

FINAL FEASIBILITY REPORT ON DETAILED HYDROGRAPHIC SURVEY

SONE RIVER

**FROM GANGA CONFLUENCE AT TODARPUR (CH 0 KM), TO INDRAPURI
BARRAGE NEAR DEHRI (CH 141.0 KM)**

NATIONAL WATERWAY NO- 94

VOLUME-I

Submitted To



INLAND WATERWAYS AUTHORITY OF INDIA
A-13, Sector-1,NOIDA
DIST-Gautam Buddha Nagar
UTTAR PRADESH
PIN- 201 301(UP)
Email: hc.iwai@nic.in
Web: www.iwai.nic.in

Submitted By

STRABAG

STRABAG INDIA PVT LTD.
Southern Park, Unit No.6, 4th Floor
D-2, DDA District Centre,
Saket, New Delhi 110017 India
Tel : 91-11 492 01 492 , 91-11 492 01 454
Fax : 91-11 -492 01 493
Email: info@strabagindia.com
Web:www.strabagindia.com

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List of Abbreviations

SD	Sounding Datum
CD	Chart Datum
RTK	Real time Kinematic
DGPS	Differential Global Positioning Systems
TS	Total Station
GPS	Global Positioning Systems
BM	Bench Mark
MSL	Mean Sea Level
RL	Reference Level
HFL	Highest Flood Level
HTL	High Tension Line
CH	Chainage
WGS	World Geodetic System
UTM	Universal Transverse Mercator
LAD	Least Available Depth

SALIENT FEATURES AT A GLANCE

REGION-VII							
Consultant: STRABAG INDIA PVT LTD.							
Name	SONE RIVER					NW -94	
Length	141.0 km From Ganga Confluence at Todarpur to Indrapuri Barrage Near Dehri						
State	Bihar						
Survey Period	23rd January 2016 to 07th February 2016						
Tidal / Non-tidal	Non tidal						
Availability of Depth (reduced) (mtrs)							
	(0-25 KM)	(25-50 KM)	(50-75 KM)	(75-100 KM)	(100-125 KM)	(125-141 KM)	Total
<1.2	17.800	25.000	25.000	25.000	25.000	16.000	133.800
1.2-1.4	2.400	0.000	0.000	0.000	0.000	0.000	2.400
1.5-1.7	1.300	0.000	0.000	0.000	0.000	0.000	1.300
1.8-2	1.200	0.000	0.000	0.000	0.000	0.000	1.200
>2.0	2.300	0.000	0.000	0.000	0.000	0.000	2.300
TOTAL	25.000	25.000	25.000	25.000	25.000	16.000	141.000
Average Slope per KM (m)	0.355	0.450	0.446	0.424	0.522	0.422	
Width Range (m)	900-2400	1800-2300	1700-2000	2060-2490	2600-3800	3500-4300	
Average Vel (m/s)	0.550	0.220	0.000				
Discharge (Cu.m/sec.)	60.983	29.270					
Bathy Survey conducted for Length (Km)	21.86	1.45	Topo Survey				23.31
Dredging Quantity (Observed)							
							Total
Class 1	2,56,954.29	6,46,102.72	7,39,809.54	7,25,249.31	7,26,463.41	3,80,646.42	34,75,225.69
Class 2	5,02,107.45	10,07,008.86	11,68,740.67	11,20,630.04	11,46,108.06	6,15,244.93	55,59,840.01
Class 3	9,57,855.10	15,65,880.52	18,45,075.16	17,51,045.93	18,39,206.44	9,93,221.92	89,52,285.07
Class 4	13,35,004.87	19,45,755.40	23,03,011.41	21,82,479.35	23,10,557.03	12,63,331.63	1,13,40,139.69
Dredging Quantity (Reduced)							
							Total
Class 1	4,43,102.39	11,68,531.19	13,03,112.95	10,78,309.03	10,98,956.64	8,42,303.98	59,34,316.18
Class 2	7,61,085.30	17,39,669.10	19,28,149.34	16,19,804.77	16,61,492.76	12,43,269.56	89,53,470.83
Class 3	13,13,285.05	25,93,252.65	28,32,550.42	24,26,429.42	25,05,987.93	18,22,024.87	1,34,93,530.34
Class 4							

	17,26,675.94	31,08,254.97	33,57,606.01	29,20,925.17	30,21,404.94	21,56,352.63	1,62,91,219.66
No. of Bridge							
7							
Clearances less than Class (no.)							
Class	Horizontal	Vertical					
Class 1	1	2	Vertical clearance of <u>01 no.</u> HT line is less than required 19m.				
Class 2	3	4					
Class 3	4	4					
Class 4	4	5					
No. of Dams, Barrages, Weirs, Anicut etc.							
1							
Indarpuri Barrage	Ch 141 km						
Number of days Water not available							
CWC Gauge	Maner	Koilwar	Indarpuri				
Chainage (km)	8.42	18.65	134.45				
Class 1	31	156	75				
Class 2	33	181	81				
Class 3	35	223	87				
Class 4	37	257	97				
	Seasonal (153d)		Seasonal (153d)				
Cargo availability							
Nil							
Passenger Movement							
Yes (Across the river)							
Present IWT use							
Nil							
Recommendation of the Consultant							
Road are available on both the bank along the stretch and Rail network is available within 5km of river corridor. Significant sand mining activity may be observed along the entire stretch. No Ghats or ferry services is observed. No possibility of any tourism.							
Viable or not-viable							
Further cargo study is suggested							

(Signature)

Date:

Name of Consultant

SECTION – I: INTRODUCTORY CONSIDERATIONS

1.1 River Course. Inland Waterways Authority of India has awarded contract of detailed Hydrographic Survey and feasibility report in Region VII, the proposed 38 new Waterways including assessment of river training works and further development cost, for eco-friendly navigations in the waterways, to STRABAG India Pvt. Ltd. The detailed hydrographic and topographic survey task were undertaken from Ganga confluence at Todarpur Lat 25°42'15.20"N, Long 84°52'02.07"E) to Indrapuri Barrage at near Dehri (Lat 24°50'14.39"N, Long 84°08'07.79"E).

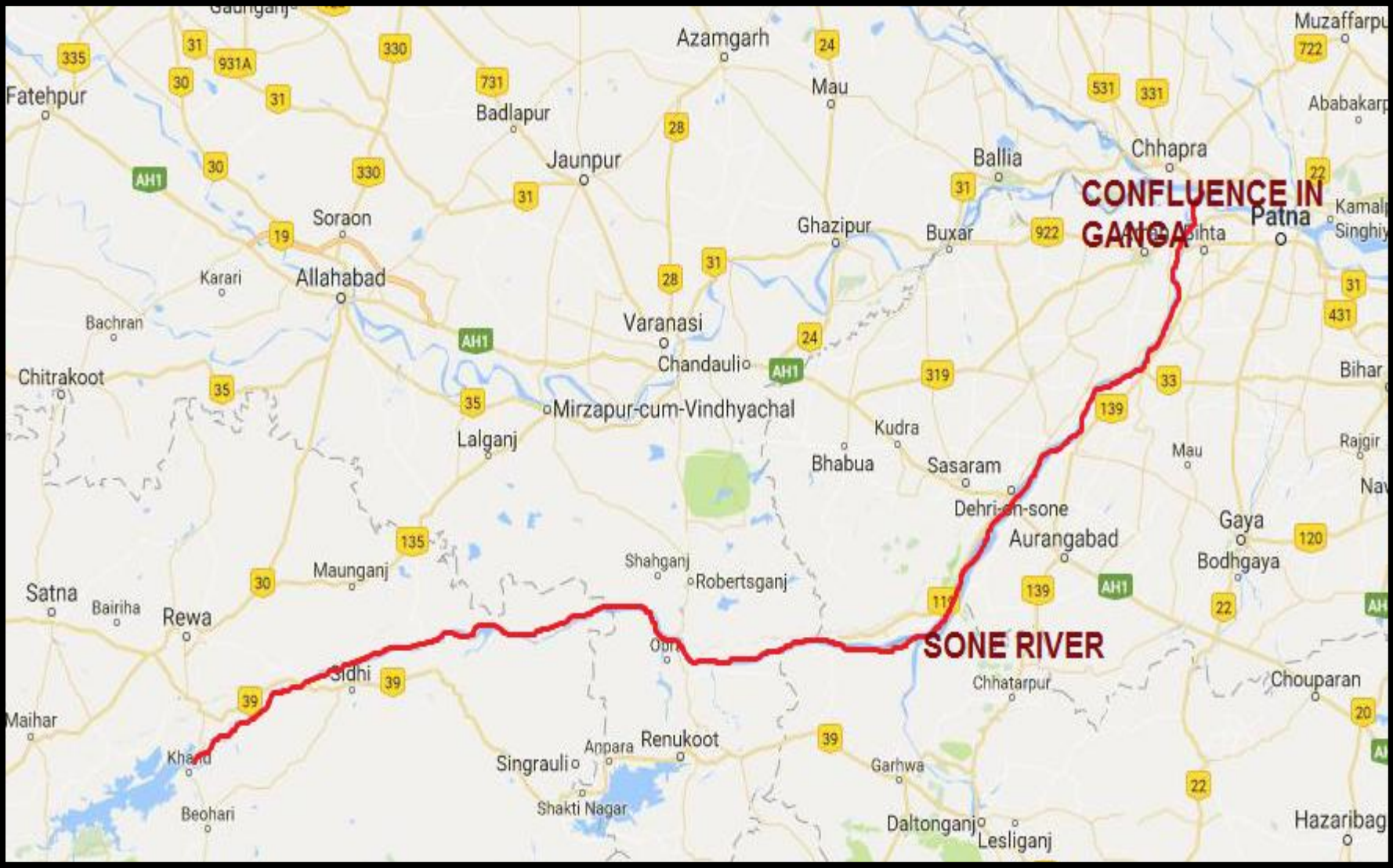
The Sone originates near Amarkantak in Madhya Pradesh, just east of the headwater of the Narmada River, and flow north-northwest through Madhya Pradesh state before turning sharply eastward where it encounters the southwest-northeast-Kaimur range. The parallels the Kaimur hills, flowing east-northeast through Uttar Pradesh, Jharkhand and Bihar state to join the Ganga river just west of Patna. Geologically, the lower valley of the Sone is an extension of the Narmada Valley, and the Kaimur Range an extension of the Vindhya Range. Dehri on Sone and Sonbhadra are the major cities situated on Son River. The Sone River at 784 kilometers (487 mi) long, is one of the largest rivers of India. The Sone has a steep gradient (35–55 cm per km) with quick run-off and ephemeral regimes, becoming a roaring river with the rain-waters in the catchment area but turning quickly into a fordable stream. The Son, being wide and shallow, leaves disconnected pools of water in the remaining part of the year. The channel of the Son is very wide (about 5 km at Dehri on Sone) but the floodplain is narrow, only 3 to 5 kilometers (2 to 3 mi) wide.

The feasibility study of Sone River being envisaged for the development the waterway navigation. It is expected to boost the much needed irrigation projects and water way transportation in and around the river, which will provide a better living standards of the local populace

1.2 Tributaries. Its tributaries are Gopad, Kanhar, North koel and Richand River.

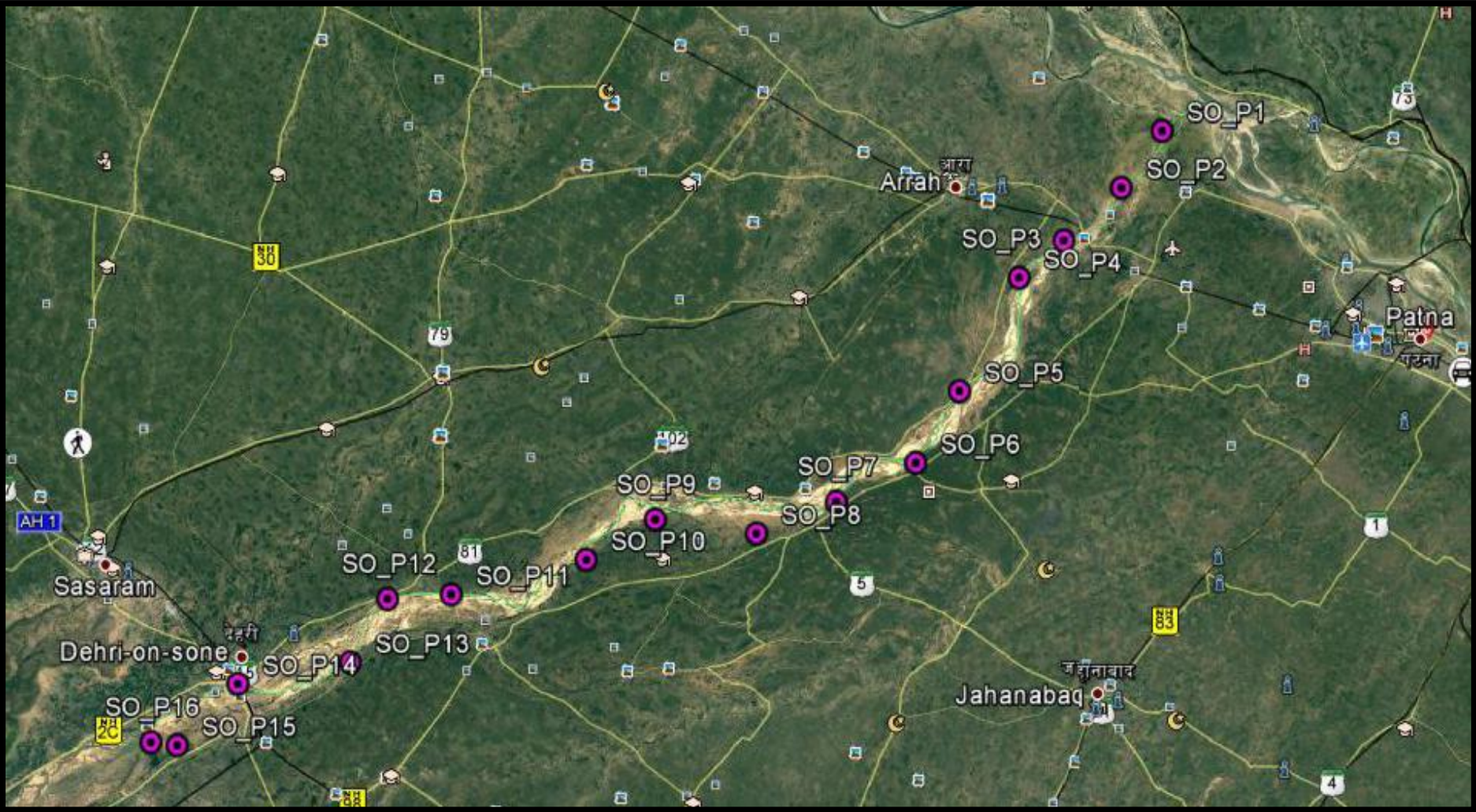
1.3 States & Districts. It originates in near Amarkantak in Madhya Pradesh just east head of Narmada River and flows through the states of Madhya Pradesh, Uttar Pradesh, Jharkhand and it is confluence in Ganga of state Bihar. The course of waterway understudy of Sone River is 141.00 km length in of the river from Ganga confluence to upstream.

1.4 (a) Full Course of Waterway.



IWAI - NW-94, Sone River (Todarpur to Indrapuri barrage near Dehri)

1.4 (b) Course of Waterway under study.



IWAI - NW-94, Sone River (Todarpur to Indrapuri barrage near Dehri)

1.5 Scope of Works. Strabag India Pvt Ltd. conducted hydrographic and topographic survey of Sone River from Ganga confluence at Todarpur (Ch. 0 km) Lat 25°42'15.20"N, Long 84°52'02.07"E to Indrapuri Barrage Near Dehri (Ch. 141.0 km), 24°50'14.39"N, Long 84°08'07.79"E was carried out 23rd January 2016 to 07th February 2016. The scope of the work for the conduct of survey of Sone River includes: -

- Undertake bathymetric and topographic survey of proposed waterway.
- Establishing horizontal and vertical control stations
- Construction of benchmark pillars and establishing its reduced level w.r.to Mean Sea Level
- Setting up and deployment of water level gauges
- Current velocity and discharge measurements
- Collection and analysis of water and bottom samples.
- A collection of topographic features including existing cross structures.
- Analysis of survey data, including assessment of water availability for navigation.
- Preparation of survey charts and feasibility report

SECTION – 2: METHODOLOGY ADOPTED TO UNDERTAKE STUDY

2.1 Methodology. The detailed bathymetric and topographic survey of Sone river (141 km) from Ganga confluence at Todarpur (Ch. 0 km) Lat 25°42'15.20"N, Long 84°52'02.07"E to Indrapuri Barrage Near Dehri (Ch. 141 km) Lat 24°50'14.39"N, Long 84°08'07.79"E was carried out by dedicated topographic and bathymetric team with highest degree of professionalism, enthusiasm and quality from 23rd Jan 2016 to 07th Feb 2016. Details of Horizontal and Vertical Control adopted for the survey of Sone River is placed at Annexure 7 to this report. The survey was undertaken with cross-section corridor of 300m and line spacing of 150m. The plotting of chart was done on UTM projection at zone 45N as per specification. Details of survey chart scheming and sample fair sheet is placed at Annexure 15 to this report.

2.1(a) **Personnel and Resources.** Total 32 personnel were involved which includes Party Chief, Sr. Surveyors, surveyors, helpers, cooks and drivers for the task in addition to resources viz. vehicles, logistics etc. which are tabulated below.

2.1(b) **Equipment Used.** Various equipment's were used during the survey operations which is tabulated below as well as elaborately described in the succeeding paragraphs.

HYDROGRAPHIC SURVEY EQUIPMENTS

Equipment	Make	Qty. Deployed
Echo sounder	500 DF dual Frequency	2
DGPS	Trimble SPS 356/461	2
Current Meter	Vertical Axis-Cup Type	1
Grab Sampler	Vanveen grab	1
Software	HYPACK data acquisition	1
Tide Pole	Manual	06

TOPOGRAPHIC SURVEY EQUIPMENTS

Equipment	Make	Qty. Deployed
GPS Sets	Trimble Spectra	5
Auto Level	Leica	2
Total Station	Topcon	1
Total Station	Leica	1
Software	HYPACK data acquisition	1
Software	AutoCAD	1
Software	Trimble Spectra Survey office v.8	1

2.1(c) Topographic Survey. The Topographic survey was carried out 23rd Jan 2016 to 07th Feb 2016. The weather was fog and cold, for most of the survey period. The survey was undertaken as per the approved line provided by IWAI. The spot level points in the cross line were spaced at 10 m interval. The plotting of the chart was done on UTM Projection at Zone 45N. The spot levels along the river banks and dry river beds were obtained by using Trimble DGPS in RTK mode. The topographic survey for the entire survey stretch was conducted to collect the following data: -

- Spot levels of the River bed and Banks
- 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 Spot Levelling by Trimble DGPS

The details of all spot levels are provided in the respective sheets being presented along with this report. The details of bank protection and features across the river are Placed at Annexure 5 & 6 respectively. Additionally, a soft copy of the same in XYZ format is being handed over as deliverable data.

2.1(d) **Bathymetric Survey.** Bathy 500 DF Echo Sounder was used to obtain soundings onboard the survey boat. The working frequency of 210 and 33 kHz was used for sounding operations. Trimble SP 461/ 356 DGPS was used for positioning. The digital output from the echo sounder and DGPS were 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 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/Topographic Spot leveling was also carried out in the area where the survey boat cannot be operated due to the low depth.



Bathymetric Survey operation

2.1(e) **Calibration.** The equipment used for the survey was calibrated by the equipment supplier. The equipment calibration certificates are placed at Annexure - 13 to this report.

2.2 Description of Bench Mark. Trimble Spectra Precision DGPS system was used in standalone static observation mode for 24 hrs. For establishment of geodetic control in the survey area. Extension of the geodetic control was achieved by setting up BM pillars throughout the river stretches at every 10km chainage. Coordinates of such pillars were established by simultaneous Static observations between established and new stations. The data was processed using Spectra Precision Survey Office software. Details of these BM pillars along with stationed recovery descriptions are mentioned below. Benchmark was recovered near CWC gauge at Koilwar Rail Bridge, Bihar. Relevant pictures are also being attached for reference. Leveling was carried out from BM to TBM & TBM to BM and required accuracy was achieved. Simultaneous GPS observation was carried out at TBM, near CWC gauge and LBM at Intermediate College, Koilwar state of Bihar. RL value of the CWC bench mark is 58.829m. Leveling data being enumerated subsequently.



CWC BM at Koilwar Near rail Bridge at Ch. 18.62 km

NAME OF BM	VALUE OF CWC BM (m)	Latitude	Longitude
CWC Koilwar	58.829	25°34'17.78"N	84° 47'40.78"E

2.3 Tidal Influence Zone and Tidal Variation. Total 141.0 km length of river stretch was completely non-tidal. However, tidal observations were undertaken as per tender document for the entire duration of the survey. Tidal data being attached at **Annexure- 3** along with this report.

2.4 Methodology to Fix Sounding Datum. The average water level of minimum of last six year data at CWC gauge Koilwar was provided by IWAI as sounding datum. Sounding datum for all the tide gauge fixed on interpolating method from established gauge of CWC. In dry areas, Sounding Datum was established as per deepest bed level of the river. The details of established datum value for stretches are as tabulated below:-

Stretch (KM)		Established SD wrt MSL
From	To	
0.000	5.500	43.086
5.500	9.350	43.703
9.350	15.870	44.397
15.870	20.100	47.339
20.100	24.020	48.303
24.020	33.955	50.778
33.955	47.605	57.003
47.605	59.530	62.737
64.910	67.935	67.451
67.935	76.440	70.101
85.155	85.155	74.902
88.390	96.825	77.736
96.825	108.456	85.127
108.456	115.822	87.723
115.822	125.560	91.717
125.560	136.064	97.052
136.064	141.000	101.78

2.5 Maximum and Minimum Water Level. Maximum and minimum water level of CWC Gauges data in sounding datum at Para 2.4 and HFL at para 2.10.

2.6 Salient Features of Dam, Barrages, Weirs, Anicuts, Locks and Aqueducts, etc. There is only one Barrage i.e. Indrapuri Barrage at Ch. 141.00 KM.

Salient Features	
Name of the Structure	Sone Barrage
Nearest city	Sasaram
District	Rohtas
State	Bihar
Name of River	Sone
Basin	Ganga
Year of commencement	1962
Year of completion	1968
Design flood (Cumec)	40470
Length of Barrage and Anicut (m)	1407
No. of bays (i.e. number of openings)	60
Width of Bay (m)	18.27
Type of spillway gate	OT
Spillway gates - Number	60
Spillway gates - Size (m)	18.7 x 5.00
Pond level (m)	108.09
Highest Flood Level (m)	109.6
Under sluice bay - Number	7
Gates for under sluice - Number	7
Gates for under sluice -Size (m)	18.7 m * 4.42 m
Means for dissipating energy (Hydraulic)	Stilling Basin and Friction blocks
Status of BWA Construction	Completed

2.7 Description of Erected Bench Mark Pillars. New Bench Mark Pillar (15 Nos) were constructed as per the Specification of Tender Documents. The Extension of Horizontal and Vertical Control was carry out by base line processing with the nearest reference station. Details of erected BM pillars is Place at **Annexure 9**. The final accepted co-ordinate and Reference Level value of Tons BM Pillar are as below:-

S.No	Station	Chainage (KM)	Latitude (N)	Longitude (E)	Northing (m)	Easting (m)	Ht above MSL (m)	SD wrt MSL (m)
1	BASE_SONE19		25°34'34.99"N	84°47'25.56"E	2830621.879	278050.239	56.721	
2	TBM_KOILWAR	18.75	25°34'17.78"N	84°47'40.78"E	2830084.590	278466.869	61.479	47.339
3	SO P1	5.50	25°40'50.14"N	84°49'41.73"E	2842103.348	282040.991	52.622	43.703
4	SO P2	12.55	25°37'16.00"N	84°48'45.54"E	2835539.350	280364.624	51.063	44.397
5	SO P3	21.20	25°33'20.61"N	84°46'48.67"E	2828349.076	276982.643	60.337	48.303
6	SO P4	26.85	25°30'37.48"N	84°45'12.31"E	2823374.866	274207.897	62.281	50.778
7	SO_P5	41.06	25°24'0.91"N	84°44'33.09"E	2811188.382	272905.397	67.782	57.003
8	SO P6	54.15	25°19'0.21"N	84°41'10.26"E	2802031.514	267075.121	72.230	62.737
9	SOP 7	64.91	25°15'2.18"N	84°37'46.26"E	2794805.322	261239.248	73.817	67.451
10	SO_P8	70.96	25°14'5.67"N	84°34'33.98"E	2793162.469	255826.404	79.336	70.101
11	SO_P9	81.92	25°12'6.48"N	84°28'53.47"E	2789669.684	246225.031	83.639	74.902
12	SO_P10	88.39	25° 8'51.39"N	84°27'36.70"E	2783705.216	243962.923	82.717	77.736
13	SO_P11	105.26	25° 3'21.04"N	84°21'29.22"E	2773735.356	233468.244	89.110	85.127
14	SO_P12	111.65	25° 1'43.68"N	84°18'7.41"E	2770850.355	227750.701	95.559	87.723
15	SO_P13	119.99	24°58'14.70"N	84°15'58.61"E	2764490.279	224008.352	94.523	91.717
16	SO_P14	131.13	24°54'26.30"N	84°11'54.98"E	2757599.351	217027.270	108.301	97.052
17	SO_P15	141.00	24°50'23.63"N	84° 7'58.82"E	2750267.337	210240.628	114.924	101.78



Static Observation at Ch. 5.40 km & Ch. 59.00 km

2.8 Description of Erected Tide Gauges. Tide gauges were erected throughout the river stretch. Water level reading as per prescribed format along with chainage is mentioned at **Annexure 3**. The Detail of erected tide pole which are used for reduction of Sounding is as follows.

Tide Gauge No	Location	Chainage (km)	Easting/Northing (m)	Zero of Tide Gauge W.r.t MSL (m)	Period of Observation
TP1	Bingawan village	5.40	282191.882E 2842159.736N	43.082	During the Conduct of Bathy Survey
TP2	Haripur village	12.53	280530.896E 2835261.544N	43.943	During the Conduct of Bathy Survey
TP 2A	Koilwar	18.75	278810.636E 2829914.481N	46.653	During the Conduct of Bathy Survey
TP3	Dhandiha village	21.09	276936.850E 2828226.745N	48.352	During the Conduct of Bathy Survey
TP4	Kosihan village	26.8	274374.692E 2823377.884N	51.767	During the Conduct of Bathy Survey
TP5	Sandesh village	41.00	272993.643E 2811289.680N	59.456	During the Conduct of Bathy Survey

Tide Gauge No	Location	Chainage (km)	Easting/Northing (m)	Zero of Tide Gauge W.r.t MSL (m)	Period of Observation
TP6	Karbasin village	54.06	267064.067E 2801775.043N	64.054	During the Conduct of Bathy Survey
TP7	Sahar Arwal Rd	64.81	261173.347E 2794416.173N	68.765	During the Conduct of Bathy Survey
TP8	Dhuri village	70.9	255927.739E 2792968.063N	71.177	During the Conduct of Bathy Survey
TP9	Rajpur	81.83	246337.860E 2788970.340N	75.757	During the Conduct of Bathy Survey
TP10	Kachhwa	88.24	244165.660E 2783333.343N	78.329	During the Conduct of Bathy Survey
TP11	Atimiganj village	105.17	233400.287E 2773603.553N	85.247	During the Conduct of Bathy Survey
TP12	Amiyawar	111.52	227947.247E 2770674.793N	87.584	During the Conduct of Bathy Survey
TP13	Majhiawan	120	225473.267E 2763516.663N	94.015	During the Conduct of Bathy Survey
TP14	Makrain village	131.03	217215.253E 2756886.704N	99.235	During the Conduct of Bathy Survey
TP15	Indarpuri	140.95	210484.493E 2750347.350N	103.481	During the Conduct of Bathy Survey



Tide Observation at Pillar No 01 Ch. 5.40 km

2.9 Chart Datum/ Sounding Datum and Reduction Details.

Sounding Datum

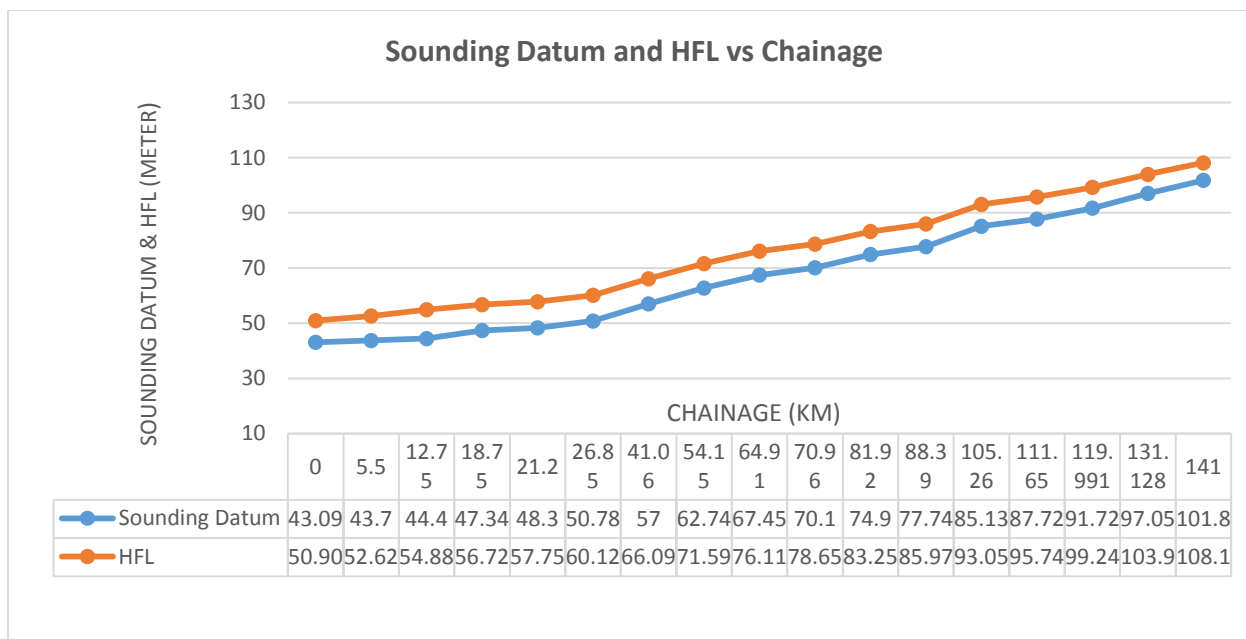
reduction table being mentioned below:-

SI #	Location of 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 wrt MSL (m)	Correction in WL data for Bathymetric survey (m)	Topo level data converted as depth for volume calculation wrt SD (m)	HFL (m)
				D +ve indicates above MSL -ve indicates below MSL			G = (E- topo levels in MSL)	
	Ganga Confl. (1140)	0		43.086		Details at Annexure-3.	A separate xyz file is created.	50.907
	SO_P1	5.5	0-9.35		43.703			52.623
	SO_P2	12.75	9.35-15.87		44.397			54.885
	Koilwar CWC	18.75	15.87-20.10		47.339			56.724
	SO_P3	21.2	20.1-24.02		48.303			57.753
	SO_P4	26.85	24.02-33.955		50.778			60.126
	SO_P5	41.06	33.955-47.605		57.003			66.094
	SO_P6	54.15	47.605-59.530		62.737			71.592
	SO_P7	64.91	59.530-67.935		67.451			76.111
	SO_P8	70.96	67.935-76.44		70.101			78.652
	SO_P9	81.92	76.440-85.155		74.902			83.255
	SO_P10	88.39	85.155-96.825		77.736			85.972
	SO_P11	105.26	96.825-108.456		85.127			93.058
	SO_P12	111.65	108.456-115.822		87.723			95.742
	SO_P13	119.991	115.822-125.56		91.717			99.245
	SO_P14	131.128	125.560-136.064		97.052	103.922		
	SO_P15	141	136.064-141.00		101.78	109.600		

2.10 HFL at Gauge Stations and Cross-Structures. HFL at CWC Gauge station Maja Road CWC Gauge and Tons Aqueduct/Tons has already been established by the CWC department and HFL for the waterway was derived as per change in the ground profile of the river

S.NO	Location and Description of CWC Gauge/ Dam/etc.	Cross-Structure Details	Chainage (km)	Established HFL wrt MSL (m)	Computed HFL at Cross – Structure wrt MSL (m)
	A	B	C	D	E
1	Maner CWC Gauge	-	8.42	53.275	
2	Koilwar CWC Gauge	-	18.65	56.724	
3	-	Koilwar Bridge	19.07		56.724
4	-	Sahar Arwal Bridge	64.37		75.922
5	-	under Construction Bridge	105.12		93.033
6	-	under Construction Bridge	130.67		103.762
7	-	Son Nagar New Rail Bridge	130.72		103.762
8	-	Son Nagar Rail Bridge	131.23		103.997
9	Indrapur CWC Gauge	-	134.45	108.10	
10	Indrapur Barrage	-	141.00	109.60	

2.11 Graph: Sounding Datum and HFL vs Chainage



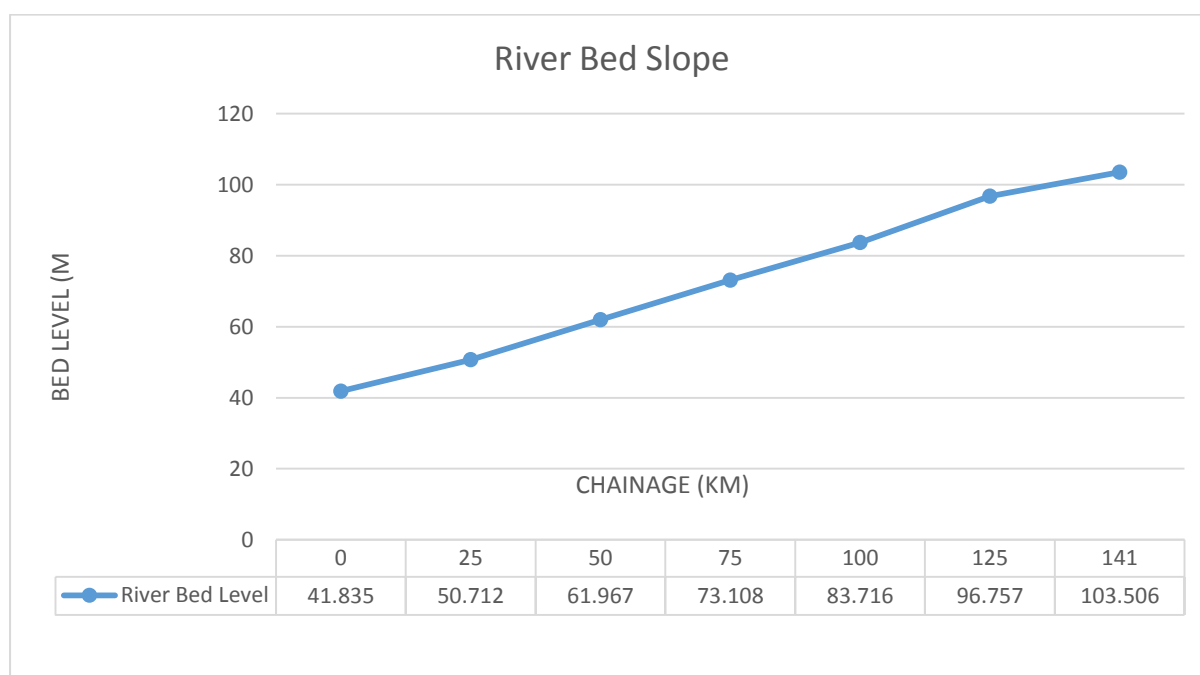
HFL AND SOUNDING DATUM TABLE

GAUGE NAME	CHAINAGE (KM)	SOUNDING DATUM (M)	HFL (M)
Ganga Confl. (1140)	0	43.086	50.907
SO_P1	5.5	43.703	52.623
SO_P2	12.75	44.397	54.885
Koilwar CWC	18.75	47.339	56.724
SO_P3	21.2	48.303	57.753
SO_P4	26.85	50.778	60.126
SO_P5	41.06	57.003	66.094
SO_P6	54.15	62.737	71.592
SO_P7	64.91	67.451	76.111
SO_P8	70.96	70.101	78.652
SO_P9	81.92	74.902	83.255
SO_P10	88.39	77.736	85.972
SO_P11	105.26	85.127	93.058
SO_P12	111.65	87.723	95.742
SO_P13	119.991	91.717	99.245
SO_P14	131.128	97.052	103.922
SO_P15	141	101.78	108.100

2.12 **Average Bed Slope.** Average bed slope of the whole river stretch being tabulated below: -

Chainage (KM)		River Bed Level (m)		River Bed Level Change (m)	Distance (km)	Slope
From	To	From	To			
Ch. 0.0 km	Ch. 25.0 km	41.835	50.712	8.877	25	1:2816
Ch. 25.0 km	Ch. 50.00 km	50.712	61.967	11.255	25	1:2221
Ch. 50.00 km	Ch. 75.00 km	61.967	73.108	11.141	25	1:2244
Ch. 75.00 km	Ch. 100.00 km	73.108	83.716	10.608	25	1:2357
Ch. 100.00 km	Ch. 125.00 km	83.716	96.757	13.041	25	1:1917
Ch. 125.00 km	Ch. 141.00 km	96.757	103.51	6.749	16	1:2371

BED SLOPE VS CHAINAGE GRAPH



2.13 Details of Dam, Barrages, Weirs, Anicuts, etc. There is only one Barrage i.e. Indrapuri Barrage at Ch. 141.00 KM.

SI No	Structure Name	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	Height w.r.t. -- (m)	Present condition
				Left Bank	Right Bank	Left Bank	Right Bank				
1	Indrapuri Barrage	141	Dehri	24°49'46.69"N 84° 8'29.91"E	24°50'20.58"N 84° 7'56.28"E	211087.990E 2749111.720N	210166.810E 2750174.270N	1407M	18.27M	18.7M	Completed



Indrapuri barrage at Ch. 141.00 km

2.14 Details of Locks. There is no any lock present in the survey stretch.

2.15 Details of Aqueducts. There is no aqueduct in this portion of the river.

2.16 Details of Existing Bridges & Crossings. There are total 07 in no's bridges are present across the river. Details is tabulated below: -

S. No	Structure Name	Chainage (km)	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (Distance Between piers) (m)	Vertical clearance wrt HFL (m)	Remarks
			Left Bank	Right Bank	Left Bank	Right Bank						
1	Koilwar Rail cum Road Bridge	19.07	25°33'42.61"N 84°48'17.14"E	25°34'9.36"N 84°47'34.63"E	279463.373E 2828985.295N	278290.048E 2829828.452N	1444.9	10	31	44.66	7.615	Completed
2	Sahar Arwal Bridge	64.37	25°14'19.35"N 84°38'40.96"E	25°15'7.61"N 84°37'50.55"E	262747.365E 2793460.725N	261362.485E 2794970.048N	2048.4	10	35	57.75	2.859	Completed
3	UC Bridge	105.12	-	25° 3'21.51"N 84°21'31.89"E	-	233543.879E 2773748.781N	-	-	-	-	-	Under Construction
4	UC Bridge	130.67	-	24°54'24.16"N 84°11'53.10"E	-	216973.512E 2757534.746N	-	-	-	-	-	Under Construction
5	Son Nagar New Rail Bridge	130.72	24°53'20.75"N 84°13'16.95"E	24°54'22.81"N 84°11'52.13"E	219287.750E 2755534.970N	216945.707E 2757493.775N	3053.2	15.5	92	30.05	4.87	Completed
6	Son Nagar Old Rail Bridge	130.76	24°53'19.66"N 84°13'16.12"E	24°54'22.04"N 84°11'51.19"E	219263.850E 2755501.670N	216918.940E 2757470.332N	3061.7	12	94	29.422	3.13	Completed
7	Son Nagar Bridge	131.23	24°53'10.48"N 84°13'8.17"E	24°54'13.09"N 84°11'43.34"E	219034.930E 2755223.400N	216692.799E 2757199.830N	3067.4	16	93	30.84	4.43	Completed

2.17 Details of Other Cross Structures. There are no any other cross structure in the present of the survey stretch.

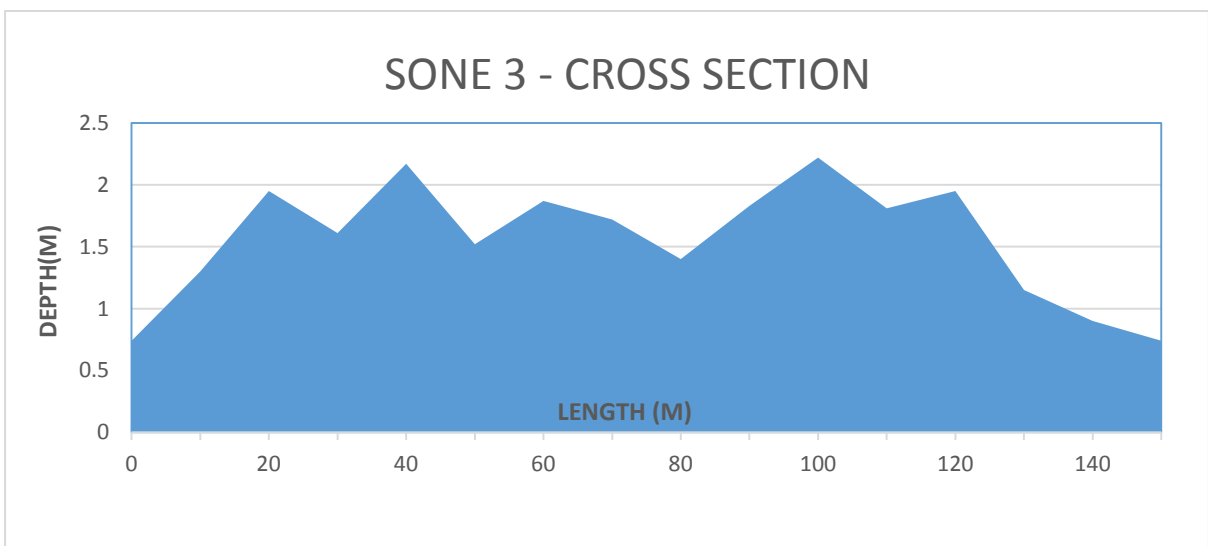
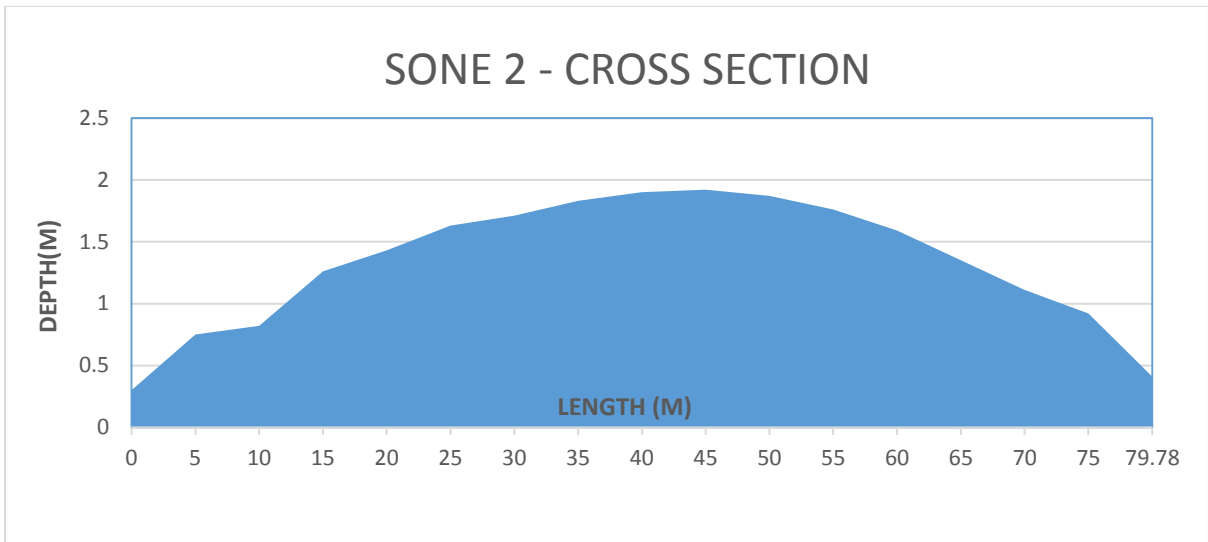
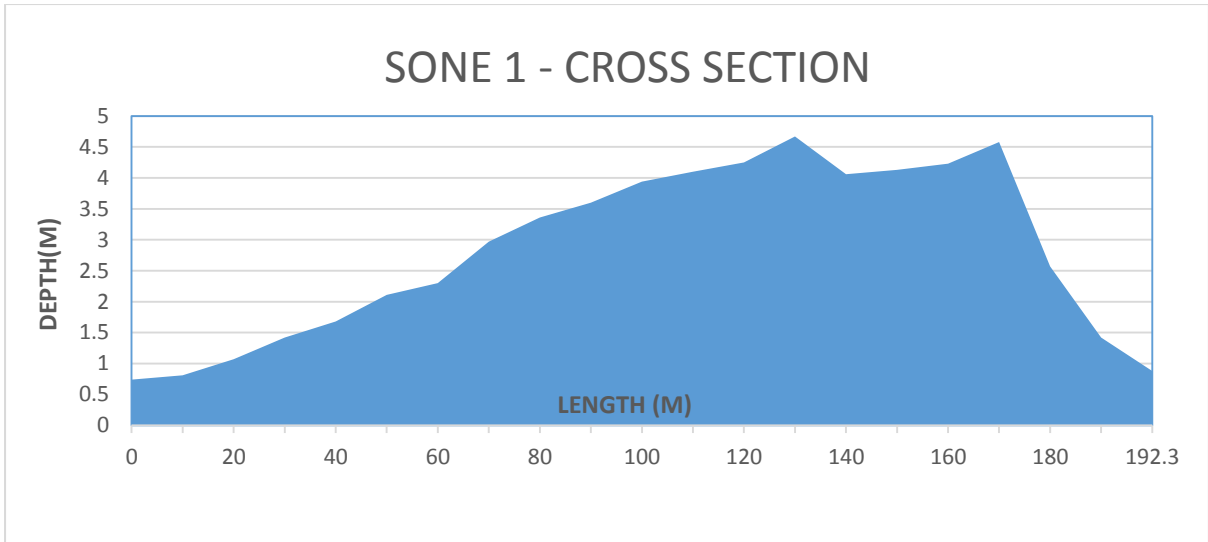
2.18 High Tension Lines / Electric Lines / Tele-Communication Lines. Details of HT lines and electric pole is tabulated below:-

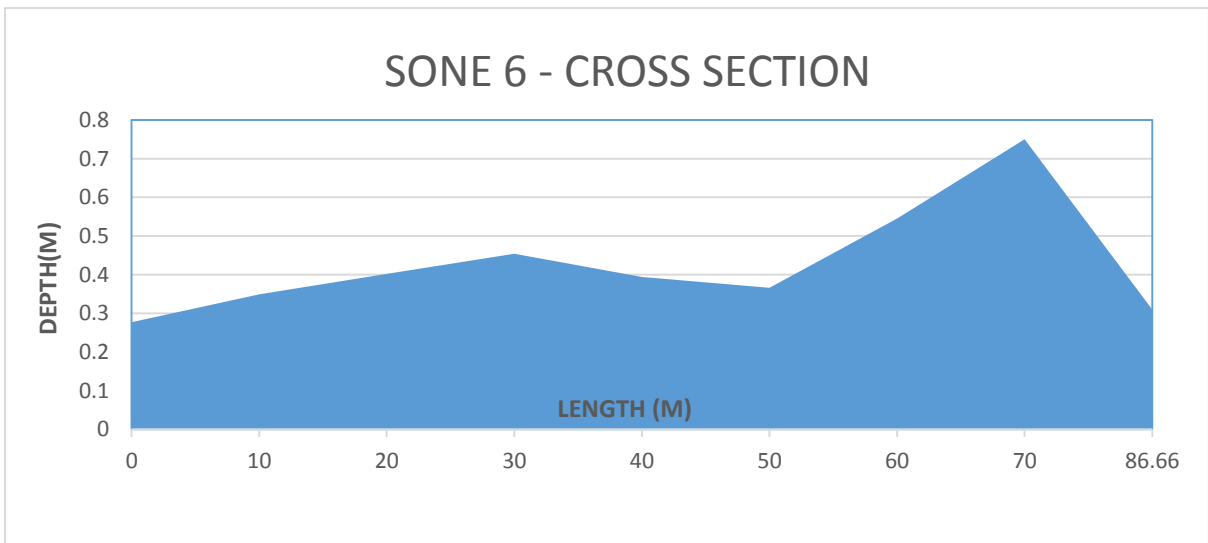
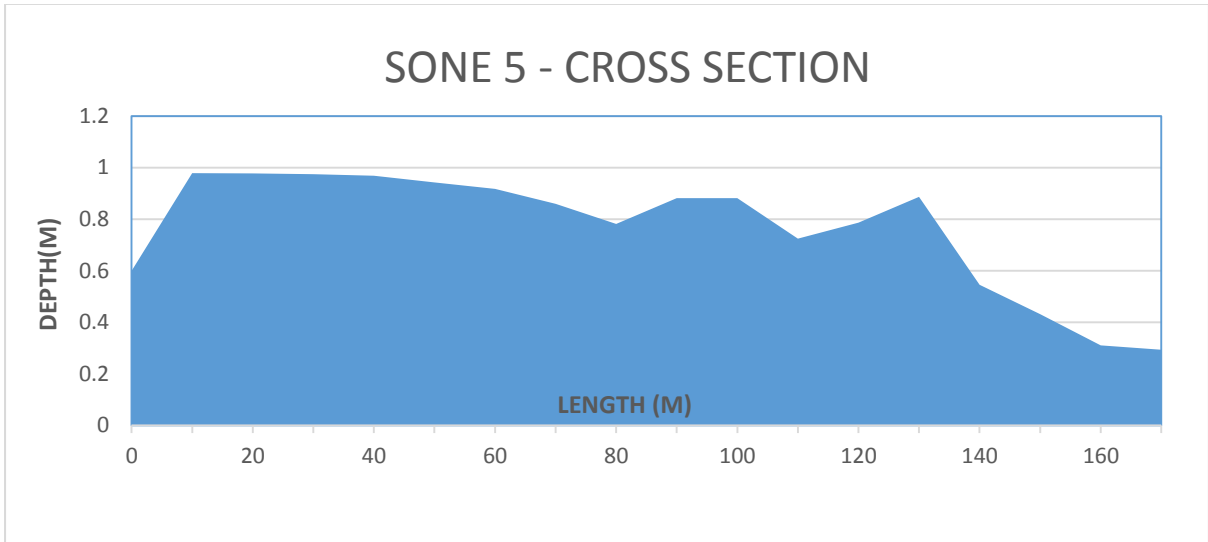
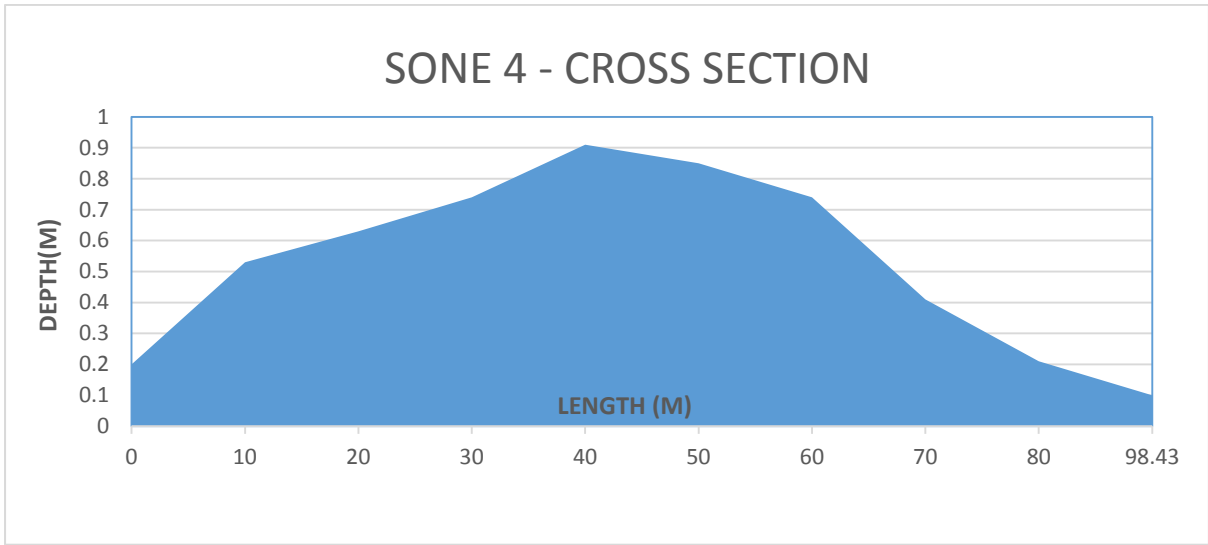
S. No	Cross-Structure Name	Chainage (km)	Position (Lat Long)		Position (UTM)		Vertical clearance w.r.t HFL (m)	Remarks
1	HT Line	103.33	25° 3'27.54"N 84°22'35.28"E	25° 3'44.42"N 84°22'34.14"E	235324.493E 2773899.729N	235302.390E 2774419.197N	21	Completed
2	HT Line	116.07	24°59'22.92"N 84°17'46.25"E	24°59'27.55"N 84°17'16.99"E	227070.200E 2766529.231N	226252.267E 2766688.548N	23	Completed
3	HT Line	116.19	24°59'19.63"N 84°17'40.44"E	24°59'23.20"N 84°17'19.04"E	226905.183E 2766431.648N	226307.327E 2766553.209N	25	Completed
4	HT Line	116.6	24°59'7.33"N 84°17'41.46"E	24°59'9.47"N 84°17'18.17"E	226926.880E 2766052.887N	226274.699E 2766131.389N	21	Completed
5	HT Line	116.77	24°59'2.15"N 84°17'42.28"E	24°59'3.68"N 84°17'15.69"E	226946.244E 2765892.297N	226201.627E 2765954.742N	19	Completed
6	HT Line	117.12	24°58'52.19"N 84°17'41.50"E	24°58'51.64"N 84°17'16.49"E	226918.703E 2765586.554N	226216.517E 2765583.231N	18	Completed

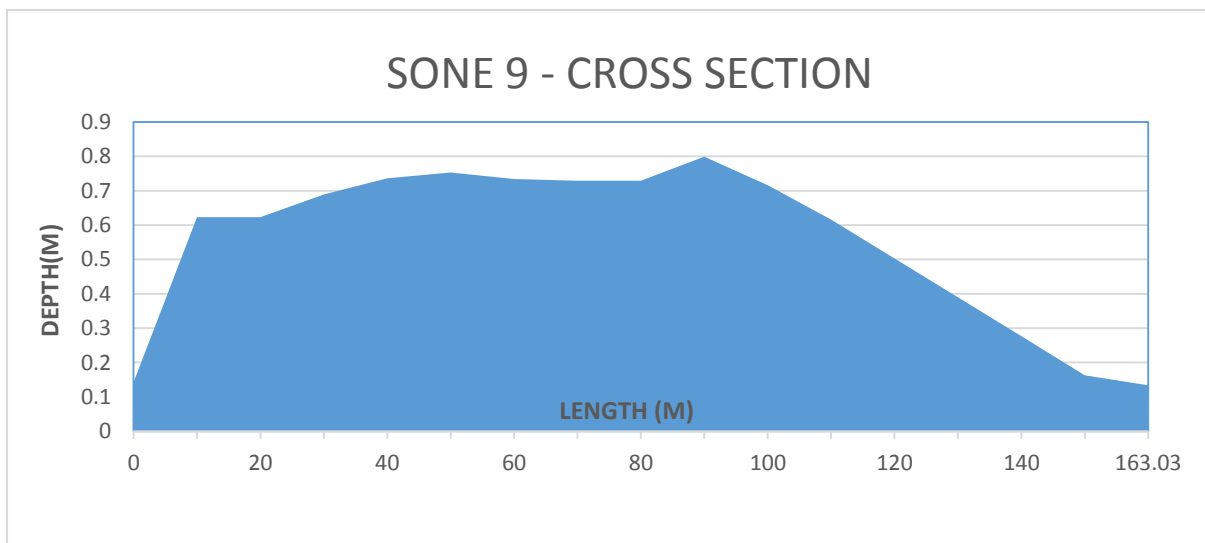
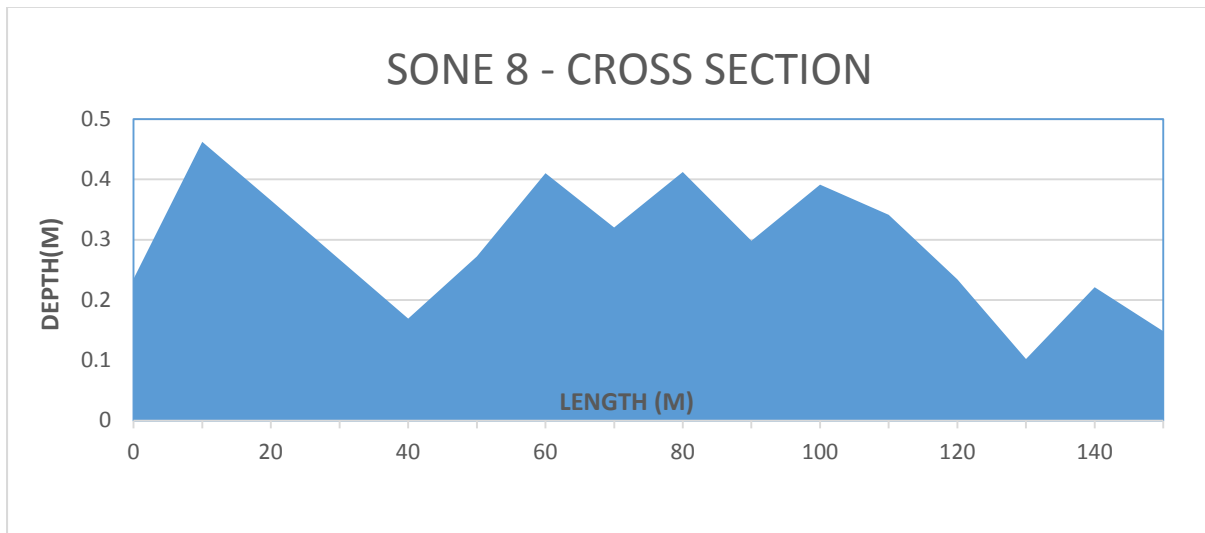
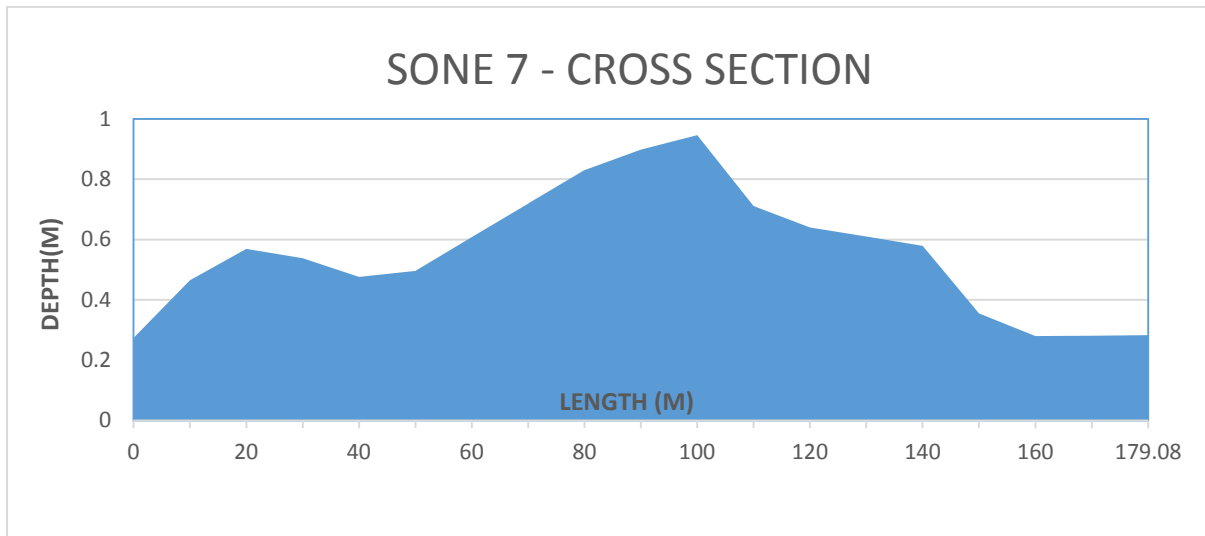
2.19 Current Meter and Discharge Details. Current meter observations and discharge calculations were undertaken at every 10 km interval approximately.

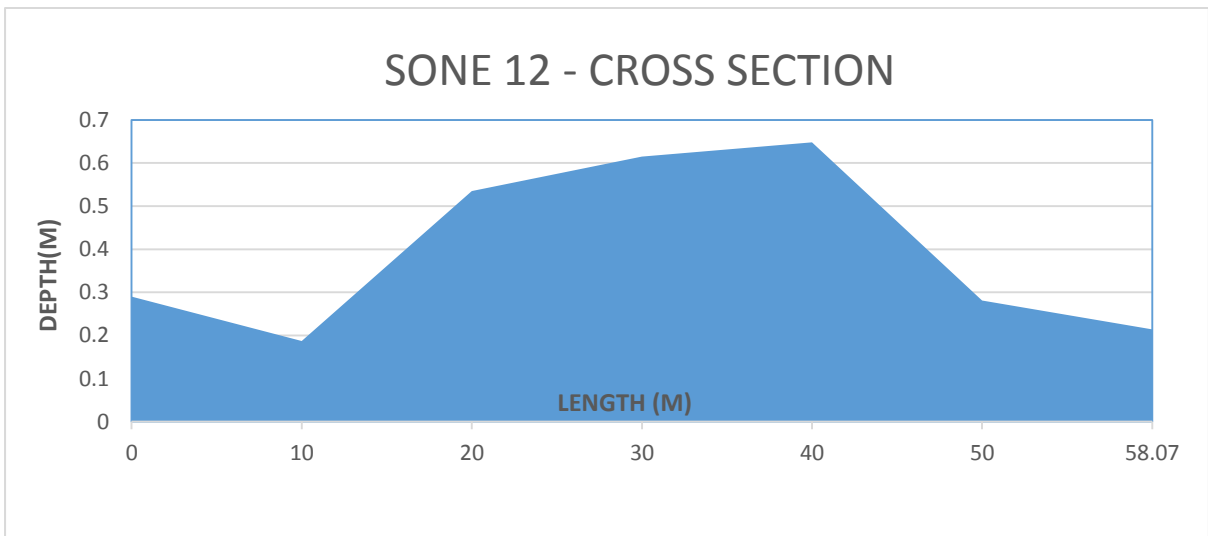
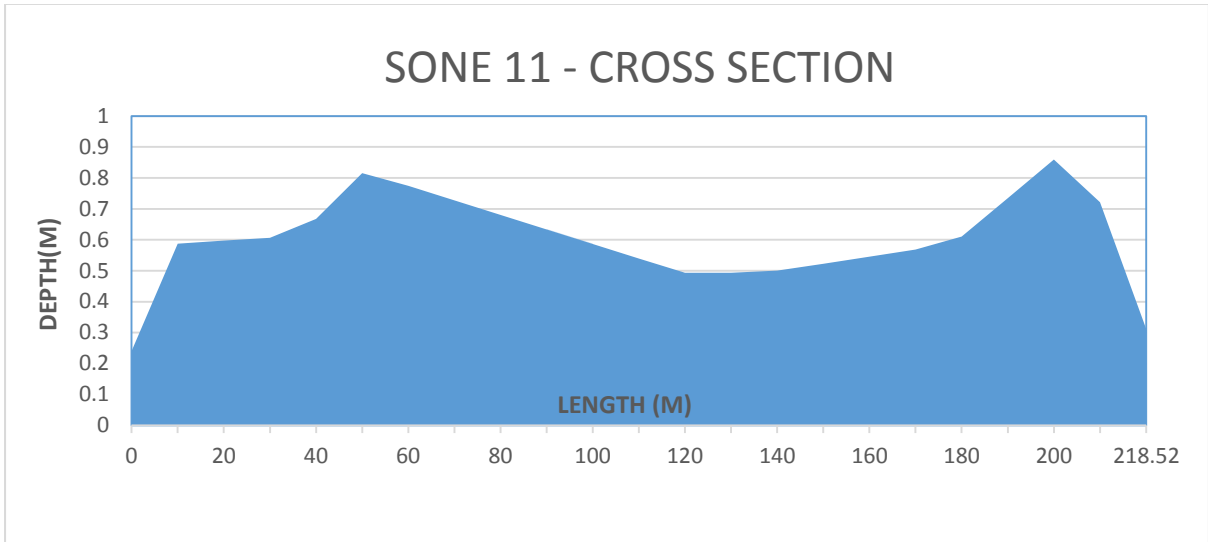
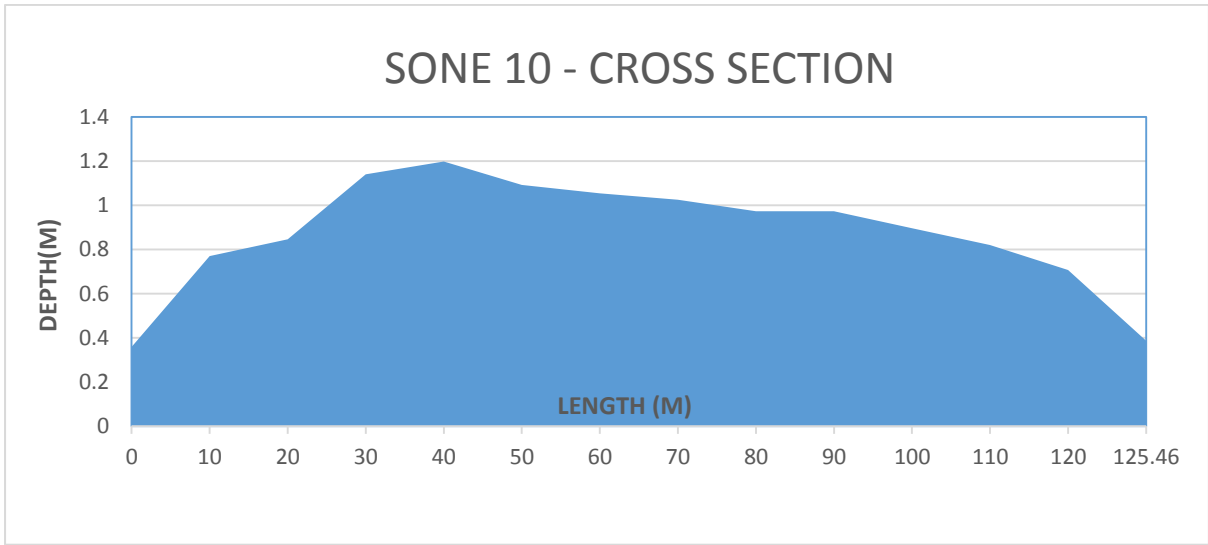
Details of the same is tabulated below:-

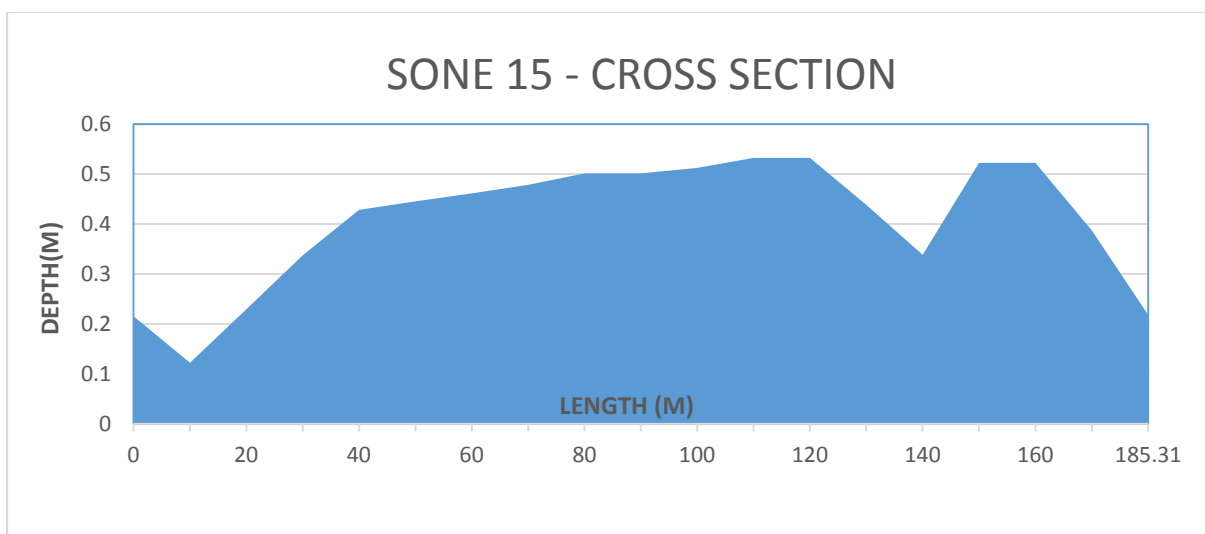
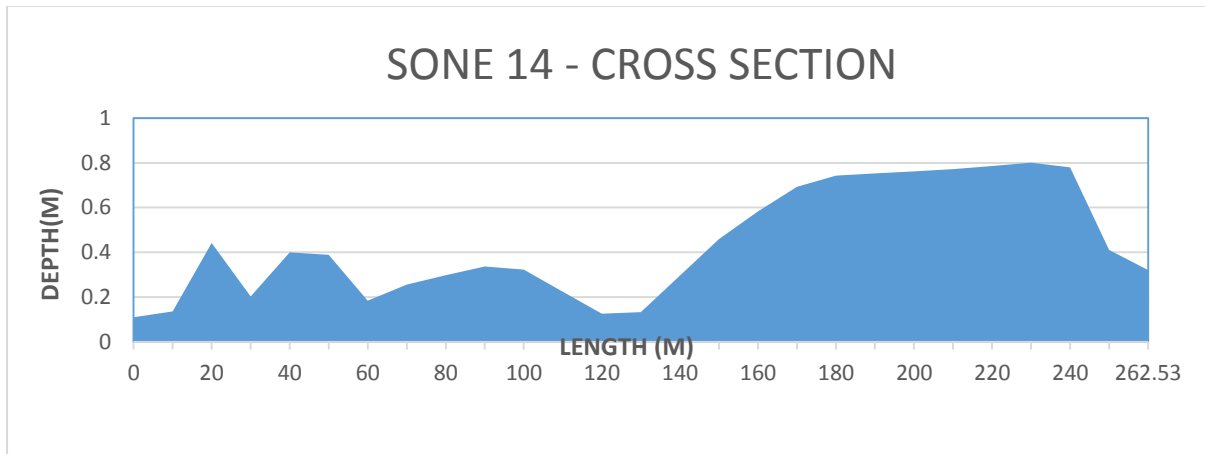
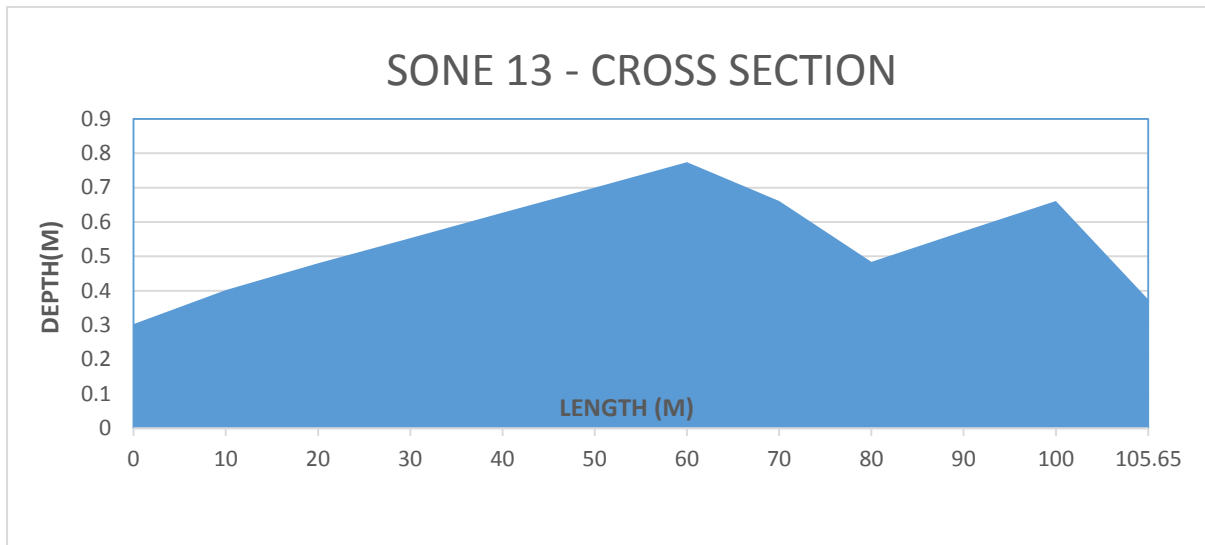
Sr.No	Chainage (KM)	Position				Observed Depth(m)	Velocity mtrs/sec	X-Sectional Area (Sq.M)	Discharge M3/Sec
		EASTING (m)	NORTNING (m)	Latitude	Longitude				
1	3.19	283264.65	2844104.8	25°41'55.79"N	84°50'24.44"E	4.67	0.5	571.945	285.973
2	13	280407.59	2835057.2	25°37'0.37"N	84°48'47.36"E	1.92	0.55	110.879	60.983
3	20	278076.24	2829005.7	25°33'42.51"N	84°47'27.46"E	2.2	0.22	243.712	53.617
4	30	275194.17	2820362.4	25°29'0.18"N	84°45'49.45"E	0.91	0.32	53.007	16.962
5	40.26	273310.85	2812055.1	25°24'29.30"N	84°44'47.05"E	0.98	0.22	133.047	29.270
6	49.93	271048.48	2803100.9	25°19'37.15"N	84°43'31.60"E	0.75	0	39.065	0.000
7	60.81	264666.26	2795945.2	25°15'41.16"N	84°39'47.95"E	0.94	0	102.536	0.000
8	69.93	256909.69	2793180.5	25°14'6.89"N	84°35'12.65"E	0.46	0	45.985	0.000
9	80.16	248039.95	2788989.5	25°11'45.49"N	84°29'58.68"E	0.8	0	92.635	0.000
10	89.92	243860.5	2781987	25° 7'55.50"N	84°27'34.21"E	1.19	0	116.187	0.000
11	100	238501.07	2775349.2	25° 4'16.63"N	84°24'27.57"E	0.86	0	136.482	0.000
12	110.35	228829.34	2771623.6	25° 2'9.48"N	84°18'45.32"E	0.65	0	24.702	0.000
13	120.05	225160.92	2763214	24°57'33.99"N	84°16'40.56"E	0.77	0	60.287	0.000
14	130.23	217958.87	2757218.7	24°54'14.55"N	84°12'28.40"E	0.8	0	115.718	0.000
15	140.83	210539.05	2750365.5	24°50'27.01"N	84° 8'9.39"E	0.53	0	67.097	0.000











2.20(a) **Soil Sample Locations.** Details of soil sample location being appended below:-

Sr.No	Chainage (km)	Position				Depth (m)
		EASTING (m)	NORTNING (m)	Latitude	Longitude	
1	0.25	285952.5544	2844493.205	25°42'9.85"N	84°52'0.59"E	1.7
2	9.89	281938.0043	2837750.43	25°38'28.67"N	84°49'40.64"E	1.8
3	19.91	278076.2404	2829005.721	25°33'42.51"N	84°47'27.46"E	0.42
4	29.95	275194.1707	2820362.386	25°29'0.18"N	84°45'49.45"E	0.46
5	40.22	273310.8546	2812055.06	25°24'29.30"N	84°44'47.05"E	0.42
6	49.91	271048.477	2803100.917	25°19'37.15"N	84°43'31.60"E	0.5
7	60.72	264666.2604	2795945.22	25°15'41.16"N	84°39'47.95"E	0.31
8	69.87	256909.6932	2793180.457	25°14'6.89"N	84°35'12.65"E	0.44
9	80.14	248039.9588	2788989.527	25°11'45.49"N	84°29'58.68"E	0.52
10	89.9	243860.5021	2781986.964	25° 7'55.50"N	84°27'34.21"E	0.38
11	99.88	238501.0712	2775349.242	25° 4'16.63"N	84°24'27.57"E	0.43
12	110.3	228829.3465	2771623.616	25° 2'9.48"N	84°18'45.32"E	0.28
13	120.05	225160.9287	2763213.962	24°57'33.99"N	84°16'40.56"E	0.34
14	130.19	217958.8756	2757218.657	24°54'14.55"N	84°12'28.40"E	0.29
15	140.71	210539.0509	2750365.537	24°50'27.01"N	84° 8'9.39"E	0.33

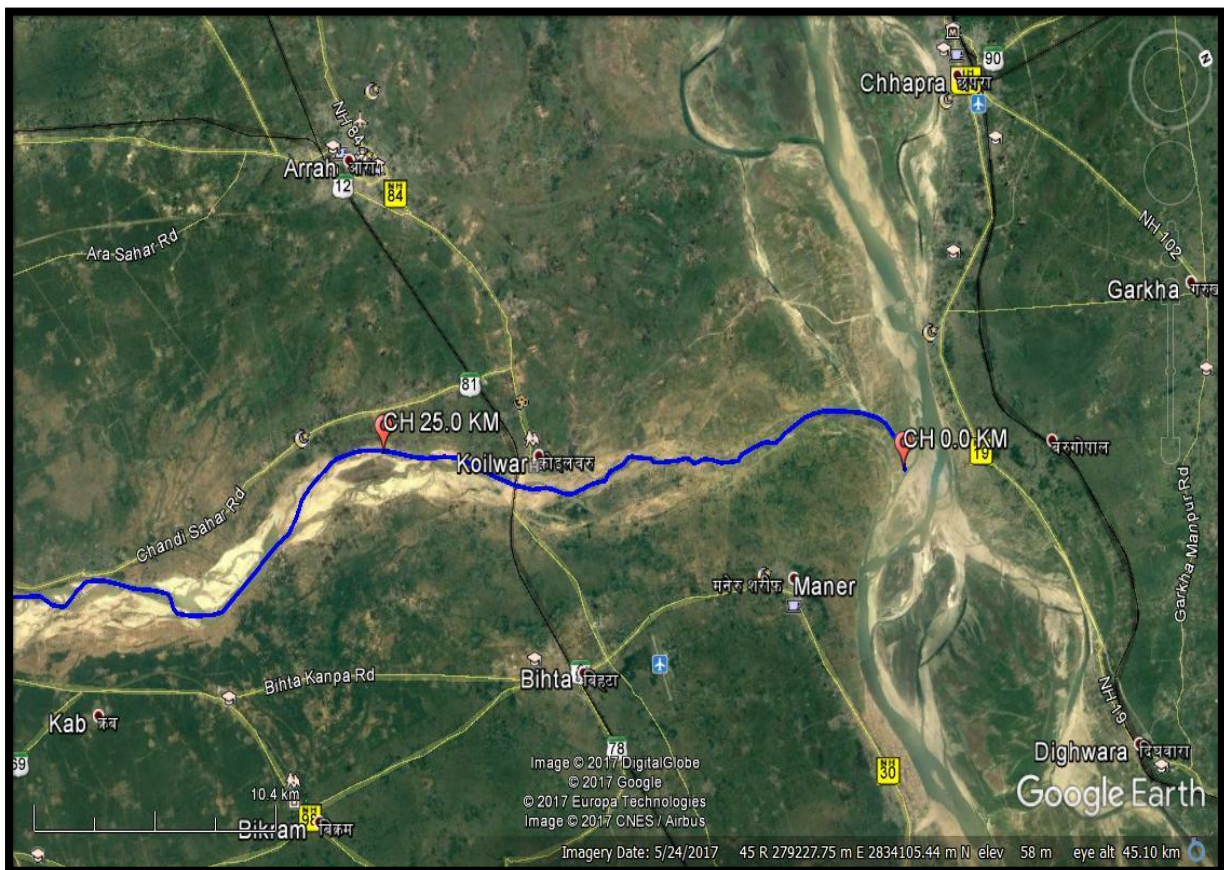
2.20(b) **Water Samples.** Water sample locations are tabulated below:-

Sr.No	Chainage (km)	Position				Total Depth (M)	Mid-Depth (0.5d) (m)
		EASTING (m)	NORTNING (m)	Latitude	Longitude		
1	0.25	285952.5544	2844493.205	25°42'9.85"N	84°52'0.59"E	1.7	0.85
2	9.89	281938.0043	2837750.43	25°38'28.67"N	84°49'40.64"E	1.8	0.9
3	19.91	278076.2404	2829005.721	25°33'42.51"N	84°47'27.46"E	0.42	0.21
4	29.95	275194.1707	2820362.386	25°29'0.18"N	84°45'49.45"E	0.46	0.23
5	40.22	273310.8546	2812055.06	25°24'29.30"N	84°44'47.05"E	0.42	0.21
6	49.91	271048.477	2803100.917	25°19'37.15"N	84°43'31.60"E	0.5	0.25
7	60.72	264666.2604	2795945.22	25°15'41.16"N	84°39'47.95"E	0.31	0.15
8	69.87	256909.6932	2793180.457	25°14'6.89"N	84°35'12.65"E	0.44	0.22
9	80.14	248039.9588	2788989.527	25°11'45.49"N	84°29'58.68"E	0.52	0.26
10	89.9	243860.5021	2781986.964	25° 7'55.50"N	84°27'34.21"E	0.38	0.19
11	99.88	238501.0712	2775349.242	25° 4'16.63"N	84°24'27.57"E	0.43	0.21
12	110.3	228829.3465	2771623.616	25° 2'9.48"N	84°18'45.32"E	0.28	0.14
13	120.05	225160.9287	2763213.962	24°57'33.99"N	84°16'40.56"E	0.34	0.17
14	130.19	217958.8756	2757218.657	24°54'14.55"N	84°12'28.40"E	0.29	0.14
15	140.71	210539.0509	2750365.537	24°50'27.01"N	84° 8'9.39"E	0.33	0.16

SECTION-3

3. Description of Waterway.

3.1 Sub-Stretch 1: From Ch 0 km to Ch 25 km. This stretch of the surveyed river is having length of 25 km and average width of 900 m to 2400 m. Current meter observation and discharge measurement were carried out at Ch. 3.19 km, Ch. 13.0 km and Ch. 20.00 km chainage. Sand mining activity is also relevant by JCB, boats, tractors and tucks in the river at Ch. 7.00 km to 12.00 and Ch. 18.00 km water pump used for irrigation. In this river stretch, there is neither any forest zone nor restricted zone. In this river stretch is having shallow patches in many places. The river is flowing in numerous streams. Fishing activity is prominent in the surveyed river length



From Ch 0 km to 25 km

Dredging quantity for substretch-1

Type	Chainage (km)		Observed				Reduced wrt 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)
Class-I	0	25	0	7.1	10,200.00	2,56,954.29	-0.3	7.0	13,700.00	4,43,102.39
Class-II	0	25	0	7.1	12,650.00	5,02,107.45	-0.3	7.0	15,600.00	7,61,085.30
Class-III	0	25	0	7.1	15,050.00	9,57,855.10	-0.3	7.0	18,500.00	13,13,285.05
Class-IV	0	25	0	7.1	17,200.00	13,35,004.87	-0.3	7.0	18,700.00	17,26,675.94

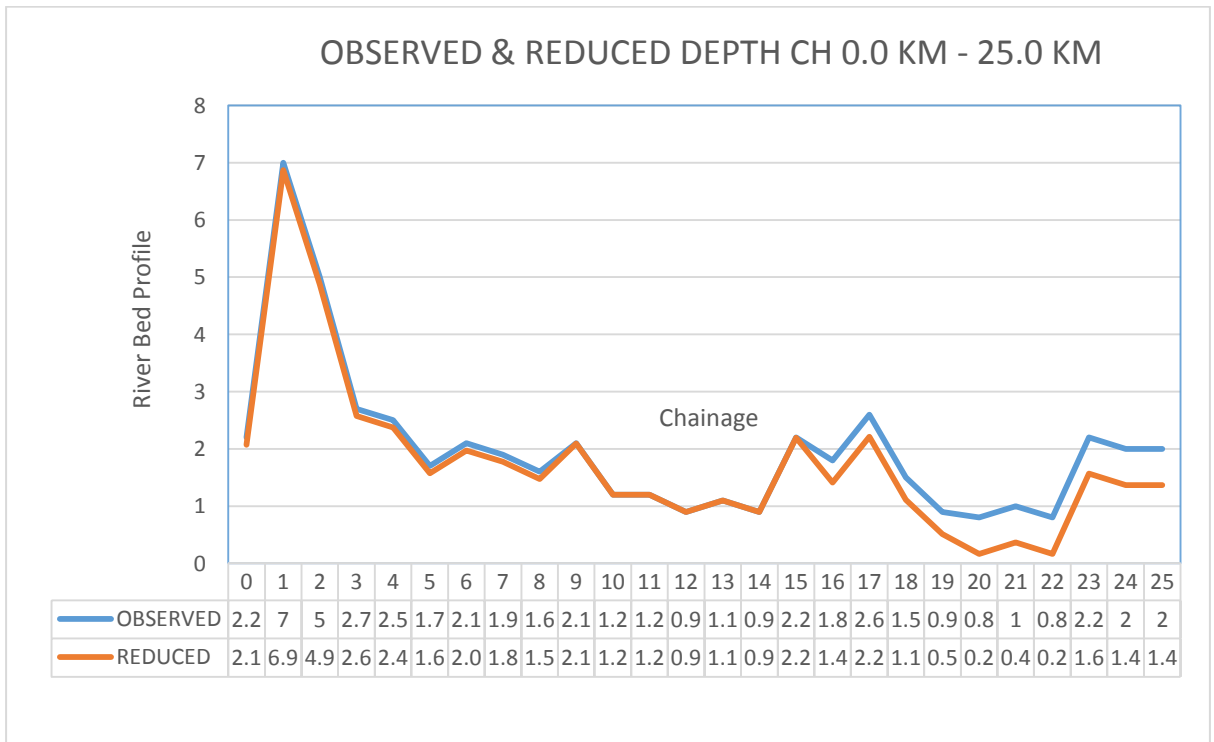
(a) Bathymetry Survey & Topographic Survey.

SUB-STRETCH-1 (0.0-25 KM)		
Type of Survey	Chainage (km)	Remarks
Bathymetry Survey	0.0 km to 14.62 km	covered by bathymetric survey
	15.48 km to 18.22 km	covered by bathymetric survey
	18.92 km to 19.38 km	covered by bathymetric survey
	20.56 km to 21.74 km	covered by bathymetric survey
	22.14 km to 25.00 km	covered by bathymetric survey
Topographic Survey	14.62 km to 15.48 km	Being Dry/Very Shallow covered by topographic method
	18.22 km to 18.92 km	Being Dry/Very Shallow covered by topographic method
	19.38 km to 20.56 km	Being Dry/Very Shallow covered by topographic method
	21.74 km to 22.14 km	Being Dry/Very Shallow covered by topographic method
	0.0 km to 25.00 km	Riverbank, prominent features along the bank.



Ganga Confluence at Ch 0 km

(c) **Observed & Reduced Depth Profile of the Stretch.** Both observed and reduced depth along with slope being mentioned below:-



Chainage (km)		River Bed Level (m)		River Bed Level Change (m)	Slope
From	To	From	To		
0.0	25	41.835	50.712	8.877	1:2816

(d) **Prominent Dam/ Barrage.** There is neither any dam nor any barrage exists in this stretch.

(d) **Tidal Stretch.** This 25 km of river stretch is completely non-tidal.

(e) **Bank.** This portion of the river is having un-protected bank.

(f) **Hindrances.** Prominent shallow patches can be noticed throughout the river which may cause significant hindrance for waterway navigation. Only low draft vessels can be operated throughout the year in many places and some places of water pump used for irrigation purpose. Sand Mining activity.



Sand Mining at Ch 12.00 km & Water Pump at Ch 18.10 km

(g) **Encroachment.** No encroachment was observed in this stretch.

(h) **Protected Area.** There is no wildlife, Defence, Atomic power plant and any other protected area present in this river stretch.

(i) **NH/ SH.** National Highway 30 of the state of Bihar and across the river i.e Koilwar road cumRail Bridge at Ch 19.07 km.

(j) **Railway Station.** Koilwar Railway Bridge runs across the river at Ch 19.07 km. Koilwar railway station exist at 0.50 km towards western side of river.

(k) **Land Use Pattern.** Land on either banks of the river being utilised for either agricultural or residentia purpose.

(l) **Crops.** Right banks of Sone River are fertile. Primary crops are mustard and wheat. (Winter crops).



Crops at Ch. 10.00 km &Ch. 11.50 km

Shallow Depth at Ch. 19.80 km

(m) **Bulk Construction Material.** There is neither any factory for construction material only coarse sand available in the river stretch.

(n) **Existing Industry.** There is no major or minor industry exists in this stretch.

(o) **Existing Ghats, Jetties and Terminals.** There is no ghat, jetty and terminal was observed in this portion.

(p) **Cargo Movement.** There is no cargo movement observed in this portion of the water way during the course of survey.

(p) **Prominent City/ town or Place of Worship.** Prominent city are Arra and Prominent town are koilwar, Bhita, maner

(q) **Ferry.** There is no ferry service available in this river stretch.

(r) **Water Sports Recreational Facilities.** There is no facility for water sports in this section. However, at Ganga confluence it can be developed due to water availability throughout the year.

(s) **Fishing Activity.** Small wooden boats were seen engaging in fishing activity in this river portion.



Fishing Boat at Ch. 6.5 km

(t) **Sand Mining.** Sand mining activity was found at Location Ch. 7.00 Km, Ch. 12.00 Km & 21.0 Km in this stretch.

(u) **Tributaries.** There is no tributary of Sone River present in this portion.

(v) **Details of Irrigational Canals.** There is no irrigational canal present in this section.

(w) **Details of Nalas.** There is no drain/ nala observed polluting the river in this portion.

(x) **Usage of Water.** Water in this portion primarily irrigation purpose.

(y) **Details of Cross-Structures.** There are one bridges in this portion Koilwar Rail cum road Bridge at Ch. 19.07 Km. Details are enumerated below:-

S. No	Structure Name	Chainage (km)	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (Distance Between piers) (m)	Vertical clearance wrt HFL (m)	Remarks
			Left Bank	Right Bank	Left Bank	Right Bank						
1	Koilwar Rail cum Road Bridge	19.07	25°33'42.61"N 84°48'17.14"E	25°34'9.36"N 84°47'34.63"E	279463.373E 2828985.295N	278290.048E 2829828.452N	1444.9	10	31	44.66	7.615	Completed



Koilwar rail cum Road Bridge at Ch 19.07 km.

3.2 Sub-Stretch 2: From Ch 25 km to Ch 50 km. This stretch of the surveyed river is having length of 25 km and average width of 1800m to 2300m. Current meter observation and discharge measurement were carried out at Ch. 30.00 km, Ch. 40.26 km and Ch.49.93km. In this river stretch, there is neither any forest zone nor restricted zone. In this river stretch is having shallow patches in many places. The river is flowing in numerous streams. Fishing activity is prominent in the surveyed river length



From Ch 25 km to 50 km

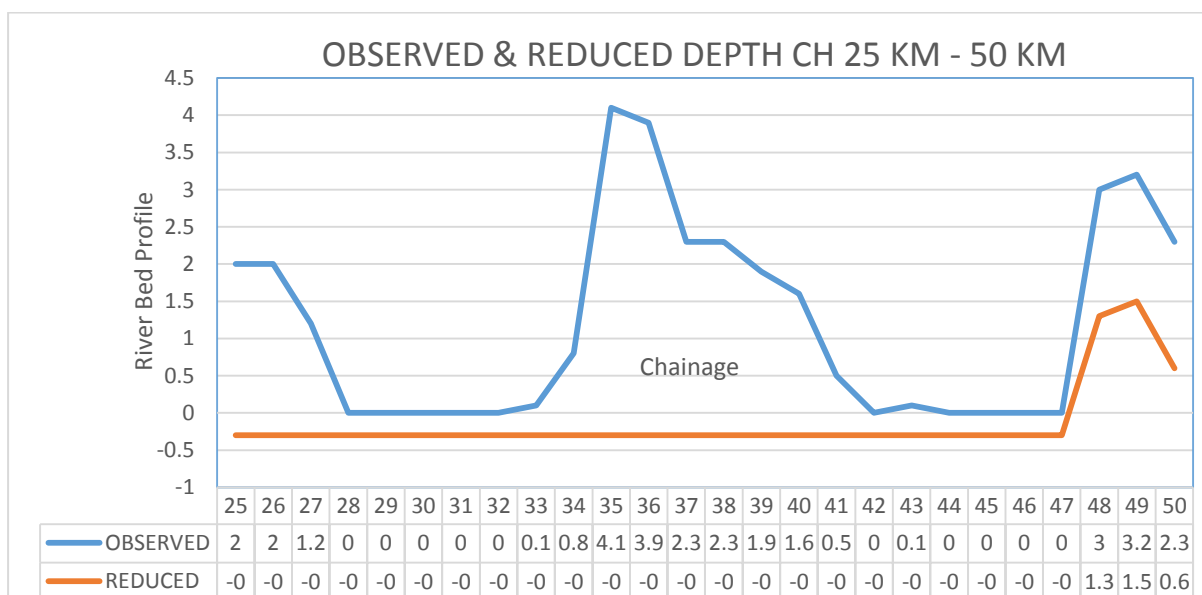
Dredging quantity for substretch-2

Type	Chainage (km)		Observed				Reduced wrt 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)
Class-I	25	50	0	4.1	15,800.00	6,46,102.72	-0.3	1.5	24,050.00	11,68,531.19
Class-II	25	50	0	4.1	16,500.00	10,07,008.86	-0.3	1.5	23,300.00	17,39,669.10
Class-III	25	50	0	4.1	17,500.00	15,65,880.52	-0.3	1.5	25,000.00	25,93,252.65
Class-IV	25	50	0	4.1	18,450.00	19,45,755.40	-0.3	1.5	25,000.00	31,08,254.97

(a) Bathymetry Survey & Topographic Survey.

SUB-STRETCH-2 (25-50 KM)		
Type of Survey	Chainage (km)	Remarks
Bathymetry Survey	25.0 km to 26.45 km	covered by bathymetric survey
Topographic Survey	26.45 km to 50.0 km	Being Dry/Very Shallow covered by topographic method
	25.0 km to 50.00 km	Riverbank, prominent features along the bank.

(c) Observed & Reduced Depth Profile of the Stretch. Both observed and reduced depth along with slope being mentioned below:-



Chainage (km)		River Bed Level (m)		River Bed Level Change (m)	Slope
From	To	From	To		
25	50	50.712	61.967	11.255	1:2221

(d) **Prominent Dam/ Barrage.** There is neither any dam nor any barrage exists in this stretch.

(d) **Tidal Stretch.** This 25 km of river stretch is completely non-tidal.

(e) **Bank.** This portion of the river is having un-protected bank.

(f) **Hindrances.** Shallow depth and I land are hindrances for navigation.



Shallow Stretch Ch 28.20 km & I-Land at Ch 42 km

(g) **Encroachment.** No encroachment was observed in this stretch.

(h) **Protected Area.** There is no wildlife, Defence, Atomic power plant and any other protected area present in this river stretch.

(i) **NH/ SH.** State Highway 81 right side of River and National Highway 98 left side of the state of Bihar.

(j) **Railway Station.** Garhani Raiway Station is located 17 km towards western side from the river.

(k) **Land Use Pattern.** Land on either banks of the river being utilised for either agricultural or residential purpose.

(l) **Crops.** Both the banks of Sone River are fertile. Primary crops are mustard and wheat but seasonal vegetable crops are also cultivated viz. peas, cauliflower, potato, tomato, cabbage, radish, etc. (winter crops).

(m) **Bulk Construction Material.** There is neither any factory for construction material only coarse sand available in the river stretch.

(n) **Existing Industry.** There is no major or minor industry exists in this stretch.

(o) **Existing Ghats, Jetties and Terminals.** There is no ghat, jetty and terminal was observed in this portion.

(p) **Cargo Movement.** There is no cargo movement observed in this portion of the water way during the course of survey.

(p) **Prominent City/ town or Place of Worship.** There is no prominent town present in this section.

(q) **Ferry.** There is no ferry service available in this river stretch.

(r) **Water Sports Recreational Facilities.** There is no facility for water sports in this section.

(s) **Fishing Activity.** Sparse fishing activity was monitored in this section.

(t) **Sand Mining.** No sand mining activity was found in this stretch.

(u) **Tributaries.** There is no tributary of Sone River present in this portion.

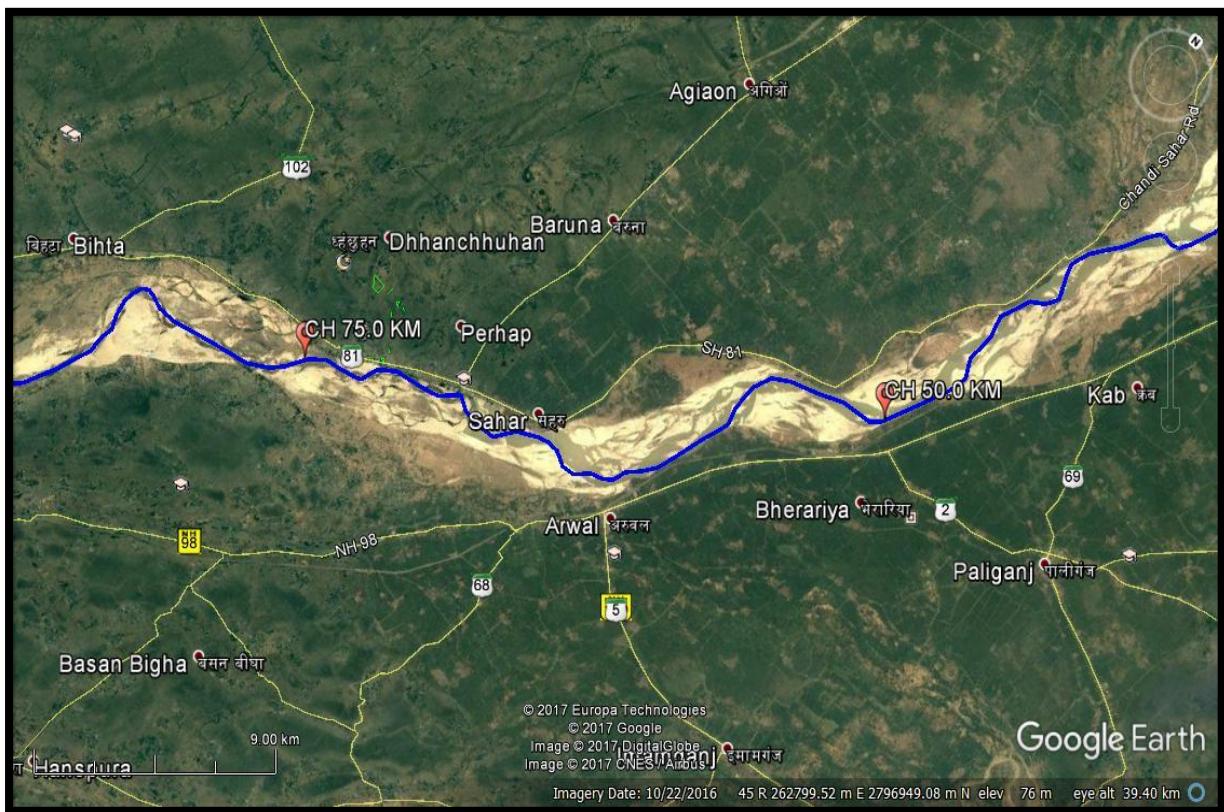
(v) **Details of Irrigational Canals.** There is no irrigational canal present in this section.

(w) **Details of Nalas.** There is no drain/ nala observed polluting the river in this portion.

(x) **Usage of Water.** Water in this portion primarily irrigation purpose.

(y) **Details of Cross-Structures.** No cross structure or HT line present in this portion.

3.3 Sub-Stretch 3: From Ch 50 km to Ch 75 km. This stretch of the surveyed river is having length of 25 km and average width of 1700m to 2000m. Bench Mark pillar no's 2 is located in this section. Details of BM pillar along with station recovery descriptions are placed at Annexure. Soil and water samples were collected at 60.72 km & Ch. 69.87. Report from authorized laboratory for the same being attached with Annexure. Current meter observation and discharge measurement were carried out at Ch. 60.81 km & Ch. 69.93. In this river stretch, there is neither any forest zone nor restricted zone. Farmers were seen engaging in agricultural activities. Primary crops are mustard, wheat etc. The river is flowing in numerous streams. Shallow patches can be noticed throughout in this stretch. Sand mining activity at Ch. 60.85 km is also relevant by JCB, tractors and tucks this stretch.



From Ch 50 km to 75 km

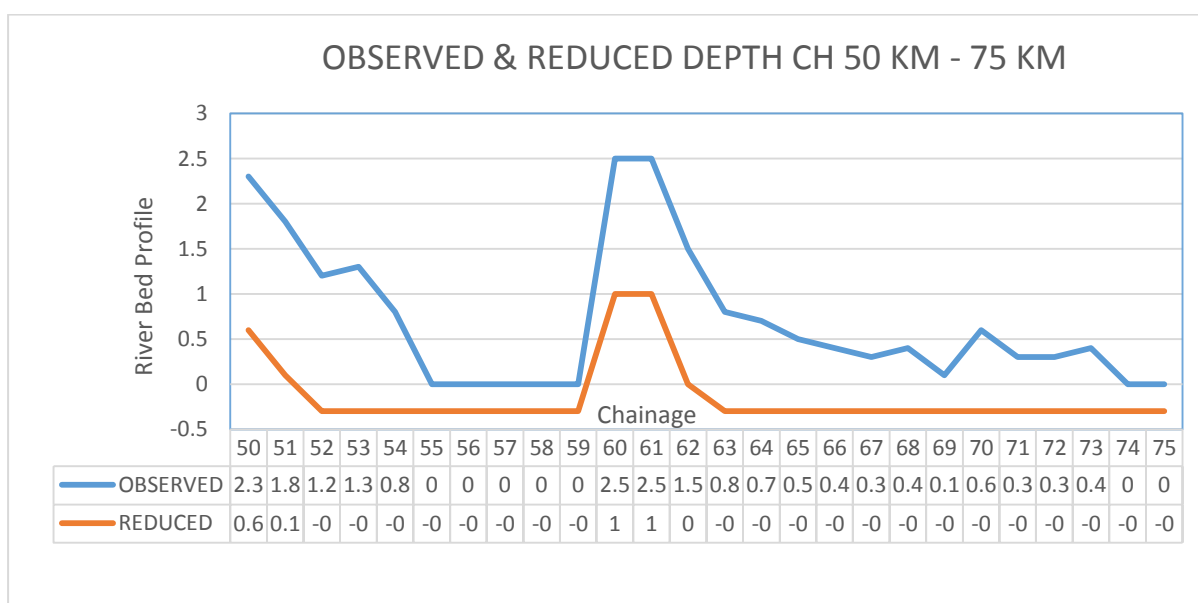
Dredging quantity for substretch-3

Type	Chainage (km)		Observed				Reduced wrt 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)
Class-I	50	75	0	2.6	20,050.00	7,39,809.54	-0.3	1.1	25,000.00	13,03,112.95
Class-II	50	75	0	2.6	22,300.00	11,68,740.67	-0.3	1.1	25,000.00	19,28,149.34
Class-III	50	75	0	2.6	23,000.00	18,45,075.16	-0.3	1.1	25,000.00	28,32,550.42
Class-IV	50	75	0	2.6	23,900.00	23,03,011.41	-0.3	1.1	25,000.00	33,57,606.01

(a) Bathymetry Survey & Topographic Survey.

SUB-STRETCH-3 (50-75 KM)		
Type of Survey	Chainage (km)	Remarks
Bathymetry Survey	50.0 km to 75.0 km	No bathymetric survey due to Shallow depth
Topographic Survey	50.0 km to 75.0 km	Being Dry/Very Shallow covered by topographic method
	50.0 km to 75.0 km	Riverbank, prominent features along the bank.

(c) Observed & Reduced Depth Profile of the Stretch. Both observed and reduced depth along with slope being mentioned below:-



Chainage (km)		River Bed Level (m)		River Bed Level Change (m)	Slope
From	To	From	To		
50	75	61.967	73.108	11.141	1:2244

(d) **Prominent Dam/ Barrage.** There is neither any dam nor any barrage exists in this stretch.

(d) **Tidal Stretch.** This 25 km of river stretch is completely non-tidal.

(e) **Bank.** This portion of the river is having un-protected bank.

(f) **Hindrances.** Shallow depth seems to be hindrance for navigation.

(g) **Encroachment.** No encroachment was observed in this stretch.

(h) **Protected Area.** There is no wildlife, Defence, Atomic power plant and any other protected area present in this river stretch.

(i) **NH/ SH.** State Highway 81 right side of River and National Highway 98 left side of the state of Bihar

(j) **Railway Station.** Piro Railway Station is located 15.8 km towards western side from the river.

(k) **Land Use Pattern.** Land on either banks of the river being utilised for either agricultural or residential purpose.

(l) **Crops.** Both the banks of Sone River are fertile. Primary crops are mustard and wheat but seasonal vegetable crops are also cultivated viz. peas, cauliflower, potato, tomato, cabbage etc. (winter crops).



Crops at Ch. 69.00 km

(m) **Bulk Construction Material.** There is neither any factory for construction material only coarse sand available in the river stretch.

(n) **Existing Industry.** There is no major or minor industry exists in this stretch.

(o) **Existing Ghats, Jetties and Terminals.** There is no ghat, jetty and terminal was observed in this portion.

(p) **Cargo Movement.** There is no cargo movement observed in this portion of the water way during the course of survey.

(p) **Prominent City/ town or Place of Worship.** The two town in this section is Right side of Bank Sahar and Left side of Bank Arwal.

(q) **Ferry.** There is no ferry service available in this river stretch.

(r) **Water Sports Recreational Facilities.** There is no facility for water sports in this section.

(s) **Fishing Activity.** No fishing activity was monitored in this section.

(t) **Sand Mining.** Sand mining activity was found at Ch. 60.85 Km in this stretch.



Sand Mining Activity at Ch. 60.85 km

(u) **Tributaries.** There is no tributary of Sone River present in this portion.

(v) **Details of Irrigational Canals.** There is no irrigational canal present in this section.

(w) **Details of Nalas.** There is no drain/ nala observed polluting the river in this portion.

(x) **Usage of Water.** Water in this portion primarily irrigation purpose.

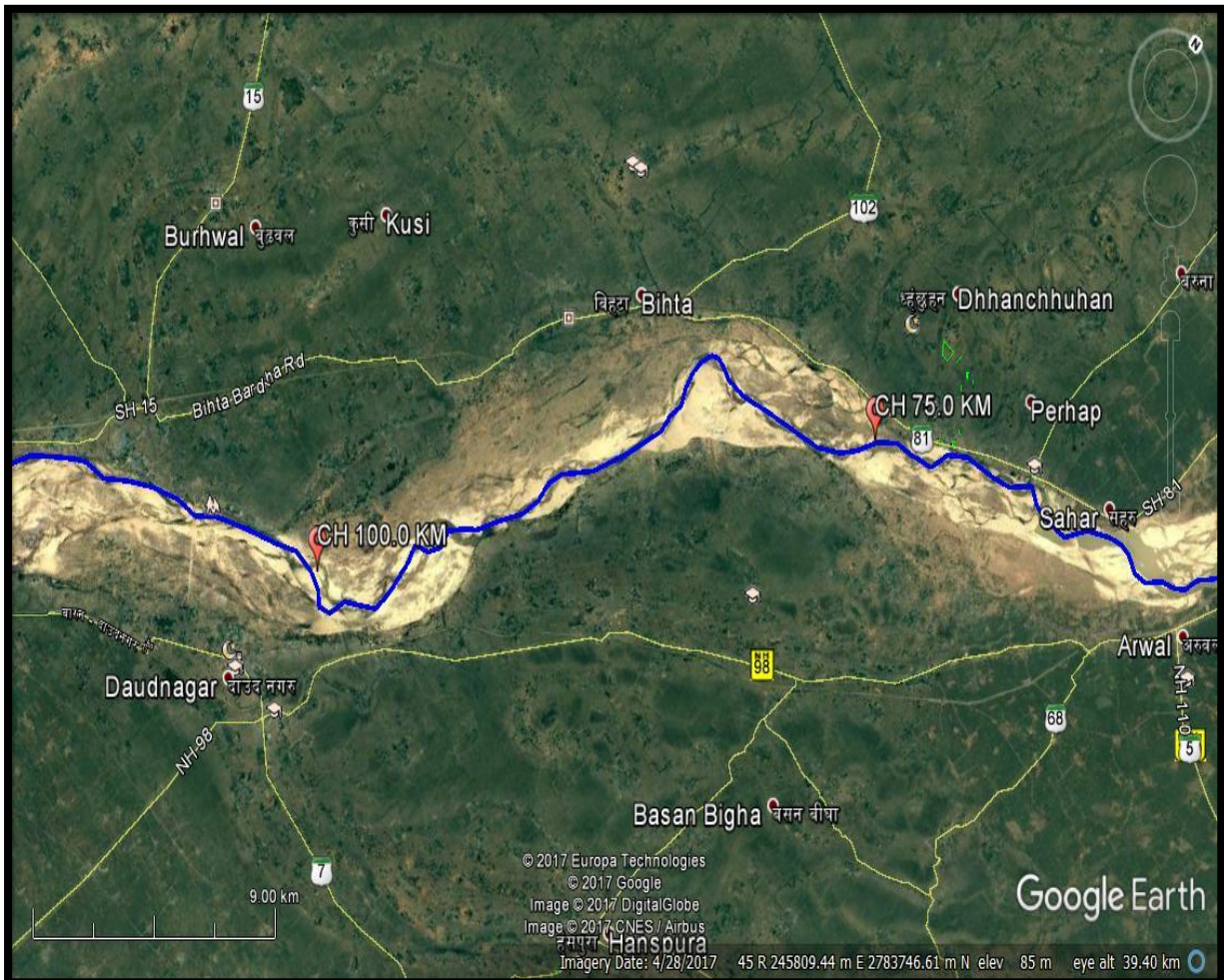
(y) **Details of Cross-Structures.** There are one bridges in this portion Sahar-Arwal Bridge at Ch. 64.37 Km. Details are enumerated below:-

S. No	Structure Name	Chainage (km)	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (Distance Between piers) (m)	Vertical clearance wrt HFL (m)	Remarks
			Left Bank	Right Bank	Left Bank	Right Bank						
2	Sahar Arwal Bridge	64.37	25°14'19.35"N 84°38'40.96"E	25°15'7.61"N 84°37'50.55"E	262747.365E 2793460.725N	261362.485E 2794970.048N	2048.4	10	35	57.75	2.859	Completed



Sahar - Arwal Bridge at Ch. 64.37 km

3.4 Sub-Stretch 4: From Ch 75 km to Ch 100 km. This stretch of the surveyed river is having length of 25 km and average width of 2060m to 2490m. Bench Mark pillar no's 3 is located in this section. Details of BM pillars along with station recovery descriptions are placed at Annexure 9. Soil and water samples were collected at Ch. 80.14, Ch. 89.90 Km & Ch. 9.88 km. Report from authorized laboratory for the same being attached with Annexure 11&12. Current meter observation and discharge measurement were carried out at Ch. 80.16, Ch.89.92 & Ch.100.00 km. In this river stretch, there is neither any forest zone nor restricted zone. Farmers were seen engaging in agricultural activities. Primary crops are mustard, wheat, radish, etc. Sand mining activity at Ch. 80.00 km is also relevant by JCB and tractors in this stretch.



From Ch 75 km to 100 km

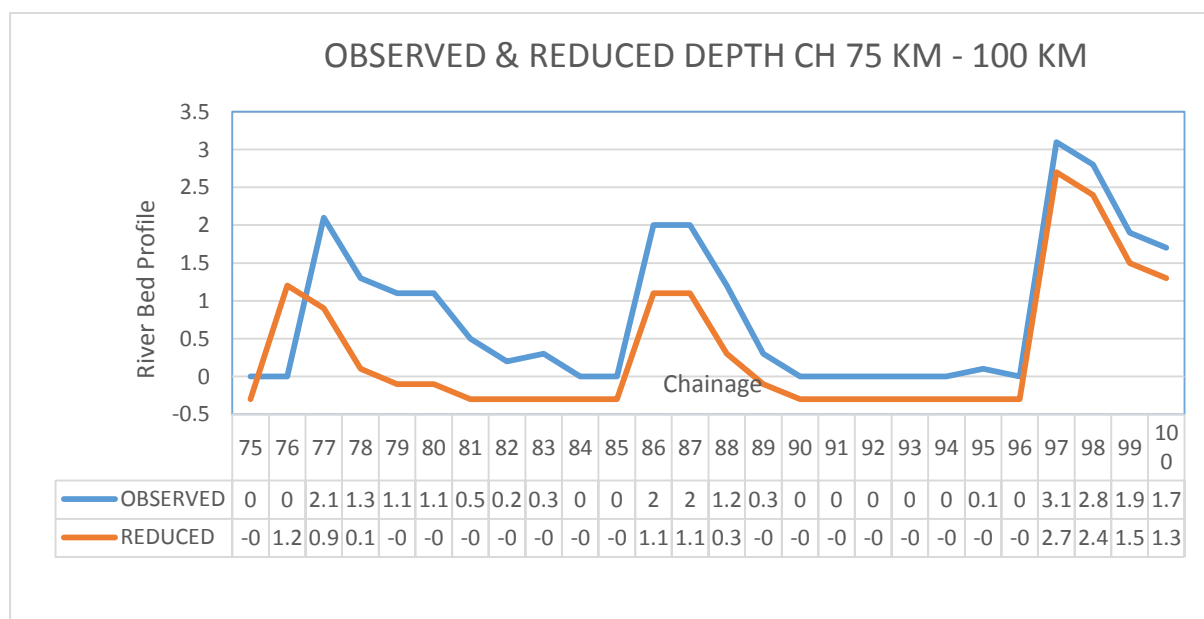
Dredging quantity for substretch-4

Type	Chainage (km)		Observed				Reduced wrt 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)
Class-I	75	100	0	3.1	18,000.00	7,25,249.31	-0.3	2.4	22,150.00	10,78,309.03
Class-II	75	100	0	3.1	20,650.00	11,20,630.04	-0.3	2.4	23,100.00	16,19,804.77
Class-III	75	100	0	3.1	19,900.00	17,51,045.93	-0.3	2.4	23,850.00	24,26,429.42
Class-IV	75	100	0	3.1	21,950.00	21,82,479.35	-0.3	2.4	23,850.00	29,20,925.17

(a) Bathymetry Survey & Topographic Survey.

SUB-STRETCH-4 (75-100 KM)		
Type of Survey	Chainage (km)	Remarks
Bathymetry Survey	75.0 km to 100.0 km	No bathymetric survey due to Shallow depth
Topographic Survey	75.0 km to 100.0 km	Being Dry/Very Shallow covered by topographic method
	75.0 km to 100.0 km	Riverbank, prominent features along the bank.

(c) Observed & Reduced Depth Profile of the Stretch. Both observed and reduced depth along with slope being mentioned below:-



Chainage (km)		River Bed Level (m)		River Bed Level Change (m)	Slope
From	To	From	To		
75	100	73.108	83.716	10.608	1:2357

(d) **Prominent Dam/ Barrage.** There is neither any dam nor any barrage exists in this stretch.

(d) **Tidal Stretch.** This 25 km of river stretch is completely non-tidal.

(e) **Bank.** This portion of the river is having un-protected bank.

(f) **Hindrances.** Shallow depth seems to be hindrance for navigation.



Shallow Depth at Ch 75.00 to 100.00 Km

(g) **Encroachment.** No encroachment was observed in this stretch.

(h) **Protected Area.** There is no wildlife, Defence, Atomic power plant and any other protected area present in this river stretch.

(i) **NH/ SH.** State Highway 81 right side of River and National Highway 98 left side of the state of Bihar.

(j) **Railway Station.** Nearest railway station is Bikramganj which is located approximately 19.34 km away from the river stretch towards western side.

(k) **Land Use Pattern.** Land on either banks of the river being utilised for either agricultural or residential purpose.

(l) **Crops.** Both the banks of Sone River are fertile. Primary crops are mustard and wheat but seasonal vegetable crops are also cultivated viz. Cauliflower, potato, tomato, cabbage, carrot, radish, etc. (winter crops).

(m) **Bulk Construction Material.** There is neither any factory for construction material only coarse sand available in the river stretch

(n) **Existing Industry.** There is no major or minor industry exists in this stretch.

(o) **Existing Ghats, Jetties and Terminals.** There is no ghat, jetty and terminal was observed in this portion.

(p) **Cargo Movement.** There is no cargo movement observed in this portion of the water way during the course of survey.

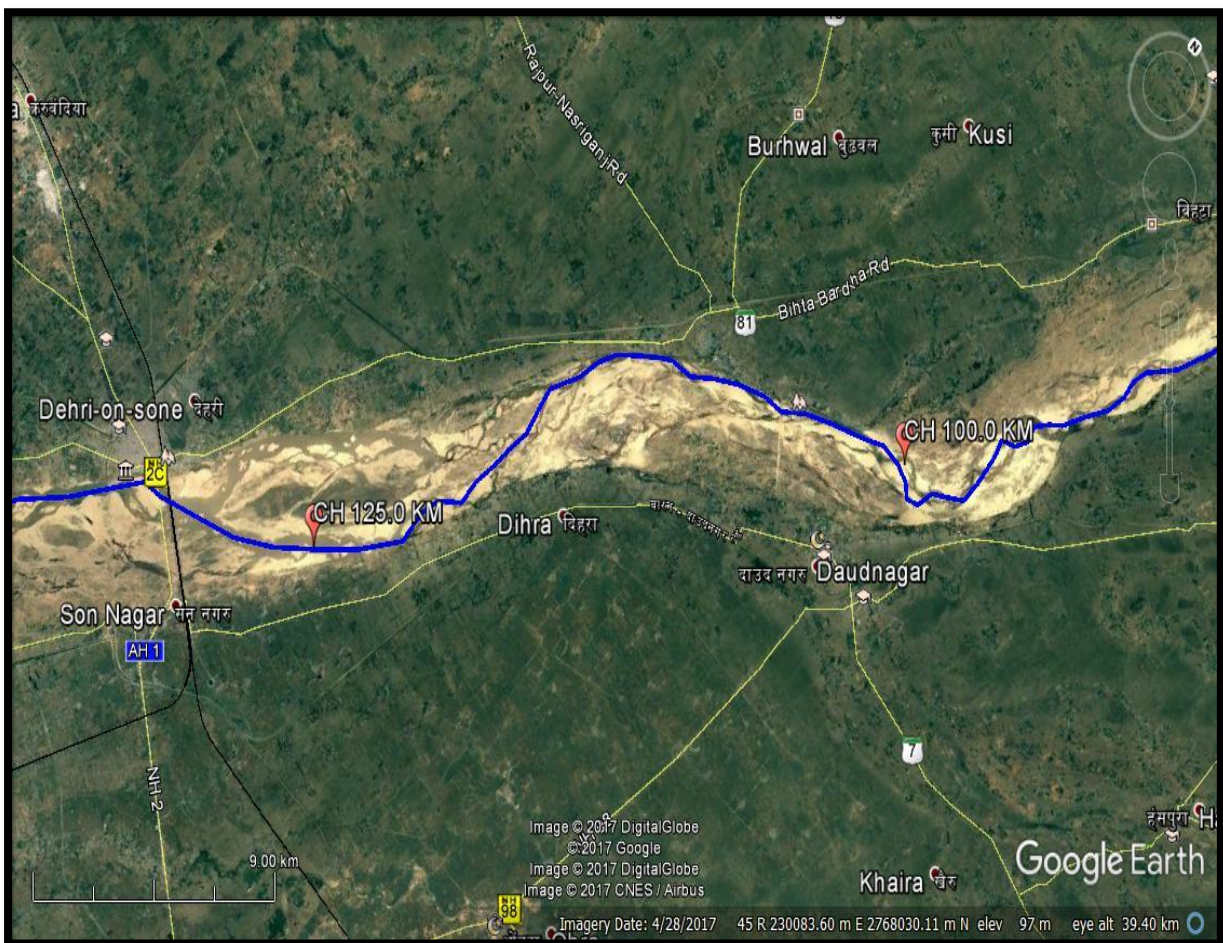
(p) **Prominent City/ town or Place of Worship.** The only town in this section is Daudnagar.

(q) **Ferry.** There is no ferry service available in this river stretch.

(r) **Water Sports Recreational Facilities.** There is no facility for water sports in this section.

- (s) **Fishing Activity.** No fishing activity was monitored in this section.
- (t) **Sand Mining.** Sand mining activity at Ch. 80.00 km was found in this stretch.
- (u) **Tributaries.** There is no tributary of Sone River present in this portion
- (v) **Details of Irrigational Canals.** There is no irrigational canal present in this section.
- (w) **Details of Nalas.** There is no drain/ nala' observed polluting the river in this portion.
- (x) **Usage of Water.** Water in this portion primarily irrigation purpose.
- (y) **Details of Cross-Structures.** There is no Cross-structure of Sone River present in this Stretch.

3.5 Sub-Stretch 5: From Ch 100 km to Ch 125 km. This stretch of the surveyed river is having length of 25 km and average width of 2600m to 3800m. Bench Mark pillars no's 2 is located in this section. Details of BM pillars along with station recovery descriptions are placed at Annexure 9. Soil and water samples were collected at Ch. 110.3 km & Ch.120.05 Report from authorized laboratory for the same being attached with Annexure 11&12. Current meter observation and discharge measurement were carried out at Ch.110.35 km & Ch.120.05 In this river stretch, there is neither any forest zone nor restricted zone. The shallow patches can be noticed throughout the river and numerous streams in the River.ch 105.12 under Construction Bridge Activity by Gammon India.ch 103 to 117 high-tension line cross the river. Sand mining activity is also relevant by JCB, boats, tractors and tucks at ch.109 km. Total river stretch is flourished with good quality of sands in most of the places.



From Ch 100 km to 125 km

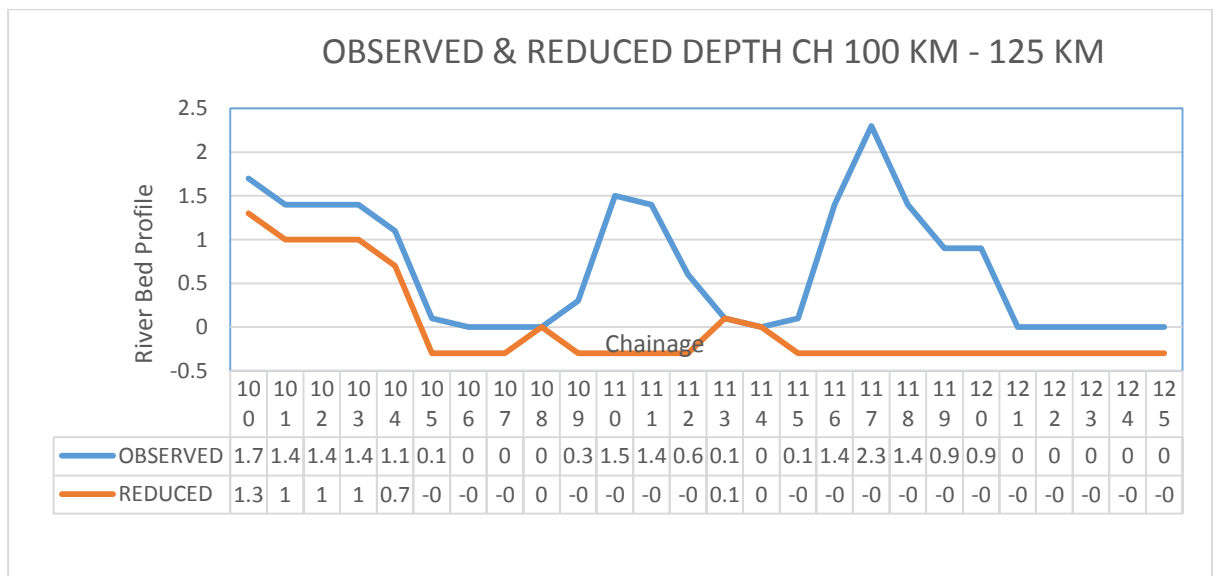
Dredging quantity for substretch-5

Type	Chainage (km)		Observed				Reduced wrt 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)
Class-I	100	125	0	2.3	17,750.00	7,26,463.41	-0.3	1.5	23,400.00	10,98,956.64
Class-II	100	125	0	2.3	19,000.00	11,46,108.06	-0.3	1.5	23,500.00	16,61,492.76
Class-III	100	125	0	2.3	24,100.00	18,39,206.44	-0.3	1.5	25,000.00	25,05,987.93
Class-IV	100	125	0	2.3	24,100.00	23,10,557.03	-0.3	1.5	25,000.00	30,21,404.94

(a) Bathymetry Survey & Topographic Survey.

SUB-STRETCH-5 (100-125 KM)		
Type of Survey	Chainage (km)	Remarks
Bathymetry Survey	100.0 km to 125.0 km	No bathymetric survey due to Shallow depth
Topographic Survey	100.0 km to 125.0 km	Being Dry/Very Shallow covered by topographic method
	100.0 km to 125.0 km	Riverbank, prominent features along the bank.

(c) Observed & Reduced Depth Profile of the Stretch. Both observed and reduced depth along with slope being mentioned below:-



Chainage (km)		River Bed Level (m)		River Bed Level Change (m)	Slope
From	To	From	To		
100	125	83.716	96.757	13.041	1:1917

(d) **Prominent Dam/ Barrage.** There is neither any dam nor any barrage exists in this stretch.

(d) **Tidal Stretch.** This 25 km of river stretch is completely non-tidal.

(e) **Bank.** This portion of the river is having un-protected bank.

(f) **Hindrances.** Shallow depth seems to be hindrance for navigation in this stretch.



Shallow Patch at Ch 110 km

(g) **Encroachment.** No encroachment was observed in this stretch.

(h) **Protected Area.** There is no wildlife, Defence, Atomic power plant and any other protected area present in this river stretch.

(i) **NH/ SH.** State Highway 15 of the state of Bihar right side of the river Bank.

(j) **Railway Station.** Nearest railway station is Dehri on one side of the river present 7 km away towards South western side.

(k) **Land Use Pattern.** Land on either banks of the river being utilised for either agricultural or residential purpose.

(l) **Crops.** Both the banks of Sone River are fertile. Primary crops are mustard and wheat but seasonal vegetable crops are also cultivated viz. peas, cauliflower, potato, cabbage, radish, etc. (winter crops).

(m) **Bulk Construction Material.** There is neither any factory for construction material only coarse sand available in the river stretch.

(n) **Existing Industry.** There is no major or minor industry exists in this stretch.

(o) **Existing Ghats, Jetties and Terminals.** There is no Ghat, jetty and terminal was observed in this portion.

(p) **Cargo Movement.** There is no cargo movement observed in this portion of the water way during the course of survey.

(p) **Prominent City/ town or Place of Worship.** The only town in this section is Nasriganj and Darihat.

(q) **Ferry.** There is no ferry service available in this river stretch.

(r) **Water Sports Recreational Facilities.** There is no facility for water sports in this section.

(s) **Fishing Activity.** No fishing activity was observed in this section.

(t) **Sand Mining.** Sand mining activity was found at Ch.109 km in this stretch.



Sand Mining Activity at Ch 109.00 km

(u) **Tributaries.** No tributary was noticed in this river stretch.

(v) **Details of Irrigational Canals.** There is no irrigational canal present in this section.

(w) **Details of Nalas.** There is no drain/ nala observed polluting the river in this portion.

(x) **Usage of Water.** Water in this portion primarily irrigation purpose.

(y) **Details of Cross-Structures.** There is one under Construction Bridge. Details is tabulated below:-

S. No	Structure Name	Chainage (km)	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (Distance Between piers) (m)	Vertical clearance wrt	Remarks
			Left Bank	Right Bank	Left Bank	Right Bank					HFL (m)	
3	UC Bridge	105.12	-	25° 3'21.51"N 84°21'31.89"E	-	233543.879E 2773748.781N	-	-	-	-	-	Under Construction



U/C Bridge at Ch 105.12 km

06 no's HT line was present in this section. Detail of HT line is tabulated below:-

S. No	Cross-Structure Name	Chainage (km)	Position (Lat Long)		Position (UTM)		Vertical clearance w.r.t HFL (m)	Remarks
1	HT Line	103.33	25° 3'27.54"N 84°22'35.28"E	25° 3'44.42"N 84°22'34.14"E	235324.493E 2773899.729N	235302.390E 2774419.197N	21	Completed
2	HT Line	116.07	24°59'22.92"N 84°17'46.25"E	24°59'27.55"N 84°17'16.99"E	227070.200E 2766529.231N	226252.267E 2766688.548N	23	Completed
3	HT Line	116.19	24°59'19.63"N 84°17'40.44"E	24°59'23.20"N 84°17'19.04"E	226905.183E 2766431.648N	226307.327E 2766553.209N	25	Completed
4	HT Line	116.6	24°59'7.33"N 84°17'41.46"E	24°59'9.47"N 84°17'18.17"E	226926.880E 2766052.887N	226274.699E 2766131.389N	21	Completed
5	HT Line	116.77	24°59'2.15"N 84°17'42.28"E	24°59'3.68"N 84°17'15.69"E	226946.244E 2765892.297N	226201.627E 2765954.742N	19	Completed
6	HT Line	117.12	24°58'52.19"N 84°17'41.50"E	24°58'51.64"N 84°17'16.49"E	226918.703E 2765586.554N	226216.517E 2765583.231N	18	Completed



High tension line at Ch 103.3 km & Ch 116.07



High tension line at Ch 116.19 km & Ch 116.6, 116.70 & Ch 117.12 km

3.6 Sub-Stretch 6: From Ch 125 km to Ch 141 km. This stretch of the surveyed river is having length of 16 km and average width of 3500 m to 4300 m. Current meter observation and discharge measurement were carried out at Ch. 140.83. Sand mining activity is also relevant by JCB, tractors and tucks in the river at Ch. 127 km. In this river stretch, there is neither any forest zone nor restricted zone. In this river stretch is having shallow patches in many places. The river is flowing in numerous streams. River bank are pitch protected at Ch. 140.0 km to 141.00.



From Ch 125 km to 141 km

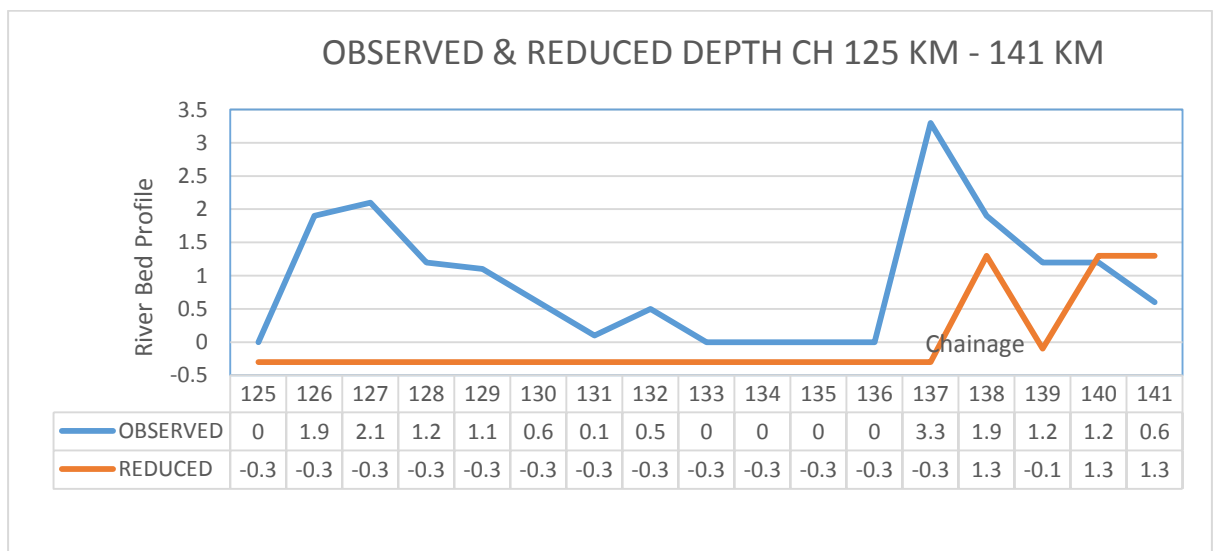
Dredging quantity for substretch-6

Type	Chainage (km)		Observed				Reduced wrt 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)
Class-I	125	141	0	3.3	10,600.00	3,80,646.42	-0.3	1.3	16,000.00	8,42,303.98
Class-II	125	141	0	3.3	12,700.00	6,15,244.93	-0.3	1.3	16,000.00	12,43,269.56
Class-III	125	141	0	3.3	12,800.00	9,93,221.92	-0.3	1.3	16,000.00	18,22,024.87
Class-IV	125	141	0	3.3	14,200.00	12,63,331.63	-0.3	1.3	16,000.00	21,56,352.63

(a) Bathymetry Survey & Topographic Survey.

SUB-STRETCH-6 (125-141 KM)		
Type of Survey	Chainage (km)	Remarks
Bathymetry Survey	125.0 km to 141.0 km	No bathymetric survey due to Shallow depth
Topographic Survey	125.0 km to 141.0 km	Being Dry/Very Shallow covered by topographic method
	125.0 km to 141.0 km	Riverbank, prominent features along the bank.

(c) Observed & Reduced Depth Profile of the Stretch. Both observed and reduced depth along with slope being mentioned below:-



Chainage (km)		River Bed Level (m)		River Bed Level Change (m)	Slope
From	To	From	To		
125	141	96.757	103.506	6.749	1:2371

(d) **Prominent Dam/ Barrage.** There is one barrage indrapuri exists in this stretch. The Indrapuri Barrage is 1,407 metres (4,616 ft.) long and is the fourth longest barrage in the world. Water from the Sone fed canal systems on both sides of the river and irrigated large areas.



Indrapuri Barrage at ch 141.00 km

(d) **Tidal Stretch.** This 16 km of river stretch is completely non-tidal.

(e) **Bank.** This portion of the river bank are pitch protected at ch 140.0 km to 141.00 km and Ch 131.5 km to 131.50 km



River Bank Pitch Procted at ch 130.50 km to 131.30 km & ch 140.00 to 141.00 km

(f) **Hindrances.** Shallow depth seems to be hindrance for navigation.



Shallow Depth at Ch. 135.00 km

(g) **Encroachment.** No encroachment was observed in this stretch.

(h) **Protected Area.** There is no wildlife, Defence, Atomic power plant and any other protected area present in this river stretch.

(i) **NH/ SH.** State Highway 15 right side of the river bank and National Highway 2 & AH1 cross the river.

(j) **Railway Station.** Railway station is Dehri on some right side of river bank and some nagar Junction of left side of river bank.

(k) **Land Use Pattern.** Land on either banks of the river being utilised for either agricultural or residential purpose.

(l) **Crops.** Both the banks of Sone River are fertile. Primary crops are mustard and wheat but seasonal vegetable crops are also cultivated viz. peas, cauliflower, potato, tomato, cabbage, etc. (winter crops).



Crops at Ch. 129.50 km

(m) **Bulk Construction Material.** There is neither any factory for construction material only coarse sand available in the river stretch.

(n) **Existing Industry.** There is no major or minor industry exists in this stretch.

(o) **Existing Ghats, Jetties and Terminals.** There is no ghat, jetty and terminal was observed in this portion.

(p) **Cargo Movement.** There is no cargo movement observed in this portion of the water way during the course of survey.

(p) **Prominent City/ town or Place of Worship.** The town in this section is Dehri, Gandhi Nagar and some Nagar.

(q) **Ferry.** There is no ferry service available in this river stretch.

(r) **Water Sports Recreational Facilities.** There is no facility for water sports in this section.

(s) **Fishing Activity.** No fishing activity was observed in this section.

(t) **Sand Mining.** Sand mining activity was found at ch.127.00 km in this stretch.



**Sand Mining Activity at
Ch. 127.0 km**

(u) **Tributaries.** No tributary was noticed in this river stretch

(v) **Details of Irrigational Canals.** There is no irrigational canal present in this section.

(w) **Details of Nalas.** There is no drain/ nala observed polluting the river in this portion.

(x) **Usage of Water.** Water in this portion primarily irrigation purpose.

(y) **Details of Cross-Structures.** There is four bridge and one barrage in this river stretch. Details for the same tabulated below:-

S. No	Structure Name	Chainage (km)	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	No of Piers	Horizontal clearance (Distance Between piers) (m)	Vertical clearance wrt HFL (m)	Remarks
			Left Bank	Right Bank	Left Bank	Right Bank						
4	UC Bridge	130.67	-	24°54'24.16"N 84°11'53.10"E	-	216973.512E 2757534.746N	-	-	-	-	-	Under Construction
5	Son Nagar New Rail Bridge	130.72	24°53'20.75"N 84°13'16.95"E	24°54'22.81"N 84°11'52.13"E	219287.750E 2755534.970N	216945.707E 2757493.775N	3053.2	15.5	92	30.05	4.87	Completed
6	Son Nagar Old Rail Bridge	130.76	24°53'19.66"N 84°13'16.12"E	24°54'22.04"N 84°11'51.19"E	219263.850E 2755501.670N	216918.940E 2757470.332N	3061.7	12	94	29.422	3.13	Completed
7	Son Nagar Bridge	131.23	24°53'10.48"N 84°13'8.17"E	24°54'13.09"N 84°11'43.34"E	219034.930E 2755223.400N	216692.799E 2757199.830N	3067.4	16	93	30.84	4.43	Completed
8	Indrapur Barrage	141.18	24°49'46.50"N 84° 8'29.83"E	24°50'20.62"N 84° 7'56.26"E	211087.690E 2749106.070N	210166.356E 2750176.219N	1412	7	-			Completed



U/C Bridge at Ch. 130.67 km



Sone Nagar New rail Bridge at Ch. 130.72 km



Old Rail Bridge sone Nagar at Ch. 130.76 km



Sone Nagar Bridge at Ch. 131.23 km



Indrapuri barrage at Ch. 141.00 km

SECTION – 4

4.1 Terminals. There is no terminal present in this waterway. However, development of terminal at Koilwar (Ch. 18.70 km) and Sone Nagar (Ch. 130.20 km) is recommended due to depth availability throughout the year proximity to the road rail networks. NH 30 and NH 2C across the Sone River. Koilwar Railway station is Located 1.0 km from the proposed terminal-1 and Sone Nagar Junction & Dehri on Sone Railway stations are located 1.5 km & 5.00 km away from the proposed terminal-2 respectively. This proposed terminal will cater for passenger as well as cargo movement throughout the river. Details of the proposed terminal being tabulated below:-

SI No	Chainage (km)	Location	Position (Lat Long)		Position (UTM)		Length (m)	Width (m)	Area (sq.m)	Present land use
			Left Bank	Right Bank	Left Bank	Right Bank				
1	18.70	Koilwar	25°34'17.57"N 84°47'42.43"E	278431.780E 2829893.240N	278512.530E 2830077.360N	25°34'11.56"N 84°47'39.67"E	200M	30M	6000	Agricultural Land
2	130.20	Sone Nagar	24°53'30.79"N 84°13'36.28"E	24°53'26.09"N 84°13'31.72"E	219836.020E 2755832.050N	219705.640E 2755690.060N	200M	50M	10000	Agricultural Land



Proposed Terminal-1 at Ch. 18.70 km



Proposed Terminal-2 at Ch. 130.20 km

SECTION – 5

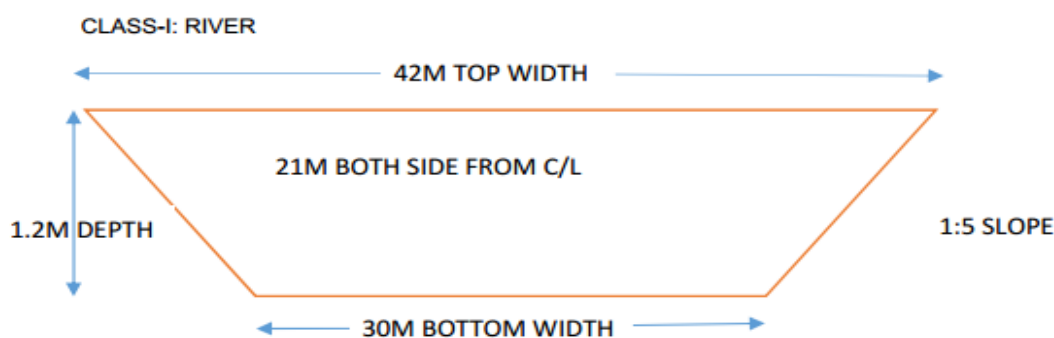
5.1 Fairway Development

The dredging channel is designed by linking deepest sounding of each cross sections and the dredging quantity is estimated for developing a navigable channel with the following dimension. The best suitable dredging channel class for the survey stretch of Sone River is identified as Class-III and the dredge volume for the Class I to Class-IV were also calculated for the entire survey stretch. The details of Fairway channel dimension used for the dredging calculation are as follows: -

Class of Channel Depth (m) Bottom	Depth (m)	Bottom width (m)	Slope
Class -I	1.2	30	1:5
Class -II	1.4	40	1:5
Class -III	1.7	50	1:5
Class -IV	2	50	1:5

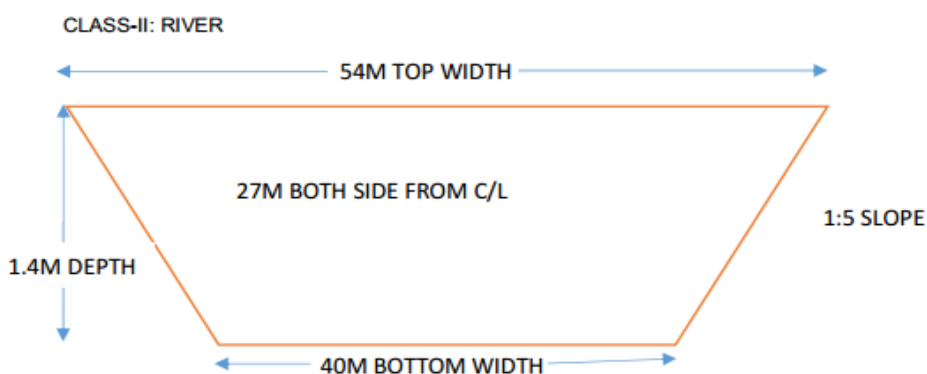
5.2 Calculation of Dredging Quantity The dredge volume calculations were accomplished using the HYPACK dredge volume computation utility. For clarity and ease of calculations, the complete channel profile was divided into segments of 1 km each (enclosed at Annexure-2). The Tin v/s Channel volume with Hypack Standard algorithm was used to calculate the dredge volume. The stretch wise summary of the dredge volume for a different class of fairway is as follows: -

1) 30m x 1.2m with side slope 1:5, along the deepest route.



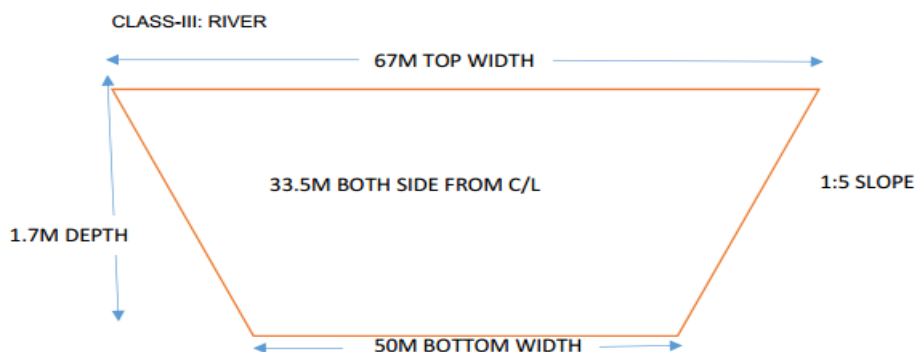
CLASS - I											
Chainage (km)		Observed					Reduced w.r.t Sounding Datum				
From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty (Cu.m)	Cumulative Drg. Qty. (cu.m)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty (Cu.m)	Cumulative Drg. Qty. (cu.m)
Ch.0 Todarpur	Ch.25 Khangaon	0.0	7.0	10,200.00	2,56,954.29	2,56,954.29	-0.3	6.9	13,700.00	4,43,102.39	4,43,102.39
Ch.25 Khangaon	Ch.50 Narainganj	0.0	4.1	15,800.00	6,46,102.72	9,03,057.01	-0.3	1.5	24,050.00	11,68,531.19	16,11,633.58
Ch.50 Narainganj	Ch.75 Mathiya	0.0	2.5	20,050.00	7,39,809.54	16,42,866.55	-0.3	-0.3	25,000.00	13,03,112.95	29,14,746.53
Ch.75 Mathiya	Ch.100 Mahadewa	0.0	3.1	18,000.00	7,25,249.31	23,68,115.86	-0.3	2.4	22,150.00	10,78,309.03	39,93,055.56
Ch.100 Mahadewa	Ch.125 Bagahi	0.0	2.3	17,750.00	7,26,463.41	30,94,579.27	-0.3	1.5	23,400.00	10,98,956.64	50,92,012.20
Ch.125 Bagahi	Ch.141 Indrapuri Barrage	0.0	3.3	10,600.00	3,80,646.42	34,75,225.69	-0.3	-0.3	16,000.00	8,42,303.98	59,34,316.18

2) 40m x 1.4m with side slope 1:5, along the deepest route.



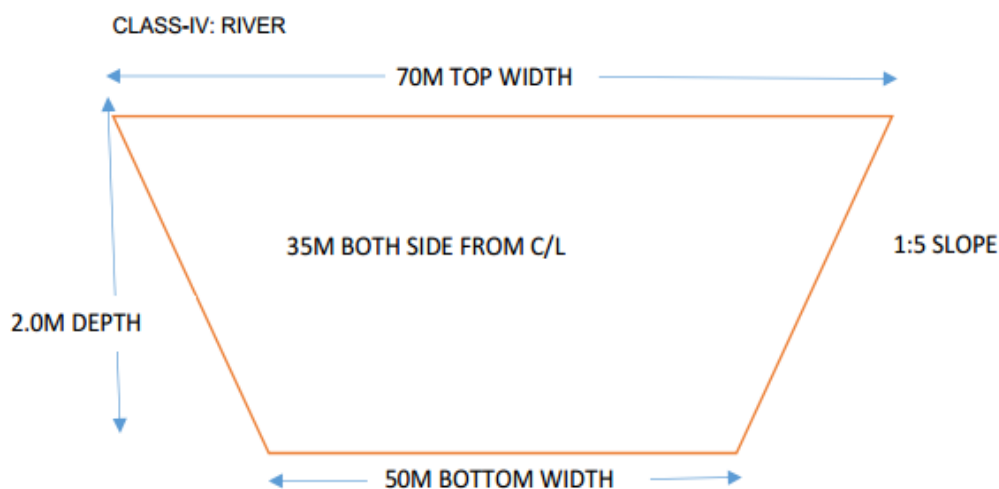
CLASS - II											
Chainage (km)		Observed					Reduced w.r.t Sounding Datum				
From	To	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty (Cu.m)	Cumulative Drg. Qty. (cu.m)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty (Cu.m)	Cumulative Drg. Qty. (cu.m)
Ch.0 Todarpur	Ch.25 Khangaon	0.0	7.0	12,650.00	5,02,107.45	5,02,107.45	-0.3	6.9	15,600.00	7,61,085.30	7,61,085.30
Ch.25 Khangaon	Ch.50 Narainganj	0.0	4.1	16,500.00	10,07,008.86	15,09,116.31	-0.3	1.5	23,300.00	17,39,669.10	25,00,754.40
Ch.50 Narainganj	Ch.75 Mathiya	0.0	2.6	22,300.00	11,68,740.67	26,77,856.98	-0.3	1.1	25,000.00	19,28,149.34	44,28,903.74
Ch.75 Mathiya	Ch.100 Mahadewa	0.0	3.1	20,650.00	11,20,630.04	37,98,487.02	-0.3	2.4	23,100.00	16,19,804.77	60,48,708.51
Ch.100 Mahadewa	Ch.125 Bagahi	0.0	2.3	19,000.00	11,46,108.06	49,44,595.08	-0.3	1.5	23,500.00	16,61,492.76	77,10,201.27
Ch.125 Bagahi	Ch.141 Indrapuri Barrage	0.0	3.3	12,700.00	6,15,244.93	55,59,840.01	-0.3	1.3	16,000.00	12,43,269.56	89,53,470.83

3) 50m x 1.7m with side slope 1:5, along the deepest route.



CLASS - III											
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)	Cumulative Drg. Qty. (cu.m)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty (Cu.m)	Cumulative Drg. Qty. (cu.m)
Ch.0 Todarpur	Ch.25 Khangaon	0.0	7.1	15,050.00	9,57,855.10	9,57,855.10	-0.3	7.0	18,500.00	13,13,285.05	13,13,285.05
Ch.25 Khangaon	Ch.50 Narainganj	0.0	4.1	17,500.00	15,65,880.52	25,23,735.62	-0.3	1.5	25,000.00	25,93,252.65	39,06,537.70
Ch.50 Narainganj	Ch.75 Mathiya	0.0	2.6	23,000.00	18,45,075.16	43,68,810.78	-0.3	1.1	25,000.00	28,32,550.42	67,39,088.12
Ch.75 Mathiya	Ch.100 Mahadewa	0.0	3.1	19,900.00	17,51,045.93	61,19,856.71	-0.3	2.4	23,850.00	24,26,429.42	91,65,517.54
Ch.100 Mahadewa	Ch.125 Bagahi	0.0	2.3	24,100.00	18,39,206.44	79,59,063.15	-0.3	1.5	25,000.00	25,05,987.93	1,16,71,505.47
Ch.125 Bagahi	Ch.141 Indrapuri Barrage	0.0	3.3	12,800.00	9,93,221.92	89,52,285.07	-0.3	1.3	16,000.00	18,22,024.87	1,34,93,530.34

4) 50m x 2.0m with side slope 1:5, along the deepest route.



CLASS - IV											
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)	Cumulative Drg. Qty. (cu.m)	Min. Depth (m)	Max. Depth (m)	Length of Shoal (m)	Dredging Qty (Cu.m)	Cumulative Drg. Qty. (cu.m)
Ch.0 Todarpur	Ch.25 Khangaon	0.0	7.1	17,200.00	13,35,004.87	13,35,004.87	-0.3	7.0	18,700.00	17,26,675.94	17,26,675.94
Ch.25 Khangaon	Ch.50 Narainganj	0.0	4.1	18,450.00	19,45,755.40	32,80,760.27	-0.3	1.5	25,000.00	31,08,254.97	48,34,930.91
Ch.50 Narainganj	Ch.75 Mathiya	0.0	2.6	23,900.00	23,03,011.41	55,83,771.68	-0.3	1.1	25,000.00	33,57,606.01	81,92,536.92
Ch.75 Mathiya	Ch.100 Mahadewa	0.0	3.1	21,950.00	21,82,479.35	77,66,251.03	-0.3	2.4	23,850.00	29,20,925.17	1,11,13,462.09
Ch.100 Mahadewa	Ch.125 Bagahi	0.0	2.3	24,100.00	23,10,557.03	1,00,76,808.06	-0.3	1.5	25,000.00	30,21,404.94	1,41,34,867.03
Ch.125 Bagahi	Ch.141 Indrapuri Barrage	0.0	3.3	14,200.00	12,63,331.63	1,13,40,139.69	-0.3	1.3	16,000.00	21,56,352.63	1,62,91,220.00

SECTION – 6

6.1 Conclusion. The river corridor consists of a length of 141.00 km from Todarpur at Ganga confluence (Ch. 0 km) to Indrapuri barrage (Ch. 141.00 km). The whole river is non-tidal and is one of the tributary of Ganga. Sounding operation was carried out from Ch. 0 km to Ch. 26 km. Topographic survey was carried out from Ch. 0 km to Ch.141.00 km. Total length of the waterway is having different range of depths. In most of the stretches, shallow patches is very much prominent. Sand mining activity is also relevant by JCB, boats, tractors and tucks in the whole river. Canal system and pump house are also prominent for the irrigational purpose throughout the waterway. The dredging on the waterway will improve the depth of the channel for any navigational requirement. The River banks are well connected with the road network and are moderately connected with Railway Network. The road is near parallel on both sides throughout the river stretch.

The 133.8 km of river length is having depth below 1.2 m, 2.40 km of river length is having depth between 1.2 m to 1.4 m, 1.30 km of river length is having depth between 1.5 m to 1.7 m and 1.20 km of river length is having depth between 1.8 m to 2.0 m. The length of river having depth more than 2 m is 2.3 km only. There is only one barrage i.e. Indrapuri Barrage (Ch.141.0 km) exists in the Survey stretch. There are seven cross structures and six high-tension line exist in the waterway, which are presently in use. Minimum and maximum horizontal clearance of cross structures are 29.422m and 57.75m respectively. Minimum and maximum vertical clearances of cross structures are 2.859m & 7.615m wrt HFL respectively. Min & max vertical clearance of power cables are 18.0m & 25.0m wrt HFL respectively.

There is neither any protected area (Atomic/ Port/ Wildlife/ Research) nor any hindrance exist in the whole waterway. Information gather from local populace that the availability of maximum water is only during monsoon season. There is no cargo, passenger ferry and tourism facility is available in the river stretch. Both banks of the Sone River is very much fertile. Cultivation of wheat, mustard, peas, potato and carrot etc. has been noticed during the course of survey. Land along the river is mainly utilized for agricultural purpose. However, in some places, it is also used as residential purposes. The whole river stretch is well connected with the rail and road

networks within 3 to 5 Km. Prominent cities are Maner, Koilwar, Sahar, Arwal and Dehri on sone. There are no any ferry services in the present survey stretch. There is no water sport facility available in the whole river portion. There are no any tourism facilities are present in the whole river. Cities along the river viz. are Maner, Koilwar, Sahar, Arwal and Dehri on sone, etc. are well connected with both rail and road networks.

There is no terminal present in this waterway. However, development of terminals at Koilwar (Ch. 18.70 km) and Sone Nagar (Ch.130.20 km) seems viable. These places are well connected by rail and road networks. These proposed terminals will cater for passenger as well as cargo movement throughout the river.

The feasibility survey were carried out at river sone river (length 141 km) Todarpur, Ganga confluence (Ch. 0 km) to Indrapuri Barrage (Ch.141.0 km).The Dredging quantity being tabulated below: -

Class	Dredging. Qty. (cu.m)
Class I	59,34,316.18
Class II	89,53,470.80
Class III	1,34,93,530.34
Class IV	1,62,91,220.00

Average width of the surveyed river corridor is 300m – 500m and hence development of dredging channel as per Class III being recommended. It is not feasible to maintain a dredged channel due to repaid siltation. Sustainable navigational channel can be developed by augmenting RCC river wall on the both banks.

Consultant Recommendation

- Road are available on both the bank along the stretch and Rail network is available within 5km of river corridor.
- Significant sand mining activity may be observed along the entire stretch.
- No Ghats or ferry service is observed.
- Cargo study is suggested.