ACTION PLAN FOR BHARALU RIVER NEAR PRAGJYOTISH COLLEGE-PRIORITY I

1. Basic information about the Stretch

The river is a non- perennial one. Initially Bharalu River received perennial flow from Bahini River which originates from Khasi Hills of Meghalaya at Umtyrnga and travels a distance of 9.29 Km before confluence with Bharalu River at Jonali point. The width of the River is on an average 14 meters. Since last fifteen years (15) approx. the natural flow of Bahini River has been totally blocked at Natun Bazar area of Basistha Chariali locality with the help of sluice gate. The Bahini river then flows through Lalmati area near Water Resource department where it meets Basistha river and then finally travels as Basistha Bahini River finally to confluence with Deepor Beel. Bahini River from Bakrapara area in Basistha Chariali now becomes a sewerage drain as the natural flow is obstructed at Natun bazar area. It then travels below NH at Beltola and through major areas like AG office Road, Krishnapur, Saurabh Nagar, Rukminigaon, Downtown area, Ganeshguri, Hengerabari, Zoo Road and finally confluences with Bharalu River at Jonali point carrying all the city sewage including commercial sewage. There is no natural flow of the river at present and only the domestic sewage and commercial sewage are being carried away by the river. It is also observed that the river banks are being encroached specially from Sarabbhati area to the confluence point and hence at many places it is becoming narrower as a result of encroachment.

The total catchment area of the Bharalu is about 120 sq. km. which is almost equally divided between the hill region and the plains. It is estimated that the river drains an area of 10.94 sq. km. of the city. The catchment area has seen a very rapid urbanisation in recent years and the river has detoured to a large extent due to unabated encroachment and ever-increasing dumping of garbage into it. The velocity of flow in Bharalu River is estimated to be 1.07-1.37 m/sec. The Flood Control and irrigation Department of the Govt. of Assam has erected a sluice structure near the Pragjyotish College at Bharalumukh to regulate the discharge level, particularly to stop reverse flow from the Brahmaputra during high floods.

1.1. Polluted river stretch/length

The length of the polluted stretch of Bharalu River is 6.20 KM with an area of 109 sq.km. **(Fig 1).** The stretch identified as polluted is from Jonali point to Bharalumukh. The encroachment on the river banks are spreading due to which the width of the river is becoming narrower and shallower.

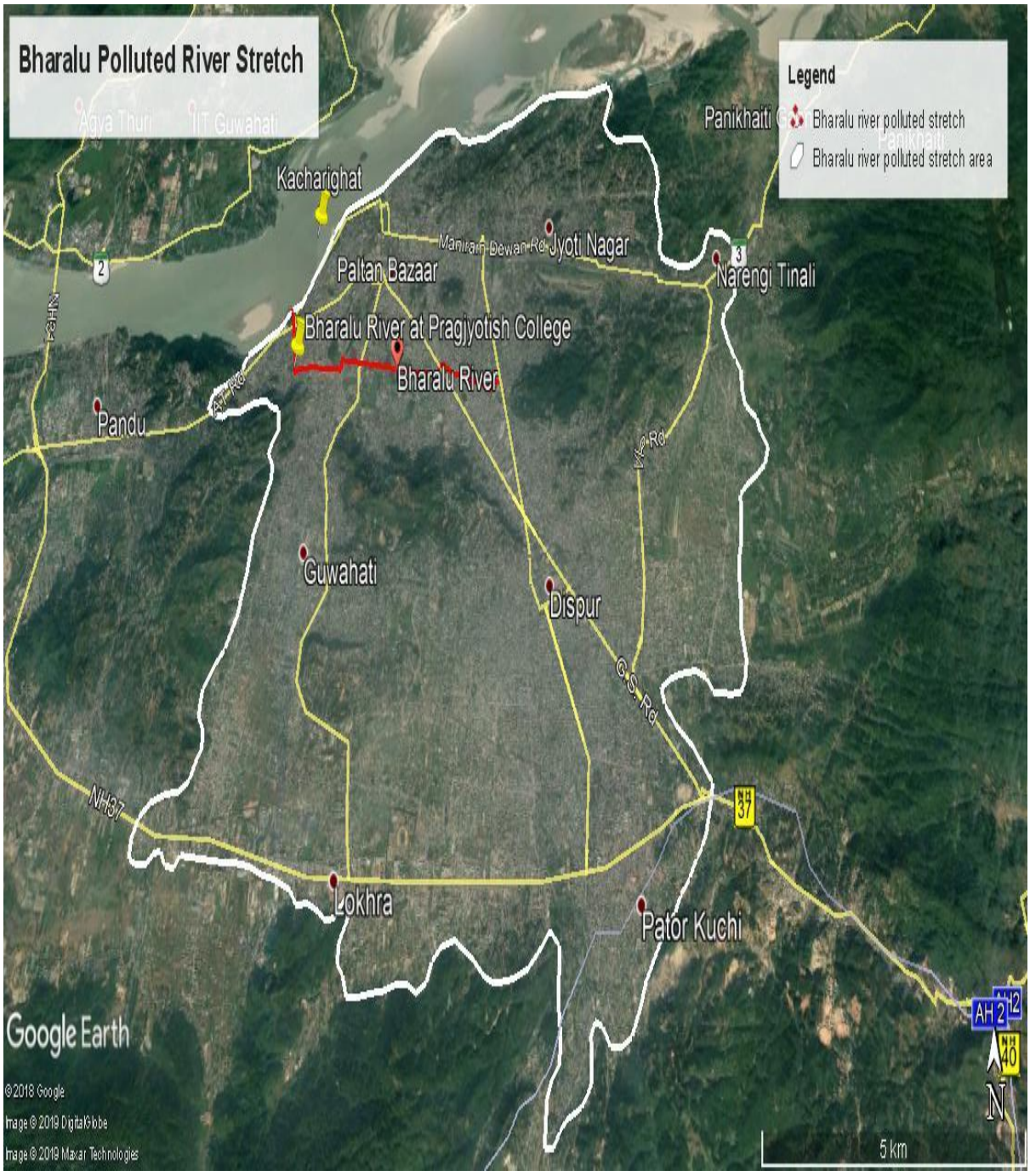

Fig 1: Map showing the polluted river stretch of Bharalu river

2. Background:

In compliance of the direction of Hon'ble National Green Tribunal, Principal Bench, New Delhi in the matter of news published in 'The Hindu' authored by Jacob Koshy, Titled 'More river stretches are now critically polluted CPCB', Government of Assam constituted River Rejuvenation Committee (RRC) vide memorandum 673/2018 dated 19/12/2018 for effective abatement of pollution, rejuvenation, protection and management of the identified polluted stretches, for bringing the polluted river stretches to be fit at least for bathing purposes within six months

3. Basis of Action Plan for Bharalu polluted river stretch

The action plan for rejuvenation, protection and management of the identified polluted river stretch of Assam has been prepared based on the following

- As per direction of Hon'ble National Green Tribunal, Principal Bench, New Delhi in the matter of news published in 'The Hindu' authored by Jacob Koshy, Titled 'More river stretches are now critically polluted CPCB'
- Comprehensive report on Prevention and Control of Pollution in River Hindon: An Action Plan for Rejuvenation' [Submitted in compliance to Hon'ble National Green Tribunal]

4. Components of Action Plan

(a) Industrial Pollution Control

- Inventorisation of industries
- Categories of industry and effluent quality
- Treatment of effluents, compliance with standards and mode of disposal of effluents
- Regulatory regime.

(b) Identification, Channelization, Treatment and Utilization of Treated Domestic Sewage

- Identification of towns in the catchment of river

- Town-wise Estimation of quantity of sewage generated and existing sewage treatment capacities to arrive at the gap between the sewage generation and treatment capacities;
- Identification of towns for installing sewerage system and sewage treatment plants.
- Storm water drains now carrying sewage and sullage joining river and interception and diversion of sewage to STPs,
- Treatment and disposal of septage and controlling open defecation.

(c) River catchment/Basin Management-Controlled ground water extraction and periodic quality assessment

- Periodic assessment of groundwater resources and regulation of ground water extraction by industries particularly in over exploited and critical zones/blocks.
- Ground water re-charging /rain water harvesting
- Periodic ground water quality assessment and remedial actions in case of contaminated groundwater tube wells/bore wells or hand pumps.
- Assessment of the need for regulating use of ground water for irrigation purposes.

(d) Flood Plain Zone

- Regulating activities in flood plain zone.
- Management of Municipal, Plastic, Hazardous, Bio-medical and Electrical and Electronic wastes.
- Greenery development- Plantation plan.

(e) Ecological/Environmental Flow (E-Flow)

- Issues relating to E-Flow
- Irrigation practices

(f) Such other issues which may be found relevant for restoring water quality to the prescribed standards.

5. **Action Plan as per direction of Hon'ble NGT**

The components to be discussed in the action plan for rejuvenation, protection and management of identified polluted stretch of Bharalu river are as follows

5.1. Industrial Pollution Control

Classified industrial units are observed with infrastructural facilities (ETPs, STPs) in the periphery of 109 sq. km of the polluted river stretch along with other industrial establishments.

Further directions were issued by the PCBA to all the industrial units which has failed to comply with the discharged norms. Moreover, the Board has also issued direction to build their own set up in their premises which do not have STP/ETP.

The classified industry details situated at the radius of the polluted river stretch is presented at **Table I.**

Table I: Industry Details as per the following of the Bharalu polluted river stretch

S.N	Name of the Industry	Category	Total Water Consumption (KLD)		Waste water generation in KLD	Without consent / Directions issued	ETPs	CETPs		OCEMS	Gaps KLD
			GW	Supplied Water				Existing	Proposed		
1	Guwahati Refinery , IOCL	17 -Category (Petroleum Refinery)	NIL	11283 (River Brahmaputra)	5032	Consent granted	Installed; as per records 5032 KLD of Effluent is treated and reused.	NIL	NIL	Installed	NIL
2	DIESEL SHED, NEW GUWAHATI	RED(Railway Locomotive workshop)	1.1	NIL	1.1	Under process (on query) Inspection to be done.	Functional	NIL	NIL	N/A	NIL
3	Guwahati Medical College & Hospital, Bhangagarh, Guwahati	Red	NIL	350	280	Under Process	STP Functional	NIL	NIL	N/A	NIL
4	Kiranshree, Athgaon.	Green	2	NIL	1.5	Granted	Functional	NA	NA	NA	NIL
5	Monsoon Polymers, City Complex, Kalapahar.	Orange	5	NIL	4	Granted	Functional	NA	NA	NA	NIL
6	Assam Dyeing Works, Cycle Factory, Kalapahar.	Red	2.5	NIL	2	Granted	Functional	NA	NA	NA	NIL

S.N	Name of the Industry	Category	Total Water Consumption (KLD)		Waste water generation in KLD	Without consent / Directions issued	ETPs	CETPs		OCEMS	Gaps KLD
			GW	Supplied Water				Existing	Proposed		
7	Panacea Diagnostic Centre, Rajgarh, Ghy.	Orange	1	NIL	0.8	Not applied	Functional	NA	NA	NA	NIL
8	Hotel Asian Palace, Ulubari, Ghy.	Green	4	NIL	3.2	Under process	Functional	NA	NA	NA	NIL
9	Sanjay Products, Fatashil Ambari.	Orange	1.5	NIL	1	Granted till 31.03.2019	Functional	NA	NA	NA	NIL
10	Goenka Nursing Home, Bharalumukh, Ghy.	Orange	30	NIL	30	Under process	Functional	NA	NA	NA	NIL
11	Kumar's Nursing Home, Kumarpara.	Orange	10	NIL	10	Under process	Functional	NA	NA	NA	NIL
12	Rapid Diagnostics, Sarabhati.	Orange	0.2	NIL	0.16	Not applied	Functional	NA	NA	NA	NIL
13	Rosa Restaurant,	Green	3	NIL	2.4	Under process	Not installed. Direction issued	NA	NA	NA	2.4
14	Makhan Bhog, Ulubari.	Green	5	NIL	4.5	Not applied	Functional	NA	NA	NA	NIL
15	Woodland Marriage Hall, Ulubari.	Green	5	NIL	4.5	Not applied	Not installed. Direction issued	NA	NA	NA	4.5
16	Signature Estate (Assam Plywood)	Red	120	NIL	100	Granted	STP Provided	NA	NA	NA	NIL

S.N	Name of the Industry	Category	Total Water Consumption (KLD)		Waste water generation in KLD	Without consent / Directions issued	ETPs	CETPs		OCEMS	Gaps KLD
			GW	Supplied Water				Existing	Proposed		
17	RK Life Services Pvt. Ltd. Apollo Clinic, Bora Service.	Orange	1	NIL	1	Under process	Functional	NA	NA	NA	NIL
18	Nemcare Hospital Pvt. Ltd. Bhangagarh, Ghy.	Orange	50	NIL	45	Granted	Functional	NA	NA	NA	NIL
19	Nemcare Hospital, Bhangagarh, Ghy.	Orange	60	NIL	52	Granted	Functional	NA	NA	NA	NIL
20	Pulse Diagnostic, Bhangagarh, Ghy.	Orange	1	NIL	0.8	Under process	Functional	NA	NA	NA	NIL
21	Primus Diagnostic, Bhangagarh, Ghy.	Orange	1	NIL	0.8	Under process	Functional	NA	NA	NA	NIL
22	Alcare Diagnostic, Lalganesh, Guwahati-34	Orange	3	NIL	2.4	Not applied	Functional	NA	NA	NA	NIL
23	Orthodontic Clinic, Bhangagarh, Ghy.	Orange	1	NIL	0.8	Granted	Functional	NA	NA	NA	NIL
24	Health Care Diagnostic, Bhangagarh, Ghy.	Orange	0.6	NIL	0.5	Under process	Functional	NA	NA	NA	NIL
25	Aruna Memorial Hospital, Bhangagarh, Ghy.	Orange	15	NIL	12	Under process	Functional	NA	NA	NA	NIL
26	Apex Diagnostic, Bhangagarh, GMCH Road, Royal Market, Guwahati – 05	Orange	1	NIL	0.8	Under process	Functional	NA	NA	NA	NIL

S.N	Name of the Industry	Category	Total Water Consumption (KLD)		Waste water generation in KLD	Without consent / Directions issued	ETPs	CETPs		OCEMS	Gaps KLD
			GW	Supplied Water				Existing	Proposed		
27	K.N. Baruah (Bids), Roodraksh Mall, Ghy.	Orange	0.4	NIL	0.3	Granted	Functional	NA	NA	NA	NIL
28	Midland Hospital, RG Baruah Road, Ghy.	Orange	10	NIL	9	Under process	Functional	NA	NA	NA	NIL
29	Exotica Greens, RG Baruah Road, Ghy.	Orange	50	NIL	45	Not applied	STP Provided	NA	NA	NA	NIL
30	Hariyana Bhawan, R.K.S. Chowdhury, Narayan Nagar, Bharalumukh, Ghy-9.	Green	5/during marriage party	NIL	5	Not applied	Not installed. Direction issued	NA	NA	NA	5
31	East India Haemotological Laboratory, Rudraksh Mall, Near Big Bazar, G.S. Road, Bhangagarh, Guwahati-05.	Orange	0.4	NIL	0.3	Under process	Functional	NA	NA	NA	NIL
Total			**389.7 KLD**	**11633 KLD**	**5652.86 KLD**						**11.9 KLD**

Following are the suggestions for control of industrial pollution control

- The industry that will extract groundwater for manufacturing process should not operate unless they possess valid permission for groundwater extraction from Central Ground Water Authority.
- No industries should discharge their effluent directly into drains without treatment, rather they should reuse their treated effluent/sewage.
- Direction to be issued to the units which are not complying to the effluent discharge norms as per Section 5 of the Environment (Protection) Act, 1986, by PCBA for ensuring compliance to the discharge norms.

6. Identification, Channelisation, Treatment and Utilization of Treated Domestic Sewage

6.1. Major towns located on the bank

Guwahati is the major city located on the bank of the Bharalu river. The approximate population of the Guwahati (Metro) is 655000 as per Census 2011 in the demarcated catchment area of Bharalu river including the floating population. The major localities identified in and around the catchment areas are Tarun Nagar, Anil Nagar, Nabin Nagar, Bhangagarh, Ulubari, Sarabbhatti, Bishnupur, Athgaon, Fatashil Ambari, Kumarpara and Bharalumukh. .

6.2. Town wise estimation of quantity of sewage generated and existing sewage treatment capacities

The major town responsible for contribution of sewage in the Bharalu river is Guwahati City. The sewage generated by the Guwahati city at present is around **70740** KL per day.

6.3. Identification of towns for installing sewerage system and sewage treatment plants.

As per the survey done three (03) STPs has been proposed at Guwahati city in consultation with the District Administration.

1	No. of STPs	03 Nos.
2	Capacity of STP	15 MLD, 25 MLD and 35 MLD Total= 75 MLD
3	Identification of town/place for Installation of STPs	1. At Jonali point 2. Another near the confluence of Borsola with Bharalu River at Sarabbhati area. 3. One at just before confluence with Brahmaputra river at Bharalumukh

Sewage generation and gaps in treatment are presented in **Table II &III** below.

Table II: Sewage generation and gaps in treatment at present

S.N	Area	Population as per 2011 census including floating population	Water Consumption (KLD) @135 lpcd	Sewage Generation (KLD)	No. of STPs Proposed	Existing Treatment capacity (KLD)	Gaps in KLD
1	**Catchment area of Bharalu river**	**655000**	**88425**	**70740**	**03**	**NIL**	**70740**

Table III: Total gap in projected population and sewage generation till 2030

S.N	Area	Projected Population till 2030	Water Consumption (KLD) @135 lpcd	Sewage Generation (KLD)	No. of STPs Proposed	Existing Treatment capacity (KLD)	Gaps in KLD
1	**Catchment area of Bharalu river**	**695000**	**93825**	**75060**	**03**	**NIL**	**75060**

At present the Bharalu catchment area is over populated. There is no any land availability for future human settlement and expansion within the periphery of the catchment area.

6.4. Water Quality of the river stretch

There is one (01) sampling location of Bharalu River at Guwahati Metro district under NWMP as per the following

Table IV: Monitoring Locations Details

Sampling Location	Coordinates
Bharalu river near Pragjyotish College	26°10'3.35" N 91°43'52.38" E

The change in the water quality of Bharalu river in terms of BOD value for the period 2016-2019 is presented below:

Table V: BOD value in mg/l of Bharalu river from the year January, 2016-April, 2019

Year	BOD Value (mg/l)	Year	BOD Value (mg/l)	Year	BOD Value (mg/l)	Year	BOD Value (mg/l)
Jan-16	35.0	Jan-17	24.6	Jan-18	24.2	Jan-19	18.0
Feb-16	52.0	Feb-17	32.0	Feb-18	17.0	Feb-19	38.0
Mar-16	32.0	Mar-17	38.0	Mar-18	33.0	Mar-19	48.0
Apr-16	20.0	Apr-17	18.0	Apr-18	32.0	Apr-19	54.0
May-16	12.7	May-17	17.8	May-18	18.0		
Jun-16	34.0	Jun-17	28.2	Jun-18	20.0		
Jul-16	22.0	Jul-17	6.0	Jul-18	18.0		
Aug-16	8.2	Aug-17	8.0	Aug-18	26.0		
Sep-16	9.0	Sep-17	12.0	Sep-18	14.0		
Oct-16	29.0	Oct-17	8.4	Oct-18	9.3		
Nov-16	20.4	Nov-17	26.0	Nov-18	36.0		
Dec-16	20.1	Dec-17	42.0	Dec-18	16.0		

The detail analytical data of the Bharalu river for the month of April 2019 are presented in **Table VI**

Table VI: Latest analysis report of Bharalu river near Pragjyotish College- April 2019

Parameter	Value
D.O. (mg/L)	Nil
pH	7.3
Cond(µS/cm)	542
BOD(mg/L)	54
COD(mg/L)	98
NO_3 -N (mg/L)	2.6
TSS (mg/L)	118
Turbidity (NTU)	6
p-Alkalinity (mg/L)	0
m-Alkalinity (mg/L)	74

Parameter	Value
Hardness (mg/L)	108
Calcium as $CaCO_3$(mg/L)	74
Magnesium as $CaCO_3$ (mg/L)	34
Chloride as Cl- (mg/L)	52
Sulphate as SO_4^{-2} (mg/L)	54.2
Phosphate as PO_4 (mg/L)	0.9
TKN (mg/L)	11.5
NH_4-N (mg/L)	3.94
Total Dissolved Solids (mg/L)	326
TFS (mg/L)	82
Fluoride (mg/l)	0.59
Boron (mg/l)	0.027
Na (mg/L)	65.5
K (mg/L)	18.8
Total Iron (mg/L)	0.58
Lead (mg/L)	0.018
Zinc (mg/L)	0.055
Copper (mg/L)	0.008
Total Chromium (mg/L)	BDL
Nickel (mg/L)	BDL
Cadmium (mg/L)	BDL
Mercury (mg/L)	BDL
Arsenic(mg/L)	0.01
Total Coliform (MPN/100ml)	5300
Faecal Coliform (MPN/100ml)	4200

The above data indicated that the BOD load is above 3 mg/l on all the occasion. This is due to the discharge of untreated sewage directly in to the river.

6.5. Drains contributing to pollution

There were almost 39 outfalls identified in the entire stretches of Bharalu River from its origin at Jonali point up to Bharalumukh and these outfalls are either domestic or commercial. Besides, there are many small household drains which discharges the waste water directly in to the Bharalu River. The details of the drains/outfalls are presented in **Table VII** and photographs were shown from Figure 2 to Figure 14.

Table VII: Major drains/ outfall contributing to the pollution load of Bharalu River

S.N	Major drains/ outfall	Locality/area	No. of Drains
1	Major outfall at the origin of Bharalu river at Jonali Bridge consists of a) One drain is coming from Refinery, Locoshed area b) Other is coming from Bahini River which itself is a sewarage drain. c) Two drains are from domestic sewerage	Jonali	04 Nos.
2	Another drain just about 300 m away from the origin of Bharalu River. 06 more drains /Sluice gate near Tarun Nagar bridge.	Tarun Nagar	07 Nos.
3	Major drain at Anil Nagar Pump house	Anil Nagar	01 No
4	From Rajgarh Bridge to Kanaklata Bridge	Rajgarh	08 Nos.
5	At Kanaklata Bridge one Major outfall from Bhangagarh area	Rajgarh	01 No.
6	Below Bhangagarh Bridge at GS Road 02 Nos. are from Ulubari end and 01 drain from Bhangagarh end	Bhangagarh	03 Nos.
7	One major commercial outfall from Borthakur Mill area in the backside of ASTC workshop, Rupnagar	Rupnagar	01 Nos.
8	Major commercial outfall near Maajhar, Ulubari from Assam Police Radio Organisatio (APRO)	Ulubari	01 No.
9	One commercial outfall from B K Kakoti Road below Ulubari Agriculture campus wooden bridge. One more outfall from the premises of agriculture campus, Ulubari	Ulubari	02 Nos.
10	Outfall at the starting of R K Mission Road, Ulubari below the bridge	Ulubari	02 Nos.
11	At Sarabbhati Chariali, One outfall from Arya Nagar and another major outfall from Rehabari	Sarabbhati	02 Nos.
12	Major outfall at sarabbhati	Sarabbhati	01 No.
13	Major outfall at Athgaon from Fakirtola inner drain	Athgaon	01 No.
14	Commercial outfall from Kumarpara area	Kumarpara	02 Nos.
15	Major outfall from Shantipur area near Bharalumukh Sluicegate	Bharalumukh	01 No.
16	Major outfall from Kumarpara area near Bharalumukh railway crossing	Bharalumukh	01 No.
17	Major outfall from A T Road at Bharalumukh Chowk	Bharalumukh	01 No.

Photographs of the outfalls.

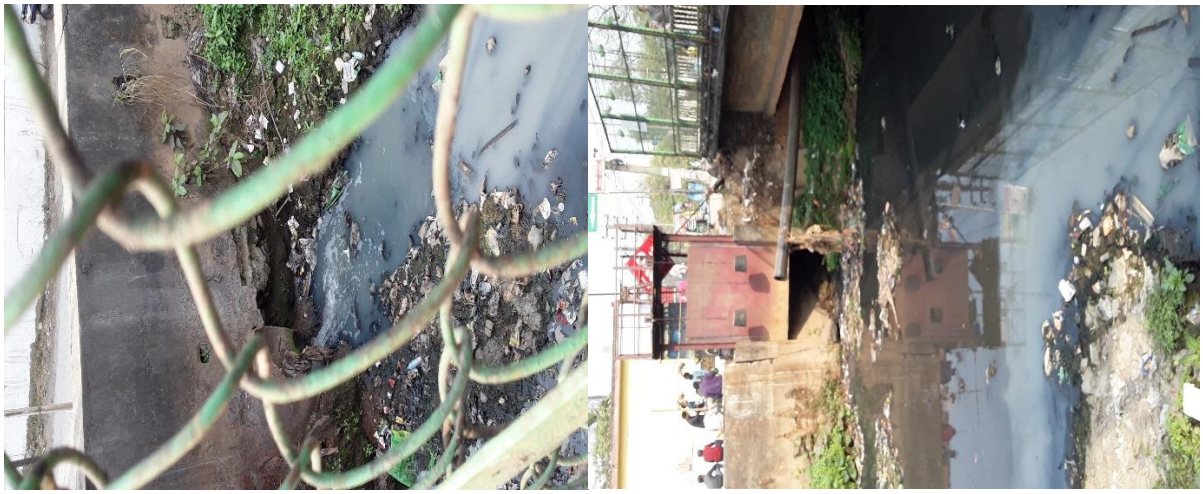

Fig.2: Two outfall at Jonali point

Fig 3. Outfall at Tarun Nagar area

Fig.4 Anil Nagar outfall

Fig.5 Rajgarh outfall

Fig:6 Bhangagarh outfall

Fig.7 Maajhar outfall

Fig.8 Ulubari outfall

Fig.9 R K Mission Road outfall

Fig.10 Sarabbhatti Chariali

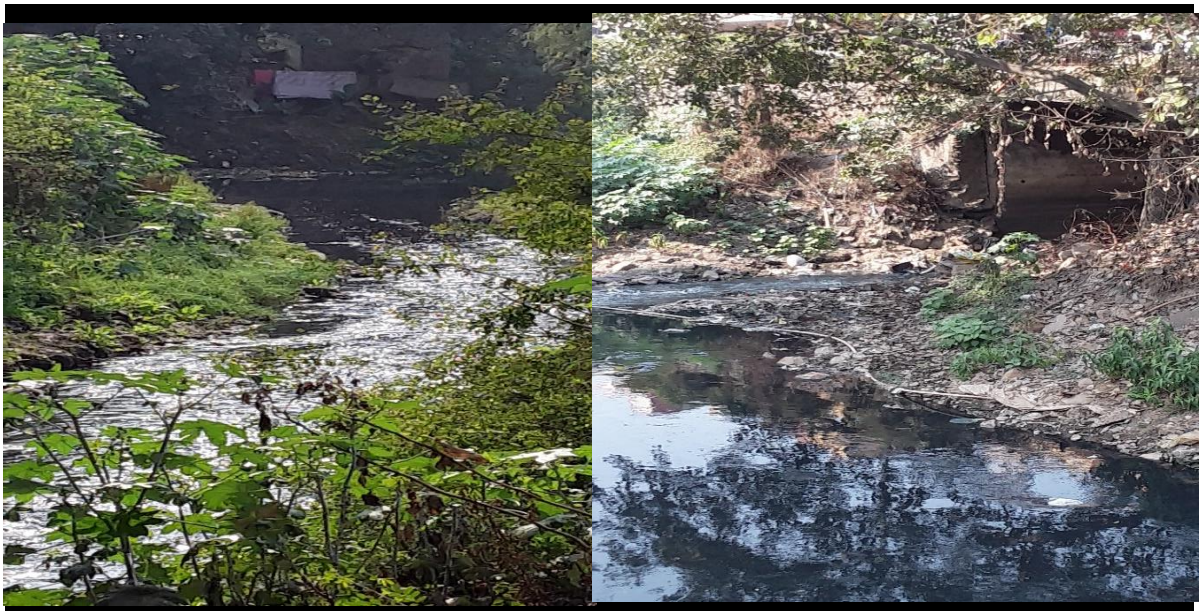

Fig.11 Borsola & Sorusola Beel outfall

Fig.12 Fakirtola Inner drain outfall

Fig.13 Shantipur area outfall at Bharalumukh

Fig.14 AT Road outfall at Bharalumukh

6.6. Characteristics of the major drains

The drains mainly carries commercial, industrial as well as residential wastes. Direct dumping of residential and commercial garbage into the channel is making it shallower and heavily silted. As a result, during rainy season water overflows and inundates the areas. It is also observed that the drains of the town are also becoming a regular garbage-dumping site. The water quality of the major drains are presented in **Table VIII** below:

Table: VIII Analytical data of the drains outfalling in Bharalu River

Source	D.O. (mg/L)	pH	Cond(µS/L)	BOD(mg/L)	COD(mg/L)	NO_3-N (mg/L)	TSS (mg/L)	Turbidity (NTU)	p-Alkalinity (mg/L)	m-Alkalinity (mg/L)	Total Hardness (mg/L)	Calcium as $CaCO_3$(mg/L)	Magnesium as $CaCO_3$ (mg/L)	Chloride as Cl^- (mg/L)	Sulphate as SO_4^{-2} (mg/L)	Phosphate as PO_4 (mg/L)	TKN (mg/L)	NH_4-N (mg/L)	Total Dissolved Solids (mg/L)	TFS (mg/L)	Fluoride (mg/l)	Boron (mg/l)	Na (mg/L)	K (mg/L)	T-Fe (mg/L)	Lead as Pb (mg/L)	Zinc as Zn (mg/L)	Copper as Cu (mg/L)	Chromium as Cr(T) (mg/L)	Nickel as Ni (mg/L)	Cadmium as Cd (mg/L)	Mercury as Hg (mg/L)	Arsenic as As (µg/L)	Total Coliform (MPN/100ML)	Faecal Coliform (MPN/100ML)
Water from refinery locoshed area drain before confluence with Bharalu river at Jonali	NIL	7.3	585.0	56.0	146.8	2.8	126.0	8.0	NIL	284.0	182.0	122.0	60.0	62.0	38.0	1.4	13.6	4.2	378.0	92.0	0.56	0.032	48.8	15.9	0.58	0.022	0.058	0.010	BDL	BDL	BDL	BDL	0.010	95000	7500
Water from drain at Jonali before confluence with Bharalu river.	NIL	7.5	594.0	54.0	142.2	3.0	136.0	12.0	NIL	286.0	178.0	116.0	62.0	64.0	28.4	1.9	14.0	4.4	382.0	94.0	0.59	0.030	52.6	19.4	0.66	0.024	0.056	0.008	BDL	0.002	BDL	BDL	0.008	110000	21000
Water from drain after confluence with Bharalui River at Jonali	NIL	7.3	634.0	58.0	156.4	3.3	120.0	10.0	NIL	298.0	200.0	144.0	56.0	60.0	36.6	2.5	13.8	4.2	410.0	98.0	0.56	0.034	58.6	18.2	0.74	0.026	0.062	0.006	BDL	0.004	0.002	BDL	0.010	29000	21000
water from drain before confluence with Bharalu river at Ulubari Mazar	NIL	7.4	653.0	54.0	152.6	3.1	128.0	8.0	NIL	320.0	216.0	144.0	72.0	72.0	31.3	2.1	13.4	4.0	422.0	102.0	0.54	0.028	52.8	16.4	0.56	0.022	0.054	0.010	BDL	BDL	0.002	BDL	0.008	5300	3600
Water from Sarabbhati drain before confluence with Bharalu river at Sarabbhati	NIL	7.4	584.0	56.0	150.8	2.8	136.0	10.0	NIL	224.0	174.0	112.0	62.0	60.0	38.2	2.1	13.6	4.1	374.0	92.0	0.58	0.0	58.2	14.6	0.62	0.028	0.066	0.010	BDL	0.006	BDL	BDL	0.010	21000	15000
Water from Bishnupur drain after confluence with Bharalu river at Bishnupur	NIL	7.4	534.0	50.0	144.8	1.7	130.0	6.0	NIL	256.0	164.0	102.0	62.0	56.0	26.8	1.5	13.8	4.2	344.0	84.0	0.52	0.0	49.3	17.2	0.58	0.026	0.058	0.008	BDL	0.004	0.004	BDL	0.010	110000	21000

6.7. Flow details of the major drains contributing to river pollution

The flow details of major drains are presented in **Table IX** below:

Table IX: Flow Details of the Major drains out falling in Bharalu River

S.No	Major Drains/Outfall of the Bharalu River	Type of liquid waste	Flow details of the major drains/outfalls (m^3/s)	Flow details of the major drains/outfalls (MLD)
1	Refinery locoshed area drain before confluence with Bharalu river at Jonali	Commercial & Domestic	0.22	19.1
2	Drain at Jonali before confluence with Bharalu river.	Domestic	0.05	4.32
3	Drain after confluence with Bharalui River at Jonali	Domestic	0.03	2.60
4	Drain before confluence with Bharalu river at Ulubari Mazar	Domestic	0.18	15.56
5	Sarabbhati drain before confluence with Bharalu river at Sarabbhati	Domestic	0.14	12.1
6	Bishnupur drain after confluence with Bharalu river at Bishnupur	Domestic	0.09	7.8
7	Other minor drains	Domestic	Cumulative flow	10.0 (Approx.)
Total				**71.48 MLD**

6.8. Sewage generation from the towns located on the banks of the polluted river

The main contributor of pollution in the river is municipal sewage besides commercial and industrial wastes. There are no treatment systems for the sewages at present. Drains are directly connected to the Bharalu river there by

finding its way to Brahmaputra river without treatment. Moreover, Sewage treatment facility has not been set up yet in Assam.

6.9. Number of Sewage treatment plants present and treatment capacity, and gaps

There is no any sewage treatment plant at present. The gaps in sewage treatment capacity is **71 MLD** at present and up to 2030 it is estimated to be **75 MLD**

6.10. Number of STPs proposed and capacity

As per the survey report on Bharalu river, three (3) numbers of STPs have been proposed along the bank of River Bharalu are at Jonali point, another near the confluence of Borsola with Bharalu River at Sarabbhati area and the last one at just before confluence with Brahmaputra river at Bharalumukh. In this regard, Prinicipal Secretary to the Govt. of Assam, Guwahati Development Department has directed Guwahati Municipal Corporation on 11.04.2019 to prepare Detailed Project Report (DPR) for the installation of STPs.

6.10. Interception and diversion of drains /in situ treatment given

03 numbers of STPs have been proposed along with interceptor drains for in situ treatment before outfall.

6.11. Drainage system/ sewerage network present/proposed

There is no sewerage system at present. In this project 3 numbers of STPs along with interceptor drains for collection of the sewage of the basin has been proposed. All the sewage of the catchment area of the river shall be collected by interceptor drains and shall be treated in the proposed STPs.

6.12. Treatment and Disposal of Septage and controlling Open Defecation

Some of the households in the towns are equipped with ordinary septic tanks and the slum dwellers in the catchment areas of the river have kuccha latrines. However, around 2914 toilets have been constructed in the Kamrup metro district under Swachh Bharat Abhiyan to achieve open defecation free area.

6.13. Short term measures

- In- situ treatment of sewage by Bioremediation.
- Dosing of microbes near the drain outfall of all the drains.

- Strict vigilance of the industries to check that no industrial effluent is out falling in the drains.

Following remedial actions will be taken in consideration of treatment and disposal of sewage

- Sewage Treatment plant should be installed for treatment
- Every individual households should be connected to sewer lines.
- Roadside hotels/restaurants should not be allowed to dispose untreated sewage and solid waste into the nearby drains or rivers. These establishments should be properly regulated by the concerned authority.
- Public awareness to control open defecation and understand the sanitary hygiene.
- Local administration should provide proper pucca toilets for the individuals or atleast community toilets through the IHHL scheme under Swachh Bharat Mission.

7. Controlled Ground water Extraction and quality Assessment

About 49% of the households rely on tube well to obtain potable water. Very few numbers of the population owns earthen well whereas some of them depends on both supplied water as well as concrete well.

The details of estimated ground water resource in Kamrup district is presented below in **Table X**

Table X: Estimation of ground water resource in the Kamrup district

Ground water extraction details	Ground water	Irrigation Practices	Ground water recharging mechanism	Rain water harvesting
Gross Ground Water Draft	1487.29 mcm	Minor and medium irrigation schemes such as DTW and STW.	Recharging of ground water are done by creation of Pond/lakes/reservoirs under government schemes.	➢ The roof top rainwater harvesting is practiced in Government buildings, School and Offices.
Net Ground Water Availability	715.97 mcm			
Stage of Ground Water Development	43%			

Ground water extraction details	Ground water	Irrigation Practices	Ground water recharging mechanism	Rain water harvesting
Existing draft for Irrigation Use	586 mcm			➢ Industries should be encouraged for roof top rain water harvesting.
Future provision for Domestic & Industrial Use	105.16 mcm			

The Kamrup district is still under 'Safe' category and sufficient resources are still available for future development

7.1. Status of Ground Water

The water quality is found to be well within the permissible limit for drinking, irrigation and industrial purposes. Due to slightly higher content of iron in some sporadic patches of the area and fluoride content exceeding permissible limit in some pockets in and around Guwahati City, water needs to be treated before being used for drinking purpose.

7.2. Ground water Quality of Shantipur area under NWMP (Catchment of River Bharalu)

Table XI: Latest analysis report of Ground water from Shantipur area- May 2019 (Under NWMP)

Parameter	Value
pH	6.8
Cond(µS/cm)	193
BOD(mg/L)	2.7
COD(mg/L)	5.4
NO_3 -N (mg/L)	0.7
TSS (mg/L)	20
Turbidity (NTU)	6
p-Alkalinity (mg/L)	NIL
m-Alkalinity (mg/L)	84
Hardness (mg/L)	62
Calcium as $CaCO_3$(mg/L)	40
Magnesium as $CaCO_3$ (mg/L)	22
Chloride as Cl- (mg/L)	22

Parameter	Value
Sulphate as SO_4^{-2} (mg/L)	14.5
Phosphate as PO_4 (mg/L)	0.6
Total Dissolved Solids (mg/L)	116
TFS (mg/L)	28
Fluoride (mg/l)	0.6
Boron (mg/l)	0.028
Na (mg/L)	1.2
K (mg/L)	0.4
Total Iron (mg/L)	0.56
Lead (mg/L)	BDL
Zinc (mg/L)	0.138
Copper (mg/L)	0.006
Total Chromium (mg/L)	BDL
Nickel (mg/L)	BDL
Cadmium (mg/L)	BDL
Mercury (mg/L)	BDL
Arsenic(mg/L)	0.004
Total Coliform (MPN/100ml)	NIL
Faecal Coliform (MPN/100ml)	NIL

7.3. Remedial Actions

The following remedial actions will be taken in consideration of contaminated ground water sources, controlled ground water extraction and periodic quality assessment

- Ground water of deeper aquifers should be analyzed for periodic assessment of element like Arsenic, Fluoride, Iron etc.
- Alternate sources of drinking water should be explored and prioritized.
- Awareness campaigns about health hazards due to intake of excessive Arsenic, Fluoride are the need of the time.
- Role of pesticides used for agricultural activity should be carefully observed.
- Survey should be conducted regarding ground water uses by different categories such as domestic, Industries etc. and also to identify the over exploited and critical areas in the river stretches with respect to ground water extraction.
- Effective management of industrial effluent or sewage for preventing contamination of ground water sources.

- The industry that will extract groundwater for manufacturing process should not operate unless they possess valid permission for groundwater extraction from Central Ground Water Authority.
- Strict vigilance and conducting inspection of the industries to rule out any forceful treated effluent injection in to ground water resources.
- Roof top rain water harvesting techniques should be encouraged for industrial, commercial or individual households and community.

8. Flood Plain Zone

The following are the identified flood prone area for the polluted river stretch

Name of River	Flood plain areas
Bharalu River	Tarun Nagar, Anil Nagar, Nabin Nagar, Bhangagarh, Ulubari, Sarabbhatti, Bishnupur, Athgaon, Fatashil Ambari, Kumarpara and Bharalumukh. .

8.1. Regulating activities in the Flood Plain Zone

The following activities need to be regulated in the flood plain zones.

S.No	Action points	Responsible authority
1	Plantation in the flood plain zone	Forest Department
2	Checking Encroachment	Local administration
3	Demarcation of the flood plain zone	Water Resource Department
4	Prohibition of disposal of all kinds of wastes	District Administration

8.2. Waste management status and proposed action

Table XII: Management of Industrial, Municipal, Hazardous, Biomedical, Plastic and Electronics Waste

Sl. No	Type	Status	Proposed actions	Authority
1	**Industrial Waste**	➢ Authorisation have been granted to different industries in line with Water act 1974, Hazardous Waste (Management, Handling and Transboundary Movement) Rule, 2008. ➢ Regular monitoring by PCBA	➢ Direction issued to the industries to identify the non-point sources and arrest contamination of storm water. ➢ Directions to be issued to the defaulter units.	Pollution Control Board Assam

Sl. No	Type	Status	Proposed actions	Authority
		to ensure that the terms and conditions are strictly adhered in accordance with the prescribed standards.		
2	**Municipal solid waste**	➢ Guwahati Municipal Corporation has engaged NGOs ward wise for collection of Municipal Solid Waste from the generation source itself. ➢ The wastes are being segregated into dry and wet waste categories and are collected separately. ➢ Municipal solid wastes are being dumped unscientifically near Boragaon area at present.	➢ Directions have been issued by Pollution control Board, Assam to concerned Municipality Board in this regard. ➢ Formation of City Sanitation task Force ➢ Door-to-door garbage Collection of waste ➢ Implementation of segregation of waste at source ➢ Formation of Neighbourhood Community ➢ Awareness camapigns Processing and disposal of waste	Guwahati Municipal Corporation
3	**Plastic Waste**	➢ Dumping is carried out unscientifically in the open space along with the municipal waste. ➢ No proper segregation of bio-degradable and non-biodegradable waste ➢ No proper segregation of dry and wet waste ➢ Lack of scientific disposal facilities/infrastructure technology like decentralized composting or bio-methanation plant, waste to energy plant, solid waste management plant.	➢ Issue directions to Municipal Board to segregate and collect plastic waste and initiate necessary steps to channelize the waste to authorized agencies for recycling and reprocessing	Guwahati Municipal Corporation /Pollution Control Board Assam
4	**Hazardous Waste**	➢ Hazardous waste are managed by hazardous waste generating industries	➢ Awareness campaign regarding health and other issues related to	Pollution Control Board Assam

Sl. No	Type	Status	Proposed actions	Authority
		itself by disposing the same through authorised recycler, secured landfill area, Bio-remediation etc. ➢ Lack of TSDF facility for commonly utilization by hazardous waste generating industries	Hazardous waste ➢ PCBA has initiated correspondence with the Govt. of Assam for allotment of land for TSDF.	
5	**Bio-medical Waste**	➢ Segregation at the source under Biomedical waste Management Rules, 1998 ➢ The segregated waste is transported and then incinerated by Fresh Air Waste Management Services Pvt. Ltd at Common Biomedical Waste Treatment Facility, Panikheti	➢ Four more Common Biomedical Waste Treatment Facility (CBWTF) are proposed for the other towns of the State as one CBWTF is permitted at a radius of 70 kms, ➢ Direction issued to all HCF unit to implement the BMW Rules, 2016 as ammended in all HCF Units. (As per guidelines of CPCB)	HCF units/Pollution Control Board Assam
6	**E –waste**	➢ Annual return in (Form-3) is submitted by E-Waste generating units to PCBA from time to time for onwards transmission to CPCB ➢ Most of the e-waste generator have sent their e-waste to their respective manufacturer. ➢ There is no authorised recycler, refurbisher, dismantler etc. available to ensure environmentally sound management of E-waste. ➢ There is no "facility" wherein the process of dismantling, recycling, and disposal of e-waste are carried out.	Few entrepreneur approached PCBA for registration and authorisation as Recycler	Pollution Control Board Assam

8.3. Bio Medical waste generation and Gaps in treatment (Bharalu river Stretch)

Table XIII: Bio Medical waste generation and gaps in treatment (Bharalu river stretch)

Sl. No	Name of the HCF units	Category	BMW Generation (Kg/Day)	Treatment facility	Gaps in Treatment
1	Guwahati Medical College & Hospital, Bhangagarh, Guwahati	Red	468	**Common Bio Medical Waste Treatment Facility (CBWTF) at Panikhaiti by Fresh Air**	**No Gaps in Bio Medical Waste in the catchment area of the river.**
2	Panacea Diagnostic Centre, Rajgarh, Ghy.	Orange	0.8		
3	Goenka Nursing Home, Bharalumukh, Ghy.	Orange	4.67		
4	Kumar's Nursing Home, Kumarpara.	Orange	8.7		
5	Rapid Diagnostics, Sarabhati.	Orange	3.1		
6	RK Life Services Pvt. Ltd. Apollo Clinic, Bora Service.	Orange	6.7		
7	Nemcare Hospital Pvt. Ltd. Bhangagarh, Ghy.	Orange	119.3		
8	Nemcare Hospital, Bhangagarh, Ghy.	Orange	80.73		
9	Pulse Diagnostic, Bhangagarh, Ghy.	Orange	5.63		
10	Primus Diagnostic, Bhangagarh, Ghy.	Orange	2.2		
11	Alcare Diagnostic, Lalganesh, Guwahati-34	Orange	4.91		
12	Orthodontic Clinic, Bhangagarh, Ghy.	Orange	0.526		
13	Health Care Diagnostic, Bhangagarh, Ghy.	Orange	0.85		
14	Aruna Memorial Hospital, Bhangagarh, Ghy.	Orange	13.39		

Sl. No	Name of the HCF units	Category	BMW Generation (Kg/Day)	Treatment facility	Gaps in Treatment
15	Apex Diagnostic, Bhangagarh, GMCH Road, Royal Market, Guwahati – 05	Orange	4.71		
16	K.N. Baruah (Bids), Roodraksh Mall, Ghy.	Orange	2.37		
16	Midland Hospital, RG Baruah Road, Ghy.	Orange	7.6		
17	East India Haemotological Laboratory, Rudraksh Mall, Near Big Bazar, G.S. Road, Bhangagarh, Guwahati-05.	Orange	0.93		
Total			**735.12 kg/day**		**NIL**

8.3. Gaps identified in Municipal Waste Management

Presently, around 393 MT/day of Municipal solid wastes are generated from the catchment area of the river.

However, these Municipal solid wastes are being dumped at Boragaon dumping yards which is located 15 km far away from the catchment area.

There is no any solid waste management facility in the catchment area of the river.

8.4 Gaps in Industrial waste Management

Table XIV: Gaps in Hazardous Waste Management

S.N	Name of the units	Category	Sludge Generation MTA	Type of Sludge	Treatment facility	Gaps in Treatment
1	Guwahati Refinery, IOCL, Noonmati, Guwahati	RED	1692	Oily Sludge residual cake	**Bio-remediation at their own premises.**	**No Gaps in Hazardous Waste Management**
Total			**1692 MTA**			**NIL**

8.5 Greenery development - Plantation Plan

State has initiated afforestation in the degraded forestland, also raising roadside plantation besides creating check dams/embankments in the river catchment areas to combat erosion and soil conservation.

The following remedial actions has to be initiated in consideration of greenery development

- Raise plantation along the river bank to control the flow run off water directly to the river
- Bamboo species to be raised as it is a good soil binder thereby stabilize the banks of the river from erosion

9. Environmental Flow (E-Flow)

9.1. Stretch of river perennial or non- perennial/flow available/water usage in the stretch

The entire river stretch is non- perennial. There is no any natural flow in the river. Only the city untreated sewage is being discharged directly in to the river. The natural flow of the river is blocked in the upper reaches of the river at Natun Bazar of Beltola area. The reason for blocking the Bahini river water is that it creates artificial flooding in Guwahati city during monsoon season even during a single heavy shower. The velocity of flow in Bharalu River is estimated to be 1.07-1.37 m/sec.

Maintenance of E -Flow

During lean season the natural flow of the river can be maintained by opening the sluice gate at Natun bazar area from where water from Bahini river enters from Meghalaya. There are no any lakes/Ponds and other water bodies in the catchment area nor any provision for construction of artificial lakes/ponds as the stretch is highly populated and there is no any land availability.

9.2. Irrigation practices in the river/Utilization of treated sewage

There is no any irrigation practices at present as the water quality of the river is very poor. However the treated sewage can be used for many purposes which are as follows:

- Treated water can be used for de-dusting of roads in order to minimise the impact of PM_{10} and $PM_{2.5}$.
- For irrigation purpose.
- It can be used for roadside gardening.
- It can also be used for curing during construction works.
- Treated sewage can be supplied to industries for non-potable uses.

9.3. Achievable Goals

Designated Best use	Class of Water	Criteria
Irrigation, Industrial Cooling, Controlled Waste disposal	**E**	**pH between 6.0 to 8.5** **Electrical Conductivity at 25C micro mhos/cm Max.2250** **Sodium absorption Ratio Max. 26** **Boron Max. 2mg/l**

10. Identified organisations responsible for preparation and execution of the action plans

Organisations responsible for preparation and execution of the action plans are as follows:

- Secretary to the Govt. of Assam, Environment and Forest department
- Secretary to the Govt. of Assam, Urban Development department
- Commissioner, Industries and Commerce, Assam
- Member Secretary, Pollution Control Board Assam
- Commissioner, Guwahati Municipal Corporation
- Commissioner to the Govt. of Assam, Water Resource Department
- Divisional Forest officer, Social Forestry, Basistha, Guwahati -29

11. Monitoring mechanism proposed for implementation of action plans

The water quality assessment and evaluation of impacts is necessary to understand the river state at various stages of the project implementation and post implementation of the project. Therefore the water quality assessment and evaluation of the project achievements is essential component for the long term benefit of the project. The monitoring and evaluation also indicate for taking corrective measure at appropriate time. The ill effects may be controlled by taking step at right time for right cause. The monitoring & evaluation schedule and plan proposed is as under.

11.1 Water Quality Stations (WQS):

The water quality monitoring will include following parameters, which shall be monitored at monthly interval or as and when required. The one complete unit to be purchased and identified parameters to be monitored at defined sampling stations.

The sampling station is:

- Bharalu River near Pragjyotish college.

The parameters to be monitored are as follows.

1	pH	6	Bio-Chemical Oxygen Demand (BOD)
2	Turbidity	7	Faecal coliform
3	Conductivity	8	Total coliform
4	Temperature		
5	Dissolved Oxygen (DO)		

Most of the parameters will be monitored manually and will be incorporated in database.

12. Public Mass awareness etc.

Any river conservation project to be implemented successfully, public awareness is of utmost importance. Unless the public are made aware about the irreversible damage and pollution caused by indiscriminate littering and dumping of waste and garbage in drain and water bodies connected to Bharalu River, the project cannot be implemented in true sense of the word to achieve conservation. Some members of the communities are already aware that there is a need for river conservation programme and that they will be benefitted. Hence, it should be ensured with the following points

- The communities are effectively involved in all the stages of the project cycle from conceptualization, to preparation, to finalization, to implementation and finally O & M.
- Public Awareness & Public Participation should be affront-end activity of the project
- The entire programme of conservation should be conceived, formulated, implemented, monitored and evaluated in close consultation with the stake holding communities.
- Therefore, education and awareness programmes are key to the sustainability of the various components implemented as part of the river restoration project.

13. Action Plan

Table XV: Action Points

Type	Action Points	Responsible Authority	Time Targeted	Cost Estimate (In crores)
Industries	a) Strict observation/ monitoring of industrial effluent/waste water discharge strictly for compliance. b) Stringent action against non-complying industrial units c) No industry should operate or continue manufacturing process unless they possess valid permission for ground water extraction from Central Ground Water Authority (CGWA) d) Small service providing units like street food selling vendors, laundry etc should not be allowed to dispose solid, liquid or semi-liquid wastes directly into the drains or sewers. e) Set up online monitoring system in the major industries. f) To stress all the industrial units to	**Pollution Control Board Assam**	**3 Months (August, 2019 To October, 2019)**	**NIL**

Type	Action Points	Responsible Authority	Time Targeted	Cost Estimate (In crores)
	adopt cleaner technology and take appropriate measures for reduction of effluent, recycling and reuse of treated water g) Directions has been issued for Zero Liquid Discharge (ZLD) in the major polluting industrial units			
Interception and treatment of raw sewage	a) The quality of waste water flowing in the drains of identified polluted stretch have to be analysed and studied to assess the drain wise characteristics of waste water. b) Concerned departments should design the installation of Sewage Treatment Plant (STP) based on flow details of the drains and utilization capacity and ensure that each households are connected to the sewers as applicable. c) Sewage Treatment Plant should also consider treatment and disposal of	**PCBA/ Municipal Corporation/ ULBs/ District Administration/ Water Resource Department**	**2 Years (August,2019 to July, 2021)**	**111.5**

Type	Action Points	Responsible Authority	Time Targeted	Cost Estimate (In crores)
	sewage for river catchment area settlement including discharge from toilets constructed under Swachh Bharat Mission d) To trap the discharge using strainers before falling into river. e) Channelization including diversion of sewage generated from households to sewer lines/interception of all the drains presently carrying sewage and for ensuing proper treatment through the upcoming STPs. f) Local administration should provide pucca latrines to all the households through Individual Households Latrines (IHHL) Scheme under Swachh Bharat Mission.			
	a) Conducting survey regarding ground water usage by category wise such as domestic, community, industries etc. and also identification of over exploited and	**PCBA/CGWA**		

Type	Action Points	Responsible Authority	Time Targeted	Cost Estimate (In crores)
Ground Water Assessment	critical blocks in the river stretches with respect to the ground water extraction. b) Carry out assessment of ground water survey in the catchment area of the identified polluted stretch once in a year to ensure quality. c) All the industries should have valid NOC from CGWA. d) To promote roof top rain water harvesting by the industrial, commercial including individual households thereby recharging the ground water. e) Directions to be issued that no industries should inject their treated effluent for ground water recharging.		**Continuous** **6 Months (February,2020 to July, 2020)**	**0.5**
Flood Plain Zone	a) Conservation of the river through watershed management. b) Cleaning of the river bed and bank. c) Afforestation on both the banks to prevent soil erosion d) Recreational activities to be	**Soil Conservation Department/Water Resource/ Municipal Corporation /Forest Department/ Tourism**	**6 Months (February,2020 to July, 2020)**	

Type	Action Points	Responsible Authority	Time Targeted	Cost Estimate (In crores)
	promoted. e) Erection of pathway of the river banks. f) Prohibition of disposal of municipal, plastic, biomedical and other wastes in the polluted stretch of the river bank g) Demarcation of the flood plain zone.	**Department/PWD Assam/District Administration**		**1.0**
	h) Checking /removal of encroachment in the flood plain zone of the polluted river stretch	**Revenue Department/District Administration**	**To be decided by the Government**	
	The plan for the polluted stretches of the river may be implemented in a time bound manner by fragmenting activities as a) Modification of consent conditions in and around the polluted stretches. b) Surveillance of sources of pollution in contrast to the norms. c) Assessment of water quality of the polluted stretches on monthly basis has already been commencing d) The monitoring committee may convene meeting of	**Pollution Control Board Assam**	**3 Months (August,2019 to October, 2020)** **c) Monthly Basis**	**NIL**

Type	Action Points	Responsible Authority	Time Targeted	Cost Estimate (In crores)
	Stakeholder organizations on Quarterly basis with under the chairmanship of Chief Secretary			
Solid Waste	a) Prohibition of direct disposal of solid waste in the river banks. b) Frequent River Surface cleaning by removal of debris, plastics etc.	**Guwahati Municipal Corporation/ Water Resource Department**	**3 Months (November, 2019 to January, 2020)**	**0.4**
Environmental Flow	a) Flow measurement of the river should be carried out by the concerned department and the record has to be maintained b) Fresh water flowing through escape channels/small barrages should be checked. c) The river can be of good potential for irrigation practices and should be carried out by the farmers.	**Water Resource Department**	**Continuous**	**0.1**
Public Awareness	a) Awareness programs to highlight the issues related with the direct discharge of solid waste and open defecation. b) Mass awareness to conserve water.	**Environment & Forest Department /UDD/GMC**	**Continuous**	**0.1**

Type	Action Points	Responsible Authority	Time Targeted	Cost Estimate (In crores)
Total Budget Estimate				**113.6 crores**

Members of River Rejuvenation Committee (RRC)

Secretary to the Govt of Assam
Environment & Forest Department

Secretary to the Govt of Assam
Urban Development Department

23/7/19

Commissioner
Industries and Commerce Assam

Member Secretary
Pollution Control Board Assam