Climate Resilient Water Safety Plan

Cox's Bazar Pourashava Water Supply System

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Department of Public Health Engineering (DPHE)

UKaid

World Health Organization
Country Office for Bangladesh

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1. Introduction

The comprehensive risk assessment and management approach from source to consumer is most effective means of consistently ensuring the drinking water safety termed as water safety plan (WSP). The climate resilient water safety plan considered the climatic hazards more rigorously along with the environmental hazards. The climatic variability, climate extreme events and environmental problems (water salinity) has been deteriorating the physical, chemical and biological quality of supply water as well as the water availability. As a result the incidences of water born/washed/related diseases such as diarrhoea, cholera, dysentery, skin diseases, jaundice, hepatitis and vector born disease like malaria, dengue, etc., are increasing significantly in Bangladesh. In addition, climatic and environmental hazards can have impact at different steps of a water supply system, e.g., source/catchment, treatment plant, storage, distribution and household connections of the piped line water supply system. The extreme climate events have been deteriorating the water quality chemically and biologically, and affecting availability of fresh water, which are leaving the people to a vulnerable situation.

The Cox's Bazar Pourashava is situated by the side of the Bay of Bengal. The primary climatic parameters namely temperature, rainfall, humidity along with the climate extreme events like sea level rise, storms, tidal surges were found as major threats in this area as far as water supply system is concerned. To develop a climate resilient WSP for this Pourashava, a team was formed by involving the Pourashava water professionals, Professionals from Department of Public Health Engineering, Bangladesh Meteorological Department etc. The team developed the climate resilient water safety plan for Pourashava water supply system in collaboration with DPHE with the technical assistance of PMID and WHO. Implementation of the climate resilient water safety plan will eventually reduce the risk of water-borne diseases by improving the quality of water. The increase of temperature, humidity and rainfall, cyclone and tidal surges were the major climatic threats found in Cox's Bazar Pourashava which can deteriorate the water quality and safety. The increase of temperature would affect the water quality and availability, and hence health of Pourashava dwellers. Inadequate solid waste management, poor drainage facility, lack of fecal sludge management services, salinity and arsenic problem in ground water were the major environmental concerns for the water supply system. The water table goes down during the summer season (March to May) in this area too, which causes scarcity of water. Together with changed temperature, depletion of water table during dry season, salinity in groundwater, cyclones and tidal surges, Cox's Bazar Pourashava dwellers have become more vulnerable considering its health impact.

The climate resilient WSP document for Cox's Bazar Pourashava was aimed at developing an operational monitoring plan as well as verification monitoring plan to facilitate effective implementation of WSP at field level. The supporting programs needed to implement the plans have also been identified and compiled in this document. In this climate resilient WSP document, some samples of monitoring log sheets for staff of the Pourashava Water Supply Section (PWSS) are provided that would help to keep record of different information in relation to the climate resilient WSP implementation in Cox's Bazar Pourashava. It is expected that this WSP document for Cox's Bazar Pourashava will be utilized in prioritizing interventions that are needed to improve the water supply system and to gain confidence of users on the Water Supply System. The systematic approach suggested in the WSP would help PWSS staff to gradually overcome the limitations that often drive them to compromise with water quality.

2. Water Safety Plan (WSP) Team

2.1 Cox's Bazar Pourashava WSP Team

The authority of Cox's Bazar Pourashava under Cox's Bazar district is committed to engage relevant staff of Pourashava Council and other stakeholders to implement "Climate Resilient Water Safety Plan" for Cox's Bazar Pourashava and to provide continuous support. In this respect, a statement of such commitment was signed by the top authority, and circulated as declaration. The statement will be included in the citizen charter of the Pourashava. In order to implementing the Climate Resilient WSP, the Mayor of Cox's Bazar Pourashava assembled a Climate Resilient WSP team in consultation with DPHE. The Climate Resilient WSP team will be responsible for developing, implementing and maintaining the WSP. The team is presented in Table 1.

Table 1: List of members of Cox's Bazar Pourashava WSP team

No.	Name	Affiliation /Job Title	Role in WSP team	Contact Information (Phone no.)
1	Md. Mahbubur Rahman Chowdhury	Mayor, Cox's Bazar Pourashava	Chairman	01741-133060
2	Md. Nurul Alam	Executive Engineer (Pourashava)	General Secretary	01688-559151
3	Anupom Dey	Executive Engineer (DPHE)	Member	01554-316502
4	Mir Md. Sirajul Kalam Azad	Assistant Engineer	Member	01819-536189
5	Ranjit Kumar Dey	Water Super	Member	01710-418669
6	Ashraful Huda Siddiki Jamshed	Councillor	Member	01819-102984
7	Civil Surgeon	Civil Surgeon	Member	0341-63768
8	Representative of Cox's Development Authority	Cox's Development Authority	Member	01813-781137
9	Zahed Sarwar Sohel	Journalist	Member	01819-832390
10	Deepshikha Chakma	Sub. Asst. Engineer (DPHE)	Member	01557-184728
11	Md. Nasir Uddin	Head Master, Cox's Govt. Girls High School	Member	01714-375115
12	Local Representative	Bangladesh Awami League, Cox's Bazar	Member	01684-840001
13	Meteorologist	BMD Station, Cox's Bazar	Member	0341-63618

2.1.1 WSP Team Objective

The members of climate resilient WSP team of Cox's Bazar Pourashava will operate to accomplish the following objectives:

- Supporting all activities aimed at ensuring supply of safe water to all consumers.
- Maintaining the Pourashava supply water considering environmental and climatic concerns regularly.
- Capacity building of all officers, staff and workers of Water Supply Section (PWSS) of the Pourashava through training.

- Awareness rising among the consumers about the importance of "safe water" and "safe use of water" through courtyard meetings.
- Regular monitoring of quality of the supplied water at source and at consumers' end.
- Encouraging all consumers to pay water bill regularly.
- Ensuring proper implementation of climate resilient WSP in Cox's Bazar Pourashava and support all PWSS staff to implement each step of the documented WSP.
- Maintaining update of the log books, e.g., maintenance of the system, water quality monitoring and complaint log books.

2.1.2 Roles and Responsibilities of WSP Team

It is helpful if the responsibilities of each WSP member are clearly defined during formation of the climate resilient WSP team so that it becomes clear who will do what and when. The team includes people with authority to make any required changes easy, as well as those with technical ability to develop climate resilient WSP and supervise the implementation. For successful implementation of the climate resilient WSP, the major tasks of the Team can be outlined as follows:

1. Regular checking of the progress on improvement plan.
2. Regular checking and reviewing different log books if the assigned professionals/workers are preserving different types of data and information
3. Regular checking of operational monitoring works.
4. Regular checking of WSP application and its functional integrity in different steps.
5. Preparation and checking of annual report on climate resilient WSP and impact of WSP on water supply system.
6. Facilitating implementation of the decisions taken by climate resilient WSP team in meetings.
7. Monitoring actions taken by Pourashava Water Supply Section to implement WSP.
8. Facilitation of awareness raising program for consumers on safe water.
9. Encouraging all consumers to pay water bill regularly.
10. Increasing number of water connections by campaigning.
11. Participating in review of climate resilient WSP each year.
12. Maintaining all log books.

The individual roles and responsibilities of the WSP Team members are described below in Table 2.

Table 2: Roles and responsibilities of members of climate resilient WSP team

Team Members	Roles & Responsibility
Chairman	• Sign letters and documents relevant to climate resilient WSP, supervise the implementation • Chair the regular climate resilient WSP team meeting • Make necessary recommendations to implement the decisions taken climate resilient WSP team • Take required steps to ensure financial support to implement WSP • Distribute responsibilities among the climate resilient WSP team members and supervise their progress activities

Team Members	Roles & Responsibility
	• Ensure review of climate resilient WSP document
Member Secretary	• Maintain communication with climate resilient WSP team Adviser & members, and sharing of relevant information • Keep record of all climate resilient WSP documents, meeting minutes, training events, plans etc. • Check climate resilient WSP monitoring log books regularly • Monitor quality of supplied water at regular interval • Verification of climate resilient WSP implementation through sanitary inspection • Develop emergency plans and prepare PWSS staff for emergency situations • Take necessary steps to review and update climate resilient WSP each year
Member	• Carry out the tasks related to climate resilient WSP assigned by Chairman and Adviser of climate resilient WSP team • Communicate regularly with all relevant stakeholders • Communicate regularly with the Surveillance committee • Assist staff to collect data related about the user satisfaction • Help PWSS to take necessary steps during emergency situations • Provide necessary support to PWSS to ensure a successful implementation of climate resilient • Participate all climate resilient WSP meetings, trainings and review workshops

2.1.3 Engagement of Stakeholders

Department of Public Health Engineering (DPHE) is considered as the main stakeholder of the Cox's Bazar Pourashava piped water supply system. DPHE professionals have advisory roles to provide all sorts of technical supports for the implementation of climate resilient WSP. In addition, the Executive Engineer, DPHE, Cox's Bazar, will coordinate participation of different stakeholders and national surveillance committee to implement the developed climate resilient WSP in the Cox's Bazar Pourashava Water Supply System.

3. Description of Cox's Bazar Pourashava Water Supply System

3.1 Description of Water Supply System

The Pourashava piped water supply system of Cox's Bazar Pourashava was established in 1962. It used the groundwater as the source water. Groundwater was extracted by using eight production tube wells through submersible pumps from boreholes. The depth at which the submersible pumps extract water varied from 200'-555'. The average daily production of water was 2,400 m^3/day. During the summer seasons (March to May), production of water was less due to water table depletion. Water was supplied for approximately 10-11 hours every day to the consumers. The water supply system in Cox's Bazar Pourashava did not have any treatment system and water was supplied to consumers through direct pumping. The flow diagram of the water supply system of Cox's Bazar Pourashava is shown in Figure 1.

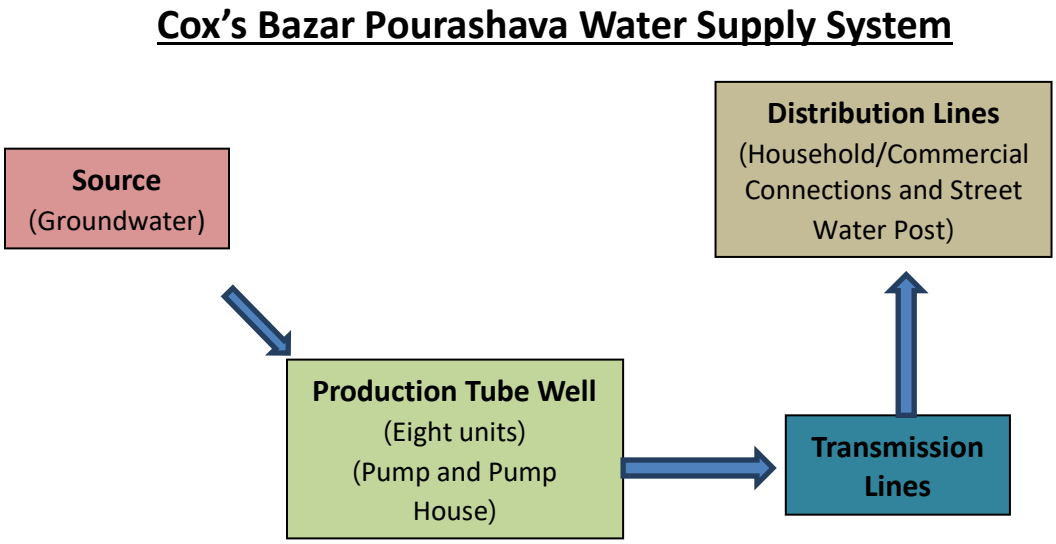

Figure 1: Flow diagram of Cox's Bazar Pourashava Water Supply System

The total number of connections in Cox's Bazar Pourashava water supply system was 996. The Pourashava consists of twelve wards and five of these twelve wards had piped water supply. The key information about the water supply system of Cox's Bazar Pourashava is summarized in Table 3 below.

Table 3: Different information on the Cox's Bazar Pourashava piped water supply system

Step	Description	
Source of Water	Current source	Ground water
	Total number of production tube well (PTW)	11 (active = 8; inactive =3)
	Average depth	200-455 ft
	Abstraction process	Submersible pump
Water Treatment Process	No treatment system.	
Reservoirs	No reservoirs.	

Step	Description
Distribution Line	Total length of pipe line : 28.37 Km (diameter: 10"8"/6"/4"; Household connection diameter: 1"/0.75"/0.5")
Distribution time	10-13 hours / day
Intended use	The distributed water is used for cooking, personal hygiene and household washing purposes. Only around 20% people drink water from this source.
No. of Sluice Valves	23, out of which only three are active.
No. of Wash Out Chambers	No wash out valve was found in the system.

3.2 Water Quality of Cox's Bazar Pourashava Piped Water Supply System

Source water sample was collected from the production well and analysed for arsenic, iron, manganese and E. coli. A total of seven samples were collected in this regard from seven production tube wells. The results are presented in Table 4. It is evident from the table that the risk for arsenic contamination was low and below Bangladesh standard (0.05 mg/l), and the iron and manganese concentration was also below the Bangladesh standard.. The risk of microbiological contamination was found intermediate in two samples from two production tube wells and low in other five production tube wells of the source water.

Table 4: Analysis result of different water quality parameters at source

Location	Date of Testing	E Coli/ 100 ml	Microbial Risk (based on E Coli concentration)	Electrical Conductivity (µs/cm)	As (mg/l)	Fe (mg/l)	Mn (mg/l)	Chemical Risk (based on As concentration)
Pump House-4 (ward#11)	16.8.2016	0	low	387	<MDL	0.15	<MDL	low
Pump House-5 new (ward#10)	16.8.2016	0	low	507	<MDL	0.35	<MDL	low
Pump House-5 old (ward#10)	16.8.2016	0	low	744	0.014	0.1	<MDL	low
Pump House-6 (ward#10)	16.8.2016	0	low	863	0.002	0.3	<MDL	low
Pump House-3 (ward#9)	16.8.2016	0	low	1214	0.004	0.15	<MDL	low
Pump House-8 (ward#10)	16.8.2016	7	intermediate	672	0.022	0.3	<MDL	low
Pump House-2 (ward#9)	16.8.2016	7	intermediate	1080	<MDL	0.3	<MDL	low

A total of 15 water samples were collected from the pipeline of the water supply system at different user`s house in five different wards where piped water supply was available. The water quality test was performed for fecal contamination. The results are presented in Table 5. The table indicated that the fecal contamination of the supplied water in ward 3, 8 and 11 were found very high.

Table 5: Water quality test results for samples collected from user points in Cox's Bazar Pourashava

Sl. No.	Ward No	Name of the User	E Coli/ 100 ml	Microbial Risk (based on E Coli concentration)
1	11	District Food Office	3	intermediate
2	11	Saikat Bagan Bari	0	low
3	11	Adv. Habibur Rahman	240	very high
4	10	Saidul Haq Azad	0	low

Sl. No.	Ward No	Name of the User	E Coli/ 100 ml	Microbial Risk (based on E Coli concentration)
5	10	Prof. G M Shafi	0	low
6	10	President, Dist Press Club	0	low
7	3	Shahpir Residential Hotel	0	low
8	3	Gulshan Ara Begum	480	very high
9	3	Adv. Md Bokhtiar	320	very high
10	8	Bakhtiar Kamal Chwd	49	high
11	8	Machang	52	high
12	8	Ongchola	520	very high
13	9	Onubroto Dhar	4	intermediate
14	9	General Hospital	3	intermediate
15	9	Dulal Das	0	low

Among the 15 samples tested in five wards in Cox's Bazar Pourashava, 27% of the samples were found having "very high" (> 99 CFU/100 ml) concentration of E. Coli. Apart from that, 13% of the samples were found within "high" (10-99 CFU/100 ml) concentration category, 20% within "intermediate" (1-9 CFU/100 ml) category and 40% in "low" (0 CFU/100 ml) category. The result indicates incidences of contamination of supplied water in the pipe lines in few areas of the water supply system, which might be the result of leakages in pipe lines/sluice valve chambers that causes intrusion of contaminated water when the pressure of water is low in the pipe lines or during the periods of no supply (zero pressure).

In supplied water the iron concentration was low but according to the local users and Pourashava staff, salinity and iron concentration in the Pourashava supplied water was one of the main problem along with suspended particles. Due to lack of regular maintenance of pipe lines, which forms iron layers inside the pipe, the iron concentration in supplied water was reported to be high. The Pourashava water supply system did not have any functional chlorination or any other disinfection system which needs to be introduced, as fecal contamination in supply water was found high in few wards.

4. Hazardous Event and Risk Analysis

The potential hazards and hazardous events that could result in the water supply being, or becoming, contaminated or interrupted were identified in a workshop participated by all the water supply section staff. Field visits were conducted to the different components of the water supply system to identify the potential biological, physical and chemical hazards associated with each step and/or hazardous events in the drinking-water supply that can affect the water quality. The different steps of hazard analysis process are described below.

4.1 Identification of Hazards Associated with Water Supply System

The hazardous event is defined as an event that introduces the hazards to, or fails to remove them from, the water supply. Hazard is defined as the physical, microbial, chemical & radiological agents that cause harm to public health. The process of identification of hazards and hazardous events was determined through two processes.

1) A workshop was held in presence of Cox's Bazar Pourashava water supply system and DPHE staff, which was facilitated by a team from PMID, and the hazards and hazardous events were documented.
2) Direct observation/inspection of different components of the water supply system with Pourashava water professionals/staffs and DPHE representatives.

4.1.1 Indetified Environmental Hazards

Salinity in groundwater was found as one of the major environmental threats for the water supply system of Cox's Bazar Pourashava. According to the Pourashava water supply section staff, salinity of groundwater was high in production tube wells in ward 9 and 10. It was also reported by water supply section staff that salinity in groundwater was higher near the sea, which indicates intrusion of salt water from sea level rise. With more extraction of groundwater in coming years, it is more likely that saltwater intrusion into the aquifers would increase, which will eventually increase salinity in source of the production tube wells.

Cox's Bazar Pourashava authority manages the solid waste management system which covers a few areas in the Pourashava. There were some designated places in few wards where households dumped their solid waste. The dumped waste in different wards was then collected by trucks and finally dumped into the designated waste dumping place. But according to the Pourashava authority, there were many households who did not dump their household waste into the designated places and throw the waste here and there in open environment, which pollutes the environment. Therefore, inadequate solid waste management was a hazardous event in the Pourashava which can create hazard for water and environment.

The absence of any fecal sludge management system in Cox's Bazar Pourashava was found to be another potential hazard for the water supply system in the Pourashava. It was found that households were responsible for desludging of their own pits/septic tanks once it become full. According to the Pourashava

staff, most of the households use pit latrines in the Pourashava. There are few households where latrines with septic tanks were found. But due to absence of fecal sludge management system, the households empty their pits/septic tanks manually and dump the raw sludge into open environment (rivers, canals, drains etc.) which create significant environmental hazards. The fecal waste dumped into the open drains and open environment can get mixed with rainwater and hence, has a chance of getting into the pipe lines through the leakages. The overflow of pits/septic tanks, if not desludged regularly, can also become a source of disease transmission into the pipe lines or water collection/storage system at households. The pipe lines that run through the drains are vulnerable to this hazard as these pipe lines were reported to have leakages very often.

Inadequate drainage facility within the Pourashava was found as another environmental hazard for water supply system. Due to lack of sufficient drainage system, which is further worsened by dumping of solid waste into these drains, the surface runoff after heavy rain events cannot drain out into water bodies soon which creates water stagnation in few wards. This was found to be another threat to water supply system as this contaminated water can enter into the pipe lines that have leakages.

4.1.2 Identification of Climatic hazards

The temperature increase, humidity, heavy rainfall, sea level rise and natural hazards (cyclone and storm surge) were the major climatic concern in Cox's Bazar Pourashava. According to WHO's Guideline for Drinking Water Quality, high water temperature enhances the growth of microorganisms and may increase taste, odor, color and corrosion problems.

The water table goes down during the summer season (March to May) which causes scarcity of water. Together with changed temperature, depletion of water table during dry season and frequent natural disasters, Cox's Bazar Pourashava dwellers were found to be in vulnerable condition considering the health impact. The annual humidity is also one important indicator for some of the vector borne disease such as dengue fever.

The sea level rise will increase the chance of intrusion of salt water into the aquifers, which was the only source of water in the Pourashava. It was also reported by the Pourashava water supply section staff that salinity level had been increasing in groundwater. In addition, the natural hazards (cyclone and tidal surges) were found to be another concern as during the period of these hazards, the water supply system could not function due to power failure and other operational difficulties.

4.2 Assessment of Risk

The process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for water safety and therefore should be addressed in the WSP. The risks associated with each hazard were assessed by semi-quantitative risk matrix approach which includes:

a. Identify the likelihood (L) of the occurrence (e.g. certain, likely, possible, unlikely & rare) (Table 6)
b. Evaluate the severity (S) of consequences if the hazard occurred (e.g. Insignificant, minor, moderate, major & catastrophic) (Table 7)

c. Estimate risk score (R) by multiplying individual score of likelihood and severity (Equation 3.1) and
d. The risk will be classified according to the risk score (R); High (>15), Medium (6-14) and Low (<5) (Table 7)

Table 6: Definition & score of "likelihood" and "severity" in risk analysis

Likelihood		Severity	
Rank (Score)	**Definition**	**Rank (Score)**	**Definition**
Almost Certain (5)	Once per day	Catastrophic (5)	Potentially lethal to a large Population
Likely (4)	Once per week	Major (4)	Potentially lethal to a small Population
Possible (3)	Once per month	Moderate (3)	Potentially harmful to a large population but no mortality
Unlikely (2)	Once per year	Minor (2)	Potentially harmful to a small population but no mortality
Rare (1)	Once every five years	Insignificant (1)	Negligible impact in terms of severity of disease or numbers of people affected

Estimation of Risk Score = Likelihood × Severity .....(3.1)

Table 7: Risk Score & Ranking

		Severity				
		Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Likelihood	Almost certain (5)	5	10	15	20	25
	Likely (4)	4	8	12	16	20
	Possible (3)	3	6	9	12	15
	Unlikely (2)	2	4	6	8	10
	Rare (1)	1	2	3	4	5

Risk Rating

Low (**L** ≤ 5)	Medium (**M** 06-14)	High (**H** ≥ 15)

4.3 Development of the Hazard Matrix

A hazard matrix was developed for Cox's Bazar Pourashava water supply system and is presented in Table 8.

4.4 Determination and Validation of Control Measures

Control measures are the preventive actions for controlling the hazardous events associated with different parts of the water supply system that ensure the supplied water consistently meets water quality targets. These are systematic activities, which reduce the risks associated with the hazardous events. The reduction in risk achieved by each control measure is an indication of its effectiveness, which can be validated through historical record, intensive program of monitoring or technical data from scientific

literature. The existing control measure for each of the identified hazards of Cox's Bazar Pourashava water supply system was assessed considering its functionality and the risk scores were recalculated again to see its effectiveness and validated as presented in hazard table (Table 8).

4.5 Reassessment of the Risks

When some of the existing control was found ineffective or not sufficient for long time, then the risk was recalculated in terms of likelihood and consequences taking into account the effectiveness of each control. Risks were prioritized in terms of their likely impact on the capacity of the system to deliver safe water. High priority risks may require upgraded/new operational control or system modification (improvement action plan) to achieve the water quality targets. Lower priority risks can often be minimized as part of routine good practice activities. Table 8 shows the identified hazardous events and associated risks for different components of Cox's Bazar Pourashava water supply system. The existing control system, reassessed risks and prioritization of risks along with proposed new control are also described in the Table 8. In addition, required additional control measures and improvement plans, if needed, are shown to counter the risk of different components of the system.

Table 8: Hazard matrix for Cox's Bazar Pourashava water supply system

Ref No	Step	Hazardous Event	Hazard type	Risk (without control) L = likelihood S = severity R = risk score	Risk with climate factors L = likelihood S = severity R = risk score	Existing Control Measures/ preventive action/ barriers	Is the existing control measure effective? Y = yes, N = no U = uncertain N/A: Not applicable	Risk with existing control L = likelihood S = severity R = risk score	Required Corrective Action	Risk after Corrective Actions L = likelihood S = severity R = risk score	Improvement Action Plan Ref. (Ch. 4)
4.1.1	Source	Scarcity of water in source (groundwater) due to depletion of water table during dry season (March-May).	Physical	L: 2, S:2 R: 4 (Low)	L: 3, S: 2 R: 6 (Medium)	No existing control measure.	N/A	L: 3, S: 2 R: 6 (Medium)	Prevent installation of irrigation pump in and around the catchment area. Encourage users to reduce wastage of water.	L: 2, S:2 R: 4 (Low)	N/A
4.1.2		Consumption/use of water with high salinity by consumers due to high Salinity in groundwater.	Physical, Chemical	L: 5, S:2 R: 10 (Medium)	L: 5, S: 2 R: 10 (Medium)	No existing control measure	N/A	L: 5, S: 2 R: 10 (Medium)	N/A	L: 5, S: 2 R: 10 (Medium)	Install surface water treatment plant.
4.2.1	Tube Well and Pump House	Contamination of groundwater at source (PTW) due to ineffective sanitary seal and unhygienic condition in pump house.	Physical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 2, S: 5 R: 10 (Medium)	Sanitary seal exists.	Y	L: 1, S: 5 R: 5 (Low)	N/A	L: 1, S: 5 R: 5 (Low)	N/A
4.2.2		Contamination of groundwater at source (PTW) due to ineffective non-return valve that cannot prevent back flow of water into aquifer.	Microbial	L: 2, S:5 R: 10 (Medium)	L: 2, S: 5 R: 10 (Medium)	Non-return valve exists.	Y	L: 1, S: 5 R: 5 (Low)	N/A	L: 1, S: 5 R: 5 (Low)	N/A
4.2.3		Interrupted water supply causing scarcity of water due to power failure because of poor electric appliances.	Physical	L: 2, S:3 R: 6 (Medium)	L: 2, S:3 R: 6 (Medium)	Repair after any casualty occurs.	N	L: 2, S:3 R: 6 (Medium)	Regular monitoring of electric equipment at PTW and store required maintenance equipment.	L: 1, S:3 R: 3 (Low)	N/A
4.3.1	Transmission and Distribution Pipe Lines	Contamination of water in pipeline due to leakage which would aggravate due to increase in temperature as concentration of fecal bacteria increases with rise in temperature . Also tidal surge may cause intrusion of polluted water through the leakages.	Microbial	L: 2, S:5 R: 10 (Medium)	L: 3, S: 5 R: 15 (High)	Repair the pipelines if any leakage is found.	U	L: 3, S: 5 R: 15 (High)	Identify the reasons for leakage in pipe lines and take preventive actions.	L: 2, S: 5 R: 10 (Medium)	Provide leak detection device and capacitate the pipe line mechanics about the use of it.

Ref No	Step	Hazardous Event	Hazard type	Risk (without control) L = likelihood S = severity R = risk score	Risk with climate factors L = likelihood S = severity R = risk score	Existing Control Measures/ preventive action/ barriers	Is the existing control measure effective? Y = yes, N = no U = uncertain N/A: Not applicable	Risk with existing control L = likelihood S = severity R = risk score	Required Corrective Action	Risk after Corrective Actions L = likelihood S = severity R = risk score	Improvement Action Plan Ref. (Ch. 4)
4.3.2		Contamination of water in pipe line due to inadequate operation of wash out valves in pipe lines. If not cleaned regularly, increased temperature will increase fecal contamination in water.	Physical, Chemical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 3, S: 5 R: 15 (High)	No existing control measure.	N/A	L: 3, S: 5 R: 15 (High)	Make the wash out valves functional and operate the valves at regular interval.	L: 2, S: 5 R: 10 (Medium)	Increase the number of wash out valves and make the existing ones functional considering the demand.
4.3.3		Water stagnation, tidal surge and erratic rainfall will increase contamination of water at sluice valve chamber due to intrusion of contaminated water through leakages in gland packing. Also tidal surge may cause intrusion of polluted water through these leakages.	Physical, Chemical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 3, S: 5 R: 15 (High)	No existing control measure.	N/A	L: 3, S: 5 R: 15 (High)	Improve the protection system of sluice valve chambers by providing cover and raising side walls, and regular checking for leakages.	L: 2, S: 5 R: 10 (Medium)	Repair the sluice valve chamber covers and fill the sluice valve chamber with sand.
4.4.1	Household	Contamination of water at house connection pipe joint through leakage because of using rubber sandal instead of rubber gasket during providing house connection, especially for the connection in low lying areas.	Physical, Chemical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 3, S: 5 R: 15 (High)	No existing control measure.	N/A	L: 3, S: 5 R: 15 (High)	Use rubber gasket and employ expert pipe mechanics during providing house connection	L: 1, S: 5 R: 5 (Low)	
4.4.2		Contamination of water due to leakage in house connection pipe when pipe line is exposed to waste water drain and increased temperature will create a more favourable condition for further water quality deterioration.	Physical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 3, S: 5 R: 15 (High)	Use pipe casing if pipe line goes through drain, and raise pipe lines above drain height.	Y	L: 1, S: 5 R: 5 (Low)	N/A	L: 1, S: 5 R: 5 (Low)	
4.4.3		Contamination of water during collection at households due to unhygienic condition near water collection tap and platform. Erratic rainfall, water stagnation will further degrade the condition at water collection points.	Physical, Microbial	L: 2, S:4 R: 8 (Medium)	L: 4, S: 4 R: 16 (High)	PWSS staff encourages consumers to maintain hygiene.	U	L: 4, S: 4 R: 16 (High)	PWSS staff, through Mayor notice, will make it mandatory for all consumers to maintain hygiene and construct platform at collection point	L: 2, S: 4 R: 8 (Medium)	N/A

Ref No	Step	Hazardous Event	Hazard type	Risk (without control) L = likelihood S = severity R = risk score	Risk with climate factors L = likelihood S = severity R = risk score	Existing Control Measures/ preventive action/ barriers	Is the existing control measure effective? Y = yes, N = no U = uncertain N/A: Not applicable	Risk with existing control L = likelihood S = severity R = risk score	Required Corrective Action	Risk after Corrective Actions L = likelihood S = severity R = risk score	Improvement Action Plan Ref. (Ch. 4)
4.4.4		Contamination of water stored in underground tanks in households due to intrusion of surface runoff from surrounding areas when groundwater tank is at lower elevation which can get inundated due to water stagnation because of erratic rainfall.	Physical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 3, S:5 R: 15 (High)	Consumers try to protect their underground tanks from surface runoff using barriers/ embankments.	U	L: 2, S: 5 R: 10 (Medium)	PWSS staff, through Mayor notice, will make it mandatory for all consumers to maintain hygiene and construct platform at collection point	L: 1, S: 5 R: 5 (Low)	N/A
4.4.5		Contamination of water in consumer's underground tank and OHT due to absence of lid/cover.	Physical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 2, S:5 R: 10 (Medium)	Consumers try to protect their underground tanks/ OHT by using covers.	Y	L: 1, S: 5 R: 5 (Low)	PWSS staff, through Mayor notice, will make it mandatory for all consumers to use appropriate lid on tanks	L: 1, S: 5 R: 5 (Low)	N/A
4.4.6		Increased temperature will create a more favourable condition for fecal coliform to increase its concentration in underground and overhead tank water at households because of not cleaning the tank regularly.	Physical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 4, S:5 R: 20 (High)	Consumers clean the tank when they think it is necessary.	U	L: 4, S:5 R: 20 (High)	PWSS staff, through Mayor notice, will make it mandatory for all consumers to clean their underground and OHT regularly	L: 2, S: 5 R: 10 (Medium)	N/A
4.4.7		Wastage of water from OHT of consumer because of over flow.	Physical	L: 3, S:2 R: 6 (Medium)	L: 3, S:2 R: 6 (Medium)	Consumers try to avoid wastage of water.	U	L: 2, S: 2 R: 4 (Low)	PWSS staff, through Mayor notice, will make it mandatory for all consumers to prevent over flow from OHT	L: 1, S: 1 R: 1 (Low)	N/A
4.4.8		Contamination of water by users because of unhygienic storage of water in households. Increased temperature will create a more favourable condition for fecal coliform if storage system is unhygienic.	Physical, Microbial	L: 2, S:5 R: 10 (Medium)	L: 3, S:5 R: 15 (High)	Consumers try to follow good practices for storing water according to their perception.	U	L: 2, S: 5 R: 10 (Medium)	PWSS staff, through Mayor notice, will demonstrate consumers how to collect/ store water	L: 1, S: 5 R: 5 (Low)	N/A
4.4.9		Unavailability of water at households during supply hour due to use of illegal suction pumps in the pipe lines by some users.	Physical	L: 3, S:2 R: 6 (Medium)	L: 3, S:2 R: 6 (Medium)	Users have been warned to not use these pumps.	U	L: 3, S:2 R: 6 (Medium)	PWSS staff, through Mayor notice, has to take strict actions to stop using these illegal pumps.	L: 1, S: 5 R: 5 (Low)	N/A

5. Improvement Action Plan

Improvement action plan is the action plan for new (future) operational controls or any other improvements. Table 8 identifies significant risks to the safety of water and demonstrates that required existing controls are not effective or are absent, or the reassessment of respective hazardous events are under high or medium risk, then an improvement opportunity or new operational control should be proposed. Every high or unacceptable reassessed risk needs some action to reduce the risk to an acceptable level, assuming that the improvement is effective.

Based on the proposed new control measure or improvement opportunity, the timeline for implementing improvement action plans can be classified as follows:

1) Short term action plan – this type of improvement action plan can be implemented within maximum three months and a minimum budget is required to accomplish such activity, which is under control by the respective staff and does not need consent from top authority.
2) Medium term action plan – This type of action plan can be implemented within maximum six months for which a minimum amount of budget is required from the authority and the authority has ability to provide such amount. In this case the section chief or utility authority is sufficient to approve the budget.
3) Long term action plan – This type of action plan can be implemented within six month to two years, which required top authority approval and seeking of donor fund / loan.

Table 9 shows the proposed improvement action plan, which is based on the hazard and risk analysis in Table 8 made for different components of Cox's Bazar Pourashava water supply system. Successful implementation of this action plan will ensure the utility to provide safe water to the consumer. The action plan also indicated about the person who is responsible for the associated task and a tentative timeline. Other short-term and medium-term improvements are considered as "corrective measures" in this document.

Table 9: Improvement action plan of Cox's Bazar Pourashava water supply system

Step	Hazardous Event Reference	Activities	Description	Responsibility	Time frame	Plan Type	Status
Source	4.1.2	Install Surface Water Treatment Plant.	Due to saltwater intrusion in groundwater, use of surface water as source of water needs to be started through surface water treatment plant.	Mayor, Cox's Bazar Pourashava and Executive Engineer, Cox's Bazar Pourashava	June, 2018	Long term	Not-started
	-	Install a chlorination system.	The chlorination system will reduce microbial contamination in supplied water.	Mayor, Cox's Bazar Pourashava and Executive Engineer, Cox's Bazar Pourashava	June, 2017	Long term	Not-started

Step	Hazardous Event Reference	Activities	Description	Responsibility	Time frame	Plan Type	Status
Transmission and Distribution Pipe Lines	4.3.1	Provide leak detection device and capacitate the pipe line mechanics about the use of it.	The leak detection device will help identifying the leakages in pipe lines, and hence will help preventing intrusion of biological and agrochemical hazards.	Mayor, Cox's Bazar Pourashava and Executive Engineer, Cox's Bazar Pourashava	March, 2017	Medium term	Not-started
	4.3.2	Increase the number of wash out valves considering the demand, and also make the existing wash out chambers functional.	For regular operation of wash out valves to clean the pipe lines, additional wash out chambers need to be installed to cover the full network. Also the existing chambers need to be modified for convenience of operation.	Mayor, Cox's Bazar Pourashava and Executive Engineer, Cox's Bazar Pourashava	December, 2016	Short term	Not-started
	4.3.3	Repair the sluice valve chamber covers and fill the sluice valve chamber with sand.	For smooth operation of water supply system and prevention of contamination through leakages in sluice valve chambers, the sluice valves need to be protected.	Mayor, Cox's Bazar Pourashava and Executive Engineer, Cox's Bazar Pourashava	December, 2016	Short term	Not-started

6. Operational Monitoring and Corrective Actions

Operational monitoring plan and corrective action are management procedures to ensure that the Control Measure works as intended and that proper and timely corrective action is taken when operational targets are not met. Corrective action is action to be taken when the results of monitoring at a control point indicate an actual or pending loss of control.

A systematic monitoring plan is needed to convey the message to the authority that the control system or new control system for different components of water supply system identified in Table 10 are working properly. During monitoring, if it is found that the control measure of a certain component exceeds beyond the control limit i.e. not working properly to prevent hazardous event, then the operational staff will take necessary and appropriate corrective action to mitigate the problem. The monitoring plan should also guide such corrective action plan corresponding to the control limit of respective monitoring indicators. Altogether this will be mentioned here as Operational Monitoring Plan. Table 10 shows the operational monitoring plan for Cox's Bazar Pourashava Water Supply System in which the following issues are considered for the monitoring plan:

1) What will be monitored?
2) How it will be monitored?
3) Where it will be monitored?
4) Who will monitor it?
5) When it will be monitored?

Moreover, the critical control limit for each control system is defined in the table. Accordingly, the corrective action procedure is described in the plan if the control system fails to meet the critical control limit. The responsible staff for the monitoring activities will note the monitoring information using a log sheet.

In Table 8 a reference number has been mentioned for operational monitoring against each existing or new control measure, and the same sequence is followed to describe the overall operational monitoring plan in Table 10.

Table 10: Operational monitoring plan of Cox's Bazar Pourashava water supply system

Step	Reference of Hazardous Event	Monitoring of Operational Control		Control Limit	Corrective Action		Reference Supporting Programs
Source	4.1.1	What	Is there any incidence of installing irrigation pump within catchment area?	No irrigation pump has been installed within 500m of catchment area	What	Inform higher authority and WSP team	9.1 to 9.10,
		How	Inspection		How	Phone/ visit	
		When	Once in 3 months		When	If any incidence is found	
		Where	Within 500 m area of catchment		Where	Office	
		Who	Pump Operator		Who	Pump Operator	
Pump House	4.2.1	What	Is Sanitary Seal working properly?	Sanitary seal is in good condition	What	Repair Sanitary Seal	9.2
		How	Inspection		How	Hire/employ expert labour	
		When	Once in a month		When	If found broken	

Step	Reference of Hazardous Event	Monitoring of Operational Control		Control Limit	Corrective Action		Reference Supporting Programs
		Where	Pump house		Where	Pump house	
		Who	Pump Operator		Who	Water Super	
	4.2.2	What	Is non-return valve working properly?	Non-return valve is functional	What	Repair/ replace non-return valve	**9.2**
		How	Listening the sound		How	Hire/employ mechanic	
		When	Once in a month		When	If found not functioning	
		Where	Pump house		Where	Pump house	
		Who	Pump Operator		Who	Water Super	
	4.2.3	What	Is the electric connections working properly?	All electric equipment are in good condition	What	Replace/ repair equipments if found in vulnerable condition	**9.2**
		How	Inspection		How	Hire/employ electrician	
		When	Once in a month		When	If found in risky/ vulnerable condition	
		Where	Pump house		Where	Pump house	
		Who	Pump Operator		Who	Water Super	
Transmission and Distribution Line	**4.3.1**	What	Are there any leakages in the distribution line?	No leakages in pipe lines	What	Repair of leakages in the distribution line	**9.2**
		How	Visual inspection		How	Purchasing new material	
		When	Once in a month		When	As required	
		Where	Distribution line		Where	Distribution line	
		Who	Pipeline Mechanic		Who	Water Super	
	4.3.2	What	Is wash out working or not?	Washout is operational	What	Ensure that all wash outs valves are functional	**9.2**
		How	Visual inspection		How	Re-designing the wash out valves and making necessary arrangements	
		When	Once in a month (at least)		When	Sufficient pressure is not available at wash out	
		Where	Wash out chamber		Where	Wash out chamber	
		Who	Pipeline Mechanic		Who	Water Super	
	4.3.3	What	Is there any waste material or stagnated water in sluice valve?	Sluice valve chamber is clean and there is no leakage	What	Filling the chamber by sand and install appropriate cover	**9.2**
		How	Inspection		How	Purchase materials and hire labor	
		When	Once in a month		When	When found in hazardous condition	
		Where	Sluice valve chamber		Where	Sluice valve chamber	
		Who	Pipeline Mechanic		Who	Water Super	
Household Connection	**4.4.1**	What	Is proper instruments (rubber gasket, drill machines etc.) used during providing new HH connection	Rubber gasket and pipe cutting machine are used for new HH connection	What	Ensure availability of instruments during providing connection	**9.2**
		How	Visual inspection		How	Standard instrument purchase	
		When	During providing new connection		When	When proper method is not followed	
		Where	At household		Where	At house connection site	
		Who	Pipeline Mechanic		Who	Water Super	
	4.4.2	What	Is house connection pipe line exposed to open drain?	No house connection pipe line is exposed to wastewater drain	What	Use casing pipe to cover the pipe line from wastewater and elevate the pipe above drain	**9.1 to 9.10**
		How	Inspection		How	Hire/employ mechanic	
		When	Once in a month		When	If exposed house connection pipe is seen	

Step	Reference of Hazardous Event	Monitoring of Operational Control		Control Limit	Corrective Action		Reference Supporting Programs
		Where	Household connection pipe line		Where	Household connection pipe line	
		Who	Bill Distributor		Who	Water Super	
	4.4.3	What	Is the water collection place/ platform hygienic?	The water collection place/ platform is clean and hygienic	What	Place an order for all consumers to maintain hygiene and construct platform at collection point.	**9.1 to 9.10**
		How	Inspection		How	Through Mayor notice	
		When	Once in six months		When	If hygienic platform is not found	
		Where	Households		Where	Households	
		Who	Bill Distributor		Who	Water Super	
	4.4.4	What	Is the underground tank's top level at least 6" above the ground level?	All households have their underground tank's top level at least 6" above ground level	What	Place an order for all consumers to raise the level of underground tank's top	**9.1 to 9.10**
		How	Inspection		How	Through Mayor notice	
		When	Once in six months		When	If underground tank's top level is found below ground level	
		Where	Households		Where	Households	
		Who	Bill Distributor		Who	Water Super	
	4.4.5	What	Do underground reservoir and OHT have lid?	Households that have underground reservoir and OHT use lid/ cover to protect water from contaminatio n	What	Place an order for all consumers to use lid/ cover for underground reservoir and OHT	**9.1 to 9.10**
		How	Inspection		How	Through Mayor notice	
		When	Once in six months		When	If underground tank and OHT lid/cover is not found	
		Where	Households that have underground and OHT		Where	Households	
		Who	Bill Distributor		Who	Water Super	
	4.4.6	What	Do consumers regularly clean their underground reservoirs and OHT?	Consumers keep their underground reservoir and OHT clean, and maintain hygiene	What	Place an order for all consumers to clean their underground reservoir and OHT regularly	**9.1 to 9.10**
		How	Inspection		How	Through Mayor notice	
		When	Once in six months		When	If underground tank and OHT is found in unhygienic condition	
		Where	Households		Where	Households	
		Who	Bill Distributor		Who	Water Super	
	4.4.7	What	Does wastage of water occurs through overflow from reservoirs?	Consumers switch the motor off as soon as the reservoir gets full each time	What	Place an order for all consumers to prevent wastage of water through overflow	**9.1 to 9.10**
		How	Inspection		How	Through Mayor notice	
		When	Once in six months		When	If overflow is observed at any household	
		Where	Households		Where	Households	
		Who	Bill Distributor		Who	Water Super	
	4.4.8	What	Is the practice of collection and storage of water by consumers hygienic?	Consumers practice hygienic ways to collect and	What	Place an order for all consumers to follow hygienic practice during water collection and storage	**9.1 to 9.10**
		How	Inspection		How	Through Mayor notice	
		When	Once in six months		When	If unhygienic practice is observed	

Step	Reference of Hazardous Event	Monitoring of Operational Control		Control Limit	Corrective Action		Reference Supporting Programs
		Where	Households	store water in house	Where	Households	
		Who	Bill Distributor		Who	Water Super	
	4.4.9	What	Is there any practice of using illegal pumps in the pipe lines to get more water during supply hour?	No household is using illegal pumps in the pipe lines to get more water during supply hour	What	Disconnect the pipe line of the user	9.1 to 9.10
		How	Inspection		How	Hire/employ mechanic	
		When	Once in three months		When	If illegal pumps used	
		Where	Households		Where	Households	
		Who	Bill Distributor		Who	Water Super	

The operational monitoring log books were prepared for Cox's Bazar Pourashava based on Table 10 which is presented in Annex 1. It is to be noted that while preparing the log books, the capacity of Pourashava Water Supply Section was considered. Therefore, only those operational monitoring plans were considered in the log books which would be possible for the water supply section staff to execute.

7. Verification Procedure

The verfifcation process is required for the consistant delivery of the safe water considering health based targets. It will prodcue a tangible evidence that the overall system design, its operation and magement are effective in delivering safe water consitantly and constantly considering the specified quality water. It includes three following majror activities as mentioned below.

1. Delivered water quality monitoring – will provide information that the delivered water is safe
2. Internal and external auditing of WSP operational activities – helps to assess the WSP activities and verify the status of proper implementation process
3. Consumer satisfaction – checking that consumers are satisfied with the supplied water

The schedule for verfication of different control measures condiering the hazard is prosented in Table 11.

Table 11: Verification schedule of water safety plan for Cox's Bazar Pourashava

Step	Description	When	Responsible Person/ Organization	Record
System Maintenance	1. Checking whether any tube well is installed within 500 m of the production tube well 2. Sanitary seal is working properly, pump house is clean and electric connections are in good condition 3. Wash out at different locations of pipe network 4. Maintenance of sluice valve chambers	Once in six months	Executive Engineer - Pourashava, and Executive Engineer- DPHE	Log book (Annex 1.1)
Water Quality Monitoring	Check quality of water at source and pipelines of the water supply network.	Once in six months	Executive Engineer- Pourashava, and Executive Engineer- DPHE	Log book (Annex 1.2)
Complaint Log Book	Check whether the complaints are registered properly and actions are taken.	Once in six months	Executive Engineer- Pourashava, and Executive Engineer- DPHE	Log book (Annex 1.3)
Disease Information Register	Check if the information are written in the log book	Every Month	Executive Engineer- Pourashava, and Executive Engineer- DPHE	Log Book (Annex 1.4)
Water Table Recording Register	Check if the water table was properly measures and information is recored in the log book	Every Month	Executive Engineer- Pourashava, and Executive Engineer- DPHE	Log Book (Annex 1.5)
Log Book for Pump Operation Record	Check the pumping hour and total production per day.	Every Month	Executive Engineer- Pourashava, and Executive Engineer- DPHE	Log Book (Annex 1.6)
Household Practice Register Book	Check the practices in households to comply with WSP messages.	Every Month	Executive Engineer- Pourashava, and Executive Engineer- DPHE	Log Book (Annex 1.7)

8. Management Procedures

8.1 Management Procedure

Water Safety Plan Team will be responsible for planning, implementation, monitoring modification, review, auditing, and resource allocation etc. of the water safety plan. The team will consist of 13 members headed by the Mayor of the Pourashava. The member Secretary will be responsible for keeping and storing of all sorts of the documents in relation with the water safety plan implementation will. All sorts of communication need to make through the WSP team leader. Such management procedures are divided into three parts as presented below:

1) General Procedures: All of the actions need to be documented to maintain, normal operating conditions for the production of safe drinking water. This includes procedures of all treatment processes, distribution system operations and maintenance of the system. These are called Standard Operating Procedure (SOP). Moreover, all types of records from different components need to be kept in the log sheets.
2) Procedures for corrective action: Procedures are in place for incident situations (situations outside of normal operating conditions), describing corrective actions necessary to maintain safe water and protect consumers. All information related to the incident and associated corrective measure need to be recorded.
3) Procedures for emergency: There should be management procedures setting out a communication plan to alert and inform consumers and other stakeholders when there is a problem with the safety of water supply.

8.2 Control of Document and Records

It is essential to keep written documents for each step of WSP related activities. On the other hand, all sort of records related to WSP activities need to be collected in a prescribed format or log sheet. Such written documents and keeping records in log sheets are part of management procedure that ensures proper operation of WSP activities. The documents and records related to management procedures will be controlled by member Secretary WSP team and Assistant Engineer (Water) of PWSS section of Cox's Bazar. Assistant Engineer (Water) will also be responsible to circulate the necessary documents and records to the concerned person in PWSS and also to WSP Team members. Table 12 shows the list of management procedures of Cox's Bazar PWSS section.

Table 12: Management procedures for related documents

No	Management procedures	Controlled by	Status of document preparation
1	Citizen Charter	Executive Engineer and Water Super, Cox's Bazar Pourashava	Not started
2	Water Safety Plan	Executive Engineer and Water Super, Cox's Bazar Pourashava	Under preparation
3	Operational Monitoring Log Sheet	Executive Engineer and Water Super, Cox's Bazar Pourashava	Completed; Annex-1

8.3 Communicating Procedure of Water Quality Related Information

The consumers have right to get information in relation to the quality of water they are getting form the supply system. A communication plan is presented in Table 13.

Table 13: Communication plan for water quality related issues

No	Issue	Information	Media
1	Emergency advise during any significant incidents with the drinking water supply	- To drink boiled water - To clean reservoir	- Through miking
2	Summary information to be made available to consumers	- Water quality of supplied water	- Notice Board
3	Establishment of mechanisms to receive and actively address community complaints in a timely fashion	- Customer complain - Procedure of corrective action and notify to customer	- Customer complaint register (log) book - Approval from customer prior to take corrective action

9. Supporting Programs

Supporting programs will create an enabling environment for the proper implementation of water safety plan that will help to achieve the health based targets. Each of the programs is composed of a set of activities which includes awareness, education, training and modification of water supply system among the users as well as the providers can be treated as a win situation. The supporting programs are enrolled under the improvement action plan of the WSP and could be short, medium and long term. The supporting programs developed or to be developed for Cox's Bazar Pourashava water supply system includes:

- Consumers education supporting program
- Operator training supporting program
- Environmental sanitation improvement program

The Pourashava Water Super of the water supply system will be responsible for developing, coordinating, maintaining and implementing the supporting programs. The Pourashava authority can utilize its own technical resources for supporting program or can engage NGOs, universities or training institution for implementation of the consumer's education support program. The list of supporting programs for Cox's Bazar Pourashva water supply system is provided in Table 14 below.

Table 14: List of Supporting Program for WSP of Cox's Bazar Pourashava

Sl. No.	Description	Responsibility	Timeframe	Status
9.1	Meeting of WSP Team (local meeting)	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.2	Orientation of caretakers and Users on CC Resilient WSP	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.3	Orientation session with TLCC	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.4	Orientation Session with Ward Sanitation taskforce Committee	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.5	Session with School Teachers and School Management Committees	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.6	Cable TV Show (5 minutes Programme)	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.7	Local Newspaper Report	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.8	CC resilient WSP Campaign at community level	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.9	Bill Board	Mayor, Executive Engineer and Water Super	January, 2017	Not-started
9.10	Sign Board	Mayor, Executive Engineer and Water Super	January, 2017	Not-started

10. WSP Review Procedure

10.1 Purpose of WSP Review

The purpose of the water safety plan document review is to maintain its effectiveness considering the information and experiences gathered during its implementation aiming the health based targets. The review need to be done periodically considering its designed activities to overcome any unavoidable and unfavourable circumstances. The review need to be done in terms of water supply management system, technical aspect of the supply system, water quality, water availability.

10.2 Review Procedure and Elements

WSP Team will meet at least once in a year to review all aspects of water safety planning. Gathering information or records from operational monitoring and verification monitoring will help the review process significantly. The progress of improvement action plan should also be discussed in the review meeting. Moreover the following issues can be considered for discussion in the review meetings:

- Changes of membership of the WSP team and allocation of responsibility among team members
- Climate change the new emerging issue and its long term impact on the water supply system
- Direction of necessary action, and responsibility of the concerned staff during emergency
- Changes or modification necessary for water supply management system in catchment, treatment or distribution process especially considering the climate change issues
- Outcome of internal and external audits
- Staff changes in water supply section
- Keeping and archiving all types of documents and records

10.3 WSP Document Up-gradation

The water safety plan document is a live document and it could be modified or improved considering the new knowledge or information as obtained during its implementation. The WSP Document Controller is responsible for keeping an up-to-date version of the WSP and circulation of the updated version to other WSP team members and interested parties.

Annex - 1: Operational Monitoring Log Sheet

Annex 1.1: Log Sheet for System Maintenance

Name of the task: ..... Frequency: .....

Sl. No.	Date	Task Performed	Location	Signature	Comments

List of tasks to be performed as part of system maintenance (separate pages will be provided in a single log book for these tasks):

1. Checking whether any tube well is installed within 500 m of the production tube well
2. Sanitary seal is working properly, pump house is clean and electric connections are in good condition
3. Wash out at different locations of pipe network
4. Maintenance of sluice valve chambers

Annex 1.2: Log Sheet for Water Quality Monitoring

Sl. No.	Date	Parameter Tested	Sampling Location	Concentration	Unit	Signature	Comments

Annex 1.3: Complaint Register Book

Sl. No.	Date	Description of the Complaint	Location	Action Taken	Signature	Comments

Annex 1.4: Disease Information Register

No.	Year	Month	Reported Cases in Respective upazila Sadar Hospital or any government Hospital existed in the Pourashava						
			Diarrhea	Cholera	Dysentery	Hepatitis	Jaundice	Skin Disease	...

Annex 1.5: Water Table Recording Register

Month	Water Table (ft) Year													
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Jan														
Feb														
Mar														
Apr														
May														
Jun														
Jul														
Aug														
Sep														
Oct														
Nov														
Dec														

Annex 1.6: Log Sheet for Pump Operation Record

Date	Pump No	Start Time	Flow Meter Reading at Start Time	End Time	Flow Meter Reading at End Time	Comment	Signature

Annex 1.7: Household Practice Record Register Book

Date	User ID	Address	Practice that was found inappropriate	Action taken	Comment	Signature

This log book will register if any of the below casualties were found in the households:

- whether consumers are collecting and storing water in hygienic manner,
- underground tanks are above ground level in all households,
- underground tank and OHT have proper lid/ cover,
- consumers cleaning their underground and OHT regularly,
- if there is any wastage of water though overflow in households, and
- if anyone is using illegal pumps, and audit the log book used for regular monitoring.

Annex - 2: Images

Figure 2: Opening ceremony of hazard analysis workshop in Cox's Bazar Pourashava

Figure 3: Group work during hazard analysis workshop