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

UMNGOT RIVER (NW- 106) (20.05 km)

FROM "BANGLADESH BORDER NEAR LARBAMON TO NONGRYNGKOH"

Survey Period from 11.04.16 TO 21.04.16

FINAL REPORT ON HYDROGRAPHICAL SURVEY OF UMNGOT RIVER, MEGHALAYA

REPORT SUBMISSION DATE- 13.09.2018

SUBMITTED BY:

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Acknowledgement

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We would like to use this opportunity to pen down our profound gratitude and appreciations to **Ms. Nutan Guha Biswas, IAS, Chairperson, IWAI** for spending their valuable time and guidance for compleing this project of " Detailed Hydrography and Topography survey in Umngot River." PSC 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).**

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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 of Contents

Section-1: Introductory Considerations 10
1.1 River Course: Background information, Historical Information, Origin, End 10
1.2 Tributaries / Network of River/ Basin 11
1.3 State / District through which river passes 11
1.4 Project Site Location Map 11
1.4 Site map:- 12
1.6 Scope of work 13

Section-2: Methodology Adopted to undertake Study 14

2.1 Methodology Adopted including Resources and equipment used and calibration 14
2.2 Description of Bench Marks (B.M) / authentic Reference Level used:- 16
2.3 Tidal Influence Zone and tidal variation in different stretches:- 17
2.4 Methodology to fix Chart Datum / Sounding Datum- 17
2.5 Six years minimum Water Levels to arrive at Chart Datum (CD) / Sounding Datum (SD):- 17
2.6 Transfer of Sounding Datum table for tidal rivers / canals 17
2.7 Table Indicating tidal variation at different observation points (say at every 10 Km) 17
2.8 Salient Features of Dam, Barrages, Weirs, Anicut, Locks, Aqueducts etc 17
2.9 Description of erected Bench Mark Pillars:- 17
2.10 Details of collected Water level of different gauge stations:- 18
2.11 Chart Datum / Sounding Datum and Reductions details: 19
2.12-High Flood Level (H.F.L) at known Gauge Stations:- 19
2.13 Average Bed Slope:- 20
2.14 Details of Dam/Barrage/Weirs/Anicut etc. w.r.t MSL:- 20
2.15 Details of Locks:- 20
2.16 Details of Aqueducts:- 20
2.17 Details of existing Bridges and Crossing over waterway:- 21
2.18 Details of other Cross structures, pipe-lines, under water cables:- 21
2.19 High Tension Lines / Electric Lines/Tele-communication lines:- 21
2. 20 Current Meter and Discharge Details:- 21
2.21-a. Soil Sample Locations:- 21
b. Water Sample Locations:- 21

Section-3: Detailed Hydrographic Survey- Stretch Wise 22

3.1 From Cainage 0.00 Km to Chainage 10.00 Km (Dawki village to Mawshun village) 22
3.2 From chainage 10.00 km to 20.05 km (Mawshun village to Nongryngkoh village) 24

Section 4: Terminals 29

4.1 Details of Land use, owner etc.:- 29

Section 5: Fairway development:- 30

Section 6: Conclusion 34

6.1 Dredging volume:- 34

Annexure:-.....35

Annexure-1 Source and type of data collected from various agencies:- 35
Annexure-2 Min. / max. Depth, length of shoal per km-wise for different classification in the designed dredged channel:- 35
Annexure-3 Observed depth at 200 meter interval:- 39
Annexure-4 Reduced Depth at 200 meter interval:-.....42
Annexure-5 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:- 45
Annexure-6 Details of Bathymetric surveys carried out:-.....46
Annexure-7 Bank Protection along the Bank:-.....46
Annexure-8 Details of Features across the Bank:- 46
Annexure-9 Detailed methodology adopted for carrying out survey/Horizontal Control and Vertical Details Control:- 47
Annexure-10 -Photographs of Equipment:-.....50
Annexure-11 Bench Mark Forms:-.....53
Annexure-12 -Levelling Calculation : 55
Annexure-13- Soil Sample:-.....56
Annexure-14 Water Samples.....59
Annexure-15 Calibration Certificate:-.....61
Annexure-16 Site Picture:- 64
Annexure-17 Survey Charts:-.....65

Lists of Figure

Figure 1- Site Map of Umngot River..... 10
Figure 2 Project Site Location Map..... 11
Figure 3- Site map 12
Figure 4-CWC Gauge position, Office and pillar of Umngot River 16
Figure 5 Chainage 0.00 km to Chainage 10.00 km 22
Figure 6 Steel Bridge (Chainage- 0.681 km)..... 23
Figure 7- Dawki Ferry ghat (Chainage-0.32 km) 23
Figure 8 chainage 10.00 km to 20.05 km 24
Figure 9-Dawki Ferry Terminal (Chainage-0.320 km) 29
Figure 10- Topography survey Instruments 48
Figure 11- Bathymetry Survey Instrument..... 49
Figure 12- Survey Vessel 50
Figure 13 DGPS System Instrument 51
Figure 14 Echo Sounder Instrument..... 51
Figure 15- Google image view of BM-1 53
Figure 16-Google image view of BM-2 54
Figure 17- Dawki Site..... 64

List of Table

Table 1-Detail Equipment list 14
Table 2 Bench Mark Details 17
Table 3 Water level data of different Gauge stations 18
Table 4-Chart Datum / Sounding Datum & Reduction Details 19
Table 5- H.F.L Details 19
Table 6-Average Bed Slope 20
Table 7- Bridge Details 21
Table 8- Details Current Meter List 21
Table 9-Soil Sample Location 21
Table 10- Water Sample Location 21
Table 11- Dredging Quantity of Class—I 30
Table 12- Dredging Quantity of Class—II 31
Table 13- Dredging Quantity of Class—III 32
Table 14- Dredging Quantity of Class—IV 33
Table 15- Dredging Calculation of Class-I 35
Table 16- Dredging Calculation of Class-II 36
Table 17- Dredging Calculation of Class-III 37
Table 18- Dredging Calculation of Class-IV 38
Table 19-Observed depth at 200 meter interval 41
Table 20- Reduced depth at 200 meter interval 44
Table 21- Details of Collected water level of Different gauge stations 45
Table 22- Leveling Calculation of Umngot River 55
Table 23- Calibration Certificate of DGPS Equipment 61
Table 24- Calibration Certificate of Echo- Sounder 62
Table 25- Calibration Certificate of South RTK 63
Table 26- Survey Charts 65

Salient Features of Umngot River

Sl	Particulars	Details
1.	Name of the Consultant	Precision Survey consultancy
2.	Region / Cluster number & State(s)	Region IX, Meghalaya
3.	a) Waterway name b) NW # c) Total Stretch and length of declared NW (from … to…, length…km) d) Survey Period (… to …)	a) Umngot River b) NW-106 c) From Bangladesh Border near Larbamon (Chainage-0.000 km) to Nongryngkoh (Chainage-20.05 km) d) 11th April, 2016 to 21st April, 2016
4.	Tidal & non tidal portions (from… to, length, tidal variation at every 10 km)	There are no Tidal influence or portions found in this zone of River.
5.	LAD (Least Available Depth) status i) < 1.2 m ii) 1.2 m to 1.4 m iii) 1.5 m to 1.7 m iv) 1.8 m to 2.0 m v) > 2.0 m	**Observed Depth**

Sub-Stretch-1 (0 -10 km)	Sub-Stretch- 2 (10 -20.05 km)	Total (km)
5.2	10.05	15.25
1.2	0	1.2
1.2	0	1.2
1.2	0	1.2
1.2	0	1.2
Total = 10.0	Total =10.05	Total=20.05

Reduced Depth

Sub-Stretch-1 (0 -10 km)	Sub-Stretch- 2 (10 -20.05 km)	Total (km)
5.4	10.05	15.45
1.2	0	1.2
1.2	0	1.2
1.0	0	1.0
1.2	0	1.2
Total = 10.0	Total =10.05	Total= 20.05

6. Cross structures
i) Dams, weirs, barrages etc (total number; with navigation locks or not)
ii) Bridges, Power cables etc
[total number; range of horizontaland verticalclearances w.r.t H.F.L /MHWS]

i) There is no Dam, weir or Barrage found in this zone of river.

ii) Total number of Steel Bridges- 2 (Two)

Clearance w.r.t H.F.L	Min (m)	Max (m)
Horizontal Clearance (m)	74.582	85.45
Vertical Clearance w.r.t. H.F.L (m)	10.26	11.29

iii) There are no High Tension lines found in this zone of river.

7. Slope

Reach		River / Canal Bed Level Change (m)	Distance (km)	Slope (m/km)	Slope (cm/km)
From	To				
0.300	1.500	1.300	1.20	0.650	65.00
1.600	2.500	1.000	0.90	0.500	50.00
2.600	3.500	1.050	0.90	0.525	52.50
3.600	4.500	0.750	0.90	0.375	37.50
4.600	5.500	2.700	0.90	1.350	135.00
5.600	6.500	2.800	0.90	1.400	140.00
6.600	7.500	2.500	0.90	1.250	125.00
7. 600	8.500	2.200	0.90	1.100	110.00
8. 600	9.500	2.600	0.90	1.300	130.00
9. 600	10.500	2.400	0.90	1.200	120.00
10. 600	11500	2.500	0.90	1.250	125.00
11. 600	12.500	2.700	0.90	1.350	135.00
12. 600	13.500	2.700	0.90	1.350	135.00
13. 600	14.500	2.600	0.90	1.300	130.00
14. 600	15.500	2.400	0.90	1.200	120.00
15. 600	16.500	2.400	0.90	1.200	120.00
16. 600	17.500	2.500	0.90	1.250	125.00
17. 600	18.500	2.300	0.90	1.150	115.00
18. 600	20.05	2.500	1.45	1.250	125.00
Total			17.95	Avg-1.103	Avg-110.26

8. Discharge Report

Sl. No	Chainage (km)	Discharge (Cubic meter/sec)	Dated 11.04.16 to 21.04.16
1	0.304	83.61	
2	3.731	83.08	
Avg. Discharge		83.345	

.

9.	i) Present IWT operations ii) Ferry services, tourism, cargo, if any	As Follows Dawki Ferry service (Ch.-0.320 km) is available in this zone of river. There is light cargo available in this zone of river with light goods and vegetables. Dawki services a trade route between India and Bangladesh. Jaintia hill, Khasi hill, Dawki is the major tourist places located in this zone of river.
10	Approx. distance of Rail & Road from waterway/Industry	Nearest Railway station - Nil Name of National highway close to the River - NH-40 (very close to waterway), Fishing activity at Dawki is very famous and it is also the professions of the native villagers in this region of river. There is no major industry found in this zone of river.
11	Any other information / comment	

Section-1: Introductory Considerations

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

Umngot flows through Dawki, a small but busy town in the East Jaintia Hills district near the Indo-Bangladesh border. The town itself is a mere 95 km from Shillong. Umngot itself is a prime fishing spot for fishermen from nearby areas. The river is the natural boundary between Ri Pnar (of Jaintia Hills) with Hima Khyrim (of Khasi Hills) over which hangs a single span suspension bridge. It is the gateway to Bangladesh.

The river Umngot, flowing towards south, starts its journey from the eastern part of the Shillong peak, which is at the height of about 1800 m above sea level. It separates East Khasi Hills District from Jaintia Hills District by creating a boundary in between the two. Boat race is organized every year on this river at Umsyiem in the months of March - April. The calmly flowing river covers a distance of 82 Km and irrigates around 800 Sq km of farmland. At the final lap of its journey it enters into the plains of Bangladesh. Umngot River is also called by the name Dawki River, which has greenish-bluish color transparent water. The water of this river is so clear that one can get the clear view of the bottom of the river even from a distance, due to its transparency, the shadows of the boats fall on the bottom of the river, which makes the viewer feel that boats are floating in the air. The scene in and around this river is so mesmerizing that one cannot leave the place with ease.

Figure 1- Site Map of Umngot River

1.2 Tributaries / Network of River/ Basin

There are no tributaries found in this zone of river.

1.3 State / District through which river passes

The river passes through the district of East Jaintia Hills of the state of Meghalaya.

1.4 Project Site Location Map

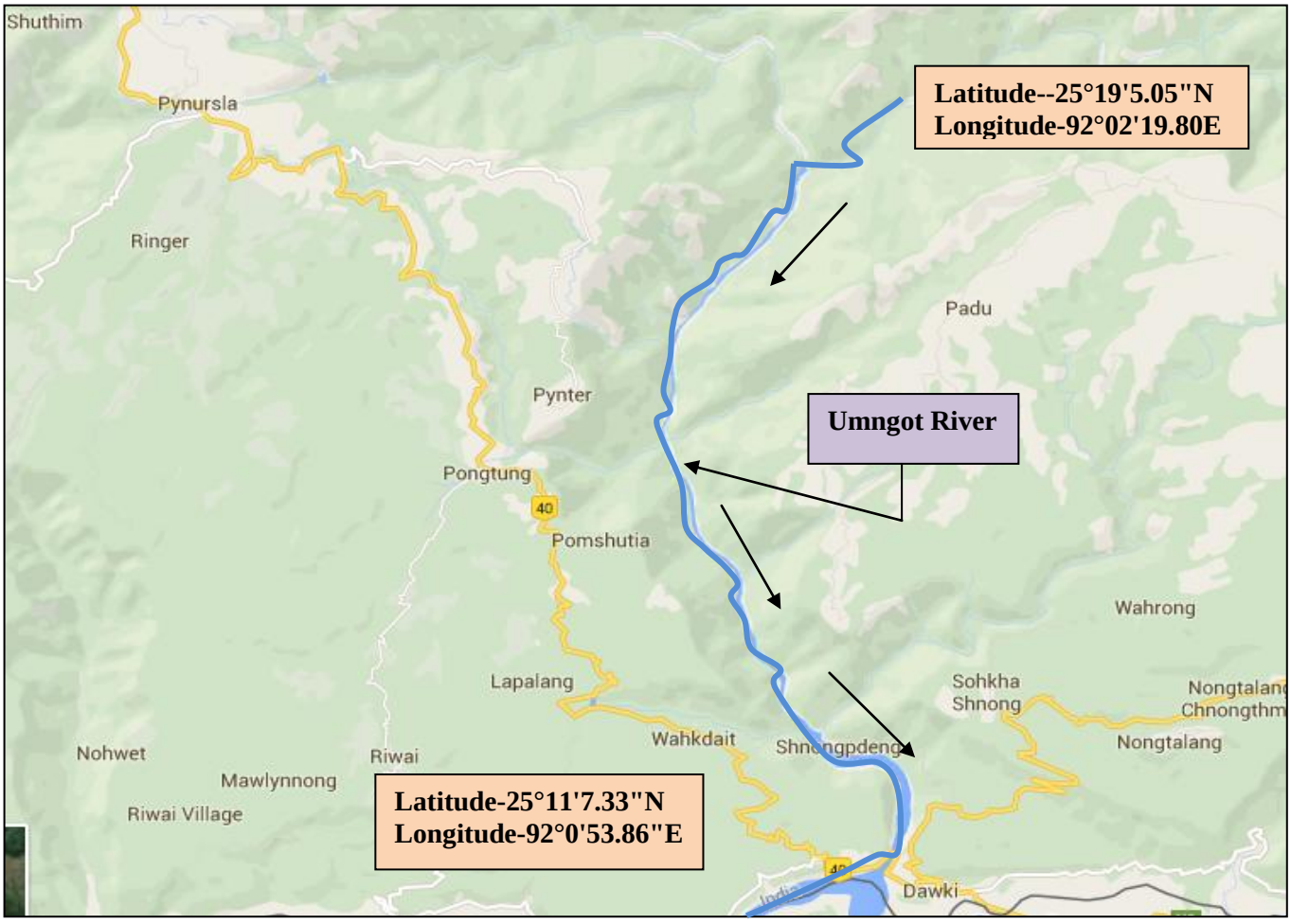


Figure 2 Project Site Location Map

1.4 Site map:-

Figure 3- Site map

1.6 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 with inscription "IWAI", "PSC" and BM No. can be seen on the face of the pillar.
- The main objective of the Study was to recommend the strategy and programs for the development of the Umngot River waterway and to provide an appropriate economic and organizational framework for restoring trade and navigation (cargo and passengers) on the Umngot River with an aim to do as follows:
- Improve public and private investments into transport on the Umngot River, in accordance with adequate economic and financial analysis;
- Propose enhancement of coordination of activities regarding inland navigation and to set up priorities of public interests;
- Obtain an integrated approach considering water management, energy production, flood control and environmental aspects in the Umngot River basin and Propose improvement of the infrastructure.

Section-2: Methodology Adopted to undertake Study

2.1 Methodology Adopted including Resources and equipment used and calibration

- **Equipment:-**

Followings equipments were employed for the Bathymetry and Topography 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

Table 1-Detail Equipment list

- **Conduct of survey work**

- **Topographic Survey**

The Topographic Survey of Umngot River has been carried out from "Bangladesh Border near Larbamon (Lat. - 25°11'07.33"N, Long.-92°0'53.86"E) to Nongryngkoh (Lat. - 25°19'5.05"N, Long. - 92°2'19.80"E) (20.05 kms)." The length of the topography survey has been carried out From Bangladesh Border near Larbamon (Chainage-0.000 km) to Nongryngkoh (Chainage-20.05 km)

- The Topographic survey was 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.

- **Bathymetry Survey**

The length of the Bathymetry survey has been carried out from Chainage 0.00 km to Chainage 1.334 km. The layer of water is very low in this region of river and so it is not possible to carry out the bathymetry survey in the entire stretches of the river.

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 1498 m/s on single beam echo sounder during acquisition. 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 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 Umngot River. The DGPS position along with water depths was recorded simultaneously and the tidal reduction was applied to the obtained depths.

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

For the Topography Survey, the Horizontal / Vertical control has been carried out from the Gauge Level of Central water commission near Dawki village. The value of the CWC Gauge level is tabulated below -

Location Name	Geographic position		UTM position		Elevation (m)
	Latitude (N)	Longitude (E)	Northing	Easting	
Dawki village	25°11'22.56"	92° 1'5.44"	2786303.148	401074.001	71.720 m.

Figure 4-CWC Gauge position, Office and pillar of Umngot River

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

There is no tidal influence found in this part of the region of Assam.

2.4 Methodology to fix Chart Datum / Sounding Datum-

The CWC level was used for transfer of sounding datum and in topography the same level is used to interpolate the datum. The Lowest level in the Each KM of Stretch is taken As Datum and same is used for reduction and other calculations.

2.5 Six years minimum Water Levels to arrive at Chart Datum (CD) / Sounding Datum (SD):-

For this NW, CD was not provided by IWAI. However there is a CWC Gauge station at (Chainage 0.650 km) (show at page-16). The CWC level was used for transfer of sounding datum. In topography also the same level is used to interpolate the datum. The Lowest level in the Each KM of Stretch is taken As Datum and same is used for reduction and other calculations as mentioned in table no-4 page no-19.

2.6 Transfer of Sounding Datum table for tidal rivers / canals

There is no Tidal influence or Tidal effects found in this zone of river.

2.7 Table Indicating tidal variation at different observation points (say at every 10 Km)

There is no Tidal influence or Tidal effects found in this zone of river.

2.8 Salient Features of Dam, Barrages, Weirs, Anicut, Locks, Aqueducts etc

There are no Dams, Barrage, Weirs, Anicut, Locks, Aqueducts found in this zone of river.

2.9 Description of erected Bench Mark Pillars:-

Station	Location	Chainage (km)	Latitude (N)	Longitude (E)	Easting	Northing	BM Height above MSL (m)	BM Height above SD (m)
BM 1	Dawki village	0.304	25°11'12.56"	92° 1'2.34"	400985.363	2785996.666	80.786	17.686
BM 2	Shnongpdeng village	3.731	25°12'29.20"	92° 0'26.20"	399991.209	2788361.894	93.931	29.531

Table 2 Bench Mark Details

2.10 Details of collected Water level of different gauge stations:-

Chainage (km)	Gauge station	Location	Easting	Northing	Latitude (N)	Longitude (E)	W. L w.r.t M.S.L (m)
0.300	GS (TP)--1	Larbamon	400961.550	2786002.580	25°11'12.77"	92°01'01.498"	63.860
1.500	GS (TP)--2	Dawki	401379.860	2787158.110	25°11'50.431"	92°01'16.142"	64.700
2.500	GS (TP)--3	Lymba	401005.660	2787994.420	25°12'17.528"	92°01'02.555"	65.700
3.500	GS (TP)--4	Shnongpdeng	400103.030	2787903.290	25°12'14.35"	92°00'30.328"	66.750
4.500	GS (TP)--5	Amkoi	399570.780	2788697.930	25°12'40.053"	92°00'11.101"	67.500
5.500	GS (TP)--6	Pashum	399207.270	2789536.540	25°13'07.225"	91°59'57.889"	70.200
6.500	GS (TP)--7	Pashum	398690.790	2790363.080	25°13'33.967"	91°59'39.212"	73.000
7.500	GS (TP)--8	Burma	398511.420	2791320.450	25°14'05.044"	91°59'32.546"	75.500
8.500	GS (TP)--9	Burma	397849.700	2792015.840	25°14'27.486"	91°59'08.71"	77.700
9.500	GS (TP)--10	Mawshun	397661.740	2792985.510	25°14'58.96"	91°59'01.73"	80.300
10.500	GS (TP)--11	Pynter	397309.220	2793896.600	25°15'28.489"	91°58'48.883"	82.700
11.500	GS (TP)--12	Pynter	397464.070	2794838.810	25°15'59.154"	91°58'54.162"	85.200
12.500	GS (TP)--13	Pynter	397734.950	2795785.250	25°16'29.985"	91°59'03.59"	87.900
13.500	GS (TP)--14	Pynter	398362.580	2796547.710	25°16'54.923"	91°59'25.822"	90.600
14.500	GS (TP)--15	Nongkhlieng	399064.040	2797235.940	25°17'17.466"	91°59'50.717"	93.200
15.500	GS (TP)--16	Nongkhlieng	399567.770	2798066.450	25°17'44.584"	92°00'08.506"	95.600
16.500	GS (TP)--17	Nongkhlieng	400253.320	2798598.870	25°18'02.056"	92°00'32.878"	98.000
17.500	GS (TP)--18	Nongkhlieng	400991.630	2799178.830	25°18'21.085"	92°00'59.126"	100.500
18.500	GS (TP)--19	Nongkhlieng	401737.920	2799763.660	25°18'40.273"	92°01'25.661"	102.800
19.500	GS (TP)--20	Nongryngkoh	402675.850	2800082.070	25°18'50.844"	92°01'59.12"	105.300

Table 3 Water level data of different Gauge stations

2.11 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 +ve indicates above MSL -ve indicates below MSL	E	F = (E- WL data in MSL)	G = (E- Topo levels in MSL)
1	GS (TP)--1	0.300	0.0-1.0		63.100	-0.760	Umngot Reduced Topo.xyz
2	GS (TP)--2	1.500	1.0-2.0		64.400	-0.300	
3	GS (TP)--3	2.500	2.0-3.0		65.400	-0.300	Submitted in Soft Copy
4	GS (TP)--4	3.500	3.0-4.0		66.450	-0.300	
5	GS (TP)--5	4.500	4.0-5.0		67.200	-0.300	
6	GS (TP)--6	5.500	5.0-6.0		69.900	-0.300	
7	GS (TP)--7	6.500	6.0-7.0		72.700	-0.300	
8	GS (TP)--8	7.500	7.0-8.0		75.200	-0.300	
9	GS (TP)--9	8.500	8.0-9.0		77.400	-0.300	
10	GS (TP)--10	9.500	9.0-10.0		80.000	-0.300	
11	GS (TP)--11	10.500	10.0-11.0		82.400	-0.300	
12	GS (TP)--12	11.500	11.0-12.0		84.900	-0.300	
13	GS (TP)--13	12.500	12.0-13.0		87.600	-0.300	
14	GS (TP)--14	13.500	13.0-14.0		90.300	-0.300	
15	GS (TP)--15	14.500	14.0-15.0		92.900	-0.300	
16	GS (TP)--16	15.500	15.0-16.0		95.300	-0.300	
17	GS (TP)--17	16.500	16.0-17.0		97.700	-0.300	
18	GS (TP)--18	17.500	17.0-18.0		100.200	-0.300	
19	GS (TP)--19	18.500	18.0-19.0		102.500	-0.300	
20	GS (TP)--20	19.500	19.0-20.05		105.000	-0.300	

Table 4-Chart Datum / Sounding Datum & Reduction Details

2.12-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	Dawki village		0.300	77.200	

Table 5- H.F.L Details

2.13 Average Bed Slope:-

Reach		River / Canal Bed Level Change (m)	Distance (km)	Slope (m/km)	Slope (cm/km)
From	To				
0.300	1.500	1.300	1.20	0.650	65.00
1.600	2.500	1.000	0.90	0.500	50.00
2.600	3.500	1.050	0.90	0.525	52.50
3.600	4.500	0.750	0.90	0.375	37.50
4.600	5.500	2.700	0.90	1.350	135.00
5.600	6.500	2.800	0.90	1.400	140.00
6.600	7.500	2.500	0.90	1.250	125.00
7. 600	8.500	2.200	0.90	1.100	110.00
8. 600	9.500	2.600	0.90	1.300	130.00
9. 600	10.500	2.400	0.90	1.200	120.00
10. 600	11500	2.500	0.90	1.250	125.00
11. 600	12.500	2.700	0.90	1.350	135.00
12. 600	13.500	2.700	0.90	1.350	135.00
13. 600	14.500	2.600	0.90	1.300	130.00
14. 600	15.500	2.400	0.90	1.200	120.00
15. 600	16.500	2.400	0.90	1.200	120.00
16. 600	17.500	2.500	0.90	1.250	125.00
17. 600	18.500	2.300	0.90	1.150	115.00
18. 600	20.05	2.500	1.45	1.250	125.00
Total			17.95	Avg-1.103	Avg-110.26

Table 6-Average Bed Slope

2.14 Details of Dam/Barrage/Weirs/Anicut etc. w.r.t MSL:-

There are no Dams, Barrage, weirs, Anicut found in this river zone.

2.15 Details of Locks:-

There are no locks found in this river zone.

2.16 Details of Aqueducts:-

There are no aqueducts found in this zone of river.

2.17 Details of existing Bridges and Crossing over waterway:-

Sl. No	Structure Name	Chainage (km)	Location	Position				Length (m)	Width (m)	Nos. Of Piers	Horizontal Clearance (m)	Vertical Clearance w.r.t H.F.L (m)
				Latitude (N)	Longitude (E)	Easting	Northing					
1	Steel Bridge	0.681	Dawki	25°11'23.72"	92° 1'9.14"	401178.833	2786338.938	90.30	3.50	2	74.582	11.29
2	Steel Bridge	3.817	Shnongpdeng	25°12'28.70"	92° 0'19.78"	2788347.929	399811.483	185.74	1.21	2	85.45	10.26

Table 7- Bridge Details

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

There are no cross structures, pipe lines or under water cables found in this zone of river.

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

There are no High tension lines found in this zone of river.

2. 20 Current Meter and Discharge Details:-

Since water depth was too low between chainage 3.731 km and 20.05 km, no bathymetry survey, current or discharge measurements has been conducted. The data recorded for ch.0.304 km and 3.731 km are given below-

Stretch No.	Chainage (km)	Position				Observed Depth (m) (D)	Velocity (m/sec.)	Average Velocity (m/sec.)	X-Sectional area (sq. m.)	Discharge (Cu.m/sec)
		Latitude (N)	Longitude (E)	Easting (m)	Northing (m)		0.5 D			
1	0.304	25°11'15.69"	92°0'58.947"	400890.7831	2786092.9283	0.3	0.523	0.523	159.87	83.61
2	3.731	25°12'28.05"	92° 0'23.53"	399916.38	2788326.86	0.4	0.425	0.425	195.48	83.08

Table 8- Details Current Meter List

2.21-a. Soil Sample Locations:-

9	Chainage (km)	Latitude (N)	Longitude (E)	Easting (m)	Northing (m)	Depth (m)
1	0.304	25°11'15.69"	92°0'58.947"	400890.7831	2786092.9283	0.3
2	3.731	25°12'28.05"	92° 0'23.53"	399916.38	2788326.86	0.4

Table 9-Soil Sample Location

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	0.304	25°11'15.69"	92°0'58.947"	400890.7831	2786092.9283	0.3	0.15
2	3.731	25°12'28.05"	92° 0'23.53"	399916.38	2788326.86	0.4	0.20

Table 10- Water Sample Location

Section-3: Detailed Hydrographic Survey- Stretch Wise

3.1 From Cainage 0.00 Km to Chainage 10.00 Km (Dawki village to Mawshun village)

Figure 5 Chainage 0.00 km to Chainage 10.00 km

The width of Umngot River from chainage 0.00 km to Chainage 10.00 km is approximately 285 m to 85.47m. The average width portion of the river is 75 m.

During the survey it was noticed that A Steel Bridge is located near at chainage of 0.681km. Larbamon, Dawki, Bakur, Darrang, Sohkha Mission, wahlyngdoh, Khonglah, Nongbarehrim, Amdoh are situated right bank side of the river and Kongwang, wahkdait, mawriang, Pashum , Burma, Mawshun, pongtung are situated left bank side of the river. BM-1 and BM-2 both have been situated near at chainage of 0.304 km and 3.731 km right bank side of this stretch. The nature of the river bed is Rocky and Boulders in this stretches. Dawki ferry ghat is located near at chainage 0.32 km.

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	0.03	11.8	10000	327347.400	-0.3	11.7	10000	393140.550
II	0.00	10.00	0.02	11.8	10000	519920.200	-0.3	11.7	10000	615298.510
III	0.00	10.00	0.02	11.8	10000	813203.590	-0.3	11.7	10000	943906.300
IV	0.00	10.00	0.018	11.8	10000	994419.580	-0.3	11.7	10000	1134642.620

Figure 6 Steel Bridge (Chainage- 0.681 km)

Figure 7- Dawki Ferry ghat (Chainage-0.32 km)

3.2 From chainage 10.00 km to 20.05 km (Mawshun village to Nongryngkoh village)

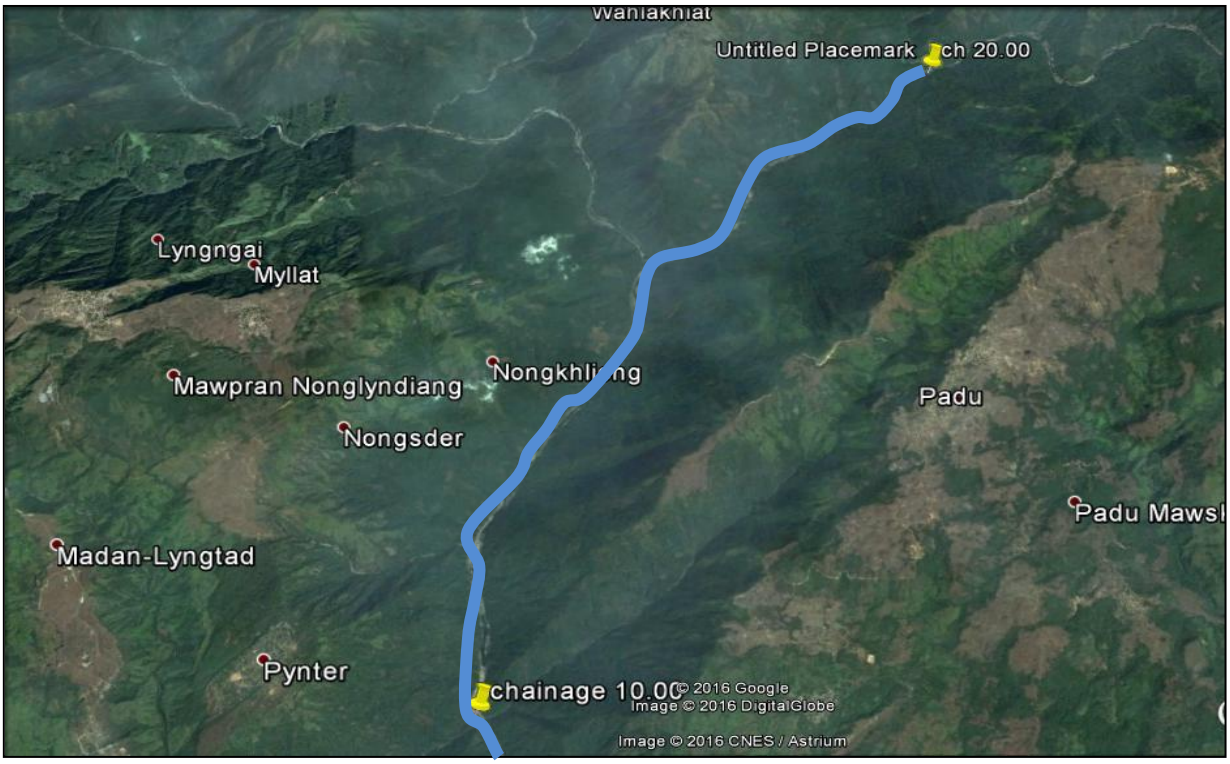


Figure 8 chainage 10.00 km to 20.05 km

The width of Umngot River from chainage 10.00 km to 20.00 km is approximately 72.41 m to 70 m. The average width portion of the river is 50m.

During the survey it was noticed that Mawsohrisa, Pynter, Pynursla, Lyting lyngdoh, Langkyrdem, New Nongryngkoh, Madan Lyngtad, Nongsder, Lyngngai are situated left bank side of the river and Padu, Pamtbuh, Amjajer Roko, Lurniang, Mawlong, Padubah, Amtapoh, Pamtadong are situated right bank side of the river. The total stretches are covered with dense forests and hills. The nature of the river bed is Rocky and Boulders in this stretches.

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	20.05	0.03	0.3	10000	377937.500	-0.3	0	10000	468957.430
II	10.00	20.05	0.026	0.3	10000	600252.490	-0.3	0	10000	726581.960
III	10.00	20.05	0.022	0.4	10000	931561.670	-0.3	0	10000	1096302.680
IV	10.00	20.05	0.018	0.4	10000	1134278.590	-0.3	0	10000	1307792.740

- **Bathymetry Survey**

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

The layer of water in the river is not sufficient for carrying out the Bathymetric survey. The length of the Bathymetry survey is 0.00 km to 1.334 km.

- **Topographic Survey**

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

The Topography survey has been carried out from Bangladesh Border near Larbamon to Nongryngkoh. The length of the Topography survey is 0.00 km to 20.05 km.

a) Prominent Dams / Barrage:-

There are no Dams, Barrage found in this zone of River.

b) Tidal stretch, tidal range. Pondage stretch / length of Dam, Barrages, Weirs, Anicut, Locks:-

There are no Dams, Barrages, weirs, Anicut; Locks are found in this zone of river.

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

The both side banks of the river are covered with rocks, boulders, many outcrops and dense forest. The river is located very low position from the hilly area. The population in the riverside is average. However, the river side is protected by rocky stone, boulders etc. Both side dense forest are also protected the river from the domestic and outsider activities. As a result, the water of the river is very clean and poisons less in this region of river.

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

Indo-Bangladesh Border is situated near the riverside at Dawki. So the Border area is highly protected. Beside dense forests, rock and Boulders are also covered the whole bank side of the river side.

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

Near the bank side of the Umngot River, the Jayantia Hills, dense forest have been located. Forest side and Wildlife area have become Unapproachable and also defence its own states from Bangladesh. The Indo-Bangladesh border is highly protected near at Dawki from nearby states.

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

NH-40, NH- 44E, NH-44 are the two major communications way near the river side. Besides, SH- 4, SH-7 and SH-9 are also communicative way for the local villagers and also for the tourist. AH-2 is also a good communication way towards the villages.

g) Railway Line and Stations in the vicinity:-

No Railway line or stations have been found in this zone of river.

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

The major portion of the land is occupied by agriculture. Major crops are Rice, Tea, Mustard, Maize etc have been cultivated in this zone of river. The right bank mostly occupied with scattered forest area and agriculture. The most important forest products are timber, bamboo and firewood. The land is also used for Jhum cultivation.

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

The Major crops along the river are Rice and Maize. Besides, the Horticulture crops are Orange, Lemon, Pineapple, Guava, Litchi, Banana, Jackfruit etc have been cultivated in this zone of river. Beside this, Non-traditional crops like Tea, Cashew nut; Oilseeds, Tomato, Mushroom, wheat etc. have been cultivated in this zone of river. Besides, Jhum cultivation is still practised in this zone of river.

j) Availability of Bulk / Construction Material:-

There is no useful construction material found in this zone of river. As a rocky area, small rocks, outcrops, sandstone are available in this region of river.

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

Meghalaya is a industrially backward state. There are some numbers of small-scale industries like bakeries, furniture making, steel fabrication; tyre retreading, spice etc have been located in this zone of river. Fishing culture is one of the major professions in this region of river. Besides, collecting honey, hunting beast in the forest are also the other activities in this region of river.

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

Dawki ferry ghat is located near at chainage of 0.32 km near the steel bridge found in this zone of river. Fishing culture in Dawki is communicated between India and Bangladesh. Hundreds of Fishermen are engaged in this profession.

Chainage (km)	Name of Ferry ghat	Location	Easting	Northing	Latitude (N)	Longitude (E)	Present Condition
0.32	Dawki Ferry ghat	Dawki	400942.38	2785984.09	25°11'12.165"	92° 1'0.818"	Well and movement cargo with light goods like vegetables, cycle, Fish etc. Temporary jetty is made in this zone of river.

m) Existing Cargo Movement:-

Dawki ferry ghat is located near at chainage of 0.32 km near the steel bridge found in this zone of river. Dawki serves a busy trade route between India and Bangladesh. The Cargo movement is available in the Dawki ferry ghat service which is the major place for fishing. Dawki is one of the major tourist places in the state of Meghalaya.

Chainage (km)	Name of Ferry ghat	Location	Easting	Northing	Latitude (N)	Longitude (E)	Present Condition
0.32	Dawki Ferry ghat	Dawki	400942.38	2785984.09	25°11'12.165"	92° 1'0.818"	Well and movement cargo with light goods like vegetables, cycle, Fish etc. Temporary jetty is made in this zone of river.

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

Dawki, Burma, Padu etc. Important places are situated in this zone of river.

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

Dawki, Burma, Padu etc. Important places are situated in this zone of river.

p)Availability of Passenger Ferry Services and Recreational Facilities:-

Dawki ferry ghat is located near at chainage of 0.32 km near the steel bridge found in this zone of river. Dawki serves a busy trade route between India and Bangladesh. Fishing activities is one of the prime professions in this region of river.

Chainage (km)	Name of Ferry ghat	Location	Easting	Northing	Latitude (N)	Longitude (E)	Present Condition
0.32	Dawki Ferry ghat	Dawki	400942.38	2785984.09	25°11'12.165"	92° 1'0.818"	Well and movement cargo with light goods like vegetables, cycle, Fish etc. Temporary jetty is made in this zone of river

q) Available and probable Water Sport Recreational Facilities:-

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

r) Fishing activities:-

The Umngot itself is a prime fishing spot for fishermen from nearby areas. Fishing culture is one of the main professions in this region of river. India and Bangladesh both the countrymen are engaged in the fishing activities in Dawki sites. Umngot River is the lifeline of the people of its important places for fishing culture. Umngot provides diverse habitat in its downstream for living biota such as stream, riparian zones and wetlands etc. Umngot has some of the richest riverine fisheries in India. The river has over fish species and forms an important component of livelihood and nutritional security in the downstream stretches in Meghalaya. The wetlands are ecologically and economically important for the local people. Fishing in Umngot River is very famous among the people.

s) Sand mining:-

Illegal river sand mining across the country is on the rise for past many years in Indian, which results in adverse impact on river system and dependent communities. In Umngot gravel mining was noticed during the survey period. Besides this, sand is also exported to other states as it becomes demandful for making Building or Industries.

t) Tributaries:-

There is no tributary found in this zone of river.

u) Details of Irrigation Canals and Outlets:-

The irrigation canal and outlets are found near at chainage of 4 km, 5 km, 7 km at the right side of the river bank and chainage 10 km, 16 km and 19 km at the left bank side of the river.

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

No Nalas are found in this zone of river.

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

In Recent time's man avoid to 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 of the river is very clean in this region of river. Sometimes, the water becomes suitable for drinking. The water of the river is also used for cultivation. Dawki ferry service is available in this region of river.

Section 4: Terminals

Dawki ferry ghat terminal is located near at chainage of 0.681 km near the steel bridge found in this zone of river. Dawki serves a busy trade route between India and Bangladesh. Fishing activities is one of the prime professions in this region of river.

Chainage (km)	Name of Ferry ghat	Location	Easting	Northing	Latitude (N)	Longitude (E)	Present Condition
0.32	Dawki Ferry ghat	Dawki	400942.38	2785984.09	25°11'12.165"	92° 1'0.818"	Well and movement cargo with light goods like vegetables, cycle, Fish etc. Temporary jetty is made in this zone of river.

Figure 9-Dawki Ferry Terminal (Chainage-0.320 km)

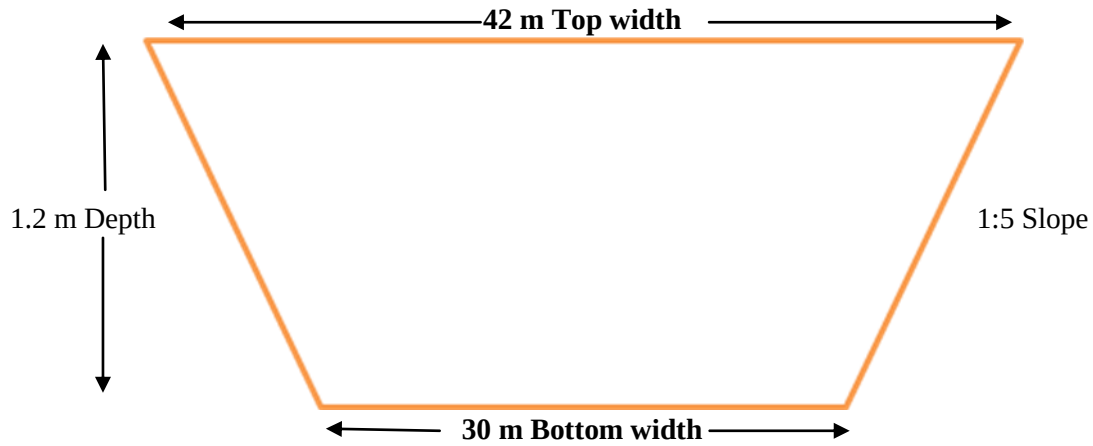
4.1 Details of Land use, owner etc.:-

The Bank of the river is covered with dense forest, rock, boulder etc. Due to rock and Boulders, The agriculture is not suitable in this region of river. In spite of rocky lands, crops like Rice, Maize etc. are cultivated in this zone of river. The both side lands are covered with mainly dense forest, hilly areas etc. The population in this region of river are average. So the land is not useful like plane area. The Agriculture is not much suitable in this zone of river.

Section 5: Fairway development:-

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

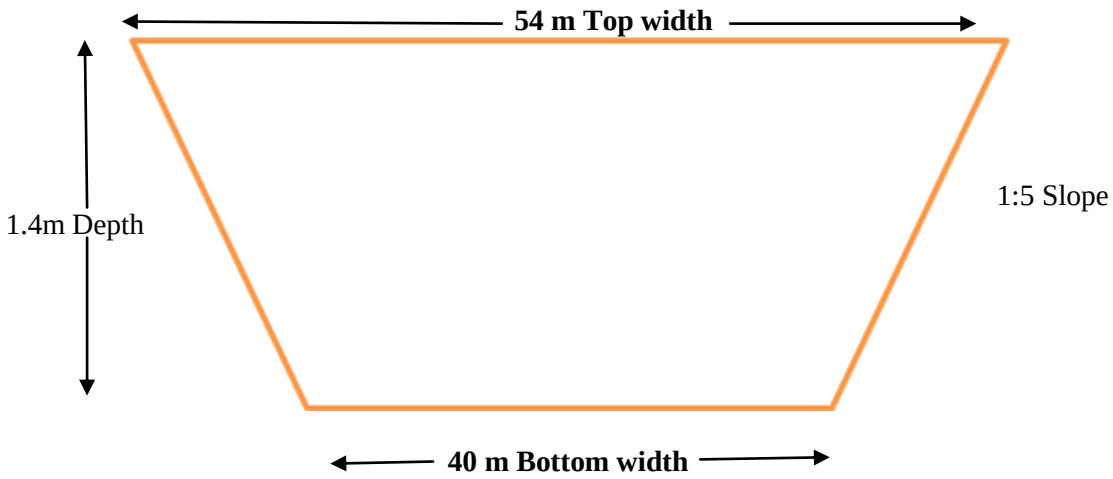
Class-I: - (Channel design: - Bottom width- 30 meter, Top width- 42 meter)



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min. depth (m)	Max depth (m)	Length of Shoal (m)	Avg. Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Avg. Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
Dawki	Mawshun	0	10	0.03	11.8	10000	0.99	327347.4	327347.4	-0.3	11.7	10000	1.19	393140.55	393140.55
Mawshun	Nongryngkoh	10	20.05	0.03	0.3	10000	1.14	377937.5	705284.9	-0.3	0	10000	1.42	468957.43	862097.98
Total						20000		705284.9		Total		20000		862097.98	

Table 11- Dredging Quantity of Class—I

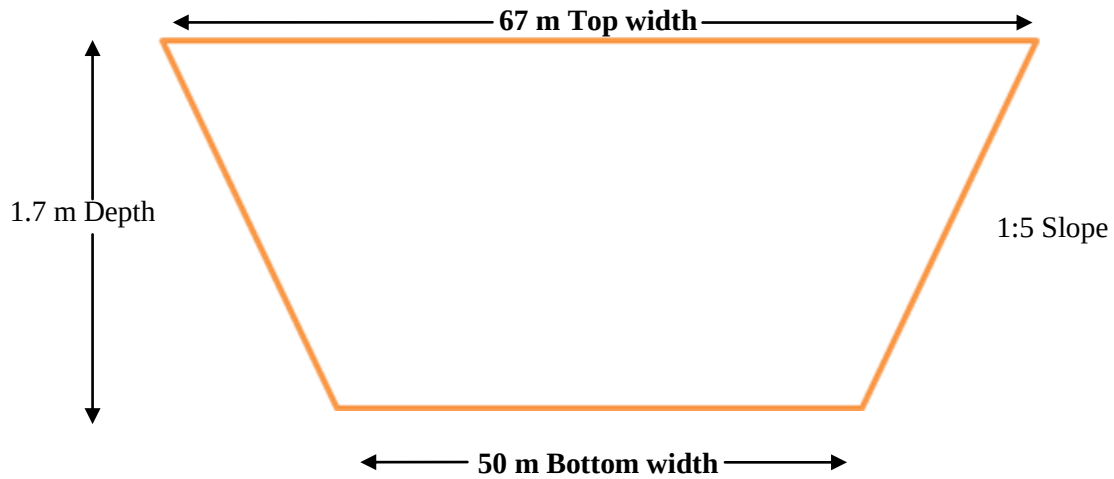
Class-II: - (Channel design: - Bottom width- 40 meter, Top width- 54 meter)



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min. depth (m)	Max depth (m)	Length of Shoal (m)	Avg. Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min Depth (m)	Max. Depth (m)	Length of Shoal (m)	Avg. Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
Dawki	Mawshun	0	10	0.02	11.8	10000	1.18	519920.2	519920.2	-0.3	11.7	10000	1.40	615298.51	615298.51
Mawshun	Nongryn	10	20.05	0.026	0.3	10000	1.36	600252.49	1120172.69	-0.3	0	10000	1.65	726581.96	1341880.47
Total						20000		1120172.69		Total		20000		1341880.47	

Table 12- Dredging Quantity of Class—II

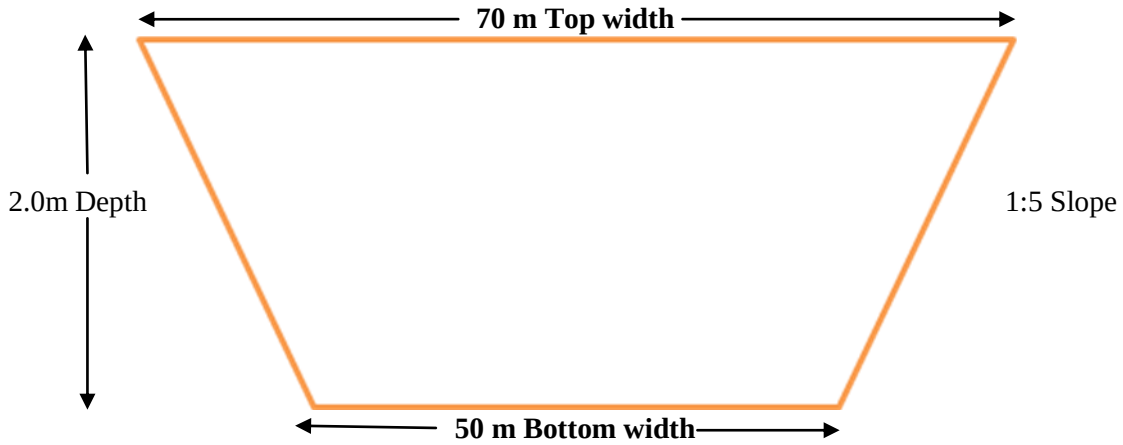
Class-III: - (Channel design: - Bottom width- 50 meter, Top width- 67 meter)



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min depth (m)	Max depth (m)	Length of Shoal (m)	Avg. Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min Depth (m)	Max. Depth (m)	Length of Shoal (m)	Avg. Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
Dawki	Mawshun	0	10	0.02	11.8	10000	1.48	813203.59	813203.59	-0.3	11.7	10000	1.72	943906.3	943906.3
Mawshun	Nongryngkoh	10	20.05	0.022	0.4	10000	1.69	931561.67	1744765.26	-0.3	0	10000	1.99	1096302.7	2040209
Total						20000		1744765.26		Total		20000		2040209	

Table 13- Dredging Quantity of Class—III

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



Location		Chainage (km)		As per Observed Soundings						As per Reduced Soundings					
From	To	From	To	Min depth (m)	Max depth (m)	Length of Shoal (m)	Avg Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max Depth (m)	Length of Shoal (m)	Avg. Depth of Cut (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
Dawki	Mawshun	0	10	0.018	11.8	10000	1.81	994419.58	994419.58	-0.3	11.7	10000	2.06	1134642.6	1134642.6
Mawshun	Nongrygkoh	10	20.05	0.018	0.4	10000	2.06	1134278.6	2128698.17	-0.3	0	10000	2.38	1307792.7	2442435.36
Total						20000		2128698.17		Total		20000		2442435.36	

Table 14- Dredging Quantity of Class—IV

Section 6: Conclusion

The surveyed stretch of Umngot River is 20.05 km in length and was not explored for any navigational possibility in earlier time. Dawki Ferry services are available in this zone of river near at chainage of 0.32 km. The light cargo is available in this ferry ghat with light goods and vegetables etc. Garo, Khasi etc. communities are located in this zone of river. Indo-Bangladesh Border is located near Dawki in this zone of river. Fishing is the important sector for daily earning lives for the local villagers.The right bank of the river is moderately connected with roads and other infrastructures than the left bank. The settlements are thickly populated on the right bank where as the left bank is sparsely distributed. However, there is a good scope for developing tourism along the entire stretch of Umngot. The river bed of Umngot River is mainly rock and Boulders in nature with isolated incident of small scale and conventional sand/Gravel mining by the local peoples. The river banks of entire stretch are covered with vegetation and beyond that cultivation is prominent. Encroachment was observed in many parts of the river banks. The water flow of the river is not obstructed from top to bottom of the entire stretch. The average water velocity during the survey period is around 0.80 m/s. The communication is connected with two Steel Bridge in this zone. No Railway line or RCC bridges have been found in this zone of river. Dawki is the major place located in this zone of river. Fishing is one of the major professions which is available in dawki site.

The transportation is well connected with NH-40, NH- 44 which is the strong transportation system in this zone of river. Besides, SH-4, SH-7 and SH-9 are also situated in this zone of river but there were lots of possibility to improve the cargo transportation by Rail and roads. If the Ferry services will develop in future, the passengers are really very helpful for daily communication and transportation system.

6.1 Dredging volume:-

Class Details	As per Observed Soundings (cubic meter)	As per Reduced Soundings (cubic meter)
Class I	705284.90	862097.98
Class II	1120172.69	1341880.47
Class III	1744765.26	2040209
Class IV	2128698.17	2442435.36

Annexure:-

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

The Topography survey has been considered from the CWC Gauge site and all the particulars data are 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:-

Chainage (km)		As per Observed soundings					As per Reduced soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
0	1	0.1	11.8	1000	7181.28	7181.28	-0.3	11.7	1000	9605.71	9605.71
1	2	0.03	8.7	1000	22053.1	29234.38	-0.3	8.5	1000	25916.07	35521.78
2	3	0.03	0.2	1000	38375.05	67609.43	-0.3	0	1000	45073.46	80595.24
3	4	0.03	0.3	1000	30120.56	97729.99	-0.3	0	1000	34396	114991.24
4	5	0.03	0.3	1000	36245.42	133975.4	-0.3	0	1000	38269.16	153260.4
5	6	0.03	0.3	1000	40453.55	174429	-0.3	0	1000	50280.45	203540.85
6	7	0.03	0.2	1000	34889.3	209318.3	-0.3	0	1000	42708.64	246249.49
7	8	0.03	0.2	1000	39510.14	248828.4	-0.3	0	1000	48953.07	295202.56
8	9	0.03	0.2	1000	39578.72	288407.1	-0.3	0	1000	49323.8	344526.36
9	10	0.04	0.2	1000	38940.32	327347.4	-0.3	0	1000	48614.19	393140.55
10	11	0.03	0.2	1000	39182.99	366530.4	-0.3	0	1000	48875.06	442015.61
11	12	0.03	0.2	1000	39157.55	405688	-0.3	0	1000	48774.1	490789.71
12	13	0.03	0.2	1000	38713.74	444401.7	-0.3	0	1000	48142.93	538932.64
13	14	0.03	0.2	1000	36992.16	481393.9	-0.3	0	1000	45817.95	584750.59
14	15	0.03	0.2	1000	35151.2	516545.1	-0.3	0	1000	43204.55	627955.14
15	16	0.03	0.3	1000	36125.52	552670.6	-0.3	0	1000	44329.04	672284.18
16	17	0.03	0.3	1000	38588.95	591259.6	-0.3	0	1000	48216.86	720501.04
17	18	0.03	0.2	1000	36919.42	628179	-0.3	0	1000	45648.61	766149.65
18	19	0.03	0.2	1000	41034.78	669213.8	-0.3	0	1000	51066.89	817216.54
19	20.05	0.03	0.3	1000	36071.19	705284.9	-0.3	0	1000	44881.44	862097.98
Total				20000	705284.9		Total		20000	862097.98	

Table 15- Dredging Calculation of Class-I

Class-II:-

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
0	1	0.02	11.8	1000	11348.17	11348.17	-0.3	11.7	1000	15199.23	15199.23
1	2	0.027	8.7	1000	34350.27	45698.44	-0.3	8.5	1000	41482.24	56681.47
2	3	0.029	0.3	1000	61234.66	106933.1	-0.3	0	1000	71043.97	127725.44
3	4	0.026	0.3	1000	50273.82	157206.92	-0.3	0	1000	57045.75	184771.19
4	5	0.028	0.3	1000	58411.36	215618.28	-0.3	0	1000	62231.15	247002.34
5	6	0.028	0.3	1000	62705.7	278323.98	-0.3	0	1000	76079.79	323082.13
6	7	0.026	0.3	1000	55647.66	333971.64	-0.3	0	1000	66684.98	389767.11
7	8	0.027	0.3	1000	62964.35	396935.99	-0.3	0	1000	76114.1	465881.21
8	9	0.026	0.2	1000	61705.24	458641.23	-0.3	0	1000	74906.43	540787.64
9	10	0.036	0.3	1000	61278.97	519920.2	-0.3	0	1000	74510.87	615298.51
10	11	0.028	0.3	1000	61398.16	581318.36	-0.3	0	1000	74634.77	689933.28
11	12	0.026	0.3	1000	61356.54	642674.9	-0.3	0	1000	74444	764377.28
12	13	0.026	0.3	1000	60914.62	703589.52	-0.3	0	1000	73897.2	838274.48
13	14	0.028	0.2	1000	59134.24	762723.76	-0.3	0	1000	71455.35	909729.83
14	15	0.027	0.3	1000	57370.74	820094.5	-0.3	0	1000	68970.26	978700.09
15	16	0.028	0.3	1000	58282.85	878377.35	-0.3	0	1000	70038.8	1048738.9
16	17	0.027	0.3	1000	61022.39	939399.74	-0.3	0	1000	74209.61	1122948.5
17	18	0.029	0.3	1000	59122.02	998521.76	-0.3	0	1000	71355.27	1194303.8
18	19	0.028	0.3	1000	64486.54	1063008.3	-0.3	0	1000	78240.07	1272543.8
19	20.05	0.027	0.3	1000	57164.39	1120172.69	-0.3	0	1000	69336.63	1341880.47
Total				20000	1120172.69		Total		20000	1341880.47	

Table 16- Dredging Calculation of Class-II

Class-III:-

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
0	1	0.02	11.8	1000	18710.6	18710.6	-0.3	11.7	1000	24770.33	24770.33
1	2	0.024	8.7	1000	55040.23	73750.83	-0.3	8.5	1000	66543.61	91313.94
2	3	0.028	0.3	1000	95945.52	169696.35	-0.3	0	1000	109618.78	200932.72
3	4	0.022	0.3	1000	81011.45	250707.8	-0.3	0	1000	90923.07	291855.79
4	5	0.026	0.3	1000	92374.7	343082.5	-0.3	0	1000	98704.83	390560.62
5	6	0.026	0.3	1000	95820.45	438902.95	-0.3	0	1000	113010.08	503570.7
6	7	0.022	0.3	1000	86844.92	525747.87	-0.3	0	1000	101446.18	605016.88
7	8	0.024	0.3	1000	97857.47	623605.34	-0.3	0	1000	115039.41	720056.29
8	9	0.022	0.3	1000	95042.85	718648.19	-0.3	0	1000	112165.75	832222.04
9	10	0.032	0.3	1000	94555.4	813203.59	-0.3	0	1000	111684.26	943906.3
10	11	0.026	0.4	1000	94411.44	907615.03	-0.3	0	1000	111473.28	1055379.6
11	12	0.022	0.3	1000	94325.3	1001940.33	-0.3	0	1000	111243.86	1166623.4
12	13	0.022	0.3	1000	94024.25	1095964.58	-0.3	0	1000	110791.23	1277414.7
13	14	0.026	0.3	1000	92339.57	1188304.15	-0.3	0	1000	108480.44	1385895.1
14	15	0.024	0.3	1000	90750.36	1279054.51	-0.3	0	1000	106259.71	1492154.8
15	16	0.026	0.3	1000	91486.55	1370541.06	-0.3	0	1000	107151.47	1599306.3
16	17	0.024	0.3	1000	94193.67	1464734.73	-0.3	0	1000	111229.81	1710536.1
17	18	0.028	0.4	1000	92265.97	1557000.7	-0.3	0	1000	108319.85	1818856
18	19	0.026	0.4	1000	99505.61	1656506.31	-0.3	0	1000	117344.61	1936200.6
19	20.05	0.024	0.3	1000	88258.95	1744765.26	-0.3	0	1000	104008.42	2040209
Total				20000	1744765.26		Total		20000	2040209	

Table 17- Dredging Calculation of Class-III

Class-IV:-

Chainage (km)		As per Observed Soundings					As per Reduced Soundings				
From	To	Min. depth (m)	Max. depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty. (cubic meter)	Cumulative Dredging Quantity (cubic meter)
0	1	0.02	11.8	1000	23259.67	23259.67	-0.3	11.7	1000	30393.38	30393.38
1	2	0.021	8.7	1000	68690.25	91949.92	-0.3	8.5	1000	81749.74	112143.12
2	3	0.027	0.3	1000	117204.26	209154.18	-0.3	0	1000	131769.29	243912.41
3	4	0.018	0.4	1000	99864.64	309018.82	-0.3	0	1000	110573.46	354485.87
4	5	0.024	0.4	1000	113615.54	422634.36	-0.3	0	1000	120620.43	475106.3
5	6	0.024	0.4	1000	116012.89	538647.25	-0.3	0	1000	134107.31	609213.61
6	7	0.018	0.3	1000	106176.33	644823.58	-0.3	0	1000	121645.04	730858.65
7	8	0.021	0.3	1000	119317.04	764140.62	-0.3	0	1000	137446.14	868304.79
8	9	0.018	0.4	1000	115514.27	879654.89	-0.3	0	1000	133590.72	1001895.51
9	10	0.028	0.4	1000	114764.69	994419.58	-0.3	0	1000	132747.11	1134642.62
10	11	0.024	0.4	1000	114657.44	1109077.02	-0.3	0	1000	132616.26	1267258.88
11	12	0.018	0.4	1000	114764.24	1223841.26	-0.3	0	1000	132632.44	1399891.32
12	13	0.018	0.4	1000	114125.73	1337966.99	-0.3	0	1000	131734.4	1531625.72
13	14	0.024	0.3	1000	112520.64	1450487.63	-0.3	0	1000	129541.53	1661167.25
14	15	0.021	0.4	1000	111017.49	1561505.12	-0.3	0	1000	127364.84	1788532.09
15	16	0.024	0.3	1000	111892.49	1673397.61	-0.3	0	1000	128381.16	1916913.25
16	17	0.021	0.3	1000	114308.29	1787705.9	-0.3	0	1000	132209.65	2049122.9
17	18	0.027	0.4	1000	112674.2	1900380.1	-0.3	0	1000	129644.54	2178767.44
18	19	0.024	0.4	1000	120999.94	2021380.04	-0.3	0	1000	139804.1	2318571.54
19	20.05	0.021	0.3	1000	107318.13	2128698.17	-0.3	0	1000	123863.82	2442435.36
Total				20000	2128698.17		Total			2442435.36	

Table 18- Dredging Calculation of Class-IV

Annexure-3 Observed depth at 200 meter interval:-

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
0	0.1	0.2	0.02	0.2	0.02	0.2	0.02	0.2
200	0.1	0.2	0.02	0.2	0.02	0.2	0.02	0.2
400	7.5	11.8	7.3	11.8	7.2	11.8	7.2	11.8
600	4.2	7.1	4.0	7.1	3.7	7.1	3.6	7.2
800	3.7	6.7	3.5	6.7	3.2	6.7	3.2	6.8
1000	1.2	1.8	1.0	1.9	1.0	2.1	1.0	2.2
1200	2.6	8.7	2.5	8.7	2.3	8.7	2.2	8.7
1400	0.04	0.2	0.039	0.3	0.038	0.3	0.037	0.3
1600	0.03	0.1	0.028	0.2	0.026	0.2	0.024	0.3
1800	0.03	0.1	0.027	0.2	0.024	0.2	0.021	0.2
2000	0.03	0.1	0.029	0.2	0.028	0.2	0.027	0.3
2200	0.04	0.2	0.038	0.3	0.036	0.3	0.034	0.3
2400	0.04	0.1	0.036	0.1	0.032	0.2	0.028	0.3
2600	0.04	0.1	0.039	0.2	0.038	0.2	0.037	0.3
2800	0.04	0.2	0.038	0.2	0.036	0.2	0.034	0.3
3000	0.04	0.1	0.039	0.2	0.038	0.2	0.037	0.3
3200	0.03	0.2	0.026	0.2	0.022	0.3	0.018	0.3
3400	0.03	0.3	0.027	0.3	0.024	0.3	0.021	0.3
3600	0.04	0.1	0.037	0.2	0.034	0.3	0.031	0.3
3800	0.05	0.2	0.048	0.3	0.046	0.3	0.044	0.3
4000	0.04	0.1	0.039	0.2	0.038	0.3	0.037	0.4
4200	0.05	0.2	0.048	0.3	0.046	0.3	0.044	0.4
4400	0.05	0.1	0.047	0.2	0.044	0.3	0.041	0.3
4600	0.05	0.2	0.049	0.3	0.048	0.3	0.047	0.3
4800	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
5000	0.04	0.3	0.036	0.3	0.032	0.3	0.028	0.4
5200	0.03	0.1	0.029	0.2	0.028	0.3	0.027	0.4
5400	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
5600	0.05	0.1	0.049	0.2	0.048	0.3	0.047	0.3
5800	0.04	0.2	0.038	0.2	0.036	0.3	0.034	0.3
6000	0.04	0.1	0.039	0.2	0.038	0.3	0.037	0.3
6200	0.03	0.2	0.027	0.3	0.024	0.3	0.021	0.3
6400	0.03	0.1	0.026	0.2	0.022	0.2	0.018	0.2
6600	0.03	0.1	0.028	0.2	0.026	0.2	0.024	0.3
6800	0.05	0.2	0.049	0.3	0.048	0.3	0.047	0.3
7000	0.03	0.2	0.027	0.3	0.024	0.3	0.021	0.3
7200	0.04	0.1	0.038	0.2	0.036	0.2	0.034	0.2
7400	0.05	0.2	0.049	0.3	0.048	0.3	0.047	0.3
7600	0.04	0.1	0.038	0.2	0.036	0.3	0.034	0.3

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
7800	0.03	0.2	0.027	0.2	0.024	0.3	0.021	0.3
8000	0.04	0.1	0.039	0.2	0.038	0.2	0.037	0.3
8200	0.04	0.2	0.038	0.2	0.036	0.2	0.034	0.3
8400	0.03	0.1	0.026	0.2	0.022	0.2	0.018	0.2
8600	0.03	0.1	0.029	0.2	0.028	0.2	0.027	0.3
8800	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
9000	0.04	0.2	0.039	0.2	0.038	0.3	0.037	0.4
9200	0.04	0.1	0.038	0.2	0.036	0.3	0.034	0.3
9400	0.04	0.1	0.039	0.2	0.038	0.2	0.037	0.3
9600	0.04	0.1	0.037	0.2	0.034	0.3	0.031	0.3
9800	0.04	0.2	0.036	0.3	0.032	0.3	0.028	0.3
10000	0.04	0.1	0.038	0.2	0.036	0.3	0.034	0.3
10200	0.04	0.2	0.039	0.3	0.038	0.3	0.037	0.3
10400	0.04	0.1	0.037	0.2	0.034	0.3	0.031	0.3
10600	0.03	0.2	0.028	0.3	0.026	0.4	0.024	0.4
10800	0.04	0.1	0.039	0.2	0.038	0.3	0.037	0.3
11000	0.03	0.2	0.028	0.2	0.026	0.3	0.024	0.3
11200	0.04	0.1	0.037	0.2	0.034	0.3	0.031	0.3
11400	0.05	0.2	0.049	0.2	0.048	0.3	0.047	0.3
11600	0.03	0.2	0.028	0.3	0.026	0.3	0.024	0.4
11800	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
12000	0.03	0.1	0.026	0.2	0.022	0.3	0.018	0.4
12200	0.04	0.2	0.039	0.2	0.038	0.3	0.037	0.3
12400	0.05	0.1	0.049	0.2	0.048	0.3	0.047	0.3
12600	0.03	0.1	0.028	0.2	0.026	0.2	0.024	0.2
12800	0.04	0.2	0.039	0.3	0.038	0.3	0.037	0.3
13000	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
13200	0.03	0.2	0.029	0.2	0.028	0.3	0.027	0.3
13400	0.04	0.1	0.037	0.2	0.034	0.3	0.031	0.3
13600	0.04	0.1	0.036	0.1	0.032	0.2	0.028	0.3
13800	0.04	0.2	0.038	0.2	0.036	0.3	0.034	0.3
14000	0.04	0.1	0.039	0.2	0.038	0.3	0.037	0.3
14200	0.03	0.1	0.027	0.2	0.024	0.3	0.021	0.3
14400	0.03	0.2	0.028	0.2	0.026	0.3	0.024	0.3
14600	0.03	0.1	0.029	0.2	0.028	0.3	0.027	0.4
14800	0.04	0.2	0.038	0.3	0.036	0.3	0.034	0.3
15000	0.05	0.1	0.047	0.2	0.044	0.3	0.041	0.3
15200	0.04	0.1	0.039	0.2	0.038	0.3	0.037	0.3
15400	0.03	0.2	0.028	0.2	0.026	0.3	0.024	0.3
15600	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
15800	0.05	0.2	0.046	0.3	0.042	0.3	0.038	0.3

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Observed		Observed		Observed		Observed	
	Min	Max	Min	Max	Min	Max	Min	Max
16000	0.05	0.3	0.049	0.3	0.048	0.3	0.047	0.3
16200	0.03	0.2	0.029	0.2	0.028	0.3	0.027	0.3
16400	0.03	0.2	0.027	0.3	0.024	0.3	0.021	0.3
16600	0.04	0.3	0.038	0.3	0.036	0.3	0.034	0.3
16800	0.03	0.1	0.029	0.2	0.028	0.3	0.027	0.3
17000	0.04	0.1	0.038	0.2	0.036	0.3	0.034	0.3
17200	0.04	0.2	0.037	0.3	0.034	0.3	0.031	0.3
17400	0.03	0.2	0.029	0.3	0.028	0.4	0.027	0.4
17600	0.04	0.1	0.038	0.2	0.036	0.3	0.034	0.3
17800	0.04	0.2	0.038	0.2	0.036	0.3	0.034	0.3
18000	0.04	0.2	0.036	0.3	0.032	0.4	0.028	0.4
18200	0.04	0.1	0.039	0.2	0.038	0.3	0.037	0.3
18400	0.04	0.2	0.039	0.2	0.038	0.3	0.037	0.3
18600	0.04	0.1	0.037	0.2	0.034	0.3	0.031	0.3
18800	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
19000	0.04	0.1	0.039	0.2	0.038	0.3	0.037	0.3
19200	0.03	0.2	0.028	0.2	0.026	0.2	0.024	0.3
19400	0.03	0.3	0.027	0.3	0.024	0.3	0.021	0.3
19600	0.03	0.1	0.029	0.2	0.028	0.3	0.027	0.3
19800	0.03	0.1	0.028	0.2	0.026	0.3	0.024	0.3
20.05	0.03	0.2	0.027	0.2	0.024	0.3	0.021	0.3

Table 19-Observed depth at 200 meter interval

Annexure-4 Reduced Depth at 200 meter interval:-

Chainage (in meter)	Class-I Reduced		Class-II Reduced		Class-III Reduced		Class-IV Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
0.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
400.000	6.2	10.4	6.0	10.6	5.4	10.6	5.3	10.7
600.000	2.7	11.7	2.5	11.7	2.3	11.7	2.1	11.7
800.000	3.4	6.3	3.2	6.5	3.1	6.8	2.7	6.9
1000.000	0.4	3.5	0.4	3.7	0.4	3.7	0.4	3.8
1200.000	2.5	8.5	2.3	8.5	2.1	8.5	2.0	8.5
1400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
1600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
1800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
2800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
3800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
4800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
5800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
6800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
7600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0

Chainage (in meter)	Class-I Reduced		Class-II Reduced		Class-III Reduced		Class-IV Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
7800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
8800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
9800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
10800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
11800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
12800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
13800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
14800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
15800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0

Chainage (in meter)	Class-I		Class-II		Class-III		Class-IV	
	Reduced		Reduced		Reduced		Reduced	
	Min	Max	Min	Max	Min	Max	Min	Max
16200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
16800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
17800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
18800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19200.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19400.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19600.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
19800.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
20000.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0
20005.000	-0.3	0	-0.3	0	-0.3	0	-0.3	0

Table 20- Reduced depth at 200 meter interval

Annexure-5 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:-

Tide Pole name	Chainage (km)	Time	T. Reading (m)	Zero of TP w.r.t. MSL (m)	W.L w.r.t. MSL (m)	SD value w.r.t. MSL (m)	Corrected Tide (m)
			A	B	C = A+B	D	E = D-C
GS-1	0.300	24 Hrs	0.25	63.61	63.860	63.100	-0.760
GS-2	1.500	24 Hrs	0.29	64.41	64.700	64.400	-0.300
GS-3	2.500	24 Hrs	0.31	65.39	65.700	65.400	-0.300
GS-4	3.500	24 Hrs	0.37	66.38	66.750	66.450	-0.300
GS-5	4.500	24 Hrs	0.43	67.07	67.500	67.200	-0.300
GS-6	5.500	24 Hrs	0.47	69.73	70.200	69.900	-0.300
GS-7	6.500	24 Hrs	0.53	72.47	73.000	72.700	-0.300
GS-8	7.500	24 Hrs	0.59	74.91	75.500	75.200	-0.300
GS-9	8.500	24 Hrs	0.63	77.07	77.700	77.400	-0.300
GS-10	9.500	24 Hrs	0.68	79.62	80.300	80.000	-0.300
GS-11	10.500	24 Hrs	0.73	81.97	82.700	82.400	-0.300
GS-12	11.500	24 Hrs	0.77	84.43	85.200	84.900	-0.300
GS-13	12.500	24 Hrs	0.79	87.11	87.900	87.600	-0.300
GS-14	13.500	24 Hrs	0.81	89.79	90.600	90.300	-0.300
GS-15	14.500	24 Hrs	0.83	92.37	93.200	92.900	-0.300
GS-16	15.500	24 Hrs	0.85	94.75	95.600	95.300	-0.300
GS-17	16.500	24 Hrs	0.87	97.13	98.000	97.700	-0.300
GS-18	17.500	24 Hrs	0.91	99.59	100.500	100.200	-0.300
GS-19	18.500	24 Hrs	0.93	101.87	102.800	102.500	-0.300
GS-20	19.500	24 Hrs	0.95	104.35	105.300	105.000	-0.300

Table 21- Details of Collected water level of Different gauge stations

Annexure-6 Details of Bathymetric surveys carried out:-

The layer of water in the river Umngot is not sufficient for carrying out the Bathymetry Survey. The length of the Bathymetry survey is 0.000 km to 1.334 km.

Annexure-7 Bank Protection along the Bank:-

The bank of the river is generally protected by embankment and Boulder pitching. Boulder pitching, embankment has been protected in this river side. Besides, Jayantia Hills and dense forest side are also protected the bank of the river. However, in the rainy season, flood damages the crops (paddy field) etc. Due to this, the State Government has to incur heavy non plan expenditure for repairing of roads and bridges every year. To counteract the flood menace, permanent measures for protecting paddy fields, cultivation lands and habitats are necessary. As such, enhanced allocation is required for flood control projects.

Annexure-8 Details of Features across the Bank:-

The bank of the river includes with villages, agricultural field, Irrigation canals and outlets, Steel Bridges, dense Forest, Jayantia Hills etc. Rocks and Boulders are the nature of the bed level of the river. The both side river bank are highly protected by embankment and bolder pitching due to flood, erosion etc. The villagers are also situated near the bank side of the river. Recently different kinds of industries are also located near the bank side of the river. Jayantia Hills, dense forests have been situated in this zone of river and protected the river side.Dawki, Padu, Berma etc. villages have been located in this zone of river.

Annexure-9 Detailed methodology adopted for carrying out survey/Horizontal Control and Vertical Details Control:-

- **Establishment of Horizontal Control:-**

  The Horizontal control for Topography surveys: - 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.

  The Horizontal control for Bathymetry surveys: - DGPS is receiving corrections from Beacons.

Establishment of Vertical Control:-

Vertical control from C.W.C Gauge is used for the entire Survey work. It's value is 71.720 w.r.t. MSL has been considered for calculating the vertical levels. Water level is collected every 10km interval. Total 2 nos. of BM was established along the 20.05 km stretch of the river Umngot with the reference of CWC Gauge, which was fixed at Dawki Village.

Topography Survey:-

The survey was commenced on 11 th April 2016 and completed on 21st April 2016. Then the days Summer season and the climate become very hot which reached about 35◦ 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 46 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 10- Topography survey Instruments

- **Bathymetry Survey:-**

The Bathymetry survey was generally carried out using Bathy 500MF 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.

The Bathymetry survey was not carried out in this zone of river due to lacking of water. The layer of water is not sufficient for carrying out the Bathymetry survey. The Bathymetry survey has been carried out from 0.00 km to 1.150 km.

Figure 11- Bathymetry Survey Instrument

Annexure-10 -Photographs of Equipment:-

Following equipments were employed for the Bathymetry and Topography 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:-

The bathymetric survey was conducted using one motorized boat. This boat was also used to collect water sample, current velocity, soil sample etc.

Figure 12- Survey Vessel

- **Positioning System:-**

- **1 no Trimble DGPS system (SPS361)**

Figure 13 DGPS System 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 14 Echo Sounder Instrument

- **Current Meter:-**
  - **1 no. current meter (**AEM 213-D**) was used during water velocity**
  - **observation**
- **Calibration**

The equipments used for the survey were calibrated by the equipment supplier. The equipment calibration certificates are placed at ***Annexure*** to this report.

Annexure-11 Bench Mark Forms:-

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	R.L (m)
BM1	2785996.666	400985.363	25°11'12.56"	92° 1'2.34"	80.786
Pillar Established by : - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal; Date of Establishment : 15.04.16					
Station Description :-					
Benchmark is located near Dawki 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", "PSC" and BM No. can be seen on the face of the pillar. The measurements of the bench mark pillar from notable locations / edges as follows: South side from Road -0.34kms.					
Life of Station : 15Yrs	Datum: - WGS 84			**ZONE :**46 N	

Figure 15- Google image view of BM-1

BM Name	Northing (m)	Easting (m)	Latitude (N)	Longitude (E)	RL (m)
BM 2	2788361.894	399991.209	25°12'29.20"	92° 0'26.20"	93.931

Pillar Established by : - Precision Survey Consultancy. Surveyor – Mr. Debasis Mondal
Date of Establishment : 17.04.16

Station Description :-

Benchmark is located near Shnongpdeng 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", "PSC" and BM No. Can be seen on the face of the pillar.

The measurements of the bench mark pillar from notable locations / edges as follows:
South from Steel Bridge –2.28kms

Life of Station : 15Yrs	Datum: - WGS 84	**ZONE :**46 N

Figure 16-Google image view of BM-2

Annexure-12 -Levelling Calculation :

Leveling from GS-1 to BM-1

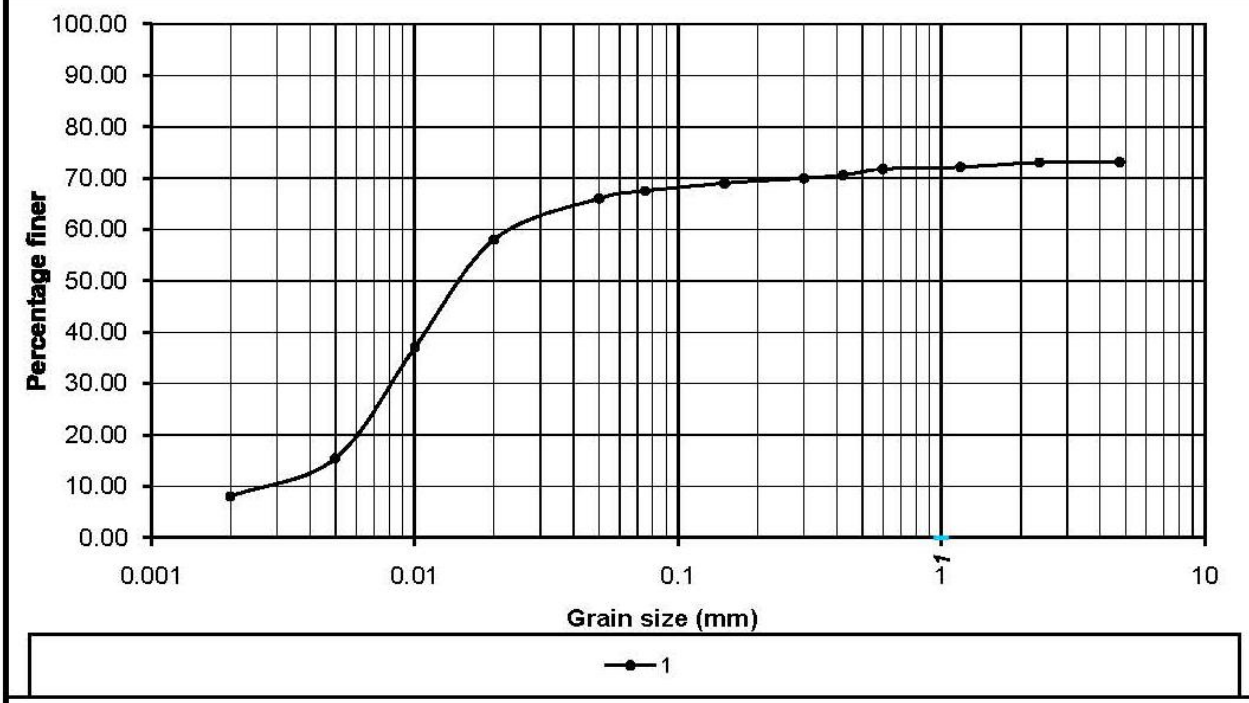
B.S	I.S	F.S	RISE (+)	FALL (-)	RL	REMARKS
0.313					80.786	BM-1
0.450		2.876		2.563	78.223	
0.687		1.629		1.179	77.044	
0.425		2.308		1.621	75.423	
0.338		1.986		1.561	73.862	
0.670		2.970		2.632	71.230	
0.552		1.344		0.674	70.556	
0.870		2.328		1.776	68.780	
0.289		2.275		1.405	67.375	
0.614		1.419		1.130	66.245	
0.356		1.495		0.881	65.364	
0.543		0.641		0.285	65.079	
0.678		0.738		0.195	64.884	
		1.702		1.024	63.860	GS 1

Table 22- Leveling Calculation of Umngot River

Annexure-13- Soil Sample:-

RESULTS OF TEST OF SOIL SAMPLES										
SITE-UMNGOT RIVER										
PHYSICAL ANALYSIS OF SOIL										
SL. NO	B.M	GRAVEL (%)	SAND (%)	SILT+CLAY (%)	SPECIFIC GRAVITY	PH VALUE	SILT (%)	CLAY (%)	Cu	Cc
1	1	26.27	18.92	54.21	2.65	7.48	46.20	8.01	7.67	0.97
2	2	16.85	34.12	49.03	2.64	7.40	37.40	9.17	6.06	1.38

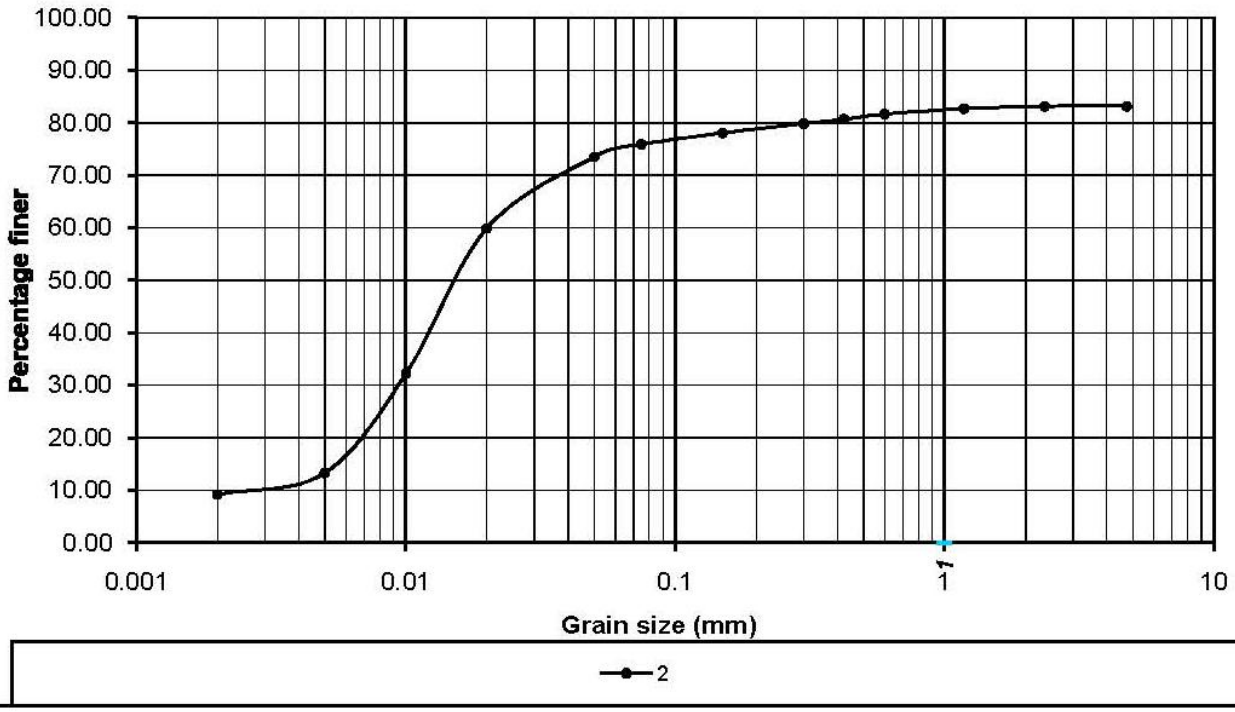
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-4.75*	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Sand (%)**	**Gravel (%)**
1	8.01	46.20	18.92	26.87

*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	9.17	39.86	34.12	16.85

*Silt & Clay

Annexure-14 Water Samples

RESULTS OF EXAMINATION OF SAMPLES OF WATER

SITE-UMNGOT RIVER

PARAMETER-pH Value at 25^0C

SL. NO	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPPER	pH value at 25^0C	5.4	6.5-8.5
2		MIDDLE		6.1	
3		LOWER		6.4	
4	2	UPPER		5.5	
5		MIDDLE		6.0	
6		LOWER		6.2	

RESULTS OF EXAMINATION OF SAMPLES OF WATER

SITE-UMNGOT RIVER

PARAMETER-Sulphates as SO_4 (mg/l)

SL. NO	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPPER	Sulphates as SO_4(mg/l)	94	400 (mg/l)
2		MIDDLE		94	
3		LOWER		92	
4	2	UPPER		95	
5		MIDDLE		94	
6		LOWER		93	

RESULTS OF EXAMINATION OF SAMPLES OF WATER

SITE-UMNGOT RIVER

PARAMETER-Chloride as Cl (mg/l)

SL. NO	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPPER	Chloride as Cl (mg/l)	3	2000mg/l for concrete not containing embedded steel and 500 mg/l for reinforced concrete work
2		MIDDLE		2	
3		LOWER		3	
4	2	UPPER		2	
5		MIDDLE		2	
6		LOWER		3	

RESULTS OF EXAMINATION OF SAMPLES OF WATER

SITE-UMNGOT RIVER

PARAMETER-Sediment Concentration (mg/l)

SL. NO	B.M	LOCATION	PARAMETER	WATER SAMPLE RESULTS	PERMISSIBLE LIMIT IS:456-2000
1	1	UPPER	Sulphates as SO_4(mg/l)	55	2000 (mg/l)
2		MIDDLE		20	
3		LOWER		38	
4	2	UPPER		52	
5		MIDDLE		22	
6		LOWER		39	

Annexure-15 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 CONSUTLANCY
ADDRESS	:	Vichitra SP-45, KWIC Bankra, P.S.- Domjur, Dist. –Howrah, Pin: 711 403 (W.B)
INSTRUMENT	:	DGPS EQUIPMENT
SERIES	:	SPS-361
SERIAL NUMBER	:	5308K59587
CALIBRATION DATE	:	03/02/2016
VALIDITY	:	03/02/2017

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 23- Calibration Certificate of DGPS Equipment

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, P.S.-Vichitra SP-45,KWIC NH-6, Dist. –Howrah Pin: 711 403 W.B
INSTRUMENT	:	Echo Sounder
SERIES	:	Bathy 500 MF
SERIAL NO.	:	B5MF0560
CALIBRATION DATE	:	05/02/2016
VALIDITY	:	04/02/2017

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.

Pan India Consultants Pvt. Ltd. Gurgaon

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 Echo- 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-86
MAKE	:	SOUTH
INSTRUMENT SR. NO.	:	H0986214510 (Accuracy –RTK Mode-Horizontal = 10mm +: PPm RMS, Vertical = 20mm +: PPm RMS H0986214519 (Static Mode – Horizontal = 2.5 mm + 1 PPm Vertical = 5mm + PPm)
CALIBRATION DATE	:	03/02/2016
VALID UPTO	:	02/02/2017
ISSUED TO	:	PRECISION SURVEY CONSULTANCY

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

Authorised Signatory

Table 25- Calibration Certificate of South RTK

Annexure-16 Site Picture:-

Figure 17- Dawki Site

Annexure-17 Survey Charts:-

LIST OF SURVEY CHARTS OF UNMGOT RIVER (NW-106)_MEGHALAYA								
Sl. No.	Chart No.	Location	Chainage (Form…….km. To…...km.)	Chart Datum And Water Level (m.) w.r.t. MSL			Value of Reduction	Remarks
				Chainage (km.)	CD (m.)	WL (m.)		
1.	P_01	Larbamon to Pashum	0.00 km to 5.00 km.	0.300	63.100	63.860	-0.760	GS:- 1
				1.500	64.400	64.700	-0.300	GS:- 2
				2.500	65.400	65.700	-0.300	GS:- 3
				3.500	66.450	66.750	-0.300	GS:- 4
				4.500	67.200	67.500	-0.300	GS:- 5
2.	P_02	Pashum to Mawshun	5.00 km to 9.30 km.	4.500	67.200	67.500	-0.300	GS:- 5
				5.500	69.900	70.200	-0.300	GS:- 6
				6.500	72.700	73.000	-0.300	GS:- 7
				7.500	75.200	75.500	-0.300	GS:- 8
				8.500	77.400	77.700	-0.300	GS:- 9
3.	P_03	Mawshun to Nongkhlieng	9.30 km to 13.76 km.	8.500	77.400	77.700	-0.300	GS:- 9
				9.500	80.000	80.300	-0.300	GS:- 10
				10.500	82.400	82.700	-0.300	GS:- 11
				11.500	84.900	85.200	-0.300	GS:- 12
				12.500	87.600	87.900	-0.300	GS:- 13
				13.500	90.300	90.600	-0.300	GS:- 14
4.	P_04	Nongkhlieng to Nongryngkoh	13.76 km to 17.20 km.	13.500	90.300	90.600	-0.300	GS:- 14
				14.500	92.900	93.200	-0.300	GS:- 15
				15.500	95.300	95.600	-0.300	GS:- 16
				16.500	97.700	98.000	-0.300	GS:- 17
5.	P_05	Nongryngkoh to New Nongryngkoh	17.20 km to 20.05 km.	16.500	97.700	98.000	-0.300	GS:- 17
				17.500	100.200	100.500	-0.300	GS:- 18
				18.500	102.500	102.800	-0.300	GS:- 19
				19.500	105.000	105.300	-0.300	GS:- 20

Table 26- Survey Charts

Note: Scale: - 1:5000 in each survey Chart

Survey period: - 11th April, 2016 to 21th April, 2016

✧ **G.S:-** Gauge Station