.115		null	11	1.085	4.429	O	11	1.19		null	11	1.145	4.507	O	11	1.061		null	11	1.16	5.01	O
12	1.13		null	12	1.15		null	12	1.21	8.528	O	12	1.12		null	12	1.16	5.585	O	12	1.175	5.123	O
13	1.11	4.911	O	13	1.21	6.863	O	13	1.185	5.96	O	13	1.1		null	13	1.15		null	13	1.21		null
14	1.12	5.654	O	14	1.31	11.317	O	14	1.205		null	14	1.1		null	14	1.23		null	14	1.235	7.157	O
15	1.12	5.523	O	15	1.29	10.023	O	15	1.18	5.602	O	15	1.12		null	15	1.185	6.167	O	15	1.18		null
16	1.145		null	16	1.21		null	16	1.145		null	16	1.1		null	16	1.14		null	16	1.12	3.471	O
17	1.18	7.429	O	17	1.16	4.998	O	17	1.16		null	17	1.08		null	17	1.23	8.23	O	17	1.08	2.846	O
18	1.23	9.337	O	18	1.15		null	18	1.22		null	18	1.06		null	18	1.21		null	18	1.13	3.725	O
19	1.29		null	19	1.205		null	19	1.165	5.041	O	19	1.07		null	19	1.1	3.604	O	19	1.48	36.18	O
20	1.21		null	20	1.23	7.25	O	20	1.1	3.321	O	20	1.095		null	20	1.125	3.92	O	20	2.21		null
21	1.24		null	21	1.2	6.506	O	21	1.135	4.206	O	21	1.11	3.718	O	21	1.18	5.968	O	21	3.68		null
22	1.23		null	22	1.105		null	22	1.175	5.469	O	22	1.13		null	22	1.205		null	22	2.34		null
23	1.26		null	23	1.2		null	23	1.17		null	23	1.07		null	23	1.23		null	23	2.35	177.1	O
24	1.28		null	24	1.175	5.746	O	24	1.15	4.763	O	24	1.08	3.115	O	24	1.18	5.863	O	24	2.16	115.8	O
25	1.25		null	25	1.13	4.309	O	25	1.12	3.702	O	25	1.09	3.516	O	25	1.165		null	25	2.26	146.8	O
26	1.28		null	26	1.175		null	26	1.15	4.695	O	26	1.125	5.02	O	26	1.12	3.725	O	26	2.22		null
27	1.15		null	27	1.17		null	27	1.16	4.607	O	27	1.115		null	27	1.075		null	27	1.92		null
28	1.16		null	28	1.17		null	28	1.145	4.343	O	28	1.1		null	28	1.13	4.248	O	28	2.71	313.125	O
29	1.21		null					29	1.135	4.018	O	29	1.08		null	29	1.18	5.735	O	29	2.775	340.561	O
30	1.26	6.87	O					30	1.135		null	30	1.15		null	30	1.26	7.813	O	30	3.05	351.6	O
31	1.215	6.876	O					31	1.13	4.125	O					31	1.265	8.05	O				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	2.27	147.1	O	1	2.025	126.868	O	1	2.01	111.3	O	1	1.8		null	1	1.32	14.08	O	1	1.16		null
2	1.92	86.81	O	2	2.47		null	2	1.81		null	2	1.76		null	2	1.315		null	2	1.29	13.06	O
3	1.83	80.89	O	3	2.8		null	3	2.155	126	O	3	1.98	91.93	O	3	1.075	3.359	O	3	1.305	13.75	O
4	1.79	71.41	O	4	3.105	480.7	O	4	2.215	140.5	O	4	1.595		null	4	1.3		null	4	1.305		null
5	1.61	49.6	O	5	3.1		null	5	2.25	147.2	O	5	1.49		null	5	1.315		null	5	1.295	14.12	O
6	1.66		null	6	3.16	516.5	O	6	1.93		null	6	1.42		null	6	1.25		null	6	1.245	11.36	O
7	2.29	181.5	O	7	4.015	893.1	O	7	1.9		null	7	1.585	31.89	O	7	1.27	13.08	O	7	1.1		null
8	2.74	283.8	O	8	2.855		null	8	2	104.6	O	8	1.65		null	8	1.265		null	8	1.025		null
9	3.3	468.3	O	9	2.49		null	9	2.25		null	9	1.9	90.04	O	9	1.155		null	9	1		null
10	2.55		null	10	2.32		null	10	1.84		null	10	1.65		null	10	1.035	3.119	O	10	1.155		null
11	2.41		null	11	2.355	183.5	O	11	2.74	280.4	O	11	1.585		null	11	1.04	3.3	O	11	1.12		null
12	2.57		null	12	2.06		null	12	2.92	380.4	O	12	1.395		null	12	1.265	10.09	O	12	1.04		null
13	1.96		null	13	1.99	109.8	O	13	2.53		null	13	1.325	10.93	O	13	1.255	9.954	O	13	1.12		null
14	1.88	88.34	O	14	2.05	144.3	O	14	2.57		null	14	1.5		null	14	1.115	5.498	O	14	1.105		null
15	2.84	345.5	O	15	2.205		null	15	2.35	161.5	O	15	1.48		null	15	1.115	5.536	O	15	1.015		null
16	2.6	250.8	O	16	2.01		null	16	2.215	133.1	O	16	1.44		null	16	1.07		null	16	0.98		null
17	2.8		null	17	1.815		null	17	1.85	86.919	O	17	1.25	8.802	O	17	1.02	3.516	O	17	1		null
18	3.09		null	18	1.76	72.29	O	18	1.73		null	18	1.28	9.7	O	18	1.135		null	18	1.02	2.907	O
19	2.305		null	19	1.69	63.72	O	19	1.64	56.49	O	19	1.335		null	19	1.12	6.006	O	19	1.035		null
20	1.975		null	20	2.51		null	20	1.66	60.26	O	20	1.2	7.944	O	20	1.15	6.887	O	20	1.04		null
21	1.81	78.06	O	21	2.21	139	O	21	1.96		null	21	1.3		null	21	1.14		null	21	1.02		null
22	2		null	22	2.105		null	22	1.68	62.94	O	22	1.32	11.47	O	22	1.15		null	22	1.01		null
23	2.05	120.4	O	23	2.435		null	23	1.92		null	23	1.255	9.524	O	23	1.02		null	23	1		null
24	2.92	461.3	O	24	2.655		null	24	2.25		null	24	1.19	6.936	O	24	1.025	2.771	O	24	0.99		null
25	3.21		null	25	2.46	225.6	O	25	2.2	136.7	O	25	1.18		null	25	1.26	11.79	O	25	1.01		null
26	3.14		null	26	2.115		null	26	2.18	134	O	26	1.13		null	26	1.29		null	26	1.02		null
27	4.09	2645	O	27	2.055	108.4	O	27	1.99		null	27	1.13	4.372	O	27	1.15	6.49	O	27	1		null
28	8.51	2633	O	28	2.06	122.3	O	28	2.535		null	28	1.1	3.365	O	28	1.215		null	28	1.015		null
29	3.05		null	29	2.48		null	29	2.13	124.5	O	29	1.26		null	29	1.26		null	29	1.005		null
30	2.49		null	30	2.19		null	30	1.88		null	30	1.21	7.701	O	30	1.185		null	30	1		null
31	2.23	153.2	O	31	1.94		null					31	1.33		null					31	0.94		null

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2004 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	0.98	1.7	C	1	1.18	8.2	C	1	1.07	3.7	C	1	1.17	6.7	C	1	1.155	4.942	O	1	1.06	2.6	C
2	1.01	2.187	O	2	1.15	7.2	C	2	1	2.1	C	2	1.12	4.248	O	2	1.155	6.2	C	2	1.22	7.029	O
3	0.98	1.654	O	3	1	2.5	C	3	1.11	4.621	O	3	1.09	4.2	C	3	1.05	3.1	C	3	1.205	6.628	O
4	1.02	3	C	4	1.1	5.6	C	4	1.135	5.6	C	4	1.085	4	C	4	1.05	3.1	C	4	1.19	6.528	O
5	0.99	1.853	O	5	1.185	8.6	C	5	1.245	10	C	5	1.1	4.3	C	5	1.19	7.6	C	5	1.185	6.715	O
6	0.96	1.297	O	6	1.155	7.4	C	6	1.25	10.2	C	6	1.04	2.8	C	6	1.215	8.8	C	6	1.165	6.5	C
7	1.08	3.445	O	7	1.165	6.721	O	7	1.16	6.5	C	7	1.16	6	C	7	1.22	8.9	C	7	1.09	2.982	O
8	1	5.2	C	8	1.115	6	O	8	1.09	4.3	C	8	1.13	5.3	C	8	1.255	9.189	O	8	1.055	2.366	O
9	1.095	5.3	C	9	1.14	5.561	O	9	1.09	3.613	O	9	1.045	3	C	9	1.195	7.9	C	9	1.28	9.293	O
10	1.08	5	C	10	1.215	8.842	O	10	1.19	6.739	O	10	1.09	4.2	C	10	1.1	4.5	C	10	1.2	8	C
11	1.08	4.8	C	11	1.22	8.947	O	11	1.19	6.907	O	11	1.155	5.9	C	11	1.055	3.3	C	11	1.195	7.9	C
12	1.01	2.8	C	12	1.22	8.956	O	12	1.235	9.178	O	12	1.085	4.2	C	12	1.17	6.8	C	12	1.195	7.9	C
13	0.955	1.3	C	13	1.205	8.179	O	13	1.245	8.173	O	13	1.13	4.438	O	13	1.16	6.5	C	13	1.235	8.7	C
14	1.05	3.9	C	14	1.215	8.732	O	14	1.22	7.5	C	14	1.16	6	C	14	1.15	6.1	C	14	1.05	2.4	C
15	1.1	5.4	C	15	1.16	6.5	C	15	1.095	3.416	O	15	1.13	4.028	O	15	1.2	8	C	15	1.055	2.434	O
16	1.13	5.036	O	16	1.18	7.2	C	16	1.17	6.611	O	16	1.125	4.251	O	16	1.185	7.5	C	16	1.65	58.033	O
17	1.135	5.828	O	17	1.24	9.7	C	17	1.24	8.251	O	17	1.165	5.835	O	17	1.1	4.5	C	17	1.75	58.796	O
18	1.14	7	C	18	1.27	11.5	C	18	1.27	11.5	C	18	1.105	4.4	C	18	1.06	3.5	C	18	2.1	118.931	O
19	1.04	3.7	C	19	1.235	9.5	C	19	1.25	7.63	O	19	1.115	4.8	C	19	1.24	8.079	O	19	1.765	55.568	O
20	1.085	4.161	O	20	1.25	9.636	O	20	1.245	9.5	C	20	1.13	5.3	C	20	1.38	15.181	O	20	1.435	30.5	C
21	1.09	4.318	O	21	1.185	7.541	O	21	1.22	9	C	21	1.165	6.7	C	21	1.155	4.793	O	21	1.29	12.118	O
22	1.13	5.766	O	22	1.16	6.5	C	22	1.1	4.5	C	22	1.17	6.8	C	22	1.135	4.199	O	22	1.32	12.413	O
23	1.145	5.97	O	23	1.155	6.326	O	23	1.07	2.267	O	23	1.185	7.5	C	23	1.13	4	C	23	1.175	6.366	O
24	1.14	5.715	O	24	1.185	7.5	C	24	1.19	7.7	C	24	1.18	6.232	O	24	1.09	2.787	O	24	1.17	6.466	O
25	1.13	5.1	C	25	1.155	6.4	C	25	1.22	8.6	C	25	1.165	6.7	C	25	1.045	2.361	O	25	1.23	9.455	O
26	1.05	3.9	C	26	1.18	7.3	C	26	1.215	8.5	C	26	1.11	4.6	C	26	1.05	2.2	C	26	1.28	11.694	O
27	1.12	5.103	O	27	1.2	7.886	O	27	1.195	7.8	C	27	1.045	2.197	O	27	1.28	12	C	27	1.3	12	C
28	1.2	8.037	O	28	1.18	7.3	C	28	1.235	9.6	C	28	1.045	2.093	O	28	1.255	10.5	C	28	1.595	45	C
29	1.195	7.94	O	29	1.165	6.8	C	29	1.02	2.5	C	29	1.18	6.026	O	29	1.28	12	C	29	1.5	40	C
30	1.205	8.284	O					30	1.04	3	C	30	1.165	5.125	O	30	1.235	9.5	C	30	1.8	81.829	O
31	1.21	8.576	O					31	1.17	6.7	C					31	1.105	4.6	C				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	2.33	173.313	O	1	3.735	725	C	1	1.675	59	O	1	1.95	90	C	1	1.12	4.431	O	1	1.27	11.504	O
2	3	352	C	2	5.58	2517.666	O	2	1.85	76.448	O	2	1.75	60	C	2	1.315	14.689	O	2	1.255	11.016	O
3	1.93	84.434	O	3	6.32	1784.726	O	3	1.68	59.515	O	3	1.7	58	C	3	1.295	14	C	3	1.255	11.181	O
4	2.63	218	C	4	7.65	3614.612	O	4	1.65	51.531	O	4	1.87	79.126	O	4	1.285	13.2	C	4	1.27	11.139	O
5	1.95	89.777	O	5	3.37	505	C	5	1.6	43	O	5	1.71	58.892	O	5	1.265	12.5	C	5	1.205	9.5	C
6	2.32	145	C	6	3.2	430	C	6	1.405	29.901	O	6	1.63	49	C	6	1.28	13	C	6	1.035	3.165	O
7	1.975	95	C	7	3.01	360	C	7	2.11	120	O	7	1.64	50	C	7	1.215	9.5	C	7	1.015	2.792	O
8	1.67	55	C	8	2.73	260	C	8	1.64	50	O	8	1.57	42	C	8	1.115	5.5	C	8	1.2	9.2	C
9	1.53	40	C	9	3.145	520.25	O	9	1.625	48	O	9	1.59	44	C	9	1.125	6	C	9	1.23	10.5	C
10	1.465	35	C	10	3.065	441.863	O	10	1.62	45	O	10	1.52	35.5	C	10	1.365	16.767	O	10	1.17	8	C
11	2.46	200	C	11	2.88	426.005	O	11	1.89	80	O	11	1.57	40	C	11	1.325	14.985	O	11	1.17	8	C
12	2.44	195.493	O	12	5.75	1519.615	O	12	1.705	60	O	12	1.585	43.5	C	12	1.31	14	C	12	1.27	12.8	C
13	2.41	190.517	O	13	3.51	630	C	13	1.95	90	O	13	1.515	35	C	13	1.25	11.5	C	13	1.09	5	C
14	2.29	149.994	O	14	2.79	300	C	14	1.68	55.083	O	14	1.38	20	C	14	1.28	13	C	14	1.28	13.2	C
15	2.51	244.269	O	15	3.38	560	C	15	1.735	62.808	O	15	1.46	28	C	15	1.125	6	C	15	1.315	15	C
16	2.05	105.631	O	16	3.365	540	C	16	1.66	57.825	O	16	1.445	27	C	16	1.02	3	C	16	1.13	6.3	C
17	1.83	63.636	O	17	2.96	370	C	17	1.725	62.953	O	17	1.43	25	C	17	1.28	13	C	17	1.195	9	C
18	1.68	56	C	18	2.7	275	C	18	1.555	38.173	O	18	1.26	12.553	O	18	1.275	12.75	C	18	1.19	8.7	C
19	1.58	43.382	O	19	2.655	265	C	19	1.45	31.5	O	19	1.29	13.539	O	19	1.265	12.5	C	19	1.145	7	C
20	1.47	34.77	O	20	2.92	350	C	20	1.86	72.868	O	20	1.4	20.055	O	20	1.26	12	C	20	1.05	3.461	O
21	1.57	45	C	21	2.78	303.048	O	21	1.79	67.731	O	21	1.395	19.902	O	21	1.23	10.5	C	21	1.02	2.619	O
22	1.955	90	C	22	3.16	460	C	22	2.245	140.949	O	22	1.315	15	C	22	1.055	3.5	C	22	1.02	2.636	O
23	2.065	105	C	23	2.955	352.864	O	23	1.925	85.183	O	23	1.38	18.402	O	23	1.085	4.5	C	23	1.05	3.612	O
24	2.39	165	C	24	3.16	455.431	O	24	1.9	82.981	O	24	1.415		null	24	1.235	11	C	24	1.055	4	C
25	2.105	112	C	25	2.975	380	C	25	2.34	157.154	O	25	1.295	13.81	O	25	1.265	12.5	O	25	1.045	3.5	C
26	2.22	128.281	O	26	2.565	240	C	26	2.22	140	O	26	1.35	17.289	O	26	1.285	13.2	C	26	1.055	4	C
27	2.42	197.094	O	27	2.18	130	C	27	1.87	80	O	27	1.32	15.5	C	27	1.23	10.5	C	27	1.025	3	C
28	2.44	178	C	28	2.02	105	C	28	1.78	65	O	28	1.31	14	C	28	1.245	11.25	C	28	1.015	2.5	C
29	3.65	650	C	29	1.78	65	C	29	1.99	95	O	29	1.29	13.5	C	29	1.04	3.651	O	29	1.02	2.7	C
30	3.35	500	C	30	1.68	50	C	30	1.76	63	O	30	1.295	13.75	C	30	1.055	4.176	O	30	1.02	2.7	C
31	3.42	550	C	31	1.655	47	C					31	1.285	13.25	C					31	1.02	2.7	C

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2005 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.035	3	C	1	1.06	3.7	C	1	1.05	3	C	1	1.13	5.491	O	1	1.15	6	C	1	1.35	17	C
2	1.05	3.6	C	2	1.12	6	C	2	1.07	3.5	C	2	1.12	4.999	O	2	1.125	5	C	2	1.41	18.5	C
3	1.02	2.7	C	3	1.14	6.5	C	3	1.075	4	C	3	1.115	4.9	C	3	1.1	4.5	C	3	1.43	19	C
4	1.02	2.7	C	4	1.15	6.6	C	4	1.08	4	C	4	1.095	4.037	O	4	1.125	5	C	4	1.41	18.5	C
5	1.02	2.7	C	5	1.19	8.4	C	5	1.09	4.5	C	5	1.07	3.5	C	5	1.17	6.8	C	5	1.39	17	C
6	1.03	2.67	O	6	1.245	11	C	6	1.075	4	C	6	1.12	5	C	6	1.18	7	C	6	1.155	6	C
7	1.07	4.217	O	7	1.11	5.128	O	7	1.075	3.656	O	7	1.15	6.628	O	7	1.15	6	C	7	1.36	17.2	C
8	1.07	3.926	O	8	1.145	6.566	O	8	1.04	3	C	8	1.15	5.815	O	8	1.17	6.8	C	8	1.355	17	C
9	1.06	3.7	C	9	1.19	8.382	O	9	1.05	2.806	O	9	1.145	5.8	C	9	1.13	5.2	C	9	1.37	17.5	C
10	1.06	3.603	O	10	1.23	9.634	O	10	1.12	5	C	10	1.085	4	C	10	1.08	4	C	10	1.35	17	C
11	1.025	2.46	O	11	1.2	8.7	C	11	1.125	5	C	11	1.06	3.153	O	11	1.195	8	C	11	1.38	16.72	O
12	1.03	2.507	O	12	1.21	9	C	12	1.13	5.2	C	12	1.05	2.816	O	12	1.2	8.1	C	12	1.345	17	C
13	1.065	3.966	O	13	1.2	8.7	C	13	1.09	4.5	C	13	1.05	2.9	C	13	1.18	7	C	13	1.145	4.856	O
14	1.065	4.068	O	14	1.11	5.043	O	14	1.07	3.5	C	14	1.09	3.743	O	14	1.21	8.5	C	14	1.42	18.46	O
15	1.095	4.645	O	15	1.16	7.106	O	15	1.05	3	C	15	1.13	5.5	C	15	1.22	8.8	C	15	1.37	17.5	C
16	1.1	5.2	O	16	1.21	9.005	O	16	1.05	3	C	16	1.13	5.5	C	16	1.15	6	C	16	1.365	17.4	C
17	1.05	3.75	O	17	1.23	10	C	17	1.095	4.8	C	17	1.15	6.1	C	17	1.1	4.5	C	17	1.41	18.5	C
18	1.02	2.7	O	18	1.325	15.5	C	18	1.155	6.5	C	18	1.11	3.976	O	18	1.27	11.5	C	18	1.38	17.7	C
19	1.03	3	O	19	1.34	15.9	C	19	1.23	9	C	19	1.06	2.704	O	19	1.24	10.3	O	19	1.45	20	C
20	1.09	5	O	20	1.32	15	C	20	1.16	6.5	C	20	1.115	4.336	O	20	1.26	11.6	C	20	1.17	6.002	O
21	1.115	6	O	21	1.12	5.295	O	21	1.1	4.8	C	21	1.13	5.221	O	21	1.25	11	C	21	1.34	14.748	O
22	1.07	4	O	22	1.055	3.8	C	22	1.06	3.3	C	22	1.16	6	C	22	1.235	10.1	O	22	1.35	17.874	O
23	1.07	4	O	23	1.085	4.321	O	23	1.095	4.8	C	23	1.15	5.8	C	23	1.155	6.2	C	23	1.34	15.039	O
24	1.095	5.2	O	24	1.085	4.196	O	24	1.09	4.5	C	24	1.145	5.3	C	24	1.21	8.5	C	24	1.43	19.931	O
25	1.025	2.8	O	25	1.11	5	C	25	1.095	4.8	C	25	1.15	5.347	O	25	1.31	14.5	C	25	1.9	92.849	O
26	1.08	4.7	O	26	1.09	4.5	C	26	1.08	4	C	26	1.16	5.553	O	26	1.25	11.2	C	26	1.97	90	C
27	1.07	4	O	27	1.11	5	C	27	1.1	4.8	C	27	1.17	6.594	O	27	1.35	17	C	27	2.73	290	C
28	1.07	4	O	28	1.105	4.8	C	28	1.09	3.883	O	28	1.185	7.053	O	28	1.335	16.1	O	28	3.27	500	C
29	1.075	4.4	O					29	1.12	4.934	O	29	1.2	7.507	O	29	1.37	19	C	29	4	860	C
30	1.11	5.2	O					30	1.135	5.689	C	30	1.17	6.7	C	30	1.15	8	C	30	4.9	1270	C
31	1.105	5.5	O					31	1.12	5	C					31	1.26	11.5	C				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	3.63	704	C	1	6.92	2500	C	1	1.945	66.109	O	1	1.82	58	C	1	1.34	20	C	1	1.23	12.99	O
2	3.4	613	C	2	7.3	2750	C	2	1.79	72	C	2	1.72	48	C	2	1.12	5	C	2	1.215	12.53	O
3	4.6	1111	C	3	5.49	1680	C	3	2.1	130	C	3	1.77	55	C	3	1.1	4	C	3	1.3	16.69	O
4	3.035	474	C	4	3.48	600	C	4	2.03	105	C	4	1.7	40	C	4	1.12	5	C	4	1.31	16.9	C
5	2.97	452	C	5	3.22	495	C	5	2.42	210	C	5	1.64	35	C	5	1.25	12.727	O	5	0.97	3.865	O
6	2.455	272	C	6	3.26	510	C	6	2.79	335	C	6	1.71	62.688	O	6	1.265	12.75	C	6	1.345	18.39	O
7	2.1	161	C	7	2.97	380	C	7	2.54	227	C	7	1.57	25	C	7	1.1	4.736	O	7	1.35	18.63	O
8	1.94	113	C	8	2.705	300	C	8	2.205	127	C	8	1.5	20	C	8	1.12	5.218	O	8	1.335	20.28	O
9	1.795	67	C	9	2.805	340	C	9	2.42	169.117	O	9	1.58	27	C	9	1.25	15.561	O	9	1.31	16.9	C
10	1.67	36	C	10	2.46	220	C	10	4.69	1042.11	O	10	1.35	20.113	O	10	1.25	15.333	O	10	1.345	18.5	C
11	1.575	9	C	11	2.32	190	C	11	3.22	506.614	O	11	1.545	23	C	11	1.18	12.099	O	11	1.3	16.81	O
12	2.31	227	C	12	2.39	210	C	12	4.06	972.607	O	12	1.5	20	C	12	1.135	5.413	O	12	1.05	6.1	C
13	2.02	137	C	13	2.315	185	C	13	3.41	570	C	13	1.23	9.453	O	13	1.135	5.5	C	13	1.3	16.8	C
14	1.945	113	C	14	2.46	220	C	14	2.76	300	C	14	1.45	16	C	14	1.02	2.694	O	14	1.28	15.3	C
15	1.955	116	C	15	2.39	210	C	15	2.97	364.394	O	15	1.475	20	C	15	1.155	11	C	15	1.28	15.3	C
16	1.725	47.982	O	16	2.3	180	C	16	2.69	277.862	O	16	1.345	10	C	16	1.3	15	C	16	1.31	16.9	C
17	1.655	31	C	17	2.84	355	C	17	2.55	255	C	17	1.39	11	C	17	1.31	17.854	O	17	1.275	15.25	O
18	1.51	9	C	18	2.79	340	C	18	2.4	200	C	19	1.42	18.425	O	18	1.235	13.79	O	18	1.28	15.3	C
19	1.605	17	C	19	2.68	295	C	19	3.2	515.753	O	20	1.42	18.633	O	19	1.21	12.076	O	19	0.9	2.99	O
20	1.61	20	C	20	3	410	C	20	2.63	285	C	21	1.38	20.794	O	20	1.24	13	C	20	1.205	11.87	O
21	2.08	140	C	21	3.19	495	C	21	2.76	278.755	O	22	1.4	21.148	O	21	1.025	2.839	O	21	1.2	11.3	C
22	3.17	517.699	O	22	2.67	293	C	22	3.75	706.194	O	23	1.315	9.5	C	22	1.245	14.292	O	22	1.22	12.68	O
23	3.16	510	C	23	2.38	200	C	23	4.65	1164.199	O	24	1.12	4.949	O	23	1.24	13.611	O	23	1.18	10.86	O
24	2.6	322	C	24	2.25	170	C	24	3.02	410	C	25	1.25	12.649	O	24	1.2	12.829	O	24	1.2	12	C
25	3.755	752	C	25	2.095	125	C	25	2.48	225	C	26	1.32	9.7	C	25	1.245	14.156	O	25	1.25	14.5	C
26	8.15	2804	C	26	2.135	135	C	26	2.26	162.095	O	27	1.46	24.534	O	26	1.26	15.382	O	26	1.01	3.852	O
27	12.08	4483	C	27	2.18	145	C	27	2.125	110	C	28	1.41	22.039	O	27	1.205	12.1	C	27	0.9	2.99	O
28	5.41	1479	C	28	2.095	125	C	28	2.035	92.493	O	29	1.39	20.578	O	28	1.005	3.763	O	28	1.155	9.258	O
29	3.585	684	C	29	1.985	100	C	29	1.92	85.096	O	30	1.29	10.5	C	29	1.2	12.062	O	29	1.15	8.574	O
30	3.26	560	C	30	1.86	80	C	30	1.85	70	C	31	1.12	5.043	O	30	1.24	13	C	30	1.16	9.25	O
31	4.31	985	C	31	1.785	70	C													31	1.155	9.103	O

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2006 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.16	9.3	C	1	1.245	14	C	1	1.315	17.25	O	1	1.175	10.352	O	1	1.16	9.226	O	1	1.34	18.59	O
2	1.035	4.008	O	2	1.28	14.59	O	2	1.335	18.21	O	2	1.235	13	C	2	1.015	3.959	O	2	1.045	4.98	O
3	0.95	3	C	3	1.28	14.55	O	3	1.335	18.07	O	3	1.025	10.601	O	3	1.35	19.148	O	3	1.05	5.16	O
4	1.1	6.873	O	4	1.28	14.36	O	4	1.315	17.17	O	4	1.25	13.5	C	4	1.36	19.75	C	4	1.03	5.89	C
5	1.16	9.292	O	5	1.3	16.8	C	5	1.295	16.3	C	5	1.29	15.562	O	5	1.36	19.733	O	5	0.9	1.1	O
6	1.15	9.697	O	6	1.3	16.66	O	6	1.05	4.946	O	6	1.325	17.75	C	6	1.35	19.153	O	6	0.895	5.371	O
7	1.165	9.648	O	7	1.325	17.45	O	7	1.255	13.98	O	7	1.3	16.632	O	7	1.36	19.15	C	7	1.28	14.77	C
8	1.2	11.3	C	8	1.335	18.36	O	8	1.28	14.5	C	8	1.32	17.196	O	8	1.01	3.929	O	8	1.23	12.48	C
9	0.955	2.893	O	9	1.315	17.25	O	9	1.3	16.63	O	9	1.04	4.93	C	9	1.01	3.984	O	9	1.2	11.24	C
10	0.9	1.102	O	10	1.28	14.5	C	10	1.335	18.35	O	10	1.04	4.924	O	10	1.34	18.411	O	10	1.18	10.47	C
11	1.115	8	C	11	1.335	18.84	O	11	1.2	12.4	C	11	1.32	17.2	C	11	1.36	19.794	O	11	1.15	9.39	C
12	0.97	3.005	O	12	1.3	16.5	C	12	1.23	12.5	C	12	1.34	18.39	O	12	1.355	19.268	O	12	1.01	5.42	C
13	1.04	4.111	O	13	1.07	5.21	O	13	1.01	3.87	O	13	1.315	17.15	C	13	1.37	20.5	C	13	0.905	3.41	C
14	1.13	8.5	C	14	1.255	13.95	O	14	1.2	11.64	O	14	1.325	17.75	C	14	1.3	16.6	C	14	1.18	10.47	C
15	1.235	14	C	15	1.285	14.67	O	15	1.25	13.75	O	15	1.345	19.25	C	15	0.97	3	C	15	1.27	14.29	C
16	0.99	3.5	C	16	1.215	12.33	O	16	1	3.71	O	16	1.365	20.5	C	16	0.95	2.5	C	16	1.3	15.77	C
17	1.13	8.091	O	17	1.135	8.356	O	17	1.01	3.375	O	17	1.18	10.422	O	17	1.395	22.25	C	17	1.31	16.29	C
18	1.125	9.199	O	18	1.135	8.378	O	18	1.25	13.57	O	18	1.34	18.612	O	18	1.4	23	C	18	1.285	15.02	C
19	1.175	9.67	O	19	1.1	6	C	19	1.265	14.94	O	19	1.35	19.127	O	19	1.38	20.75	C	19	1.02	5.65	C
20	1.155	9.623	O	20	0.9	1.107	O	20	1.01	3.884	O	20	1.34	18.531	O	20	1.39	21.5	C	20	1.33	17.37	C
21	1.28	15.521	O	21	1.1	6.808	O	21	0.905	1.158	O	21	1.36	19.131	O	21	1.3	16.6	C	21	1.55	37.776	O
22	1.25	14.5	C	22	1.16	9.227	O	22	1.24	12.98	O	22	1.34	18.476	O	22	1.01	3.96	O	22	1.44	24.31	C
23	1.125	8.033	O	23	1.21	12.03	O	23	1.25	13.48	O	23	1.345	19	C	23	1.35	19.214	O	23	2.06	94.937	O
24	1.295	16.5	C	24	1.295	16.31	O	24	1.295	16.23	O	24	1.36	19.71	O	24	1.365	20.553	O	24	1.76	72.129	O
25	1.23	12.752	O	25	1.29	15.65	O	25	1.295	15.45	O	25	1.365	20.314	O	25	1.12	8.187	O	25	2.11	61.073	O
26	1.3	16.8	C	26	1.29	15.65	O	26	1.235	13	C	26	1.36	19.673	O	26	1.32	17.24	C	26	1.53	38.14	O
27	0.91	1.42	O	27	1.175	9.805	O	27	1.005	3.724	O	27	1.39	21.42	O	27	1.1	7.957	C	27	1.48	27.29	C
28	1.23	12.804	O	28	1.305	16.99	O	28	1.085	7.967	O	28	1.365	20.295	O	28	1.11	7.95	C	28	2.35	153.83	O
29	1.12	8	C					29	1.18	11.19	O	29	1.35	19.15	C	29	0.98	3.89	O	29	2.4	210.86	C
30	0.995	3.699	O					30	1.2	12.4	C	30	1.36	19.7	O	30	1.16	9.25	C	30	4.8	1135.81	C
31	1.24	13.425	O					31	1.18	10.32	O					31	1.36	19.765	O				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	3.85	899.82	O	1	3.42	557.6	C	1	2.355	188.73	O	1	1.91	88.58	C	1	1.36	19.09	C	1	1.21	13.74	O
2	2.95	380.94	C	2	3.16	442.88	O	2	2.69	241.04	O	2	3.71	671.74	C	2	1.36	19.09	C	2	1.38	24.41	O
3	3.22	531.134	O	3	2.72	265.49	O	3	2.525	230.06	C	3	2.475	204.77	O	3	1.365	19.39	C	4	0.94	1.81	C
4	3.76	703.85	O	4	2.49	195.66	O	4	2.15	122.3	O	4	2.05	108.26	C	4	1.34	17.93	C	6	1.25	17.16	O
5	3.73	709.25	O	5	2.41	184.8	O	5	2.24	157.5	C	5	2.13	119.88	O	5	1.218	11.85	C	7	1.18	10.59	O
6	4.24	890.47	C	6	4.29	911.78	C	6	1.97	103.01	O	6	2.27	142.88	O	6	1.08	7.2	C	8	1.29	18.14	O
7	3.2	473.63	C	7	6.4	2313.882	O	7	2.26	159.75	O	7	2.25	136.45	O	7	1.465	26.14	C	9	1.28	18.39	O
8	2.5	209.41	O	8	7.71	2646.04	C	8	1.86	71.75	C	8	1.93	83.88	C	8	1.36	19.09	C	10	1.14	7.22	C
9	2.36	196.39	C	9	7.6	2000.33	O	9	1.78	82.31	O	9	1.76	65.94	O	9	1.35	18.5	C	11	0.98	3.11	O
10	2.25	136.73	O	10	3.69	644.73	O	10	1.74	54.12	C	10	1.93	83.88	C	10	1.34	17.93	C	12	0.95	2.81	O
11	2.2	127.88	O	11	4.48	1027.73	O	11	1.79	82.38	O	11	2.52	216.55	O	11	1.35	18.5	C	13	1.18	10.63	O
12	2.125	120.36	O	12	3.29	507.71	C	12	2.55	238.7	C	12	2.25	177.54	O	12	1.27	14.29	C	14	1.19	10.01	O
13	2.11	117.68	O	13	3.09	432.48	C	13	2.54	235.24	C	13	1.74	61.592	O	13	1.1	7.78	C	15	1.245	11.53	C
14	2.32	182.7	C	14	3.71	729.5	O	14	2.56	224.91	O	14	1.7	49.05	C	14	1.28	18.3	O	16	1.28	18.11	O
15	2.18	149.687	O	15	3.94	765.05	C	15	2.61	229.59	O	15	1.63	41.06	C	15	1.285	20.13	O	17	1.1	5.85	C
16	2.17	137.71	C	16	3.54	604.36	C	16	2.75	308.89	C	16	1.45	29.07	O	16	1.35	21.69	O	18	0.98	3.29	O
17	2.24	157.5	C	17	5.84	1630.22	C	17	2.07	112.8	C	17	1.54	39.75	O	17	1.345	17.254	O	19	0.945	2.9	O
18	2.54	235.24	C	18	3.42	557.6	C	18	2.52	216.48	O	18	1.51	36.88	O	18	1.37	19.69	C	20	1.15	9.51	O
19	2.38	203.53	C	19	2.68	284.11	C	19	2.5	200.95	O	19	1.5	36.16	O	19	1.35	18.5	C	21	1.12	9	O
20	2.32	182.72	O	20	2.4	210.86	C	20	2.04	110.78	O	20	1.48	27.29	C	20	0.97	3.96	O	22	1.12	8.9	O
21	2.65	286.55	O	21	2.5	231.49	O	21	2.28	169.19	O	21	1.46	25.77	C	21	0.95	3.25	O	23	1.275	17.72	O
22	3.28	503.9	C	22	2.3	174.3	O	22	1.85	69.19	O	22	1.36	19.09	C	22	1.36	23.03	O	24	1.26	12.23	C
23	3.67	659.75	C	23	2.6	256.07	C	23	1.86	71.75	C	23	1.34	17.93	C	23	1.34	21.24	O	25	0.995	2.93	C
24	3.23	485.62	O	24	2.53	215.29	O	24	1.8	62.46	C	24	1.35	18.5	C	24	1.335	20.64	O	26	0.85	1.05	O
25	2.54	235.24	C	25	2.35	187.88	O	25	1.73	61.31	O	25	1.37	19.69	C	25	1.36	22.92	O	27	1.1	7.71	O
26	2.42	212.29	O	26	2.28	151.3	O	26	1.81	63.94	C	26	1.41	21.02	O	26	1.25	13.36	C	28	1.015	4.37	O
27	2.74	349.15	O	27	2.24	157.5	C	27	1.77	73.111	O	27	1.415	21.92	O	27	0.98	3.38	O	29	1.05	5.38	O
28	3.96	783.41	O	28	2.42	209.62	O	28	1.75	56.95	O	28	1.4	20.14	O	28	0.98	4.19	O	30	1.11	6.18	C
29	5.15	1391.22	O	29	2.47	201.985	O	29	1.76	53.27	O	29	1.38	20.3	C	29	1.26	16.94	O	31	1.133	7.04	C
30	4.75	1113.31	C	30	2.44	218.07	O	30	1.75	55.44	C	30	1.1	7.78	C	30	1.04	9.36	O				
31	3.59	595.8	O	31	2.35	192.9	C					31	1.4	21.58	C								

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2007 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	0.935	1.72	C	1	1.3	14.19	C	1	1.315	14.11	O	1	1.285	13.44	C	1	1.31	14.7	C	1	1.38	16.572	O
2	0.87	0.71	O	2	1.31	18.08	O	2	1.36	14.35	O	2	1.11	3.96	O	2	1.26	12.23	C	2	1.4	18.147	O
3	0.91	1.39	O	3	1.305	17.67	O	3	1.3	13.51	O	3	1.19	8.75	O	3	1.35	16.85	C	3	1.435	21.43	C
4	0.98	2.89	O	5	1.16	10.1	O	4	1.29	13.69	C	4	1.25	11.76	C	4	1.33	15.76	C	4	1.1	3.337	O
5	0.91	1.32	C	6	1.26	14.01	O	5	1.08	4.21	O	5	1.18	8.69	O	5	1.35	16.23	O	5	1.415	20.029	C
6	1.08	5.21	C	7	1.28	16.96	O	6	1.25	11.76	C	6	1.26	12.23	C	6	1.335	16.03	C	6	1.44	19.529	O
7	1.1	5.85	C	8	1.28	16.31	O	7	1.18	8.74	C	7	1.285	13.44	C	7	1.16	8.51	O	7	1.4	15.972	O
8	1.005	3.26	O	9	1.29	16.64	O	8	1.18	8.74	C	8	1.275	12.95	C	8	1.3	12.23	O	8	1.42	16.532	O
9	0.98	3.02	O	10	1.29	13.69	C	9	1.19	8.8	O	9	1.14	4.69	O	9	1.37	16.84	O	9	1.44	18.937	O
10	1.09	7.77	O	11	1.295	13.94	C	10	1.14	7.22	C	10	0.98	2.6	C	10	1.38	18.56	C	10	1.43	21.074	C
11	1.135	8.75	O	12	1.17	10.06	O	11	1.26	12.23	C	11	1.24	8.88	O	11	1.31	11.85	O	11	1.16	8.074	O
12	1.125	8.45	O	13	1.285	16.09	O	12	1.08	3.49	O	12	1.255	10.75	O	12	1.335	16.03	C	12	1.41	15.606	O
13	1.13	6.86	C	14	1.295	15.87	O	13	1.17	6.8	O	13	1.25	9.8	O	13	1.25	11.76	C	13	1.425	18.119	O
14	1.03	3.79	C	15	1.3	16.01	O	14	1.25	10.89	O	14	1.28	13.19	C	14	1.106	3.54	O	14	1.44	21.788	C
15	0.98	2.86	O	16	1.31	14.7	C	15	1.23	10.2	O	15	1.18	8.74	C	15	1.25	10.53	O	15	1.41	15.854	O
16	0.89	0.91	O	17	1.295	12.97	O	16	1.235	10.86	O	16	1.11	3.67	O	16	1.22	8.63	O	16	1.27	9.733	O
17	0.98	2.83	O	18	1.29	13.69	C	17	1.26	10.93	O	17	1.25	9.16	O	17	1.32	12.09	O	17	1.35	15.85	C
18	0.99	3.02	O	19	1.07	3.8	O	18	1.32	15.23	C	18	1.385	18.85	C	18	1.36	17.22	O	18	1.04	2.285	O
19	1.195	10.4	O	20	1.26	11.8	O	19	1.1	5.85	C	19	1.27	10.08	O	19	1.35	16.06	O	19	1.1	4.455	O
20	1.25	16.77	O	21	1.285	12.25	O	20	1.06	2.96	O	20	1.25	10.59	O	20	1.36	17.41	C	20	1.245	10.331	O
21	1.245	11.53	C	22	1.3	14.1	O	21	1.13	5.34	O	21	1.28	13.19	C	21	1.13	3.74	O	21	1.32	13.679	O
22	1.09	5.53	C	23	1.31	14.34	O	22	1.17	6.62	O	22	1.26	12.23	C	22	1.33	14.97	O	22	1.22	9.083	O
23	1.265	12.47	C	24	1.35	16.23	O	23	1.195	7.22	O	23	1.27	12.71	C	23	1.395	17.62	O	23	1.38	16.663	O
24	1.295	13.94	C	25	1.295	13.94	C	24	1.2	7.14	O	24	1.1	5.85	C	24	1.39	17.12	O	24	1.6	35.148	C
25	1.29	13.69	C	26	1.28	13.19	C	25	1.25	11.76	C	25	1.29	13.69	C	25	1.425	18.32	O	25	2	85.836	C
26	1.25	11.76	C	27	1.3	14.05	O	26	1.095	3.31	O	26	1.35	16.85	C	26	1.34	15.45	O	26	2	86.588	O
27	1.15	7.59	C	28	1.31	14.15	O	27	1.2	6.97	O	27	1.3	14.19	C	27	1.335	16.03	C	27	1.97	81.12	C
28	1.29	13.69	C					28	1.22	10.02	O	28	1.37	17.98	C	28	1.13	3.71	O	28	2.77	248.124	O
29	1.25	17.37	O					29	1.26	10.8	O	29	1.32	15.23	C	29	1.33	15.76	C	29	2.55	182.415	O
30	1.315	14.96	C					30	1.25	11.76	C	30	1.18	8.74	C	30	1.385	16.8	O	30	2.48	146.961	O
31	1.305	17.68	O					31	1.315	14.96	C					31	1.37	17.68	O				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	2.86	292.096	C	1	1.98	79.985	O	1	2.95	322.223	C	1	1.55	35.343	O	1	1.14	6.031	C	1	1.05	3.787	O
2	5.82	1512.035	O	2	2.29	130.882	O	2	2.78	266.746	C	2	1.62	37.082	C	2	1.2	12.205	O	2	1.035	3.038	C
3	5.06	1574.761	C	3	2.35	152.691	C	3	2.31	142.322	O	3	1.45	22.517	C	3	1.27	15.24	O	3	0.98	2.526	O
4	3.75	671.092	O	4	2.54	210.662	O	4	2.015	88.252	C	4	1.545	33.742	O	4	1.2	8.291	C	4	1.06	4.365	O
5	3.51	653.271	O	5	4.1	867.986	C	5	2.34	150.469	C	5	1.55	33.632	O	5	1.035	4.657	O	5	1.2	10.988	O
6	3.17	403.199	C	6	4.78	1051.7	O	6	3.69	609.6	O	6	1.465	23.635	C	6	1.13	8.675	O	6	1.08	5.196	O
7	2.59	199.3	O	7	3.33	468.797	C	7	2.78	270.353	O	7	1.45	22.517	C	7	1.28	15.853	O	7	1.05	3.904	O
8	2.34	150.469	C	8	4.91	1205.519	O	8	2.52	193.41	C	8	1.285	14.924	O	8	1.05	3.394	C	8	1.04	3.154	C
9	2.23	127.256	C	9	3.41	508.433	O	9	2.22	125.257	C	9	1.695	44.874	C	9	1.06	3.645	C	9	1.05	3.394	C
10	2.61	217.254	C	10	3.21	441.986	O	10	1.98	81.17	O	10	1.55	34.543	O	10	1.14	6.031	C	10	0.94	1.291	C
11	2.47	182.142	O	11	2.94	318.79	C	11	1.82	59.818	C	11	1.445	24.891	O	11	1.18	7.491	C	11	0.87	0.518	C
12	2.3	134.222	O	12	2.885	300.293	C	12	1.7	50.273	O	12	1.45	22.517	C	12	1.04	3.154	C	12	0.94	1.291	C
13	2.93	358.044	O	13	2.59	216.889	O	13	1.93	72.224	O	13	1.405	19.349	C	13	1.06	3.645	C	13	0.98	2.365	O
14	2.66	227.899	O	14	2.54	198.57	C	14	1.605	40.088	O	14	1.38	17.708	C	14	1.12	5.369	C	14	1.02	3.054	O
15	2.48	183.325	C	15	2.54	198.57	C	15	1.75	51.143	C	15	1.16	8.369	O	15	1.195	8.086	C	15	1.02	2.507	O
16	2.245	128.071	O	16	2.52	207.472	O	16	1.585	33.737	C	16	1.37	19.899	O	16	1.04	4.697	O	16	1.08	4.177	C
17	2.18	117.444	C	17	2.42	170.982	O	17	1.46	27.014	O	17	1.375	19.85	O	17	1.08	5.617	O	17	1.11	4.892	O
18	1.98	82.674	C	18	2.33	148.265	C	18	1.42	20.374	C	18	1.375	17.39	C	18	1.04	3.154	C	18	0.98	2.009	O
19	2.14	119.84	O	19	2.415	197.91	O	19	3.32	443.119	O	19	1.235	14.703	O	19	0.98	2.621	O	19	1.05	3.213	O
20	2.05	95.069	O	20	2.53	193.437	O	20	2.41	171.496	O	20	1.185	11.824	O	20	0.88	0.604	C	20	1.015	2.377	O
21	1.74	54.558	O	21	2.26	133.364	C	21	2.06	95.736	C	21	1.14	6.031	C	21	1.11	5.639	O	21	1.02	2.705	C
22	1.62	37.082	C	22	2.61	223.624	O	22	1.95	74.727	O	22	1.08	5.31	O	22	1.02	3.593	O	22	1.09	4.458	C
23	1.575	38.735	O	23	2.28	130.6	O	23	1.77	53.542	C	23	1.18	7.491	C	23	1.07	4.717	O	23	0.81	0.153	C
24	1.55	30.575	C	24	2.2	113.552	O	24	1.665	43.108	O	24	1.25	14.39	O	24	1.05	3.394	C	24	0.97	1.88	O
25	1.63	38.071	C	25	1.88	67.888	C	25	1.59	34.204	C	25	1.175	10.522	O	25	1.155	6.557	C	25	0.84	0.304	C
26	1.57	32.36	C	26	2.04	92.366	C	26	2.13	93.4	O	26	1.15	8.699	O	26	0.87	0.518	C	26	1	2.375	O
27	1.565	32.815	C	27	2.03	91.938	O	27	1.69	47.162	O	27	1.18	10.016	O	27	0.85	0.368	C	27	0.95	1.436	C
28	3.06	361.395	C	28	2.08	99.176	C	28	1.62	40.427	O	28	1.15	6.379	C	28	1.12	5.796	O	28	1	2.242	O
29	3.12	383.868	C	29	2.62	279.254	C	29	1.99	84.246	C	29	1.02	4.326	O	29	1.09	5.364	O	29	0.99	2.143	O
30	2.85	311.776	O	30	3.43	518.625	O	30	1.71	46.537	C	30	1	4.279	O	30	1.04	3.154	C	30	1.01	2.495	C
31	2.35	152.691	C	31	3	378.44	O					31	1.205	12.618	O					31	1	2.23	O

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2008 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	0.98	2.128	O	1	1.23	9.508	O	1	1.3	13.015	C	1	1.06	5.503	O	1	1.38	17.708	C	1	1.44	22.163	C
2	0.99	2.18	O	2	1.25	10.499	C	2	1.24	10.033	C	2	1.15	5.148	O	2	1.18	7.491	C	2	1.14	5.003	O
3	1	2.294	C	3	1.27	11.468	C	3	1.1	3.637	O	3	1.22	9.271	O	3	1.47	24.015	C	3	1.42	20.972	D
4	0.99	2.184	O	4	1.08	3.386	O	4	1.17	5.826	O	4	1.2	8.291	C	4	1.35	15.85	C	4	1.43	21.365	D
5	0.99	2.165	O	5	1.2	8.681	O	5	1.285	10.764	O	5	1.25	10.48	O	5	1.2	8.291	C	5	1.45	25.821	O
6	1	2.294	C	6	1.2	8.153	O	6	1.25	10.499	C	6	1.2	8.291	C	6	1.33	14.677	C	6	1.42	17.492	O
7	0.99	2.139	O	7	1.24	9.852	O	7	1.185	6.224	O	7	1.13	5.079	O	7	1.42	20.374	C	7	1.41	19.814	C
8	0.99	2.179	O	8	1.25	10.225	O	8	1.21	8.708	C	8	1.17	5.786	O	8	1.46	23.259	C	8	1.46	23.802	C
9	1	2.256	O	9	1.24	10.033	C	9	1.23	9.579	C	9	1.32	10.409	O	9	1.47	24.015	C	9	1.15	6.303	D
10	1	2.201	O	10	1.26	10.977	C	10	1.15	5.587	O	10	1.34	11.612	O	10	1.42	20.374	C	10	1.41	17.113	O
11	1.01	2.302	O	11	1.08	3.365	O	11	1.17	7.109	C	11	1.42	16.195	O	11	1.25	10.499	C	11	1.31	15.234	O
12	1.04	3.154	C	12	1.195	7.077	O	12	1.23	9.495	O	12	1.32	14.11	C	12	1.15	6.379	C	12	1.78	57.953	C
13	1.01	2.495	C	13	1.26	10.039	O	13	1.2	8.415	O	13	1.27	11.468	C	13	1.5	26.367	C	13	1.73	53.437	O
14	1.01	2.288	O	14	1.26	9.86	O	14	1.22	8.909	O	14	1.18	5.96	O	14	1.48	24.785	C	14	1.68	45.977	O
15	1.055	3.518	C	15	1.25	10.145	O	15	1.25	9.905	O	15	1.2	8.324	O	15	1.55	30.575	C	15	2.22	127.329	D
16	1.19	8.492	O	16	1.23	9.463	O	16	1.24	10.033	C	16	1.18	5.925	O	16	1.54	29.704	C	16	1.58	37.938	O
17	1.2	8.719	O	17	1.24	10.033	C	17	1.11	3.8	O	17	1.29	12.487	C	17	1.56	31.46	C	17	1.35	15.511	C
18	1.22	9.599	O	18	1.09	3.493	O	18	1.18	6.172	O	18	1.37	17.076	C	18	1.45	22.517	C	18	1.29	11.888	C
19	1.28	11.971	C	19	1.18	6.206	O	19	1.24	9.459	O	19	1.12	8.284	O	19	1.13	5.694	C	19	1.2	7.916	D
20	1.19	7.885	C	20	1.205	8.498	C	20	1.2	8.29	O	20	1.24	10.033	C	20	1.53	28.848	C	20	1.16	6.303	D
21	1.025	2.614	O	21	1.25	10.027	O	21	1.24	10.033	C	21	1.14	5.049	O	21	1.5	26.367	C	21	1.15	6.138	D
22	1.15	6.95	O	22	1.24	9.664	O	22	1.25	9.775	O	22	1.18	5.9	O	22	1.53	28.848	C	22	1.26	10.448	C
23	1.16	6.738	C	23	1.21	8.779	O	23	1.14	6.031	C	23	1.17	5.698	O	23	1.58	33.275	C	23	1.14	5.817	D
24	1.21	8.957	O	24	1.2	8.291	C	24	1.08	4.177	C	24	1.21	8.631	O	24	1.55	30.575	C	24	1.3	12.395	C
25	1.22	9.199	O	25	1.18	6.038	O	25	1.08	4.177	C	25	1.4	15.953	O	25	1.52	28.007	C	25	1.485	25.932	C
26	1.235	9.805	C	26	1.17	5.862	O	26	1.21	8.708	C	26	1.42	16.622	O	26	1.15	6.379	C	26	1.58	38.896	O
27	1.15	6.379	C	27	1.23	7.603	O	27	1.23	9.579	C	27	1.32	14.11	C	27	1.57	32.36	C	27	1.67	45.905	O
28	1.04	2.555	O	28	1.24	9.841	O	28	1.25	10.499	C	28	1.16	6.738	C	28	1.5	26.367	C	28	1.495	26.81	D
29	1.16	6.502	O	29	1.22	9.013	O	29	1.29	12.487	C	29	1.5	26.367	C	29	1.52	28.007	C	29	1.63	40.086	C
30	1.2	8.291	C					30	1.24	10.033	C	30	1.43	21.074	C	30	1.485	25.175	C	30	3.55	561.45	D
31	1.23	9.579	C					31	1.15	5.207	O					31	1.49	25.569	C				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	3.85	638.677	C	1	2.44	175.482	C	1	1.81	65.367	O	1	1.53	24.831	O	1	1.35	16.63	O	1	1.01	2.581	D
2	3	324.878	C	2	2.85	296.216	O	2	1.75	54.117	C	2	1.59	35.876	C	2	1.39	18.321	C	2	1.38	16.965	O
3	2.58	207.596	O	3	3.02	331.056	C	3	2.25	135.151	C	3	1.295	13.868	O	3	1.14	6.131	O	3	1.39	18.321	C
4	2.51	219.054	O	4	2.68	247.868	O	4	2.1	100.138	O	4	1.48	25.499	C	4	1.4	16.189	O	4	1.4	19.06	C
5	2.63	209.393	O	5	2.9	294.858	C	5	1.955	79.94	O	5	2.25	135.151	C	5	1.4	17.019	O	5	1.335	15.159	O
6	2.275	140.158	C	6	3.8	695.644	O	6	2.15	119.659	O	6	2.62	209.303	O	6	1.4	17.341	O	6	1.395	18.068	O
7	1.92	70.286	O	7	3.37	485.762	O	7	1.89	73.138	C	7	2.13	112.385	C	7	1.4	17.279	O	7	1.37	16.887	C
8	1.77	56.66	C	8	2.94	331.799	O	8	1.845	66.241	O	8	2.6	193.85	O	8	1.41	19.814	C	8	0.99	2.224	D
9	1.71	46.595	O	9	6.4	2208.784	C	9	2.45	177.75	C	9	1.93	79.097	C	9	1.385	17.957	C	9	1.37	14.5	C
10	1.78	57.953	C	10	4.93	1188.604	C	10	2.95	342.778	O	10	2.33	137.26	O	10	1.05	3.402	D	10	1.28	13.496	O
11	3.2	398.549	O	11	6.55	2156.898	O	11	2.47	185.782	O	11	1.94	80.623	C	11	1.39	16.691	O	11	1.38	17.597	C
12	2.38	162.178	C	12	4.495	1100.874	O	12	2.1	117.867	O	12	1.78	57.953	C	12	1.395	16.921	O	12	1.28	13.022	O
13	2.245	134.161	C	13	4.02	817.085	O	13	1.98	86.873	C	13	1.56	33.034	O	13	1.375	17.24	C	13	1.38	16.6	C
14	2.03	85.357	O	14	4.95	1200.383	C	14	2.15	112.385	C	14	1.64	41.175	C	14	1.365	16.53	O	14	1.25	9.995	C
15	1.84	66.017	C	15	4.12	760.299	C	15	3.5	582.081	O	15	1.6	34.674	O	15	1.4	17.268	O	15	1	2.399	D
16	2.05	98.371	C	16	3.13	374.737	O	16	2.71	241.822	C	16	1.53	31.387	O	16	1.395	18.689	C	16	1.34	15.505	O
17	2.6	199.437	O	17	2.79	263.514	C	17	5.36	1553.691	O	17	1.495	25.921	O	17	1.03	3.152	O	17	1.34	14.845	C
18	2.01	81.615	O	18	2.73	211.806	O	18	2.94	326.785	O	18	1.45	22.975	C	18	1.395	16.79	O	18	1.37	16.887	C
19	1.8	60.583	C	19	2.19	123.506	C	19	2.7	254.664	O	19	1.45	22.975	C	19	1.4	17.883	O	19	1.35	15.511	C
20	1.745	53.491	C	20	1.96	80.187	O	20	3.37	448.581	C	20	1.25	9.995	C	20	1.4	17.633	O	20	1.34	14.845	C
21	1.66	37.035	O	21	1.87	69.407	O	21	2.5	189.308	C	21	1.4	19.06	C	21	1.39	16.606	O	21	1.35	15.511	C
22	1.64	41.175	C	22	1.76	50.821	O	22	2.33	141.638	O	22	1.35	15.511	C	22	1.39	16.581	O	22	1.07	3.617	O
23	1.62	34.702	O	23	1.725	51.021	C	23	2.11	108.794	C	23	1.4	19.06	C	23	1.4	19.06	C	23	1.36	15.951	O
24	1.645	35.797	O	24	1.645	41.725	C	24	2.015	84.128	O	24	1.42	20.583	C	24	1.02	2.773	C	24	1.385	16.857	O
25	1.575	31.315	O	25	1.62	37.4	O	25	1.83	61.994	O	25	1.4	19.06	C	25	1.39	18.321	C	25	1.38	17.597	C
26	1.88	71.685	C	26	1.56	32.87	C	26	1.75	51.253	O	26	1.42	20.583	C	26	1.395	18.689	C	26	1.09	3.93	O
27	3.08	349.94	C	27	1.58	34.5	O	27	1.68	42.023	O	27	1.13	6.407	O	27	1.4	17.534	O	27	1.34	15.39	O
28	3.8	713.829	O	28	1.455	23.18	D	28	1.63	37.116	O	28	1.38	17.597	C	28	1.12	5.208	D	28	1.38	17.597	C
29	3.6	535.496	C	29	1.48	23.395	O	29	1.47	24.643	C	29	1.17	8.065	O	29	1.34	15.656	O	29	1.09	3.855	O
30	3.93	791.392	O	30	1.41	19.814	C	30	1.57	27.449	O	30	1.36	16.779	O	30	1.25	9.995	C	30	1.39	17.232	O
31	3.03	342.582	O	31	1.37	16.887	C					31	1.27	10.915	C					31	1.42	18.954	O

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2009 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.375	16.666	O	1	1.39	11.676	C	1	1.42	13.354	C	1	1.46	11.2	D	1	1.43	10.681	O	1	1.1	0.819	O
2	1.375	16.809	O	2	1.09	1.396	O	2	1.17	2.991	O	2	1.5	12.814	O	2	1.4	10.173	O	2	1.56	25.911	D
3	1.395	11.858	O	3	1.235	5.869	O	3	1.3	7.644	D	3	1.5	12.555	O	3	1.4	9.095	C	3	1.56	25.911	D
4	1.395	11.946	C	4	1.36	10.472	O	4	1.4	11.653	O	4	1.49	12.543	O	4	1.12	0.69	D	4	1.56	25.911	D
5	1.08	1.304	O	5	1.36	10.514	O	5	1.39	11.676	C	5	1.44	10.49	C	5	1.5	13.216	O	5	1.555	25.447	D
6	1.29	7.037	C	6	1.33	9.79	O	6	1.47	16.46	C	6	1.16	1.663	D	6	1.52	13.364	O	6	1.535	23.41	D
7	1.37	10.421	O	7	1.335	10.388	O	7	1.39	11.676	C	7	1.47	11.558	C	7	1.53	13.806	O	7	1.54	24.079	C
8	1.38	11.147	C	8	1.33	8.723	C	8	1.32	8.281	C	8	1.42	9.294	O	8	1.46	11.1	O	8	1.13	1.487	O
9	1.32	9.4	O	9	1.13	2.717	O	9	1.17	2.993	O	9	1.47	11.065	O	9	1.52	13.373	C	9	1.43	15.822	O
10	1.36	10.134	C	10	1.31	9.286	O	10	1.27	6.276	C	10	1.44	10.49	C	10	1.38	8.411	C	10	1.54	24.079	O
11	1.37	10.633	C	11	1.335	10.008	O	11	1.34	9.179	C	11	1.17	1.925	C	11	1.11	0.472	C	11	1.44	13.086	O
12	1.1	0.577	D	12	1.335	10.396	O	12	1.15	0.741	O	12	1.42	9.789	C	12	1.395	10.133	O	12	1.4	13.081	O
13	1.35	9.649	C	13	1.395	11.336	O	13	1.39	10.919	O	13	1.16	1.663	D	13	1.53	13.763	O	13	1.45	16.681	C
14	1.39	11.676	C	14	1.36	10.134	C	14	1.41	12.779	C	14	1.46	11.2	C	14	1.48	11.446	O	14	1.47	18.206	C
15	1.38	10.771	O	15	1.36	10.134	C	15	1.39	11.676	C	15	1.44	10.058	O	15	1.55	14.586	O	15	1.15	1.773	O
16	1.37	10.633	C	16	1.1	1.779	D	16	1.18	3.479	D	16	1.47	11.029	O	16	1.54	14.031	O	16	1.5	20.829	D
17	1.395	11.608	O	17	1.31	8.985	O	17	1.42	13.354	C	17	1.49	13.027	O	17	1.54	14.112	C	17	1.53	23.189	C
18	1.4	12.22	C	18	1.36	10.497	O	18	1.45	13.894	O	18	1.52	13.373	C	18	1.54	14.112	C	18	1.53	23.41	D
19	1.1	1.728	O	19	1.36	10.134	C	19	1.45	14.087	O	19	1.5	12.642	C	19	1.54	14.112	C	19	1.51	22.316	D
20	1.39	11.247	O	20	1.22	5.689	O	20	1.46	14.641	O	20	1.19	2.468	D	20	1.54	14.112	C	20	1.405	13.665	D
21	1.38	10.632	O	21	1.35	10.247	O	21	1.44	13.915	O	21	1.5	12.739	O	21	1.54	14.112	C	21	1.4	13.164	C
22	1.395	11.359	O	22	1.33	8.723	C	22	1.42	13.354	C	22	1.52	13.481	O	22	1.54	14.112	C	22	1.18	2.574	O
23	1.395	11.291	O	23	1.13	2.701	O	23	1.17	2.76	O	23	1.5	12.675	O	23	1.55	14.483	C	23	1.47	18.994	D
24	1.42	13.813	O	24	1.15	2.902	O	24	1.46	14.608	O	24	1.56	14.994	O	24	1.38	8.411	C	24	1.52	22.751	D
25	1.37	10.633	C	25	1.43	13.828	O	25	1.46	14.601	O	25	1.56	14.929	O	25	1.11	0.472	C	25	1.52	22.316	D
26	1.13	2.336	C	26	1.42	13.711	O	26	1.45	14.138	O	26	1.56	14.857	C	26	1.56	14.857	C	26	1.47	18.994	D
27	1.09	1.397	O	27	1.44	14.143	O	27	1.43	13.943	C	27	1.17	1.925	D	27	1.54	14.112	C	27	1.5	20.621	D
28	1.36	9.974	O	28	1.43	13.783	O	28	1.445	10.991	O	28	1.57	15.315	O	28	1.53	13.742	C	28	1.435	15.581	C
29	1.36	10.492	O					29	1.47	11.558	C	29	1.54	14.118	O	29	1.55	14.483	C	29	1.3	6.829	O
30	1.37	11.332	O					30	1.2	2.371	O	30	1.56	14.857	C	30	1.52	13.373	C	30	1.5	17.264	O
31	1.38	11.028	O					31	1.4	10.065	O					31	1.39	8.752	C				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.52	22.316	C	1	1.8	57.485	O	1	2.1	101.38	C	1	1.345	8.577	D	1	1.35	10.069	C	1	1.52	18.446	O
2	1.52	17.59	O	2	1.79	51.896	C	2	2.98	306.685	O	2	1.32	8.414	C	2	1.15	1.866	C	2	1.61	35.594	O
3	1.39	10.087	O	3	1.84	65.141	O	3	2.25	129.417	O	3	1.405	13.497	C	3	1.14	1.629	D	3	1.53	18.049	O
4	1.63	40.466	O	4	1.79	51.896	C	4	2.175	117.598	O	4	1.93	72.178	C	4	1.47	17.542	O	4	1.56	18.736	O
5	1.55	24.987	C	5	1.73	44.241	C	5	2.65	255.279	O	5	2.8	292.157	O	5	1.45	16.531	O	5	1.54	26.671	O
6	1.33	9.041	O	6	1.64	40.33	O	6	2.89	303.622	C	6	5.4	1424.516	O	6	1.45	16.346	O	6	1.6	29.778	C
7	1.62	31.815	C	7	1.59	26.312	D	7	2.58	217.862	O	7	2.6	216.59	C	7	1.485	16.416	O	7	1.2	3.648	O
8	1.56	26.145	D	8	1.58	25.325	D	8	2.35	153.494	C	8	2.335	145.13	O	8	1.45	116.681	C	8	1.54	26.758	O
9	1.44	16.31	D	9	1.64	33.92	C	9	2.05	89.209	O	9	1.96	75.413	O	9	1.45	16.395	O	9	1.55	26.153	O
10	1.74	45.641	O	10	1.58	25.325	D	10	1.98	81.536	O	10	1.92	70.617	C	10	1.45	16.099	O	10	1.51	17.332	O
11	1.6	29.778	C	11	1.65	34.998	C	11	1.8	63.332	O	11	1.8	53.233	C	11	1.55	26.274	O	11	1.56	26.348	O
12	2.11	103.255	C	12	1.635	33.387	C	12	1.78	50.577	C	12	1.72	46.578	O	12	2.23	122.781	O	12	1.58	27.81	C
13	1.93	74.114	O	13	1.6	27.325	D	13	2.04	90.499	C	13	1.58	27.81	C	13	1.75	48.421	O	13	1.54	24.079	C
14	4.15	917.59	O	14	1.545	24.531	C	14	1.995	82.055	O	14	1.54	18.396	O	14	1.6	29.778	C	14	1.2	3.707	O
15	6.4	2597.219	D	15	1.5	20.621	C	15	2.34	146.145	O	15	1.47	15.583	O	15	1.45	16.681	C	15	1.53	18.848	O
16	3.505	537.732	C	16	1.68	38.335	C	16	1.84	58.75	C	16	1.44	14.738	O	16	1.53	17.554	O	16	1.54	18.44	O
17	3.34	455.637	O	17	1.63	40.142	O	17	1.81	64.619	O	17	1.45	16.681	C	17	1.63	39.339	O	17	1.57	26.852	C
18	3.26	411.553	O	18	1.91	72.601	O	18	1.56	26.73	O	18	1.4	13.164	C	18	1.62	38.361	O	18	1.55	25.881	O
19	2.46	179.899	C	19	1.62	31.815	C	19	1.5	24.426	O	19	1.33	10.887	O	19	1.53	18.448	O	19	1.53	18.444	O
20	2.325	146.927	O	20	1.995	86.523	O	20	1.58	27.81	C	20	1.3	6.599	D	20	1.35	8.819	D	20	1.54	24.079	C
21	3.09	372.347	C	21	2.05	84.951	O	21	1.46	17.435	C	21	1.28	6.366	O	21	1.52	22.316	C	21	1.03	0.617	D
22	4.42	1043.299	O	22	2.2	127.461	O	22	1.54	24.079	C	22	1.48	16.079	O	22	1.41	13.833	C	22	1.135	1.517	D
23	4.48	1076.196	O	23	1.95	75.352	C	23	1.68	46.152	O	23	1.425	13.805	O	23	1.22	4.117	O	23	1.51	17.187	O
24	4.48	1053.138	O	24	2.34	146.227	O	24	1.95	75.63	O	24	1.32	10.376	O	24	1.49	19.799	C	24	1.52	22.316	C
25	3.18	405.599	C	25	2.42	170.051	C	25	1.73	48.46	O	25	1.32	8.414	C	25	1.52	17.036	O	25	1.52	22.316	C
26	2.9	306.889	C	26	2.21	125.009	O	26	1.6	27.325	D	26	1.26	5.555	C	26	1.58	25.325	D	26	1.125	1.285	O
27	2.995	305.279	O	27	2.13	111.072	O	27	1.49	19.799	C	27	1.16	2.119	C	27	1.52	17.394	O	27	1.525	22.751	C
28	3.005	342.269	C	28	2.03	88.746	C	28	1.41	13.833	C	28	1.15	1.866	C	28	1.51	21.46	C	28	1.13	1.408	C
29	2.45	185.107	O	29	2.05	88.34	O	29	1.37	11.256	C	29	1.36	10.654	C	29	1.49	19.799	C	29	1.27	5.99	C
30	2.21	123.076	O	30	2.46	179.899	C	30	1.385	10.634	D	30	1.35	10.069	C	30	1.21	3.927	O	30	1.39	12.511	C
31	2.045	86.235	O	31	2.39	141.14	O					31	1.46	17.435	C					31	1.23	4.35	C

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2010 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.21	4.286	O	1	1.17	2.388	D	1	1.16	2.119	C	1	1.36	10.654	C	1	1.35	10.069	C	1	1.02	0.661	C
2	1.27	6.236	O	2	1.45	16.681	C	2	1.16	2.194	O	2	1.35	10.069	C	2	1.39	12.511	C	2	1.2	5.103	D
3	1.24	4.735	C	3	1.45	14.568	O	3	1.36	11.013	O	3	1.29	7.601	O	3	1.16	2.694	O	3	1.16	3.597	C
4	1.315	10.109	O	4	1.45	14.499	O	4	1.36	11.206	O	4	1.2	3.295	C	4	1.33	9.22	O	4	1.16	3.189	O
5	1.46	17.435	C	5	1.46	14.983	O	5	1.4	13.067	O	5	1.16	2.119	C	5	1.24	5.773	O	5	1.16	3.597	D
6	1.43	13.111	O	6	1.46	15.108	O	6	1.4	12.694	O	6	1.18	2.886	O	6	1.37	11.256	C	6	1.18	4.231	C
7	1.43	13.01	O	7	1.45	16.681	C	7	1.41	13.833	C	7	1.32	8.938	O	7	1.36	10.654	C	7	1.17	4.003	D
8	1.44	14.061	O	15	1.16	2.251	D	8	1.19	2.976	C	8	1.36	11.34	O	8	1.39	12.511	C	8	1	0.787	D
9	1.42	14.52	C	16	1.32	10.321	O	9	1.14	1.629	D	9	1.37	11.256	C	9	1.34	9.5	C	9	1.15	3.301	D
10	1.28	6.441	C	17	1.4	13.363	O	10	1.38	11.687	O	10	1.39	12.511	C	10	1.17	2.388	C	10	1.16	3.597	D
11	1.22	3.993	O	18	1.42	13.624	O	11	1.4	12.674	O	11	1.395	12.835	C	11	1.43	15.223	C	11	1.28	8.636	O
12	1.45	14.581	O	19	1.42	13.927	O	12	1.42	14.52	C	12	1.19	2.976	C	12	1.4	13.164	C	12	1.49	21.663	C
13	1.45	14.581	O	20	1.44	14.477	O	13	1.38	11.875	C	13	1.17	2.388	C	13	1.37	11.256	C	13	1.4	15.074	C
14	1.45	16.681	C	21	1.42	14.52	C	14	1.4	13.164	C	14	1.37	11.256	C	14	1.37	11.47	O	14	1.13	2.422	O
15	1.44	14.316	O	22	1.14	1.629	D	15	1.06	0.318	D	15	1.375	11.564	C	15	1.41	13.339	O	15	1.37	11.636	O
16	1.44	14.882	O	23	1.41	13.833	C	16	1.38	11.875	C	16	1.4	12.78	O	16	1.2	3.295	C	16	1.81	67.112	O
17	1.43	15.223	C	24	1.415	13.331	O	17	1.33	8.949	C	17	1.39	11.718	O	17	1.15	1.866	C	17	2.7	226.616	O
18	1.3	9.685	O	25	1.42	13.661	O	18	1.35	10.663	O	18	1.41	13.833	C	18	1.005	0.007	C	18	1.65	40.423	O
19	1.44	14.553	O	26	1.415	13.486	O	19	1.35	10.317	O	19	1.2	3.456	O	19	1.41	13.833	C	19	2.28	118.944	O
20	1.45	16.681	C	27	1.37	11.256	C	20	1.37	11.63	O	20	1.36	11.081	O	20	1.41	13.833	C	20	1.94	75.002	C
21	1.44	14.401	O	28	1.14	1.629	C	21	1.38	11.875	C	21	1.44	14.326	O	21	1.39	12.511	C	21	1.57	31.89	O
22	1.44	14.622	O					22	1.2	2.976	D	22	1.44	13.396	O	22	1.395	12.835	C	22	1.45	18.575	C
23	1.43	13.778	O					23	1.3	7.394	C	23	1.45	14.655	O	23	1.39	12.511	C	23	1.94	68.271	O
24	1.5	20.621	C					24	1.33	8.949	C	24	1.44	13.878	O	24	1.19	2.976	C	24	2.27	127.855	O
25	1.26	6.009	O					25	1.345	9.783	C	25	1.41	13.833	C	25	1.34	9.5	C	25	2.11	108.222	O
26	1.45	16.681	C					26	1.345	9.783	C	26	1.2	3.179	O	26	1.34	9.5	C	26	1.74	52.033	O
31	1.48	18.994	C					27	1.34	9.5	C	27	1.39	12.14	O	27	1.36	10.654	C	27	1.55	26.784	C
								28	1.295	7.149	C	28	1.39	12.511	C	28	1.39	12.511	C	28	1.445	18.207	D
								29	1.17	2.388	C	29	1.39	11.825	O	29	1.41	13.833	C	29	1.6	35.698	O
								30	1.305	7.643	C	30	1.39	11.704	O	30	1.38	11.875	C	30	1.45	18.575	D
								31	1.29	6.909	C					31	1.17	3.041	O				

July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.55	26.784	C	1	3.98	765.774	C	1	3.635	827.951	O	1	1.535	28.79	O	1	1.15	3.092	O	1	1.25	6.9	C
2	2.9	323.022	C	2	3.48	532.11	O	2	2.84	456.142	C	2	1.41	17.483	C	2	1.32	10.288	C	2	1.32	11.054	O
3	1.95	76.591	C	3	4	775.31	C	3	2.535	261.008	O	3	1.34	12.858	C	3	1.35	11.938	O	3	1.3	8.764	O
4	2.07	97.081	C	4	3.75	651.73	O	4	2.31	145.485	O	4	1.345	10.389	O	4	1.42	13.295	O	4	1.3	8.691	O
5	1.9	64.445	O	5	2.7	259.571	O	5	2.47	192.949	C	5	1.37	11.392	C	5	1.65	36.647	C	5	1.33	10.832	C
6	1.88	70.146	O	6	2.29	139.258	O	6	2.9	356.837	O	6	1.555	44.655	O	6	1.45	19.82	O	6	1.125	2.62	D
7	1.8	54.64	C	7	2.3	143.193	O	7	2.8	377.372	C	7	1.38	13.022	O	7	1.4	15.074	C	7	1.18	4.399	D
8	2.27	132.242	O	8	2.78	283.236	C	8	2.7	204.355	O	8	1.325	14.891	O	8	1.32	10.802	O	8	1.2	4.922	D
9	2.33	146.667	O	9	2.305	142.473	O	9	2.805	395.503	O	9	1.26	8.262	C	9	1.32	10.974	O	9	1.22	5.67	D
10	2	84.808	C	10	2.32	150.465	C	10	2.4	215.704	C	10	1.235	6.9	C	10	1.34	11.719	O	10	1.32	10.994	O
11	2.21	124.356	C	11	2.1	105.856	O	11	2	123.381	O	11	1.18	4.922	D	11	1.935	68.824	O	11	1.31	9.759	C
12	2.2	120.733	O	12	2.42	175.966	O	12	1.95	83.128	C	12	1.185	4.922	D	12	1.58	29.567	C	12	1.15	3.301	C
13	2.1	102.618	C	13	2.08	96.952	O	13	1.87	66.775	O	13	1.3	5.67	D	13	1.42	13.294	O	13	1.09	1.581	O
14	2.53	199.093	O	14	2.215	125.399	C	14	1.775	55.979	C	14	1.8	70.076	O	14	1.885	66.585	C	14	1.1	1.787	O
15	2.6	216.888	O	15	2.06	95.272	C	15	1.68	43.163	O	15	1.395	22.404	O	15	1.47	21.352	O	15	1.19	4.57	D
16	2.17	107.228	O	16	1.92	67.054	O	16	1.865	70.343	C	16	1.35	13.017	O	16	2.375	159.759	O	16	1.17	3.907	D
17	2.23	128.553	C	17	1.8	64.419	O	17	1.92	76.365	O	17	1.35	13.785	C	17	1.62	33.512	C	17	1.19	4.57	C
18	1.85	61.511	C	18	2.35	158.117	C	18	2.005	104.261	O	18	1.26	8.143	D	18	1.445	19.624	O	18	1.2	4.922	D
19	2.03	83.694	O	19	2.3	145.447	C	19	1.9	83.128	C	19	1.385	10.022	C	19	1.4	12.772	O	19	1.165	3.75	C
20	2.225	127.497	C	20	2.23	128.553	C	20	1.76	67.843	O	20	1.76	65.575	O	20	1.88	65.47	O	20	1.05	1.171	O
21	2	79.856	O	21	1.95	69.093	O	21	1.73	46.975	C	21	1.72	41.965	O	21	1.6	31.506	C	21	1.07	1.219	O
22	3.52	610.237	O	22	2.41	173.858	C	22	1.635	56.338	O	22	1.54	35.688	O	22	1.91	69.342	O	22	1.35	12.044	O
23	4.08	791.078	O	23	2.08	94.816	O	23	1.59	29.567	D	23	1.52	25.027	O	23	1.54	26.67	O	23	1.34	11.626	O
24	3.22	438.776	C	24	2.37	151.198	O	24	1.745	57.335	C	24	1.455	20.475	C	24	1.39	14.422	C	24	1.32	10.288	C
25	3.87	714.155	C	25	2.22	126.446	C	25	1.82	70.056	O	25	1.335	11.613	O	25	1.34	11.392	C	25	1.35	11.967	C
26	4.45	1036.277	O	26	2.215	125.667	O	26	1.55	29.093	C	26	1.455	20.214	O	26	1.31	9.759	C	26	1.23	6.065	C
27	4.04	811.386	O	27	2.22	127.133	O	27	1.795	45.699	O	27	1.44	20.959	O	27	1.26	7.339	C	27	1.035	0.855	D
28	3.35	489.655	C	28	2.07	94.821	O	28	1.985	112.218	C	28	1.455	19.751	O	28	1.245	6.475	C	28	1.12	2.494	C
29	3.25	412.122	O	29	1.97	79.823	C	29	1.58	43.309	O	29	1.44	20.377	O	29	1.21	5.289	C	29	1.35	12.082	O
30	3.05	349.959	O	30	5.53	1708.368	O	30	1.485	28.338	O	30	1.34	12.761	O	30	1.23	6.268	D	30	1.38	14.825	O
31	2.34	155.477	O	31	5.05	1337.609	C					31	1.24	6.065	C					31	1.2	4.922	D

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2011 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May				June			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.23	6.065	C	1	1.33	11.239	O	1	1.34	11.511	O	1	1.34	11.635	O	1	1.34	11.392	C	1	1.41	18.73	O
2	1.16	3.597	C	2	1.34	11.392	C	2	1.35	11.991	O	2	1.4	17.719	O	2	1.06	1.093	O	2	1.38	17.737	D
3	1.045	1.119	O	3	1.34	11.456	O	3	1.24	6.065	D	3	1.25	6.9	C	3	1.1	2.024	C	3	1.39	17.365	O
4	1.21	5.289	D	4	1.35	11.878	O	4	1.34	11.582	O	4	1.04	0.926	C	4	1.31	9.681	O	4	1.42	19.383	O
5	1.35	11.967	C	5	1.35	11.909	O	5	1.35	11.948	O	5	0.99	0.731	O	5	1.35	12.028	O	5	1.39	18.405	C
6	1.34	11.745	O	6	1.3	9.245	C	6	1.34	11.392	C	6	1.34	11.611	O	6	1.36	13.026	O	6	1.15	3.403	O
7	1.16	3.597	D	7	1.03	0.787	D	7	1.04	1.418	D	7	1.37	13.242	O	7	1.31	9.759	C	7	1.31	13.463	C
8	1.29	8.746	C	8	1.01	0.934	O	8	1.35	11.958	O	8	1.36	12.911	O	8	1.34	11.392	C	8	1.38	17.737	D
9	1.34	11.392	C	9	1.32	10.288	C	9	1.345	11.949	O	9	1.35	11.967	C	9	1.05	1.154	O	9	1.38	17.737	D
10	1.04	1.056	O	10	1.28	8.813	O	10	1.35	11.929	O	10	1.37	13.163	C	10	1.17	3.907	C	10	1.4	18.25	O
11	1.27	7.793	D	11	1.34	11.526	O	11	1.34	11.612	O	11	1.06	1.138	O	11	1.12	2.02	O	11	1.35	15.821	C
12	1.35	12.051	O	12	1.31	9.759	C	12	1.34	11.392	C	12	1.25	8.218	O	12	1.42	18.923	O	12	1.46	23.178	C
13	1.34	11.625	O	13	1.33	10.832	C	13	1.35	11.967	C	13	1.34	11.618	O	13	1.41	18.62	O	13	1.88	63.667	O
14	1.3	8.748	O	14	1.03	0.787	C	14	1.335	11.214	O	14	1.36	12.557	C	14	1.42	16.427	C	14	1.56	32.045	D
15	1.32	10.853	O	15	1.03	0.787	D	15	1.15	3.75	D	15	1.365	12.982	O	15	1.41	15.743	C	15	1.59	37.906	O
16	1.31	9.759	C	16	1.33	10.832	C	16	1.34	11.994	O	16	1.41	18.408	O	16	1.05	1.17	O	16	1.75	55.948	O
17	1.04	1.046	O	17	1.35	12.036	O	17	1.36	12.401	O	17	1.37	13.163	C	17	1.13	2.75	C	17	2.54	207.198	C
18	1.35	12.196	O	18	1.27	6.275	O	18	1.35	11.996	O	18	1.05	1.165	O	18	1.41	18.556	O	18	2.02	93.135	C
19	1.34	11.55	O	19	1.3	9.327	O	19	1.36	12.557	C	19	1.26	7.339	C	19	1.42	16.427	C	19	1.75	50.297	C
20	1.35	12.027	O	20	1.28	8.262	C	20	1.34	11.392	C	20	1.41	18.461	O	20	1.4	17.703	O	20	1.58	37.263	O
21	1.33	11.224	O	21	1.03	0.787	D	21	1.04	0.87	O	21	1.41	18.611	O	21	1.41	18.576	O	21	1.6	35.91	C
22	1.34	11.521	O	22	1.08	1.313	O	22	1.1	2.024	D	22	1.36	12.557	C	22	1.42	16.427	C	22	1.975	85.468	C
23	1.33	10.832	C	23	1.36	12.911	O	23	1.36	12.702	O	23	1.38	13.609	O	23	1.06	1.241	C	23	1.79	57.912	C
24	1.04	1.044	O	24	1.34	11.392	C	24	1.37	13.189	O	24	1.37	13.163	C	24	1.15	3.301	C	24	1.54	30.208	C
25	1.36	12.64	O	25	1.34	11.673	O	25	1.35	11.983	O	25	1.06	1.124	O	25	1.37	13.286	O	25	1.56	32.045	C
26	1.35	11.967	C	26	1.34	11.592	O	26	1.33	11.316	O	26	1.25	8.27	O	26	1.42	16.427	C	26	1.49	25.892	C
27	1.06	1.139	O	27	1.35	11.967	C	27	1.3	9.245	C	27	1.42	18.918	O	27	1.4	15.074	C	27	2.13	104.66	O
28	1.3	9.329	O	28	1.1	2.024	D	28	1.08	1.319	O	28	1.41	18.508	O	28	1.35	11.967	C	28	2.17	121.533	C
29	1.35	11.967	C					29	1.33	11.331	O	29	1.4	17.72	O	29	1.36	12.557	C	29	2.82	276.203	O
30	1.34	11.392	C					30	1.31	9.655	O	30	1.42	18.894	O	30	1.05	1.077	C	30	2.04	89.274	O
31	1.04	1.036	O					31	1.36	12.557	C					31	1.1	2.024	C				

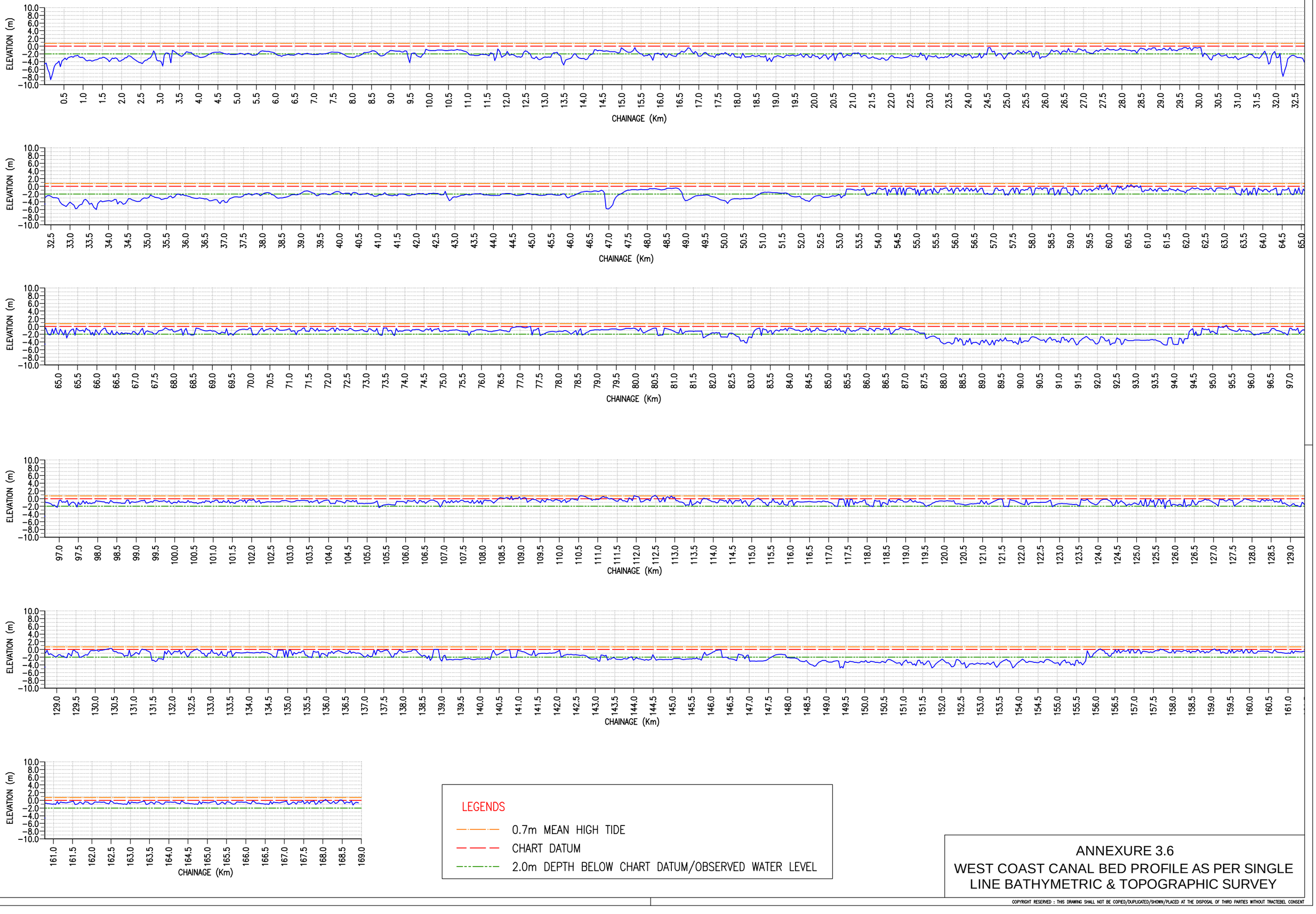
July				August				September				October				November				December			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.8	58.476	O	1	3.6	587.606	O	1	2.34	158.065	C	1	1.69	45.567	C	1	1.38	17.814	O	1	1.28	12.784	O
2	1.67	43.304	D	2	2.95	330.599	C	2	2.715	256.098	C	2	1.77	55.304	C	2	1.36	17.289	O	2	1.26	11.586	O
3	1.74	51.523	C	3	2.6	230.57	O	3	2.96	349.028	O	3	1.55	31.118	C	3	1.39	17.706	O	3	1.27	11.325	C
4	1.57	36.606	O	4	2.4	168.694	O	4	3.9	741.546	C	4	1.36	17.465	O	4	1.37	17.084	C	4	1.29	12.367	C
5	1.83	63.342	C	5	2.8	281.867	C	5	3.45	515.593	O	5	1.35	17.129	O	5	1.36	16.885	O	5	0.99	2.17	O
6	1.54	30.208	D	6	2.66	239.413	O	6	2.76	275.663	O	6	1.95	81.375	C	6	1.37	17.084	C	6	1.1	4.952	O
7	1.67	43.304	D	7	2.68	245.872	C	7	5.35	1653.882	O	7	1.85	74.226	O	7	1.09	4.246	C	7	1.225	9.997	O
8	2.65	240.835	O	8	2.37	165.574	O	8	3.1	383.801	C	8	1.7	46.724	C	8	1.34	16.663	O	8	1.265	11.83	O
9	3	347.774	C	9	2.21	129.862	C	9	2.41	175.556	O	9	1.55	31.118	C	9	1.34	16.627	O	9	1.28	11.84	C
10	2.9	313.891	C	10	2.21	129.862	C	10	2.12	111.573	C	10	1.36	17.095	O	10	1.31	13.463	C	10	1.24	9.863	C
11	3.2	441.267	O	11	2.02	93.135	C	11	2.04	96.667	C	11	1.28	13.436	O	11	1.33	15.614	O	11	1.25	10.337	C
12	3.33	479.768	C	12	2.29	142.663	O	12	2.25	140.094	O	12	1.48	25.076	C	12	1.33	14.614	C	12	0.98	1.978	O
13	3.29	487.489	O	13	2.58	217.885	C	13	2.05	98.462	C	13	1.75	49.492	O	13	1.33	14.614	C	13	0.975	2.033	O
14	5.8	1939.249	O	14	3.1	383.801	C	14	1.86	67.603	C	14	1.87	77.716	O	14	1.02	3.007	O	14	1.24	11.048	O
15	3.05	357.594	O	15	2.74	263.539	C	15	2.18	120.748	O	15	1.6	37.532	O	15	1.29	12.367	C	15	1.24	11.009	O
16	2.56	212.505	C	16	2.4	161.372	O	16	2.68	247.004	O	16	2.07	102.11	C	16	1.33	15.684	O	16	1.23	10.989	O
17	2.535	205.882	C	17	2.49	194.244	C	17	2.05	98.462	C	17	2.33	175.427	O	17	1.31	14.809	O	17	1.24	10.986	O
18	3.8	732.535	O	18	2.26	129.22	O	18	2.205	128.803	C	18	1.77	55.304	C	18	1.265	12.497	O	18	1.26	10.825	C
19	4.33	964.569	O	19	2.63	234.485	O	19	2.1	108.886	O	19	1.6	38.256	O	19	1.28	13.36	O	19	0.98	1.757	C
20	4.32	953.566	C	20	2.41	171.758	O	20	1.8	59.243	C	20	1.48	25.076	D	20	1.31	13.463	C	20	1.14	6.78	O
21	2.91	317.195	D	21	2.575	216.533	C	21	1.805	59.915	C	21	1.45	22.717	D	21	1.21	10.355	O	21	1.25	10.337	C
22	2.48	191.707	C	22	2.25	138.268	C	22	1.75	52.225	O	22	1.45	22.717	D	22	1.29	13.838	O	22	1.27	11.797	O
23	2.53	204.197	O	23	2.045	97.562	C	23	1.62	38.841	O	23	1.365	16.763	C	23	1.3	13.538	O	23	1.26	11.539	O
24	2.51	199.372	C	24	2.2	122.926	O	24	1.62	39.699	O	24	1.27	12.992	O	24	1.335	14.911	C	24	1.23	9.778	O
25	2.64	239.185	O	25	2.23	128.521	O	25	1.64	40.036	C	25	1.3	12.908	C	25	1.29	13.462	O	25	1.24	9.863	C
26	2.26	127.378	O	26	2.08	92.847	O	26	1.625	40.384	O	26	1.29	12.367	C	26	1.28	13.405	O	26	0.98	1.757	C
27	2.12	111.573	C	27	3.75	693.082	O	27	1.64	40.036	C	27	1.18	9.81	O	27	1.285	12.102	C	27	1.22	9.723	O
28	2.02	93.033	O	28	4.52	1059.642	C	28	1.635	41.11	O	28	1.17	6.9	C	28	0.995	2.477	O	28	1.26	10.825	C
29	3.5	522.855	O	29	6.1	1956.082	O	29	1.34	16.607	O	29	1.13	5.479	C	29	1.04	3.813	O	29	1.26	11.537	O
30	3.8	671.984	O	30	4.19	886.344	C	30	1.56	29.333	O	30	1.26	10.825	C	30	1.29	12.367	C	30	1.24	10.098	O
31	3.48	545.501	C	31	3.005	349.517	C					31	1.11	5.257	O					31	1.25	10.337	C

Gauge-Discharge Data: Badlapur (WU000P8)
Period: 2012 (HZS=Absolute Gauge;HHS=With M.S.L.)

January				February				March				April				May			
Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed	Day	Mean Gauge (m)	Discharge cumecs	Observed/Computed
1	1.23	9.401	C	1	1.305	13.184	C	1	1.39	17.67	O	1	1.36	16.445	C	1	1.41	18.188	O
2	0.98	1.962	O	2	1.3	13.638	O	2	1.37	16.931	O	2	1.05	2.426	O	2	1.28	13.029	O
3	0.88	0.51	C	3	1.31	14.26	O	3	1.37	17.084	C	3	1.23	9.782	O	3	1.29	12.367	C
4	1.25	11.032	O	4	1.315	13.746	C	4	1.32	14.032	C	4	1.39	18.405	C	4	1.41	18.293	O
5	1.25	10.337	C	5	1.305	13.184	C	5	1.06	2.506	O	5	1.37	17.084	C	5	1.4	17.819	O
6	1.26	10.825	C	6	1.25	11.106	O	6	1.12	5.657	O	6	1.36	16.445	C	6	1.41	19.783	C
7	1.23	9.858	O	7	1.29	13.208	O	7	1.37	17.084	C	7	1.37	17.122	O	7	1.04	2.957	C
8	1.26	10.825	C	8	1.32	15.599	O	8	1.38	17.737	C	8	1.38	17.737	C	8	1.36	16.445	C
9	0.99	2.09	O	9	1.31	14.744	O	9	1.05	2.384	O	9	1.04	2.32	O	9	1.41	19.783	C
10	1.16	6.726	O	10	1.315	15.495	O	10	1.37	17.084	C	10	1.24	10.125	O	10	1.36	16.445	C
11	1.23	9.807	O	11	1.32	14.032	C	11	1.38	17.737	C	11	1.39	17.722	O	11	1.36	16.445	C
12	1.27	11.418	O	12	1.31	13.463	C	12	1.04	2.336	O	12	1.38	16.938	O	12	1.39	18.405	C
13	1.28	12.789	O	13	1	2.029	O	13	1.16	6.954	O	13	1.39	17.721	O	13	1.34	15.21	C
14	1.27	11.523	O	14	1.1	4.537	C	14	1.36	16.445	C	14	1.4	19.087	C	14	1.06	3.44	C
15	1.26	10.825	C	15	1.38	17.53	O	15	1.36	16.445	C	15	1.37	17.084	C	15	1.39	18.405	C
16	1.25	10.337	C	16	1.38	17.405	O	16	1.34	17.108	O	16	1	2.116	C	16	1.4	17.571	O
17	1.28	12.833	O	17	1.39	17.792	O	17	1.39	17.784	O	17	1.19	8.319	O	17	1.36	16.819	O
18	1.28	12.858	O	18	1.395	17.945	O	18	1.41	19.783	C	18	1.4	17.86	O	18	1.38	16.985	O
19	1.29	13.392	O	19	1.38	17.737	C	19	1.05	2.357	O	19	1.39	17.606	O	19	1.37	16.694	O
20	1.3	13.623	O	20	1.05	3.193	C	20	1.34	16.95	O	20	1.37	16.865	O	20	1.35	15.821	C
21	1.29	13.276	O	21	1.03	2.241	O	21	1.39	17.524	O	21	1.36	16.594	O	21	1.04	2.288	O
22	1.27	11.325	C	22	1.37	17.084	C	22	1.36	16.596	O	22	1.4	19.087	C	22	1.3	12.908	C
23	1.3	13.599	O	23	1.38	17.07	O	23	1.37	17.084	C	23	1.03	2.224	O	23	1.36	16.371	O
24	1.29	13.301	O	24	1.37	16.556	O	24	1.21	9.027	O	24	1.34	16.166	O	24	1.37	16.603	O
25	1.31	14.2	O	25	1.4	18.331	O	25	1.31	13.463	C	25	1.38	16.974	O	25	1.34	16.121	O
26	1.3	12.367	C	26	1.37	17.084	C	26	1.04	2.355	O	26	1.38	17.1	O	26	1.38	16.991	O
27	1.29	13.322	O	27	1.04	2.321	O	27	1.25	10.337	C	27	1.38	17.737	C	27	1.36	16.445	C
28	1.3	13.547	O	28	1.32	14.61	O	28	1.33	16.885	O	28	1.4	17.59	O	28	1.06	2.448	O
29	1.29	12.367	C	29	1.36	16.445	C	29	1.32	16.365	O	29	1.39	18.405	C	29	1.26	10.803	O
30	1.3	13.571	O					30	1.34	16.585	O	30	1.26	10.788	O	30	1.39	18.405	C
31	1.29	12.367	C					31	1.35	17.618	O					31	1.39	17.139	O

ANNEXURE 3.6

OBSERVED BED PROFILE OF KALYAN-THANE-MUMBAI WATERWAY VIAL ULHAS RIVER



ANNEXURE 3.6

WEST COAST CANAL BED PROFILE AS PER SINGLE LINE BATHYMETRIC & TOPOGRAPHIC SURVEY

ANNEXURE 3.7

OBSERVED BED PROFILE OF WALDHUNI CREEK

ANNEXURE 3.7

WALDHUNI CREEK LONGITUDINAL BED PROFILE

ANNEXURE 3.8

OBSERVED BED PROFILE OF VASAI CREEK

ANNEXURE 3.8

VASAI RIVER LONGITUDINAL BED PROFILE

ANNEXURE 3.9

COMPILATION OF FIELD INFORMATION OF KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER IN IWAI FORMAT

Annexure 3. : Compilation of Field Information of Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River in IWAI Format

SL#	DESCRIPTION	DETAILS	REMARKS
	NAME OF THE FIRM	**Fugro Survey(India) Pvt Ltd.**	
	REGION / CLUSTER NO.	**Cluster-7/ Stage-1/ Maharashtra**	
1	NAME OF THE WATERWAY	Kalyan-Thane-Mumbai waterway, Vasai Creek and Ulhas River	
2	LENGTH OF THE WATERWAY (km)	145	
3	WATERWAY IN THE STATES OF	Maharastra	
4	FIELD WORK COMPLETED FOR THE LENGTH OF THE WATERWAY (km)	145.71	
TIDAL WATERWAYS			
5	Length of the waterway having tidal effects (km)	145	
6	Start & end location name having tidal effects	Till Chainage 145 km	
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	76.59 km	Depths are w.r.t. CD
9	Length of the waterway, where depths more than 1.5m is observed	5.94 km	
	Length of the waterway, where depths more than 1.0m is observed	17.73 km	
10	Existing Water level (m)	-	
11	Minimum Water Level (m)	-	
12	Highest Flood level (m)	We have not seen HFL marking in any Bridges	
CROSS-STRUCTURE INFORMATION			
13	Existing list of Dam, Barrages, Locks	(1 Dam & 2 Barrage), No locks	
14	Existing Bridges (nos.)	40	
15	Minimum Vertical and Horizontal clearances (m) as per visual estimation	Min. Vertical Cl: 3.43 M , Min. Horizontal Cl: 8 M	Vertical clearance above MHWS/HFL
16	High Tension lines	22	
NAVIGATIONAL OBSTRUCTION			
17	Rocks	No	
18	Steep gradients	No	
ENVIRONMENTAL & OTHER ISSUES			
19	Details of wildlife /forest area	Not Available	
20	Protected areas		
21	Security clearances		

SL#	DESCRIPTION	DETAILS	REMARKS
CARGO AND OTHER DETAILS			
22	Availability of passenger ferry services.along the waterway	Yes	
23	Estimated cargo movement through proposed waterway, road and rail	Estimated Cargo Movement through proposed water way is 20 MMTPA	
24	Type of crops (in different seasons) and industries along the waterway	Gharda Chemicals, Metropolitan Exichem, M/s Pest Control of India, Meghdoot Chemicals Pvt Ltd.	
25	Availability of Prominent towns / City along the waterway.	Mumbai City, Thane, Kalyan	
26	Historical and tourist places along waterway	Gateway of India	
27	Existing water sport and recreational activities and future probability	NA	
28	Existing Jetties and Terminals	Mora jetty, Ferry Wharf, Bhivandi, Kalyan	

ANNEXURE 4.1

LARGE SCALE INDUSTRIES IN KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER CATCHMENT REGION

Annexure – 4.1:Large scale Industries in Kalyan Thane Vasai creek catchment region

S.No.	Industrial Cluster	Major Industries	Commodity	Total Area (Ha)
1	DOMBIVALI INDUSTRIAL AREA	Gharda Chemical Industries	Chemicals	347.88
		Sharda Textiles	Textile	
		Coral Cosmetics	Cosmetics	
		Metropolitan Exichem Pvt. Ltd	Chemical Products	
		Eskay Industries	Brass Components	
2	MAROL INDUSTRIAL AREA	Rolta India Ltd	Software Services	127.52
		Birla Technologies Limited	Software Services	
		Indian Institute of Packaging	Educational & Research Services	
		B.S.E.S.	Electric data processing	
		M.C.S. Computers Ltd.	IT Services	
		Indian Standard Institute (ISI)	Research & Development in Packaging	
		National Test House		
		Mahanagar Telephone Nigam Ltd.		
		Zenith Computers	Personal Computers	
3	Mira Industrial Area	Shri Mahila Griha Udyog Lijjat Papad	Papad,Khakras,Detergent,Masala,Atta	7.82
		M/s Pest Control of India Pvt. Ltd	Pesticides	
4	Wagle Industrial Estate	Bradma of India	Marking Solutions	254.96
		Aplab Electronics Pvt. Ltd.	Electronic Equipment	
		Hawkins Pressure Cooker Pvt. Ltd	Pressure Cookers	
		Emco Transformer Pvt. Ltd	Transformers	
		Khandelwal Laboratories	Pharma	
		Josts Engineering Co. Ltd.	Engineering	
		Automatic Electric Ltd.	Electronic Goods	
		Windsor	Engineering	
		National Standard Duncan Ltd.		
		Gee Ltd.	ARC Welding Electrodes	
		Cybertech System & Software Ltd	Software Services	
		Cellibion Interactive Pvt. Ltd		

5	Addl Ambernath Industrial Area	ASB International Private Ltd	Engineering	558.81
		Rayona International		
		Akasha Syneotex		
		Suryavanshi Textiles Limited	Textile	
		Defiance Knitting	Knitted bleached & Dyed printed Hosiery fabrics	
		M/s Kasha Syncotex Limited	Knitted Garment & Fabrics	
		M/s Bharat Serums and Vaccines Ltd.	Pharmaceutical formulation	
		M/s Bunty Foods (India Pvt.Ltd)	Biscuits	
		M/s Sekhseria Chemicals Ltd	Tablets & Capsules	
6	Addl. Murbad Industrial Area			138.8
7	Ambernath Industrial Area	Centaur Chemicals Private Limited	Pharmaceutical	228.49
		Hamilton Industries Limited	Cycle Manufacturing	
		Ion Exchange India Limited	Water Management	
		Morarji Bris (I & E) Private Limited		
		Suparna Chemicals Limited	Metal & Metal Compounds	
		Triochem Products Limited	Pharmaceutical	
		Transchem Limited		
		M/s Albright & Murarji Pandit Ltd.	Industrial Phosphates	
8	Ambernath Phase III Industrial Area			79.54
9	Badlapur Industrial Area	Emtex Industries Pvt. Ltd	Textiles	104.62
		Bidhata Industries Ltd	Textiles	
		Honavar Electronics Ltd	Electronic Products	
		Precision Engg. Tools & Co.	Tools	
		Industrial Tubes Mfg. Pvt. Ltd	Tubes	
		Pioneer Agro Industries	Seeds	
		D.K. Pharma Chem Pvt. Ltd	Pharmaceuticals	
		M/s Mandan Textiles Pvt. Ltd	Processing Polyester & any other Synthetic	
		M/s Trimurti Synthetics Ltd.	Processing of Synthetics Textiles	
		M/s Indian Leather Cloth Industries	Textile Processing	

		M/s Harjas Plastic & Metal	Bicycle Components	
10	Kalyan Bhivandi MIDC	Laxmi Board & Paper Mills Pvt. Ltd	Paper Products	86.16
		Godhwani Brothers		
		Poly Pharma Pvt. Ltd.	Pharmaceuticals	
		Meghdoot Chemicals Pvt. Ltd.	Chemicals	
		Morani Chemicals Pvt. Ltd.	Chemicals	
11	Murbad MIDC	Oriental Containers Ltd.	Tin Containers	129.59
		Hindustan Gas Industries	Gases	
		Maharashtra Tubes Ltd		
		Lloyd Steel Ltd.	Steel Products	
		Tiger Steel Engineering (I) P.Ltd.	False Ceiling	
		M/s Praxiar India Pvt. Ltd	Liquefied Carbonic Gas	
			Total	**2064.19**

Source: MIDC and MSME

ANNEXURE 4.2

MEETING AND DISCUSSIONS

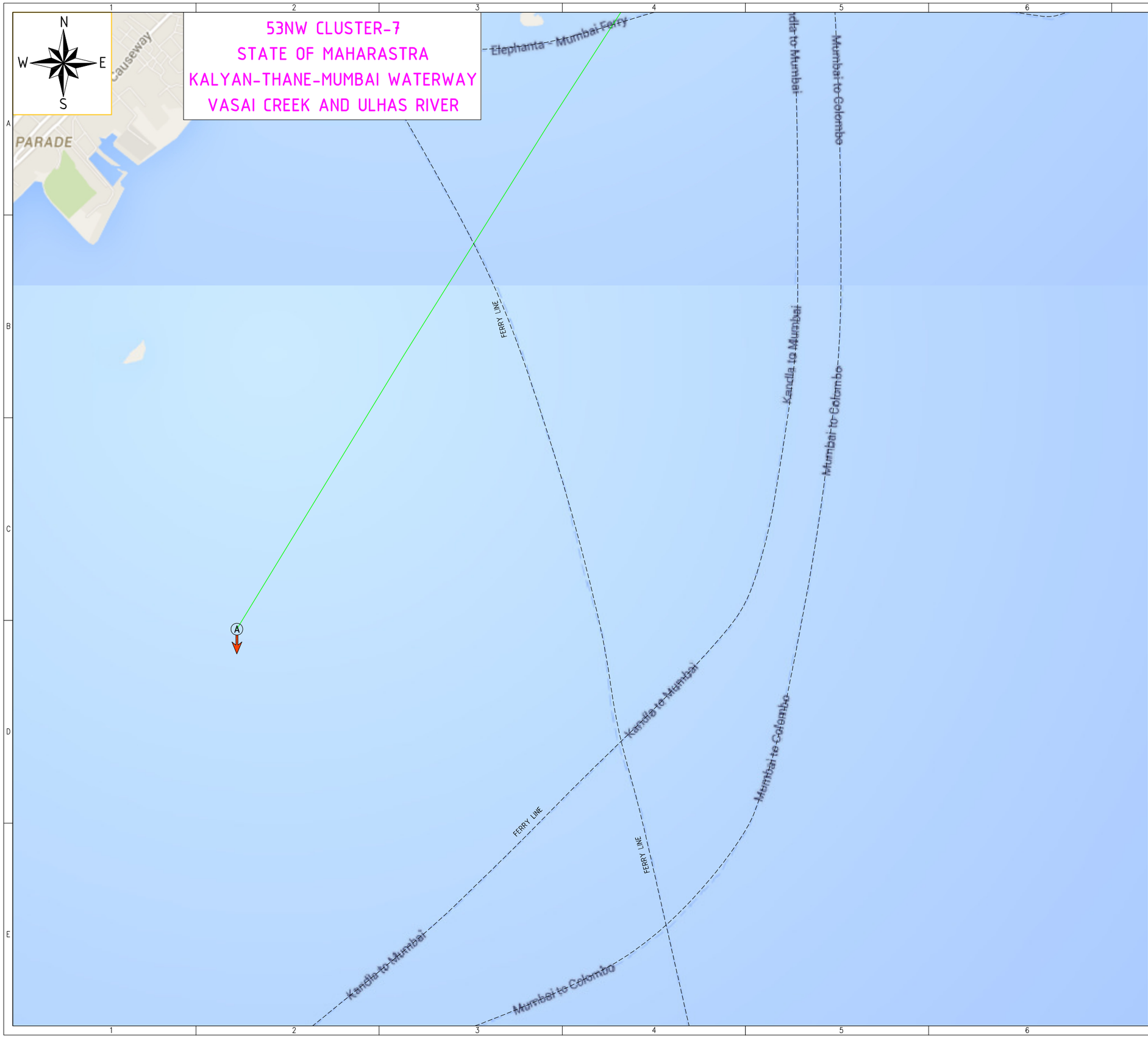
Annexure 4.2: Meeting and Discussions

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 Slav Jetty	Ports Office

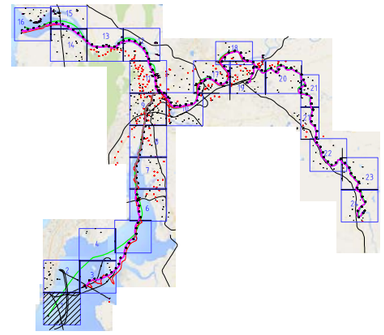
DRAWINGS

P.009051-W-20201-A06 R0 (SHEET-1 TO 24): LAYOUT PLAN – KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE

(A) POINT NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT.18°55'49.78",LONG.72°53'21.67"	POINT OF RECONNAISSANCE SURVEY (A1) NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT. 18°55'51.46",LONG. 72°53'28.16"
(B) POINT NEAR MALEGAON T.WAREDI SH-76 AT LAT.19°02'38.20",LONG.73°19'53.79"	
(C) POINT AT BRIDGE KALYAN-BADLAPUR ROAD AT LAT.19°14'06.39",LONG.73°08'49.13"	(C1) POINT OF RECONNAISSANCE SURVEY BRIDGE KALYAN-BADLAPUR ROAD LAT.19°14'6.39",LONG. 73°08'49.13"
(D) END POINT AT KALYAN LAT. 19°15'35.03", LONG. 73°09'27.77"	(D1) POINT OF RECONNAISSANCE SURVEY AT KALYAN LAT.19°15'35.03",LONG. 73°09'27.77"
(E) POINT AT VASAI CREEK AT LAT. 19°15'35.03", LONG. 73°09'27.77"	(E1) POINT OF RECONNAISSANCE SURVEY AT VASAI CREEK LAT.19°18'42.59",LONG.72°47'27.92"
(F) POINT AT KASHELI AT LAT. 19°15'35.03", LONG. 73°09'27.77"	(F1) POINT OF RECONNAISSANCE SURVEY AT KASELI LAT.19°13'23.19", LONG. 73°00'27.70"

PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

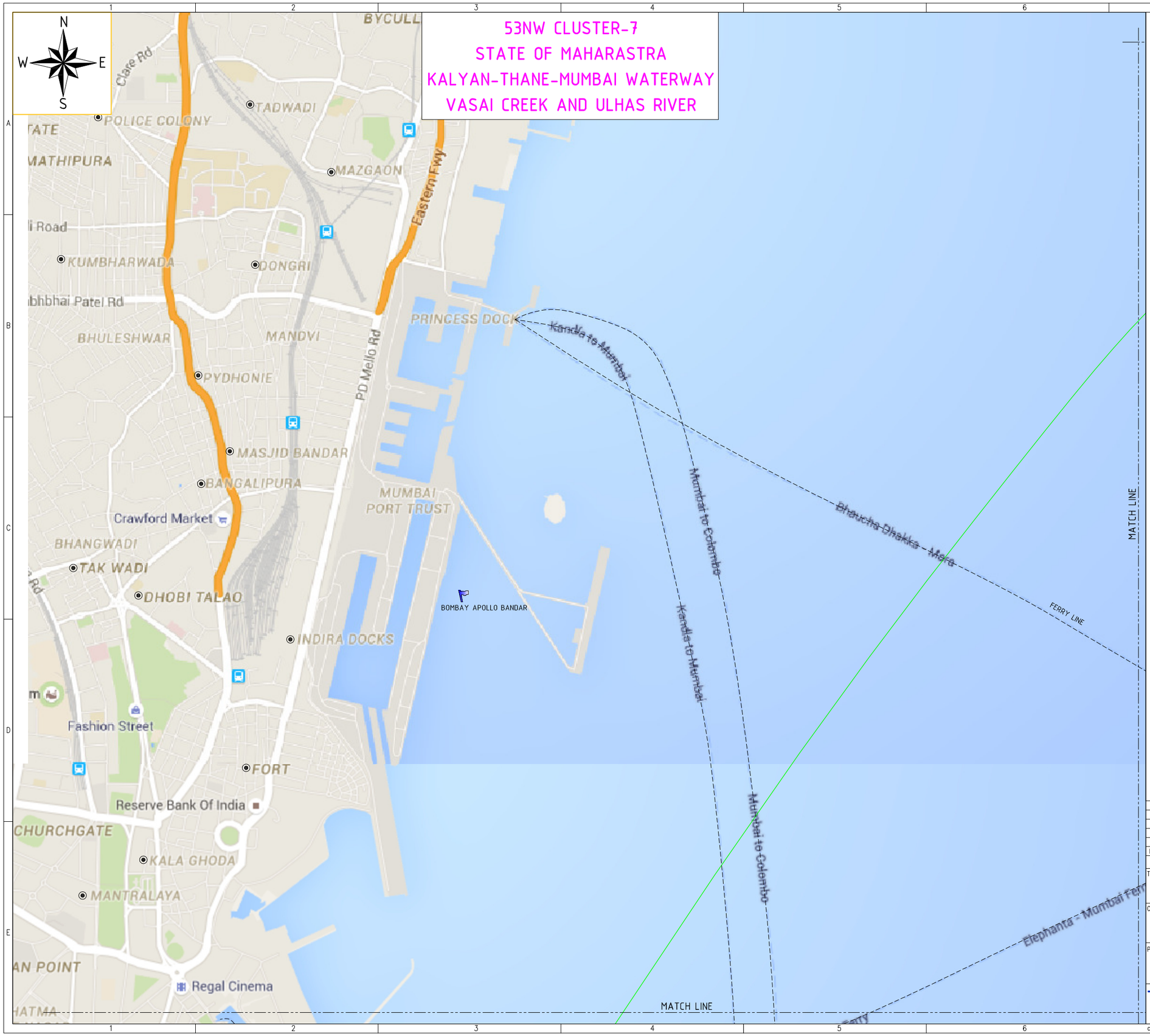
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 1–24

DRAWING NUMBER
P.0090511-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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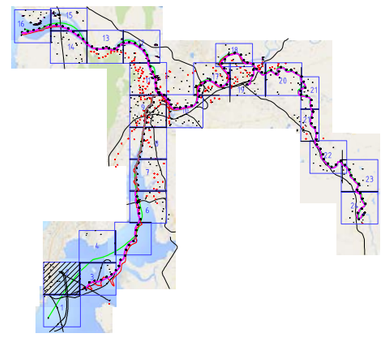

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE

(A) POINT NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT.18°55'49.78",LONG.72°53'21.67"	POINT OF RECONNAISSANCE SURVEY (A1) NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT. 18°55'51.46",LONG. 72°53'28.16"
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(F) POINT AT KASHELI AT LAT. 19°15'35.03", LONG. 73°09'27.77"	(F1) POINT OF RECONNAISSANCE SURVEY AT KASELI LAT.19°13'23.19", LONG. 73°00'27.70"

PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 2–24

DRAWING NUMBER
P.0090051–W–20201–A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N
W E
S

MATCH LINE

MATCH LINE

GHARAPURI VILLAGE

Elephanta Caves

Gharapuri

RAJ BANDARGAON

Elephanta - Mumbai Ferry

FERRY LINE

CH 6.00

CH 5.00

CH 4.00

CH 3.00

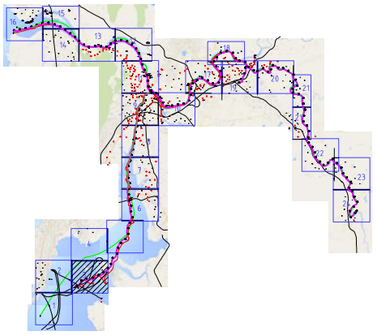
CH 2.00

CH 1.00

Dhaucha Dhakka Mora

A1

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/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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(A) POINT NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT.18°55'49.78",LONG.72°53'21.67"	(A1) POINT OF RECONNAISSANCE SURVEY NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT. 18°55'51.46",LONG. 72°53'28.16"
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PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

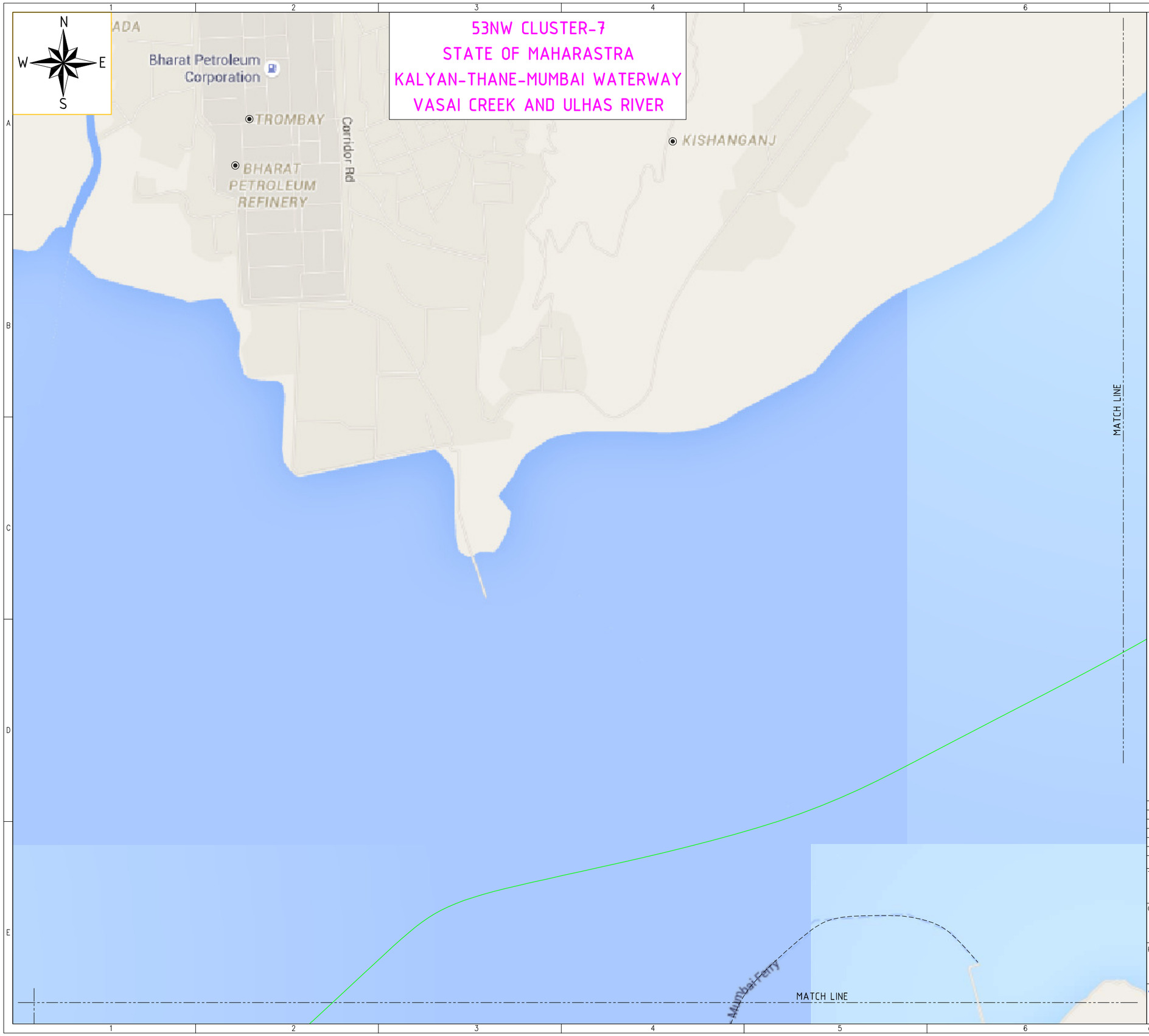
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 3–24

DRAWING NUMBER
P.0090511–W–20201–A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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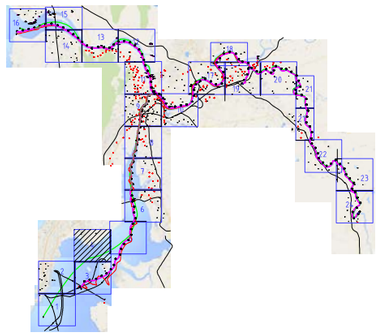

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/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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PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 4–24

DRAWING NUMBER
P.0090511-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N
W E
S

MATCH LINE

CH 15.00

CH 14.00

CH 13.00

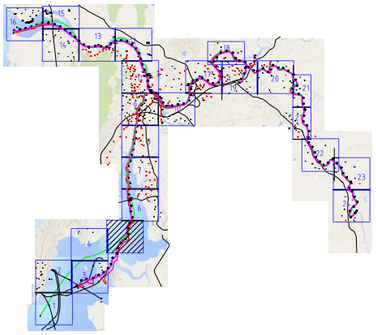
CH 12.00

CH 11.00

CH 10.00

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/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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	REVISION	DRAWN	DESIGNED	CHECKED	APPROVED	
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TITLE
LAYOUT PLAN
KALYAN-THANE-MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 5-24

DRAWING NUMBER
P.0090511-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N
W E
S

MATCH LINE

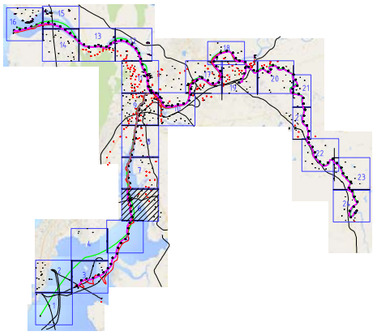
CH 21.00
CH 20.00
CH 19.00
CH 18.00
CH 17.00
CH 16.00

VASHI ROAD BRIDGE
VASHI ROAD BRIDGE
VASHI RLY. BRIDGE
Sion - Panvel Hwy

VASHI
SECTOR 19
Vashi-Turbhe Rd
SECTOR 17
SECTOR 21
SECTOR 6
SECTOR 1
SECTOR 18
Vashi Flyover
Sion - Panvel Hwy
SECTOR 24
VASHI GAON
SECTOR 30
VASHI VILLAGE
Raghuleela Mall
Palm Beach Rd
SECTOR 15
SECTOR 1
PALM BEACH
SECTOR 8
SANPADA
SECTOR 16
SECTOR 10
SECTOR 17
SECTOR 12
Palm Beach Rd
JUI GAON
SECTOR 20
JUINAGAR
SECTOR 21
JUINAGAR WEST
SECTOR 4
SECTOR
SECTOR 6
SECTOR 8
SECTOR 14
SECTOR 12
SECTOR 10
SECTOR 16A
GANUWADI
Palm Beach Rd
SECTOR 18
Nerandam Marg

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/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
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(D) END POINT AT KALYAN LAT. 19°15'35.03", LONG. 73°09'27.77"	(D1) POINT OF RECONNAISSANCE SURVEY AT KALYAN LAT.19°15'35.03",LONG. 73°09'27.77"
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PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 6–24

DRAWING NUMBER
P.0090051-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

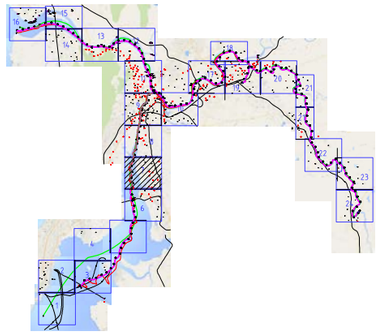
N
W E
S

MATCH LINE

GHANSOLI
SECTOR 8
JIJAMATA NAGAR, SECTOR 11
JIJAMATA NAGAR, SECTOR 7
JIJAMATA NAGAR, SECTOR 10
Bipex Rd
Thane Belapur Rd
Central Rd N
SECTOR 4
SAVALI
SECTOR 1
Shil hata - Mahape Rd
Mahape Road
SECTOR 2A
SECTOR 1
SECTOR 1
SECTOR 2
Gyan Vikas Road
Dhirubhai Ambani Knowledge City
SECTOR 4
Vashi Rd
Khairane Rd
19/C
SECTOR 5
SECTOR 6
KOPAR KHAIRANE
SECTOR 17
SECTOR 7
SECTOR 16
SECTOR 10
SECTOR 23
12B
SECTOR 13
SECTOR 14
SECTOR 11
SECTOR 28
SECTOR
Vashi Rd
PKC Rd
Gramma Marg
Thane-Belapur Rd
SECTOR 10
Palm Beach Rd
MAFCO Rd
SECTOR 10A
SECTOR 9
VASHI
MATCH LINE

CH 26.00
CH 25.00
CH 24.00
CH 23.00
CH 22.00
CH 21.00

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE

(A) POINT NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT.18°55'49.78",LONG.72°53'21.67"	POINT OF RECONNAISSANCE SURVEY (A1) NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT. 18°55'51.46",LONG. 72°53'28.16"
(B) POINT NEAR MALEGAON T.WAREDI SH-76 AT LAT.19°02'38.20",LONG.73°19'53.79"	
(C) POINT AT BRIDGE KALYAN-BADLAPUR ROAD AT LAT.19°14'06.39",LONG.73°08'49.13"	(C1) POINT OF RECONNAISSANCE SURVEY BRIDGE KALYAN-BADLAPUR ROAD LAT.19°14'6.39",LONG. 73°08'49.13"
(D) END POINT AT KALYAN LAT. 19°15'35.03", LONG. 73°09'27.77"	(D1) POINT OF RECONNAISSANCE SURVEY AT KALYAN LAT.19°15'35.03",LONG. 73°09'27.77"
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(F) POINT AT KASHELI AT LAT. 19°15'35.03", LONG. 73°09'27.77"	(F1) POINT OF RECONNAISSANCE SURVEY AT KASELI LAT.19°13'23.19", LONG. 73°00'27.70"

PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

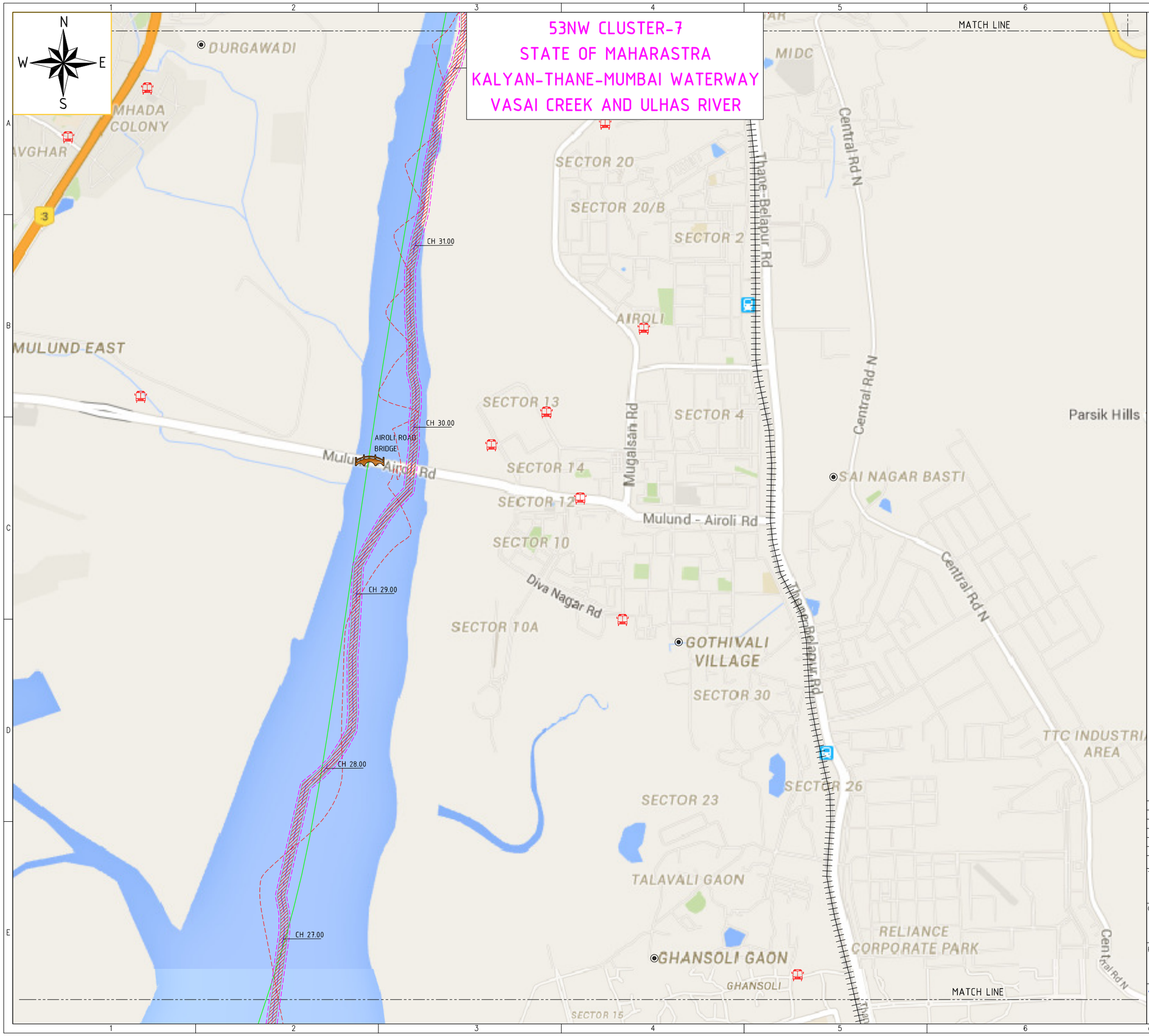
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 7–24

DRAWING NUMBER
P.009051-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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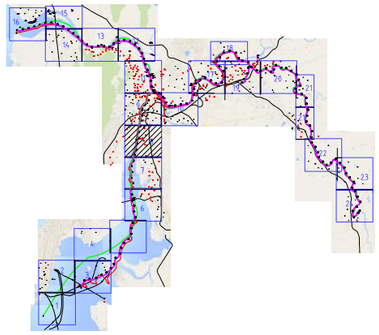

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

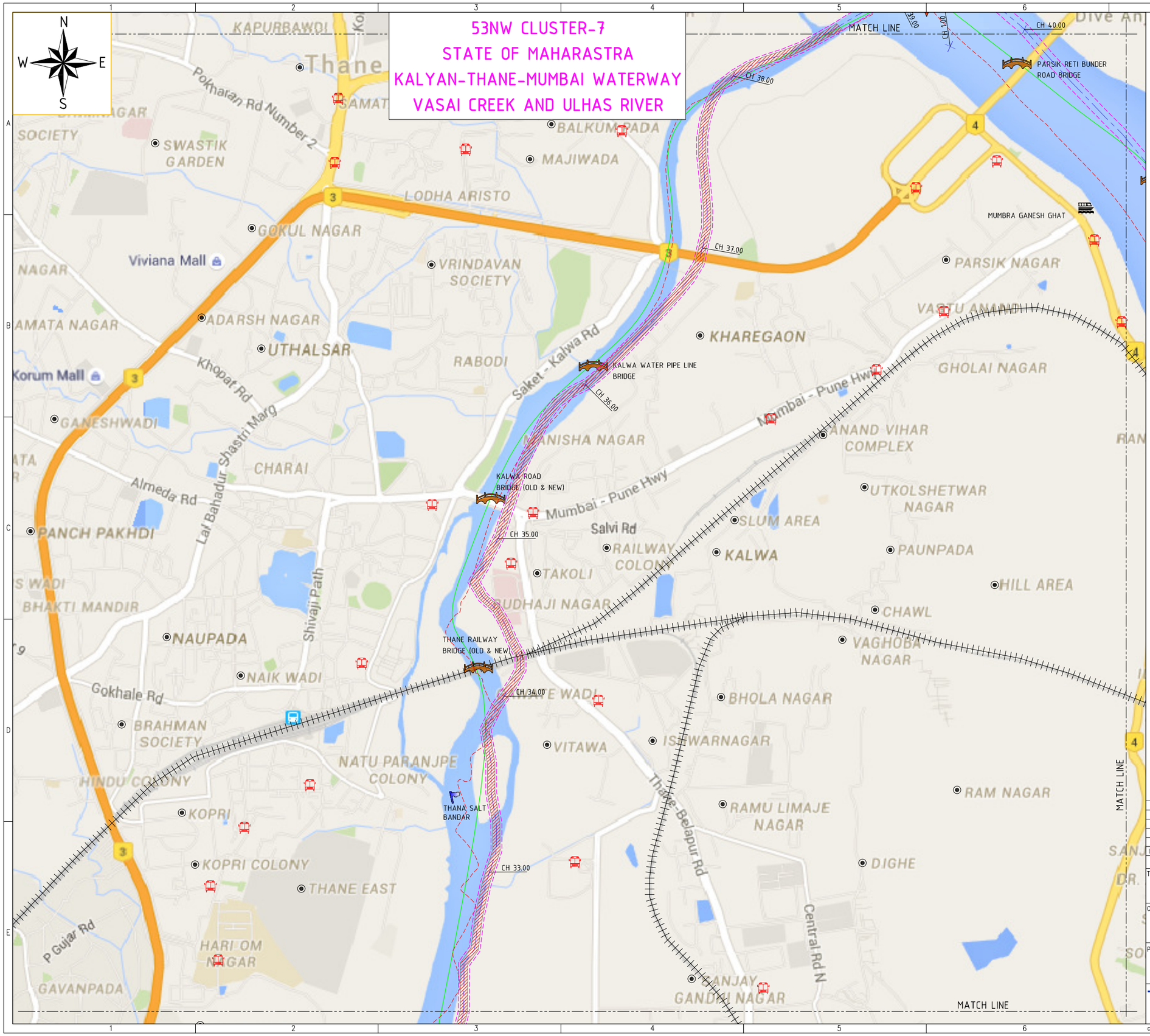
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 8–24

DRAWING NUMBER
P.009051–W–20201–A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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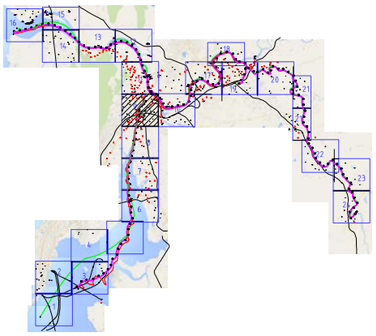

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/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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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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	REVISION	DRAWN	DESIGNED	CHECKED	APPROVED	
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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 9–24

DRAWING NUMBER P.0090051-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N
W E
S

MATCH LINE

DOMBIVLI GANESH GHAT

CH 48.00

DOMBIVLI WES

CH 41.00

GANESH GHAT WATER PIPELINE BRIDGE

Bharodi

ANJUR

BHARODI GAON

CH 47.00

CH 42.00

Alimghar

CH 43.00

ALIMGARH JETTY

CH 44.00

CH 45.00

CH 46.00

Ulhas River

Ulhas River

PATIL WADI

BHOPAR GOAN

MHATARDI GAON

RANA NAGAR

MUMBRA JETTY

DATTU WADI

DATIWALI GAON

KASHI

ILTHAN

MUMBRA

DIVA

Datiwali Rd

RUNWAL MYCITY BETWADE

OM SAI NAGAR

ZAINY COLONY

ANAND KOLIWADA

Diva-Agasan Rd

SABE GAON

GANESH NAGAR

USARGHAR GAON

Diva Shil Rd

SANJAY NAGAR

Desai Khadi

OMKAR NAGAR

DR. AMBEDKAR NAGAR

Agason

SHIVAJI NAGAR

SANTOSH NAGAR

SONAJI NAGAR

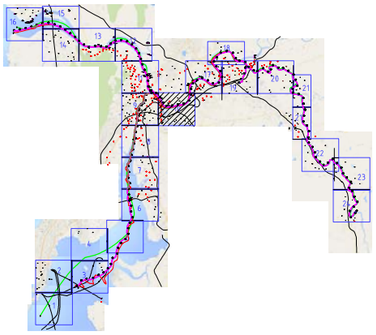
MUMBRA

Desai Khadi

CASA BELLA

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/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
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	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE

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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

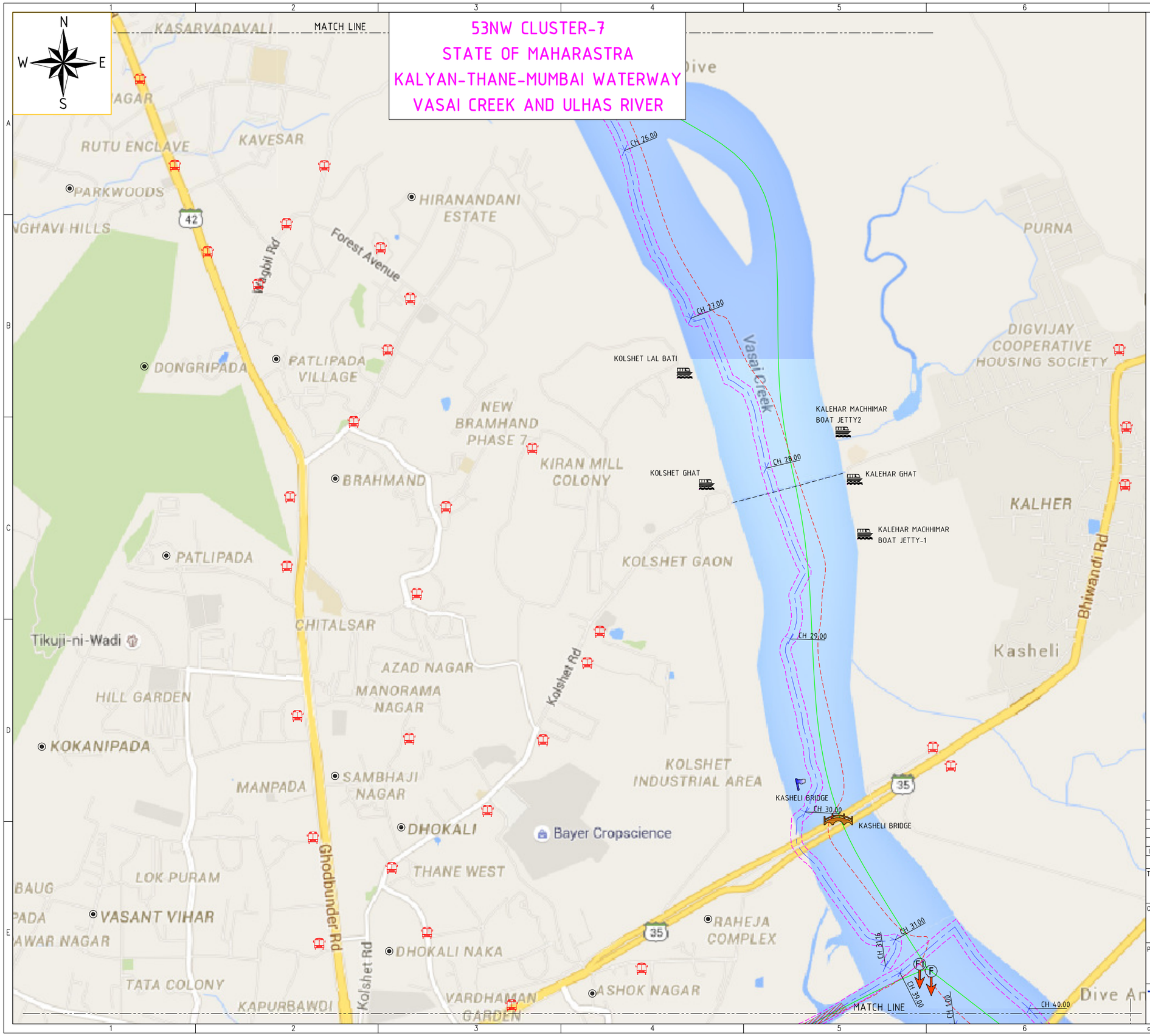
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 10–24

DRAWING NUMBER
P.0090511-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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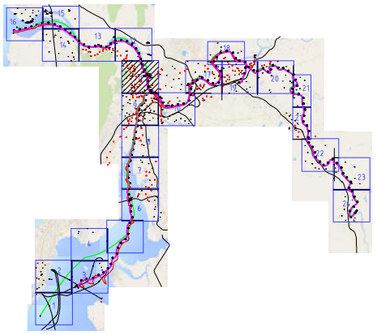

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

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

TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

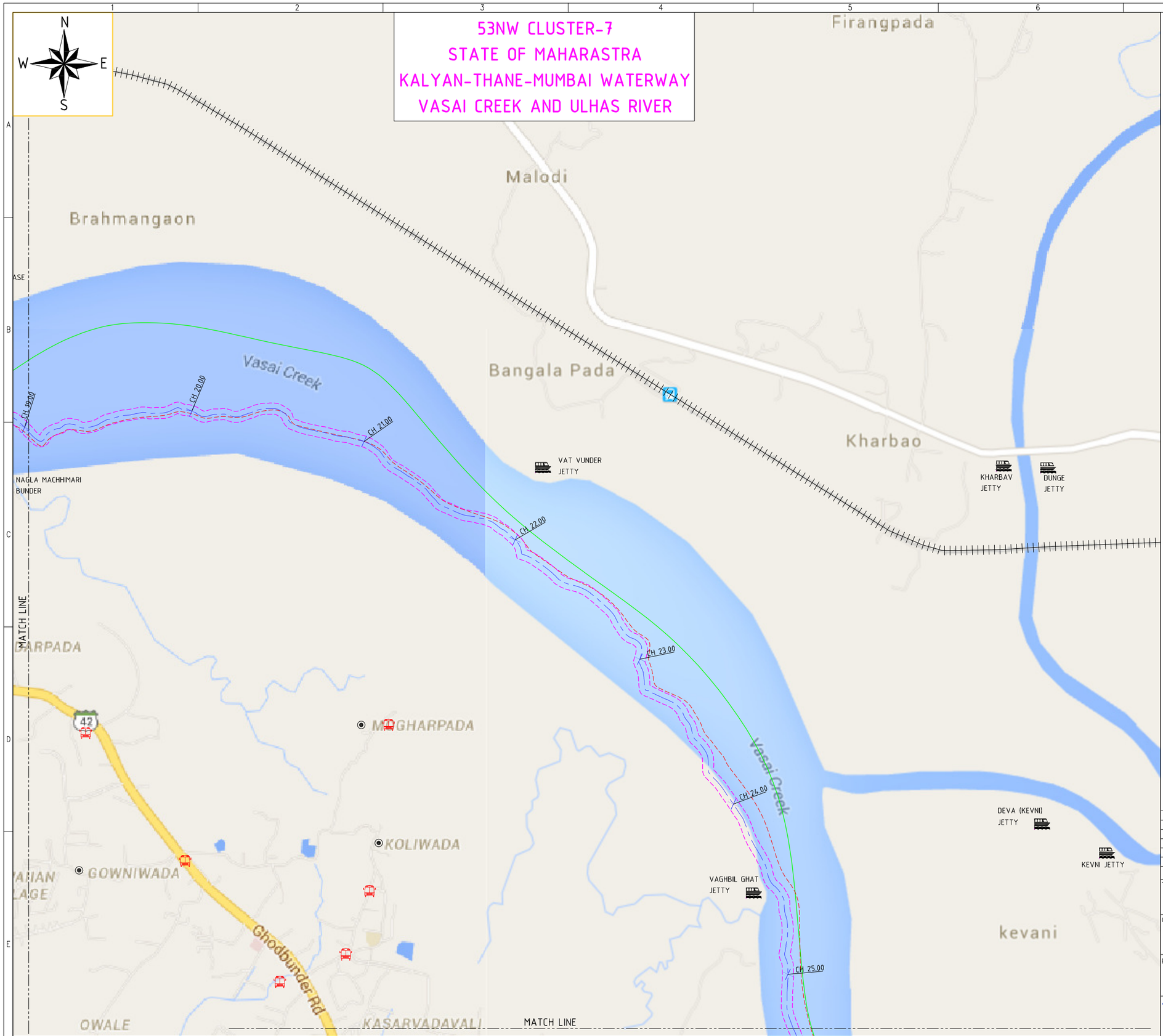
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 11–24

DRAWING NUMBER P.I.0.0.9.0.5.1.–.W.–.2.0.2.0.1.–.A.0.6 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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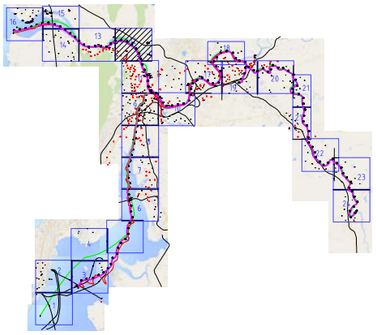

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	INDUSTRY
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	PLACE NAME
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SCALE 0 0.4 1.0KM

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

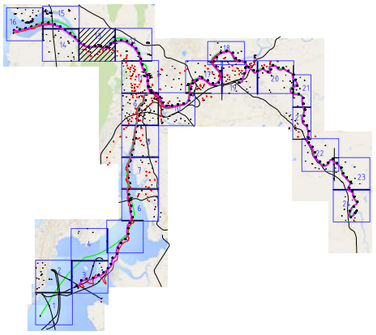
SIZE: A3 | SCALE: 1:20000 | SHEET: 12–24

DRAWING NUMBER
P.0090511-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N
W E
S

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE

(A) POINT NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT.18°55'49.78",LONG.72°53'21.67"	POINT OF RECONNAISSANCE SURVEY (A1) NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT. 18°55'51.46",LONG. 72°53'28.16"
(B) POINT NEAR MALEGAON T.WAREDI SH-76 AT LAT.19°02'38.20",LONG.73°19'53.79"	
(C) POINT AT BRIDGE KALYAN-BADLAPUR ROAD AT LAT.19°14'06.39",LONG.73°08'49.13"	(C1) POINT OF RECONNAISSANCE SURVEY BRIDGE KALYAN-BADLAPUR ROAD LAT.19°14'6.39",LONG. 73°08'49.13"
(D) END POINT AT KALYAN LAT. 19°15'35.03", LONG. 73°09'27.77"	(D1) POINT OF RECONNAISSANCE SURVEY AT KALYAN LAT.19°15'35.03",LONG. 73°09'27.77"
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(F) POINT AT KASHELI AT LAT. 19°15'35.03", LONG. 73°09'27.77"	(F1) POINT OF RECONNAISSANCE SURVEY AT KASELI LAT.19°13'23.19", LONG. 73°00'27.70"

PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 13–24

DRAWING NUMBER
P.009051-W-20201-A06 REV 0

TRACTEBEL Engineering
GDF SUEZ

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N W E S

MATCH LINE

CH 9.00 CH 10.00 CH 11.00 CH 12.00

Vasai Creek

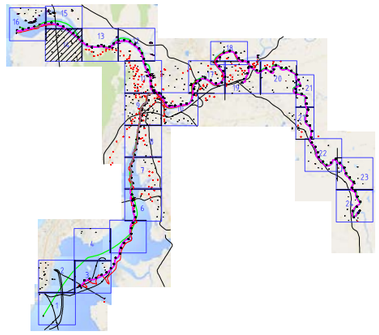
HIV KRIPA CHAWL
SALASAR NAGAR
GAONDEVI
RANUJA RAMDEV PARK
KANAKIA PARK
GHODBANDER VILLAGE
GAURAV CITY
UNIQUE GARDENS
INDRALOK PHASE 3
PHASE 4
RETIB
DAJK
MASHAC

MOTI NAGAR
BHAYANDAR EAST
POOJA NAGAR
BHAYANDAR WEST
SANT JALARAM NAGAR
GEETA NAGAR
Mira Bhayandar
NAYA NAGAR
MIRA ROAD EAST
MIRA ROAD WEST
POONAM NAGAR
SECTOR 7
SRISHTI COMPLEX
SECTOR 2
KASHIMIRA
MIRAGAON
LAXMI BAUG
KASHIGAON
MIDC

Radha Soami Satsang Beas

BP Rd
Station Rd
60 Feet Rd
Dahisar Rd
Uttan Rd
Sant Tukaram Marg
Deepak Hospital Rd
Mira Bhayandar Rd
Ramdev Park Rd
Lodha Rd
Mari Gold Rd
Ghodbandar Village Rd
GCC Club Rd
MTNL Rd
Srishti Rd
Poonam Sagar Rd
Miragaon Rd

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
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PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

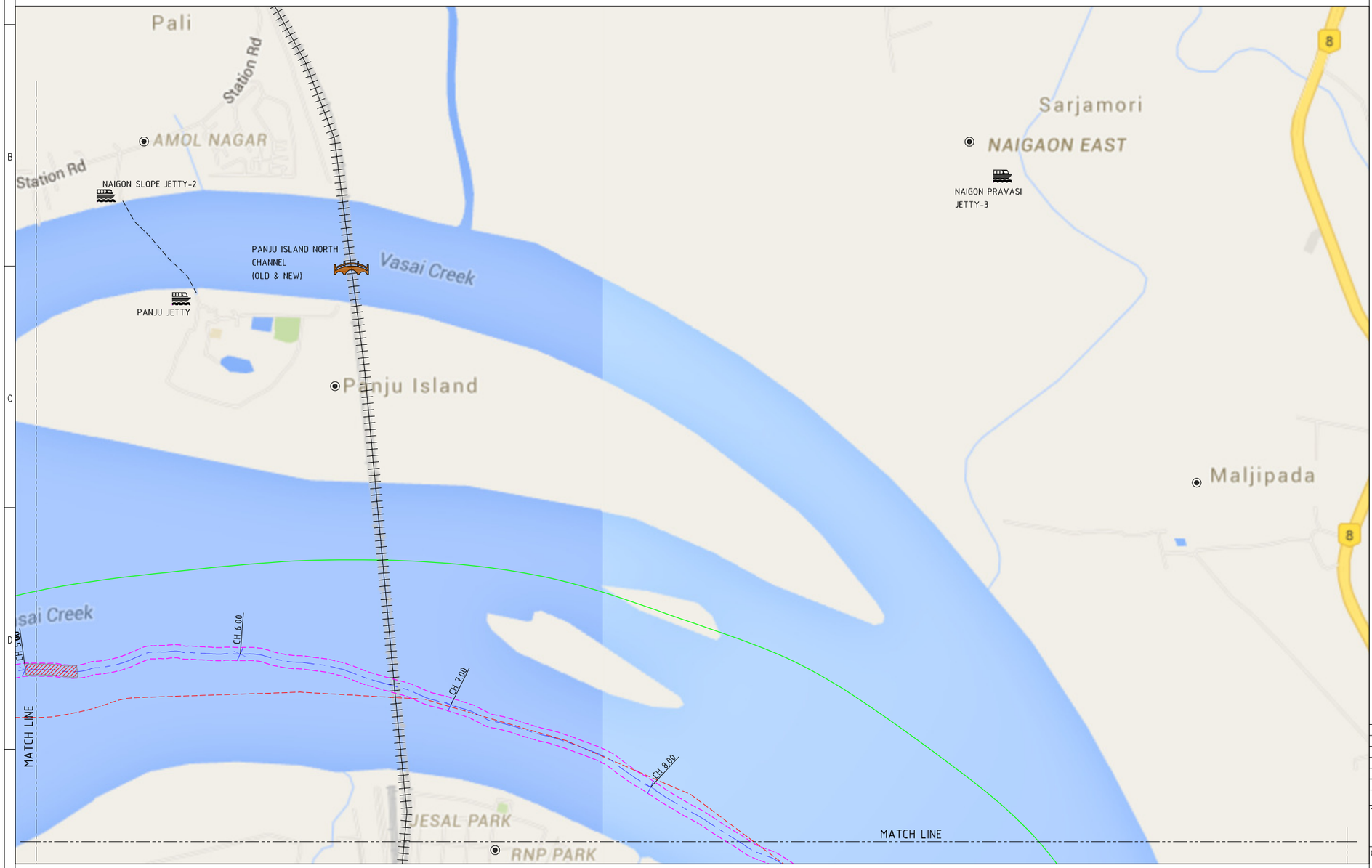
PROJECT NO. **P.009051**

SIZE: A3 | SCALE: 1:20000 | SHEET: 14–24

TRACTEBEL Engineering GDF SUEZ

DRAWING NUMBER P.0090051–W–2020201–A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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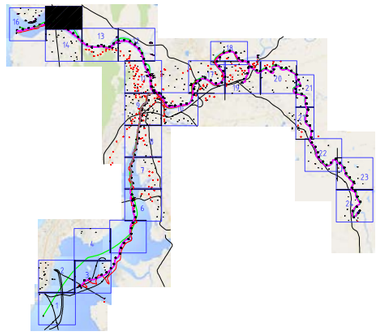

LEGEND

	BUS STOP
	HISTORICAL PLACE
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	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

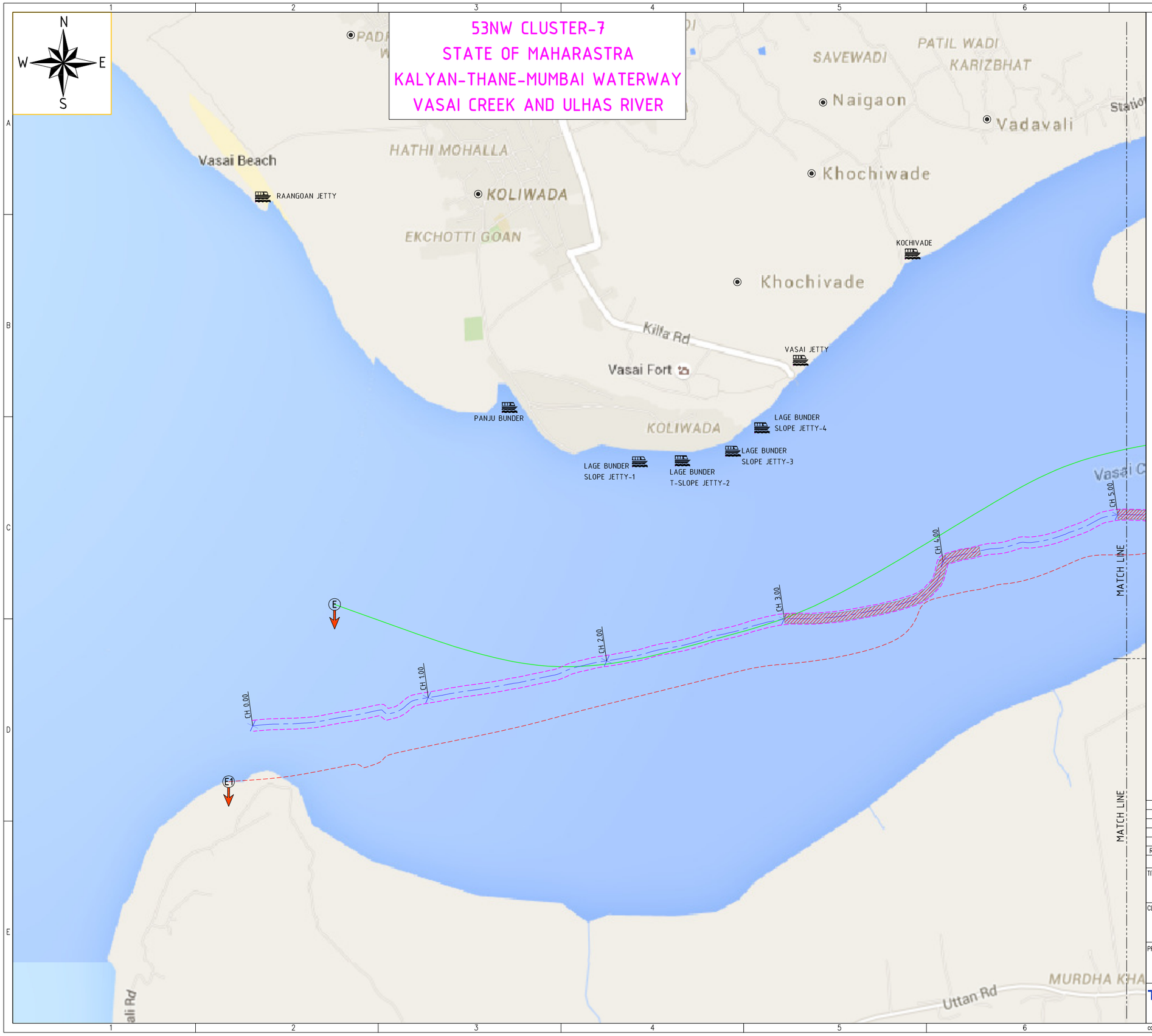
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 15–24

DRAWING NUMBER
P.I.0.0.9.0.5.1.-W-2.0.2.0.1.-A.0.6 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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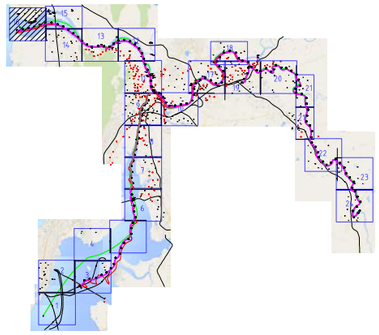

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 16–24

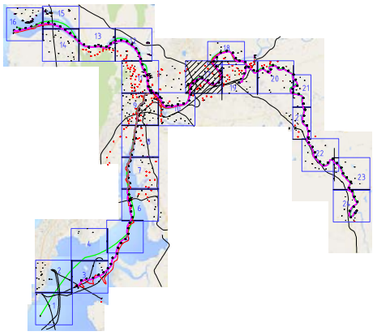
DRAWING NUMBER P.0090051-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N
W E
S

MATCH LINE
CH 59.00
KALYAN WATER PIPELINE BRIDGE
CH 58.00
CH 57.00
CH 56.00
CH 55.00
CH 54.00
CH 53.00
CH 52.00
CH 51.00
CH 50.00
CH 49.00
MATCH LINE
DIVA RLY. BRIDGE
DEVICHA PADA
PINPLAN PRAVASI JETTY
KALYAN GANESH GHAT
KALYAN BHIVANDI ROAD BRIDGE
VELHE JETTY
VELHE MACHHIMAR & PRAVASI JETTY
DOMBIVALI PRAVASI JETTY
MACHHIMAR BOAT JETTY
DOMBALI GANESH GHAT
MALAG GARH PRAVASI JETTY
MIDC
PIMPALGHAR
Gove
PIMPLAS
SAI COLONY
GIRIDHAR NAGAR
Kongaon
VASUDEV PATIL NAGAR
ANNABHAU SATHE NAGAR
KUMBHARKHAN PADA
KALU NAGAR
DEVICHA PADA
MAHARASHTRA NAGAR
NAVAPADA
UMESH NAGAR
GANESH NAGAR
VIJAY SOCIETY
AMBIKA NAGAR
THAKURWADI
BALAJI NAGAR
THAKURLI
KACHORA GAO
Kon
Metro Junc
Ulhas River
Ren Rubber Road
Kalyan Rd
Nerul Rd
222
3

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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TITLE
LAYOUT PLAN
KALYAN-THANE-MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

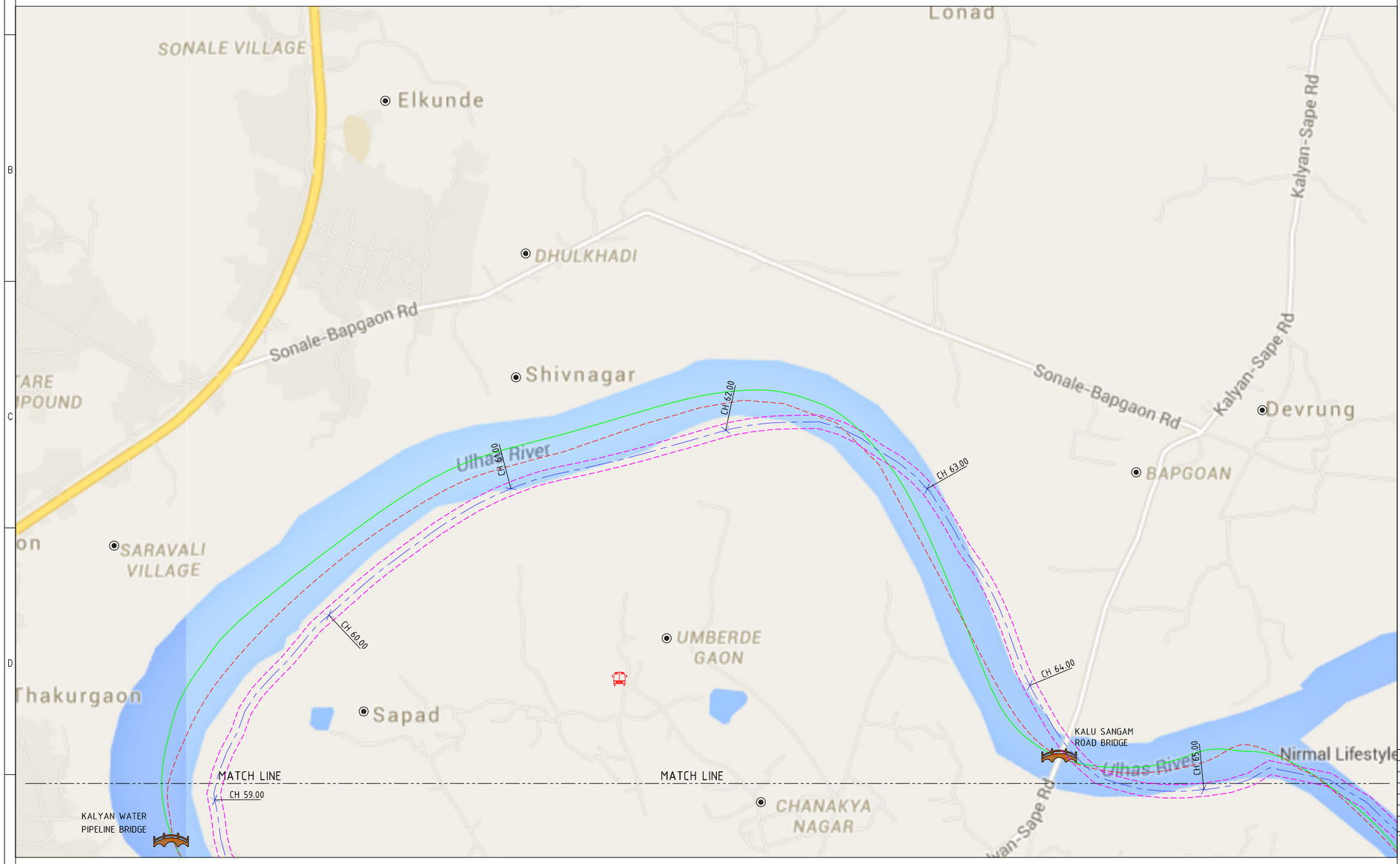
PROJECT NO. **P.009051**

SIZE: A3 | SCALE: 1:20000 | SHEET: 17–24

TRACTEBEL Engineering GDF SUEZ

DRAWING NUMBER P.009051-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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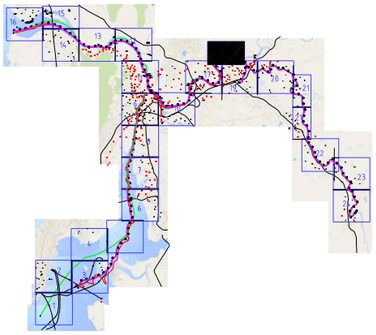

LEGEND

	BUS STOP
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

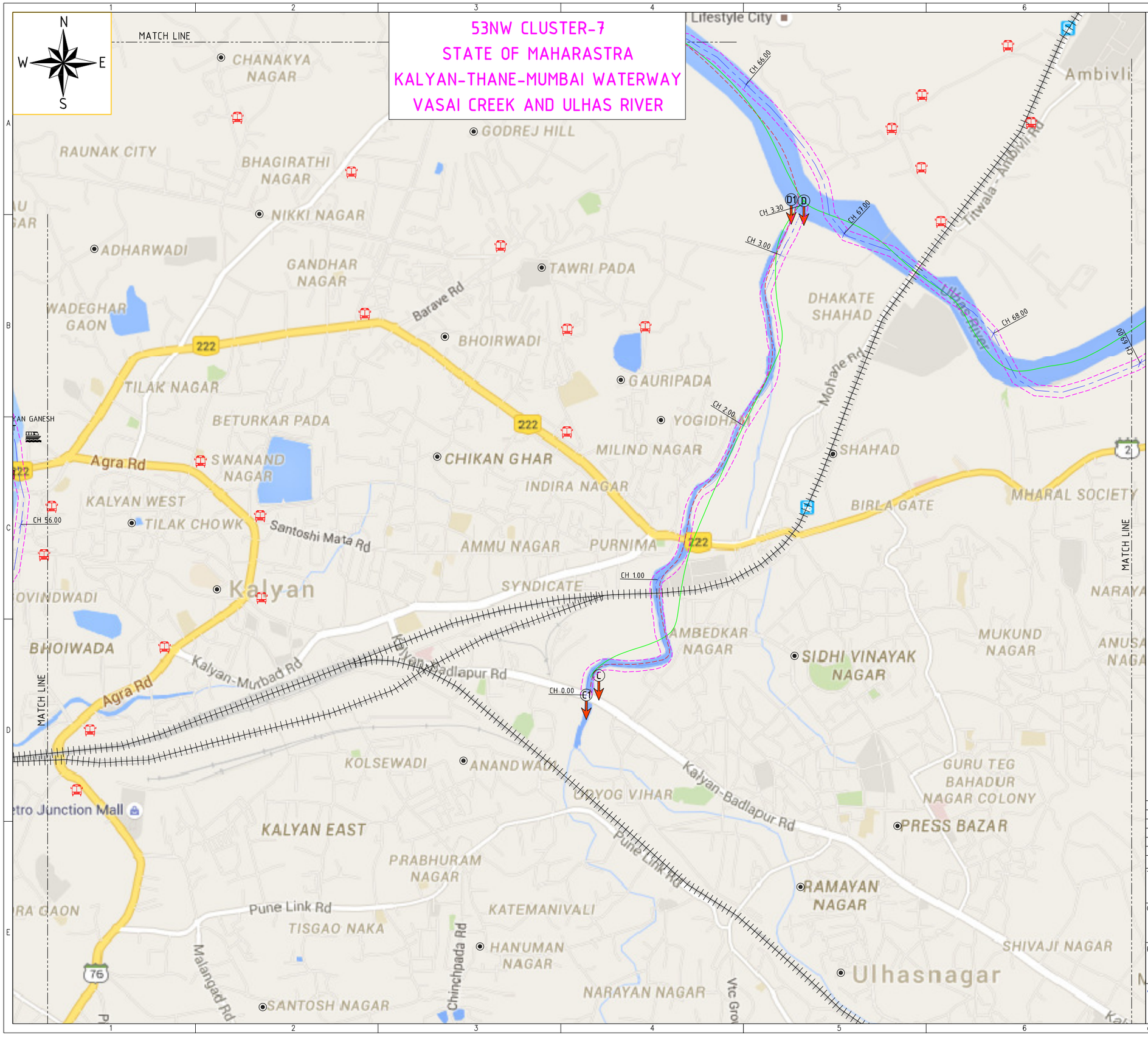
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 18–24

DRAWING NUMBER P.009051–W–20201–A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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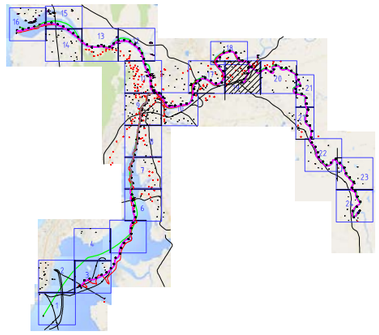

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
	DEEPEST SURVEYED WATER DEPTH (THALWEG)
	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE

(A) POINT NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT.18°55'49.78",LONG.72°53'21.67"	POINT OF RECONNAISSANCE SURVEY (A1) NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT. 18°55'51.46",LONG. 72°53'28.16"
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(C) POINT AT BRIDGE KALYAN-BADLAPUR ROAD AT LAT.19°14'06.39",LONG.73°08'49.13"	(C1) POINT OF RECONNAISSANCE SURVEY BRIDGE KALYAN-BADLAPUR ROAD LAT.19°14'6.39",LONG. 73°08'49.13"
(D) END POINT AT KALYAN LAT. 19°15'35.03", LONG. 73°09'27.77"	(D1) POINT OF RECONNAISSANCE SURVEY AT KALYAN LAT.19°15'35.03",LONG. 73°09'27.77"
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PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 19–24

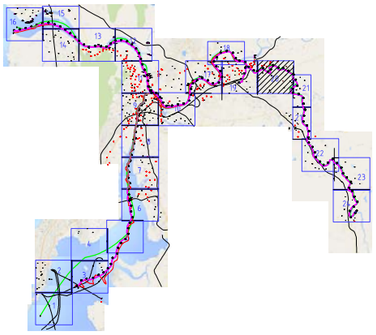
DRAWING NUMBER
P.009051-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

N
W E
S

Mohili
Galegaon
Pawshepada
Ulhas River
Rayate
Bhiwandi - Murbad Rd
222
VARAP
Kamba
Ane
Mharal
Bhisod
Raita
Nalambi
Varp
MAHATMA JYOTIBA PHULENAGAR
KAMLAKAR NAGAR
Mharal Bk
MATCH LINE
MATCH LINE
CH 69.00
CH 70.00
CH 71.00
CH 72.00
CH 73.00
CH 74.00
CH 75.00
CH 76.00
CH 77.00
CH 80.00
CH 81.00

SHEET INDEX



LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/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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PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN-THANE-MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

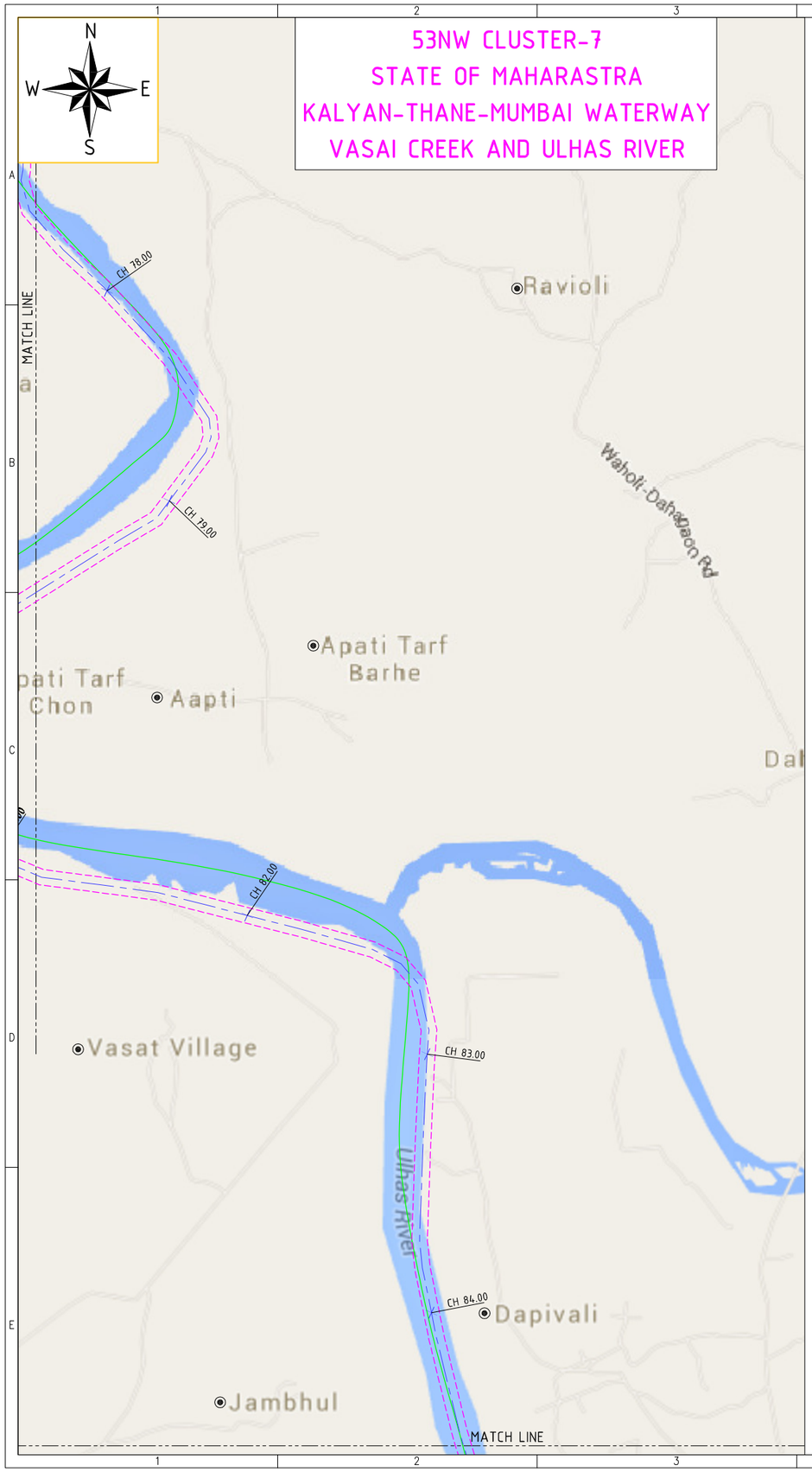
PROJECT NO.
P.009051

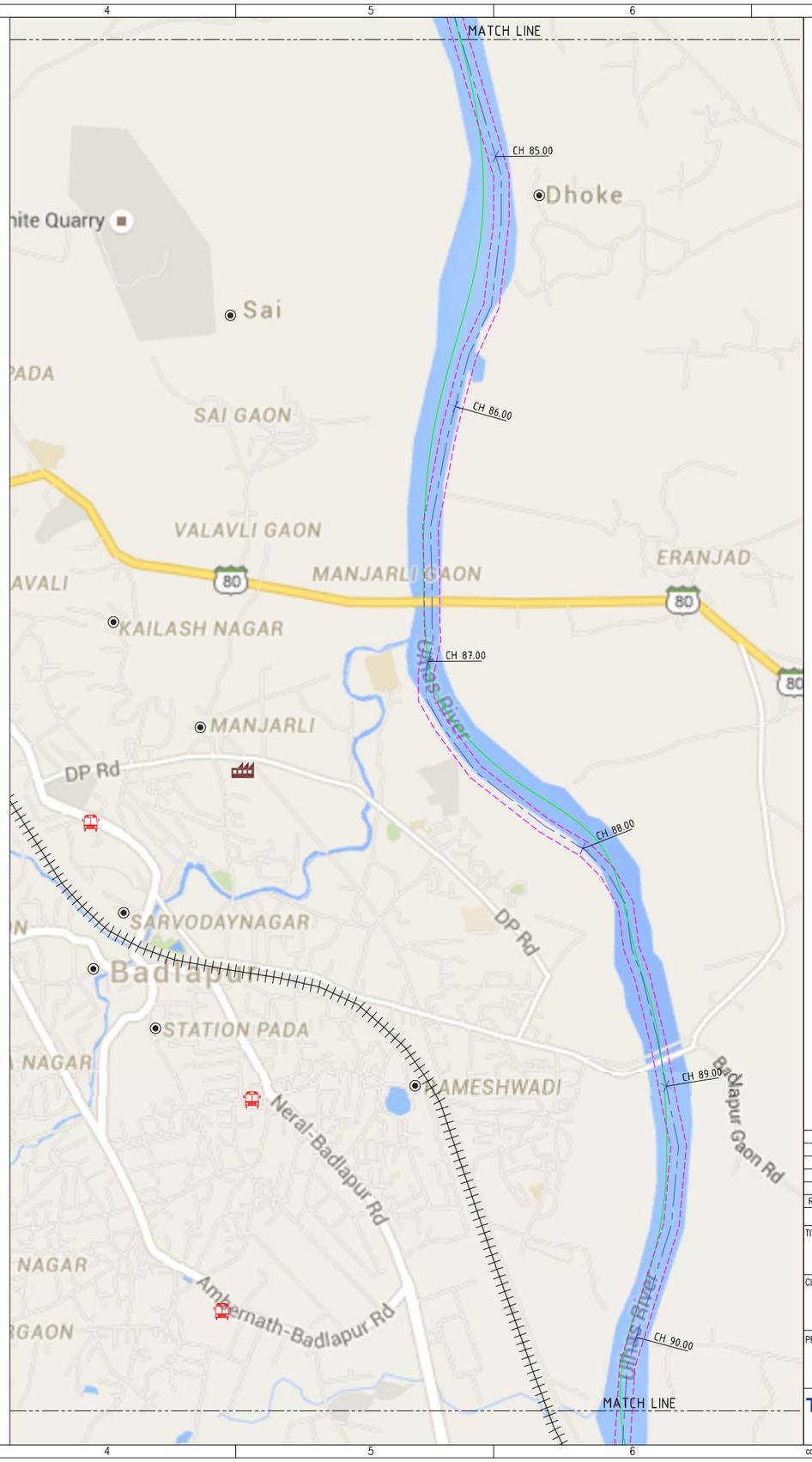
SIZE: A3 | SCALE: 1:20000 | SHEET: 20-24

TRACTEBEL Engineering
GDF SUEZ

DRAWING NUMBER
P.009051-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER





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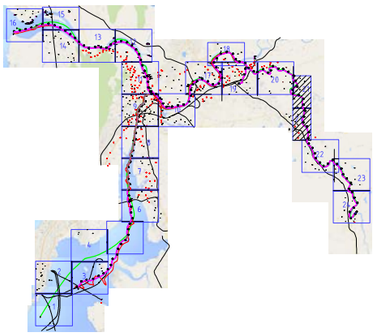

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
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	DREDGED CHANNEL / RIVER LENGTH
	RAILWAY LINE

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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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: 21–24

DRAWING NUMBER P.I.0.0.9.0.5.1.-W-2.0.2.0.1.-A.0.6 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER

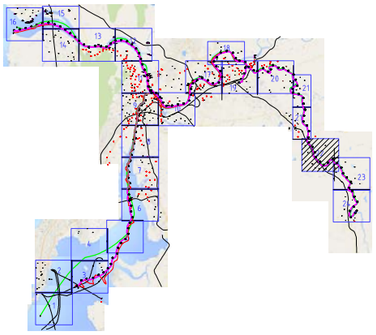
N
W E
S

MATCH LINE

CH 91.00
CH 92.00
CH 93.00
CH 94.00
CH 95.00
CH 96.00
CH 97.00
CH 98.00
CH 99.00

SUMMER VILLAGE
OVELI GAON
Sape
Kanhor
Jambhale
Chamtoli
hivali
Neral-Badlapur Rd
Ulhas River
Indgaon
Savare
Tan
Kasgaon
AMALNAGARI
Goregaon
Dhawalepada
Kudsavare
Savare Road
MATCH LINE
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/CREEK/SMALL RIVER
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PROPOSED WATERWAY LENGTH 145.0Km

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
KALYAN-THANE-MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

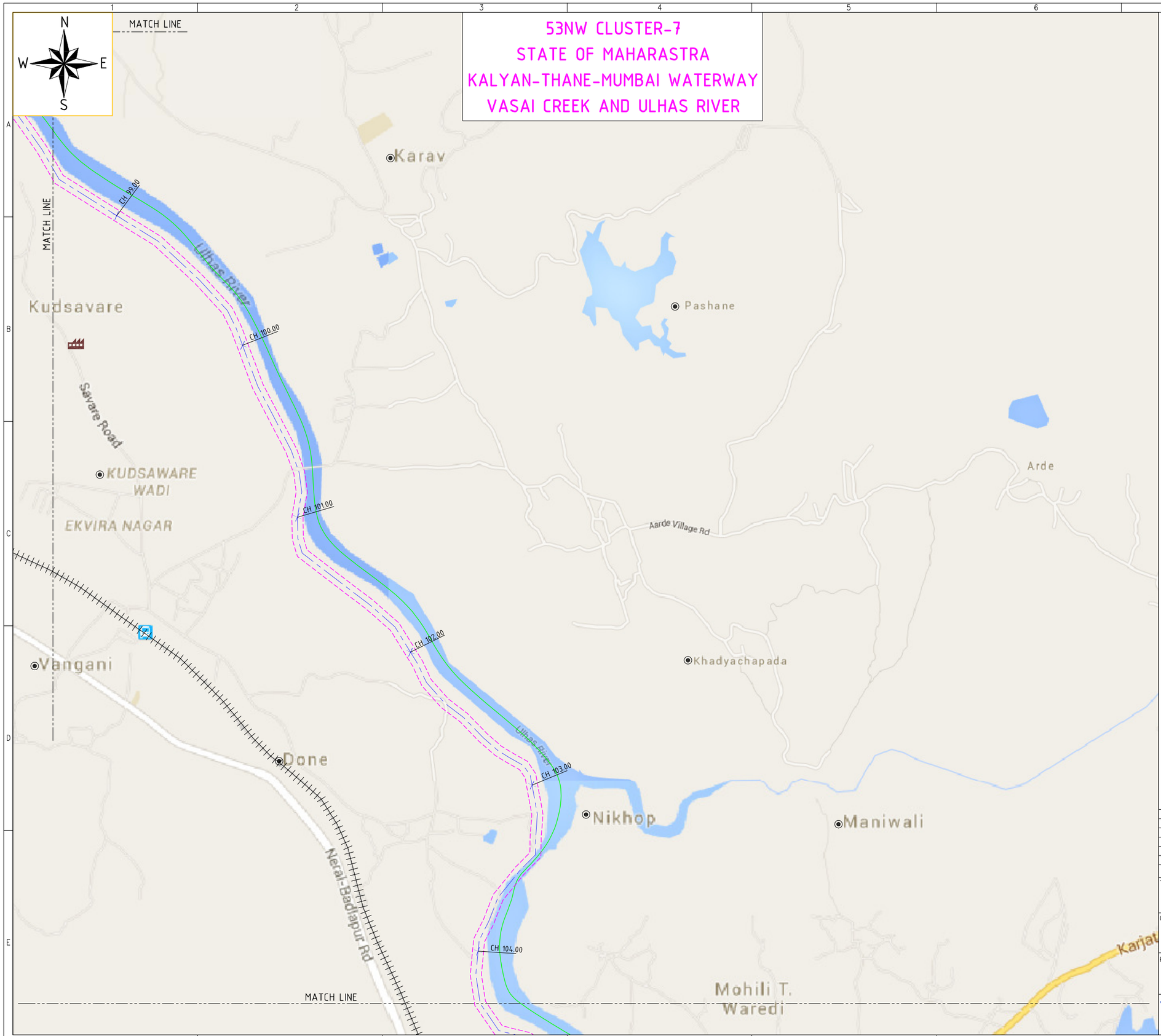
PROJECT NO. **P.009051**

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 22-24

DRAWING NUMBER
P.0090511-W-20201-A06 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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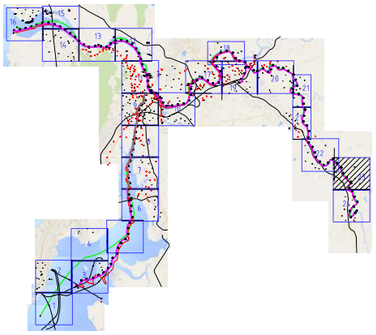

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
	ROAD BRIDGE
	NATIONAL HIGHWAY (Hwy)
	ROAD
	NALA/CREEK/SMALL RIVER
	FERRY LINE
	SURVEY (VESSEL TRACK)
	ROUTE PROVIDED BY IWAI
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PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 0.4 1.0KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

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TITLE
LAYOUT PLAN
KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER

CLIENT
INLAND WATERWAYS AUTHORITY 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

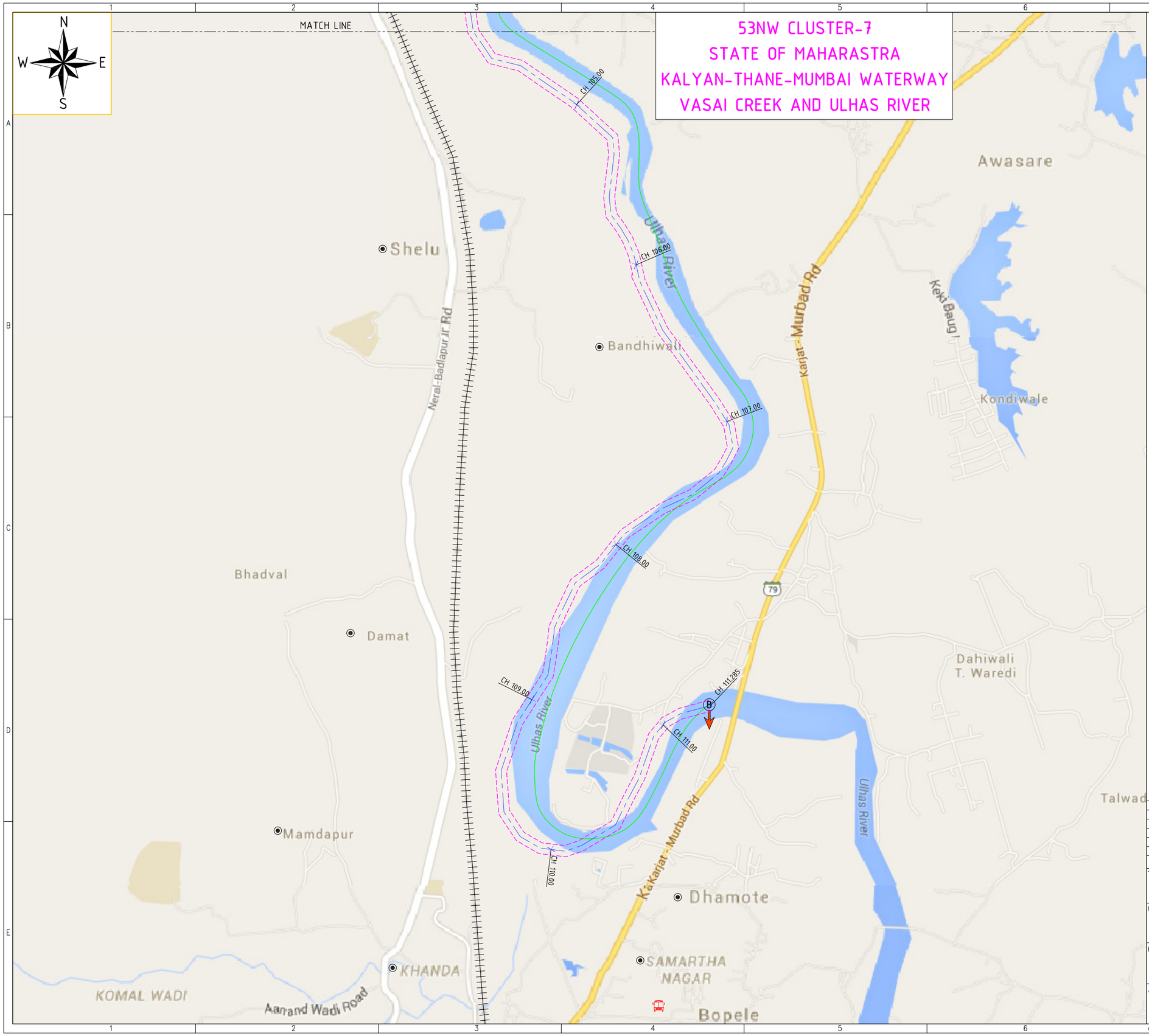
PROJECT NO. P.009051

TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 23–24

DRAWING NUMBER P.I.0.0.9.0.5.1.–W–2.0.2.0.1.–A.0.6 REV 0

53NW CLUSTER-7
STATE OF MAHARASTRA
KALYAN-THANE-MUMBAI WATERWAY
VASAI CREEK AND ULHAS RIVER



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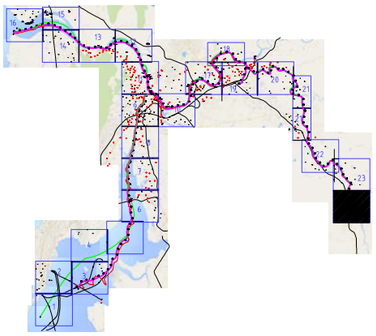

LEGEND

	BUS STOP
	HISTORICAL PLACE
	PORT
	INDUSTRY
	RAILWAY STATION
	PLACE NAME
	JETTY
	CHART DATUM
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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**

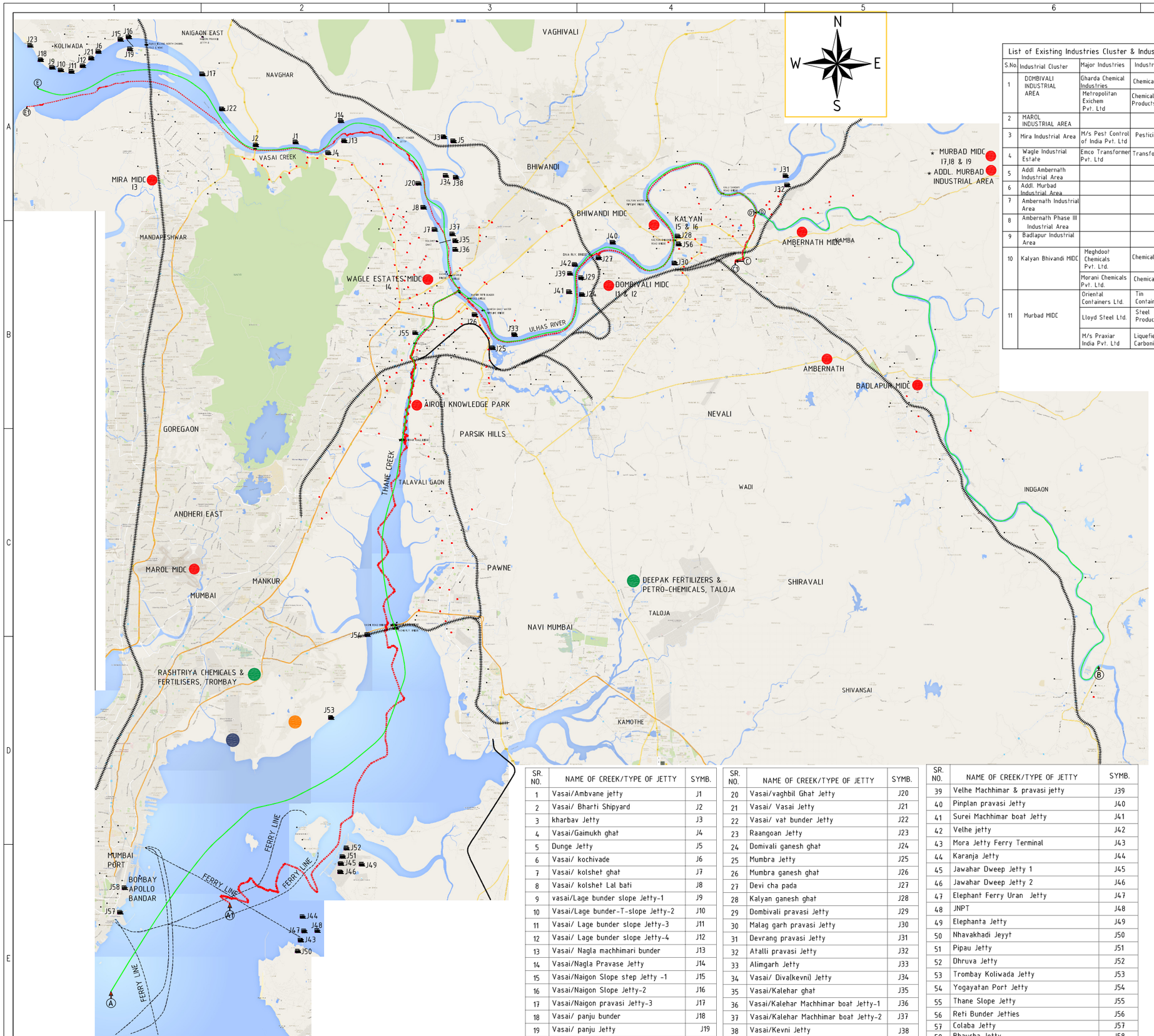
TRACTEBEL Engineering GDF SUEZ

SIZE: A3 | SCALE: 1:20000 | SHEET: 24–24

DRAWING NUMBER
P.009051-W-20201-A06 REV 0

MAPS

MAP 4.1 – LAYOUT MAP SHOWING EXISTING JETTIES AND INDUSTRIES IN VICINITY OF KALYAN-THANE-MUMBAI WATERWAY, VASAI CREEK AND ULHAS RIVER



List of Existing Industries Cluster & Industries				
S.No.	Industrial Cluster	Major Industries	Industries	SYMB
1	DOMBIVALI INDUSTRIAL AREA	Gharda Chemical Industries	Chemicals	I1
		Metropolitan Exichem Pvt. Ltd	Chemical Products	I2
2	MAROL INDUSTRIAL AREA			
3	Mira Industrial Area	M/s Pest Control of India Pvt. Ltd	Pesticides	I3
4	Wagle Industrial Estate	Emco Transformer Pvt. Ltd	Transformers	I4
5	Addl Ambernath Industrial Area			
6	Addl. Murbad Industrial Area			
7	Ambernath Industrial Area			
8	Ambernath Phase III Industrial Area			
9	Badlapur Industrial Area			
10	Kalyan Bhivandi MIDC	Meghdoot Chemicals Pvt. Ltd.	Chemicals	I5
		Morani Chemicals Pvt. Ltd.	Chemicals	I6
11	Murbad MIDC	Oriental Containers Ltd.	Tin Containers	I7
		Lloyd Steel Ltd.	Steel Products	I8
		M/s Praxiar India Pvt. Ltd	Liquefied Carbonic Gas	I9

MAP 4.1

LEGEND

- BUS STOP
- HISTORICAL PLACE
- PORT
- INDUSTRY
- RAILWAY STATION
- PLACE NAME
- JETTY
- CHART DATUM
- ROAD BRIDGE
- NATIONAL HIGHWAY (Hwy)
- ROAD
- NALA/CREEK/SMALL RIVER
- FERRY LINE
- ROUTE PROVIDED BY IWAI
- SURVEY (VESSEL TRACK)
- RAILWAY LINE
- INDUSTRIAL CLUSTERS
- FERTILISER PLANTS
- BPCL REFINERY
- HPCL REFINERY
- ★ TENTATIVE LOCATION

(A) POINT NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT.18°55'49.78",LONG.72°53'21.67"	(A1) POINT OF RECONNAISSANCE SURVEY NEAR SEA AT NAVI MUMBAI AS PROVIDED BY IWAI LAT. 18°55'51.46",LONG. 72°53'28.16"
(B) POINT NEAR MALEGAON T.WAREDI SH-76 AT LAT.19°02'38.20",LONG.73°19'53.79"	
(C) POINT AT BRIDGE KALYAN-BADLAPUR ROAD AT LAT.19°14'06.39",LONG.73°08'49.13"	(C1) POINT OF RECONNAISSANCE SURVEY BRIDGE KALYAN-BADLAPUR ROAD LAT.19°14'6.39",LONG. 73°08'49.13"
(D) END POINT AT KALYAN LAT. 19°15'35.03", LONG. 73°09'27.77"	(D1) POINT OF RECONNAISSANCE SURVEY AT KALYAN LAT.19°15'35.03",LONG. 73°09'27.77"
(E) POINT AT VASAI CREEK AT LAT. 19°15'35.03", LONG. 73°09'27.77"	(E1) POINT OF RECONNAISSANCE SURVEY AT VASAI CREEK LAT.19°18'42.59",LONG.72°47'27.92"
(F) POINT AT KASHELI AT LAT. 19°15'35.03", LONG. 73°09'27.77"	(F1) POINT OF RECONNAISSANCE SURVEY AT KASELI LAT.19°13'23.19", LONG. 73°00'27.70"

PROPOSED WATERWAY LENGTH 145.0Km

SCALE 0 4 10KM

BACKGROUND IMAGE REFERENCE FROM "GOOGLE MAP"

SR. NO.	NAME OF CREEK/TYPE OF JETTY	SYMB.
1	Vasai/Ambvane jetty	J1
2	Vasai/ Bharti Shipyard	J2
3	kharbav Jetty	J3
4	Vasai/Gaimukh ghat	J4
5	Dunge Jetty	J5
6	Vasai/ kochivade	J6
7	Vasai/ kolshet ghat	J7
8	Vasai/ kolshet Lal bati	J8
9	vasai/Lage bunder slope Jetty-1	J9
10	Vasai/Lage bunder-T-slope Jetty-2	J10
11	Vasai/ Lage bunder slope Jetty-3	J11
12	Vasai/ Lage bunder slope Jetty-4	J12
13	Vasai/ Nagla machhimari bunder	J13
14	Vasai/Nagla Pravase Jetty	J14
15	Vasai/Naigon Slope step Jetty -1	J15
16	Vasai/Naigon Slope Jetty-2	J16
17	Vasai/Naigon pravasi Jetty-3	J17
18	Vasai/ panju bunder	J18
19	Vasai/ panju Jetty	J19

SR. NO.	NAME OF CREEK/TYPE OF JETTY	SYMB.
20	Vasai/vaghbil Ghat Jetty	J20
21	Vasai/ Vasai Jetty	J21
22	Vasai/ vat bunder Jetty	J22
23	Raangoan Jetty	J23
24	Domivali ganesh ghat	J24
25	Mumbra Jetty	J25
26	Mumbra ganesh ghat	J26
27	Devi cha pada	J27
28	Kalyan ganesh ghat	J28
29	Dombivali pravasi Jetty	J29
30	Malag garh pravasi Jetty	J30
31	Devrang pravasi Jetty	J31
32	Atalli pravasi Jetty	J32
33	Alimgarh Jetty	J33
34	Vasai/ Diva(kevni) Jetty	J34
35	Vasai/Kalehar ghat	J35
36	Vasai/Kalehar Machhimar boat Jetty-1	J36
37	Vasai/Kalehar Machhimar boat Jetty-2	J37
38	Vasai/Kevni Jetty	J38

SR. NO.	NAME OF CREEK/TYPE OF JETTY	SYMB.
39	Velhe Machhimar & pravasi jetty	J39
40	Pinplan pravasi Jetty	J40
41	Surei Machhimar boat Jetty	J41
42	Velhe jetty	J42
43	Mora Jetty Ferry Terminal	J43
44	Karanja Jetty	J44
45	Jawahar Dweep Jetty 1	J45
46	Jawahar Dweep Jetty 2	J46
47	Elephant Ferry Uran Jetty	J47
48	JNPT	J48
49	Elephanta Jetty	J49
50	Nhavakhadi Jeyyt	J50
51	Pipau Jetty	J51
52	Dhruva Jetty	J52
53	Trombay Koliwada Jetty	J53
54	Yogayatan Port Jetty	J54
55	Thane Slope Jetty	J55
56	Reti Bunder Jetties	J56
57	Colaba Jetty	J57
58	Bhaucha Jetty	J58

TITLE: LAYOUT MAP SHOWING EXISTING JETTIES & INDUSTRIES IN VICINITY OF KALYAN–THANE–MUMBAI WATERWAY VASAI CREEK AND ULHAS RIVER (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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