Semi-Annual Environmental Monitoring Report

Project number: 42173-013

Period: July – December 2019
Submission Date: July 2020

BAN: Dhaka Environmentally Sustainable Water Supply Project (PART F)

ANNEXURE-6:
Previous Month Results

Month: July/2019

Table W1/2019: Weekly Sampling Results; 18/07/2019

Weekly sampling: Water quality field test parameters results; Month: July/2019											
Date: 18-07-2019					Time: 10-12						
Sample	Depth (m)	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample	0.5	30.6	7.2	0.03	75.8	32.9	6.5	14.66	40	0.23	138
2nd grab sample	4	30.3	7.3	0.03	69.2	29.4	6.61	19.08	60	0.32	110
3rd grab sample	8	30.1	7.2	0.03	68.9	32	6.87	14.28	60	0.3	140
Composite sample (1st+2nd+3rd grab sample	-	30.1	7.2	0.03	66	30.9	6.8	16.32	40	0.2	123
	Max	30.6	7.3	0.03	75.8	32.9	6.87	19.08	60	0.32	140
	Min	30.1	7.2	0.03	66	29.4	6.5	14.28	40	0.2	110
	Avg.	30.3	7.23	0.03	70.25	31.25	6.69	16.28	50	0.26	126.67

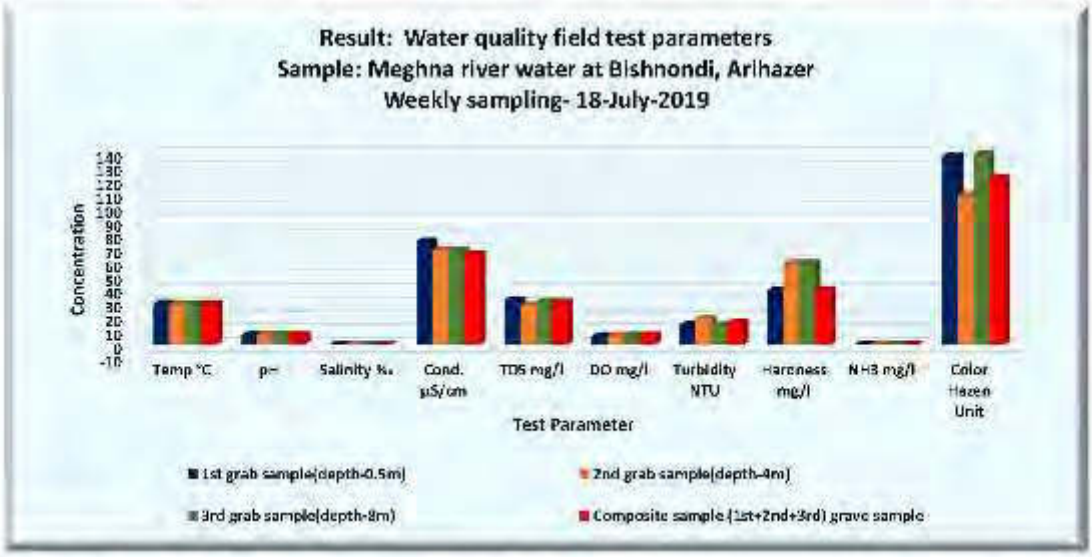


Figure W-1/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Arihazer Weekly sampling- 18-July-2019

Table W2/2019: Weekly sampling results; 25/07/2019

Weekly sampling: Water quality field test parameters results; Month: July/2019											
Date: 25-07-2019							Time: 10-12				
Sample	Depth (m)	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample	0.5	30.3	7.5	0.03	75.9	32.4	6.39	12.1	60	0.24	139
2nd grab sample	4	30.4	7.4	0.03	78.9	33.4	6.66	19.48	40	0.33	140
3rd grab sample	8	30.5	7.2	0.03	82	34.2	6.79	14.28	60	0.36	145
Composite sample (1st+2nd+3rd) grab sample	-	30	7.2	0.03	78	31	6.8	17.89	40	0.21	145
	Max	30.5	7.5	0.03	82	34.2	6.8	19.48	60	0.36	145
	Min	30	7.2	0.03	75.9	31	6.39	12.1	40	0.21	139
	Avg.	30.28	7.33	0.03	78.78	32.7	6.64	15.89	50	0.29	142.17

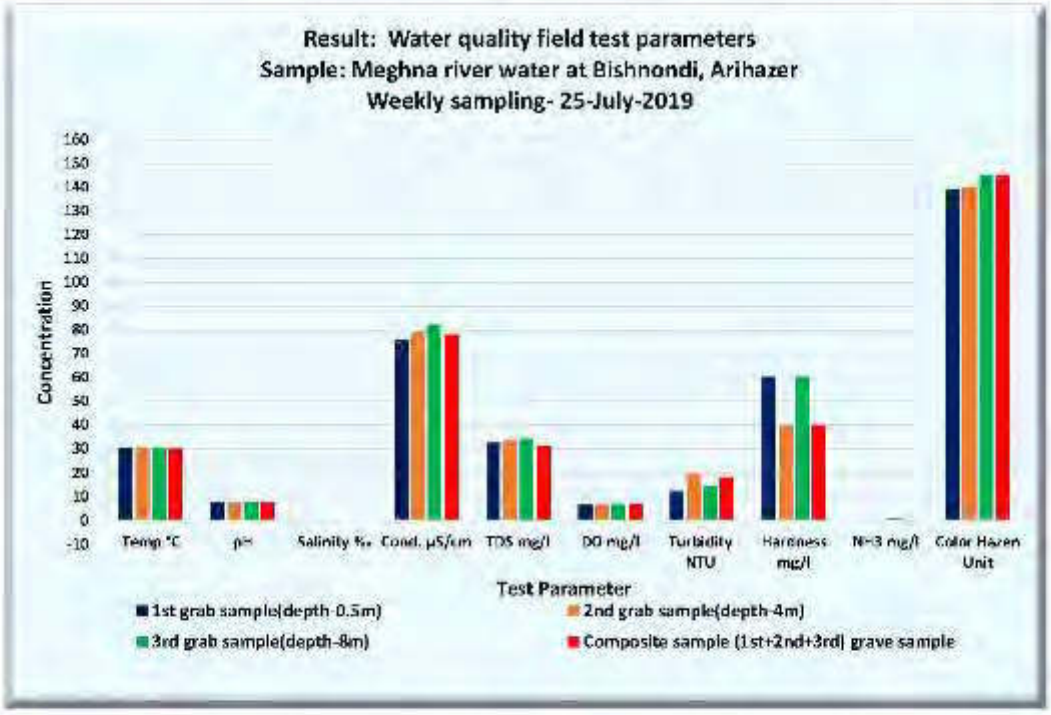


Figure W-2/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Arihazer Weekly sampling- 25-July-2019

Table W3/2019: Weekly sampling results; Month: 31/July/2019

Water quality field test parameters (weekly sample);Month: July/2019											
Date: 31-07-2019								Time: 10-12			
Sample	Depth (m)	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample	0.5	30.1	7.6	0.03	65.5	32.8	6.35	19.2	40	0.32	147
2nd grab sample	4	30.1	7.4	0.03	68.4	34.25	6.63	19.4	40	0.33	152
3rd grab sample	8	30.1	7.2	0.03	68.9	37.7	6.7	19.85	40	0.35	160
Composite sample (1st+2nd+3rd grave sample	-	30.3	7.1	0.03	65.2	32.7	6.41	19.32	40	0.33	157
	Max	30.3	7.6	0.03	68.9	37.7	6.7	19.85	40	0.35	160
	Min	30.1	7.1	0.03	65.2	32.7	6.35	19.2	40	0.32	147
	Avg.	30.17	7.3	0.03	67.02	34.64	6.52	19.47	40	0.33	153.83

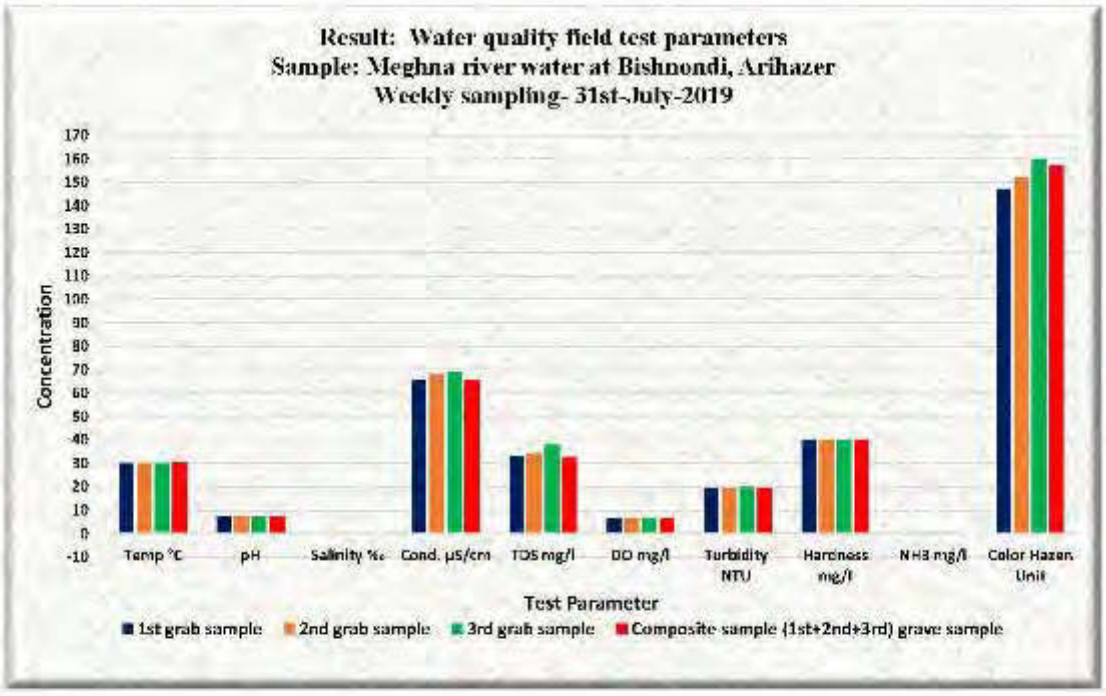


Figure 0-3/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 31st-July-2019

Month: August/2019

Table W4/2019: Weekly sampling results; Month: 1/August/2019

Water quality field test parameters (weekly sample-1st week); Month: August/2019										
Date:01- 08-2019								Time: 10-12		
Sample	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	30.5	7.5	0.03	79.5	33.7	6.36	14.9	40	0.23	139
2nd grab sample (4m depth)	30.4	7.2	0.03	75.2	31.8	6.51	17.04	40	0.27	142
3rd grab sample (8m depth)	30.5	7.2	0.03	75.8	31.9	6.79	16.86	40	0.3	145
Composite sample (1st+2nd+3rd grave sample)	30.3	7.2	0.03	78	33	6.77	12.13	40	0.24	140
Max	**30.5**	**7.5**	**0.03**	**79.5**	**33.7**	**6.79**	**17.04**	**40**	**0.3**	**145**
Min	**30.3**	**7.2**	**0.03**	**75.2**	**31.8**	**6.36**	**12.13**	**40**	**0.23**	**139**
Avg.	**30.41667**	**7.30**	**0.03**	**77.20**	**32.65**	**6.60**	**15.02**	**40**	**0.26**	**141.67**

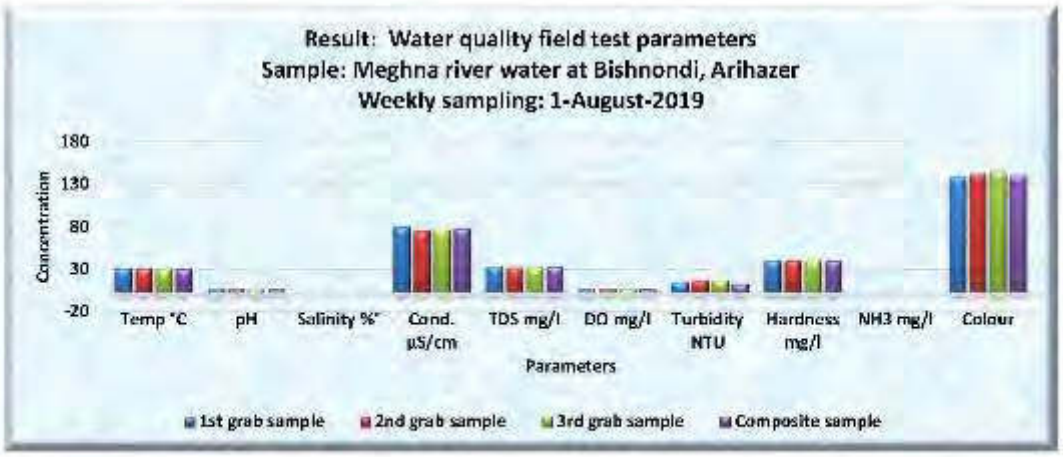


Figure 0-4/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling 1st August 2019

Table WS/2019: Weekly sampling results; Month: 8/August/2019

Water quality field test parameters (weekly sample-2nd week); Month: August/2019										
Date:08- 08-2019								Time: 10-12		
Sample	Temp °C	pH	Salinity %°	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	30.6	7.5	0.03	74.5	35.6	6.3	12.4	40	0.24	139
2nd grab sample (4m depth)	30.5	7.3	0.03	72.3	30.5	6.86	18.43	40	0.27	146
3rd grab sample (8m depth)	30.4	7.1	0.03	76.3	32.2	6.91	17.64	60	0.31	116
Composite sample (1st+2nd+3rd grave sample)	30.3	7.3	0.03	83	34.8	6.86	17.69	40	0.21	127
Max	30.6	7.5	0.03	83	35.6	6.91	18.43	60	0.31	146
Min	30.3	7.1	0.03	72.3	30.5	6.3	12.4	40	0.21	116
Avg.	30.45	7.30	0.03	76.90	33.2	6.69	16.17	46.66	0.26	131.67

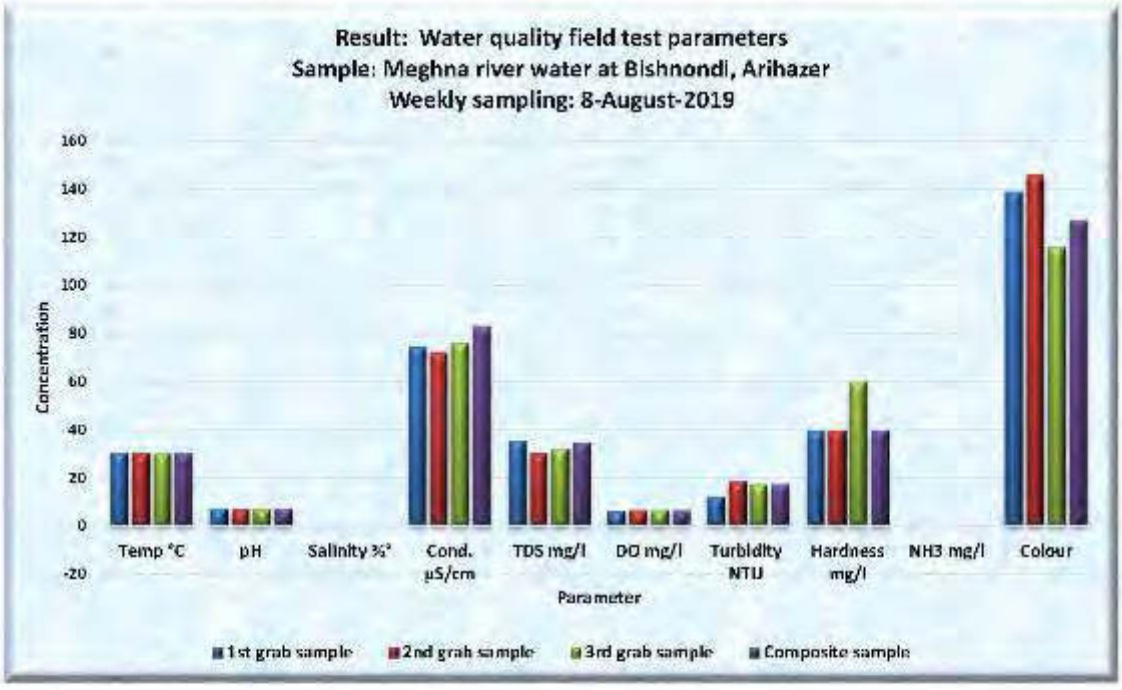


Figure 0-5/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 8th-August-2019

Table W6/2019: Weekly sampling results; Month: 14/August/2019

Water quality field test parameters (weekly sample-3rd week); Month: August/2019											
Date: 14- 08-2019									Time: 10-12		
Sample	Temp °C	pH	Salinity %°	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	30.5	7.5	0.03	64.2	30.25	6.4	19.4	40	0.33	151
2nd grab sample (4m depth)	30.4	7.5	0.03	67.4	33.2	6.32	18.89	40	0.29	180
3rd grab sample (8m depth)	30.1	7.3	0.03	68.5	32	6.69	18.5	40	0.32	144
Composite sample (1st+2nd+3rd grave sample)	30	7.3	0.03	66.1	30.1	6.78	17.7	40	0.25	170
Max	30.5	7.5	0.03	68.5	33.2	6.78	19.4	40	0.33	180
Min	30	7.3	0.03	64.2	30.1	6.32	17.7	40	0.25	144
Avg.	30.25	7.40	0.03	66.48	31.475	6.55	18.60	40	0.30	161.50

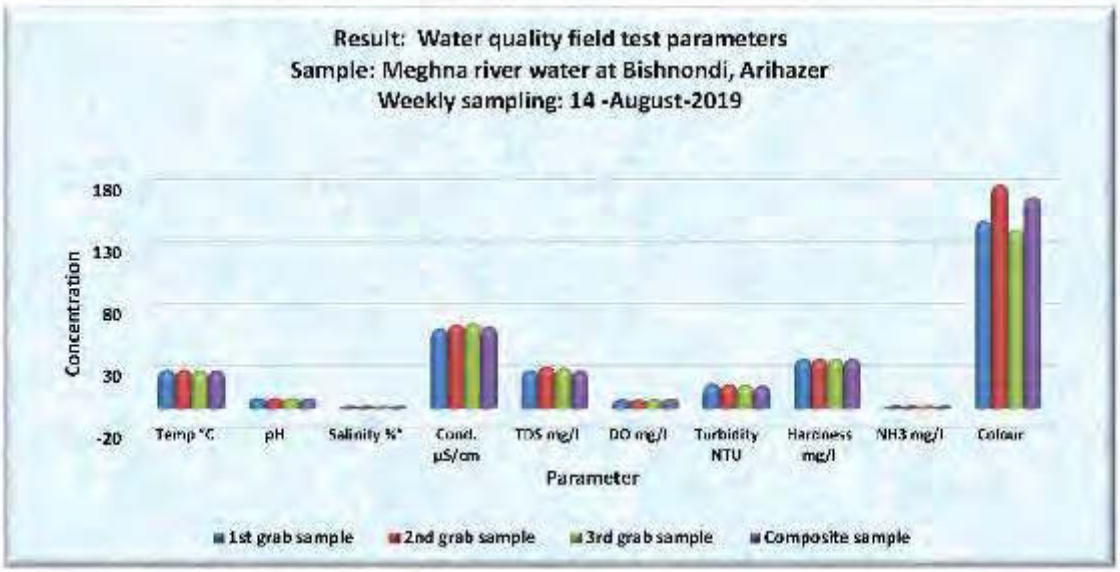


Figure 0-6/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 14th-August-2019

Table W7/2019: Weekly sampling results; Month: 21/August/2019

Water quality field test parameters (weekly sample-4th week); Month: August/2019										
Date:21-08-2019								Time: 10-12		
Sample	Temp °C	pH	Salinity %°	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	33.3	7.1	0.03	73.7	29.8	6.02	23.26	40	0.33	142
2nd grab sample (4m depth)	34.4	7.2	0.03	72.8	28.6	6.19	21.49	40	0.3	177
3rd grab sample (8m depth)	33.9	7.1	0.03	72.7	29	6.2	19.76	40	0.35	181
Composite sample (1st+2nd+3rd grave sample)	33.8	7.1	0.03	77.9	31.2	6.2	22.04	40	0.24	181
Max	34.4	7.2	0.03	77.9	31.2	6.2	23.26	40	0.35	181
Min	33.3	7.1	0.03	72.7	28.6	6.02	19.76	40	0.24	142
Avg.	33.76	7.13	0.03	74.62	29.73	6.14	21.60	40	0.30	167.33

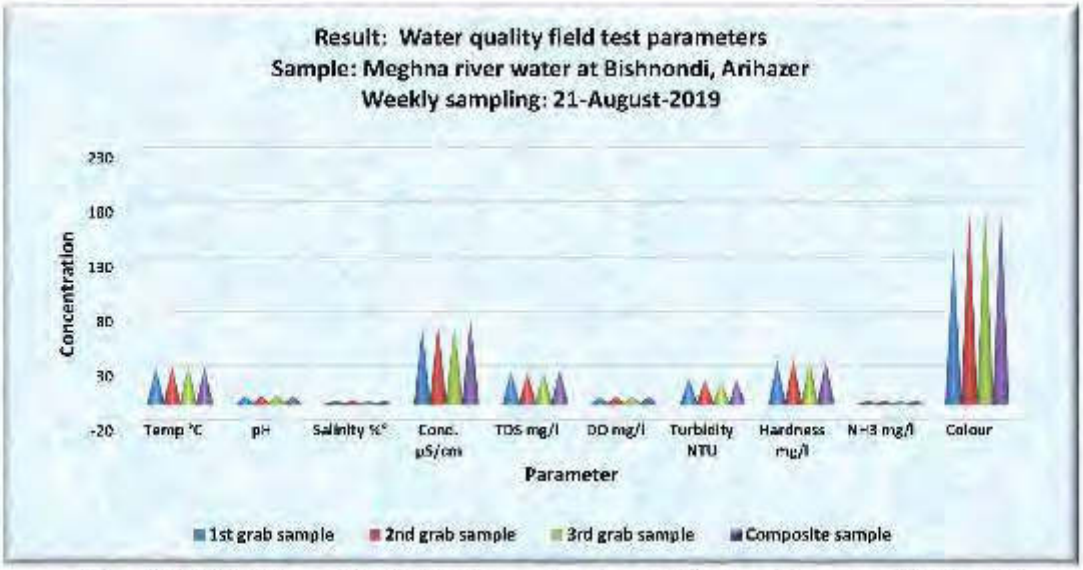


Figure 0-7/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 21st-August-2019

**Data of Fifth weekly sample (28/8/2019) = Date of seasonal sample in the same date

Laboratory Test- Monthly sample and Seasonal Sample

Laboratory Test Results- Monthly Sample

Water quality Laboratory test result- Monthly sample; Composite sample					
Test conducted by: DPHE Central Laboratory, Mohakhali, Dhaka					
1st- Monthly sample: August/2019					
Date: 31-07-2019	Composite sample Depth=[Sample-1: 0.5m+Sample-2:4m+Sample-3: 8m]				
Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
Alkalinity		38	mg/L	Titrimetric	
Aluminum	0.2	0.23	mg/L	AAS	0.002
Ammonia	0.5	0.63	mg/L	UVS	0.1
Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
Biochemical Oxygen Demand (BOD)	0.2	18	mg/L	days incubation	0.1
Chemical Oxygen Demand (COD)	4	68	mg/L	CRM	
Hardness	200-500	110	mg/L	Titrimetric	
Iron (Fe)	0.3-1	0.49	mg/L	AAS	0.05
Manganese (Mn)	0.1	0.1	mg/L	AAS	0.03
Nitrogen (Nitrite)	10	2.5	mg/L	UVS	0.1
Nitrogen (Nitrite)	<1.0	0.03	mg/L	UVS	0.02
Phosphate	6	0.73	mg/L	UVS	0.1
Total Suspended Solid (TSS)	10	4.3	mg/l	Gravimetric Method	

Laboratory Test Results - Seasonal Sample

Water quality Laboratory test result- Seasonal sample: Composite sample					
Test conducted by: DPHE Central Laboratory, Mohakhali, Dhaka					
1st seasonal sample: August/2019					
Date: 31-07-2019	Composite sample Depth=[Sample-1: 0.5m+Sample-2:4m+Sample-3: 8m]				
Water quality parameters	**Bangladesh Standard**	**Concentration present**	**Unit**	**Analysis Method**	**LOQ**
Ammonia	0.5	**0.6**	mg/L	UVS	0.1
Arsenic (As)	0.05	0.001	mg/L	AAS	0.01
Barium (Ba)	0.01	0.09	mg/L	AAS	-
Biochemical Oxygen Demand (BOD)	**0.2**	**8**	mg/L	5 days Incubation	0.1
Cadmium (Cd)	0.005	0.00058	mg/L	AAS	0.00015
Chemical Oxygen Demand (COD)	4	**36**	mg/L	CRM	-
Chloride	150-600	10	mg/L	Titrimetric	-
Coliform (Fecal)	0	**144**	N/100ml	MPM	-
Copper (Cu)	1	0.26	mg/L	AAS	0.26
Chromium (Total)[Cr]	0.05	0.008	mg/L	AAS	0.0003
Fluoride	1	0.12	mg/L	UVS	0.12
Lead (Pb)	0.05	0.004	mg/L	AAS	0.001
Nickel (Ni)	0.1	0.03	mg/L	AAS	0.01
Nitrogen (Nitrate)	10	1.9	mg/L	UVS	0.1
Nitrogen (Nitrite)	<1.0	0.03	mg/L	UVS	0.02
Phosphate	6	0.84	mg/L	UVS	0.1
Selenium (Se)	0.01	0.001	mg/L	AAS	0.002
Sodium (Na)	200	10	mg/L	AAS	0.34
Sulphate	400	1	mg/L	UVS	1
Zinc (Zn)	5	0.08	mg/L	AAS	0.05

Month: September/2019

Table W8/2019: Weekly sampling results; Month: 5/September/2019

Water quality field test parameters (weekly sample- 1st week); Month: September/2019										
Date:05- 09-2019								Time: 10-12		
Sample	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	32	7.5	0.03	71.4	29.3	6.67	17.04	40	0.23	49
2nd grab sample (4m depth)	31.6	7.6	0.03	74.3	30.7	6.68	13.81	40	0.28	51
3rd grab sample (8m depth)	31.6	7.3	0.03	73.3	30.3	6.79	15.12	40	0.21	56
Composite sample (1st+2nd+3rd grave sample)	31.4	7.4	0.03	71	29.8	6.94	12.58	40	0.28	62
Max	30.1	7.8	0.03	73	31.3	7.08	23.56	40	0.33	142
Min	29.3	7.5	0.03	58.3	27.4	7.01	17.62	40	0.24	125
Avg.	29.74	7.66	0.03	65.56	29.02	7.04	20.548	40	0.288	132.8

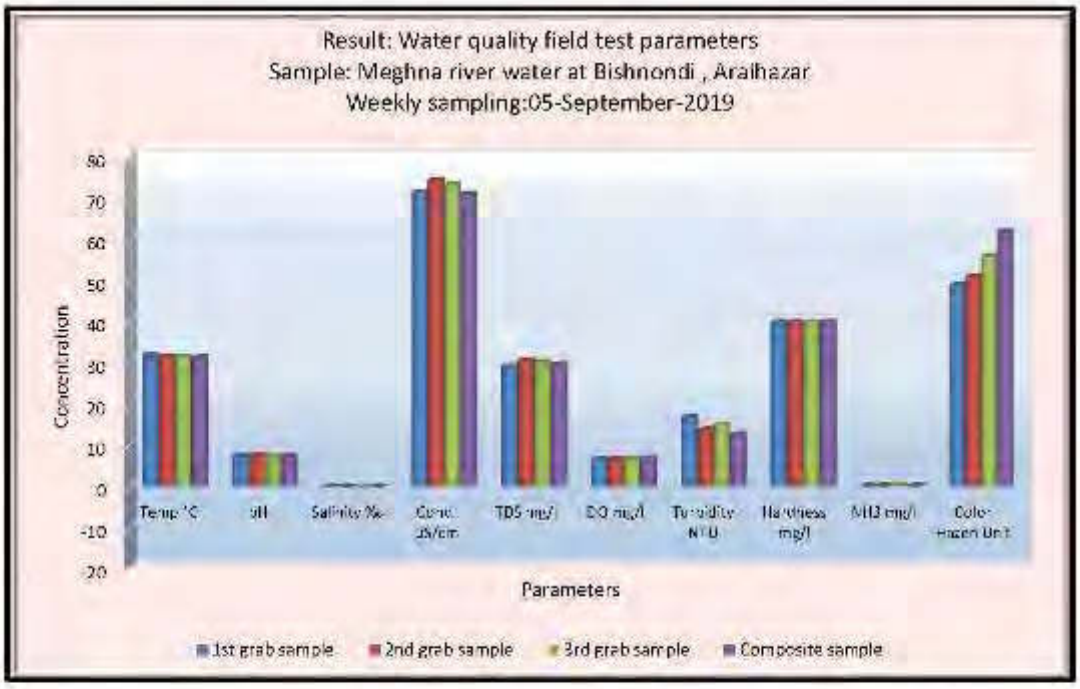


Figure 0-8/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 5th -September-2019

Table W9/2019: Weekly sampling results; Month: 14/September/2019

Water quality field test parameters (weekly sample-2nd week); Month: September/2019										
Date:14- 09-2019							Time: 10-12			
Sample	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	32	7.6	0.03	70.6	34.2	7.12	36.91	40	0.19	213
2nd grab sample (4m depth)	31.6	7.6	0.03	69.7	32.7	7.32	33.7	40	0.2	232
3rd grab sample (8m depth)	31.6	7.5	0.03	87.6	41.6	7.34	28.58	40	0.2	222
Composite sample (1st+2nd+3rd grave sample)	31.4	7.5	0.03	78.3	37.2	7.34	28.99	40	0.22	228
Max	32	7.6	0.03	87.6	41.6	7.34	36.91	40	0.2	232
Min	31.6	7.5	0.03	69.7	32.7	7.12	28.58	40	0.19	213
Avg.	31.76	7.56	0.03	77.04	36.56	7.248	32.936	40	0.196	222.4

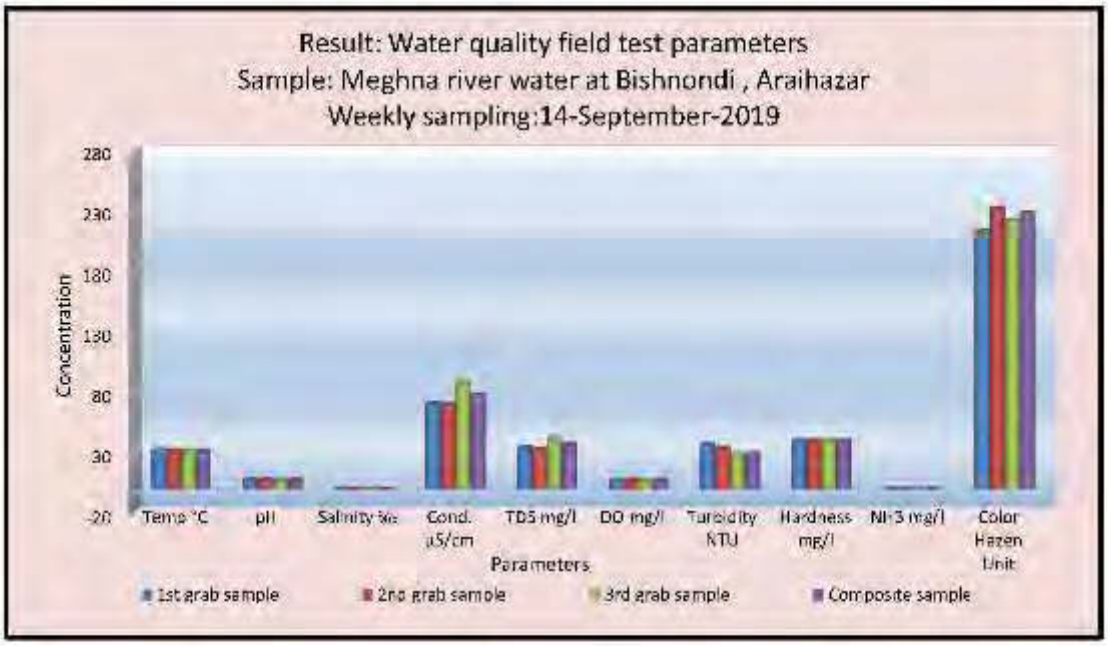


Figure 0-9/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 14th -September-2019

Table W10/2019: Weekly sampling results: Month: 21/September/2019

Water quality field test parameters (weekly sample-3rd week); Month: September/2019										
Date:21-09-2019								Time: 10-12		
Sample	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	32.7	7.4	0.03	74.2	30	6.4	16.25	40	0.3	86
2nd grab sample (4m depth)	32.4	7.6	0.03	69.4	28.2	6.76	24.27	40	0.3	88
3rd grab sample (8m depth)	32.3	7.5	0.03	71.9	29.3	6.67	20.24	40	0.28	118
Composite sample (1st+2nd+3rd grave sample)	31.7	7.4	0.03	73.3	30.2	6.77	23.32	40	0.28	92
Max	32.7	7.6	0.03	74.2	30	6.76	24.27	40	0.3	118
Min	32.3	7.4	0.03	69.4	28.2	6.4	16.25	40	0.28	86
Avg.	32.48	7.5	0.03	71.82	29.14	6.598	20.256	40	0.292	99.2

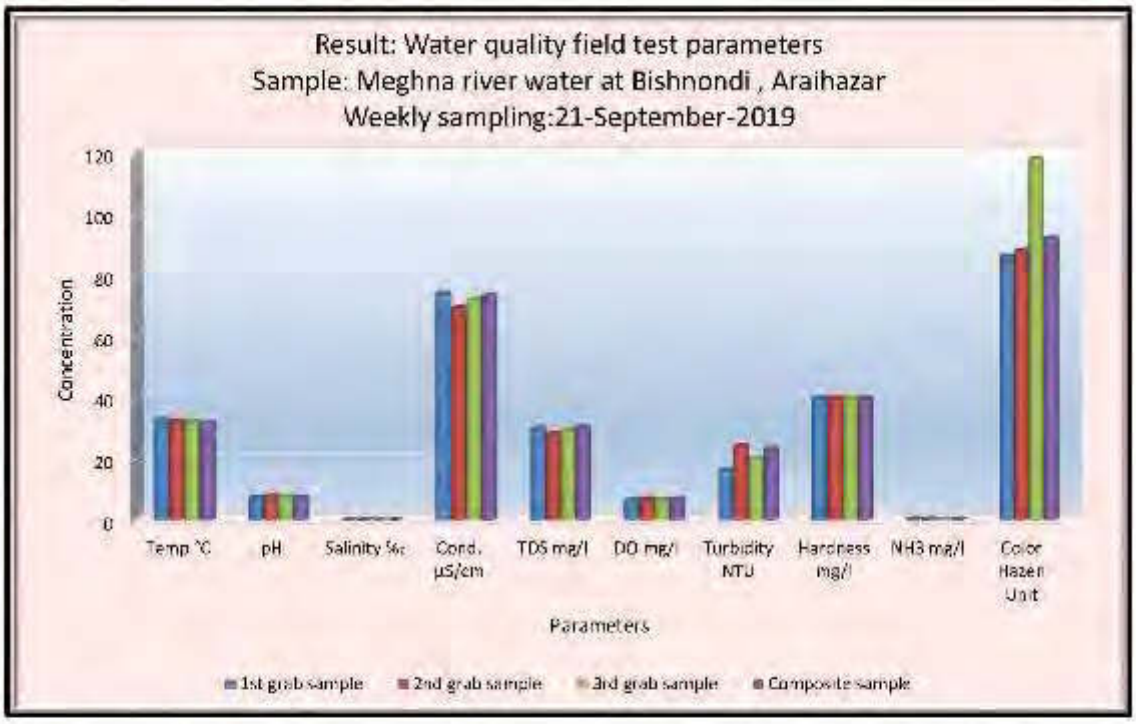


Figure 0-10/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 21st -September-2019

Table W11/2019: Weekly sampling results: Month: 28/September/2019

Water quality field test parameters (weekly sample-4th week); Month: September/2019										
Date:28-09-2019								Time: 10-12		
Sample	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample (0.5m depth)	30.1	7.7	0.03	65.2	27.7	7.01	17.62	40	0.33	142
2nd grab sample (4m depth)	29.9	7.8	0.03	73	31.3	7.02	20.38	40	0.3	130
3rd grab sample (8m depth)	29.3	7.5	0.03	58.3	27.4	7.08	23.56	40	0.24	125
Composite sample (1st+2nd+3rd grave sample)	29.6	7.5	0.03	68.4	30	7.28	20.51	40	0.28	133
Max	30.1	7.8	0.03	73	31.3	7.08	23.56	40	0.33	142
Min	29.3	7.5	0.03	58.3	27.4	7.01	17.62	40	0.24	125
Avg.	29.74	7.66	0.03	65.56	29.02	7.04	20.548	40	0.288	132.8

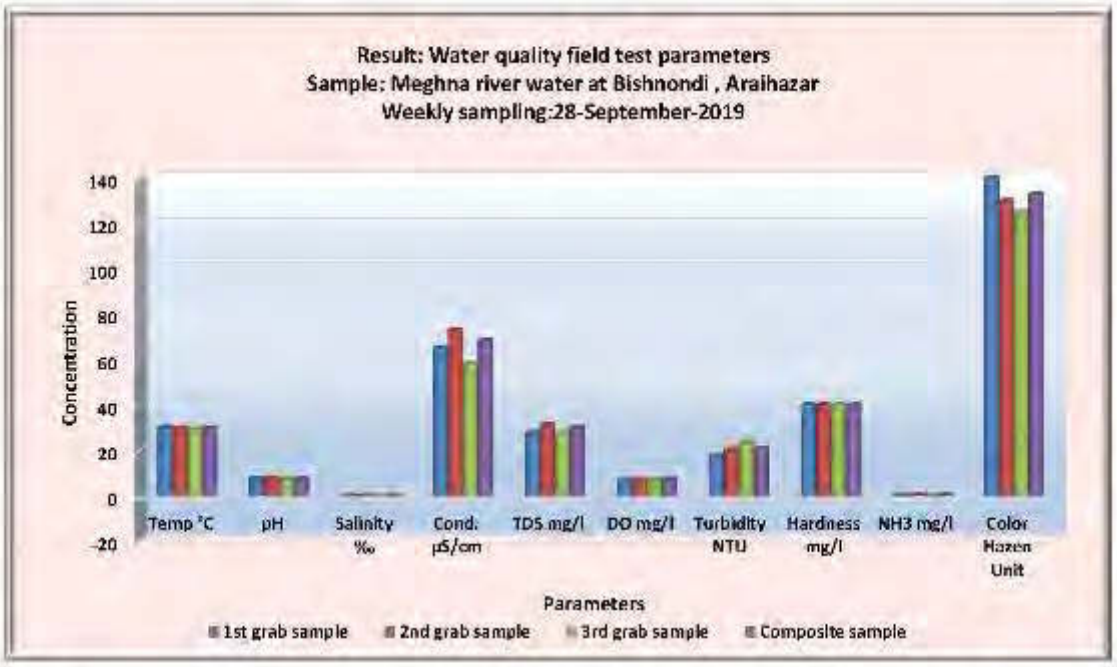


Figure 0-11/2019 Water quality field test parameters Sample: Meghna river water at Bishnondi, Araihazar Weekly sampling- 28th -September-2019

EXCUTIVE SUMMARY

To assess the variation of surface water quality over the period of eighteen months for better understanding of appropriate surface water treatment facilities for the proposed 500MLD DWASA surface treatment plant which is going to install at Bishmondi Araihazar using Meghna river water for ensuring better quality water supply at mega-city Dhaka.

Targeting the above work, ONUSHANDHANI CREEDS LIMITED, a well reputed consulting firm, has been assigned to conduct surface water quality monitoring at proposed intake point at Bishmondi, Bank of Meghna, Araihazar under DESWSP, DWASA [RFQW-3.32] for eighteen months.

This report is one of a series of monthly reports on the Surface Water Quality Monitoring (4th Phase) At Proposed Raw Water Intake Point at Bishmondi, Bank of Meghna, Araihazar Under Dhaka Environmentally Sustainable Water Supply Project (DESWSP), DWASA. The report summarizes the results of the surface water quality monitoring for the month of November/2019 including October, September, August and July of 2019.

Measurement of physicochemical parameters are Temperature; pH, Salinity, Conductivity, Turbidity, Dissolved Oxygen (DO), Total Dissolved Solid (TDS), Ammonia (NH_3), Total Hardness and color at field during weekly sampling.

During monthly sampling, composite sample were sent to DPHE Central laboratory for the analysis of a wide range of water quality parameter and parameters are Nitrate; Nitrite; COD; TSS; BOD_5; Phosphate; Alkalinity; Ammonia; Total Hardness; Arsenic; Iron; Manganese and Aluminium and field parameter ware tested as same as weekly sample parameters.

During the eighteen months study period, five times seasonal sample need to be collected which is hourly basis and sampling duration is 13 hours during daylight time and composite sample were send to DPHE Central laboratory and BCSIR Laboratory for the analysis of a wide range of water quality parameter and parameters are Arsenic; Algae; Barium; Cadmium; Chloride; Chromium(Hexavalent); Coliform(fecal); BOD; COD; Lead; Mercury; Ammonia; Nitrate; Nitrite; Phosphate; TOC; Pesticides (Organo-chorine); Pesticides (Organo-phosphorus); Oil & Grease; Fluoride; Selenium; Zinc; Sulphate; Copper; Antimony; Boron; Nickel and Sodium. Field parameter ware tested as same as weekly sample parameters.

BOD and COD values were found to be 2 mg/L and 8mg/L respectively during monthly sample analysis which is approximately constant with the proceeding month. To understand the pollution trend more data from different months are required.

Ammonia concentration of most samples are within the safe limit as per Bangladesh Drinking Water Quality Standard. (NH_3 0.5mg/L). The concentration of ammonia has dropped in the month of November. However, tendency of ammonia concentration to increase with respect to time has been found in the last four months. In conjunction, decreasing of dissolved oxygen (DO), reduction of pH value, increase of turbidity, increase of color unit were found.

The Water Quality Index (WQI) value was found to be from 115.9 to 144.2 for weekly samples and 139.5 for monthly samples. The contributing pollutants were found to be mainly turbidity and color. The standard deviations were also calculated for further analysis. It was found that the deviation was maximum for color and minimum for pH (excluding salinity).

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AOI	Area of Interest
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
DAP	Detailed Area Plan
DCC	Dhaka City Corporation
DESWSP	Dhaka Environmentally Sustainable Water Supply Project
DMDP	Dhaka Metropolitan Development Plan
DMP	Drainage Master Plan
DNCC	Dhaka North City Corporation
DND	Dhaka Narayanganj Demra Flood Control, Drainage & Irrigation Project
DSCC	Dhaka South City Corporation
DWASA	Dhaka Water Supply and Sewerage Authority
FAP	Flood Action Plan
FCD	Flood Control and Drainage
GoB	Government of Bangladesh
GIS	Geographic information system
HWL	Highest Water Level
IWM	Institute of Water Modeling
JICA	Japan International Cooperation Agency
km	Kilometer
km^2	Kilo Meters squared, square kilo meters
LGED	Local Government Engineering Department
LWL	Lowest Water Level
m/s	Meter per second
m^2	Meter squared, square meter
m^3/s	Cubic meter per second (cumec)
MRT	Mass Rapid Transit
O & M	Operation and Maintenance
PWD	Public Works Department
RAJUK	Rajdhani Unnayan Kartripakkha
RDP	Regional Development Plan
RHD	Roads and Highways Department
SN	Serial Number
SoB	Survey of Bangladesh
ToR	Terms of Reference
WL	Water Level
WQ	Water Quality

CHAPTER 1

INTRODUCTION

1 INTRODUCTION

1.1 BACKGROUND

Water is continually moving around, though, and above the Earth. It moves as water vapor, liquid water, and ice. It is constantly changing its form. Water on Earth is known by different terms, depending on where it is and where it came from. Agricultural operations can be the source of non-point pollution in surface water. The major causes of surface water pollution associated with farming and ranching are sediment and nutrients. Soil erosion and resulting sedimentation is the leading cause of surface water pollution. Siltation is the leading cause of water quality problems in rivers. Although soil erosion is a natural process, it can be greatly accelerated by human activities such as farming. Major sources of sediment include runoff from cropland, forestry and urban/suburban development are the key points for surface water pollution.

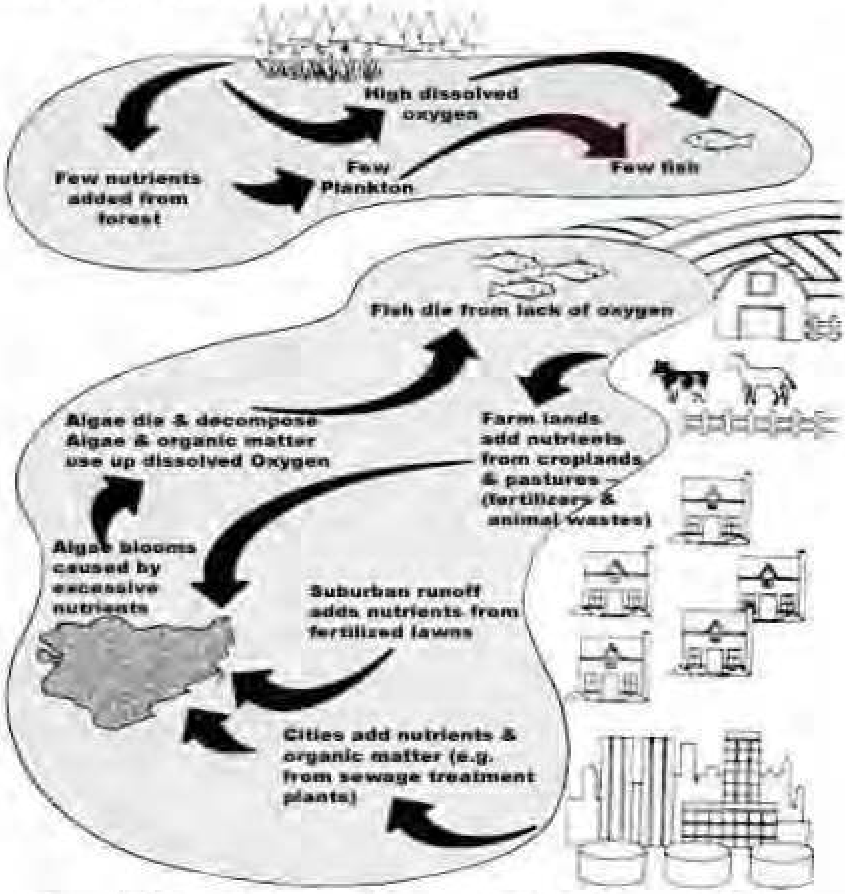


Figure 1:1 Schematic diagram- Different source for Surface water pollution

Water quality monitoring is an important aspect of overall water quality management and water resource development. A well-planned and well-managed water quality monitoring system is required to signal, control or predict the changes or trends in the quality of a particular water body, so that curative or preventive measures can be taken to restore and maintain water body properly. Monitoring is essential for the successful implementation of environmental legislation: to ensure the standards (BD Standard, Annex-1) and criteria set by government are being maintained on a continuing basis. Monitoring involves the laboratory and /or spot testing of water samples collected from desirable locations both source and supply system.

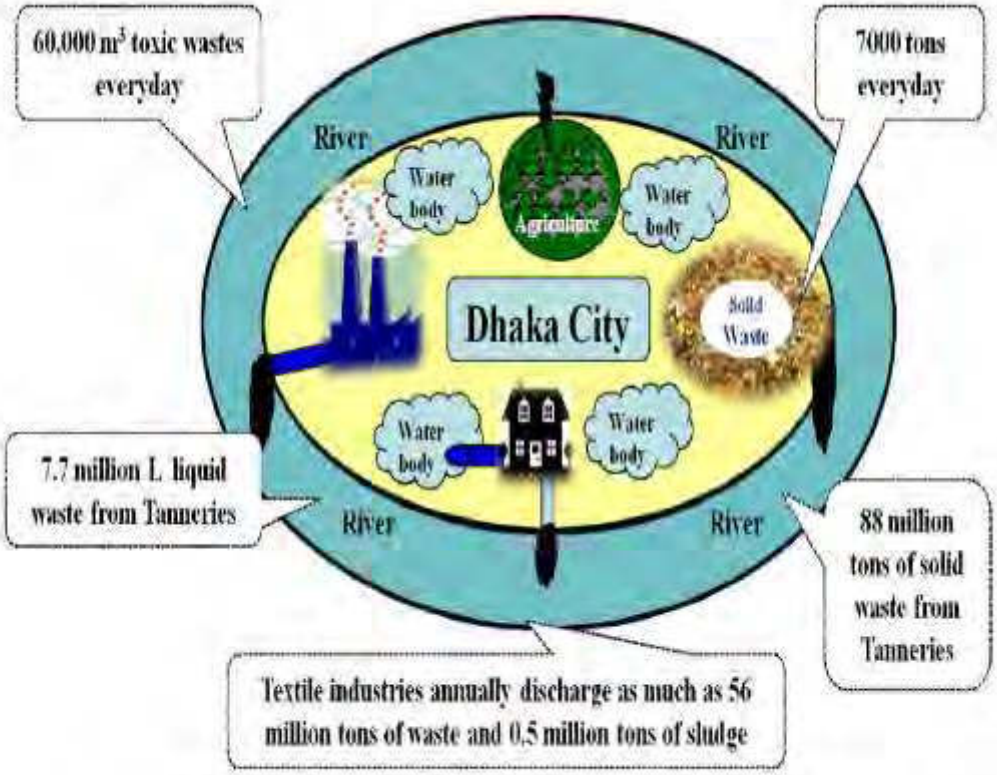


Figure 1:2 Schematic diagram-River pollution around Dhaka City

River pollution around Dhaka City from different sources is exhibited in **Figure 1.2**. The main sources include industrial untreated wastewater, tannery waste, municipal solid waste, household waste etc. [Article Ref. Environments 2(3):280-294 - June 2015 (Article Alteration of Water Pollution Level with the Seasonal Changes in Mean Daily Discharge in Three Main Rivers around Dhaka City, Bangladesh)]

1.2 OBJECTIVES

There are many instances where surface water does not meet drinking water quality standard due to presence of inferior substances or pollutants. This sort of water should not be introduced in water supply system before treatment. Rainfall (such as acid rain), storm water runoff, agriculture runoff, industrial wastes etc. can affect the color, odor, dissolved oxygen of water and also influences on major ion levels, bacteria level in surface water.

The target of this study is to know the change of surface water quality with respect to time by testing some fundamental parameters, which can represent or can give a synopsis of the given surface water quality before going for a wide scale parameter testing.

To assess the variation of surface water quality over the period of eighteen months for better understanding appropriate surface water treatment facilities for 500MLD capacity of DWASA surface treatment plant which is going to be installed at Bishnondi Araihazar using Meghna river water to ensure better quality water supply at mega-city Dhaka. In order fulfill the above objective, **Onushandhani CREEDS Ltd** has been assigned to conduct surface water quality monitoring at proposed intake point at Bishnondi, Bank of Meghna River, Araihazar under DESWSP, DWASA [RFQW-3.32] for eighteen months.

1.3 SCOPE OF WORKS

The actual works envisaged for implementation are quantified as follows:

1. Conduct hourly, weekly, monthly and seasonal sampling.
2. Conduct some water quality parameter like pH, salinity, conductivity, TDS, hardness, ammonia, color by using portable instrument and test kit
3. Organize laboratory tests for monthly and seasonal sample at DPHE Central Lab & BCSIR Lab
4. Data Analysis
5. Result Interpretation
6. Generation and submission of monthly report to DWASA

1.4 DESCRIPTION OF SAMPLING AREA

Location of the sampling point:

Chaitankanda, Bishnondi Araihazar

Geo-Coordinates: N=23° 44' 47.107" N, E=90° 43' 00.000"E

Distance from bank of Meghna River: 100m from bank of river where Surface Water Treatment Plant structure place is allocated.

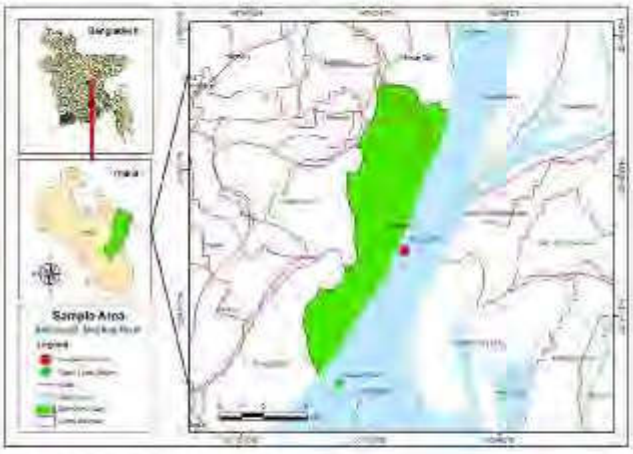


Figure 1.3 Study Area Map of Bishnondi, Araihazar

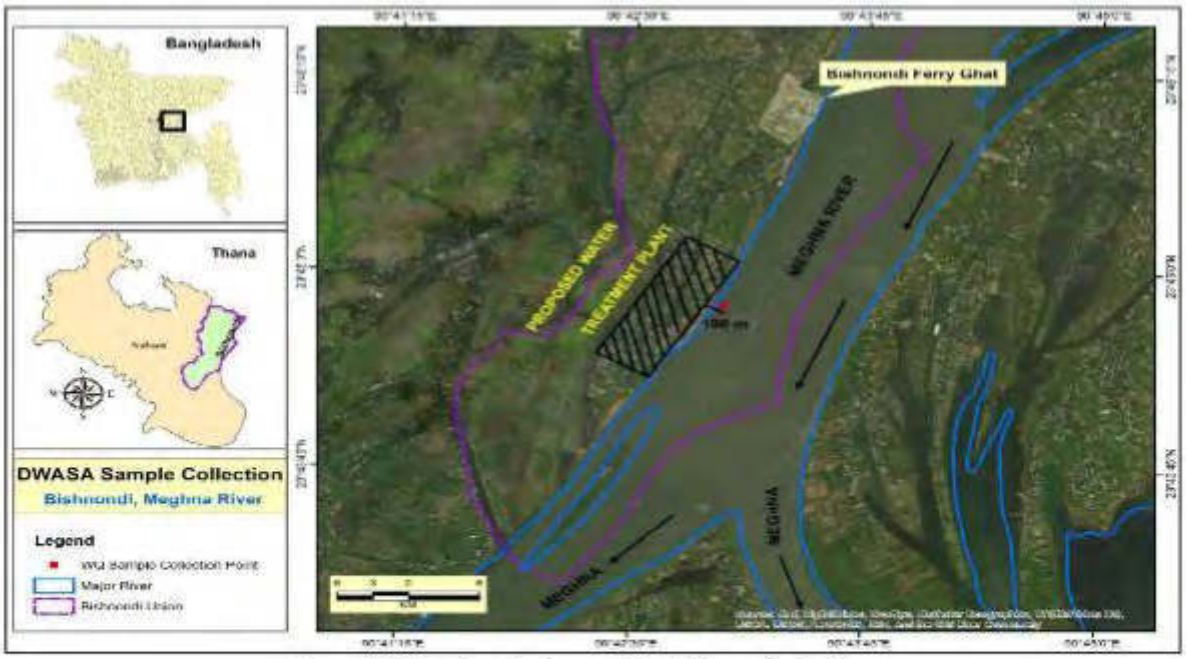


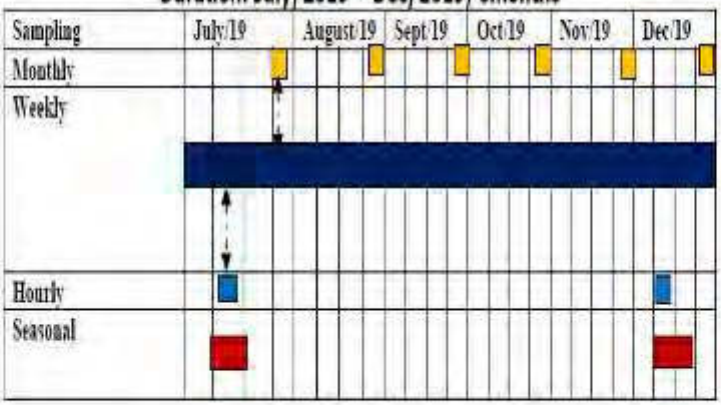
Figure 1:4 Sample collections point of Bishnondi, Araihazar

1.5 Work Plan and Professional Staffing

Schedule of Surface Water Quality Monitoring-Bishnondi, bank of Meghna River,Arihazer

[Chaitankanda, Bishnandi, Geo-Coordinates: N=23° 44' 47.107" N, E=90° 43' 00.000"E)]

Duration: July/2019 – Dec/2019; 6months



Duration: January/2020 – Dec/2020; 12months

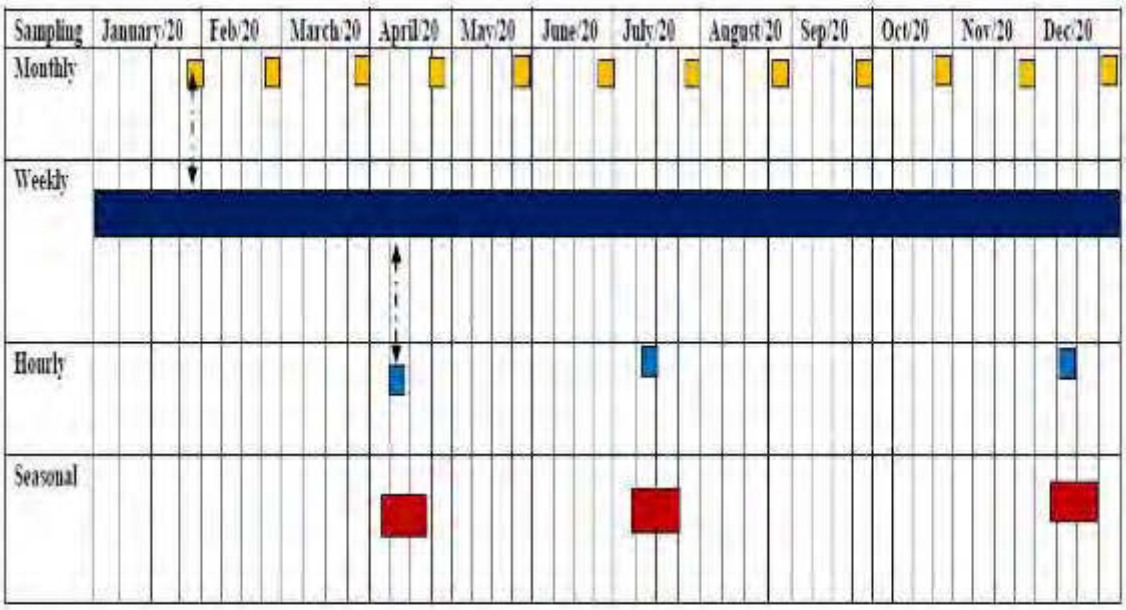


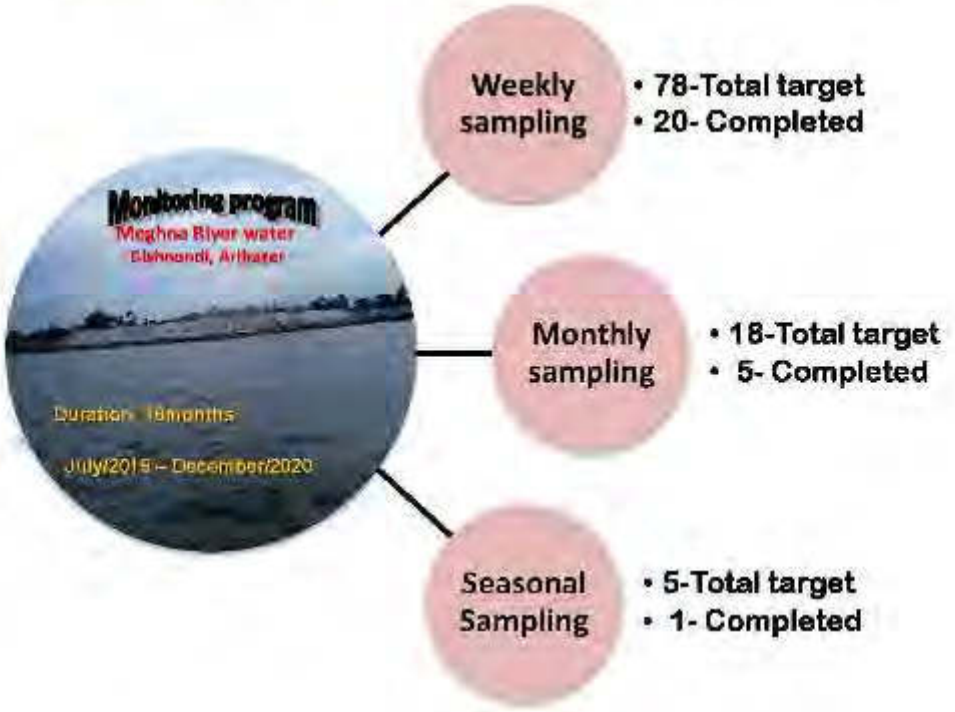
Figure 1:5 Work Plan of the Project

Table 1-1: List of Professional staff involved in this study

Name of The Expert	Position
Dr. Jubair Tariqul Alam Chowdhury	Water Quality /Environment Specialist and Adviser
Dr. Syed Zakir Hossain	River Morphological Specialist
Md. Shahadat Hossain	Water Supply Specialist
Rayaan Jubair Chowdhury	Environmental Engineer
Mohimen Ur Rahman	Water Quality Analyzer
Mansura Khanum	GIS Expert
Mahbubul Alam	Hydro-geologist
Wakil Ahmed	Junior Engineer

Progress Index

Monitoring duration: July/2019 to December/2020
Reporting Month: November/2019
Progress month=Five month July; August, September, October & November/2019



CHAPTER 2
METHODOLOGY

2 METHODOLOGY

The Methods and instruments for different parameter analysis and sample collections were selected by following the standard methods for the examination of water and wastewater proposed by APHA (American Public Health Association), AWWA (American Water Works association) & WEF (Water Environment Federation).

2.1 Sampling Approach and Methodology

a. **Sampling point:**

The sampling point is located at Bishnondi. GPS location of sampling points is N: 23° 44' 47.107" N, E: 90° 43' 00.000"E Distance between sampling point and bank of river is 100meters [minimum river bank in dry season]

b. **Water Sample:**

(i) 1st grab water sample should be collected from a depth of 0.5meter every time. Measure some physicochemical parameters (Temperature, pH, Conductivity, Turbidity, Dissolved Oxygen, TDS and Ammonia) at field and record properly.

(ii) Sample in different depths: Made up of two equal parts collected at predetermined intervals of depth between the surface and probable inlet point of the intake pipe, which is approximately 8m from surface of the river. In this case, another two grab samples (2nd & 3rd Grab) will be collected from equal depth interval and measure some physicochemical parameters (Temperature, pH, Salinity, Conductivity, Turbidity, Dissolved Oxygen, TDS and Ammonia) at field for each grab sample separately and record properly.

(iii) A composite sample (combining portions of these three multiple grab samples) should be collected for detail chemical and microbiological analysis at laboratory. Composite sample should be composition of three grab samples.

(iv) Measure physicochemical parameters (Temperature, pH, Salinity, Conductivity, Turbidity, Dissolved Oxygen, TDS and Ammonia) for composite sample, after immediate mixing of the three grab samples (1st, 2nd & 3rd Grab sample), at field and record properly.

(v) After the field physicochemical measurements have been recorded, collect water samples for laboratory analysis, both chemical and microbiological, at the same location and same depth in same manner. It is mentioned that one grab sample (1st grab sample) and one composite sample (combining portions of 1st, 2nd & 3rd grab sample) should be collected for laboratory analysis during monthly sampling and seasonal variation for special pollutants sampling.

(vi) Salinity test during high tide: Measure salinity monthly basis during high tide only at Meghna Bridge spot. Measure salinity in three different depths [See b (i) & (ii)]. Additionally, Salinity test (at 4 points): Measure salinity at 4 (four) points in between Meghna Bridge and Intake point of SWTP (Bishnondi) with three equal intervals.

For other parameter analysis at laboratory, the volume of samples and the preservative are (1) four liter-without preservative ;(2) two liter with HCl as preservative (3) four liter with HNO_3 as preservative.

Water Level: Water Level shall be measured weekly at Bishnondi sampling point. The level should be related to national datum. Other observations should be recorded properly according to a "Field Survey Form".

The following points should be considered during sampling:

- Sampling by Boat: Always collect samples upstream from the boat and as far away from the motor as possible, to minimize the chance of gas or oil contamination. Turn off the engine before collecting samples.
- When samples are collected during abnormally high or low flow, the abnormal conditions should be recorded in the field logbook and on the observation lines of the sample data form. It is important to include flow severity and days since last rainfall rain information with each sampling event. This information is very useful in interpreting the data.
- Upon arrival at the sampling site, record visual observations on the appearance of the water like color, unusual amount of suspended matter, debris or foam etc. and other information related to water quality and water use.
- Weather such as heavy rains, cold front, very dry, very wet etc. information should be recorded.
- Unusual incidences like presence of hydrogen sulfide, sewage and biological activity like excessive phytoplankton or algal growth should be recorded during sample collection and testing at field.
- The sample location should be strictly maintained in the same place during the whole period of this survey. Samples should not be collected during rainfall.
- The required instruments are Multi parameter analyzer, Turbidity meter, Ammonia kit, Flow meter, Depth measurement meter, surface water sampler, HDPE sample bottles, acid, cool box etc.

2.2 Duration of the monitoring:

The tentative duration of the study is 18 months, starting from July 2019 to December 2020.

CHAPTER 3

DESCRIPTION OF SAMPLING

3 DESCRIPTION OF SAMPLING

Following detailed discussion at DWASA office, the field survey for the study was scheduled. After the signing of the project on July 16, 2019, there were three weeks of scheduled weekly sampling.

3.1 Sampling Schedule:

Water sample will be collected under different time frequency such as weekly, monthly, seasonal and hourly. The detailed description is as follow:

Weekly sampling:

Duration: July/2019- Dec/2020; Total week= 78 weeks

Test type: Field-test using field kit and portable instrument. Weekly sample will not send to lab test.

(A) Test type: Field test: [using field kit and portable instrument]

Table 3-1: Field test parameters

Water quality parameter	1st grab sample	2nd grab sample	3rd grab sample	Composite Sample-1	Type of instrument/Kit
Temperature	78	78	78	78	Multi parameters Meter
pH,	78	78	78	78	Multi parameters Meter
Salinity	78	78	78	78	Multi parameters Meter
Conductivity	78	78	78	78	Multi parameters Meter
Turbidity	78	78	78	78	Multi parameters Meter
Dissolved Oxygen (DO)	78	78	78	78	Multi parameters Meter
TDS	78	78	78	78	Turbidity meter
Ammonia	78	78	78	78	Ammonia kit
Total Hardness	78	78	78	78	Hardness kit
Color	78	78	78	78	Colorimeter

*Orange Shade=Test by Portable instrument; Blue shade=Test by kit

Monthly sampling:

Duration: July/2019- Dec/2020; Total month= 18 months. Monthly sample will be collected 4th week of each month. Weekly sample of 4th week of each month will also be considered as monthly sample for field parameter.

Type of Test:

i. **Field test:** Same as before using field kit and portable instrument.

ii. **Laboratory test:** Sample will be send to DHPI central lab. Parameters are Nitrate; Nitrite; COD; TSS; BOD5; Phosphate; Alkalinity; Ammonia; Total Hardness; Arsenic; Iron; Manganese and Aluminum.

Hourly /Seasonal sampling:

13 hourly samples, during daylight time, will be collected five times during study period. Hourly sample will be collected during seasonal sampling.

Test type: Field test [using field kit and portable instrument] and laboratory test

Sampling time: July/2019; Dec/2019; April/20120; July/2020 & Dec/2020

Frequency of sampling =5times during study period (18 month)

(A) Parameter test at field during hourly sampling including total number:

Table 3-2: Hourly Sampling parameters

Water quality parameter	1st grab sample	2nd grab sample	3rd grab sample	Composite Sample-1	Type of instrument/Kit
Temperature	13x5=65	13x5=65	13x5=65	13x5=65	Multi parameters Meter
pH	13x5=65	13x5=65	13x5=65	13x5=65	Multi parameters Meter
Salinity	13x5=65	13x5=65	13x5=65	13x5=65	Multi parameters Meter
Conductivity	13x5=65	13x5=65	13x5=65	13x5=65	Multi parameters Meter
Dissolved Oxygen (DO)	13x5=65	13x5=65	13x5=65	13x5=65	Multi parameters Meter
TDS (Total Dissolved Solid)	13x5=65	13x5=65	13x5=65	13x5=65	Multi parameters Meter
Turbidity	13x5=65	13x5=65	13x5=65	13x5=65	Turbidity meter
Ammonia	13x5=65	13x5=65	13x5=65	13x5=65	Ammonia kit
Total Hardness	13x5=65	13x5=65	13x5=65	13x5=65	Hardness kit

**Hours = 13; Season = 5; *Orange Shade = Test by Portable instrument; Blue shade = Test by kit*

(B) List of water quality test parameter at laboratory during hourly sampling:

Arsenic; Algae; Antimony; Ammonia; Barium; Boron; Cadmium; Chloride; Chromium (Hexavalent); Coliform (fecal); Copper; BOD_{5day}, COD; Lead; Mercury; Nitrate; Nitrite; Nike; Phosphate; TOC; Pesticides (Organo-chorine); Pesticides (Organo-phosphorus); Oil & Grease; Fluoride; Selenium; Sulphate ; Sodium; Zinc.

3.2 Field Visits

Total of 04 (four) field visits were conducted during September/2019. The field visit schedule along with personnel involved is shown in table

Table 3-3: Field Visit Schedule

Date	Sampling Type	Personnel
01/08/2019	Weekly Sampling	Name: Md. Shahadat Hossain Designation: Water Quality Analysis Specialist
		Name: Mohimen Ur Rahman Designation: Water Quality Analysis Assistant
		Name: Sourav Kanti Paul Designation: Water Quality Analysis Assistant
		Name: Fakhrul Islam Designation: Survey Assistant
08/08/2019	Weekly Sampling	Name: Md. Shahadat Hossain Designation: Water Quality Analysis Specialist
		Name: Mohimen Ur Rahman Designation: Water Quality Analysis Assistant
		Name: Sourav Kanti Paul Designation: Survey Assistant
		Name: Fakhrul Islam Designation: Survey Assistant
14/08/2019	Weekly Sampling	Name: Dr. J.T.A Chowdhury Designation: Water Quality Expert and Adviser of the Study
		Name: Rayaan Jubair Chowdhury Designation: Environmental Engineer
		Name: Mohimen Ur Rahman Designation: Water Quality Analysis Assistant
		Name: Sourav Kanti Paul Designation: Survey Assistant
		Name: Fakhrul Islam Designation: Survey Assistant
21/08/2019		Name: Mohimen Ur Rahman Designation: Water Quality Analysis Assistant
		Name: Sourav Kanti Paul Designation: Survey Assistant
		Name: Fakhrul Islam Designation: Survey Assistant
28/08/2019	Seasonal Sampling	Name: Dr. J.T.A Chowdhury Designation: Water Quality Expert and Adviser of the Study
		Name: Sourav Kanti Paul Designation: Survey Assistant
		Name: Fakhrul Islam Designation: Survey Assistant
		Name: Mohimen Ur Rahman Designation: Water Quality Analysis Assistant

*Photo of field sampling activities are shown in Annexures-3.

3.3 Laboratory Tests

(A) Laboratory test during monthly sampling including name of the parameter, total number of samples, type of sample and name of the lab are as below :

Table 3-4: Laboratory test parameters for monthly sample

Water quality parameter	Composite Sample	Name of the Lab
Nitrate	18	DPHE Center Lab, Mohalchari
Nitrite	18	
COD	18	
TSS	18	
BOD_5	18	
Phosphate	18	
Alkalinity	18	
Ammonia	18	
Total Hardness	18	
Arsenic	18	
Iron	18	
Manganese	18	
Aluminium	18	

(B) Laboratory test during hourly sampling including name of the parameter, total number sample, name of the lab is as below:

Table 3-5: Laboratory test parameters for hourly sample

Water quality parameter	Composite Sample	Name of the Lab
Arsenic	5	DPHE
Algae	5	BCSIR
Barium	5	DPHE
Cadmium	5	DPHE
Chloride	5	DPHE
Chromium(Hexavalent)	5	BCSIR
Coliform(fecal)	5	DPHE
BOD	5	DPHE
COD	5	DPHE
Lead	5	DPHE
Mercury	5	BCSIR
Ammonia	5	DPHE
Nitrate	5	DPHE
Nitrite	5	DPHE
Phosphate	5	DPHE
TOC	5	BCSIR
Pesticides(Organo-chorine)	5	BCSIR
Pesticides(Organo-phosphorus)	5	BCSIR
Oil & Grease	5	BCSIR
Fluoride	5	DPHE
Selenium	5	DPHE
Zinc	5	DPHE
Sulphate	5	DPHE
Copper	5	DPHE
Antimony	5	BCSIR
Boron	5	BCSIR
Nikel	5	DPHE
Sodium	5	DPHE

Major instrument for use in Lab

The below major instrument will be used during laboratory analysis as per "Standard Methods- For the Examination of Water and Wastewater"; 20th Edition; Prepared & Published by American Public Health Association (APHA); American Water Works Association (AWWA) and Water Environment Federation (WEF):

Table 3-6: Laboratory test equipment used for test

Parameter	Major equipment for test
Aluminum	Atomic absorption spectrophotometer
Alkalinity	Ion meter/ UV-Visible Spectrophotometer
Arsenic	Atomic absorption spectrophotometer (HVG)
Barium	Atomic absorption spectrophotometer
Cadmium	Atomic absorption spectrophotometer (heavy metal)
Chloride	Ion chromatograph (Anion)
Chromium (Hexavalent)	Ion chromatograph (Hexavalent chrome)
COD	COD Reactor, burette stand.
BOD5 20 °C	Incubator, BOD bottle
Coliform (Fecal)	Autoclave, incubator, filtration unit.
Lead	Atomic absorption spectrophotometer (heavy metal)
Mercury	Atomic absorption spectrophotometer for Hg analysis
Nitrate	Ion chromatograph (Anion)/UV-Visible Spectrophotometer
Nitrite	Ion chromatograph (Anion)/UV-Visible Spectrophotometer
Phosphate	Ion chromatograph (Anion)/ UV-Visible Spectrophotometer
S.S	Balance, Dehydrator, Desiccators, filtration unit
Sulfate	Ion chromatograph (Anion)/ UV-Visible Spectrophotometer
Silica	UV-Visible Spectrophotometer
Total dissolved solids	Balance, Dehydrator, Desiccators, filtration unit
Zinc	Atomic absorption spectrophotometer
TOC	TOC analyzer
Pesticides (Organo Chlorine)	GC-MS
Pesticides (Organo Phosphorus)	GC-MS
Oil & Grease	Solvent Extraction

Figure 3:1 Central Laboratory, DPHE, Mohakhali, Dhaka

Figure 3:2 Bangladesh Council for Scientific and Industrial Research (BCSIR)

3.4 List of portable instrument/ Test kit and others use during field activities:

The following items are required for the Water Quality Monitoring activities:

a. Multi parameters Meter (for pH, DO, Electrical Conductivity (EC), TDS. In addition, salinity test) HACH, USA
b. Turbidity meter for the measurement of Turbidity, HACH, USA
c. Testing Kits for NH3-N, As, Hardness, Alkalinity tests
d. Sampling bottles (different sizes)
e. Distilled water
f. Different acids (HCl, HNO3) for sample preservation, washing of sample bottle etc.
g. Required glassware, washing bottle etc.

3.5 Field Survey data form:

A field survey data form has been developed which is shown in the **Annexure-1** section of this report.

3.6 Drinking Water Quality Standard:

Bangladesh Drinking Water Quality standards [ENVIRONMENT CONSERVATION RULES 1997, Published: 28th August, 1997, Government of the People's Republic of Bangladesh, Ministry of Environment] are shown in the **Annexure-2** section of the report.

4 RESULTS AND DISCUSSIONS

4.1 Weekly sampling- Field test results

Table 4-1-1: Weekly Sampling Field Test Results: Sampling date: 02/11/2019

Water quality field test parameters (weekly sample); Month: November/2019											
Date:02-11-2019											**Time: 10-12**
Sample	**Depth (m)**	**Temp (°C)**	**pH**	**Salinity ‰**	**Cond. (µS/cm)**	**TDS (mg/l)**	**DO (mg/l)**	**Turbidity (NTU)**	**Hardness (mg/l)**	**NH3 (mg/l)**	**Color (Hazen Unit)**
1st grab sample	0.05	30.3	7.3	0.03	74.6	32	6.52	70	40	0.33	325
2nd grab sample	4	28.3	7.3	0.03	74.3	32.8	6.83	72	40	0.35	326
3rd grab sample	8	28.2	7.2	0.03	79.4	35	6.79	65	40	0.33	315
Composite Sample		28	7.2	0.03	77.1	33.9	6.84	70	40	0.33	321

Water quality field test parameters (weekly sample); Month: November/2019											
Date:02-11-2019											**Time: 10-12**
Sample	**Depth (m)**	**Temp °C**	**pH**	**Salinity ‰**	**Cond. µS/cm**	**TDS mg/l**	**DO mg/l**	**Turbidity NTU**	**Hardness mg/l**	**NH3 mg/l**	**Color Hazen Unit**
1st grab sample	0.05	30.3	7.3	0.03	74.6	32	6.52	70	40	0.33	325
2nd grab sample	4	28.3	7.3	0.03	74.3	32.8	6.83	72	40	0.35	326
3rd grab sample	8	28.2	7.2	0.03	79.4	35	6.79	65	40	0.33	315
Max(Grab Sample)		30.3	7.3	0.03	79.4	35	6.83	72	40	0.35	326
Min(Grab Sample)		28.2	7.2	0.03	74.3	32	6.52	65	40	0.33	315
Avg(Grab Sample)		28.933	7.2667	0.03	76.1	33.2667	6.7133	69	40	0.33667	322
Std. Dev (Grab Sample)		1.185	0.058	0.000	2.862	1.553	0.169	3.606	0.000	0.012	6.083
Composite sample		28	7.2	0.03	77.1	33.9	6.84	70	40	0.33	321

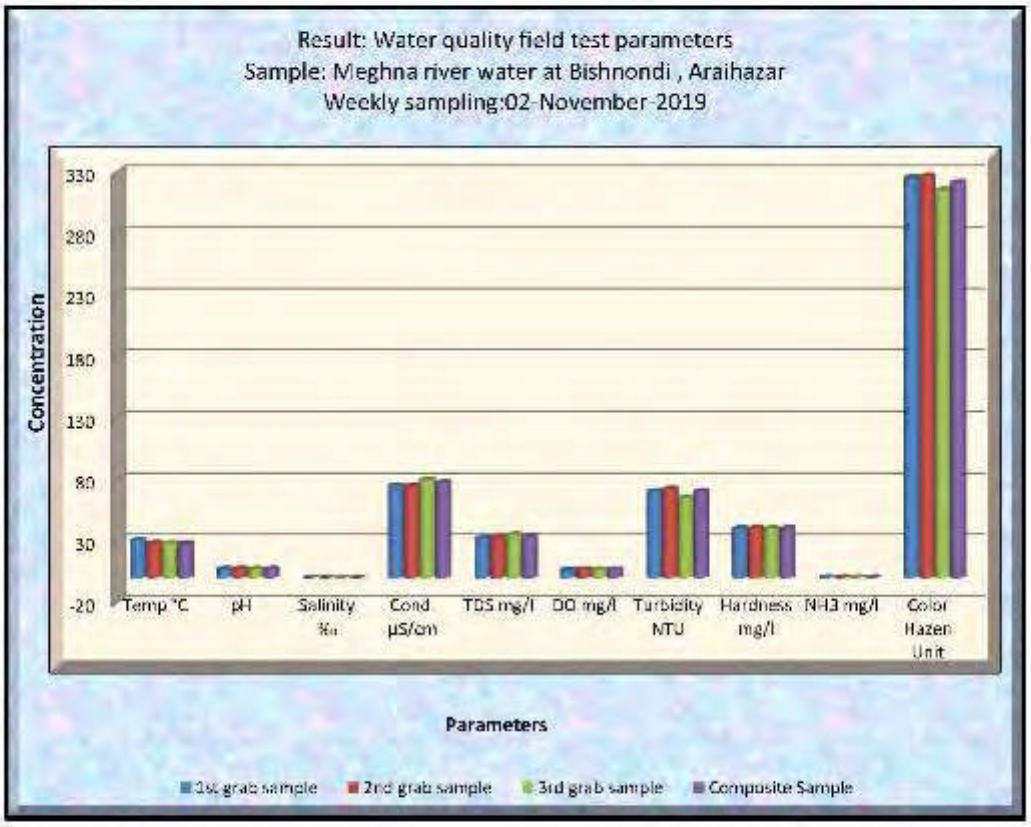


Figure 4:1:1 Comparison of different water quality parameters at different depth; 1st week.

Table 4-1-2: Weekly Sampling Field Test Results: Sampling date:11/11/2019

Water quality field test parameters (weekly sample); Month: November/2019											
Date:11-11-2019										**Time: 10-12**	
Sample	**Depth (m)**	**Temp(°C)**	**pH**	**Salinity ‰**	**Cond. (µS/cm)**	**TDS (mg/l)**	**DO (mg/l)**	**Turbidity (NTU)**	**Hardness (mg/l)**	**NH3 (mg/l)**	**Color (Hazen Unit)**
1st grab sample	0.5	27.7	7.4	0.03	80.8	37.3	7.08	32.26	40	0.3	213
2nd grab sample	4	27.1	7.5	0.03	83.8	31.5	7.01	31.32	40	0.55	197
3rd grab sample	8	26.8	7.3	0.03	74.8	31.2	7.12	32.2	40	0.36	182
Composite Sample		27.2	7.4	0.03	77.4	32.4	7.09	30.96	40	0.4	189

Water quality field test parameters (weekly sample); Month: November/2019											
Date:11-11-2019										**Time: 10-12**	
Sample	**Depth (m)**	**Temp °C**	**pH**	**Salinity ‰**	**Cond. µS/cm**	**TDS mg/l**	**DO mg/l**	**Turbidity NTU**	**Hardness mg/l**	**NH3 mg/l**	**Color Hazen Unit**
1st grab sample	0.5	27.7	7.4	0.03	80.8	37.3	7.08	32.26	40	0.3	213
2nd grab sample	4	27.1	7.5	0.03	83.8	31.5	7.01	31.32	40	0.55	197
3rd grab sample	8	26.8	7.3	0.03	74.8	31.2	7.12	32.2	40	0.36	182
Max(Grab Sample)		27.7	7.5	0.03	83.8	37.3	7.12	32.26	40	0.55	213
Min(Grab Sample)		26.8	7.3	0.03	74.8	31.2	7.01	31.32	40	0.3	182
Avg(Grab Sample)		27.2	7.4	0.03	79.8	33.3333	7.07	31.92667	40	0.40333	197.333333
Std. Dev (Grab Sample)		0.4583	0.1	0	4.58258	3.43851	0.0557	0.526245	0	0.13051	15.5026879
Composite sample		27.2	7.4	0.03	77.4	32.4	7.09	30.96	40	0.4	189

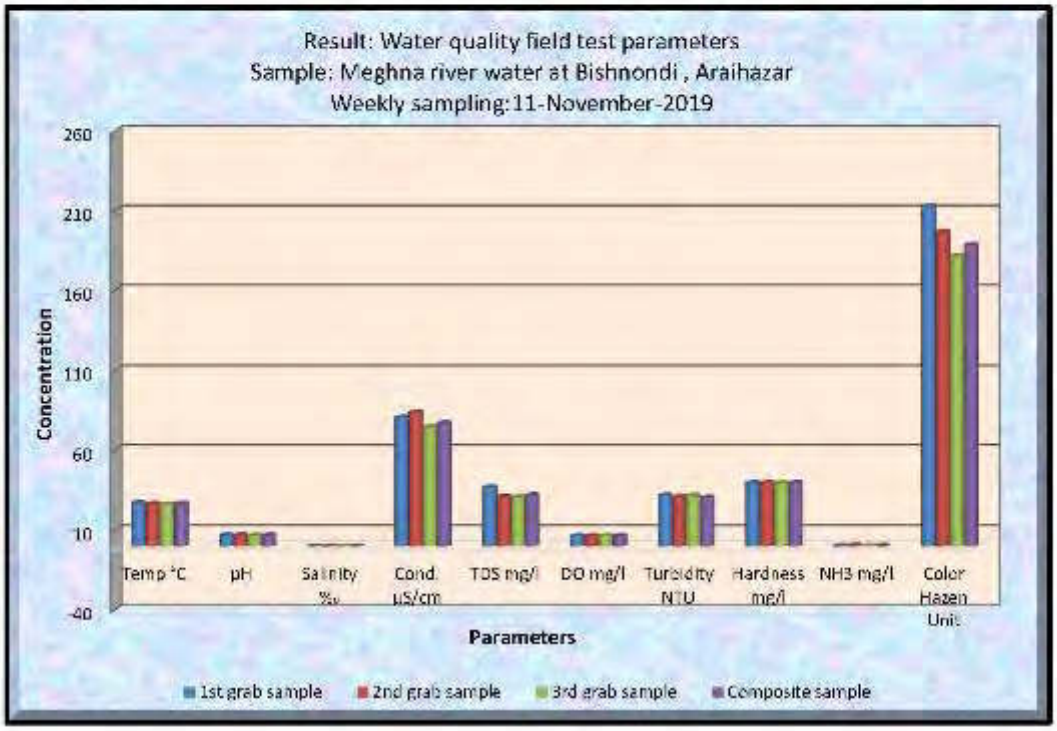


Figure 4: 1:2 Comparison of different water quality parameters at different depth; 2nd week.

Table 4-1-3: Weekly Sampling Field Test Results: Sampling date: 16/11/2019

Water quality field test parameters (weekly sample); Month: November/2019											
Date:16-11-2019											**Time: 10-12**
Sample	Depth (m)	Temp (°C)	pH	Salinity ‰	Cond. (µS/cm)	TDS (mg/l)	DO (mg/l)	Turbidity (NTU)	Hardness (mg/l)	NH3 (mg/l)	Color (Hazen Unit)
1st grab sample	0.5	28.2	7.5	0.03	76.1	34.3	7.02	26.25	40	0.33	211
2nd grab sample	4	27	7.6	0.03	77.3	36.1	6.98	28.32	40	0.51	215
3rd grab sample	8	26.6	7.3	0.03	76.5	34.9	7.09	29.25	40	0.48	205
Composite Sample		27.2	7.5	0.03	76.9	34.9	7.02	28.25	40	0.49	204

Water quality field test parameters (weekly sample); Month:September/2019											
Date:16-11-2019											**Time: 10-12**
Sample	Depth (m)	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample	0.5	28.2	7.5	0.03	76.1	34.3	7.02	26.25	40	0.33	211
2nd grab sample	4	27	7.6	0.03	77.3	36.1	6.98	28.32	40	0.51	215
3rd grab sample	8	26.6	7.3	0.03	76.5	34.9	7.09	29.25	40	0.48	205
Max(Grab Sample)		28.2	7.6	0.03	77.3	36.1	7.09	29.25	40	0.51	215
Min(Grab Sample)		26.6	7.3	0.03	76.1	34.3	6.98	26.25	40	0.33	205
Avg(Grab Sample)		27.267	7.4667	0.03	76.6333	35.1	7.03	27.94	40	0.44	210.333333
Std. Dev (Grab Sample)		0.8327	0.1528	0	0.61101	0.91552	0.0557	1.535676	0	0.09644	5.03322296
Composite sample		27.2	7.5	0.03	76.9	34.9	7.02	28.25	40	0.49	204

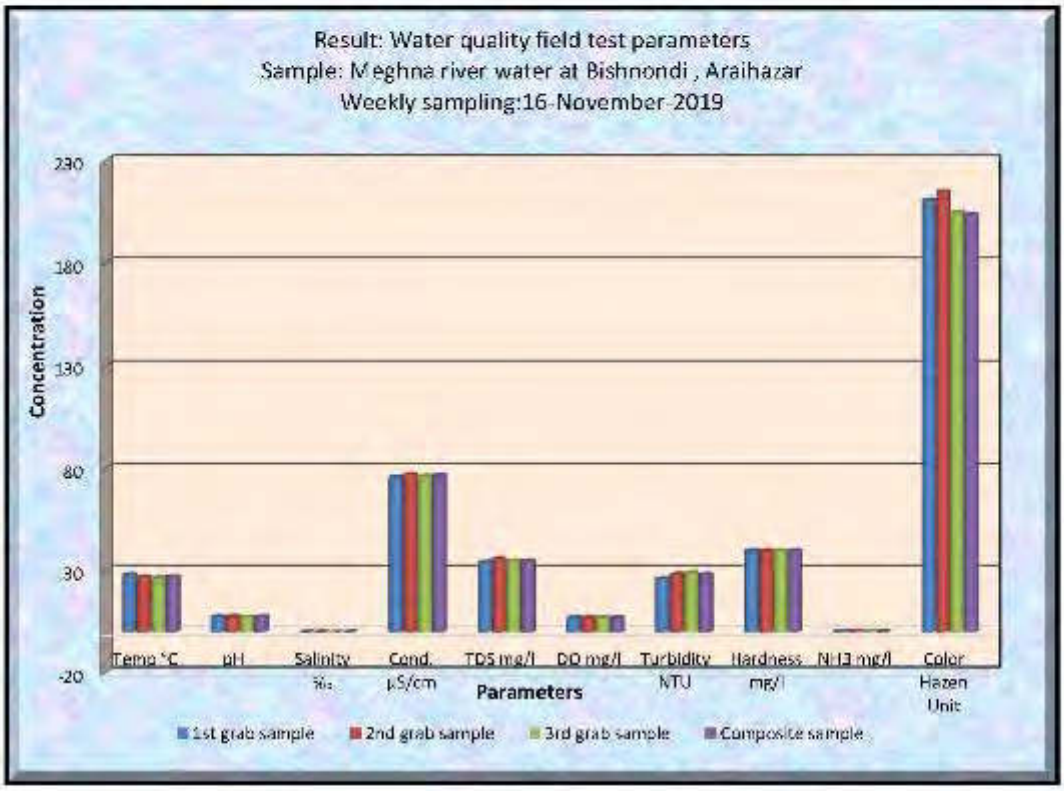


Figure 4:1:3 Comparison of different water quality parameters at different depth; 3rd week.

Table 4-1-4: Weekly Sampling Field Test Results: Sampling date:23/11/2019

Water quality field test parameters (weekly sample); Month: November/2019											
Date:23-11-2019											**Time: 10-12**
Sample	**Depth (m)**	**Temp (°C)**	**pH**	**Salinity ‰**	**Cond. (µS/cm)**	**TDS (mg/l)**	**DO (mg/l)**	**Turbidity (NTU)**	**Hardness (mg/l)**	**NH3 (mg/l)**	**Color (Hazen Unit)**
1st grab sample	0.5	28.3	7.6	0.03	79.2	37	6.56	25.51	40	0.4	185
2nd grab sample	4	27.3	7.6	0.03	77.6	36.4	6.83	29.92	40	0.33	182
3rd grab sample	8	26	7.6	0.03	82.3	38.7	7.14	26.79	40	0.35	180
Composite Sample		26.7	7.4	0.03	79.7	37.6	7.14	26.39	40	0.38	181

Water quality field test parameters (weekly sample); Month: November/2019											
Date:23-11-2019											**Time: 10-12**
Sample	Depth (m)	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH3 mg/l	Color Hazen Unit
1st grab sample	0.5	28.3	7.6	0.03	79.2	37	6.56	25.51	40	0.4	185
2nd grab sample	4	27.3	7.6	0.03	77.6	36.4	6.83	29.92	40	0.33	182
3rd grab sample	8	26	7.6	0.03	82.3	38.7	7.14	26.79	40	0.35	180
Max(Grab Sample)		28.3	7.6	0.03	82.3	38.7	7.14	29.92	40	0.4	185
Min(Grab Sample)		26	7.6	0.03	77.6	36.4	6.56	25.51	40	0.33	180
Avg(Grab Sample)		27.2	7.6	0.03	79.8	37.44	6.846	27.53	40	0.362	182.4
Std. Dev (Grab Sample)		1.1533	1E-15	0	2.38956	1.19304	0.2902	2.268751	0	0.03606	2.51661148
Composite sample		26.7	7.4	0.03	79.7	37.6	7.14	26.39	40	0.38	181

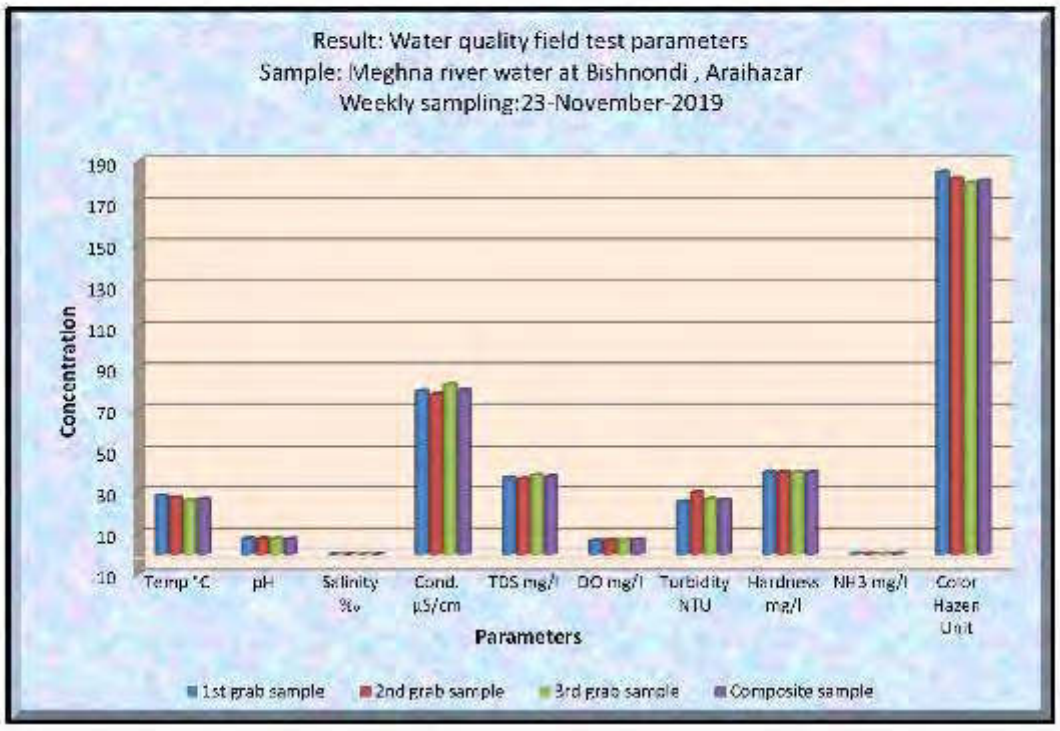


Figure 4:1:4 Comparison of different water quality parameters at different depth; 4th week.

Table 4-1-5: Weekly Sampling Field Test Results: Sampling date:30/11/2019

Water quality field test parameters (weekly sample); Month: November/2019											
Date:30-11-2019											**Time: 10-12**
Sample	**Depth (m)**	**Temp (°C)**	**pH**	**Salinity ‰**	**Cond. (µS/cm)**	**TDS (mg/l)**	**DO (mg/l)**	**Turbidity (NTU)**	**Hardness (mg/l)**	**NH3 (mg/l)**	**Color (Hazen Unit)**
1st grab sample	0.5	27.7	7.4	0.03	87.1	40.5	6.65	23.14	40	0.4	215
2nd grab sample	4	26.8	7.5	0.03	86.3	40.6	7.16	20.85	40	0.45	245
3rd grab sample	8	26.7	7.4	0.03	85.8	40.4	7.17	20.46	40	0.43	210
Composite Sample		26.8	7.4	0.03	86.3	40.4	7.04	23.34	40	0.42	219

Water quality field test parameters (weekly sample); Month: November/2019											
Date:30-11-2019											**Time: 10-12**
Sample	**Depth (m)**	**Temp °C**	**pH**	**Salinity ‰**	**Cond. µS/cm**	**TDS mg/l**	**DO mg/l**	**Turbidity NTU**	**Hardness mg/l**	**NH3 mg/l**	**Color Hazen Unit**
1st grab sample	0.5	27.7	7.4	0.03	87.1	40.5	6.65	23.14	40	0.4	215
2nd grab sample	4	26.8	7.5	0.03	86.3	40.6	7.16	20.85	40	0.45	245
3rd grab sample	8	26.7	7.4	0.03	85.8	40.4	7.17	20.46	40	0.43	210
Max(Grab Sample)		27.7	7.5	0.03	87.1	40.6	7.17	23.14	40	0.45	245
Min(Grab Sample)		26.7	7.4	0.03	85.8	40.4	6.65	20.46	40	0.4	210
Avg(Grab Sample)		27.07	7.433	0.03	86.4	40.5	6.9933	21.48333	40	0.4267	223.3333
Std. Dev (Grab Sample)		0.551	0.058	0	0.65574	0.1	0.2974	1.447907	0	0.0252	18.92969
Composite sample		26.8	7.4	0.03	86.3	40.4	7.04	23.34	40	0.42	219

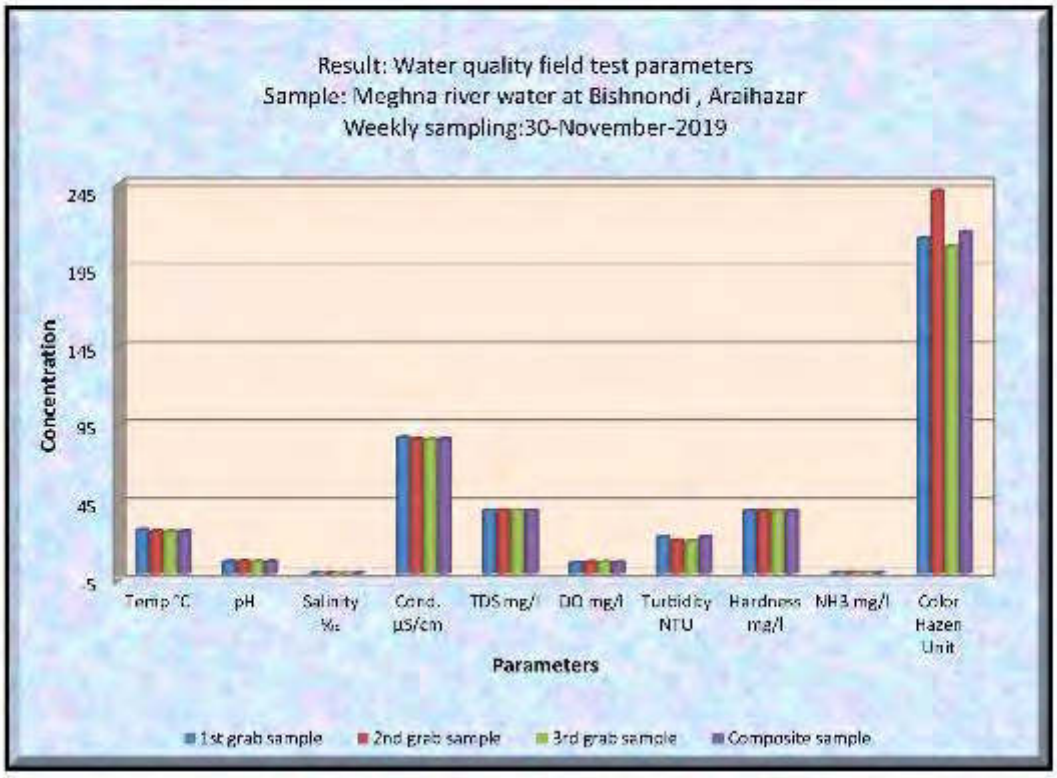


Figure 4:1:5 Comparison of different water quality parameters at different depth; 5th week.

4.2 Laboratory Test Results Monthly Sample

Water quality Laboratory test result- Monthly sample; Composite sample					
Test conducted by; DPHE Central Laboratory, Mohakhali, Dhaka					
4th - Monthly sample: November/2019					
Date: 31-07-2019	Composite sample Depth= [Sample-1: 0.5m+Sample-2:4m+Sample-3: 8m]				
Water quality parameters	**Bangladesh Standard**	**Concentration present**	**Unit**	**Analysis Method**	**LOQ**
Alkalinity		92	mg/L	Titrimetric	
Aluminum	0.2	**0.193**	mg/L	AAS	0.002
Ammonia	0.5	**0.56**	mg/L	UVS	0.1
Arsenic (As)	0.05	0.001	mg/L	AAS	0.001
Biochemical Oxygen Demand (BOD)	0.2	**2**	mg/L	days Incubation	0.1
Chemical Oxygen Demand (COD)	4	**12**	mg/L	CRM	
Hardness	200-500	113	mg/L	Titrimetric	
Iron (Fe)	0.3-1	0.21	mg/L	AAS	0.05
Manganese (Mn)	0.1	0.03	mg/L	AAS	0.03
Nitrogen (Nitrate)	10	2.2	mg/L	UVS	0.1
Nitrogen (Nitrite)	<1.0	0.03	mg/L	UVS	0.02
Phosphate	6	1.0	mg/L	UVS	0.1
Total Suspended Solid (TSS)	10	1	mg/L	Gravimetric Method	

CHAPTER 5

CONCLUSION

5 CONCLUSION

BOD and COD have been observed to have higher trend in monthly sample. Low BOD and COD value is an indicator of good quality water, while high value indicates polluted water. Bacteria consume dissolved oxygen (DO) when large amounts of organic matter from sewage or other discharges are present in the water.

BOD and COD tests result during monthly sample analysis by laboratory have been found to be 2 mg/L and 12mg/L respectively. This value is higher than the BD standard value of BOD and COD and has remained approximately constant with the preceding month. It needs more observations from other months to understand the trend of pollution.

Continuous water quality monitoring is essential for efficient management of urban rivers water in urban periphery area or urban /village residential area for the prompt control of pollution. Due to the rapid responses of urban rivers to intensive land use and/or diverse pollution sources, the deterioration of the water quality may be accelerated, immediately posing a direct or indirect threat to human health and aquatic ecosystems. The degree of organic pollution that occurs due to an excessive amount of organic matter has been typically monitored by measuring BOD and COD values in rivers. A high level of BOD deteriorates river water quality by rapid decomposition of biodegradable organic matter and the subsequent depletion of dissolved oxygen, while COD traditionally represents the total organic matter. However, both concentrations are quantified by the amount of oxygen consumed for a particular chemical oxidation of organic compounds in samples. Enrichment of total nitrogen in rivers may result in excessive growth of algae, need more chlorine during chlorination and finally different DBPs will be produced that toxic for human health.

Increase in ammonia concentration, decrease in dissolved oxygen (DO), reduction of pH value, increase of turbidity, increase of color unit requires more critical review/observation over the study period. Ammonia value has decreased in November (0.56 mg/L) than from October (0.7 mg/L) but remained approximately in the preceding months (0.63 mg/L in September and 0.6 mg/L in August).

It has been observed that there is an increase in total suspended solid (TSS) from August to September (4.3 mg/L to 6 mg/L) but remained almost same in October (5 mg/L) and dropped significantly on November (1 mg/L). This decrease might occur due to the decrease in flow of river but further data and analysis is required.

In order to provide an overall quality of water, Water Quality Index (WQI) has been calculated for the weekly and monthly samples. A Water Quality Index (WQI) is a means by which water quality data is summarized for reporting to the public in a consistent manner. A chart has been provided below for the water quality classification based on WQI.

Water quality classification based on WQI value.

Class	WQI Value	Water Quality Status
A	<50	Excellent
B	51-100	Good
C	101-200	Poor
D	201-300	Very Poor
E	>300	Water Unsuitable for Drinking

The WQI value for the weekly samples was **144.2(1st week), 115.9(2nd week), 132.5(3rd week), 109.4(4th week)** and **121.6(5th week)** respectively. The higher WQI value was contributed by the increase in turbidity and color but it remained almost constant throughout the month. The WQI value for the monthly sample was **139.5.** The contributing pollutants were COD and BOD for the increase in WQI value in monthly than from weekly (4th week). **The the monthly WQI value is high and has almost remained constant from the preceding month.**

In order to further investigate using statistical analysis, standard deviation of different parameters for composite samples (weekly samples) were calculated.

Composite Sample: November 2019

Sampling Date	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH_3 mg/l	Color Hazen Unit
2/11/2019	28	7.2	0.03	77.1	33.9	6.84	70	40	0.33	321
11/11/2019	27.2	7.4	0.03	77.4	32.4	7.09	30.96	40	0.4	189
16/11/2019	27.2	7.5	0.03	76.9	34.9	7.07	28.25	40	0.49	204
23/11/2019	26.7	7.4	0.03	79.7	37.6	7.14	26.39	40	0.38	181
30/11/2019	26.8	7.4	0.03	86.3	40.4	7.04	23.34	40	0.42	219
Max	28	7.5	0.03	86.3	40.4	7.14	70	40	0.49	321
Min	26.7	7.2	0.03	76.9	32.4	6.84	23.34	40	0.33	181
Avg	27.18	7.38	0.03	79.48	35.84	7.026	35.788	40	0.404	222.8
Std. Dev	0.3119	0.10954	0	3.975173	3.17695	0.1139	19.32529	0	0.05857	56.79084

It can be seen that standard deviation of color has increased from the preceding month (12.4% in October and 25.2% in November).

ANNEXURES

ANNEXURES

ANNEXURE-1: Field Survey Data Form

DWASA Surface Water Quality Monitoring Program

(1) Sample location : Bishnondi (Bank of Meghna River), Aribazer

[Chottankonda, Bishnandi. Geo-Coordinates: N 23° 44' 4".107" N, E 90° 43' 00.000"E)]

[Distance: 100m from bank of river where SWTP structure place is allocated]

(2) Field Observations:

Upon arrival at a sampling site, record visual observations on the appearance of the water and other information related to water quality and water use as bellow:

Parameter	Observation
a. Water Colour	Greenish /reddish / yellowish / Muddy / Colour less
b. Water appearance	Unusual amount of suspended matter / debris / foam
c. Rain fall	Heavy / Medium/ Low / None
d. Day	Cloudy day/ very dry/very wet
e. Unusual Odors	Hydrogen sulfide odor/ musty odor /sewage odor/ none
f. Biological Activity	Excessive growth of algal / Phytoplankton/ others...../none

(3) Water quality field test parameters (Weekly sample / Monthly sample)

Date: **Time:**

Sample	Depth (m)	Temp °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH_3 mg/l	Color	Flow ft³/s
1st grab sample	0.8											
2nd grab sample	4											
3rd grab sample	8											
Composite Sample (1st+2nd+3rd Grave sample)	-											

Note-1:
Field test parameters (Weekly & Monthly): Temp=Temperature; pH= Salinity, Cond=Conductivity; DO=Dissolved Oxygen; Turbidity; TDS=Total Dissolve Solid; Hardness; NH_3 = Ammonia; Color

Note-2:

Lab test parameters (Monthly sampling): Nitrate; Nitrite; COD; TSS; BOD_5; Phosphate; Alkalinity; Ammonia; Total Hardness; Arsenic; Iron; Manganese; Aluminum

(4) Seasonal Sample:

(4.A) Water quality field test parameters (Hourly sampling-1st grab sample)

Date: **Depth: 0.5meter**

Time	Temp. °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH_3 mg/l	Color	Flow ft³/s
6AM											
7AM											
8AM											
9AM											
10AM											
11AM											
12											
1PM											
2PM											
3PM											
4PM											
5PM											
6PM											

Note-3:
Seasonal Sampling (Composite sample) for Lab Test: Arsenic; Algae; Barium; Cadmium; Chloride; Chromium Hexavalent); Coliform(Fecal); BOD; COD; Lead; Mercury; Ammonia; Nitrate; Nitrite; Phosphate; TOC; Pesticides (Organo-chorine); Pesticides (Organo-phosphorus); Oil & Grease; Fluoride; Selenium; Zinc; Sulphate; Copper; Antimony; Boron; Nickel and Sodium.

Note-4:
Hourly sample will be collected during seasonal sampling

Note-5:
Sample volume and preservative.
(a) Non-preservative sample – four liter
(b) Preservative-HCl – One liter
(c) Preservative-HNO_3 – Two liter
(d) Preservative-H_2SO_4 –One liter

(4.B) Water quality field test parameters (Hourly sampling -2nd grab sample)

Date: Depth: 4 meter

Time	Temp. °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH_3 mg/l	Color	Flow ft³/s
6AM											
7AM											
8AM											
9AM											
10AM											
11AM											
12											
1PM											
2PM											
3PM											
4PM											
5PM											
6PM											

(4.C) Water quality field test parameters (Hourly sampling: 3rd grab sample)

Date: Depth: 8 meter

Time	Temp. °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH_3 mg/l	Color	Flow ft³/s
6AM											
7AM											
8AM											
9AM											
10AM											
11AM											
12											
1PM											
2PM											
3PM											
4PM											
5PM											
6PM											

(4.D) Water quality test parameters (Hourly sampling -Composite sample)

Date: **Depth= [Sample-1:0.05m+ Sample-2: 4m+ Sample-3: 8m]**

Time	Temp. °C	pH	Salinity ‰	Cond. µS/cm	TDS mg/l	DO mg/l	Turbidity NTU	Hardness mg/l	NH_3 mg/l	Color	Flow ft³/s
6AM											
7AM											
8AM											
9AM											
10AM											
11AM											
12											
1PM											
2PM											
3PM											
4PM											
5PM											
6PM											

4) Any other observations/comments:

Performed by (O.CREEDS) : **Date:**

Name	Designation	Signature

PMU Staff:

Name	Designation	Signature

Annexure-2: Bangladesh Drinking Water Quality standards

ENVIRONMENT CONSERVATION RULES 1997

Published: 28th August, 1997

Government of the Peoples' Republic of Bangladesh

Ministry of Environment

SL	Parameter	Unit	Standard
1	Aluminum	mg/L	0.2
2	Ammonia	,,	0.5
3	Arsenic	,,	0.05
4	Barium	,,	0.01
5	Benzene	,,	0.01
6	BOD5 20 °C	,,	0.2
7	Boron	,,	1.0
8	Cadmium	,,	0.005
9	Calcium	,,	75
10	Chloride	,,	150-600*
11	Chlorinated alkenes carbon tetrachloride	,,	0.01
	1.1 Dichloroethylene	,,	0.001
	1.2 Dichloroethylene	,,	0.03
	Tetrachloroethylene	,,	0.03
	Trichloroethylene	,,	0.09
12	Chlorinated phenols pentachlorophenol	,,	0.03
	2.4.6 Trichlorophenol	,,	0.03
13	Chlorine(residual)	,,	0.2
14	Chloroform	,,	0.09
15	Chromium (Hexavalent)	,,	0.05
16	Chromium (Total)	,,	0.05
17	COD	,,	4
18	Coliform (Fecal)	n/100 ml	0
19	Coliform (total) * At sea beach 1000	n/100 ml	0
20	Color	Hazen Unit	15
21	Copper	mg/L	1.0
22	Cyanide	,,	0.1
23	Detergent	,,	0.2
24	D.O	,,	6.0
25	Fluoride	,,	1.0
26	Hardness (as CaCO3)	,,	200- 500
27	Iron	mg/L	0.3-1.0
28	Kjeldahl nitrogen (Total)	,,	1.0
29	Lead	,,	0.05
30	Magnesium	,,	30-35
31	Manganese	,,	0.1
32	Mercury	,,	0.001
33	Nickel	,,	0.1

SL	Parameter	Unit	Standard
34	Nitrate	,,	10
35	Nitrite	,,	<1.0
36	Odor	,,	Odorless
37	Oil and Grease	,,	0.01
38	pH	,,	6.5-8.5
39	Phenol compounds	,,	0.002
40	Phosphate	,,	6
41	Phosphorus	,,	0
42	Potassium	,,	12
43	Radioactive substances (Total-radiation)	Bq/l	0.01
44	Total B B-radiation		0.1
45	Selenium	mg/l	0.01
46	Silver	,,	0.02
47	Sodium	,,	200
48	S.S	,,	10
49	Sulfide	,,	0
50	Sulfate	,,	400
51	Total dissolved solids	,,	1000
52	Temperature	°C	20-30
53	Tin	mg/l	2
54	Turbidity	JTU/NTU	10
55	Zinc	mg/l	5

** Chloride= 1000mg/l (for coastal Area)*

ANNEXURE-3: PHOTOGRAPH DURING FIELD SAMPLING IN DIFFERENT DATE

Figure: Weekly Sampling on 01/08/2019

Figure: Weekly Sampling on 08/08/2019

Figure: Weekly Sampling on 14/08/2019

Figure: Weekly Sampling on 21/08/2019

Figure: Seasonal/weekly Sampling on 28/08/2019