INLAND WATERWAYS AUTHORITY OF INDIA, A-13, SECTOR-1, NOIDA
DIST-GAUTAM BUDHA NAGAR, UTTAR PRADESH, PIN- 201 301(UP)

"FINAL FEASIBILITY REPORT ON HYDROGRAPHIC SURVEY OF MAHANANDA RIVER (NW-65) (80.391KM)

STARTING "FROM BANGLADESH BORDER NEAR ADAMPUR TO BRIDGE NEAR GOSAIPUR

SURVEY PERIOD - 12.10.15 TO 25.10.15

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FINAL REPORT ON HYDROGRAPHIC SURVEY OF MAHANANDA RIVER, WEST BENGAL

REPORT SUBMISSION DATE- 29.03.2019

SUBMITTED BY:-

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Acknowledgement

B.S.Geotech PVT.Ltd, Konnagar, Hooghly express its sincere gratitude to **IWAI** for awarding the work and guidance for completing this Project of detailed Hydrographic Survey and the Feasibility Report in **Region-VIII (Mahananda River) from Bangladesh Border near Adampur to Bridge near Gosaipur (80.391km).**

We would like to use this opportunity to pen down our profound gratitude and appreciations to **Shri Jalaj Srivastava, IAS, Chairman, IWAI** for spending their valuable time and guidance for compleing this project of " Detailed Hydrography and Topography survey in Mahananda River." B.S.Geotech would also like to thanks **Shri Pravir Pandey, Vice-Chairman, IA&AS., Shri Shashi Bhushan Shukla, Member (Traffic), Shri Alok Ranjan, Member (Finance) and Shri S.K.Gangwar, Member (Technical).**

B.S.Geotech wishes to express their gratitude to **Capt. Ashish Arya, Hydrographic Chief, IWAI, Cdr. P.K. Srivastava, Ex. Hydrographic Chief, IWAI, Shri S.V.K Reddy, Chief Engineer-I, IWAI** for his guidance and inspiration for this project. B.S.Geotech would also like to thank **Shri Rajiv Singhal, S.H.S., IWAI** for invaluable support and suggestions provided throughout the survey period. B.S.Geotech is pleased to place on record our sincere thanks to other staff and officers of **IWAI** for their excellent support and co-operation throughout the survey period.

List of Abbreviations

CD	Chart Datum
DGPS	Differential Global Positioning Systems
ETS	Electronic Total Station
GPS	Global Positioning Systems
LBM	Local Bench Mark
MSL	Mean Sea Level
RL	Reference Level
SD	Sounding Datum
SBAS	Satellite-Based Augmentation System
TBC	Trimble Business Centre
FRP	Fiber Reinforced Plastic

Table 1- List of Abbreviations

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Salient Features of Mahananda River

Sl.	Particulars	Details
1.	Name of Consultant	B.S. Geotech PVT. LTD
2.	Region number & State(s)	Region -VIII, West Bengal
3.	a) Waterway name b) NW # c) Total Stretch and length of declared NW (from…. To….; total length) d) Survey Period (… to …)	a) Mahananda River b) NW-65 c) From Bangladesh Border near Adampur to Bridge near Gosaipur (80.391 km). d) 12th October, 2015 to 25th October, 2015
4.	Tidal & non tidal portions (from… to, length, average tidal variation)	There are no Tidal influence or portions found in this zone of River.
5.	LAD status (Least Available Depth) i) < 1.2 m (km) ii) 1.2 m to 1.4 m (km) iii) 1.5 m to 1.7 m (km) iv) 1.8 m to 2.0 m (km) v) > 2.0 m (km)	**Observed Depth**

Sub Stretch-1 (0.00-10.00 km)	Sub Stretch-2 (10.00-20.00 km)	Sub Stretch-3 (20.00 – 30.00 km)	Sub Stretch-4 (30.00-40.00 km)
3.2	4.4	3.1	4.90
1.4	0	1.2	1.2
1.5	1.5	1.6	0
1.8	2.0	2.0	1.8
2.1	2.1	2.1	2.1
Total-10.0	Total- 10.0	Total- 10.00	Total- 10.00

Sub Stretch-5 (40.00-50.00 km)	Sub Stretch-6 (50.00-60.00 km)	Sub Stretch-7 (60.00-70.00 km)	Sub Stretch-8 (70.00-80.391km)
4.9	6.5	4.9	3.491
1.2	1.3	1.4	1.3
0	0	1.6	1.5
1.8	0	0	1.8
2.1	2.2	2.1	2.3
Total- 10.0	Total- 10.0	Total- 10.0	Total- 10.391

Total (km)
35.391
9.0
7.7
11.2
17.1
Total=80.391 km

Sl.	Particulars	Details

LAD status
(Least Available Depth)

Reduced Depth

	Sub Stretch-1 (0.00-10.00 km)	Sub Stretch-2 (10.00-20.00 km)	Sub Stretch-3 (20.00 – 30.00 km)	Sub Stretch-4 (30.00-40.00 km)
i) < 1.2 m (km)	8.6	7.9	6.8	6.8
ii) 1.2 m to 1.4 m (km)	1.4	0	1.2	1.1
iii) 1.5 m to 1.7 m (km)	0	0	0	0
iv) 1.8 m to 2.0 m (km)	0	0	0	0
v) > 2.0 m (km)	0	2.1	2.0	2.1
	Total-10.0	Total-10.0	Total- 10.0	Total- 10.0

	Sub Stretch-5 (40.00-50.00 km)	Sub Stretch-6 (50.00-60.00 km)	Sub Stretch-7 (60.00-70.00 km)	Sub Stretch-8 (70.00-80.391 km)
i) < 1.2 m (km)	5.8	6.8	5.4	4.391
ii) 1.2 m to 1.4 m (km)	0.5	1.2	1.2	1.1
iii) 1.5 m to 1.7 m (km)	0	0	1.4	1.3
iv) 1.8 m to 2.0 m (km)	1.7	0	0	1.6
v) > 2.0 m (km)	2.0	2.0	2.0	2.0
	Total- 10.0	Total- 10.00	Total-10.0	Total-10.391

Total
52.491
7.7
2.7
3.3
14.2
Total=80.391 km

<table>
<tr><th>Sl.</th><th>Particulars</th><th>Details</th></tr>
<tr><td>6.</td><td>Cross structures
i) Dams, weirs, barrages etc (total number; with navigation locks or not)
ii) Bridges, Power cables etc [total number; range of horizontal and vertical clearances</td><td>i) There are no Dams, Barrages found in this zone of river.

ii) RCC Bridge- 4 (Four), Rail Bridge – 4 (Four)
iii) Under-Construction Bridge- 1 (one)

<table>
<tr><th>Clearance w.r.t . H.F.L</th><th>Min (m)</th><th>Max (m)</th></tr>
<tr><td>Horizontal Clearance (m)</td><td>14.49</td><td>52.39</td></tr>
<tr><td>Vertical Clearance w.r.t. H.F.L (m)</td><td>2.80</td><td>4.40</td></tr>
</table>

iv) Electric Lines-11 (Ten)

<table>
<tr><th>Clearance w.r.t . H.F.L</th><th>Min (m)</th><th>Max (m)</th></tr>
<tr><td>Horizontal Clearance (m)</td><td>113.267</td><td>300.90</td></tr>
<tr><td>Vertical Clearance w.r.t. H.F.L (m)</td><td>3.8</td><td>6.3</td></tr>
</table>
</td></tr>
<tr><td>7.</td><td>Slope</td><td>
<table>
<tr><th colspan="2">Reach</th><th>River Level Change (m)</th><th>Distance (km)</th><th>Slope (m/km)</th><th>Slope (cm/km)</th></tr>
<tr><th>From</th><th>To</th><th></th><th></th><th></th><th></th></tr>
<tr><td>0.00</td><td>10.00</td><td>0.302</td><td>10.00</td><td>0.030</td><td>3.0</td></tr>
<tr><td>10.01</td><td>20.00</td><td>1.293</td><td>9.99</td><td>0.129</td><td>12.9</td></tr>
<tr><td>20.01</td><td>30.00</td><td>0.058</td><td>9.99</td><td>0.006</td><td>0.6</td></tr>
<tr><td>30.01</td><td>40.00</td><td>0.115</td><td>9.99</td><td>0.012</td><td>1.2</td></tr>
<tr><td>40.01</td><td>50.00</td><td>0.279</td><td>9.99</td><td>0.028</td><td>2.8</td></tr>
<tr><td>50.01</td><td>60.00</td><td>1.878</td><td>9.99</td><td>0.188</td><td>18.8</td></tr>
<tr><td>60.01</td><td>70.00</td><td>0.438</td><td>9.99</td><td>0.044</td><td>4.4</td></tr>
<tr><td>70.01</td><td>80.391</td><td>1.118</td><td>10.381</td><td>0.108</td><td>10.8</td></tr>
<tr><td colspan="4">Avg Slope</td><td>0.068 m/km</td><td>6.812cm/km</td></tr>
</table>
</td></tr>
<tr><td>8.</td><td>Discharge Report</td><td>
<table>
<tr><th>Sl No.</th><th>Chainage (km)</th><th>Discharge (m3/sec)</th></tr>
<tr><td>1</td><td>1.881</td><td>290.398</td></tr>
<tr><td>2</td><td>10.186</td><td>111.846</td></tr>
<tr><td>3</td><td>19.788</td><td>89.977</td></tr>
<tr><td>4</td><td>30.146</td><td>105.864</td></tr>
<tr><td>5</td><td>38.154</td><td>128.664</td></tr>
<tr><td>6</td><td>49.994</td><td>93.049</td></tr>
<tr><td>7</td><td>60.887</td><td>148.416</td></tr>
<tr><td>8</td><td>71.921</td><td>103.904</td></tr>
<tr><td>9</td><td>80.384</td><td>98.614</td></tr>
</table>
</td></tr>
</table>

Sl.	Particulars	Details
9.	i) Present IWT operations ii) Ferry services, tourism, cargo, if any	As Follows As much as eight numbers of passenger ferry services are available in this zone of river near at Chainage of 4.430 km (Char Kadipur), Chainage -7.779 km (Sadar ferry ghat), Chainage- 12.212 km (Nimayasara), Chainage- 13.71 km (Itakhola), Chainage- 14.913 km (Nababganj), Chainage- 15.927km (Anandipur), Chainage- 16.970 km (Daupur) and Chainage-51.900 km (khanpur ferry ghat). Cargo is lightly available in all the ferry services except Itakhola, Daupur with light goods (jute, vegetables) and vehicle like cycle and motor cycles. Adina Mosque, Gour, Malda Museum, Eklakhi Mausoleum, Raiganj Bird sanctuary etc. historical and tourist places located in this zone of river.
10.	Approx Distance of Rail & Road from Industry	Nearest Railway stations are following: i) Malda Town Railway Station (0.91 km approx from the waterway) ii) Old Malda Jn. Railway Station (1.07 km approx from the waterway) iii) Mahananda Bridge Railway Station (close to the River) iv) Eklakhi Jn. Railway Station (3.02 km approx from the waterway) v) Adina Railway Station (4.30 km approx from the waterway) a) Food processing, Cold storage, agro farming, and fishery are the major industrial activities in this region. (Close to Malda town) b) Sukjit Starch Industries producing Starch Glucose (2.00 km approx from old Malda) c) Indian Oil Corporation - L.P.G. Bottling plant (approximately1.35 km from old Malda) d) Matri Water Product Pvt. Ltd producing Packaged Drinking Water (0.25 km approx from Mission ghat) e) Milap Rim Industry producing Cycle Rim (2.30 km approx from old Malda) Name of National highway close to the River- NH- 34(0.91 km approx from old Malda Railway station), NH-81(2.00 km approx from the waterway) Name of SH- SH-10 (0.20 km approx from NH-34)
11.	Any other information/ comment	Recommend for Detailed project Report for IWT operations and the development of the waterways. The condition of the waterway is very good and also connected with NH-34 and Old Malda to Malda town Rail way connectivity. As much as eight numbers of passenger ferry services are available in this zone with light goods and vehicles in this zone of the river. Kolkata to Malda connectivity through National Highway 34 which connects Malda to Kolkata city as well as districts like North 24 Parganas, Nadia, Murshidabad, Uttar Dinajpur etc.

Section-1: Introductory Considerations

1.1 River Course: Background information, Historical Information, Origin, End:-

The Mahananda originates from the Himalayas Paglajhora Falls on Mahaladiram hill near Chimli, east of Kurseong in Darjeeling district at an elevation of 2,100 metres (6,900 ft). Rising from near Mahaldhiram of the Ghum range of the Darjeeling district, Mahananda river flows southward through the North Bengal. Mahananda is the longest river in North Bengal. But it flows to a considerable length through the State of Bihar. The river is fairly deep and navigable. It receives on its left bank tributaries such as the Nagar, the Tangan and the Punarbhaba, and on its right bank the Kalindi, Balasan and Mechi.

Mahananda is a typical river system consisting of two different streams, one arising from mountainous region of Himalayas in Nepal traverses through the Indian state of Bihar and out falls in the Ganga in left opposite to Rajmahal in Bihar and is locally named as river Fulahar. The other stream also named as Mahananda rises in downhill in Darjeeling in West Bengal and traverses a distance of about 400 kms. Through the district of Darjeeling, West Dinajpur and Malda, the river enters in Bangladesh territory and ultimately out falls in the Ganga near Godagarighat in Bangladesh just opposite to Lalgola in Murshidabad district of West Bengal. The right channel flow through the state of Bihar in the name of Fulahar. The left channel flow through the district of West Dinajpur and Malda and enters in Bangladesh in the name of Mahananda.

Both the rivers received snow melt in small quantities during non-monsoon month and receive heavy amount of water from the monsoon rains.

Both the streams receive good amount of water from the various tributaries. The average rainfall in the region is about 1400 mm. and 80% of the Annual rain occurs during 4 to 5 months. The catchment area of these two rivers stretched over sub-Himalayan region of Nepal and West Bengal, is the second highest rainfall region in India. As both the streams run very close to each other in sub-Himalayan plains which combine into single river during Peak monsoon months and inundate a huge land area in Bihar and West Bengal. The inundation takes devastating shape particularly when the main stream Ganga is at her Peak when further drainage of water becomes impossible due to obvious reason. A vast area of Bihar and West Bengal get water logged by the pool of water formed by conjunct mass of undischarged water of these two streams of Mahananda. The affected districts are Purnea and Katihar in Bihar and Darjeeling, West Dinajpur and Malda district in west Bengal.

It enters Bangladesh near Tentulia in Panchagarh District, flows for 3 kilometres (1.9 mi) after Tentulia and returns to India. After flowing through Uttar Dinajpur district in West Bengal and Kishanganj and katihar district in Bihar, it enters Malda district in West Bengal. The Mahananda divides the district into two regions — the eastern region, consisting mainly of old alluvial and relatively infertile soil is commonly known as Barind (Borendrovomee), and the western region, which is further subdivided by the river Kalindi into two areas, the northern area is known as "Tal." It is low lying and vulnerable to inundation during rainy season; the southern area consists of very fertile land and is thickly populated, being commonly known as "Diara".

1.2 - Tributaries / Network of River/ Basin:-

The left bank tributaries of Mahananda River are Nagar, Tangan, Punarbhaba and the right bank tributaries of this river are Kalindi, Balasan and Mechi.

1.3 - State / District through which river passes:-

The River Mahananda passes through the district of Uttar Dinajpur in the states of west Bengal, Kisanganj and Katihar district in the states of Bihar and Malda district in the states of west Bengal.

1.4 – Project Site Location Map:-

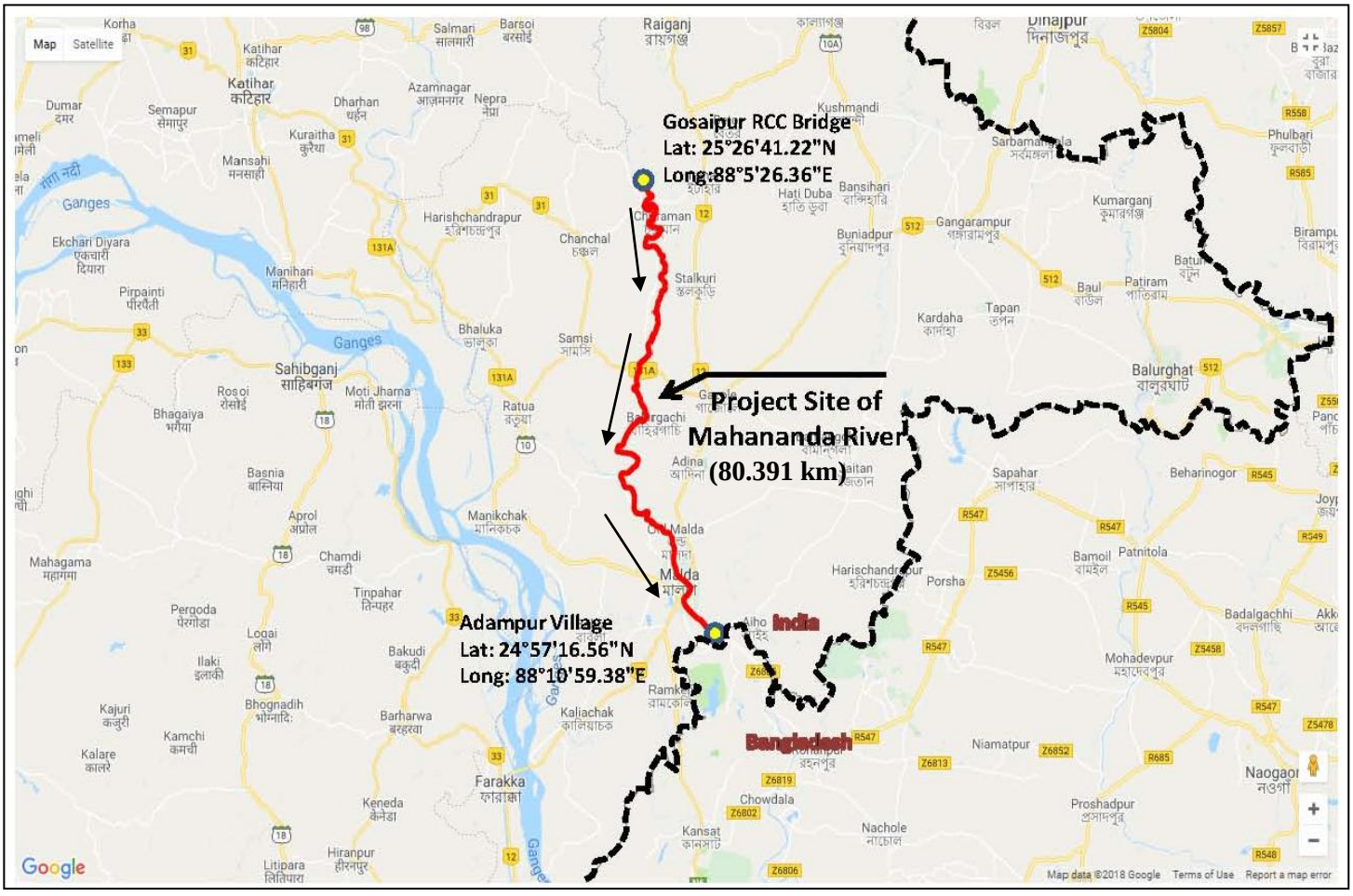


Figure 1 - Project Site Location Map

1.5 - Scope of work:-

The Scope of work shall cover all technical aspects of hydrographic survey at par with International Standards including the following for development of the river/canal for inland navigation.

The detailed hydrographic survey is to be carried out by using Automated Hydrographic Survey System (using digital Echo sounder for depth measurement, DGPS Beacons Receivers for position fixing and Hypackmax or equivalent software for data logging). The survey is to be conducted in WGS‟84 datum.

- Detailed Hydrographic Survey to assess the navigability of the waterway.
- To collect Water and bottom samples, current meter observation and discharge from the deepest route at every 10 km interval.
- To identify cross structures which are obstructing navigation
- To identify the length of bank protection required.
- The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.
- The pillar extends 60.cms above ground level. Inscription "IWAI", "B.S. Geotech" and BM No. can be seen on the face of the pillar.

Section-2: Methodology Adopted to undertake Study

2.1 - Methodology Adopted including Resources and equipment used and calibration: -

Equipment:-

Following equipments are employed for the Bathymetric and Topographic survey:-

Equipment	Make	Version	Qty Employed
Echo sounder	Bathy MF 500	……	1
Current Meter	AEM 213-D	……	1
Tide Gauge	Manual (Pole type)	----------	4
RTK	South S86T	----------	3
GPS Sets	Trimble –Becon Receiver SPS 361	----------	1
Software	HYPACK data acquisition	Version 14	1
Software	AUTOCAD	2013	1
Software	Microsoft Office	2013	1

Table 2 - Equipments

- **Conduct of survey work**

- **Topographic Survey:-**

The Topography survey of Mahananda river has been carried out from "Bangladesh Border near Adampur (Lat: - 24°57'16.56"N, Long: - 88°10'59.38"E) to Bridge near Gosaipur (Lat: - 25°26'41.22"N, Long: - 88°5'26.36"E).

The Topographic survey has been conducted to ascertain following in the survey area:-

- Spot levels
- High bank Line
- Vegetation covered
- Bridges and permanent structures
- Road, culvert and other communication network

GPS RTK (Real Time Kinematic) satellite navigation is a technique used in land survey and in hydrographic survey based on the use of carrier phase measurements of the GPS, GLONASS and / or Galileo signals where a single reference station provides the real-time corrections, providing up to centimeter-level accuracy. When referring to GPS in particular, the system is also commonly referred to as Carrier-Phase Enhancement, CPGPS. RTK systems use a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. There are several ways to transmit a correction signal from base station to mobile station. The most popular way to achieve real-time, low-cost signal transmission is to use a radio modem, typically in the UHF band. This allows the units to calculate their relative position to millimeters, although their absolute position is accurate only to the same accuracy as the position of the base station.

- **Establishment of Horizontal Control:-**

The Horizontal control for Topography survey: - High precision RTK DGPS in fix mode is using UHF Radio Modem with IHO accuracy standards, with minimum 24 hours observations at some permanent platform/base with Topographic survey Equipments like South (S86T) GNSS RTK, Total Station was used for conducting the topographic survey on UTM Projection at Zone 45 N as directed in the contract specifications.
The Horizontal control for Bathymetry survey: - DGPS is receiving corrections from Beacons from the Base station.

- **Establishment of Vertical Control:-**

Vertical control from the Irrigation Gauge and waterways department, Englishbazar, Malda is used for the entire survey work. Its value is 18.00 meter w.r.t. M.S.L has been considered for calculating the vertical levels. Total 9 no. BM was established along the 80.391 km Mahananda River with the reference of Irrigation Gauge level which is situated near the English Bazar area, Malda.

Topography Survey:-

The survey was commenced on 12th October, 2015 and completed on 25th October, 2015. Then the days were Autumn season and arrival of winter season. The climate become normal which reached about 26◦ C. Mostly day weather was sunny and was very favorable for the conduct of survey and the weather condition remains same for the entire duration of the survey.

The survey was undertaken as per the line plan provided and the spot level points in the cross line were spaced at 40 m interval. The plotting of the chart was done on UTM Projection at Zone 45 N as directed in the contract specifications. The spot levels along the river were obtained by using Trimble DGPS. The data was post processed using Trimble Business Center to get the precise position and MSL height values of the rover locations.

Figure 2- During the Topography survey

Bathymetry Survey:-

Bathy 500 MF was used to obtain soundings onboard the survey boat. A working frequency of 210 KHz was used for sounding operations. The digital output from the echo sounder was automatically fed to the HYPACK data logging software on a real-time basis for the acquisition of survey data. No breakdown of equipment was reported and the performance of the equipment was found to be satisfactory during the entire duration of the survey.

The sound velocity was set to 1470 m/s on single beam echo sounder during acquisition by bar check procedure method. The Daily bar checks were done prior to the sounding operation and before the closing of the sounding operation for the day. Being very shallow depths, the echo sounder depths were also cross-checked in between by using demarcated sounding poles during the conduct of the survey. The sounding lines were run using Survey boat to identify the design line of the Mahananda River for the possible stretch. The cross lines were run perpendicular to the orientation of river flow (i.e. perpendicular to the orientation of depth contours) in respective stretches. The spot sounding was also carried out in the area where the survey boat cannot be operated due to low depth. The hemisphere DGPS and Sounding Pole were used for Spot sounding at shallow locations in the Mahananda River. The DGPS position along with water depths was recorded simultaneously and the tidal reduction was applied to the obtained depths.

Bathy- 500MF Echo sounder: The Bathy- 500MF Echo Sounder is an electronic hydrographic survey instrument used for measuring depths with precision chart recordings and digital data output manufactured by Syqwest Incorporated, USA. The Bathy-500 echo sounding systems are based on the principle that when a sound signal is sent into the water it will be reflected back when it strikes an object. The Bathy-500 is technologically sophisticated, utilizing modern, micro processor based electronics and a thermal chart recorder mechanism. Digital processing enables the instrument to offer fully automatic digitizing capabilities. When interfaced to a NMEA 0183 compatible position sensor, it provides user with a complete, integrated hydrographic survey environment. The instrument front panel consists of a high contrast, backlit four line LCD displays and a fully sealed input keypad. The front panel encompassing system data, status and setup parameters with RS232/RS422 output format. All operating functions are set via the front panel interface. Setup selections are stored within internal, non-volatile memory for instant availability upon power-up. The instrument decodes and processes the NMEA 0183 formatted sentence GGA or GLL from GPS/DGPS using variable Baud rates for communication.

Figure 3- During the Bathymetry Survey

2.2 - Description of Bench Marks (B.M) / authentic Reference Level used:-

For Topographic survey, the Horizontal control has been carried out from the Gauge level of Irrigation and waterways Directorate office (Chainage-5.310 km) which is situated near the English Bazaar area, Malda. The value of the Gauge is:-

	Geographic position		UTM position		
Location Name	**Latitude (N)**	**Longitude (E)**	**Northing (m)**	**Easting (m)**	**Elevation (m)**
English Bazar, Malda	24°59'10.00"	88° 8'51.54"	2763900.893	615827.616	18.00 m. w.r.t M.S.L

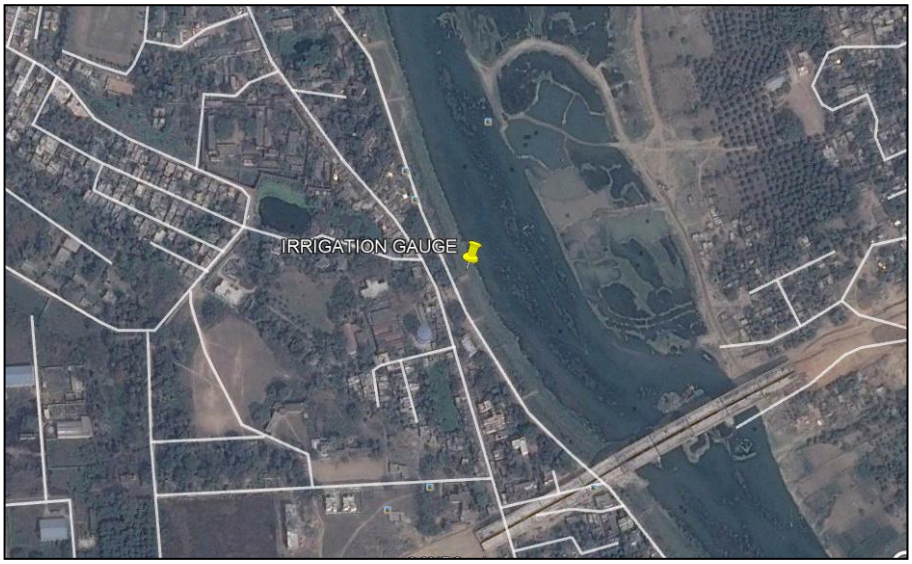


Figure 4- Irrigation Gauge position of Mahananda River near English Bazaar (Chainage-5.310 km)

Figure 5-Irrigation & waterways director office, Malda (Chainage-5.310 km)

2.3 - Tidal Influence Zone and tidal variation in different stretches:-

There are no Tidal influences or effects found in this zone of river.

2.4 -Transfer of Sounding Datum table for Tidal Rivers:-

There are no Tidal influences or effects found in this zone of river.

2.5 –Table indicating tidal variation at different observation points (say at every 10 KM):-

There are no Tidal influences or effects found in this zone of river.

2.6 - Salient features of Dam, Barrages, Weirs, Anicut, Locks and Aqueducts etc.:-

There is no Dam, Barrage, weirs, Anicut, Lock and Aquaduct found in this zone of river.

2.7- Description of erected Bench mark Pillars:-

Sl. No	BM No	Location	Chainage (km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	BM Height above M.S.L (m)	BM Height above S.D (m)
1	BM 1	Azmatpur	1.881	24°58'7.435"	88°10'24.489"	618449.741	2761997.564	24.812	15.240
2	BM 2	Barrack Colony	10.186	25°1'15.684"	88°8'6.349"	614527.65	2767755.505	22.536	12.954
3	BM 3	Chhotapara	19.788	25°5'18.202"	88°5'58.821"	610892.517	2775186.307	24.454	13.290
4	BM 4	Elahabad	30.146	25°8'36.592"	88°5'7.58"	609407.986	2781277.581	26.053	14.819
5	BM 5	Near Mahananda Bridge	38.154	25°11'1.521"	88°5'0.877"	609180.963	2786165.068	29.813	18.472
6	BM 6	Harirampur	49.994	25°15'56.933"	88°6'5.162"	610909.422	2794836.614	25.638	14.011
7	BM 7	Janipur	60.887	25°21'2.822"	88°6'7.928"	612240.155	2804247.200	26.334	12.829
8	BM 8	Kobaia	71.921	25°24'22.882"	88°6'1.631"	610682.705	2810400.286	26.337	12.394
9	BM 9	Tarapur	80.384	25°26'37.507"	88°5'25.471"	609638.531	2814533.493	26.354	11.293

Table 3 - Bench Mark Details

2.8- Description of erected Tide Gauges:-

Tide Gauge No	Chainage (km)	Location	Easting (m)	Northing (m)	Latitude (N)	Longitude (E)	W.L w.r.t MSL (m)	Period of observation
GS-(TP)-1	2.027	Raipur	618129.96	2761939.1	24°58'05.624"	88°10'13.068"	11.080	24 hrs
GS-(TP)-2	10.193	Barrack Colony	614606.43	2767842.6	25°01'18.493"	88°08'09.185"	12.389	24 hrs
GS-(TP)-3	19.758	Chhotapara	610888.75	2775184.3	25°05'18.136"	88°05'58.686"	13.670	24 hrs
GS-(TP)-4	20.014	Laksmi kandar	610807.17	2775326.6	25°05'22.784"	88°05'55.816"	13.682	24 hrs
GS-(TP)-5	30.115	Elahabad	609398.59	2781260.9	25°08'36.053"	88°05'07.24"	13.740	24 hrs
GS-(TP)-6	38.229	Maharajpur	609180.71	2786139	25°11'14.673"	88°05'00.86"	13.855	24 hrs
GS-(TP)-7	49.994	Harirampur	610870.72	2794848.8	25°15'57.34"	88°06'03.782"	14.134	24 hrs
GS-(TP)-8	60.908	Janipur	612325.15	2804210.2	25°21'01.235"	88°06'58.559"	16.012	24 hrs
GS-(TP)-9	60.985	Janipur	612378.45	2804255.7	25°21'02.699"	88°07'00.479"	16.102	24 hrs
GS-(TP)-10	71.927	Kobaia	610657.43	2810406.6	25°24'23.094"	88°06'00.728"	16.450	24 hrs
GS-(TP)-11	80.391	Madhavpur	609595.41	2814593	25°26'39.454"	88°05'23.945"	17.568	24 hrs

Table 4- Tide Gauge Details

2.9- Chart Datum / Sounding Datum and Reductions details:-

Sl no	CWC gauge / Dam / Barrage / Weir / Anicut / Bench Mark / tide gauges	Chainage (km)	Stretch for corrected soundings and topo levels (km)	Established Sounding Datum w.r.t. MSL (m) at col. A.	Sounding Datum of Tide Gauge w.r.t. MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data to be converted as depth for volume calculation w.r.t. SD (m)
	A	B	C (50% stretch is to be selected on both side of tide gauge)	D	E	F = (E- WL data in MSL)	G = (E- topo levels in MSL)
1	GS-(TP)-1	2.027	0.00-2.5		9.58	-1.5	Mahananda Reduced Topo.xyz
2	GS-(TP)-2	10.193	2.5-14.98		9.882	-2.507	
3	GS-(TP)-3	19.758	14.98-19.89		11.163	-2.507	
4	GS-(TP)-4	20.014	19.89-25.06		11.175	-2.507	**Submitted in Soft Copy**
5	GS-(TP)-5	30.115	25.06-34.17		11.233	-2.507	
6	GS-(TP)-6	38.229	34.17-44.11		11.348	-2.507	
7	GS-(TP)-7	49.994	44.11-55.45		11.627	-2.507	
8	GS-(TP)-8	60.908	55.45-60.95		13.505	-2.507	
9	GS-(TP)-9	60.985	60.95-66.46		13.595	-2.507	
10	GS-(TP)-10	71.927	66.46-76.16		13.943	-2.507	
11	GS-(TP)-11	80.391	76.16-80.391		15.061	-2.507	

Table 5 - Chart Datum / Sounding Datum & Reduction Details

2.10- High Flood Level (H.F.L) at known Gauge Stations:-

Sl no	Location and description of CWC gauge / Dam / Barrages / Weirs / Anicut / Locks / Aqueducts / BM	Cross-structure details	Chainage (km)	Established HFL / MHWS / FSL / MWL / FRL w.r.t. MSL (m)	Computed HFL at Cross-Structures w.r.t. MSL (m)
1	Maharajpur	Mahananda Railway Bridge	38.134	24.950	
2	Maharajpur	Mahananda Railway Bridge	38.151	25.180	
3	Maharajpur	Madhavpur Ghat RCC Bridge	80.00	33.590	

Table 6- H.F.L Details

2.11 - Average Slope:-

Reach (km)		River Level Change (m)	Distance (km)	Slope (m/km)	Slope (cm/km)
From	To				
0.00	10.00	0.302	10.00	0.030	3.0
10.01	20.00	1.293	9.99	0.129	12.9
20.01	30.00	0.058	9.99	0.006	0.6
30.01	40.00	0.115	9.99	0.012	1.2
40.01	50.00	0.279	9.99	0.028	2.8
50.01	60.00	1.878	9.99	0.188	18.8
60.01	70.00	0.438	9.99	0.044	4.4
70.01	80.391	1.118	10.381	0.108	10.8
Avg. Slope				0.0681m/km	6.812cm/km

Table 7 - Average slope

2.12 - Details of Dam, Barrages, Weirs, Anicut, etc. w.r.t. MSL:-

There is no Dam, Barrages etc. found in this zone of river.

2.13 - Details of Locks:-

There are no locks found in this zone of river.

2.14 - Details of Aqueducts:-

There are no aqueducts found in this zone of River.

2.15- Details of existing Bridges and Crossings over waterway:-

There are four no's of RCC bridges and four no's of Rail Bridges found in this zone of river.

Sl. No	Chainage (km)	Location	Cross-Structure details	Latitude (N)	Longitude (E)	Northing (m)	Easting (m)	Length (m)	Width (m)	No of Piers	Horizontal Clearance (m)	Vertical Clearance w.r.t H.F.L (m)	Present Condition
1	6.532	Sahapur	Sahapur Mahananda setu RCC Bridge	24°59'51.59"	88° 9'7.12"	2765183.033	616253.635	396.81	11.11	8	38.18	3.70	Complete
2	9.135	Malda	Old Malda RCC Bridge	25° 0'51.05"	88° 8'37.56"	2767005.123	615409.038	284.35	10.92	6	45.51	3.90	Complete
3	11.927	Nima Sarai	Rail Bridge	25° 2'13.51"	88° 8'0.22"	2769533.672	614341.449	385.49	5.69	7	45.36	2.80	Complete
4	11.952	Nima Sarai	Rail Bridge	25° 2'14.57"	88° 8'1.73"	2769566.229	614383.225	387.81	5.77	7	52.39	3.20	Complete
5	38.134	Maharajpur	Rail Bridge	25°11'13.24"	88° 5'1.75"	2786095.351	609206.809	164.86	5.52	4	29.23	2.90	Complete
6	38.151	Maharajpur	Rail Bridge	25°11'13.59"	88° 5'2.58"	2786106.745	609229.035	163.24	7.86	4	28.93	3.50	Complete
7	47.130	Sultanpur	Sultanpur RCC Bridge	25°14'45.59"	88° 5'21.22"	2792632.988	609698.865	198.71	11.09	3	34.57	4.40	Complete
8	80.391	Madhavpur	Madhavpur Ghat RCC Bridge	25°26'40.90"	88° 5'26.09"	2814638.313	609655.583	296.02	10.00	19	14.49	3.10	Complete

Table 8 - Bridge Details

2.16 - Details of other Cross structures, pipe-lines, under water cables:-

There is an under construction concrete bridge found in this zone of river.

Sl. No	Chainage	Location	Cross-Structure details	Latitude (N)	Longitude (E)	Northing (m)	Easting (m)	Length (m)	Width (m)	No of Piers	Horizontal Clearance (m)	Vertical Clearance w.r.t H.F.L (m)	Present Condition
1	5.21	Char Kadirpur	Under-construction concrete Bridge	24°59'3.59"	88° 9'1.36"	2763705.5	616104.6	200.01	22.13	4	46.19	3.51	Under-Construction

Table 9- Under construction concrete bridge details

2.17 - High Tension Lines / Electric lines / Tele-communication lines:-

Sl. no	Line	Chainage (km)	Location	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Horizontal clearance (m)	Vertical clearance w.r.t H.F.L (m)	Remarks
1	Electric line	11.872	Bachamari Govt.Colony	23°2'10.875"	88°7'55.177"	614200.325	2769450.674	300.90	6.3	Complete
2	Electric line	11.988	Bachamari Govt.Colony	23°2'14.673"	88°7'55.569"	614210.314	2769567.590	271.02	6.2	Complete
3	Electric line	13.181	Old Malda	25°2'53.533"	88°7'58.998"	614296.424	2770763.806	241.39	5.75	Complete
4	Electric line	13.406	Old Malda	25°2'59.612"	88°7'56.616"	614228.100	2770950.260	242.07	5.7	Complete
5	Electric line	16.376	Kadamtali	25°4'10.435"	88°7'10.435"	612915.354	2773189.934	182.91	5.5	Complete
6	Electric line	17.634	Jot Basanta	25°4'35.265"	88°6'35.264"	611927.061	2773873.864	259.036	5.2	Complete
7	Electric line	17.768	Jot Basanta	25°4'31.654"	88°6'26.654"	611683.983	2773756.293	198.57	4.8	Complete
8	Electric line	17.853	Jot Basanta	25°4'32.463"	88°6'23.764"	611602.766	2773784.981	259.18	5.1	Complete
9	Electric line	18.358	Mahish Bathani	25°4'42.987"	88°6'10.192"	611219.888	2774105.611	260.12	4.9	Complete
10	Electric line	53.061	Khanpur	25°17'28.325"	88°6'36.131"	611752.484	2797655.207	195.24	3.9	Complete
11	Electric line	57.511	Chandrapara	25°19'37.274"	88°6'56.167"	612279.812	2801626.730	113.267	3.8	Complete

Table 10- Electric line Details

2.18 - Current Meter and Discharge details:-

Stretch No.	Chainage (km)	Position				Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (Sq. m.)	Discharge (m3/sec)
		Latitude (N)	Longitude (E)	Easting (m)	Northing (m)		0.5 D			
1	1.881	24°58'00.789"	88°10'18.793"	618291.806	2761791.724	1.8	0.651	0.651	446.08	290.398
2	10.186	25°01'17.682"	88°08'13.818"	614736.497	2767818.714	2.7	0.751	0.751	148.93	111.846
3	19.788	25°05'18.024"	88°06'01.807"	610976.188	2775181.515	4.4	0.865	0.865	104.02	89.977
4	30.146	25°08'35.503"	88°05'10.427"	609487.976	2781244.705	4.7	0.920	0.920	115.07	105.864
5	38.154	25°11'13.42"	88°05'02.119"	609216.260	2786100.709	9.5	1.231	1.231	104.52	128.664
6	49.994	25°15'57.211"	88°06'06.769"	610954.326	2794845.517	5.5	0.863	0.863	107.82	93.049
7	60.887	25°21'00.95"	88°07'00.974"	612392.713	2804201.954	6.5	1.123	1.123	132.16	148.416
8	71.921	25°24'22.957"	88°06'04.142"	610752.854	2810403.166	4.6	0.912	0.912	113.93	103.904
9	80.384	25°26'40.996"	88°05'26.469"	609665.518	2814641.067	2.7	0.751	0.751	131.31	98.614

Table 11 - Current Meter Details

2.19 - (a) Soil Sample Locations:-

Sample No.	Chainage (km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Depth (m)
1	1.881	24°58'00.789"	88°10'18.793"	618291.806	2761791.724	1.8
2	10.186	25°01'17.682"	88°08'13.818"	614736.497	2767818.714	2.7
3	19.788	25°05'18.024"	88°06'01.807"	610976.188	2775181.515	4.4
4	30.146	25°08'35.503"	88°05'10.427"	609487.976	2781244.705	4.7
5	38.154	25°11'13.42"	88°05'02.119"	609216.260	2786100.709	9.5
6	49.994	25°15'57.211"	88°06'06.769"	610954.326	2794845.517	5.5
7	60.887	25°21'00.95"	88°07'00.974"	612392.713	2804201.954	6.5
8	71.921	25°24'22.957"	88°06'04.142"	610752.854	2810403.166	4.6
9	80.384	25°26'40.996"	88°05'26.469"	609665.518	2814641.067	2.7

Table 12 - Soil Sample Locations

Note: - The Soil Sample Reports have been shown in Annexure no-11, page no-97

(b) Water Sample Locations:-

Sample No.	Chainage (km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Total Depth (d) (m)	Mid-Depth (0.5d) (m)
1	1.881	24°58'00.789"	88°10'18.793"	618291.806	2761791.724	1.8	0.9
2	10.186	25°01'17.682"	88°08'13.818"	614736.497	2767818.714	2.7	1.35
3	19.788	25°05'18.024"	88°06'01.807"	610976.188	2775181.515	4.4	2.2
4	30.146	25°08'35.503"	88°05'10.427"	609487.976	2781244.705	4.7	2.35
5	38.154	25°11'13.42"	88°05'02.119"	609216.260	2786100.709	9.5	4.75
6	49.994	25°15'57.211"	88°06'06.769"	610954.326	2794845.517	5.5	2.75
7	60.887	25°21'00.95"	88°07'00.974"	612392.713	2804201.954	6.5	3.25
8	71.921	25°24'22.957"	88°06'04.142"	610752.854	2810403.166	4.6	2.3
9	80.384	25°26'40.996"	88°05'26.469"	609665.518	2814641.067	2.7	1.35

Table 13 - Water Sample Locations

Note: - The Water Sample Reports have been shown in Annexure no-12, page no-107

Section-3: Description of waterway

3.1- From Chainage 0.00 Km to Chainage 10.00 Km. (Adampur village to Mangalbari village):-

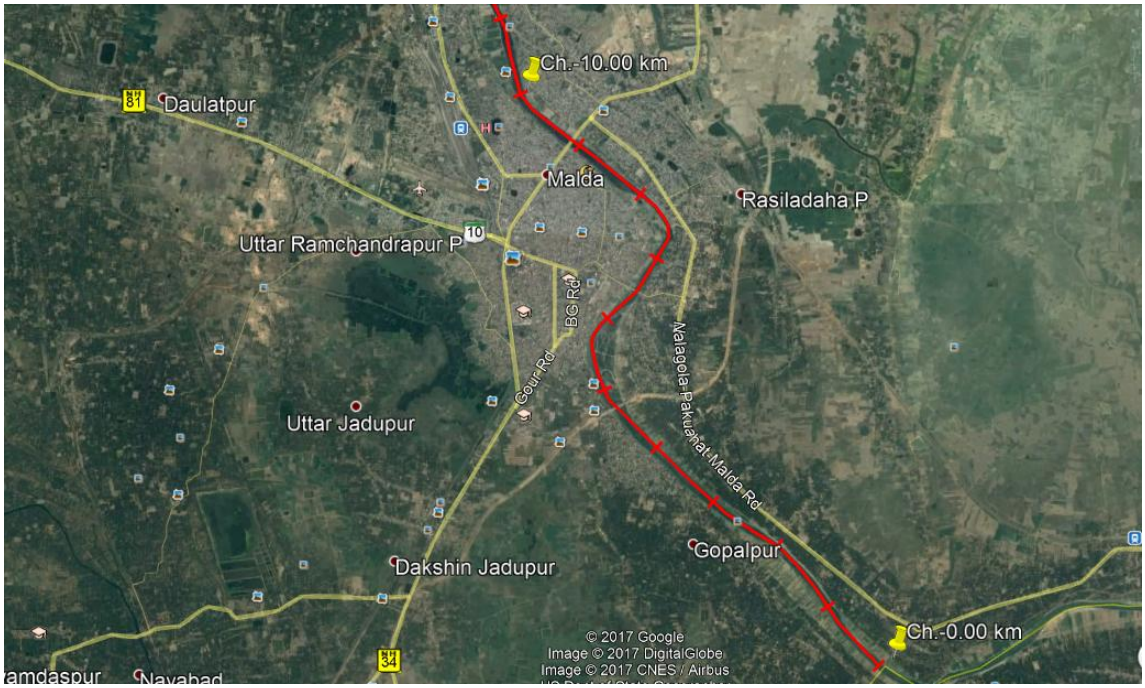


Figure 6- Chainage 0.00 km to Chainage 10.00 km

The width of Mahananda River from Chainage 0.00 Km. to Chainage 10.00 Km is approximately 86.85 m. to 113.35 m. The average width portion of the river is approximately 100.10 m.

BM-1 is situated near at Chainage of 1.881 km right bank side of the river. An under-construction RCC Bridge is situated near at Chainage of 5.210 km. The position of the under-construction Bridge is (Lat: - 24°59'3.59"N, Long: - 88° 9'1.36"E). Besides, two RCC Bridges named Sahapur Mahananda Setu RCC Bridge and Old Malda RCC Bridge are situated in this zone of river near at Chainage of 6.532 km and 9.135 km respectively. The position of the Bridges are (Lat: - 24°59'51.59"N, Long: - 88° 9'7.12"E), (Lat: - 25° 0'51.05"N, Long: - 88° 8'37.56"E). NH-34 and NH-81 is linked with this zone of river. Adampur, Azmatpur, Jotgobinda, Kadirpur, Sahapur, Mangalbari, Tantipara, Ghoshpara etc. villages are located right bank side of the river and Krishnapur, Gopalpur, Dilapur, Malda, Bagbari, Uttar Ramchandrpur, Dakhin Jadupur etc. villages are located left bank side of the river. Two numbers of ferry services named Char Kadipur ferry ghat and Sadar ferry ghat are available near at Chainage of 3.940 km and 7.779 km in this stretches of river.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	0.00	10.00	0.3	10.4	6650	46490.73	-0.3	7.9	10000	501545.33
II	0.00	10.00	0.1	10.42	9200	104520.2	-0.3	8.0	10000	746162.34
III	0.00	10.00	0.1	10.52	10000	242054.54	-0.3	8.1	10000	1105170.5
IV	0.00	10.00	0.1	10.62	10000	378073.71	-0.3	8.2	10000	1313489.3

Sl. No	Name of Ferry Ghat	Passenger Details	Latitude (N)	Longitude (E)	Cargo Details	Right Bank Chainage (km)	Left Bank Chainage (km)	Details of Available boat and vessels
1	Char Kadipur Ferry ghat	Villagers	24°58'45.69"	88° 9'20.49"	Light goods and vehicle	3.940	3.950	Small kinds of Boat
2	Sadar ferry ghat	Passenger	25° 0'27.99"	88° 9'16.81"	Light goods and vehicle	7.779	7.970	Small kinds of Boat

Figure 7-Under construction RCC Bridge (Chainage-5.210 km)

Figure 8- Sadar Ferry Ghat (Chainage-7.779km)

Figure 9-Sahapur Mahananda Setu RCC Bridge (Chainage-6.532 km)

Figure 10- Old Malda RCC Bridge (Chainage-9.135 km)

3.2 - From Chainage 10.00 Km to Chainage 20.00 Km (Mangalbari village to Barkol village):-

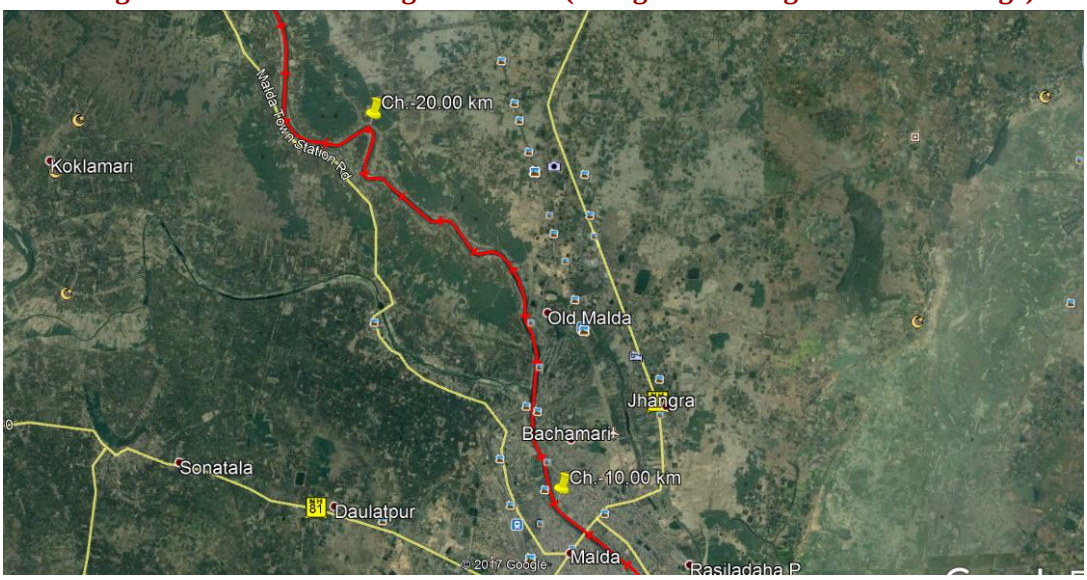


Figure 11 – Chainage 10.00 km to Chainage 20.00 km

The width of Mahananda River from Chainage 10.00 Km. to Chainage 20.00 Km is approximately 113.35 m to 88.97 m. The average width portion of the river is approximately 101.16 m.

Nine electric lines are located in this zone of river near at Chainage of 11.872 km, 11.988 km, 13.181 km, 13.406 km, 16.376 km, 17.634 km, 17.768 km, 17.853 km and 18.358 km. BM-2 and BM-3 is situated near at Chainage of 10.186 km and 19.788 km in this zone of river. Two Railway Bridges including an under pass road are situated near at Chainage of 11.927 km and 11.952 km at Nimasarai village in this zone of river. The Rail Bridge is connected between Malda towns to old Malda Jn. The position of the Bridges are (Lat: - 25° 2'13.51"N, Long: - 88° 8'0.22"E), (Lat: - 25° 2'14.57"N, Long: - 88° 8'1.73"E). Palpara, Bachamari, Mokatipur, old Malda, Rahutgaon, Kadamtali, Badanpur etc. villages are situated right bank side of the river and Malda town, Barrack colony, Sukanta pally, Nima Sarai, Itakhola, Anandipur, Jot Basanta etc. villages are located left bank side of the river. Five numbers of ferry services are available named Nimayasara ferry ghat, Itakhola ferry ghat, Nababganj ferry ghat, Anandipur ferry ghat and Daupur ferry ghat are located in this stretches of river near at Chainages of 12.212 km, 13.710 km, 14.913 km, 15.927 km and 16.970 km respectively.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	10.00	20.00	0.47	19.7	1200	1163.21	-0.3	17.2	10000	263020.94
II	10.00	20.00	0.27	19.73	2950	7667.83	-0.3	17.3	10000	407718.32
III	10.00	20.00	0.07	19.83	5900	36906.7	-0.3	17.4	10000	638954.7
IV	10.00	20.00	0.05	19.93	7350	79198.63	-0.3	17.5	10000	786119.31

Sl. No	Name of Ferry Ghat	Passenger Details	Latitude (N)	Longitude (E)	Cargo Details	Right Bank Chainage (km)	Left Bank Chainage (km)	Details of Available boat and vessels
1	Nimayasara Ferry ghat	Local villagers	25° 2'22.25"	88° 7'57.34"	Light Goods and vehicle available	12.222	12.212	Small kind of Boat
2	Itakhola Ferry ghat	Local villagers	25° 2'50.27"	88° 8'1.42"	Nil	13.715	13.710	Small kind of Boat
3	Nababganj Ferry ghat	Local villagers	25° 3'45.66"	88° 7'44.22"	Light Goods and vehicle available	14.963	14.913	Small kind of Boat
4	Anandipur ferry ghat	Local villagers	25° 3'58.23"	88° 7'16.68"	Light Goods and vehicle available	15.930	15.927	Small kind of Boat
5	Daupur Ferry ghat	Local villagers	25° 4'20.59"	88° 6'55.43"	Nil	16.880	16.970	Small kind of Boat

Figure 12- Rail Bridges (Chainage-11.927 km and 11.952 km)

Figure 13 - Under pass Road (Chainage-11.952 km)

Figure 14- Nimayasara ferry ghat (Chainage-12.212 km)

Figure 15- Itakhola ferry ghat (Chainage-13.710 km)

Figure 16- Nababganj ferry ghat (Chainage-14.913 km)

Figure 17- Anandipur Ferry ghat (Chainage-15.927 km)

3.3- From Chainage 20.00 Km to Chainage 30.00 Km (Barkol village to Elahabad village):-

Figure 18 - Chainage 20.00 to Chainage 30.00 km

The width of Mahananda River from Chainage 20.00 Km. to Chainage 30.00 Km is approximately 88.97 m to 76.68 m. The average width portion of the river is approximately 82.825 m.

Barkol, Uttar Bhatra, Paiti, Balarampur, Sanjail, Alinagar, paschim Binodpur etc. villages are located right bank side of the river and Uttar Gopinathpur, Satmara, pirganj, Sultanganj, Elahabad etc. villages are located left bank side of the river. Bent curve is found in this stretches of river. Adina Railway station and NH-34 is the major communicative way located right bank side of the river. The part of this place is covered with trees and agriculture field but the maximum part is covered with the mango trees.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	20.00	30.00	0.8	11.1	450	485.36	-0.3	8.6	10000	315752.51
II	20.00	30.00	0.6	11.2	2400	2560.53	-0.3	8.7	10000	518842.41
III	20.00	30.00	0.4	11.3	6650	22445.76	-0.3	8.8	10000	842836.96
IV	20.00	30.00	0.2	11.4	8850	55258.76	-0.3	8.9	10000	1034704.5

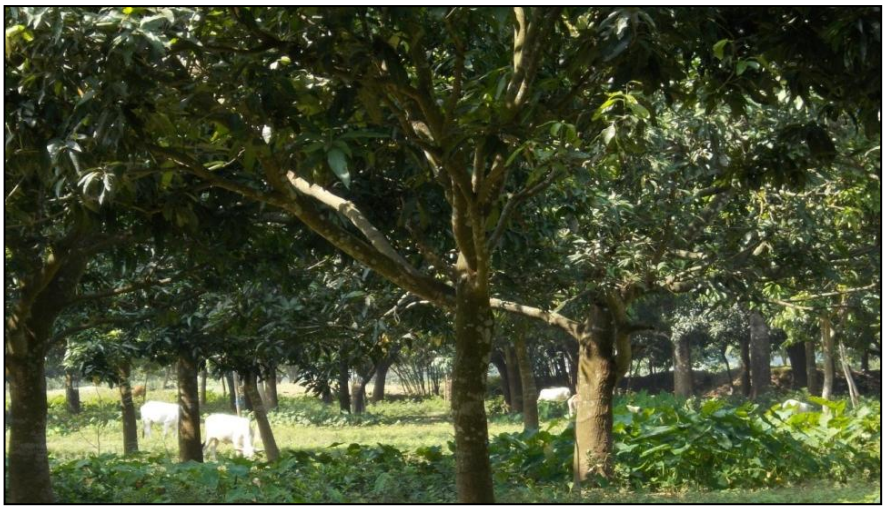


Figure 19- Mango Garden

3.4- From Chainage 30.00 Km to Chainage 40.00 Km (Elahabad village to Bahirgachi village):-

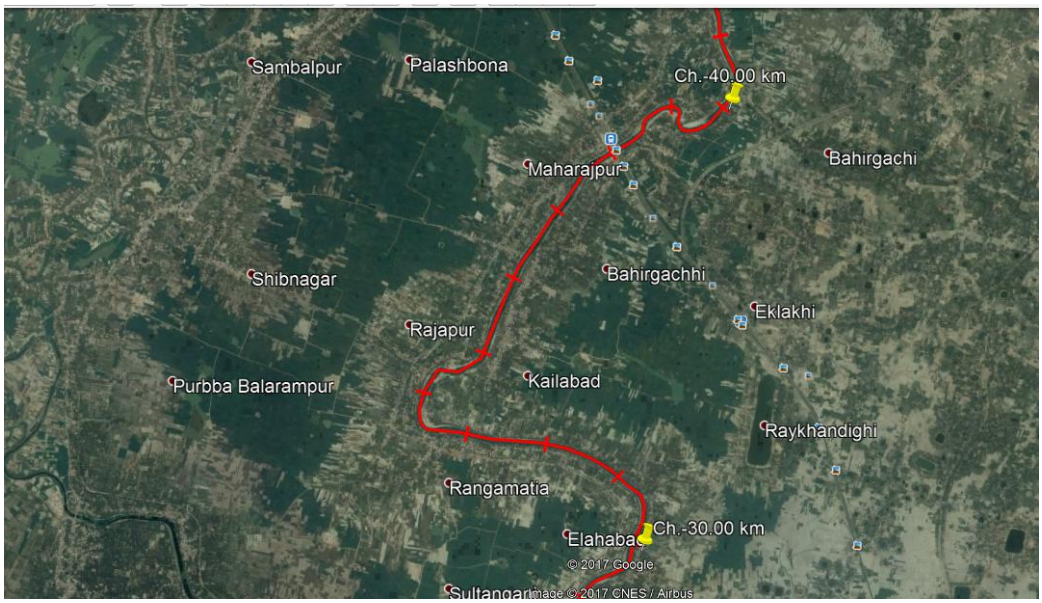


Figure 20 - Chainage 30.00 km to Chainage 40.00 km

The width of Mahananda River from Chainage 30.00 Km. to Chainage 40.00 Km is approximately 76.68 m to 69.90 m. The average width portion of the river is approximately 73.290 m.

Mahanda Bridge Railway line is situated in this zone of river near at Chainage of 38.134 km and 38.151 km. The position of the Rail Bridges are (Lat: 25°11'13.24"N, Long: 88° 5'1.75"E), (Lat: 25°11'13.59"N, Long: 88° 5'2.58"E) The Rail line helps the daily commuters and also the tourists to go to their destination very easily. The Railway line connects Mahananda Bridge Railway Station and Eklakhi Jn. Railway station. BM-4 and BM-5 is also situated in this stretches of river near at Chainage of 30.146 km and 38.154 km. Kailabad, Bahirgachhi, Eklakhi, Ramnagar etc. villages are located right bank side of the river and Elahabad, Rangamatia, Rajapur, Maharajpur etc. villages are located left bank side of the river.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	30.00	40.00	0.7	11.6	800	1043.64	-0.3	9.11	10000	293595.82
II	30.00	40.00	0.69	11.63	3150	3907.1	-0.3	9.11	10000	487365.37
III	30.00	40.00	0.6	11.64	8100	24861.05	-0.3	9.12	10000	807272.75
IV	30.00	40.00	0.5	11.65	9000	64568.9	-0.3	9.13	10000	998792.59

Figure 21- Mahananda Railway Bridge (Chainage-38.134 km and 38.151 km)

3.5- From Chainage 40.00 Km to Chainage 50.00 Km. (Bahirgachi village to Mallickpur village):-

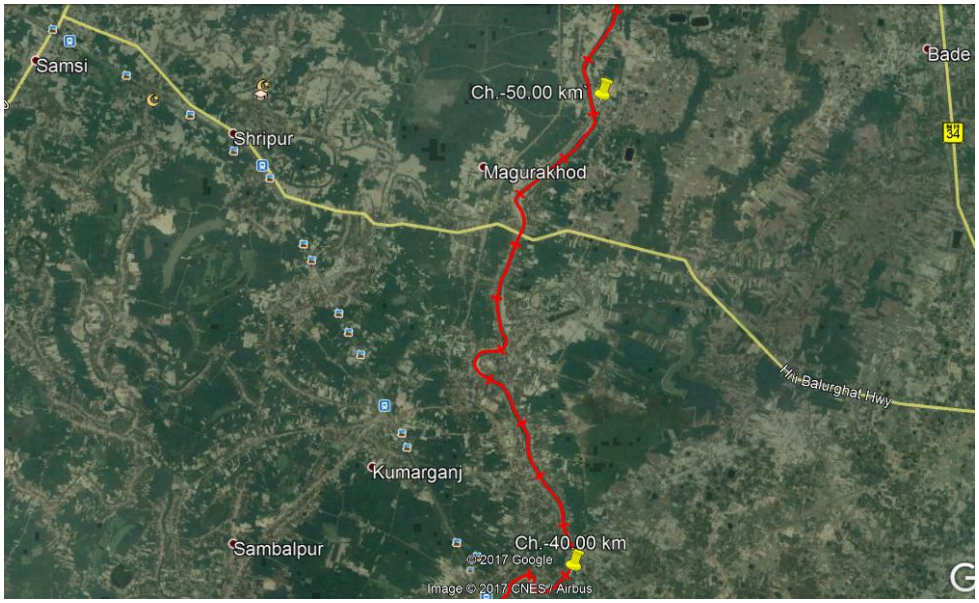


Figure 22- Chainage 40.00 km to Chainage 50.00 km

The width of Mahananda River from Chainage 40.00 Km. to Chainage 50.00 Km is approximately 69.90 m to 78.81 m. The average width portion of the river is approximately 74.355 m.

BM-6 is situated in this zone of river near at Chainage of 49.994 km. Sultanpur RCC Bridge is situated near at Chainage of 47.130 km. The position of the RCC Bridge is (Lat: 25°14'45.59"N, Long: 88° 5'21.22"E). The Road is also called Hili Balurghat highway. Saharol, Rajaram Chak, Mobarakpur, Kismat Sultanpur, Alal, Gazipur, Khod Malanchana, Kadamtali etc. villages are located right bank side of the river and Raninagar, Barail, Kumarganj, Kheria, Laskarpur, Magurakhod, Ballavpur, Laskarpur, Magura etc. villages are located left bank side of the river.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	40.00	50.00	0.08	9.3	3850	6850.62	-0.3	6.8	10000	371280.1
II	40.00	50.00	0.01	9.41	6600	25393.95	-0.3	6.9	10000	573972.58
III	40.00	50.00	0.01	9.51	10000	97089.79	-0.3	7.1	10000	892022.1
IV	40.00	50.00	0.01	9.69	10000	178215.03	-0.3	7.3	10000	1083617.3

Figure 23- Sultanpur RCC Bridge (Chainage-47.130 km)

3.6- From Chainage 50.00 Km to Chainage 60.00 Km (Mallickpur village to Ghritatala village):-

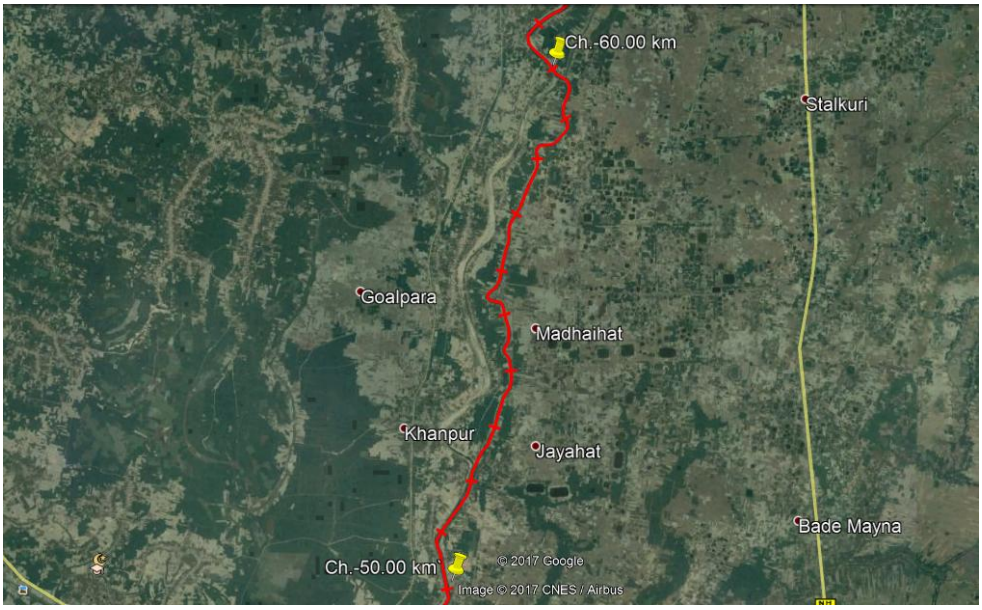


Figure 24- Chainage 50.00 km to Chainage 60.00 km

The width of Mahananda River from Chainage 50.00 Km. to Chainage 60.00 Km is approximately 78.81 m to 43.00 m. The average width portion of the river is approximately 60.905 m.

An electric line is found near at Chainage of 53.061 km in this stretches of river. Mallickpur, Aminhat, Dharampur, Jayahat, Madhaihat, Mahadipur, Malanchi, Madhuban, Ghritatala etc. villages are situated right bank side of the river and Harirampur, Gobindopur, Khanpur, Hosenpur, Goalpara, Baharabad, Chandrapara, Balarampur etc. villages are located left bank side of the river. Khanpur Ferry Ghat is located near at the Chainage of 51.90 km which is communicates between Khanpur and Jayahat.

Sl. No	Name of Ferry Ghat	Passenger Details	Latitude (N)	Longitude (E)	Cargo Details	Right Bank Chainage (km)	Left Bank Chainage (km)	Details of Available boat and vessels
1	Khanpur Ferry ghat	Local villagers	25°16'56.03"	88° 6'20.23"	Light goods and vehicle like cycle and Motor cycle	51.504	51.900	Small boat

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	50.00	60.00	0.5	9.87	8300	36453.51	-0.3	7.4	10000	466359.86
II	50.00	60.00	0.4	9.87	10000	102939.57	-0.3	7.41	10000	706648.11
III	50.00	60.00	0.3	9.88	10000	291982.14	-0.3	7.42	10000	1062649.4
IV	50.00	60.00	0.2	9.89	10000	444505.78	-0.3	7.43	10000	1266942

Figure 25- Balarampur Primary School (Chainage-40.00 km)

Figure 26-Khanpur Ferry Ghat (Chainage-51.90 km)

3.7- From Chainage 60.00 Km to Chainage 70.00 Km (Ghritatala village to Gopalpur village):-

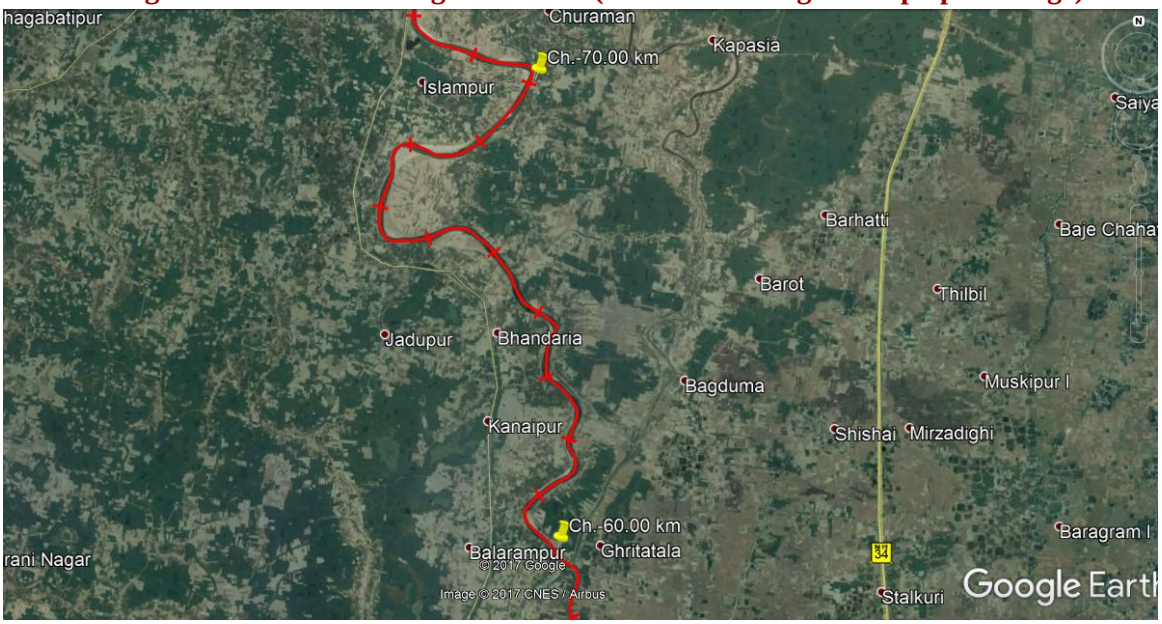


Figure 27- Chainage 60.00 km to Chainage 70.00 km

The width of Mahananda River from Chainage 60.00 Km. to Chainage 70.00 Km is approximately 43.00 m to 51.23 m. The average width portion of the river is approximately 47.115 m.

BM-7 is situated near at Chainage of 60.887 km in this zone of river. No cross structures are found in this stretches of river. Marnai, Rajkot, Bagduma, Birnagar, Kunarhat, Bochkapara, Jamalpur etc. villages are located right bank side of the river and Chandipur Darmar, Kanaipur, Bhandaria, Rahimpur, Narasinhapur, Parashurampur, Mathurapur, Islampur, Gopalpur etc. villages are located left bank side of the river.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	60.00	70.00	0.5	7.6	10000	96650.03	-0.3	5.1	10000	516628.94
II	60.00	70.00	0.4	7.6	10000	209394.41	-0.3	5.2	10000	767744.55
III	60.00	70.00	0.3	7.7	10000	433277.22	-0.3	5.3	10000	1132486.6
IV	60.00	70.00	0.2	7.8	10000	604462.32	-0.3	5.4	10000	1341731.8

3.8- From Chainage 70.00 Km to Chainage 80.391 Km (Gopalpur village to Gosaipur village):-

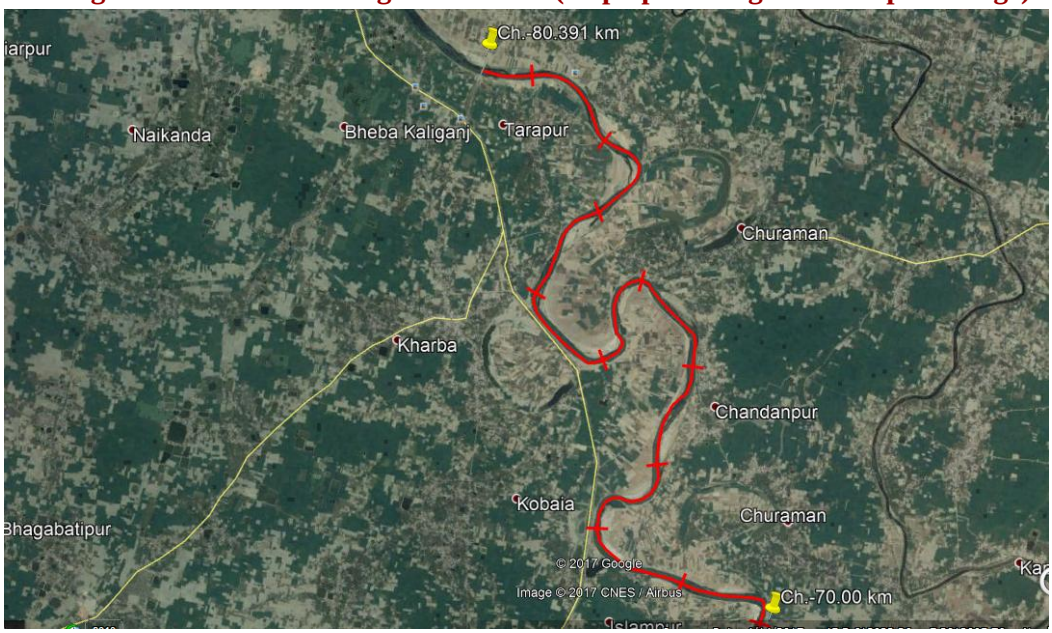


Figure 28- Chainage 70.00 km to Chainage 80.391 km

The width of Mahananda River from Chainage70.00 Km. to Chainage 80.391 Km is approximately 51.23 m to 84.92 m. The average width portion of the river is approximately 68.075 m.

Madhavpur Ghat RCC Bridge is situated in this zone of river near at Chainage of 80.391 km. The position of the RCC Bridge is (Lat: 25°26'40.90"N, Long: 88° 5'26.09"E). BM-8 and BM-9 is situated in this stretches of river near at Chainage of 71.921 km and 80.384 km. Kamardanga, Churaman, Chandanpur, Basudevpur, Gopinathpur, Gosaipur etc. villages are located right bank side of the river and Kobaia, Srikrishnapur, Ashapur, Shaktihar, Lalganj, Tarapur etc. villages are located left bank side of the river.

Class	Chainage (km)		Observed				Reduced w.r.t. Sounding Datum			
	From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)
I	70.00	80.391	0.5	7.2	10000	88778.21	-0.3	4.7	10000	474838.35
II	70.00	80.391	0.48	7.22	10000	176164.9	-0.3	4.8	10000	710229.2
III	70.00	80.391	0.46	7.32	10000	349660.3	-0.3	4.9	10000	1057135.7
IV	70.00	80.391	0.44	7.42	10000	489491.48	-0.3	5.0	10000	1259343.1

Figure 29-Madhavpur ghat RCC Bridge (Chainage-80.391 km)

- **Bathymetry Survey:-**

a) Length of the stretch for which the Bathymetric survey has been carried out:-

The Bathymetry survey of the Mahananda River has been carried out from the Chainage of 0.000 km to Chainage 80.391 km. The water level of this river is sufficient for carrying out the Bathymetry survey.

Date of Survey	Type of survey	Chainage	
		From (km)	To (km)
21.01.16	Bathymetry Survey	0.000	2.500
16.10.15	Bathymetry Survey	2.500	13.100
07.10.15	Bathymetry Survey	13.100	20.500
09.10.15	Bathymetry Survey	20.500	27.000
08.10.15	Bathymetry Survey	27.000	38.100
11.10.15	Bathymetry Survey	38.100	40.400
10.10.15	Bathymetry Survey	40.400	50.000
12.10.15	Bathymetry Survey	50.000	61.000
17.10.15	Bathymetry Survey	61.000	66.600
13.10.15	Bathymetry Survey	66.600	71.900
15.10.15	Bathymetry Survey	71.900	80.391

- **Topographic Survey:-**

a) Length of the stretch for which the Topographic survey has been carried out:-

The Topographic survey has been carried out from the Chainage of 0.00 km to Chainage 80.391 km from the Bangladesh border near Adampur village to Gosaipur Bridge area.

a) Prominent Dams / Barrage:-

There are no Dams found in this zone of river.

b) Conditions of banks (protected, un-protected):-

The bank of the river includes with villages, Roads, Ferry Ghats, Jetty, electric lines, RCC and Rail Bridges etc. RCC, Rail Bridge area are highly protected by concrete pitching. Most of the river stretches are protected by long embankments and Boulder pitching.The Bank of the River Mahananda has been affected by floods, sometimes it become dangerous during the monsoon. As a result, the lower portion or the bank side villages are flooded. The RCC and Rail bridges area are highly protected by Boulder and concrete pitching. The sand patches are also found both sides bank of the river. Boulder pitching has been noticed near at Chainage of 1.00 km to 2.4 km. The both sides bank of the river are also protected by embankment and Bituminous road. In this zone of river, many mango garden have been noticed both sides bank of the river. The river becomes polluted recent times due to animal bathing, dropping of plastics, industry based chemicals, heap of garbages etc.

c) Hindrances - Hyacinth, rocks, rapid waterfalls, steep gradient, forest, wild-life sanctuary, security issues. Obstruction (if any) for navigation, e.g. fishing stakes:-

Raiganj forest and Bird sanctuary is located 22 km far from Mahananda River. Besides Bangladesh Border is situated near Adampur village where the Mahananda River has been started. So the Forest and Border area is become unapproachable and give protection in this zone of river.

d) Details of Protected Area- Wildlife, Defence, Atomic Power Plants and any other issue attached to it:-

Raiganj Eco Park and Raiganj Bird Sanctuary is located in this zone of river, 22 km far from Mahananda River. Bangladesh Border is also located near Adampur village which is protected area and give security in this zone of river. Besides, many mango gardens are noticed in this zone of river.

e) NH/SH/MDR along and/or within 5 km from the waterways:-

NH- 80, NH-34 and NH-81 are the major national highways located in this zone of river. Besides, SH-10, SH-10 A are also located in this zone of river. So the communication system runs very easily in this zone of river.

f) Railway Line and Stations in the vicinity:-

Four numbers of total Railway lines are located in this zone of river near at Chainage of 11.927 km, 11.952 km, 38.134 km, and 38.151 km respectively. The important Railway stations like Mahananda Bridge Railway station, Kumarganj Railway station, Eklakhi Jn. Railway Station, Old Malda Jn. Railway station, Malda Town Railway station are situated in this zone of river. The Railway communication really helps for the local inhabitants and also for the tourist.

g) Land Use Pattern along Waterway on visual assessment:-

During the period of the survey it was noticed that the maximum land on the both bank of the river is used as an agricultural land. The Remaining part of the river bank sides is covered with Mango garden and forest. Different kind of industries like Agro based petro chemicals etc. are situated in this zone of river.

h) Crops / Agriculture in the region on visual assessment:-

West Bengal is the major state for all aspect in agriculture. The major crops Paddy, wheat, jute, pulses, potato, chili and Rabi crops are cultivated in this region. Raw silk yarn is also produced in this area.

i) Availability of Bulk / Construction Material:-

The availability of the construction materials is too easy for construction & any kind of structure. There are many cementing factories and brick fields are located and the sand is also available from the river.

j) Existing Industries along Waterway with their types and details:-

Different kinds of industries are located in this region of river. Agro Based, soda water, cotton textiles, wooden silk clothes, jute, Rubber, plastic and petro based, Food processing, cold storage, Agro Farming and Fishery, Packaged Mineral water, cycle Rim, L.P.G-Bottling plant etc. industries are located in this zone of river.

k) Existing Ghats, Jetties and Terminals (with conditions and facilities). Existing navigation facilities (if any):-

As much as eight numbers of temporary Jetty services are available in this zone of river near at Chainage of 3.940 km (Char Kadipur), Chainage -7.779 km (Sadar ferry ghat), Chainage- 12.212 km (Nimayasara), Chainage- 13.71 km (Itakhola), Chainage- 14.913 km (Nababganj), Chainage- 15.927km (Anandipur), Chainage- 16.970 km (Daupur) and Chainage-51.900 km (khanpur ferry ghat).

Sl. No	Name of Ferry Ghat	Passenger Details	Latitude (N)	Longitude (E)	Cargo Details	Right Bank Chainage (km)	Left Bank Chainage (km)	Details of Available boat and vessels
1	Char Kadipur Ferry ghat	Villagers	24°58'45.69"	88° 9'20.49"	Light goods and vehicle	3.940	3.950	Small kinds of Boat
2	Sadar ferry ghat	Villagers	25° 0'27.99"	88° 9'16.81"	Light goods and vehicle	7.779	7.970	Small kinds of Boat
3	Nimayasara Ferry ghat	Villagers	25° 2'22.25"	88° 7'57.34"	Light goods and vehicle	12.222	12.212	Small kinds of Boat
4	Itakhola Ferry ghat	Villagers	25° 2'50.27"	88° 8'1.42"	Nil	13.715	13.710	Small kinds of Boat
5	Nababganj Ferry ghat	Villagers	25° 3'45.66"	88° 7'44.22"	Light goods and vehicle	14.963	14.913	Small kinds of Boat
6	Anandipur ferry ghat	Villagers	25° 3'58.23"	88° 7'16.68"	Light goods and vehicle	15.930	15.927	Small kinds of Boat
7	Daupur Ferry ghat	Villagers	25° 4'20.59"	88° 6'55.43"	Nil	16.880	16.970	Small kinds of Boat
8	Khanpur Ferry ghat	Villagers	25°16'56.03"	88° 6'20.23"	Light goods and vehicle	51.504	51.900	Small kinds of Boat

l) Existing Cargo Movement:-

The cargo movement is processed through waterways system. As much as eight numbers of passenger ferry services are available in this zone of river near at Chainage of 4.430 km (Char Kadipur), Chainage -7.779 km (Sadar ferry ghat), Chainage- 12.212 km (Nimayasara), Chainage- 13.71 km (Itakhola), Chainage- 14.913 km (Nababganj), Chainage- 15.927km (Anandipur), Chainage- 16.970 km (Daupur) and Chainage-51.900 km (khanpur ferry ghat) .The light cargo is available in all the ferry services except Itakhola and Daupur ferry ghat with light goods, vegetables, cycle and motor cycle etc.

m) Prominent City / Town / Places of Worship / Historical places for Tourism:-

Old Malda, Malda Town, Eklakhi, Kumarganj, Puratuli, Rathbari, Barrack Colony etc. cities are located in this zone of river. Gour, Adina Mosque, Dakhil Darwaza, Firoz Miner, Adina Deer Park, Baroduari Mosque, Malda Museum, Eklakhi Mausoleum, Raiganj Bird Sanctuary etc. historical and tourist places are situated in this zone of river.

n) Village / colonies along the sub-stretch and approx. Population:-

Kumarpur, Adampur, Azmatpur, Mangal bari, Bagbari, Bachamari, Itakhola, Mokatipur, Anandipur, Balarampur, Sultanganj, Khanpur, Goalpara, Bhandaria etc. villages are located in this zone of river.

o) Availability of Passenger Ferry Services with facilities and Annual movement data:-

As much as eight numbers of passenger ferry services including light goods and vehicle like cycle and motor cycle are available in this zone of river near at Chainage of 3.940 km (Char Kadipur), Chainage - 7.779 km (Sadar ferry ghat), Chainage- 12.212 km (Nimayasara), Chainage- 13.71 km (Itakhola), Chainage- 14.913 km (Nababganj), Chainage- 15.927km (Anandipur), Chainage- 16.970 km (Daupur) and Chainage-51.900 km (khanpur ferry ghat). The Ferry services are really very helpful for the local villagers for a good communication.

Sl. No	Name of Ferry Ghat	Passenger Details	Latitude (N)	Longitude (E)	Cargo Details	Right Bank Chainage (km)	Left Bank Chainage (km)	Details of Available boat and vessels
1	Char Kadipur Ferry ghat	Villagers	24°58'45.69"	88° 9'20.49"	Light goods and vehicle	3.940	3.950	Small kinds of Boat
2	Sadar ferry ghat	Villagers	25° 0'27.99"	88° 9'16.81"	Light goods and vehicle	7.779	7.970	Small kinds of Boat
3	Nimayasara Ferry ghat	Villagers	25° 2'22.25"	88° 7'57.34"	Light goods and vehicle	12.222	12.212	Small kinds of Boat
4	Itakhola Ferry ghat	Villagers	25° 2'50.27"	88° 8'1.42"	Nil	13.715	13.710	Small kinds of Boat
5	Nababganj Ferry ghat	Villagers	25° 3'45.66"	88° 7'44.22"	Light goods and vehicle	14.963	14.913	Small kinds of Boat
6	Anandipur ferry ghat	Villagers	25° 3'58.23"	88° 7'16.68"	Light goods and vehicle	15.930	15.927	Small kinds of Boat
7	Daupur Ferry ghat	Villagers	25° 4'20.59"	88° 6'55.43"	Nil	16.880	16.970	Small kinds of Boat
8	Khanpur Ferry ghat	Villagers	25°16'56.03"	88° 6'20.23"	Light goods and vehicle	51.504	51.900	Small kinds of Boat

p) Available and probable Water Sport Recreational Facilities:-

There are no water sport recreational facilities available in this zone of river.

q) Fishing activities:-

Fish and fishing business are an important sector in this region. Cast nets, Scoop nets, Gill nets, Fishing lines and Traditional Bamboo Trap used for catching the fishes here. Fishing plays an important role in supporting livelihood for the inhabitants of this Region. Fishes are one of the major occupations in this region of people where so many people are engaged with this profession for the demand of fish.

r) Sand mining:-

The bank of the River Mahananda is also used for the sand mines. The Sand Mining helps the people for collection sand which is the major component for Building purposes. The Motor vehicles can easily collect the sand and move for transportation. Sand Mines is an important sector where so many people are engaged and these activities help them to get their daily livelihood.

s) Tributaries:-

The left bank tributaries of this river are the Nagar, the Tangan and the Punarbhaba, and on its right bank tributaries are the Kalindi, Balasan and Mechi.

t) Details of Irrigation Canals and Outlets:-

Kalindi River creates from Mahananda River near at Chainage of 12.400 km in the left side. The irrigation canal and outlets are found near at Chainage of 27.00 km in the left side and Chainage of 45.400 km in the right side of the river bank.

u) Details of Nalas. Polluted water discharge in to the rivers and treatment plants (if any):-

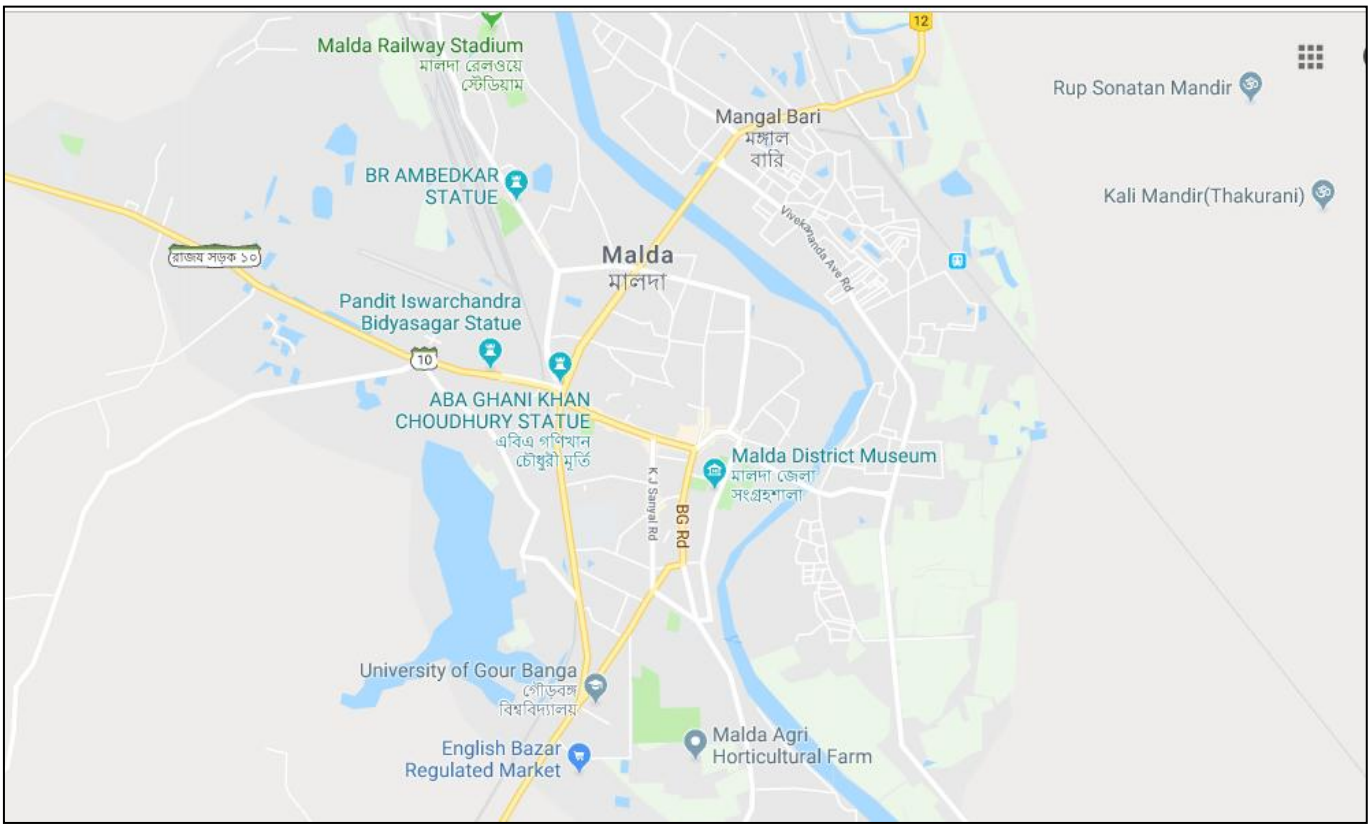
There are no Nalas found in this zone of river.

v) Usage of water (drinking, irrigation, industries, navigation etc.) Water quality:-

In Recent time's man avoid drinking the water of the river but the water is essential for cultivation which is the main occupation for the villagers of this region. The water is also used in the industrial hubs. Ferry services are also navigable in this region of river. The water is used as irrigation purposes. With the help of the irrigation system, the cultivation can easily accessible. Different kind of small industries like Agro based, cycle rim, packaged drinking water, L.P.G bottle, Rubber, plastic and chemical industry, cotton clothes etc. industries are growing up in this zone of river. As much as eight numbers of ferry services are available in this zone.

Section 4: Terminals

Malda town may develop as a proposed terminal near the Englishbazar town. This city is included with Malda Airport (Lat- 25° 0'33.63"N, Long- 88° 7'29.86"E), some ferry services like Mission ghat (Lat-24°59'41.75"N, Long- 88° 8'55.48"E), Puratuli sadar ghat (Lat- 25° 0'25.86"N, Long- 88° 9'7.37"E) and also the Malda town Railway station. Most of the Fishes are transported through the ferry services from Bangladesh. The light cargo like vegetables, light goods, fishes are available in this zone of river.



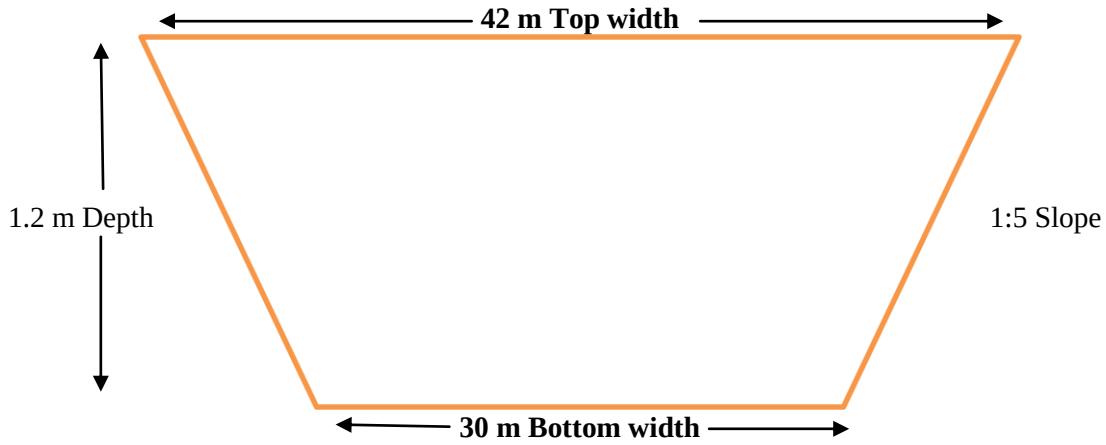
4.1 Details of Land use, owner etc.:-

The both sides bank of the River Mahananda used for cultivation. The Farmers are cultivated their crops with using this fertile land and grows a huge amount of crops every year. Besides, some portions of the land are surrounded by small industries and Forests. The land of the river sides are covered with paddy land, Mango garden, small kinds of industries etc. In this region of river side, Mango is very famous which a major profession in this zone. Farmers are not only cultivated crops like paddy, jute they also involved with honey, wax activities in the forest area.

Section 5: Fairway development:-

Dredging sections, summary of depths and dredging quantity for different classification of waterways (stretch-wise)

Class-I: (Channel design: - Bottom width- 30 meter, Top width- 42 meter)

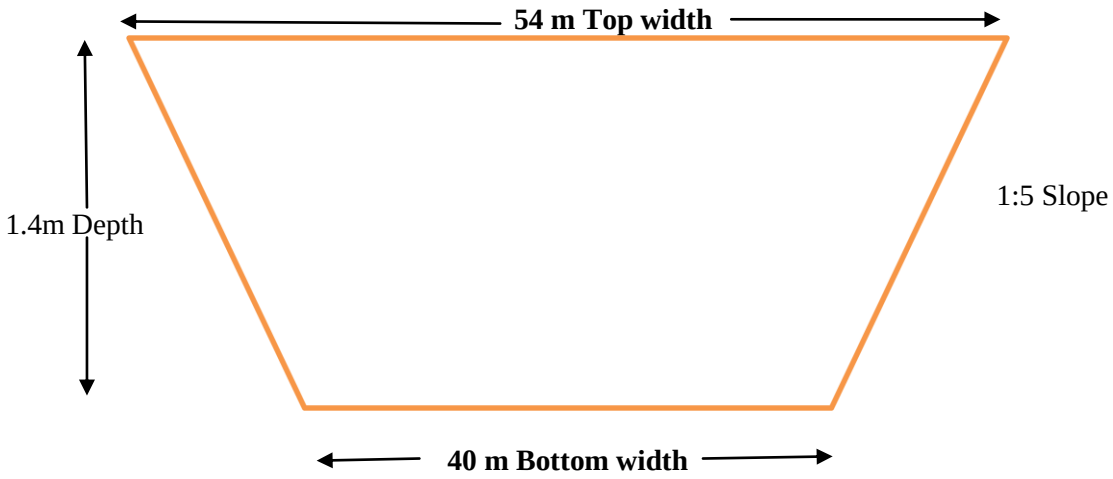


Class-I:-

Class-I													
Location		Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	From	To	Min. depth (m)	Max depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)`	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)`
Adampur	Mangalbari	0.00	10.00	0.3	10.4	6650	46490.73	46490.73	-0.3	7.9	10000	501545.33	501545.33
Mangalbari	Barkol	10.00	20.00	0.47	19.7	1200	1163.21	47653.94	-0.3	17.2	10000	263020.94	764566.27
Barkol	Elahabad	20.00	30.00	0.8	11.1	450	485.36	48139.3	-0.3	8.6	10000	315752.51	1080318.78
Elahabad	Bahirgachi	30.00	40.00	0.7	11.6	800	1043.64	49182.94	-0.3	9.11	10000	293595.82	1373914.6
Bahirgachi	Mallickpur	40.00	50.00	0.08	9.3	3850	6850.62	56033.56	-0.3	6.8	10000	371280.1	1745194.7
Mallickpur	Ghritatala	50.00	60.00	0.5	9.87	8300	36453.51	92487.07	-0.3	7.4	10000	466359.86	2211554.56
Ghritatala	Gopalpur	60.00	70.00	0.5	7.6	10000	96650.03	189137.1	-0.3	5.1	10000	516628.94	2728183.5
Gopalpur	Gosaipur	70.00	80.391	0.5	7.2	10000	88778.21	277915.31	-0.3	4.7	10000	474838.35	3203021.85
Total						41250	277915.31		Total		80000	3203021.85	

Table 14- Dredging quantity in class-I

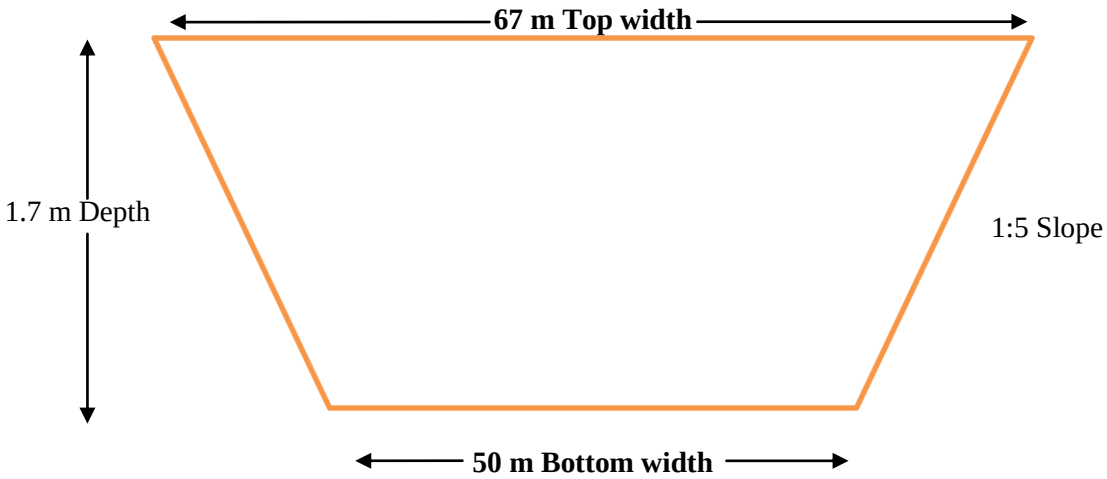
Class-II: - (Channel design: - Bottom width- 40 meter, Top width- 54 meter)



Class-II													
Location		Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	From	To	Min depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)`	Min. Depth (m)	Max Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)`
Adampur	Mangalbari	0.00	10.00	0.1	10.42	9200	104520.2	104520.2	-0.3	8.0	10000	746162.34	746162.34
Mangalbari	Barkol	10.00	20.00	0.27	19.73	2950	7667.83	112188.03	-0.3	17.3	10000	407718.32	1153880.66
Barkol	Elahabad	20.00	30.00	0.6	11.2	2400	2560.53	114748.56	-0.3	8.7	10000	518842.41	1672723.07
Elahabad	Bahirgachi	30.00	40.00	0.69	11.63	3150	3907.1	118655.66	-0.3	9.11	10000	487365.37	2160088.44
Bahirgachi	Mallickpur	40.00	50.00	0.01	9.41	6600	25393.95	144049.61	-0.3	6.9	10000	573972.58	2734061.02
Mallickpur	Ghritatala	50.00	60.00	0.4	9.87	10000	102939.57	246989.18	-0.3	7.41	10000	706648.11	3440709.13
Ghritatala	Gopalpur	60.00	70.00	0.4	7.6	10000	209394.41	456383.59	-0.3	5.2	10000	767744.55	4208453.68
Gopalpur	Gosaipur	70.00	80.391	0.48	7.22	10000	176164.9	632548.49	-0.3	4.8	10000	710229.2	4918682.88
Total						54300	632548.49		Total		80000	4918682.88	

Table 15- Dredging quantity in class-II

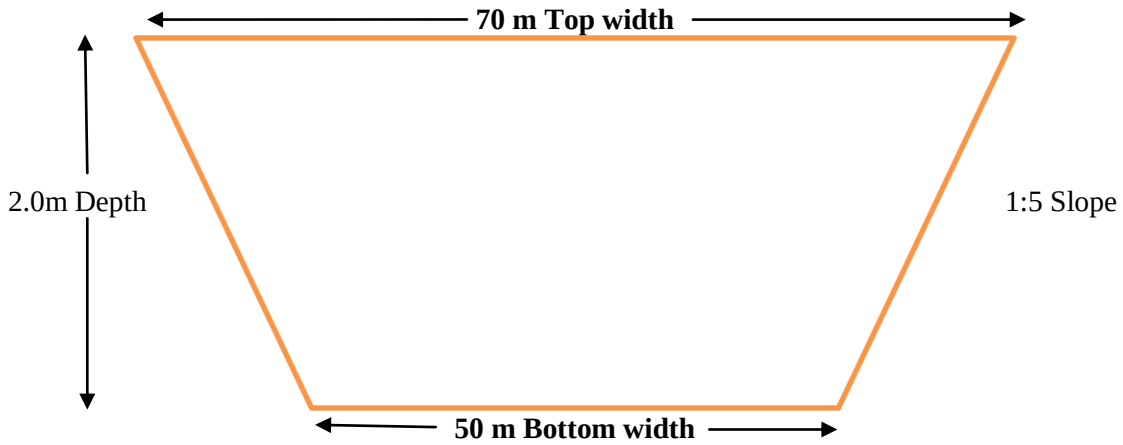
Class-III: - (Channel design: - Bottom width- 50 meter, Top width- 67 meter)



Class-III													
Location		Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	From	To	Min depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)`	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)`
Adampur	Mangalbari	0.00	10.00	0.1	10.52	10000	242054.54	242054.54	-0.3	8.1	10000	1105170.48	1105170.48
Mangalbari	Barkol	10.00	20.00	0.07	19.83	5900	36906.7	278961.24	-0.3	17.4	10000	638954.7	1744125.18
Barkol	Elahabad	20.00	30.00	0.4	11.3	6650	22445.76	301407	-0.3	8.8	10000	842836.96	2586962.14
Elahabad	Bahirgachi	30.00	40.00	0.6	11.64	8100	24861.05	326268.05	-0.3	9.12	10000	807272.75	3394234.89
Bahirgachi	Mallickpur	40.00	50.00	0.01	9.51	10000	97089.79	423357.84	-0.3	7.1	10000	892022.1	4286256.99
Mallickpur	Ghritatala	50.00	60.00	0.3	9.88	10000	291982.14	715339.98	-0.3	7.42	10000	1062649.44	5348906.43
Ghritatala	Gopalpur	60.00	70.00	0.3	7.7	10000	433277.22	1148617.2	-0.3	5.3	10000	1132486.62	6481393.05
Gopalpur	Gosaipur	70.00	80.391	0.46	7.32	10000	349660.3	1498277.5	-0.3	4.9	10000	1057135.74	7538528.79
Total						60650	1498277.5		Total		80000	7538528.79	

Table 16- Dredging quantity in class-III

Class-IV: - - (Channel design: - Bottom width- 50 meter, Top width- 70 meter)



Class-IV													
Location		Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	From	To	Min depth (m)	Maxd epth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)	Min Depth (m)	Max Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty. (cu.m.)
Adampur	Mangalbari	0.00	10.00	0.1	10.62	10000	378073.71	378073.71	-0.3	8.2	10000	1313489.33	1313489.33
Mangalbari	Barkol	10.00	20.00	0.05	19.93	7350	79198.63	457272.34	-0.3	17.5	10000	786119.31	2099608.64
Barkol	Elahabad	20.00	30.00	0.2	11.4	8850	55258.76	512531.1	-0.3	8.9	10000	1034704.48	3134313.12
Elahabad	Bahirgachi	30.00	40.00	0.5	11.65	9000	64568.9	577100	-0.3	9.13	10000	998792.59	4133105.71
Bahirgachi	Mallickpur	40.00	50.00	0.01	9.69	10000	178215.03	755315.03	-0.3	7.3	10000	1083617.3	5216723.01
Mallickpur	Ghritatala	50.00	60.00	0.2	9.89	10000	444505.78	1199820.81	-0.3	7.43	10000	1266941.97	6483664.98
Ghritatala	Gopalpur	60.00	70.00	0.2	7.8	10000	604462.32	1804283.13	-0.3	5.4	10000	1341731.76	7825396.74
Gopalpur	Gosaipur	70.00	80.391	0.44	7.42	10000	489491.48	2293774.61	-0.3	5.0	10000	1259343.13	9084739.87
Total						76650	2293774.61		Total		80000	9084739.87	

Table 17- Dredging quantity in class- IV

Section 6: Conclusion

The Survey stretch of Mahananda River is 80.391 km. Mahananda originates in the Himalayas Paglajhora Falls on Mahaldiram Hill near Chimli. As much as eight numbers of passenger ferry services namely Char Kadipara, Sadar ghat, Nimayasara ghat, Itakhola ghat, Nababganj ghat, Anandipur ghat, Daupur ghat, khanpur ghat are available in this zone of river. The light cargo is available in this zone of river like cycle, motorcycle, vegetables, jute etc. The waterway of the Mahananda River includes with many villages, Rail and Road, Jetty, Mango garden etc. There are four Railway bridges crossing over the river which is very communicative for the native villagers and also for the foreigners. The Railway lines are connected with Mahananda Bridge Railway station, Old Malda Jn. Railway station, Eklakhi Jn. Railway station, Kumarganj Railway station, Sripur Railway station etc. Four numbers of RCC bridges and an under construction bridge are situated in this zone of river which is very communicative to the daily passengers and also for the tourist. The RCC Bridges are connected with Sahapur, Old Malda, Sultanpur, Madhavpur ghat, Malda Town etc. places. Mahananda Bridge is connected with NH-34 which is one of the major communication ways in this zone of river. During the period of the survey we found the water level of the river is sufficient for carrying out the most part of the survey stretches (0.00 km to 80.100 km). The Both banks of the river are sandy in nature. Kalindi River which creates from Mahananda, located near at Chainage of 27.00 km in the left side. NH-34, NH-80, NH-81 are the major communicative way in this zone of river and other state-highways like SH-10, SH-10A, are situated for a better communication system and good transportation system.

Malda Town, Gour, Adina Mosque, English Bazar etc. famous historical and tourist places are located in this zone of river. The wildlife sanctuaries like Raiganj Bird sanctuary, Deer park is located about 22 km from the river. Collecting Mango, wax, honey etc. are also the profession in this region of people. Small kind of industries like Agro based, Food processing, packaged drinking water, cold storage, Bottling plant, Farming and Fishery, Textiles, silk and cotton clothes, Rubber, plastic and Petro based industries are growing up in this zone of river.

Recommend for Detailed project Report for IWT operations and the development of the waterways. The condition of the waterway is very good though water level is not sufficient in some places. The waterway is connected with NH-34 and Old Malda to Malda town Railway connectivity. As much as eight numbers of passenger ferry services are available in this zone with light goods and vehicles in this zone of the river. Kolkata to Malda connectivity through National Highway 34 which connects Malda to Kolkata city as well as districts like North 24 Parganas, Nadia, Murshidabad, Uttar Dinajpur etc. Malda Airport, Malda town railway station, English bazaar area are the famous communication system in this zone of river. Fish is one of the major professions which transports to Bangladesh through the ferry services.

6.1 Min width/Max width and Avg. Width of waterway:-

Sl. No	From Chainage (km)	To Chainage (km)	Min. width of waterway (m)	Max. width of waterway (m)	Avg. width of waterway (m)
1	0.00	10.00	86.85	113.35	100.10
2	10.00	20.00	113.35	88.97	101.16
3	20.00	30.00	88.97	76.68	82.825
4	30.00	40.00	76.68	69.9	73.290
5	40.00	50.00	69.9	78.81	74.355
6	50.00	60.00	78.81	43.00	60.905
7	60.00	70.00	43.00	51.23	47.115
8	70.00	80.391	51.23	84.92	68.075

6.2 Avg. Slope:-

Reach (km)		Slope (m/km)
From	To	
0.00	10.00	0.030
10.01	20.00	0.129
20.01	30.00	0.006
30.01	40.00	0.012
40.01	50.00	0.028
50.01	60.00	0.188
60.01	70.00	0.044
70.01	80.391	0.108
Avg. Slope		0.0681m/km

6.3 Min. Average Reduced Depth/ Max. Average Reduced Depth:-

Sl. No	From Chainage (km)	To Chainage (km)	Minimum Avg. Reduced Depth/Percentage				Maximum Avg. Reduced Depth/percentage			
			Class-I	Class-II	Class-III	Class-IV	Class-I	Class-II	Class-III	Class-IV
1	0.00	10.00	-0.3/-0.003	-0.3/0.003	-0.3/-0.003	-0.3/-0.003	1.41/0.0141	1.51/0.0151	1.62/0.0162	1.71/0.0171
2	10.00	20.00	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	7.93/0.0793	8.03/0.0803	8.13/0.0813	8.23/0.0823
3	20.00	30.00	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	3.59/0.0359	3.71/0.0371	3.83/0.0383	3.95/0.0395
4	30.00	40.00	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	3.74/0.0374	3.84/0.0384	3.94/0.0394	4.04/0.0404
5	40.00	50.00	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	3.13/0.0313	3.24/0.0324	3.35/0.0335	3.46/0.0346
6	50.00	60.00	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	2.57/0.0257	2.67/0.0267	2.77/0.0277	2.87/0.0287
7	60.00	70.00	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	1.2/0.012	1.33/0.0133	1.46/0.0146	1.59/0.0159
8	70.00	80.391	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	-0.3/-0.003	1.82/0.0182	1.93/0.0193	2.04/0.0204	2.15/0.0215

6.4 Range of Depths:-

Sl No	From Chainage (km)	To Chainage (km)	Reduced Depth				
			<1.2 m	1.2 m to 1.4 m	1.5 m to 1.7 m	1.8 m to 2.0 m	>2.0 m
			(km)	(km)	(km)	(km)	(km)
1	0.00	10.00	8.6	1.4	0	0	0
2	10.00	20.00	7.9	0	0	0	2.1
3	20.00	30.00	6.8	1.2	0	0	2.0
4	30.00	40.00	6.8	1.1	0	0	2.1
5	40.00	50.00	5.8	0.5	0	1.7	2.0
6	50.00	60.00	6.8	1.2	0	0	2.0
7	60.00	70.00	5.4	1.2	1.4	0	2.0
8	70.00	80.391	4.391	1.1	1.3	1.6	2.0

6.5 Dredging Summary:-

Class	Observed Dredging Qty. w.r.t Sounding Datum	Reduced Dredging Qty. w.r.t Sounding Datum
Class-I	277915.31	3203021.85
Class-II	632548.49	4918682.88
Class-III	1498277.50	7538528.79
Class-IV	2293774.61	9084739.87

Annexure:-

Annexure-1: Source and type of data collected from various agencies:-

The Chart Datum values have been provided by IWAI office.

Annexure-2: Min. / max. Depth, length of shoal per km-wise for different classification in the designed dredged channel:-

Class-I:-

Class-I											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
0	1	0.3	1.5	1000	8915.24	8915.24	-0.3	0	1000	53482.32	53482.32
1	2	0.3	1.8	1000	14522.49	23437.73	-0.3	0.3	1000	55612.79	109095.11
2	3	0.3	2.1	1000	6766.93	30204.66	-0.3	0	1000	51318.24	160413.35
3	4	0.68	1.4	700	1245.09	31449.75	-0.3	0	1000	57974.2	218387.55
4	5	0.7	2.1	800	3669.5	35119.25	-0.3	0	1000	54361.42	272748.97
5	6	0.4	3.1	100	143.88	35263.13	-0.3	0.6	1000	50844.43	323593.4
6	7	0.3	6.3	800	1812	37075.13	-0.3	3.8	1000	37723.38	361316.78
7	8	0.6	10.4	1000	9145.63	46220.76	-0.3	7.9	1000	39501.3	400818.08
8	9	0.7	2.6	150	268.73	46489.49	-0.3	0.1	1000	54007.66	454825.74
9	10	0.74	3.9	100	1.24	46490.73	-0.3	1.4	1000	46719.59	501545.33
10	11	0.47	2.4	1000	1010.78	47501.51	-0.3	0	1000	54129.56	555674.89
11	12	0.48	4.7	100	148.5	47650.01	-0.3	2.2	1000	45108.42	600783.31
12	13	0.73	7.3	100	3.93	47653.94	-0.3	4.8	1000	44419.38	645202.69
13	14	2.1	19.7	0	0	47653.94	-0.3	17.2	1000	3876.59	649079.28
14	15	2	4.6	0	0	47653.94	-0.3	2.1	1000	35761.76	684841.04
15	16	1.5	13.7	0	0	47653.94	-0.3	11.2	1000	6711.35	691552.39
16	17	2.1	12.7	0	0	47653.94	-0.3	10.2	1000	1882.17	693434.56
17	18	1.5	11.1	0	0	47653.94	-0.3	8.6	1000	41756.12	735190.68
18	19	2.1	14.1	0	0	47653.94	-0.3	11.6	1000	8292.8	743483.48
19	20	2	13.9	0	0	47653.94	-0.3	11.4	1000	21082.79	764566.27
20	21	1.6	7.7	0	0	47653.94	-0.3	5.2	1000	25264.17	789830.44
21	22	2.1	9.6	0	0	47653.94	-0.3	7.1	1000	22650.38	812480.82
22	23	0.8	2.1	100	22.4	47676.34	-0.3	0	1000	57803.05	870283.87

Class-I											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
23	24	1.5	3.2	0	0	47676.34	-0.3	0.7	1000	46569.44	916853.31
24	25	1.2	3.3	0	0	47676.34	-0.3	0.8	1000	43538.25	960391.56
25	26	2	7.2	0	0	47676.34	-0.3	4.7	1000	30518.56	990910.12
26	27	1.2	3.8	0	0	47676.34	-0.3	1.3	1000	27217.5	1018127.6
27	28	1.2	6.2	0	0	47676.34	-0.3	3.7	1000	28486.48	1046614.1
28	29	2.1	11.1	0	0	47676.34	-0.3	8.6	1000	8485.39	1055099.5
29	30	0.9	6.3	350	462.96	48139.3	-0.3	3.8	1000	25219.29	1080318.8
30	31	0.8	4.6	400	448.78	48588.08	-0.3	2.1	1000	29037.25	1109356
31	32	1.8	5.6	0	0	48588.08	-0.3	3.1	1000	15257.13	1124613.2
32	33	2	4.7	0	0	48588.08	-0.3	2.2	1000	16285.97	1140899.1
33	34	1.8	6.3	0	0	48588.08	-0.3	3.8	1000	18539.59	1159438.7
34	35	2.1	11	0	0	48588.08	-0.3	8.5	1000	23096.45	1182535.2
35	36	1.45	2.8	0	0	48588.08	-0.3	0.3	1000	50942.6	1233477.8
36	37	1.38	3	0	0	48588.08	-0.3	0.5	1000	49009.62	1282487.4
37	38	1.2	3.4	0	0	48588.08	-0.3	0.9	1000	46224.75	1328712.1
38	39	0.7	9.4	300	473.75	49061.83	-0.3	6.9	1000	25306.24	1354018.4
39	40	0.9	11.6	100	121.11	49182.94	-0.3	9.1	1000	19896.22	1373914.6
40	41	2.1	9.2	0	0	49182.94	-0.3	6.7	1000	15147.16	1389061.8
41	42	1.2	5.4	0	0	49182.94	-0.3	2.9	1000	29103.1	1418164.9
42	43	1.8	5	0	0	49182.94	-0.3	2.5	1000	31333.36	1449498.2
43	44	0.5	5.4	100	36.7	49219.64	-0.3	2.9	1000	40107.28	1489605.5
44	45	0.3	9.3	1000	2653.61	51873.25	-0.3	6.8	1000	24393.59	1513999.1
45	46	0.5	3	100	50.89	51924.14	-0.3	0.5	1000	47848.15	1561847.2
46	47	0.6	8.5	100	124.95	52049.09	-0.3	6	1000	33346.29	1595193.5
47	48	0.9	2.4	1000	1716.47	53765.56	-0.3	0	1000	48705.84	1643899.4
48	49	0.8	1.5	1000	1565.64	55331.2	-0.3	0	1000	54376.46	1698275.8
49	50	1.1	5.5	550	702.36	56033.56	-0.3	3	1000	46918.87	1745194.7
50	51	0.5	2.2	1000	4068.59	60102.15	-0.3	0	1000	57781.84	1802976.5
51	52	1.1	3.9	1000	4790.1	64892.25	-0.3	1.4	1000	54097.55	1857074.1
52	53	1.2	8.1	1000	1472.42	66364.67	-0.3	5.6	1000	49103.3	1906177.4
53	54	0.9	4.2	550	637.44	67002.11	-0.3	1.7	1000	53591.88	1959769.3
54	55	0.8	2.2	1000	4209.48	71211.59	-0.3	0	1000	53244.83	2013014.1
55	56	0.5	9.87	1000	1796.2	73007.79	-0.3	7.4	1000	46837.25	2059851.4
56	57	0.6	4.3	100	113.09	73120.88	-0.3	1.8	1000	43644.64	2103496

Class-I											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
57	58	0.9	7.2	1000	1359.07	74479.95	-0.3	4.7	1000	34027.58	2137523.6
58	59	1.1	5.6	650	2067.79	76547.74	-0.3	3.1	1000	30159.91	2167683.5
59	60	1.3	1.7	1000	15939.33	92487.07	-0.3	0	1000	43871.08	2211554.6
60	61	0.9	2.1	1000	6109.96	98597.03	-0.3	0	1000	53925.18	2265479.7
61	62	0.8	1.4	1000	15104.89	113701.92	-0.3	0	1000	57311.98	2322791.7
62	63	0.5	3	1000	13996.85	127698.77	-0.3	0.5	1000	53830.43	2376622.2
63	64	0.7	1.5	1000	7696.51	135395.28	-0.3	0	1000	52590.91	2429213.1
64	65	0.8	1.6	1000	13855.42	149250.7	-0.3	0	1000	54280.86	2483493.9
65	66	0.9	5.2	1000	11202.78	160453.48	-0.3	2.7	1000	54622.6	2538116.5
66	67	1.2	5.1	1000	9050.79	169504.27	-0.3	2.6	1000	43268.76	2581385.3
67	68	1.1	3.1	1000	6699.26	176203.53	-0.3	0.6	1000	48829.2	2630214.5
68	69	0.5	3	1000	4070.98	180274.51	-0.3	0.5	1000	52313.5	2682528
69	70	0.6	7.6	1000	8862.59	189137.1	-0.3	5.1	1000	45655.52	2728183.5
70	71	0.7	5	1000	1777.06	190914.16	-0.3	2.5	1000	49005.62	2777189.1
71	72	0.9	3.7	1000	7592.31	198506.47	-0.3	1.2	1000	40648.09	2817837.2
72	73	1.2	5.2	1000	11854.67	210361.14	-0.3	2.7	1000	50994	2868831.2
73	74	1.1	2.6	1000	9003.41	219364.55	-0.3	0.1	1000	53556.73	2922387.9
74	75	1.3	7.2	1000	3274.82	222639.37	-0.3	4.7	1000	35692.04	2958080
75	76	1.2	7.1	1000	10347.55	232986.92	-0.3	4.6	1000	44084.79	3002164.8
76	77	0.5	4.2	1000	6351.67	239338.59	-0.3	1.7	1000	39554.02	3041718.8
77	78	0.6	2.5	1000	9579.76	248918.35	-0.3	0	1000	50946.87	3092665.7
78	79	0.8	3.2	1000	16582.49	265500.84	-0.3	0.7	1000	48966.68	3141632.3
79	80.39	0.9	2.5	1000	12414.47	277915.31	-0.3	0	1000	61389.51	3203021.9
Total				41250	277915.31		Total		80000	3203021.9	

Table 18- Minimum & Maximum depth per km wise (Class-I)

Class-II:-

Class-II											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
0	1	0.2	1.57	1000	20668.87	20668.87	-0.3	0.1	1000	78483.78	78483.78
1	2	0.1	1.84	1000	27232.62	47901.49	-0.3	0.5	1000	82067.5	160551.28
2	3	0.2	2.34	1000	12937.39	60838.88	-0.3	0.1	1000	76019.65	236570.93
3	4	0.58	2.16	1000	5406.61	66245.49	-0.3	0.1	1000	85196.74	321767.67
4	5	0.69	2.03	1000	9525.19	75770.68	-0.3	0.01	1000	79885.8	401653.47
5	6	0.2	3.11	1000	2368.68	78139.36	-0.3	0.8	1000	76050.6	477704.07
6	7	0.2	6.55	1000	5956.29	84095.65	-0.3	3.9	1000	59579.9	537283.97
7	8	0.5	10.42	1000	17323.1	101418.75	-0.3	8	1000	58946.06	596230.03
8	9	0.6	2.75	1000	2790.17	104208.92	-0.3	0.2	1000	79066.67	675296.7
9	10	0.73	3.97	200	311.28	104520.2	-0.3	1.41	1000	70865.64	746162.34
10	11	0.27	2.41	1000	5006.41	109526.61	-0.3	0.2	1000	79472.38	825634.72
11	12	0.38	4.73	1000	1526.16	111052.77	-0.3	2.3	1000	67574.78	893209.5
12	13	0.72	6.44	500	698.28	111751.05	-0.3	4.81	1000	66589.47	959798.97
13	14	2	19.73	0	0	111751.05	-0.3	17.3	1000	9274.16	969073.13
14	15	1.99	5.36	100	45.56	111796.61	-0.3	2.11	1000	55845.66	1024918.8
15	16	1.4	13.76	0	0	111796.61	-0.3	11.3	1000	12407.24	1037326
16	17	2	12.74	0	0	111796.61	-0.3	10.3	1000	5478.08	1042804.1
17	18	1.4	11.45	0	0	111796.61	-0.3	8.7	1000	61244.08	1104048.2
18	19	1.9	14.01	200	198.19	111994.8	-0.3	11.8	1000	16381.86	1120430.1
19	20	1.9	13.97	150	193.23	112188.03	-0.3	11.5	1000	33450.61	1153880.7
20	21	1.5	8.05	0	0	112188.03	-0.3	5.3	1000	44972.36	1198853
21	22	2	9.6	0	0	112188.03	-0.3	7.2	1000	36883.12	1235736.1
22	23	0.6	2.19	1000	1001.77	113189.8	-0.3	0.2	1000	84943.04	1320679.2
23	24	1.4	3.35	0	0	113189.8	-0.3	0.71	1000	70010.54	1390689.7
24	25	1.1	3.32	100	13.68	113203.48	-0.3	0.9	1000	67365.48	1458055.2
25	26	1.8	7.3	0	0	113203.48	-0.3	4.9	1000	50020.9	1508076.1

Class-II											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
26	27	1	5.59	100	89.89	113293.37	-0.3	1.5	1000	48902.66	1556978.8
27	28	1	6.32	100	124.05	113417.42	-0.3	3.9	1000	48893.39	1605872.2
28	29	2	11.2	100	54.83	113472.25	-0.3	8.7	1000	22526.28	1628398.4
29	30	0.89	6.4	1000	1276.31	114748.56	-0.3	3.81	1000	44324.64	1672723.1
30	31	0.7	4.68	700	887.3	115635.86	-0.3	2.2	1000	52300.84	1725023.9
31	32	1.7	5.63	0	0	115635.86	-0.3	3.2	1000	32237.79	1757261.7
32	33	1.99	4.82	0	0	115635.86	-0.3	2.21	1000	32037.02	1789298.7
33	34	1.6	8.14	0	0	115635.86	-0.3	4	1000	33265.7	1822564.4
34	35	2	11.07	100	2.68	115638.54	-0.3	8.6	1000	39739.5	1862303.9
35	36	1.25	3.37	100	0.14	115638.68	-0.3	0.5	1000	76985.79	1939289.7
36	37	1.28	3.06	100	36.81	115675.49	-0.3	0.6	1000	73732.91	2013022.6
37	38	1	4.8	150	106.46	115781.95	-0.3	1.1	1000	70307.99	2083330.6
38	39	0.69	9.44	1000	1868.41	117650.36	-0.3	6.91	1000	42915.2	2126245.8
39	40	0.89	11.63	1000	1005.3	118655.66	-0.3	9.11	1000	33842.63	2160088.4
40	41	1.9	9.29	100	34.26	118689.92	-0.3	6.9	1000	27023.16	2187111.6
41	42	1.19	5.45	150	139.62	118829.54	-0.3	2.91	1000	49170.02	2236281.6
42	43	1.6	5.03	100	26.8	118856.34	-0.3	2.7	1000	49645.66	2285927.3
43	44	0.49	5.63	1000	1009.45	119865.79	-0.3	2.91	1000	62828.34	2348755.6
44	45	0.2	9.41	1000	5322.35	125188.14	-0.3	6.9	1000	38430.45	2387186.1
45	46	0.48	3.02	500	615.11	125803.25	-0.3	0.6	1000	71634.07	2458820.1
46	47	0.5	8.77	750	963.21	126766.46	-0.3	6.2	1000	52455.07	2511275.2
47	48	0.89	4.61	1000	6301.8	133068.26	-0.3	0.1	1000	72846.39	2584121.6
48	49	0.7	2.03	1000	6858.27	139926.53	-0.3	0.2	1000	79915.13	2664036.7
49	50	1.08	4.61	1000	4123.08	144049.61	-0.3	3.01	1000	70024.29	2734061
50	51	0.4	2.64	1000	11359.45	155409.06	-0.3	0.1	1000	84675.53	2818736.6
51	52	1.07	2.82	1000	12821.06	168230.12	-0.3	1.6	1000	79229.54	2897966.1
52	53	1	6.96	1000	7488.43	175718.55	-0.3	5.7	1000	73410.7	2971376.8
53	54	0.8	2.22	1000	6307.31	182025.86	-0.3	1.8	1000	78960.48	3050337.3
54	55	0.7	2.26	1000	14192.34	196218.2	-0.3	0.1	1000	78357.27	3128694.5
55	56	0.48	9.87	1000	6784.66	203002.86	-0.3	7.41	1000	69487.07	3198181.6

Class-II											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
56	57	0.59	4.4	1000	2860.97	205863.83	-0.3	2	1000	67639.97	3265821.6
57	58	0.88	7.27	1000	4365.76	210229.59	-0.3	4.8	1000	58420.54	3324242.1
58	59	1	5.88	1000	8309.91	218539.5	-0.3	3.11	1000	49676.57	3373918.7
59	60	1.27	1.92	1000	28449.68	246989.18	-0.3	0.1	1000	66790.44	3440709.1
60	61	0.7	2.27	1000	16786.18	263775.36	-0.3	0.2	1000	79245.43	3519954.6
61	62	0.7	1.48	1000	30114.2	293889.56	-0.3	0.01	1000	84118.95	3604073.5
62	63	0.4	3.13	1000	28472.78	322362.34	-0.3	0.6	1000	79105.46	3683179
63	64	0.68	1.58	1000	18222.53	340584.87	-0.3	0.2	1000	77542.84	3760721.8
64	65	0.79	1.78	1000	26738.94	367323.81	-0.3	0.1	1000	79767.36	3840489.2
65	66	0.8	5.29	1000	23535.95	390859.76	-0.3	2.8	1000	81451.75	3921940.9
66	67	1.18	5.29	1000	18859.18	409718.94	-0.3	2.8	1000	66124.88	3988065.8
67	68	1	3.17	1000	15667.77	425386.71	-0.3	0.7	1000	73371.2	4061437
68	69	0.49	3.33	1000	12974.54	438361.25	-0.3	0.7	1000	77400.9	4138837.9
69	70	0.5	7.6	1000	18022.34	456383.59	-0.3	5.2	1000	69615.78	4208453.7
70	71	0.68	5.09	1000	7022.18	463405.77	-0.3	2.7	1000	72848.09	4281301.8
71	72	0.8	3.81	1000	15551.63	478957.4	-0.3	1.21	1000	64121.19	4345423
72	73	1.17	5.3	1000	22745.89	501703.29	-0.3	2.8	1000	75106.1	4420529.1
73	74	0.9	2.66	1000	19077.69	520780.98	-0.3	0.3	1000	78973.25	4499502.3
74	75	1.2	7.22	1000	8831.03	529612.01	-0.3	4.8	1000	54254.65	4553757
75	76	1.1	7.11	1000	19795.48	549407.49	-0.3	4.7	1000	65583.07	4619340
76	77	0.48	4.22	1000	12860.03	562267.52	-0.3	1.8	1000	61553.83	4680893.9
77	78	0.59	2.97	1000	17477.62	579745.14	-0.3	0.01	1000	75671.65	4756565.5
78	79	0.78	3.23	1000	28266.88	608012.02	-0.3	0.9	1000	71947.71	4828513.2
79	80.391	0.8	2.52	1000	24536.47	632548.49	-0.3	0.1	1000	90169.66	4918682.9
Total				54300	632548.49		Total		80000	4918682.9	

Table 19 - Minimum & Maximum depth per km wise (Class II)

Class-III:-

Class-III											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
0	1	0.1	1.67	1000	43603.56	43603.56	-0.3	0.2	1000	114479.71	114479.71
1	2	0.1	2.04	1000	50946.67	94550.23	-0.3	0.7	1000	120588.02	235067.73
2	3	0.1	2.44	1000	26702.14	121252.37	-0.3	0.2	1000	112320.22	347387.95
3	4	0.48	2.26	1000	18834.22	140086.59	-0.3	0.2	1000	124213.56	471601.51
4	5	0.68	2.04	1000	25393.29	165479.88	-0.3	0.02	1000	116469.43	588070.94
5	6	0.1	3.31	1000	12103.82	177583.7	-0.3	1	1000	112432.3	700503.24
6	7	0.1	6.65	1000	16083.7	193667.4	-0.3	4	1000	93816.93	794320.17
7	8	0.4	10.52	1000	31047.17	224714.57	-0.3	8.1	1000	88573.66	882893.83
8	9	0.5	2.85	1000	12232.32	236946.89	-0.3	0.3	1000	115069.29	997963.12
9	10	0.72	3.98	1000	5107.65	242054.54	-0.3	1.42	1000	107207.36	1105170.5
10	11	0.07	2.61	1000	17953.95	260008.49	-0.3	0.4	1000	115818.13	1220988.6
11	12	0.28	4.83	1000	8176.74	268185.23	-0.3	2.4	1000	101478.2	1322466.8
12	13	0.71	6.45	1000	5872.93	274058.16	-0.3	4.82	1000	99403.96	1421870.8
13	14	1.9	19.83	100	61.19	274119.35	-0.3	17.4	1000	21319.84	1443190.6
14	15	1.98	5.37	600	1191.11	275310.46	-0.3	2.12	1000	86191.28	1529381.9
15	16	1.3	13.86	100	43.88	275354.34	-0.3	11.4	1000	24584.6	1553966.5
16	17	2	12.84	0	0	275354.34	-0.3	10.4	1000	15398.7	1569365.2
17	18	1	11.55	100	26.79	275381.13	-0.3	8.8	1000	89691.36	1659056.6
18	19	1.7	14.21	1000	1687.55	277068.68	-0.3	12	1000	31265.25	1690321.8
19	20	1.8	14.07	1000	1892.56	278961.24	-0.3	11.6	1000	53803.38	1744125.2
20	21	1.4	8.15	200	256.12	279217.36	-0.3	5.4	1000	76708.65	1820833.8
21	22	1.9	9.7	100	139.36	279356.72	-0.3	7.3	1000	61152.64	1881986.5
22	23	0.4	2.39	1000	9036.89	288393.61	-0.3	0.4	1000	123795.65	2005782.1
23	24	1.18	3.36	100	61.86	288455.47	-0.3	0.72	1000	105181.75	2110963.9
24	25	1	3.42	1000	1114.77	289570.24	-0.3	1	1000	102890.26	2213854.1
25	26	1.6	7.5	250	354.8	289925.04	-0.3	5.1	1000	81660.46	2295514.6
26	27	0.8	5.79	1000	1408.59	291333.63	-0.3	1.7	1000	83365.32	2378879.9
27	28	0.8	6.52	1000	3250.75	294584.38	-0.3	4.1	1000	81701.83	2460581.7
28	29	1.9	11.3	1000	2237.81	296822.19	-0.3	8.8	1000	49407.89	2509989.6
29	30	0.88	6.41	1000	4584.81	301407	-0.3	3.82	1000	76972.51	2586962.1
30	31	0.6	4.78	1000	3392.27	304799.27	-0.3	2.3	1000	87918.09	2674880.2
31	32	1.6	5.73	500	713.12	305512.39	-0.3	3.3	1000	65081.65	2739961.9
32	33	1.98	4.83	100	35.82	305548.21	-0.3	2.22	1000	62820.95	2802782.8
33	34	1.4	8.34	700	1301.23	306849.44	-0.3	4.2	1000	60991.34	2863774.2
34	35	1.9	11.17	1000	1885.39	308734.83	-0.3	8.7	1000	67823.35	2931597.5

Class-III											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
35	36	1.05	3.57	1000	1496.65	310231.48	-0.3	0.7	1000	115400.91	3046998.4
36	37	1.18	3.16	800	1134.04	311365.52	-0.3	0.7	1000	109750.58	3156749
37	38	0.8	5	1000	2466.99	313832.51	-0.3	1.3	1000	106094.23	3262843.2
38	39	0.68	9.45	1000	7184.66	321017.17	-0.3	6.92	1000	72710.44	3335553.7
39	40	0.88	11.64	1000	5250.88	326268.05	-0.3	9.12	1000	58681.21	3394234.9
40	41	1.7	9.49	1000	1433.45	327701.5	-0.3	7.1	1000	49357.15	3443592
41	42	1.18	5.46	1000	1698.69	329400.19	-0.3	2.92	1000	83504.17	3527096.2
42	43	1.4	5.23	1000	1806.71	331206.9	-0.3	2.9	1000	80608.64	3607704.9
43	44	0.48	5.64	1000	7466.07	338672.97	-0.3	2.92	1000	97280.41	3704985.3
44	45	0.1	9.51	1000	11935.98	350608.95	-0.3	7	1000	61448.31	3766433.6
45	46	0.46	3.12	1000	6215.74	356824.69	-0.3	0.7	1000	107033.02	3873466.6
46	47	0.4	8.97	1000	4329.79	361154.48	-0.3	6.4	1000	83813.53	3957280.1
47	48	0.88	4.71	1000	20568.35	381722.83	-0.3	0.2	1000	107927.47	4065207.6
48	49	0.6	2.23	1000	23842.23	405565.06	-0.3	0.4	1000	116519.1	4181726.7
49	50	1.06	4.62	1000	17792.78	423357.84	-0.3	3.02	1000	104530.3	4286257
50	51	0.3	2.74	1000	29315.11	452672.95	-0.3	0.2	1000	123331.63	4409588.6
51	52	1.04	3.02	1000	30201.7	482874.65	-0.3	1.8	1000	115145.46	4524734.1
52	53	0.8	7.06	1000	24579.3	507453.95	-0.3	5.8	1000	109931.96	4634666
53	54	0.7	2.32	1000	28890.68	536344.63	-0.3	1.9	1000	115314.37	4749980.4
54	55	0.6	2.36	1000	39605.58	575950.21	-0.3	0.2	1000	114343.51	4864323.9
55	56	0.46	9.88	1000	25292.05	601242.26	-0.3	7.42	1000	102149.51	4966473.4
56	57	0.58	4.6	1000	18090.35	619332.61	-0.3	2.2	1000	103709.31	5070182.7
57	58	0.86	7.37	1000	18546.59	637879.2	-0.3	4.9	1000	96183.41	5166366.2
58	59	0.9	5.89	1000	25744.36	663623.56	-0.3	3.12	1000	81147.36	5247513.5
59	60	1.24	2.02	1000	51716.42	715339.98	-0.3	0.2	1000	101392.92	5348906.4
60	61	0.5	2.47	1000	40782.93	756122.91	-0.3	0.4	1000	115535.33	5464441.8
61	62	0.6	1.49	1000	58085.05	814207.96	-0.3	0.02	1000	122553.9	5586995.7
62	63	0.3	3.23	1000	55279.04	869487	-0.3	0.7	1000	115332.78	5702328.4
63	64	0.66	1.78	1000	40562.54	910049.54	-0.3	0.4	1000	113386.99	5815715.4
64	65	0.78	1.88	1000	50789.09	960838.63	-0.3	0.2	1000	116294.9	5932010.3
65	66	0.7	5.39	1000	46750.32	1007589	-0.3	2.9	1000	120098.63	6052109
66	67	1.16	5.49	1000	36654.84	1044243.8	-0.3	3	1000	100805.02	6152914
67	68	0.9	3.27	1000	33014.61	1077258.4	-0.3	0.8	1000	109289.6	6262203.6
68	69	0.48	3.53	1000	34559.62	1111818	-0.3	0.9	1000	113679.03	6375882.6
69	70	0.4	7.7	1000	36799.21	1148617.2	-0.3	5.3	1000	105510.44	6481393.1
70	71	0.66	5.29	1000	21568.51	1170185.7	-0.3	2.9	1000	107748.18	6589141.2
71	72	0.7	3.82	1000	31617.73	1201803.5	-0.3	1.22	1000	98823.5	6687964.7
72	73	1.14	5.4	1000	43437.11	1245240.6	-0.3	2.9	1000	109726.03	6797690.8
73	74	0.7	2.86	1000	38365.75	1283606.3	-0.3	0.5	1000	115399.56	6913090.3

Class-III											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
74	75	1.1	7.32	1000	20641.97	1304248.3	-0.3	4.9	1000	83426.47	6996516.8
75	76	1	7.21	1000	36176.57	1340424.9	-0.3	4.8	1000	97354.8	7093871.6
76	77	0.46	4.32	1000	27502.38	1367927.3	-0.3	1.9	1000	96161.71	7190033.3
77	78	0.58	2.98	1000	34473.04	1402400.3	-0.3	0.02	1000	111728.8	7301762.1
78	79	0.76	3.43	1000	49025.01	1451425.3	-0.3	1.1	1000	105412.65	7407174.8
79	80.391	0.7	2.62	1000	46852.17	1498277.5	-0.3	0.2	1000	131354.04	7538528.8
Total				70650	1498277.5		Total		80000	7538528.8	

Table 20 - Minimum & Maximum depth per km wise (Class III)

Class - IV:-

Class-IV											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
0	1	0.1	1.77	1000	61531.9	61531.9	-0.3	0.3	1000	135261.49	135261.49
1	2	0.1	2.24	1000	70027.99	131559.89	-0.3	0.9	1000	142814.37	278075.86
2	3	0.1	2.54	1000	40369.48	171929.37	-0.3	0.3	1000	133160.27	411236.13
3	4	0.38	2.36	1000	34875.76	206805.13	-0.3	0.3	1000	146509.19	557745.32
4	5	0.67	2.05	1000	41604.4	248409.53	-0.3	0.03	1000	137366.86	695112.18
5	6	0.1	3.51	1000	22915.62	271325.15	-0.3	1.2	1000	133254.75	828366.93
6	7	0.1	6.75	1000	24226.59	295551.74	-0.3	4.1	1000	114268.39	942635.32
7	8	0.3	10.62	1000	42527.4	338079.14	-0.3	8.2	1000	106024.22	1048659.5
8	9	0.4	2.95	1000	25701.8	363780.94	-0.3	0.4	1000	135846.47	1184506
9	10	0.71	3.99	1000	14292.77	378073.71	-0.3	1.43	1000	128983.32	1313489.3
10	11	0.05	2.81	1000	32867.82	410941.53	-0.3	0.6	1000	136656.12	1450145.5
11	12	0.18	4.93	1000	17867.33	428808.86	-0.3	2.5	1000	121847.64	1571993.1
12	13	0.7	6.46	1000	12830.24	441639.1	-0.3	4.83	1000	119535.03	1691528.1
13	14	1.8	19.93	200	270.91	441910.01	-0.3	17.5	1000	29961.01	1721489.1
14	15	1.97	5.38	1000	3578.22	445488.23	-0.3	2.13	1000	105296.49	1826785.6
15	16	1.2	13.96	150	271.35	445759.58	-0.3	11.5	1000	33680.84	1860466.5
16	17	2	12.94	0	0	445759.58	-0.3	10.5	1000	23062.62	1883529.1
17	18	0.9	11.65	1000	3529.24	449288.82	-0.3	8.9	1000	106503.13	1990032.2
18	19	1.5	14.41	1000	2968.59	452257.41	-0.3	12.2	1000	41469.78	2031502
19	20	1.7	14.17	1000	5014.93	457272.34	-0.3	11.7	1000	68106.65	2099608.6
20	21	1.3	8.25	1000	2644.72	459917.06	-0.3	5.5	1000	95598.91	2195207.6
21	22	1.8	9.8	700	1281.32	461198.38	-0.3	7.4	1000	76644.02	2271851.6
22	23	0.2	2.59	1000	21261.09	482459.47	-0.3	0.6	1000	146029.38	2417881
23	24	1.17	3.37	600	1007.49	483466.96	-0.3	0.73	1000	125797.48	2543678.4
24	25	0.9	3.52	800	4240.36	487707.32	-0.3	1.1	1000	123545.94	2667224.4
25	26	1.4	7.7	750	1528.13	489235.45	-0.3	5.3	1000	101183.26	2768407.6
26	27	0.6	5.99	850	3287.02	492522.47	-0.3	1.9	1000	103802.95	2872210.6
27	28	0.6	6.72	1000	7129.25	499651.72	-0.3	4.3	1000	100334.08	2972544.7
28	29	1.8	11.4	850	4573.16	504224.88	-0.3	8.9	1000	65516.94	3038061.6
29	30	0.87	6.42	1000	8306.22	512531.1	-0.3	3.83	1000	96251.52	3134313.1
30	31	0.5	4.88	1000	8860.81	521391.91	-0.3	2.4	1000	108468.4	3242781.5
31	32	1.5	5.83	700	2326.79	523718.7	-0.3	3.4	1000	86104.89	3328886.4
32	33	1.97	4.84	300	423.82	524142.52	-0.3	2.23	1000	82680.28	3411566.7
33	34	1.2	8.54	1000	3568.82	527711.34	-0.3	4.4	1000	78028.15	3489594.8

Class-IV											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
34	35	1.8	11.27	1000	4714.46	532425.8	-0.3	8.8	1000	84278.24	3573873.1
35	36	0.85	3.77	1000	7233.01	539658.81	-0.3	0.9	1000	137610.87	3711484
36	37	1.08	3.26	1000	5438.08	545096.89	-0.3	0.8	1000	130556.65	3842040.6
37	38	0.6	5.2	1000	9699.01	554795.9	-0.3	1.5	1000	126813.45	3968854.1
38	39	0.67	9.46	1000	12241.95	567037.85	-0.3	6.93	1000	91037.83	4059891.9
39	40	0.87	11.65	1000	10062.15	577100	-0.3	9.13	1000	73213.83	4133105.7
40	41	1.5	9.69	1000	3439.96	580539.96	-0.3	7.3	1000	64706.74	4197812.5
41	42	1.17	5.47	1000	3319.93	583859.89	-0.3	2.93	1000	104684	4302496.5
42	43	1.2	5.43	1000	7374.59	591234.48	-0.3	3.1	1000	99737.42	4402233.9
43	44	0.47	5.65	1000	15602.38	606836.86	-0.3	2.93	1000	117558.25	4519792.1
44	45	0	9.61	1000	18492.42	625329.28	-0.3	7.1	1000	75558.84	4595351
45	46	0.44	3.22	1000	14097.17	639426.45	-0.3	0.8	1000	127707.62	4723058.6
46	47	0.3	9.17	1000	8410.83	647837.28	-0.3	6.6	1000	102978.17	4826036.8
47	48	0.87	4.81	1000	35157.56	682994.84	-0.3	0.3	1000	128213.07	4954249.8
48	49	0.5	2.43	1000	40868.17	723863.01	-0.3	0.6	1000	137426.86	5091676.7
49	50	1.04	4.63	1000	31452.02	755315.03	-0.3	3.03	1000	125046.33	5216723
50	51	0.2	2.84	1000	46140.2	801455.23	-0.3	0.3	1000	145532.61	5362255.6
51	52	1.01	3.22	1000	46442.23	847897.46	-0.3	2	1000	135866.6	5498122.2
52	53	0.6	7.16	1000	38771.76	886669.22	-0.3	5.9	1000	130565.96	5628688.2
53	54	0.6	2.42	1000	47999.72	934668.94	-0.3	2	1000	136081.48	5764769.7
54	55	0.5	2.46	1000	57917.04	992585.98	-0.3	0.3	1000	134901.37	5899671
55	56	0.44	9.89	1000	40836.91	1033422.9	-0.3	7.43	1000	120738.38	6020409.4
56	57	0.57	4.8	1000	31438.72	1064861.6	-0.3	2.4	1000	124536.61	6144946
57	58	0.84	7.47	1000	29451.25	1094312.9	-0.3	5	1000	118185.28	6263131.3
58	59	0.8	5.9	1000	37831.53	1132144.4	-0.3	3.13	1000	99059.72	6362191
59	60	1.21	2.12	1000	67676.42	1199820.8	-0.3	0.3	1000	121473.96	6483665
60	61	0.3	2.67	1000	59115.1	1258935.9	-0.3	0.6	1000	136268.42	6619933.4
61	62	0.5	1.5	1000	77955.57	1336891.5	-0.3	0.03	1000	144550.75	6764484.2
62	63	0.2	3.33	1000	74097.67	1410989.2	-0.3	0.8	1000	136027.87	6900512
63	64	0.64	1.98	1000	57904.93	1468894.1	-0.3	0.6	1000	133991.5	7034503.5
64	65	0.77	1.98	1000	69021.57	1537915.7	-0.3	0.3	1000	137160.28	7171663.8
65	66	0.6	5.49	1000	64586.42	1602502.1	-0.3	3	1000	142255.94	7313919.7
66	67	1.14	5.69	1000	50630.53	1653132.6	-0.3	3.2	1000	120888.53	7434808.3
67	68	0.8	3.37	1000	47474.28	1700606.9	-0.3	0.9	1000	129938.89	7564747.2
68	69	0.47	3.73	1000	52249.74	1752856.6	-0.3	1.1	1000	134488.52	7699235.7
69	70	0.3	7.8	1000	51426.51	1804283.1	-0.3	5.4	1000	126161.06	7825396.7
70	71	0.64	5.49	1000	35112.69	1839395.8	-0.3	3.1	1000	128307.5	7953704.2
71	72	0.6	3.83	1000	43252.54	1882648.4	-0.3	1.23	1000	119162.45	8072866.7
72	73	1.11	5.5	1000	60090.86	1942739.2	-0.3	3	1000	129806.21	8202672.9

Class-IV											
Chainage (km)		Observed Dredging Qty. w.r.t Sounding Datum					Reduced Dredging Qty. w.r.t Sounding Datum				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cu.m.)	Cumulative Dredging Qty (cu.m.)
73	74	0.5	3.06	1000	54108.23	1996847.5	-0.3	0.7	1000	136206.4	8338879.3
74	75	1	7.42	1000	30738.06	2027585.5	-0.3	5	1000	100714.34	8439593.6
75	76	0.9	7.31	1000	48937.09	2076522.6	-0.3	4.9	1000	116313.99	8555907.6
76	77	0.44	4.42	1000	38944.88	2115467.5	-0.3	2	1000	116841.01	8672748.6
77	78	0.57	2.99	1000	48167.08	2163634.6	-0.3	0.03	1000	132467.85	8805216.5
78	79	0.74	3.63	1000	64592.25	2228226.8	-0.3	1.3	1000	124623.47	8929840
79	80.391	0.6	2.72	1000	65547.8	2293774.6	-0.3	0.3	1000	154899.91	9084739.9
Total				74900	2293774.6		Total		80000	9084739.9	

Table 21- Minimum & Maximum depth per km wise (Class IV)

Annexure-3: Details of collected Water level of different gauge stations w.r.t. MSL (CWC, Irrigation, Ports, Maritime Boards, Observed stations during survey etc.) – Table indicating Chainage (zero at downstream) and following:-

Date	Tide Pole name	Chainage (km)	Time	T. Reading	Zero of TP w.r.t. MSL (m)	W.L w.r.t. MSL (m)	SD value w.r.t. M.S.L	Corrected Tide (m)
				A	B	C = A+B	D	E = D-C
21.01.16	GS (TP)-1	2.027	24 hrs	0.26	10.82	11.08	9.58	-2.507
16.10.15	GS (TP)-2	10.193	24 hrs	0.29	12.099	12.389	9.882	-2.507
07.10.15	GS (TP)-3	19.758	24 hrs	0.31	13.36	13.67	11.163	-1.5
09.10.15	GS (TP)-4	20.014	24 hrs	0.34	13.342	13.682	11.175	-2.507
08.10.15	GS (TP)-5	30.115	24 hrs	0.39	13.35	13.74	11.233	-2.507
11.10.15	GS (TP)-6	38.229	24 hrs	0.41	13.445	13.855	11.348	-2.507
10.10.15	GS (TP)-7	49.994	24 hrs	0.45	13.684	14.134	11.627	-2.507
12.10.15	GS (TP)-8	60.908	24 hrs	0.49	15.522	16.012	13.505	-2.507
17.10.15	GS (TP)-9	60.985	24 hrs	0.53	15.572	16.102	13.595	-2.507
13.10.15	GS (TP)-10	71.927	24 hrs	0.57	15.88	16.45	13.943	-2.507
15.10.15	GS (TP)-11	80.391	24 hrs	0.59	16.978	17.568	15.061	-2.507

Table 22- Details of Collected water level at different gauge stations

Annexure-4: Details of Bathymetric survey carried out:-

Date of Survey	Type of survey	Chainage	
		From (km)	To (km)
21.01.16	Bathymetry Survey/Topography Survey	0.000	2.500
16.10.15	Bathymetry Survey/Topography Survey	2.500	13.100
07.10.15	Bathymetry Survey/Topography Survey	13.100	20.500
09.10.15	Bathymetry Survey/Topography Survey	20.500	27.000
08.10.15	Bathymetry Survey/Topography Survey	27.000	38.100
11.10.15	Bathymetry Survey/Topography Survey	38.100	40.400
10.10.15	Bathymetry Survey/Topography Survey	40.400	50.000
12.10.15	Bathymetry Survey/Topography Survey	50.000	61.000
17.10.15	Bathymetry Survey/Topography Survey	61.000	66.600
13.10.15	Bathymetry Survey/Topography Survey	66.600	71.900
15.10.15	Bathymetry Survey/Topography Survey	71.900	80.391

Table 23- Details of Bathymetry survey

Annexure-5: Bank Protection along the Bank:-

The bank of the river includes with villages, Roads, Ferry Ghats, Jetty, electric lines, RCC and Rail Bridges etc. RCC, Rail Bridge are highly protected by concrete pitching. Most of the river stretches are protected by long embankments and Boulder pitching.The Bank of the River Mahananda has been affected by floods, sometimes it become dangerous during the monsoon. As a result, the lower portion or the bank side villages are flooded. Boulder pitching is also noticed in this zone of river near at Chainage of 1.00 km to 2.400 km. Most of the river sides of the bank are protected with embankment and Bituminous road. Animal bathing, dropping the garbages, plastics, industry based chemicals etc. affected the water of the river. As a result the river becomes polluted.

Annexure-6: Details of Features across the Bank:-

Name of Ferry Ghat	Passenger Details	Latitude (N)	Longitude (E)	Cargo Details	Right Bank Chainage	Left Bank Chainage	Details of Available boat and vessels
Char Kadipur Ferry ghat	Villagers	24°58'45.69"	88° 9'20.49"	Light goods and vehicle	3.940	3.950	Small kinds of Boat
Sadar ferry ghat	Villagers	25° 0'27.99"	88° 9'16.81"	Light goods and vehicle	7.779	7.970	Small kinds of Boat
Nimayasara Ferry ghat	Villagers	25° 2'22.25"	88° 7'57.34"	Light goods and vehicle	12.222	12.212	Small kinds of Boat
Itakhola Ferry ghat	Villagers	25° 2'50.27"	88° 8'1.42"	Nil	13.715	13.710	Small kinds of Boat
Nababganj Ferry ghat	Villagers	25° 3'45.66"	88° 7'44.22"	Light goods and vehicle	14.963	14.913	Small kinds of Boat
Anandipur ferry ghat	Villagers	25° 3'58.23"	88° 7'16.68"	Light goods and vehicle	15.930	15.927	Small kinds of Boat
Daupur Ferry ghat	Villagers	25° 4'20.59"	88° 6'55.43"	Nil	16.880	16.970	Small kinds of Boat
Khanpur Ferry ghat	Villagers	25°16'56.03"	88° 6'20.23"	Light goods and vehicle	51.504	51.900	Small kinds of Boat

Annexure-7: Detailed methodology adopted for carrying out survey. Horizontal Control and Vertical Control:-

- **Establishment of Horizontal Control:-**

The Horizontal control for Topography Survey: - High precision RTK DGPS in fix mode is using UHF Radio Modem with IHO accuracy standards, with minimum 24 hours observations at some permanent platform/base with the Topographic survey Equipments: South (S86T) GNSS RTK, Total Station was used for conducting the topographic survey on UTM Projection at Zone 45 N as directed in the contract specifications..

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The Horizontal control for Bathymetry survey: - DGPS is receiving corrections from Beacons from the Base stations.

- **Establishment of Vertical Control:-**

Vertical control from the Irrigation Gauge and waterways department, Englishbazar is used for the entire survey work. Its value is 18.00 meter w.r.t. M.S.L has been considered for calculating the vertical levels. Total 9 no. BM was established along the 80.391 km Mahananda River with the reference of Irrigation Gauge level which is situated near the English Bazar area.

Topography Survey:-

The survey was commenced on 12th October, 2015 and completed on 25th October, 2015. Then the days were Autumn season and arrival of winter season. The climate become normal which reached about 26◦ C. Mostly day weather was sunny and was very favorable for the conduct of survey and the weather condition remains same for the entire duration of the survey.

The survey was undertaken as per the line plan provided and the spot level points in the cross line were spaced at 40 m interval. The plotting of the chart was done on UTM Projection at Zone 45 N as directed in the contract specifications. The spot levels along the river were obtained by using Trimble DGPS. The data was post processed using Trimble Business Center to get the precise position and MSL height values of the rover locations. The Topographic survey for the entire survey stretch was conducted to collect the following data:-

- Spot levels
-Delineation of Islands
-Fixing of bridges and marks
-Assess the type of river bank
-Extending the vertical and horizontal control throughout the survey area
-Collection of local information along the river Banks

Topographic survey Equipments: South (S86T) GNSS RTK, Total Station was used for conducting the topographic survey.

South RTK (S86T) Satellite navigation is a technique used in land survey and in hydrographic survey based on the use of carrier phase measurements of the GPS, GLONASS and / or Galileo signals where a single reference station provides the real-time corrections, providing up to centimeter-level accuracy. When referring to GPS in particular, the system is also commonly referred to as Carrier-Phase Enhancement, CPGPS. RTK systems use a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. There are several ways to transmit a correction signal from base station to mobile station. The most popular way to achieve real-time, low-cost signal transmission is to use a radio modem, typically in the UHF band. This allows the units to calculate their relative position to millimeters, although their absolute position is accurate only to the same accuracy as the position of the base station.

RTK systems are available in dual-frequency and single-frequency versions. Dual-frequency systems deliver greater precision, faster and over longer baselines than single-frequency systems. Leica GS09 & GS12 GNSS RTK that used for the survey contains dual-frequency requires antenna and controller to suit any surveying task with a wide range of functionality. Leica GS09 & GS12 GNSS RTK Rover is extremely light-weight and cable free rover is comfortable to use and withstand even for rough use and topple over. It uses a single base station receiver and a number of mobile units. The base station re-broadcasts the phase of the carrier that it measured, and the mobile units compare their own phase measurements with the ones received from the base station. So, that centimeter level accuracy can be achieved from latitude, longitude and altitude. RTK technique in terms of general navigation, it is perfectly suited to roles like surveying. In this case, the base station is located at a known surveyed location, often a benchmark, and the mobile units can then produce a highly accurate map by taking fixes relative to that point. RTK has also found uses in auto drive/autopilot systems, precision farming and similar roles.

Figure 30- Topography Survey Instruments

- **Bathymetry Survey:-**

The Bathymetry survey was carried out using Bathy 500 portable shallow water Echo sounder supported by DGPS Beacon Receiver and HYPACK Data collection and processing software. The survey equipment was installed as per the standard procedure the survey vessel equipped with safety gears.

Bathy- 500MF Echo sounder: The Bathy- 500MF echo sounder is an electronic hydrographic survey instrument used for measuring depths with precision chart recordings and digital data output manufactured by SyQuest Incorporated, USA. The Bathy-500 echo sounding systems are based on the principle that when a sound signal is sent into the water it will be reflected back when it strikes an object. The Bathy-500 is technologically sophisticated, utilizing modern, micro processor based electronics and a thermal chart recorder mechanism. Digital processing enables the instrument to offer fully automatic digitizing capabilities. When interfaced to a NMEA 0183 compatible position sensor, it provides user with a complete, integrated hydrographic survey environment. The instrument front panel consists of a high contrast, backlit four line LCD displays and a fully sealed input keypad. The front panel encompassing system data, status and setup parameters with RS232/RS422 output format. All operating functions are set via the front panel interface. Setup selections are stored within internal, non-volatile memory for instant availability upon power-up. The instrument decodes and processes the NMEA 0183 formatted sentence GGA or GLL from GPS/DGPS using variable Baud rates for communication.

Figure 31- Bathymetry Survey Instruments

Annexure-8: Photographs of Equipment:-

Following equipment was employed for the Bathymetric and Topographic survey:-

Equipment	Make	Version	Qty Employed
Echo sounder	Bathy MF 500	……	1
Current Meter	AEM 213-D	……	1
Tide Gauge	Manual (Pole type)	-	4
RTK	South S86T		3
GPS Sets	Trimble –Becon Rover SPS 361		1
Software	HYPACK data acquisition	Version 14	1
Software	AUTOCAD	2013	1
Software	Microsoft Office	2013	1

- **Survey vessel :-**

Figure 32- Survey Vessel

- **Positioning System:-**

- 1 no Trimble DGPS system (SPS361)

Figure 33- DGPS Survey Instrument

- **Navigation & Data Logging System:-**

- To provide on-line route guidance, log navigation data, provide QC of navigation data, etc. The system comprises the following equipment:
- 1 no. DELL Laptop
- 1 no. Hypack version 2014 Navigation & Data Logging Software
- 1 no. Positioning & sensor interfaces
- Sufficient Paper Rolls

- **Single Beam Echo Sounder System:-**

  - 1 no. Bathy 500MF multi frequency Echo sounder
  - 1 no. transducer 210 kHz + mounting bracket & base plate

Figure 34- Echo Sounder Instrument

- **Current Meter:-**

  - 1 no. current meter (AEM 213-D) was used during water velocity
  - observation

Figure 35- Current Meter Reading

- **Calibration:-**

  All the equipments of Machinery details are attached in **Annexure** portion

Annexure-9: Bench Mark Forms:-

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-1	618449.741	2761997.564	24.812	24°58'7.435"	88°10'24.489"	15.240

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment: 14.10.15

Station Description :-

Benchmark - 1 is located near at Azmatpur village.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-1 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

Figure 36- BM Form & Google image view of BM-1

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-2	614527.65	2767755.505	22.536	25°1'15.684"	88°8'6.349"	12.954

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment: 14.10.15

Station Description :-

Benchmark-2 is located near at Barrack Colony area.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cm X 30cm X 150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-2 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

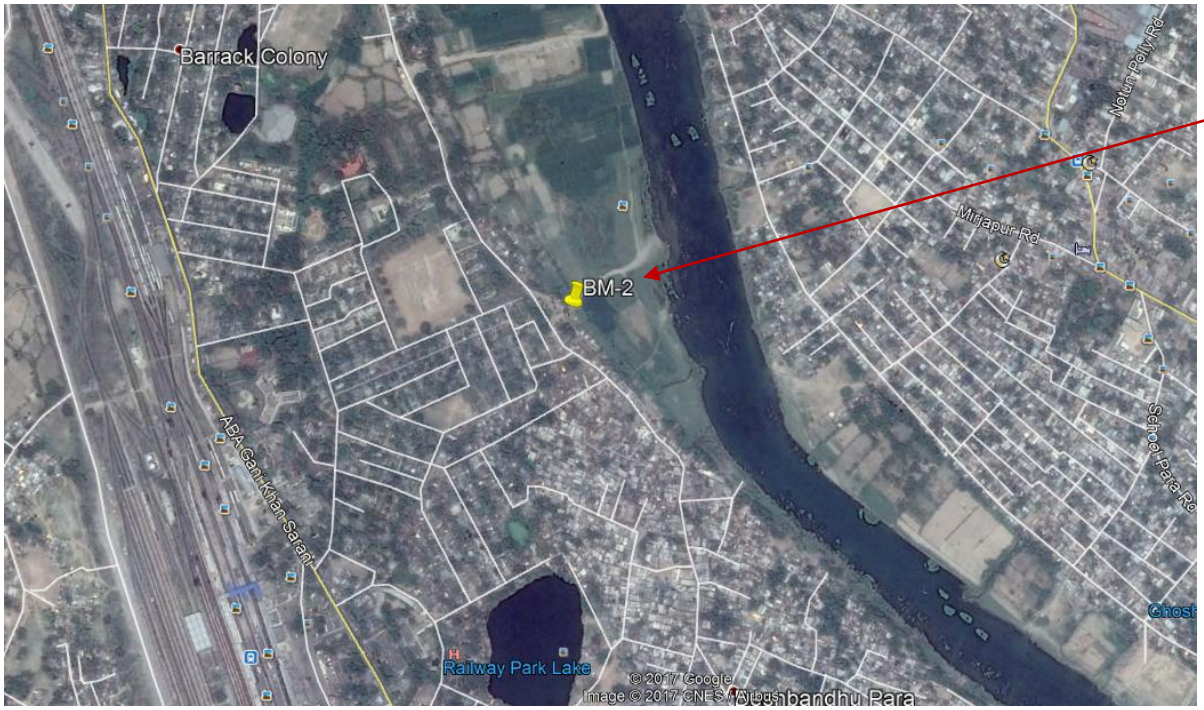


Figure 37- BM Form & Google image view of BM-2

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-3	610892.517	2775186.307	24.454	25°5'18.202"	88°5'58.821"	13.290

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment: 15.10.15

Station Description :-

Benchmark is located near at Chhotapara village.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-3 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

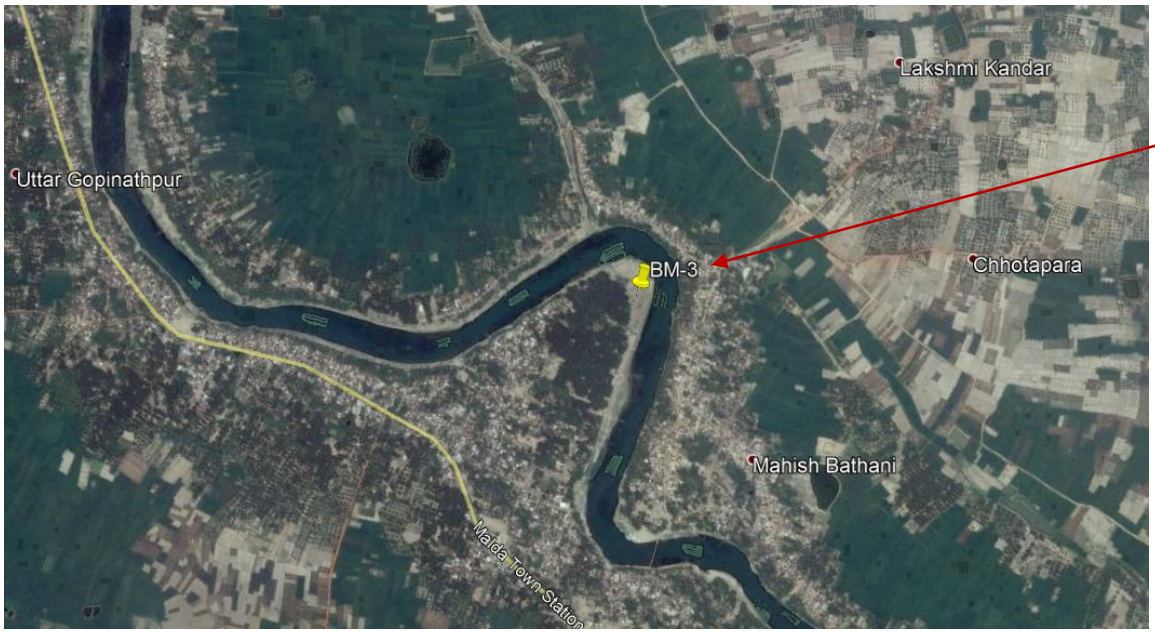


Figure 38- BM Form & Google image view of BM-3

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-4	609407.986	2781277.581	26.053	25°8'36.592"	88°5'7.58"	14.819

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment: 15.10.15

Station Description :-

Benchmark is located near at Elahabad village.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-4 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

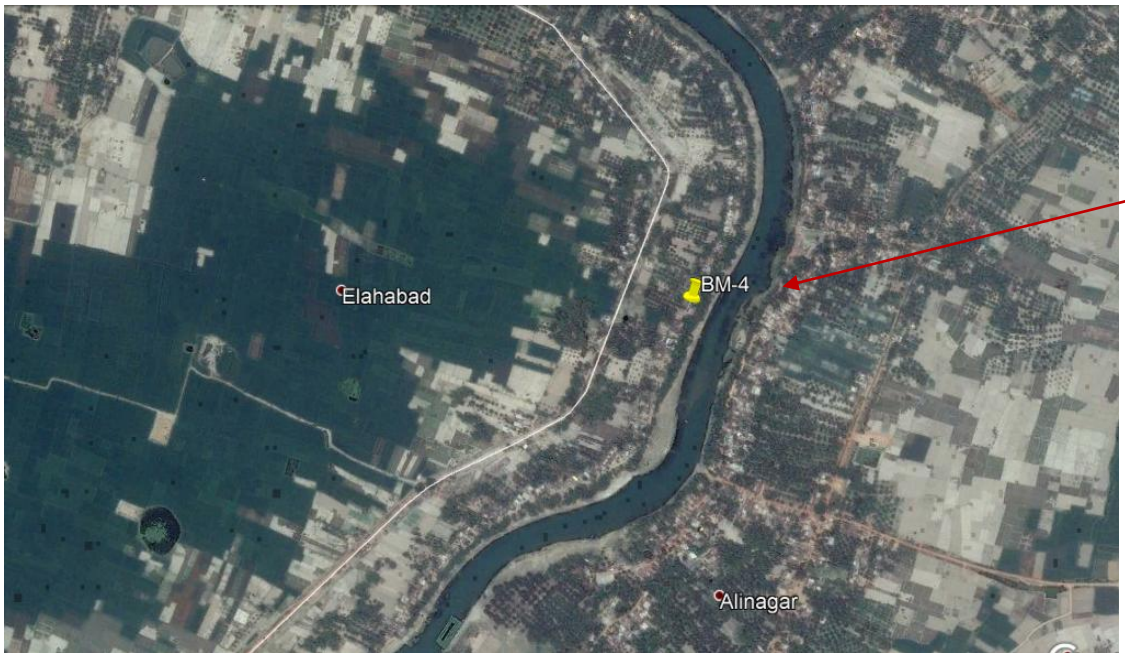


Figure 39-BM Form & Google image view of BM-4

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-5	609180.963	2786165.068	29.813	25°11'15.521"	88°5'0.877"	18.472

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment – 18.10.15

Station Description :-

Benchmark is located near at Mahananda Bridge Railway station.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-5 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

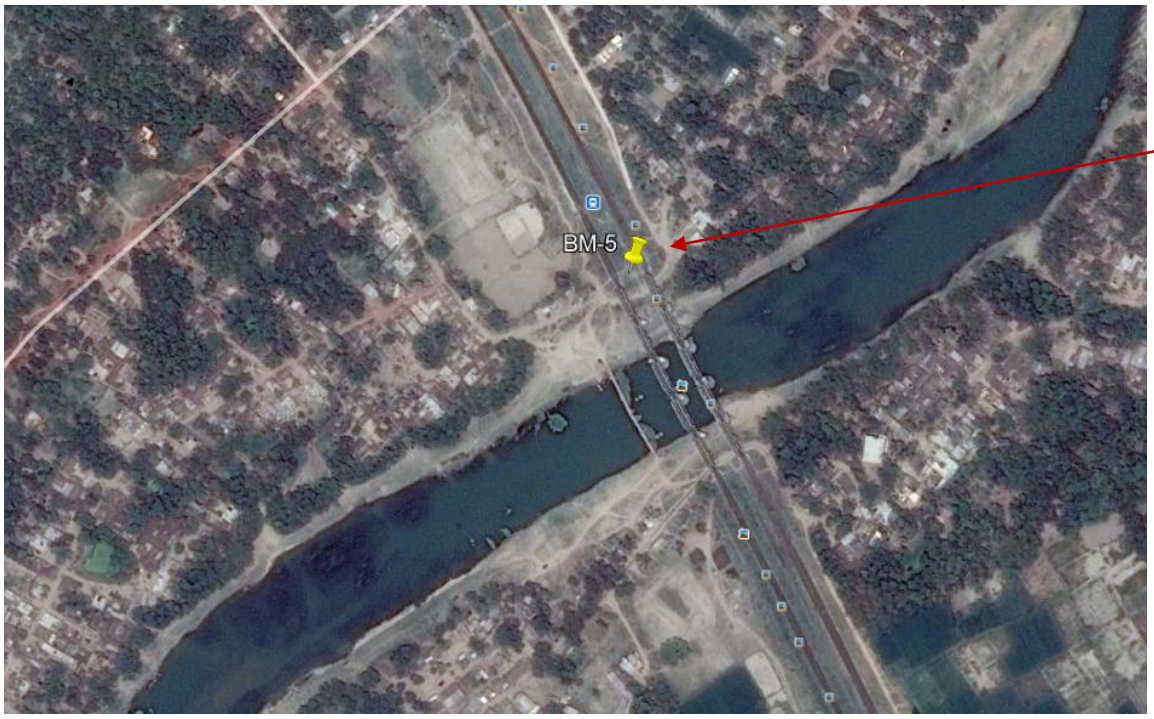


Figure 40-BM Form & Google image view of BM-5

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-6	610909.422	2794836.614	25.638	25°15'56.933"	88°6'5.162"	14.011

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment – 18.10.15

Station Description :-

Benchmark is located near Harirampur village.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-6 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

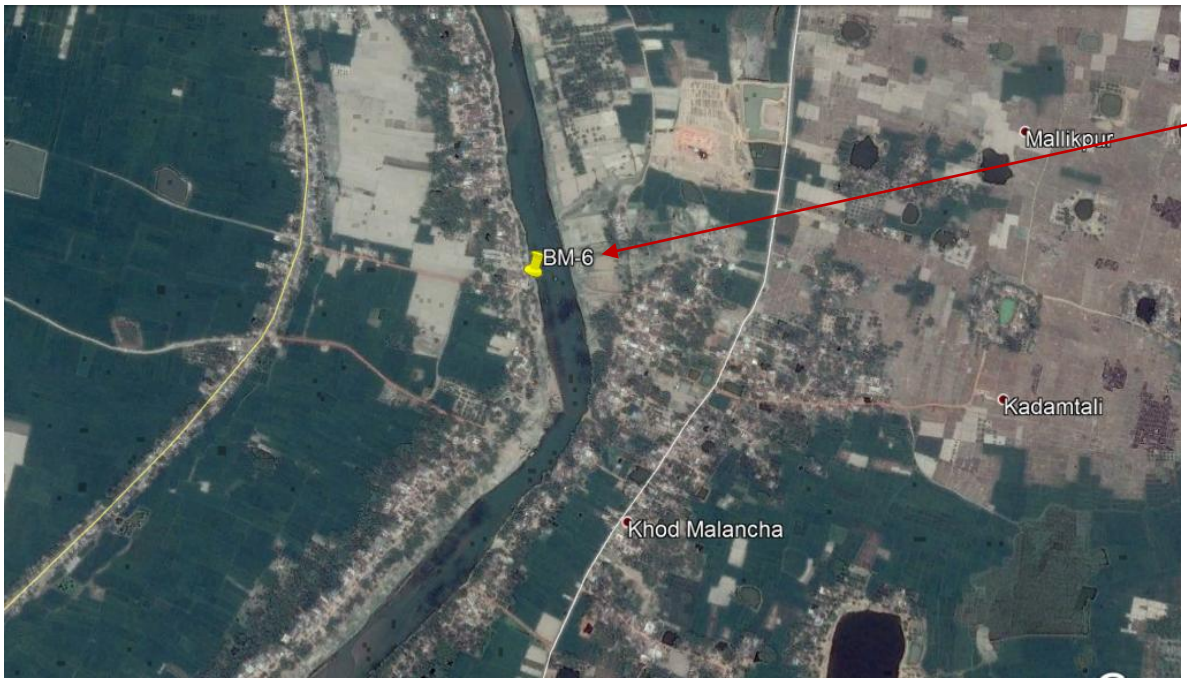


Figure 41-BM Form & Google image view of BM-6

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-7	612240.155	2804247.200	26.334	25°21'2.822"	88°6'7.928"	12.829

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment – 20.10.15

Station Description :-

Benchmark is located near Chandipur Darmar village.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-7 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

Figure 42-BM Form & Google image view of BM-7

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-8	610682.705	2810400.286	26.337	25°24'22.882"	88°6'1.631"	12.394

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment: 20.10.15

Station Description :-

Benchmark is located near Kobaia village.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cm X 30cm X 150 cm. The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-8 No. can be seen on the face of the pillar.

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

Figure 43- BM Form & Google image view of BM-8

BM Name	Easting (m)	Northing (m)	B.M Height above M.S.L (m)	Latitude (N)	Longitude (E)	B.M Height above S.D (m)
BM-9	609638.531	2814533.493	26.354	25°26'37.507"	88°5'25.471"	11.293

Pillar Established by: - B.S Geotech Pvt. Ltd. Surveyor – Mr. Bimal Das
Date of Establishment: 20.10.15

Station Description :-

Benchmark is located near the Gosaipur RCC Bridge.

The BM is denoted by a "." mark engraved on a plate. The plate is fixed on a 5cm diameter GI pipe. The GI pipe is cemented with construction pillar of 30cmX30cmX150cm.The pillar extends 60.cms above ground level. Inscription "IWAI", and BM-9 No. can be seen on the face of the pillar.

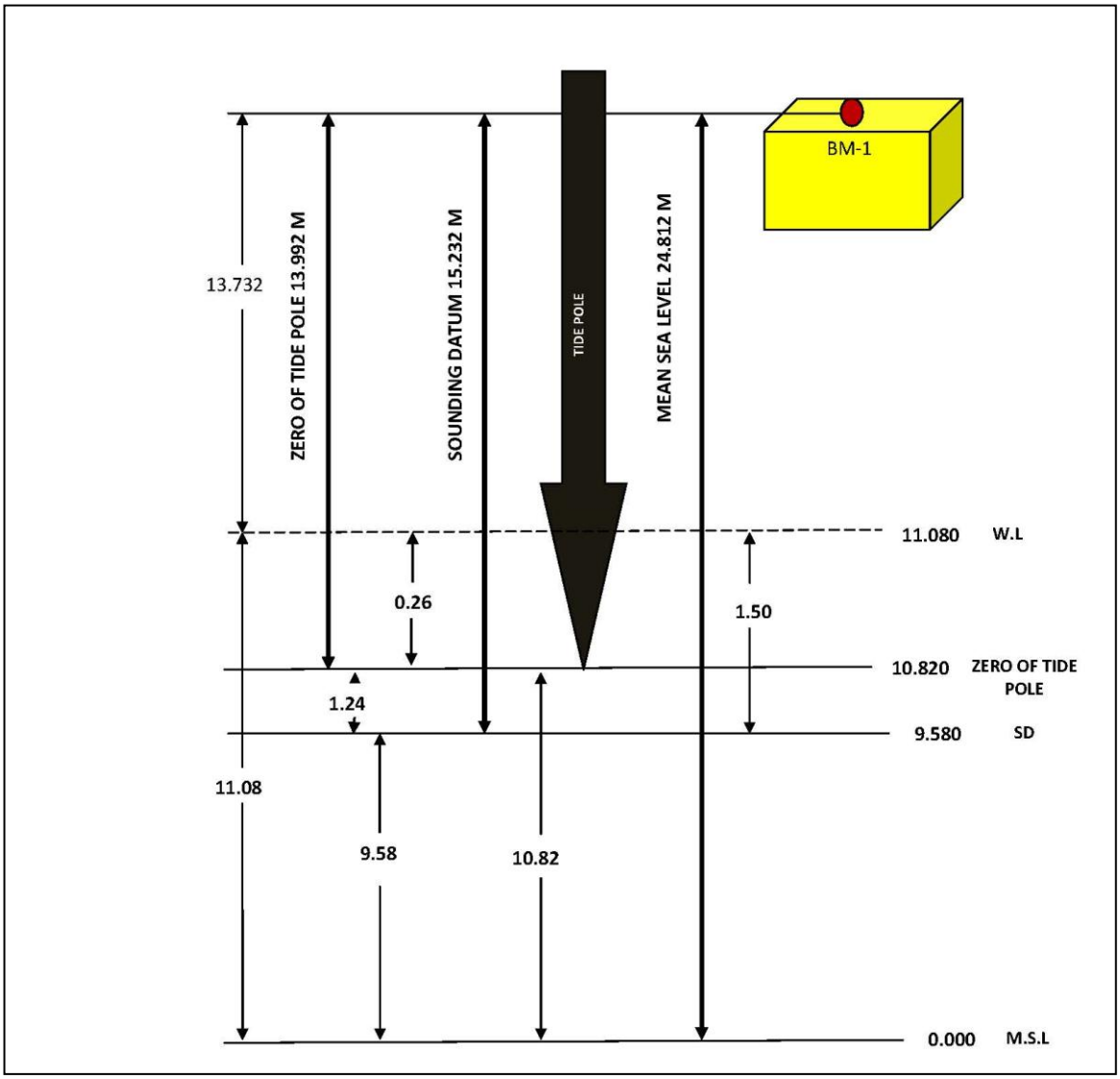
Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :** 45 N

Figure 44-BM Form & Google image view of BM-9

Annexure-10: Levelling Calculation and Levelling Diagram:-

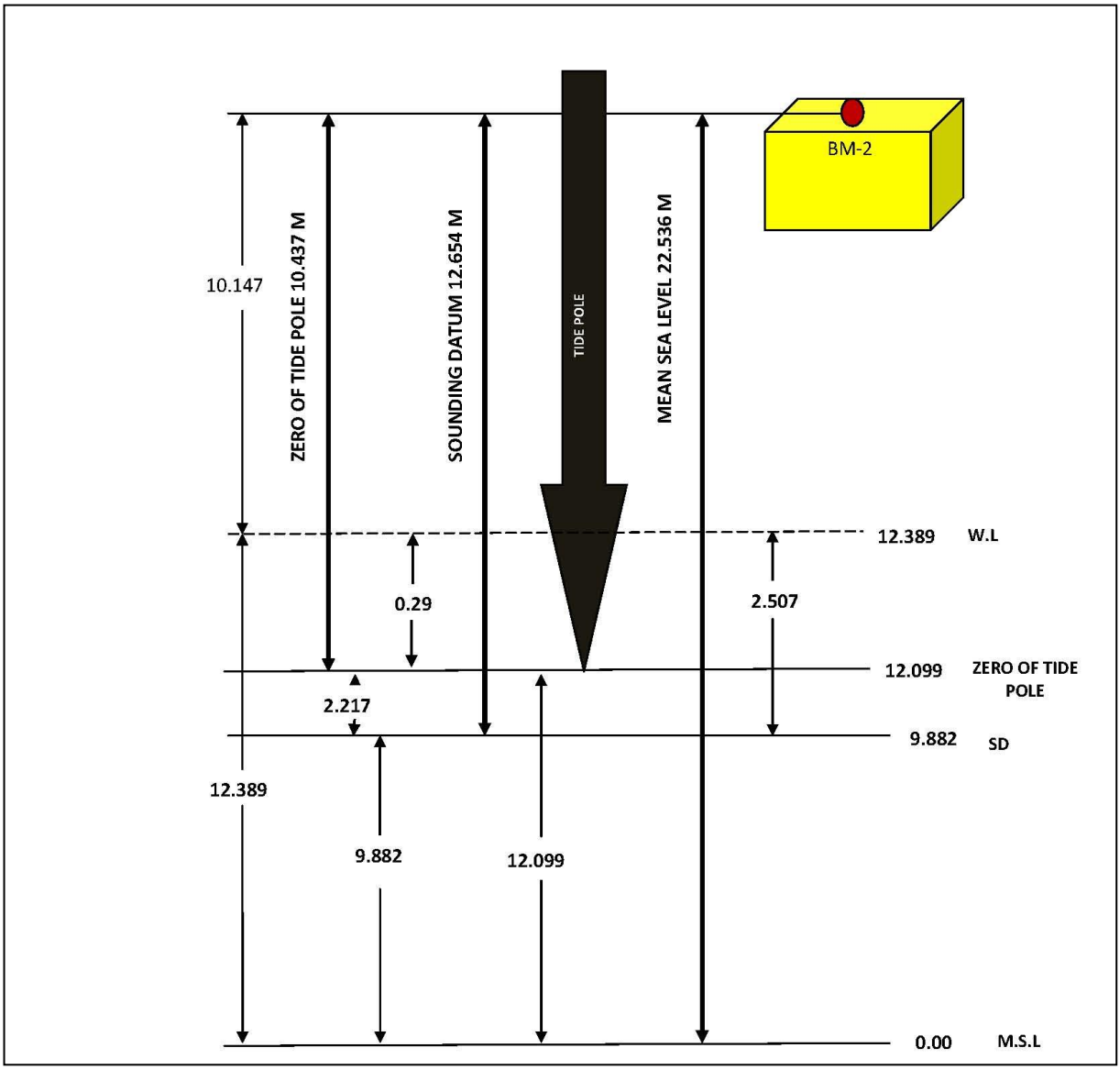
Levelling from BM-1 to GS-1

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.740					24.812	BM-1
0.588		2.866		2.126	22.686	
0.650		2.580		1.992	20.694	
0.945		2.932		2.282	18.412	
0.870		3.173		2.228	16.184	
0.625		3.022		2.152	14.032	
0.480		2.158		1.533	12.499	
		1.899		1.419	11.080	GS-1



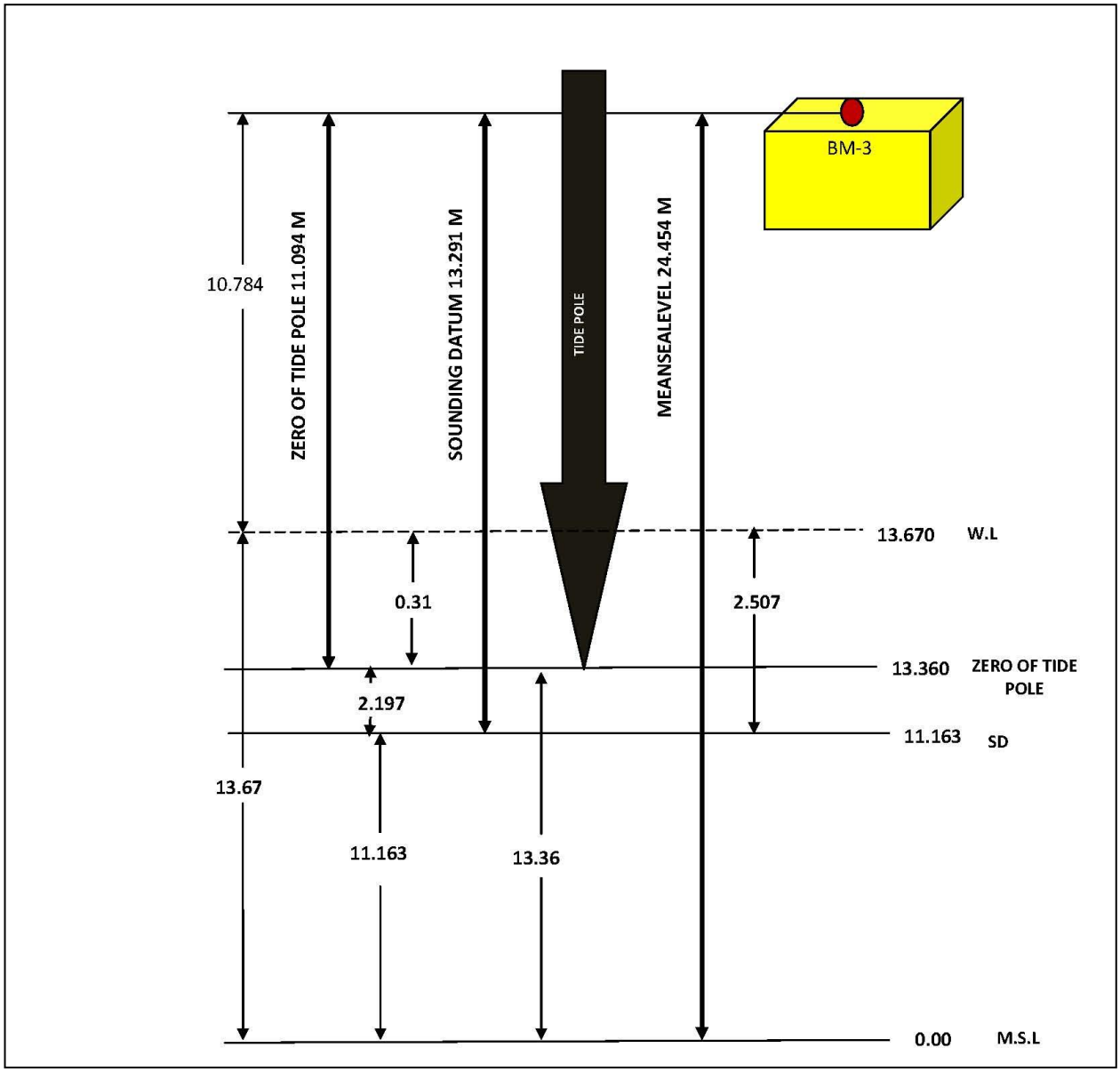
Levelling from BM-2 to GS-2

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.485					22.536	BM-2
0.540		2.550		2.065	20.471	
0.873		1.889		1.349	19.122	
0.760		2.884		2.011	17.111	
0.420		1.988		1.228	15.883	
0.745		2.310		1.890	13.993	
		2.349		1.604	12.389	GS-2



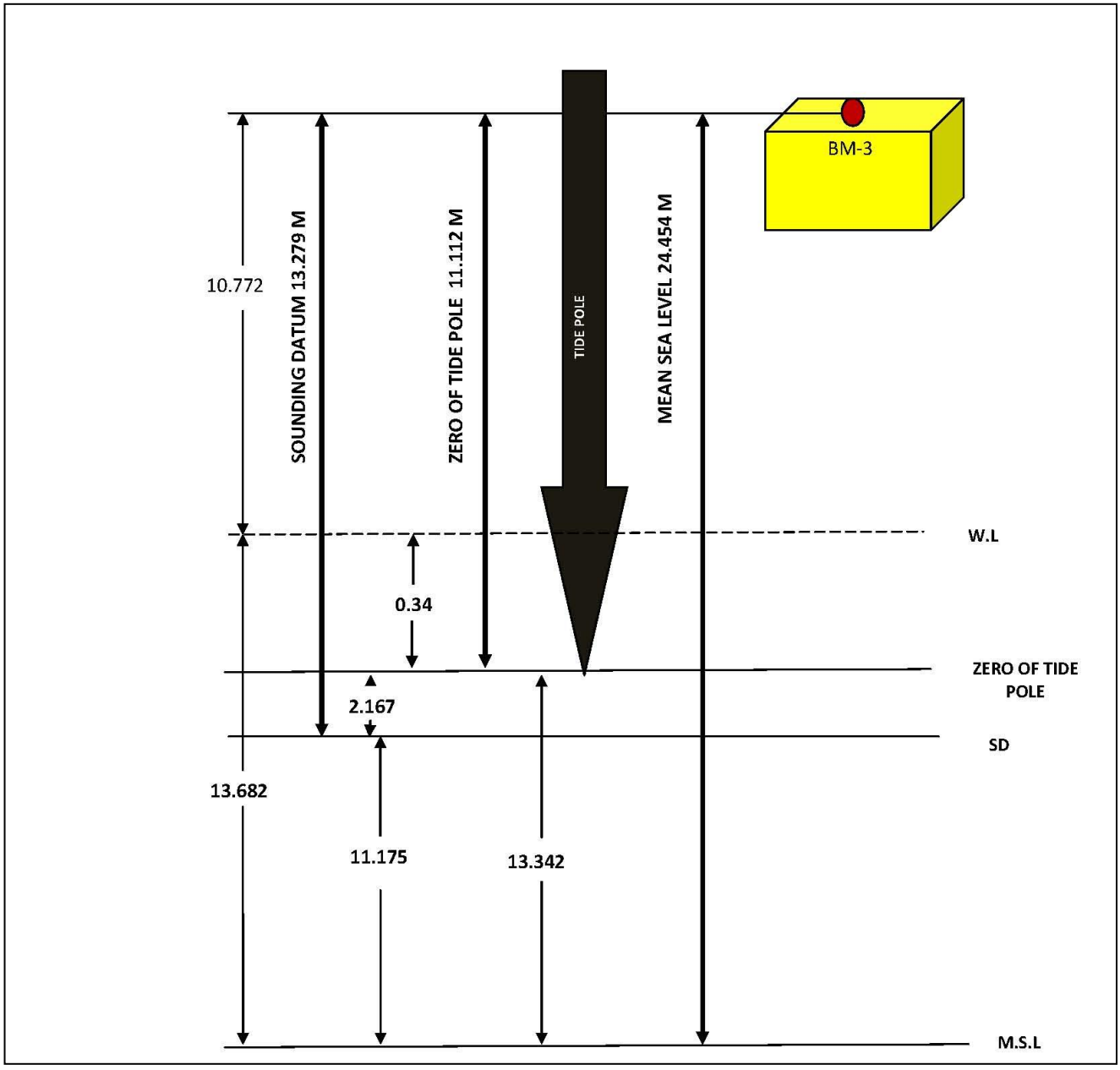
Levelling from BM-3 to GS-3

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.842					24.454	BM-3
0.344		3.185		2.343	22.111	
0.469		2.840		2.496	19.615	
0.765		2.463		1.994	17.621	
0.584		3.016		2.251	15.371	
		2.285		1.701	13.670	GS-3



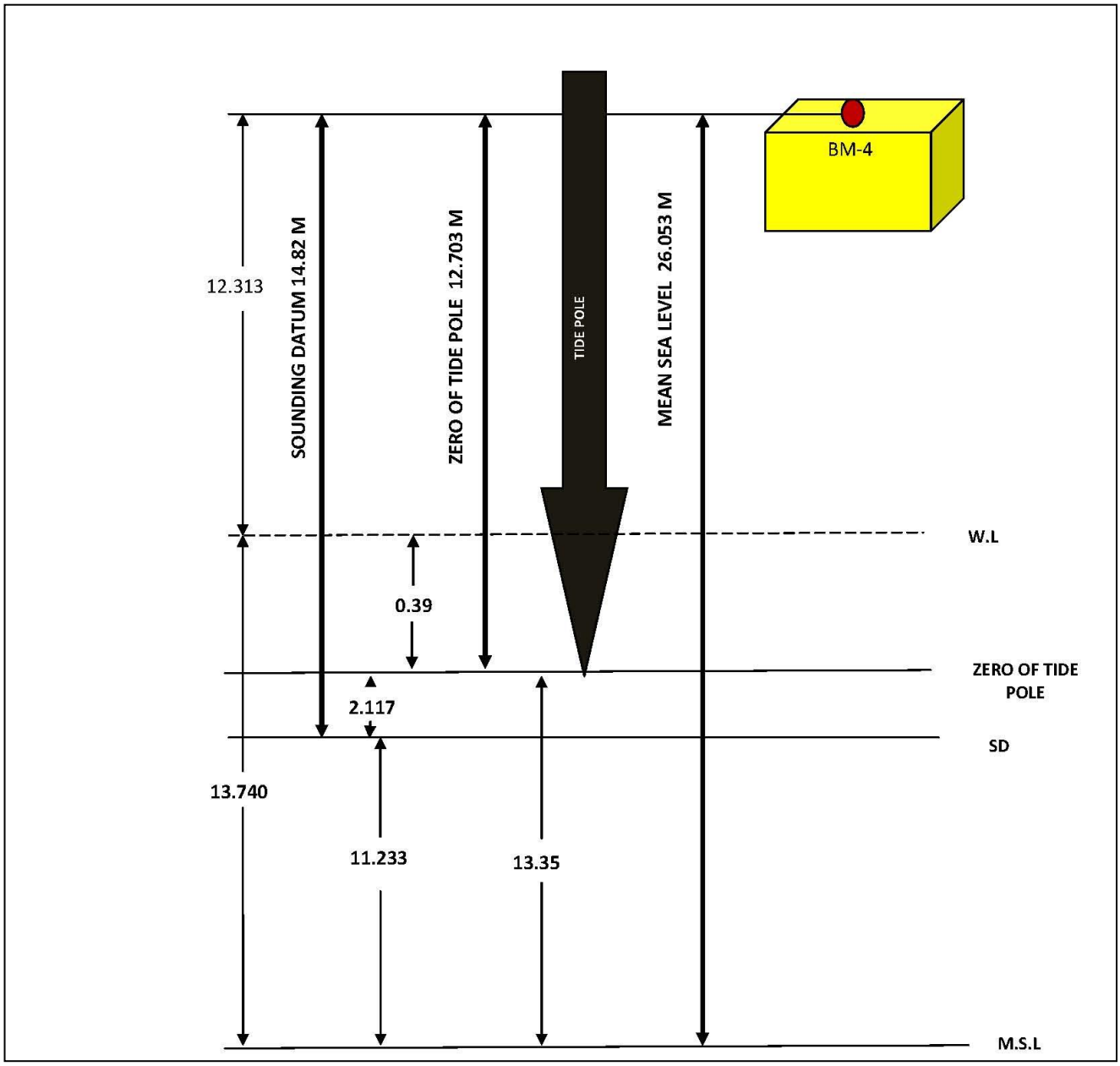
Levelling from BM-3 to GS-4

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.650					24.454	BM-3
0.945		2.884		2.234	22.220	
0.870		1.988		1.043	21.177	
0.760		2.310		1.440	19.737	
0.420		2.282		1.522	18.215	
0.745		2.228		1.808	16.407	
0.580		2.152		1.407	15.000	
		1.898		1.318	13.682	GS-4



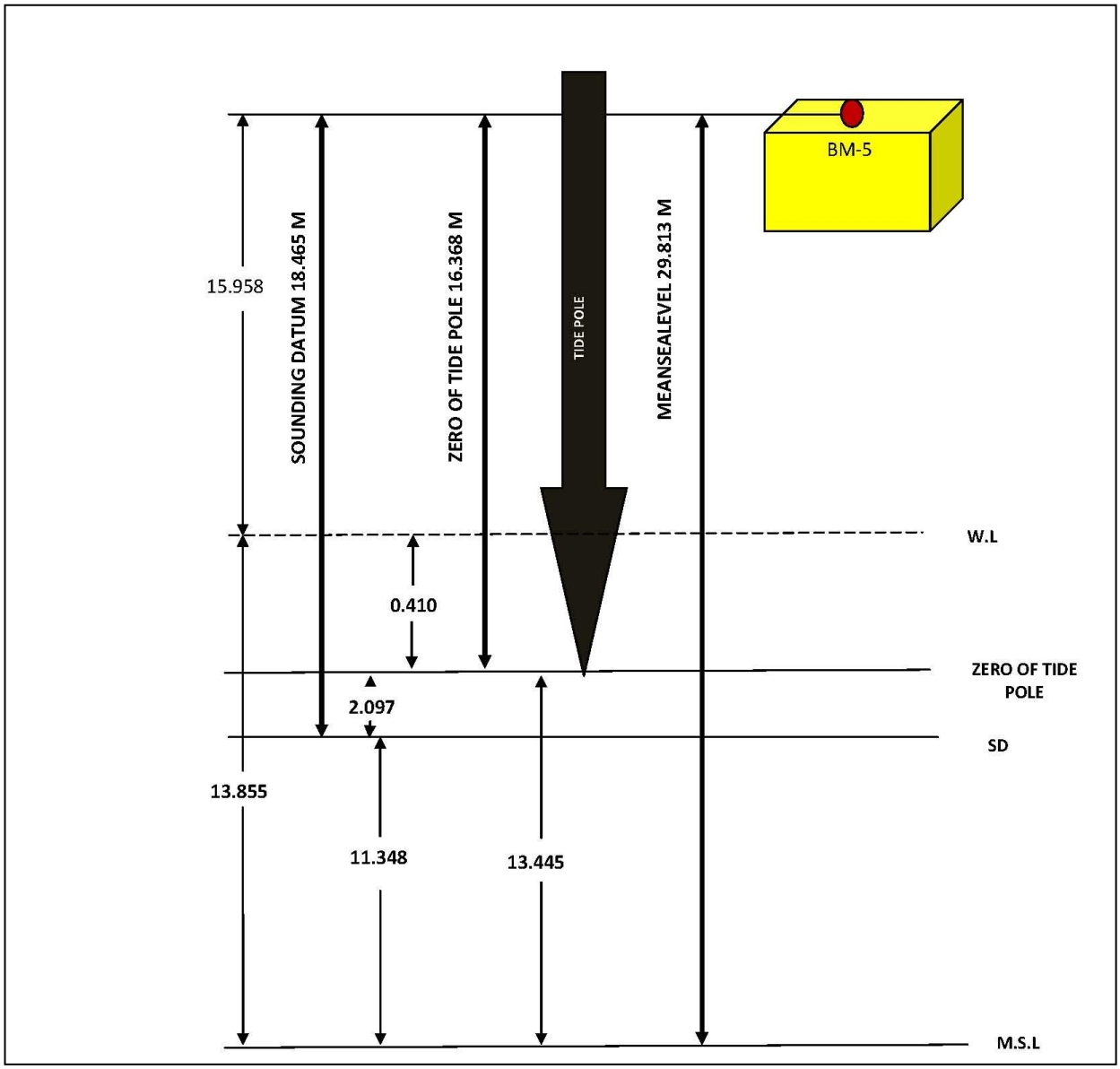
Levelling from BM-4 to GS-5

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.540					26.053	BM-4
0.873		3.173		2.633	23.420	
0.760		3.022		2.149	21.271	
0.420		3.185		2.425	18.846	
0.469		2.840		2.420	16.426	
0.584		2.463		1.994	14.432	
		1.276		0.692	13.740	GS-5



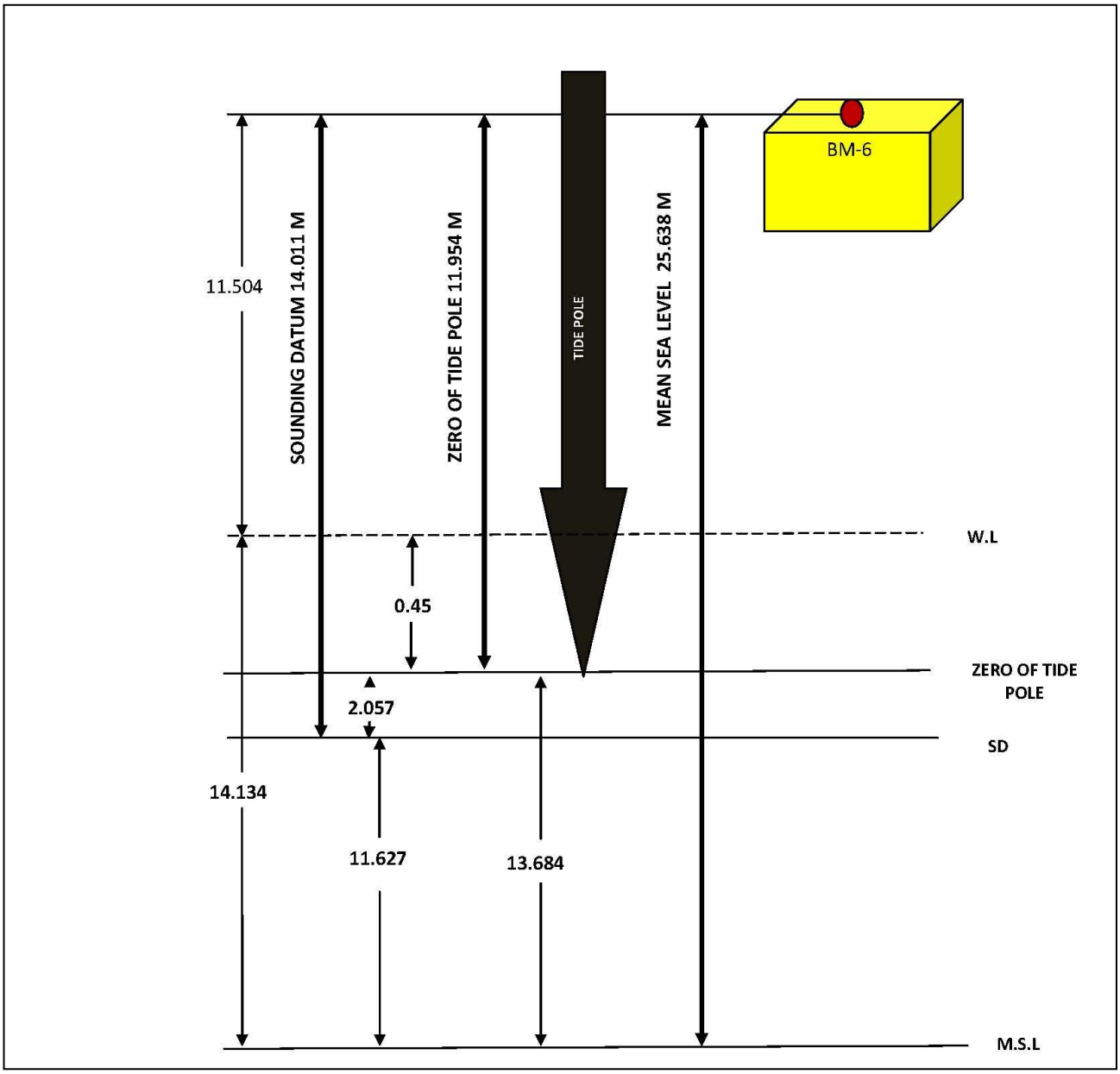
Levelling from BM-5 to GS-6

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.760					29.813	BM-5
0.420		3.014		2.254	27.559	
0.745		3.112		2.692	24.867	
0.469		2.955		2.210	22.657	
0.765		2.658		2.189	20.468	
0.584		3.582		2.817	17.651	
0.650		2.774		2.190	15.461	
		2.256		1.606	13.855	GS-6



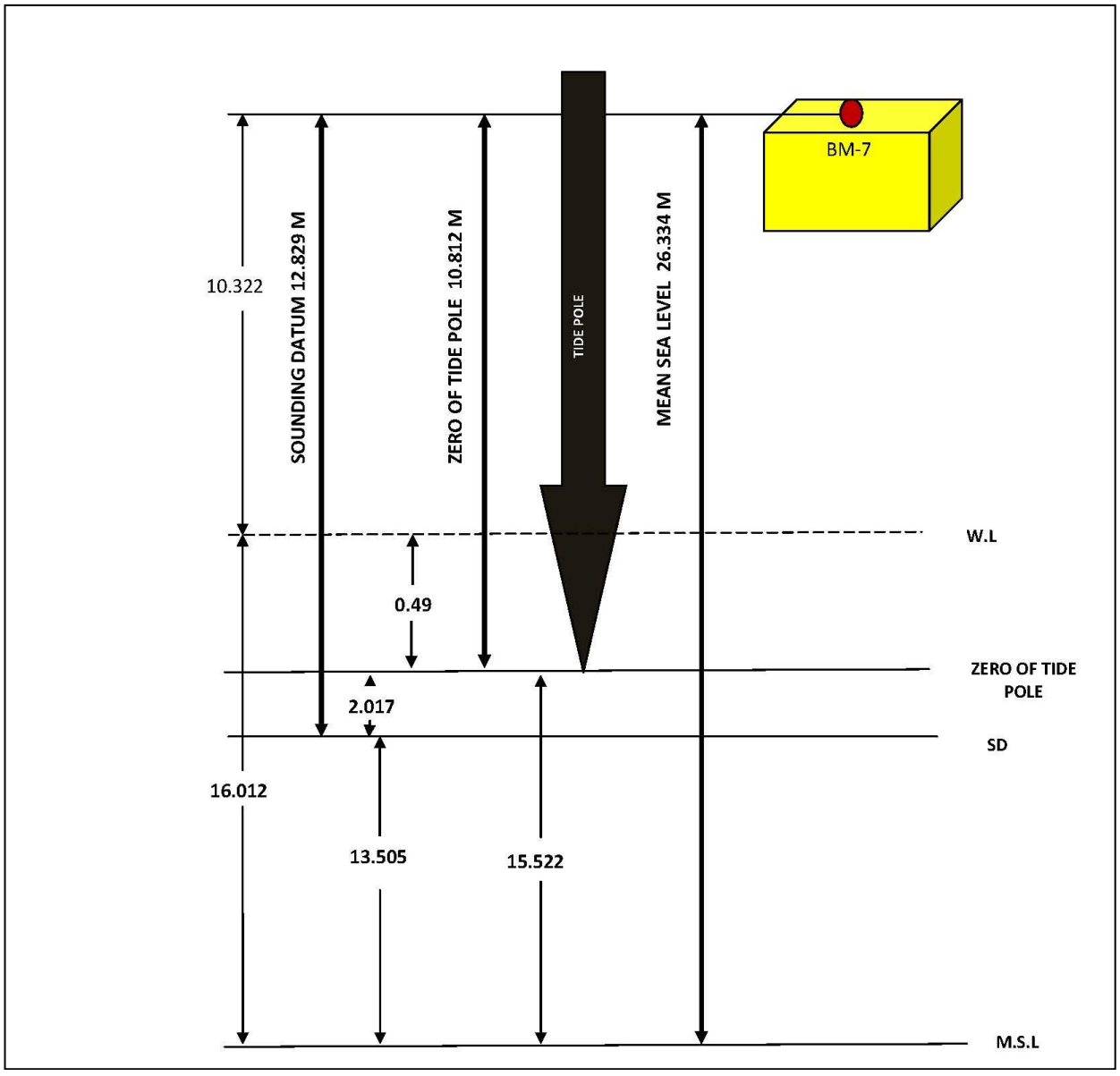
Levelling from BM-6 to GS-7

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.745					25.638	BM-6
0.870		2.936		2.191	23.447	
0.625		2.700		1.830	21.617	
0.480		2.840		2.215	19.402	
0.745		2.658		2.178	17.224	
0.865		2.474		1.729	15.495	
		2.226		1.361	14.134	GS-7



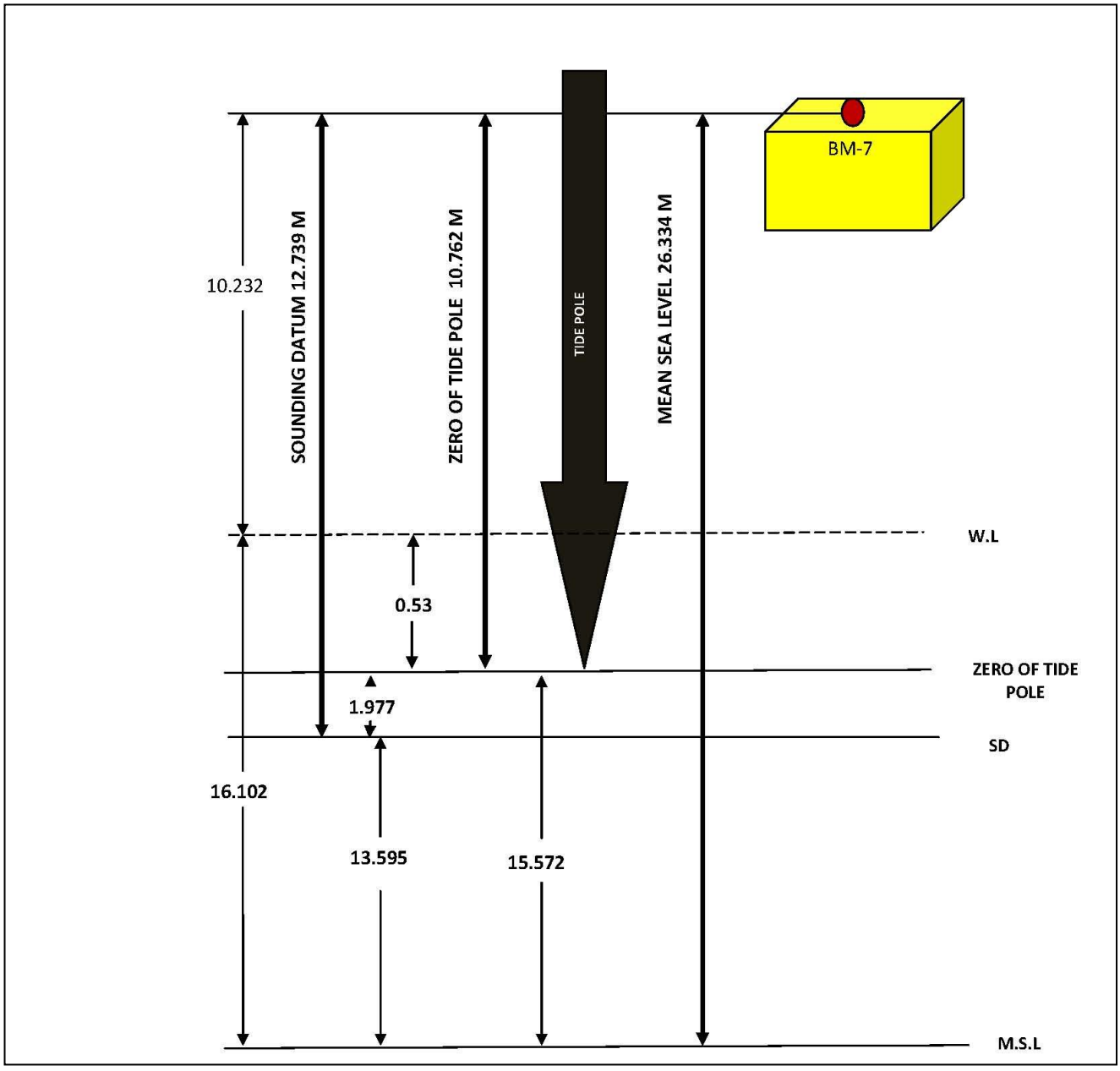
Levelling from BM-7 to GS-8

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.456					26.334	BM-7
0.412		2.012		1.556	24.778	
0.502		2.055		1.643	23.135	
0.580		2.217		1.715	21.420	
0.571		2.134		1.554	19.866	
0.324		2.012		1.441	18.425	
		2.737		2.413	16.012	GS-8



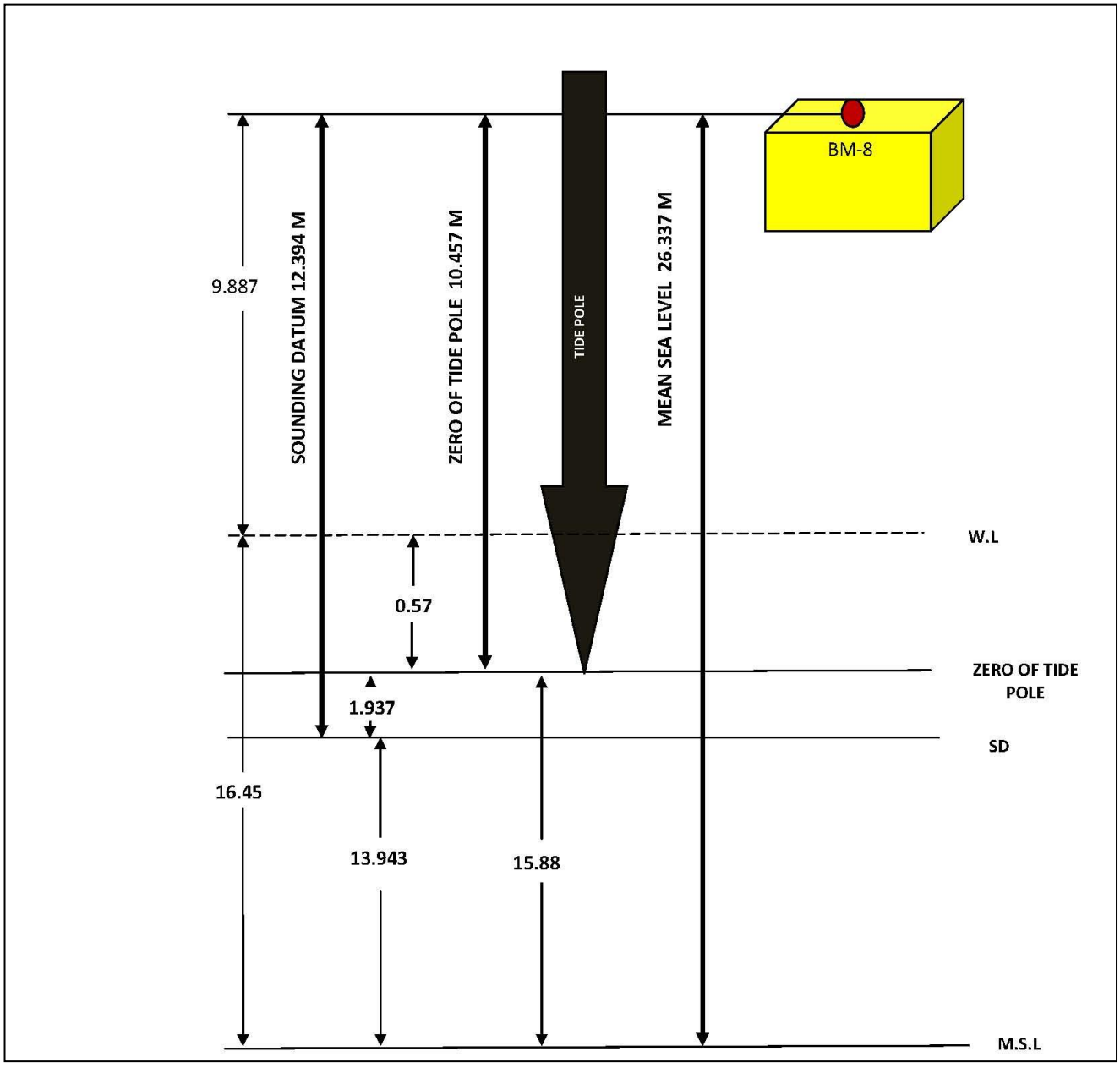
Levelling from BM-7 to GS-9

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.324					26.334	BM-7
0.480		2.282		1.958	24.376	
0.470		2.228		1.748	22.628	
0.466		2.652		2.182	20.446	
0.578		2.840		2.374	18.072	
		2.548		1.970	16.102	GS-9



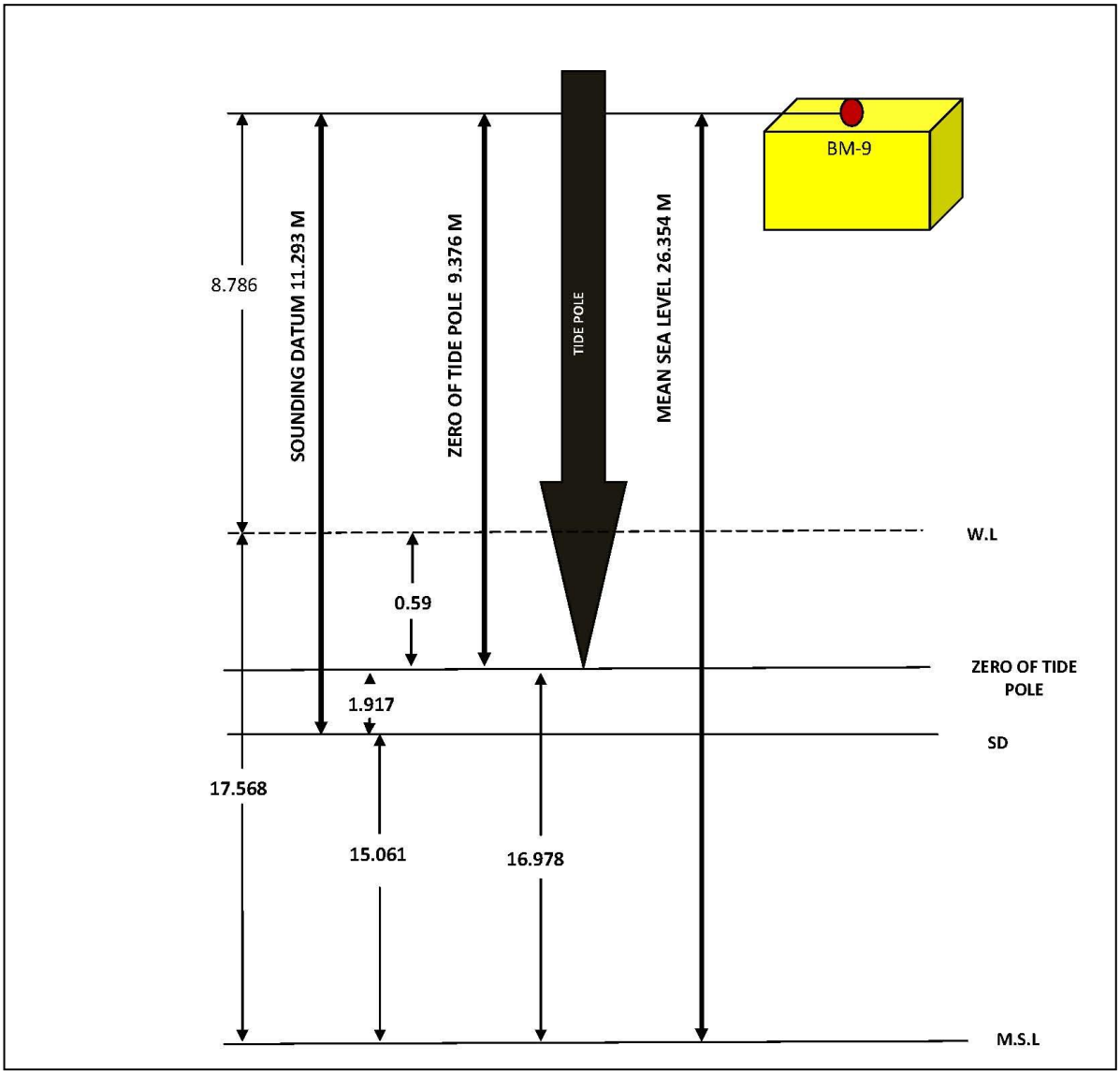
Levelling from BM-8 to GS-10

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.650					26.337	BM-8
0.945		2.658		2.008	24.329	
0.870		3.582		2.637	21.692	
0.625		2.840		1.970	19.722	
0.873		2.463		1.838	17.884	
		2.307		1.434	16.450	GS-10



Levelling from BM-9 to GS-11

BS	IS	FS	RISE (+)	FALL (-)	RL	REMARKS
0.985					26.354	BM-9
0.760		2.416		1.431	24.924	
0.420		2.285		1.525	23.399	
0.469		2.840		2.420	20.979	
0.584		2.658		2.189	18.790	
		1.806		1.222	17.568	GS-11

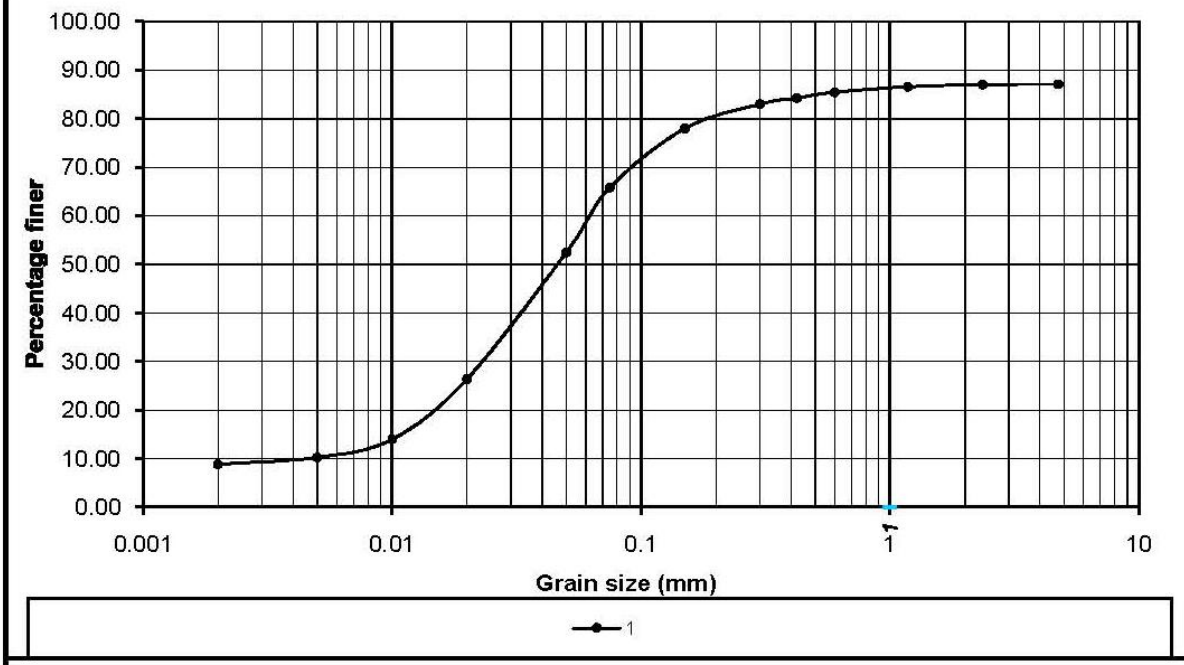


Annexure-11: Soil Sample Report:

RESULTS OF TEST OF SOIL SAMPLES										
SITE – MAHANANDA RIVER, MALDA, WB										
PHYSICAL ANALYSIS OF SOIL										
Sl.No.	**BM.**	**GRAVEL (%)**	**SAND (%)**	**SILT+CLAY (%)**	**SPECIFIC GRAVITY**	**pH VALUE**	**SILT (%)**	**CLAY (%)**	**Cu**	**Cc**
1	NEAR BM - 1	12.89	30.25	56.86	2.61	7.30	48.00	8.86	10.00	1.47
2	NEAR BM - 2	16.80	19.86	63.34	2.60	7.10	55.00	8.34	9.23	1.87
3	NEAR BM - 3	20.54	32.90	46.56	2.62	7.50	37.00	9.56	10.77	1.93
4	NEAR BM - 4	14.27	22.70	63.03	2.60	6.90	58.00	5.03	7.14	1.51
5	NEAR BM - 5	19.20	29.94	50.86	2.61	7.00	41.00	9.86	14.71	2.01
6	NEAR BM - 6	24.05	34.87	41.08	2.62	7.40	32.50	8.58	14.00	1.79
7	NEAR BM - 7	17.98	28.54	53.48	2.61	7.00	46.15	7.33	14.26	1.56
8	NEAR BM - 8	10.65	29.35	60.00	2.60	7.30	55.12	4.88	9.11	1.06
9	NEAR BM - 9	18.34	27.80	53.86	2.62	7.20	43.89	9.97	16.80	1.87

Note: - The Position of the Soil samples have been shown at Para no-2.19 (a), page no-25

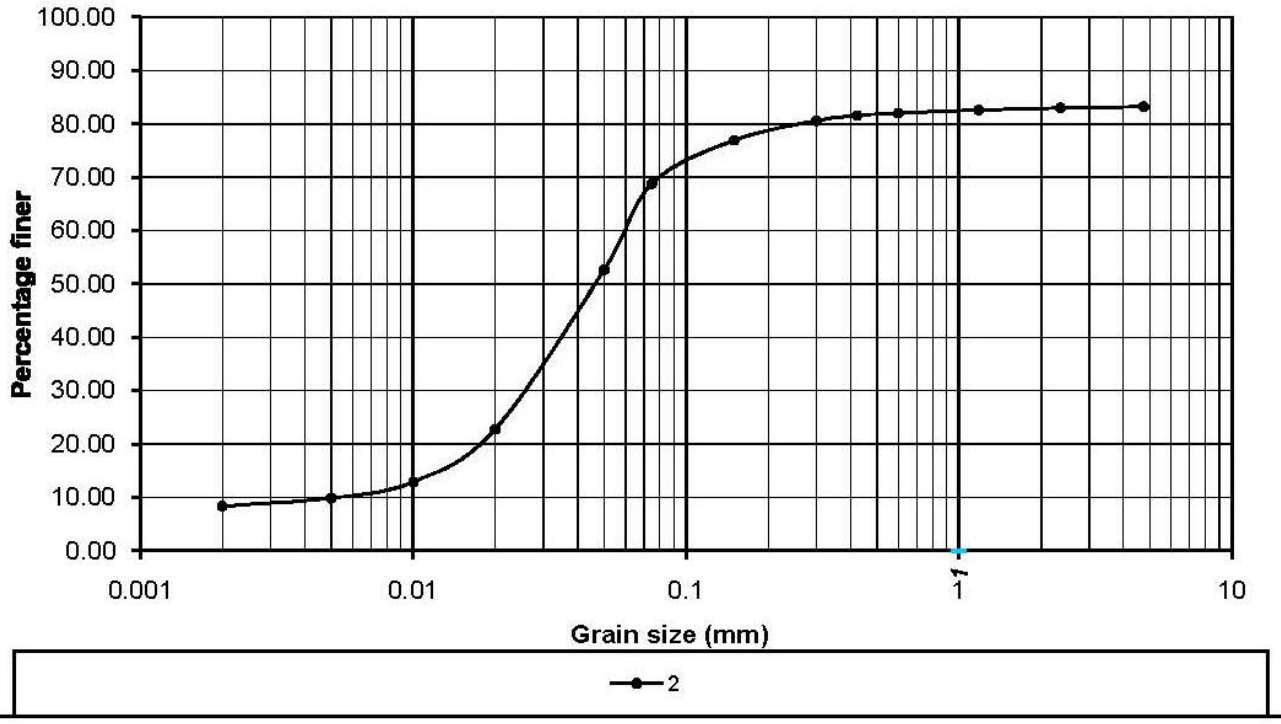
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
1	8.86	48.00	30.25	12.89

*Silt & Clay

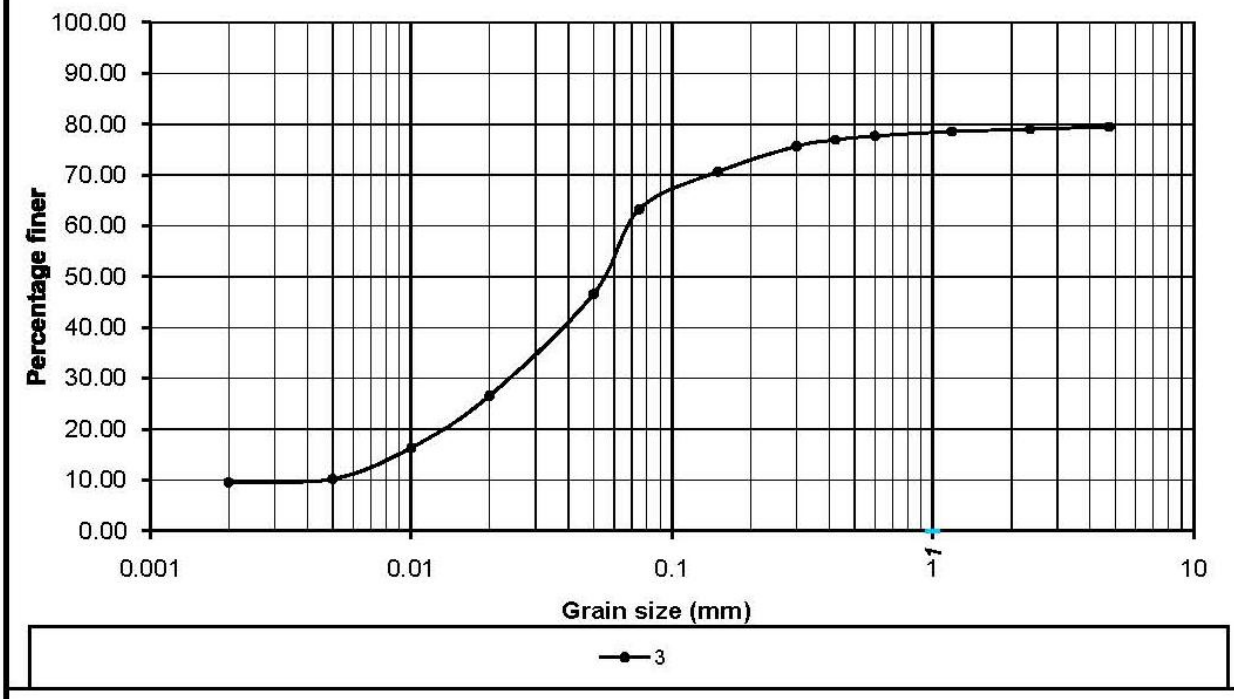
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
2	8.34	55.00	19.86	16.80

*Silt & Clay

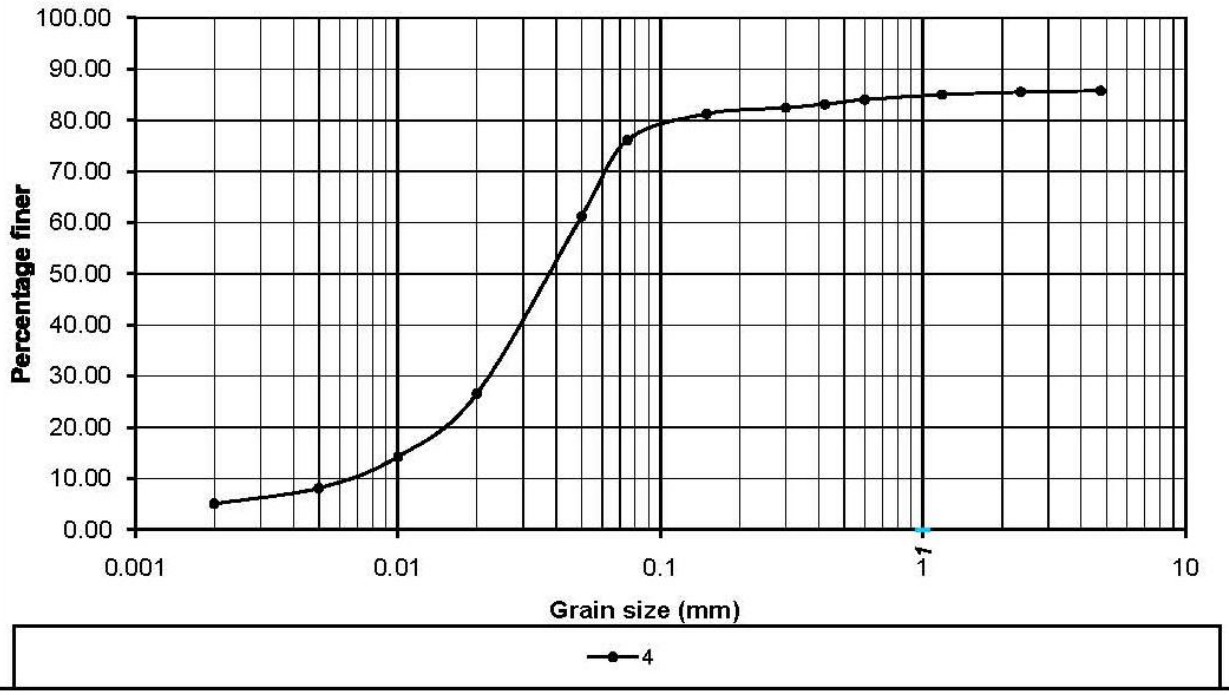
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
3	9.56	37.00	32.90	20.54

*Silt & Clay

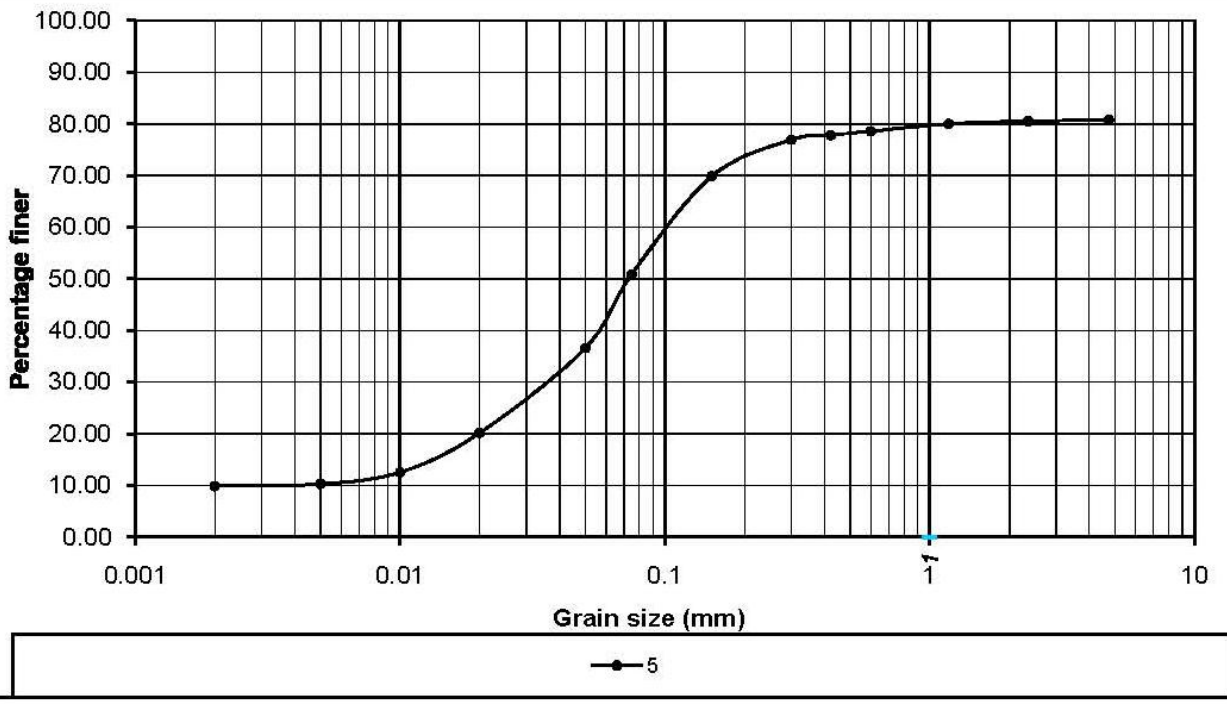
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
4	5.03	58.00	22.70	14.27

*Silt & Clay

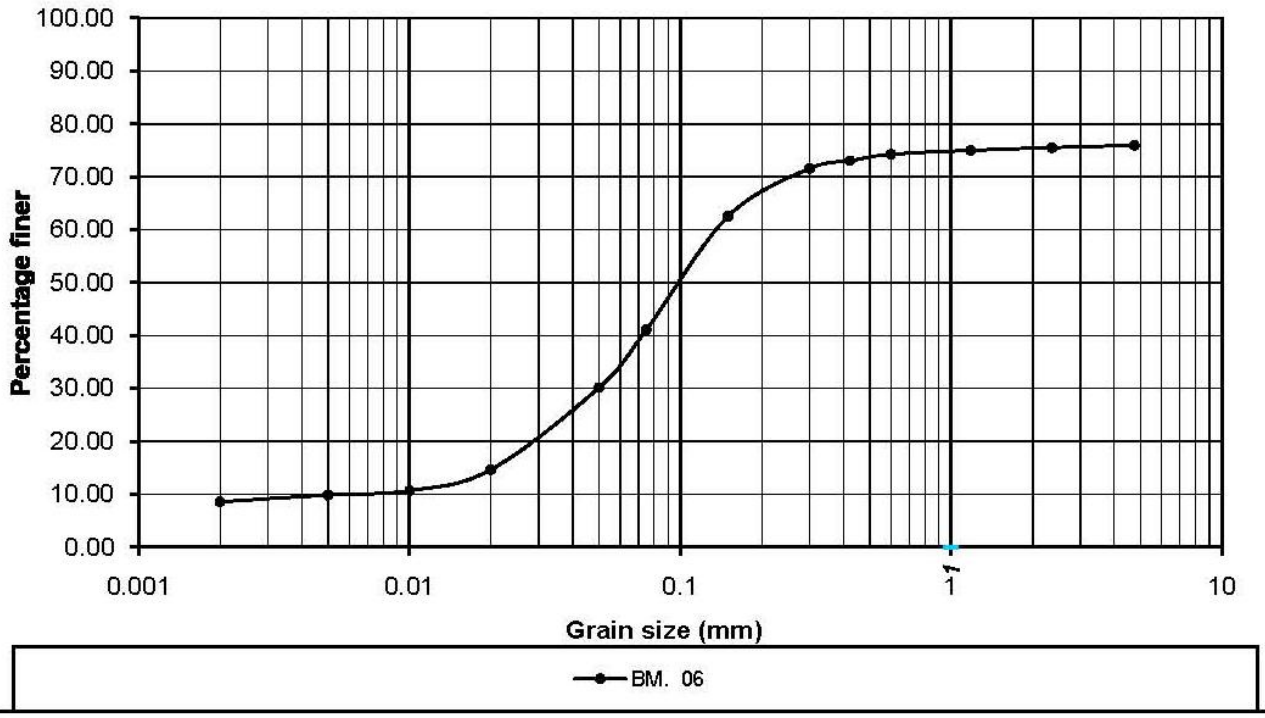
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
5	9.86	41.00	29.94	19.20

*Silt & Clay

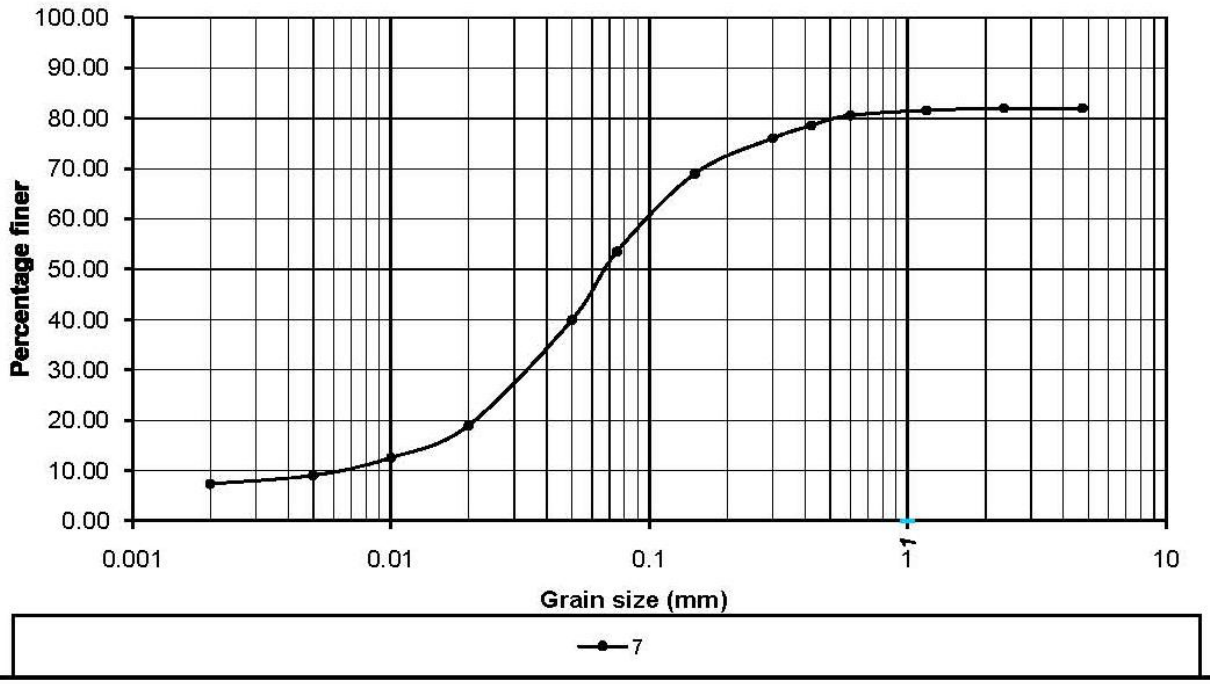
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
BM. 06	8.58	32.50	34.87	24.05

*Silt & Clay

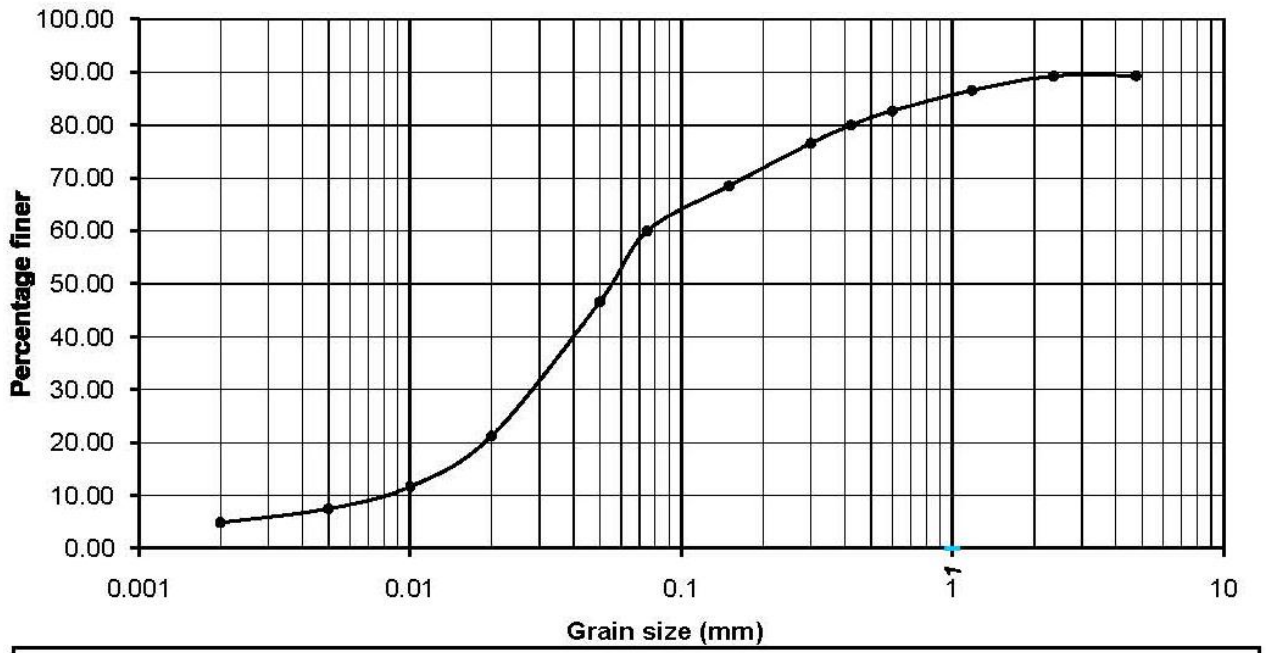
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
7	7.33	46.15	28.54	17.98

*Silt & Clay

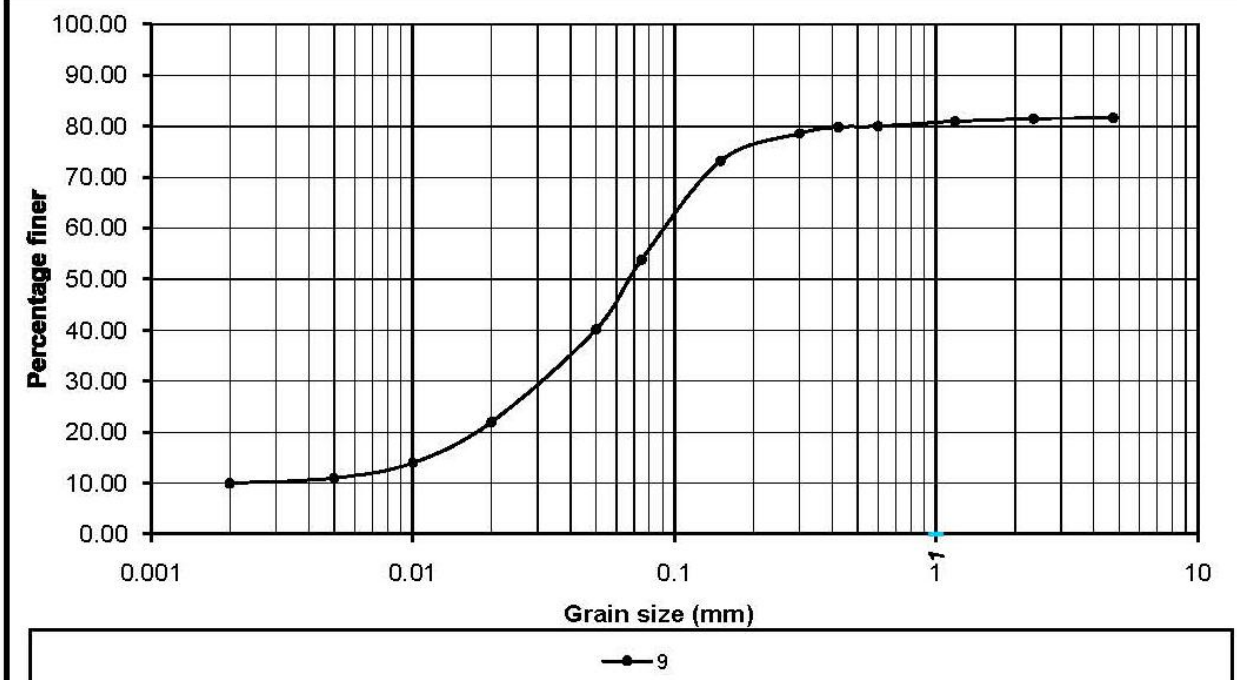
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-4.75	>4.75
Sample No.	Clay (%)	Silt (%)	Sand (%)	Gravel (%)
8	4.88	55.12	29.35	10.65

*Silt & Clay

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
9	9.97	43.89	27.80	18.34

*Silt & Clay

Annexure-12: Water Sample Report:

RESULTS OF EXAMINATION OF SAMPLES OF WATER

SITE : MAHANANDA RIVER, MALDA, W.B

PARAMETR - pH Value at 25°C

SL. NO	DEPTH	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMITS IS: 456-2000
1	D	NEAR BM-01	pH at 25°C	6.9	6.5-8.5
2	0.3D			6.9	
3	0.5D			6.7	
4	D	NEAR BM-02		6.7	
5	0.3D			6.6	
6	0.5D			6.5	
7	D	NEAR BM-03		6.5	
8	0.3D			6.6	
9	0.5D			6.6	
10	D	NEAR BM-04		6.5	
11	0.3D			6.5	
12	0.5D			6.4	
13	D	NEAR BM-05		6.7	
14	0.3D			6.6	
15	0.5D			6.5	
16	D	NEAR BM-06		6.5	
17	0.3D			6.4	
18	0.5D			6.4	
19	D	NEAR BM-07		6.5	
20	0.3D			6.5	
21	0.5D			6.5	
22	D	NEAR BM-08		6.3	
23	0.3D			6.3	
24	0.5D			6.3	
25	D	NEAR BM-09		6.5	
26	0.3D			6.4	
27	0.5D			6.5	

Note: - The Position of the Water samples have been shown at Para no-2.19 (b), page no-25

PARAMETR - Chloride as Cl(mg/l)					
SL. NO	DEPTH	LOCATION	PARAMETER	WATER SAMPLE RESULTS(mg/l)	PERMISSIBLE LIMITS IS: 456-2000
1	D	NEAR BM-01	Chloride as Cl(mg/l)	9	2000mg/l for concrete not containing embedded steel and 500 mg/l for reinforced concrete work.
2	0.3D			8	
3	0.5D			6	
4	D	NEAR BM-02		7	
5	0.3D			7	
6	0.5D			8	
7	D	NEAR BM-03		7	
8	0.3D			6	
9	0.5D			8	
10	D	NEAR BM-04		6	
11	0.3D			5	
12	0.5D			6	
13	D	NEAR BM-05		6	
14	0.3D			6	
15	0.5D			5	
16	D	NEAR BM-06		8	
17	0.3D			6	
18	0.5D			6	
19	D	NEAR BM-07		7	
20	0.3D			6	
21	0.5D			6	
22	D	NEAR BM-08		8	
23	0.3D			6	
24	0.5D			7	
25	D	NEAR BM-09		6	
26	0.3D			6	
27	0.5D			7	

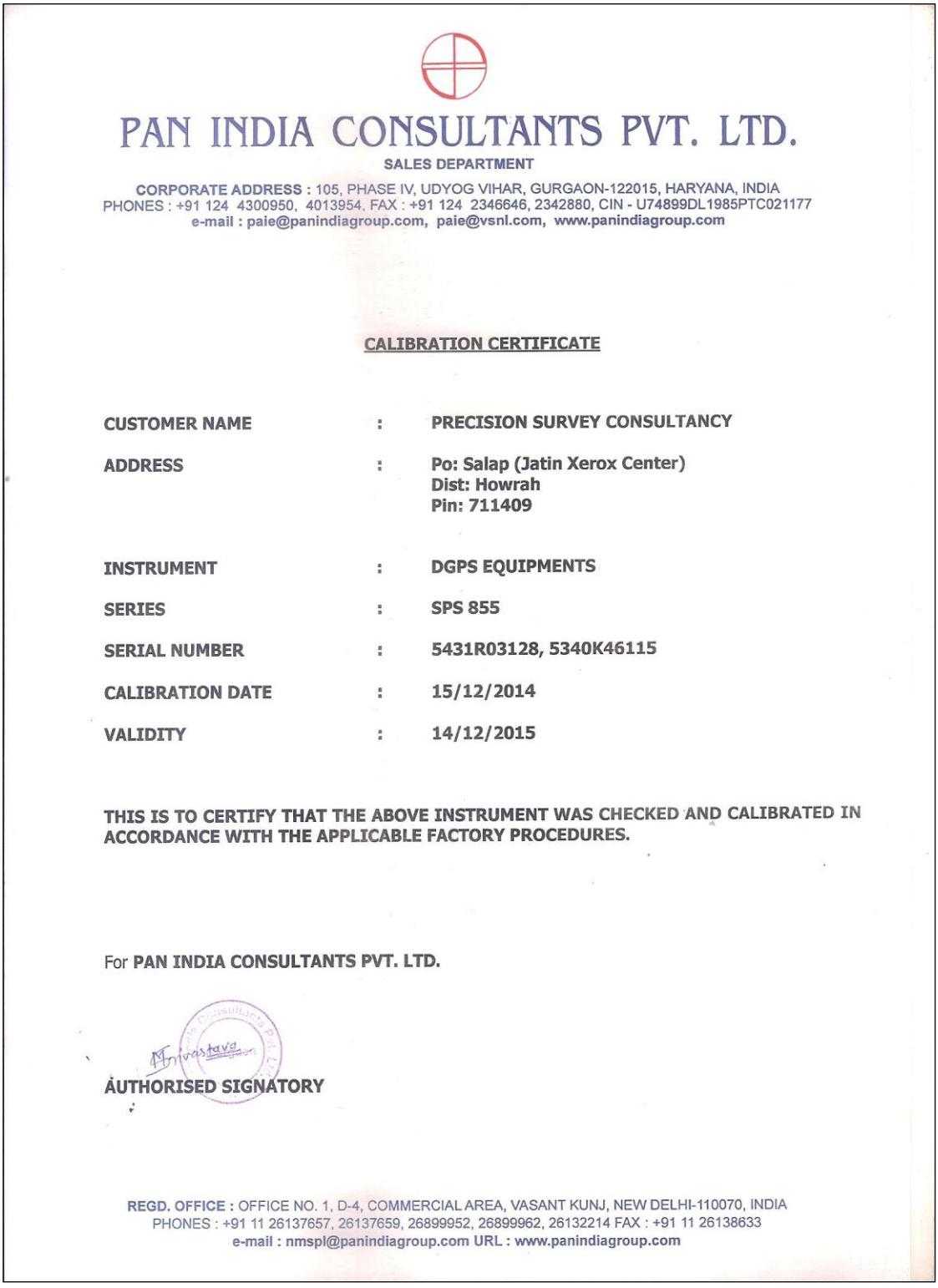
PARAMETR - Sulphates as SO_4(mg/l)

SL. NO	DEPTH	LOCATION	PARAMETER	WATER SAMPLE RESULTS(mg/l)	PERMISSIBLE LIMITS IS: 456-2000
1	D	NEAR BM-01	Sulphates as SO_4(mg/l)	24	400(mg/l)
2	0.3D			25	
3	0.5D			26	
4	D	NEAR BM-02		24	
5	0.3D			24	
6	0.5D			24	
7	D	NEAR BM-03		24	
8	0.3D			25	
9	0.5D			25	
10	D	NEAR BM-04		26	
11	0.3D			27	
12	0.5D			26	
13	D	NEAR BM-05		26	
14	0.3D			25	
15	0.5D			27	
16	D	NEAR BM-06		27	
17	0.3D			27	
18	0.5D			27	
19	D	NEAR BM-07		27	
20	0.3D			27	
21	0.5D			26	
22	D	NEAR BM-08		27	
23	0.3D			27	
24	0.5D			29	
25	D	NEAR BM-09		25	
26	0.3D			25	
27	0.5D			25	

PARAMETR - Sediment Concentration(mg/l)

SL. NO	DEPTH	LOCATION	PARAMETER	WATER SAMPLE RESULTS(mg/l)	PERMISSIBLE LIMITS IS: 456-2000
1	D	NEAR BM-01	Sediment Concentration (mg/l)	20	2000mg/l
2	0.3D			30	
3	0.5D			60	
4	D	NEAR BM-02		20	
5	0.3D			20	
6	0.5D			20	
7	D	NEAR BM-03		20	
8	0.3D			30	
9	0.5D			30	
10	D	NEAR BM-04		30	
11	0.3D			30	
12	0.5D			20	
13	D	NEAR BM-05		20	
14	0.3D			20	
15	0.5D			30	
16	D	NEAR BM-06		30	
17	0.3D			20	
18	0.5D			20	
19	D	NEAR BM-07		20	
20	0.3D			20	
21	0.5D			20	
22	D	NEAR BM-08		40	
23	0.3D			30	
24	0.5D			30	
25	D	NEAR BM-09		30	
26	0.3D			20	
27	0.5D			30	

Annexure-13: Calibration Certificate:-



PAN INDIA CONSULTANTS PVT. LTD.

SALES DEPARTMENT

CORPORATE ADDRESS : 105, PHASE IV, UDYOG VIHAR, GURGAON-122015, HARYANA, INDIA
PHONES : +91 124 4300950, 4013954, FAX : +91 124 2346646, 2342880, CIN - U74899DL1985PTC021177
e-mail : paie@panindiagroup.com, paie@vsnl.com, www.panindiagroup.com

CALIBRATION CERTIFICATE

CUSTOMER NAME	:	PRECISION SURVEY CONSULTANCY
ADDRESS	:	Po: Salap (Jatin Xerox Center) Dist: Howrah Pin: 711409
INSTRUMENT	:	DGPS EQUIPMENTS
SERIES	:	SPS 855
SERIAL NUMBER	:	5431R03128, 5340K46115
CALIBRATION DATE	:	15/12/2014
VALIDITY	:	14/12/2015

THIS IS TO CERTIFY THAT THE ABOVE INSTRUMENT WAS CHECKED AND CALIBRATED IN ACCORDANCE WITH THE APPLICABLE FACTORY PROCEDURES.

For PAN INDIA CONSULTANTS PVT. LTD.

AUTHORISED SIGNATORY

REGD. OFFICE : OFFICE NO. 1, D-4, COMMERCIAL AREA, VASANT KUNJ, NEW DELHI-110070, INDIA
PHONES : +91 11 26137657, 26137659, 26899952, 26899962, 26132214 FAX : +91 11 26138633
e-mail : nmspl@panindiagroup.com URL : www.panindiagroup.com

Table 24- Calibration Certificate of DGPS

PAN INDIA CONSULTANTS PVT. LTD.

SALES DEPARTMENT

CORPORATE ADDRESS : 105, PHASE IV, UDYOG VIHAR, GURGAON-122015, HARYANA, INDIA
PHONES : +91 124 4300950, 4013954, FAX : +91 124 2346646, 2342880, CIN - U74899DL1985PTC021177
e-mail : paie@panindiagroup.com, paie@vsnl.com, www.panindiagroup.com

CALIBRATION CERTIFICATE

CUSTOMER NAME	:	PRECISION SURVEY CONSUTLANCY
ADDRESS	:	P.O. –SALAP (Jatin Xerox Center) Dist. –Howrah Pin: 711 409
INSTRUMENT	:	ECHO –SOUNDER
SERIES	:	500MF
SERIAL NUMBER	:	B5MF0560
CALIBRATION DATE	:	28/04/2015
VALIDITY	:	27/04/2016

THIS IS TO CERTIFY THAT THE ABOVE INSTRUMENT WAS CHECKED AND CALIBRATED IN ACCORDANCE WITH THE APPLICABLE FACTORY PROCEDURES.

For **PAN INDIA CONSULTANTS PVT. LTD.**

AUTHORISED SIGNATORY

REGD. OFFICE : OFFICE NO. 1, D-4, COMMERCIAL AREA, VASANT KUNJ, NEW DELHI-110070, INDIA
PHONES : +91 11 26137657, 26137659, 26899952, 26899962, 26132214 FAX : +91 11 26138633
e-mail : nmspl@panindiagroup.com URL : www.panindiagroup.com

Table 25- Calibration Certificate of Eco Sounder

SOUTH

SOUTH PRECISION INSTRUMENT PVT. LTD.
FA - 229 B, Ground Floor, Mansarover Garden, New Delhi-110015
Ph. : 011- 45544114, 65568870 Fax: 011- 45530854 Mob.: 9999999255

Calibration Certificate

SOUTH Precision Instrument Pvt. Ltd. Calibration laboratory certifies that the instrument has been inspected, tested and calibrated in accordance with the documented procedures using measuring and test equipment, which are traceable to national standards and of the international accepted standard.

We hereby certify that the instrument mentioned below meet the specification and result of the traceability is carried out in accordance to our company's standard.

INSTRUMENT TYPE	:	GPS RTK
MODEL	:	S-86T
MAKE	:	SOUTH
INSTRUMENT SR. NO.	:	S86951117129438GEM W1286752342GM
CALIBRATION DATE	:	10/02/2015
VALID UPTO	:	09/02/2016
ISSUED TO	:	PRECISION SURVEY CONSULTANCY

For SOUTH PRECISION INSTRUMENT PVT. LTD.
For SOUTH PRECISION INSTRUMENT PVT. LTD.
Authorised Signatory

Authorised Signatory

Table 26- Calibration Certificate of GPS RTK

Annexure-14: Site Picture:-

Figure 45- Erection of Tide Gauge

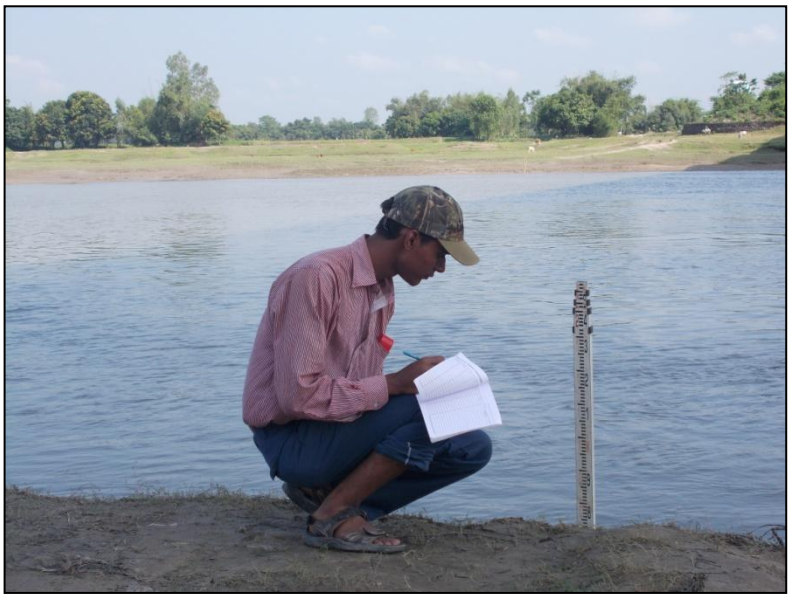


Figure 46 Tide Gauge Reading

Figure 47-Paddy land

Figure 48- Establishment of Bench Mark

Figure 49- Embankment near the River side

Figure 50-Mango garden area

Annexure-15: Survey Charts:-

Sl. No.	Chart No.	Chainage (from ..... km to .... km)	Location (from .... to .....)	Scale	Size of the Chart
1	1	0.00 km to 1.00 km	Bangladesh Border near Adampur to Azmatpur village	1:2000	A-1
2	2	1.00 km to 2.652 km	Azmatpur village to Raipur village	1:2000	A-1
3	3	2.652 km to 4.00 km	Raipur village to Char kadipur village	1:2000	A-1
4	4	4.00 km to 5.252 km	Charkadipur village to Krishnakalitala village	1:2000	A-1
5	5	5.252 km to 7.00 km	Krishnakalitala village to Chhatianmor village	1:2000	A-1
6	6	7.00 km to 8.659 km	Chhatianmor village to Ghosh para village	1:2000	A-1
7	7	8.659 km to 10.00 km	Ghosh para village to Barrack colony	1:2000	A-1
8	8	10.00 km to 11.177 km	Barrack colony to Sukanta pally	1:2000	A-1
9	9	11.177 km to 12.692 km	Sukanta pally to Itakhola village	1:2000	A-1
10	10	12.692 km to 14.292 km	Itakhola village to Anandipur village	1:2000	A-1
11	11	14.292 km to 15.674 km	Anandipur village to Rahutgaon	1:2000	A-1
12	12	15.674 km to 17.353 km	Rahutgaon to Kadamtali village	1:2000	A-1
13	13	17.353 km to 19.00 km	Kadamtali village to Mahish Bathani village	1:2000	A-1
14	14	19.00 km to 21.368 km	Mahish Bathani village to Uttar Gopinathpur village	1:2000	A-1
15	15	21.368 km to 23.00 km	Uttar Gopinathpur village to Barkol village	1:2000	A-1
16	16	23.00 km to 24.568 km	Barkol village to Paiti village	1:2000	A-1
17	17	24.568 km to 26.356 km	Paiti village to Balarampur village	1:2000	A-1
18	18	26.356 km to 28.234 km	Balarampur village to Sultanganj village	1:2000	A-1
19	19	28.234 km to 29.470 km	Sultanganj village to Alinagar village	1:2000	A-1
20	20	29.470 km to 31.228 km	Alinagar village to Rangamatia village	1:2000	A-1

Sl. No.	Chart No.	Chainage (from ..... km to .... km)	Location (from .... to .....)	Scale	Size of the Chart
21	21	31.228 km to 32.676 km	Rangamatia village to Kaliabad village	1:2000	A-1
22	22	32.676 km to 35.351 km	Kaliabad village to Ramnagar village	1:2000	A-1
23	23	35.351 km to 37.00 km	Ramnagar village to Maharajpur village	1:2000	A-1
24	24	37.00 km to 38.451 km	Maharajpur village to near Mahananda Bridge Railway station	1:2000	A-1
25	25	38.451 km to 39.685 km	Mahananda Bridge Railway station to Bahirgachi village	1:2000	A-1
26	26	39.685 km to 42.00 km	Bahirgachi village to Raninagar village	1:2000	A-1
27	27	42.00 km to 43.696 km	Raninagar village to Chator village	1:2000	A-1
28	28	43.696 km to 45.811 km	Chator village to Kismat sultanpur village	1:2000	A-1
29	29	45.811 km to 47.424 km	Kismat sultanpur village to Alal village	1:2000	A-1
30	30	47.424 km to 49.00 km	Alal village to Gazipur village	1:2000	A-1
31	31	49.00 km to 50.623 km	Gazipur village to Mallikpur village	1:2000	A-1
32	32	50.623 km to 52.290 km	Mallikpur village to Jayahat village	1:2000	A-1
33	33	52.290 km to 53.808 km	Jayahat village to Golhat village	1:2000	A-1
34	34	53.808 km to 55.428 km	Golhat village to Dakhin Shyampur village	1:2000	A-1
35	35	55.428 km to 57.327 km	Dakhin Shyampur village to Chandrapara village	1:2000	A-1
36	36	57.327 km to 59.209 km	Chandrapara village to Ghritatala village	1:2000	A-1
37	37	59.209 km to 61.323 km	Ghritatala village to Chandipur Darmar village	1:2000	A-1
38	38	61.323 km to 63.00 km	Chandipur Darmar village to Bhandaria village	1:2000	A-1
39	39	63.95 km to 64.926 km	Bhandaria village to Bochkapara village	1:2000	A-1
40	40	64.926 km to 66.303 km	Bochkapara village to Narasinhapur village	1:2000	A-1
41	41	66.303 km to 68.417 km	Narasinhapur village to Jamalpur village	1:2000	A-1
42	42	68.417 km to 69.821 km	Jamalpur village to Gopalpur village	1:2000	A-1
43	43	69.821 km to 71.00 km	Gopalpur village to Kamardanga village	1:2000	A-1

Sl. No.	Chart No.	Chainage (from ..... km to .... km)	Location (from .... to .....)	Scale	Size of the Chart
44	44	71.00 km to 73.396 km	Kamardanga village to Chandanpur village	1:2000	A-1
45	45	73.396 km to 76.00 km	Chandanpur village to Srikrishnapur village	1:2000	A-1
46	46	76.00 km to 77.763 km	Srikrishnapur village to Shaktihar village	1:2000	A-1
47	47	77.763 km to 79.796 km	Shaktihar village to Gosaipur village	1:2000	A-1
48	48	79.796 km to 80.391 km	Gosaipur village to Gosaipur RCC Bridge area	1:2000	A-1

Table 27- Survey Charts