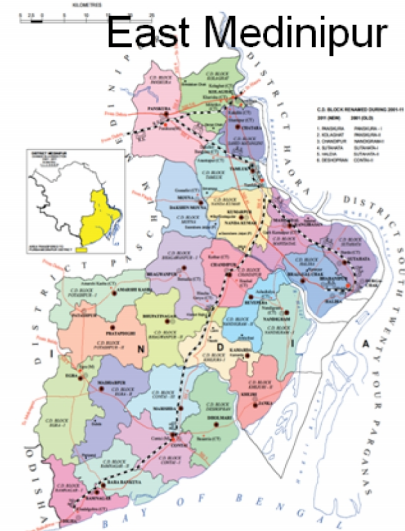
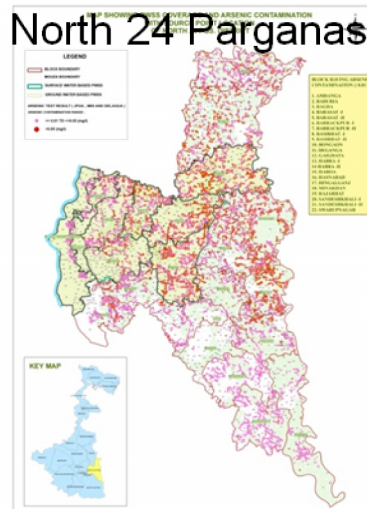
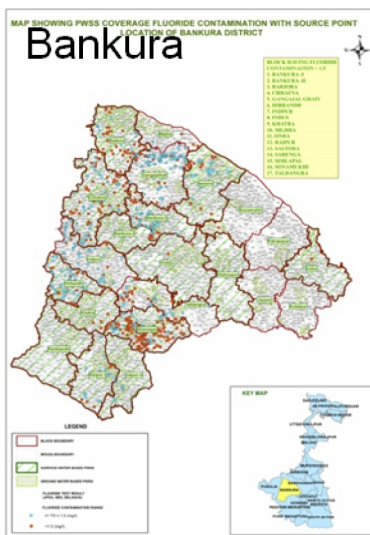


West Bengal Drinking Water Sector Improvement Project

With Assistance from Asian Development Bank

EAST MEDINIPUR DISTRICT

DRINKING WATER QUALITY ACTION PLAN



Public Health Engineering Department
Government of West Bengal

Table of Contents

List of Abbreviations	V
Chapter 1 Background and Introduction	6
1.1 Background to the Water Quality Plan	6
1.2 Rationale for the Project	7
1.3 Project Objectives	8
1.4 Scope of the Report	8
1.5 Project Stakeholders and Roles	10
Chapter 2 District Profile	12
2.1 Location and Project area	12
2.1.1 Location.....	12
2.1.1 Administrative Setup.....	13
2.1.2 Road Network and Connectivity.....	13
2.1.3 Climate	14
2.2 Physiography	15
2.2.1 Topography	15
2.2.2 Soil Characteristics.....	15
2.2.3 Land Use.....	15
2.2.4 Rivers and River Basin System of Purba Medinipur.....	16
2.2.4.1 Rupnarayan.....	17
2.2.4.2 Kangsabati and New Cossye.....	18
2.2.4.3 Kaliaghai.....	18
2.2.4.4 Haldi River	18
2.2.4.5 Rasulpur River.....	19
2.2.4.6 Pichabani-Negua Channel.....	19
2.2.5 River Water Quality-Rupnarayan	20
2.2.6 Coastal Regulation Zone	20
2.3 Geomorphology and Hydro-geology	21
2.3.1 Geomorphology	21
2.3.2 Geology.....	21
2.3.3 Hydro-geology and Ground water potential.....	22
2.3.4 Ground water potential	23
2.4 Ground Water Availability	24
2.4.1 Depletion of Ground Water Levels.....	24
2.4.2 Blocks Affected by Salinity.....	25
2.5 Impact of Climate Change	27
2.5.1 Impact of Climate Change on Water Availability	27
2.6 Disaster Management and Vulnerability	28
2.7 Socio-Economic Status (Including Gender and Health)	29
2.7.1 Demographic Profile	29
2.7.2 Economic Profile.....	29
2.7.3 Health and Gender	29
Chapter 3 Present Coverage of Water Supply	30

3.1	Commissioned Piped Water Supply Schemes	30
3.1.1	Commissioned Schemes Based on Ground Water	31
3.1.2	Commissioned Schemes Based on Surface watersources	32
3.2	Ongoing Water Supply Schemes	32
3.2.1	Ground water based Schemes	32
3.2.2	Surface water based Schemes	33
3.3	Water Supply Coverage in Urban Areas.....	33
3.4	Assessment of Existing Schemes	34
Chapter 4 Prevailing Sanitation System		36
4.1	Introduction	36
4.2	Mission Nirmal Bangla.....	36
4.3	Pre-Conditions for ODF	37
4.4	Toilet Coverage and Sanitation Scenario in the District.....	37
Chapter 5 District Criticality Assessment		38
5.1	Introduction	38
5.2	Blocks affected by salinity	38
5.3	Blocks affected by declining ground water levels	38
5.4	Criticality assessment of blocks.....	39
Chapter 6 Planning for Piped WS System By PHED.....		40
6.1	Piped WS Scheme.....	40
6.2	Components of the Schemes	40
6.2.1	Raw water Intake.....	41
6.2.1	Capacity of WTP.....	41
6.2.2	Storage Reservoirs.....	42
6.2.3	Infrastructure and Logistics.....	42
6.2.4	Operation and Maintenance Services	42
6.3	Block Cost Estimates of the proposed Schemes.....	43
6.3.1	Basis of Estimation	43
6.3.2	Summary Wise Cost Estimate	43
Chapter 7 Conservation and Demand Management		44
7.1	Introduction	44
7.2	Water Conservation	44
7.2.1	Jal Dharo-Jal Bharo programme.....	44
7.2.2	Initiatives by PHED	45
7.3	Demand Managementand Strategies.....	45
7.3.1	Operational Measures	45
7.3.2	Socio-Political Measures	46
7.3.3	Economic Measures	46

Chapter 8 Water Quality Action Plan	47
8.1 Introduction	47
8.2 Participatory Planning and Source Sustainability	47
8.3 Water Quality Management	48
8.3.1 Existing Water Quality Monitoring and Surveillance System	48
8.3.1.1 Water Quality Monitoring Setup under PHED	48
8.3.1.2 Water Quality testing laboratories in PurbaMedinipur	49
8.3.2 Key Issues	50
8.4 Sustainable Service Delivery	50
8.4.1 Providing Household level Service Connection.....	51
8.4.1 24x7 Pressurized Water Supply System	51
8.4.2 Rain water harvesting and Pond based system	51
8.5 Conclusion and Way Forward.....	51

List of Tables

Table 1-1: Salinity affected blocks in West Bengal	6
Table 2-1: Administrative Sub-Division: PurbaMedinipur	13
Table 2-2: Average Monthly Temperature in Purba Medinipur	14
Table 2-3: Average Annual Rainfall in Purba Medinipur	14
Table 2-4: Land-Use Characteristics in the district.....	15
Table 2-5: Major Rivers flowing through PurbaMedinipur	17
Table 2-6: Water Quality Parameters: Rupnarayan	20
Table 2-11: Assessed Impact of Climate Change on Water Resources	27
Table 3-1: PWSS Commissioned and Villages Covered.....	31
Table 3-2: PWSS Commissioned covering multiple Blocks	31
Table 3-3: Ongoing Ground water based PWSS-Purba Medinipur	32
Table 3-4: Service Level Status of Statutory Towns: Purba Medinipur	34
Table 3-5: Coverage of Blocks with PWS	34
Table 5-1: Blocks affected by Salinity	38
Table 5-2: Categorization of Ground Water Development	39
Table 5-3: Blocks affected by declining ground water levels.....	39
Table 5-4: Critically affected blocks	39
Table 6-1: Water Abstraction Plan	41
Table 8-1: Water Testing Laboratories for WQM	48
Table 8-2: List of Laboratories in PurbaMedinipur District	49
Table 8-3: Water Quality Action Plan	51

List of Figures

Figure 1: Districts affected by Salinity in West Bengal	7
Figure 2: Strategic Objectives	9
Figure3: District Map of East Mednipur	12
Figure 4: Road Connectivity: PurbaMedinipur.....	13
Figure 5: Rupnarayan-Haldi-Rasulpur-Pichabani Sub-basin	16
Figure 6: Kaliaghai Sub-Basin.....	16
Figure 7: Rupnarayan basin.....	17
Figure 8: Kaliaghai-Haldi Sub-basin.....	18
Figure 9: Rasulpur-Pichabani Sub-basin	19
Figure 10: Coastal Regulatory Zone: West Bengal	20
Figure 11: Hydro-geological Map of PurbaMedinipur.....	23
Figure 12: Flood Prone areas of PurbaMedinipur	28
Figure 13: Population Density: PurbaMedinipur-Blocks	29
Figure 14: Piped WS schemes in PurbaMedinipur.....	30
Figure 15: Intake on the river Rupnarayan.....	33
Figure 16: Bulk Water Supply System-Concept Plan	40

Figure 17: Proposed Intake Location 41
Figure 18: Approach to Water Quality Management 48

List of Abbreviations

BRGF	Backward Regions Grant Fund
C.D.	Community Development
CGWB	Central Ground Water Board
DDWS	Department of Drinking Water and Sanitation
GIS	Geographical Information System
Goi	Government of India
GoWB	Government of West Bengal
HDTW	Heavy Duty Tube well
IHHL	Individual Household Latrine
IMIS	Integrated Management Information System
LDTW	Low/light duty tube well?
MIS	Management Information System
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoDWS	Ministry of Drinking Water and Sanitation
NRDWP	National Rural Drinking Water Program
ODF	Open Defecation Free
PHED	Public Health Engineering Department
PRI	Panchayet Raj Institution
PWD	Public Works Department
PWSS	Piped Water Supply Scheme
SCADA	Supervisory Control and Data Acquisition
SWID	State Water and Investigation Department
TDS	Total Dissolved Solids
VWSC	Village Water and Sanitation Committee
WRIDD	Water Resource Investigation and Development Department
WSSO	Water and Sanitation Support Organization

Chapter 1 Background and Introduction

1.1 Background to the Water Quality Plan

A large part of India's population is dependent on groundwater as the major source of potable water. Contamination of groundwater, especially by naturally elevated inorganic contaminants like arsenic and fluoride, is a major issue in the State of West Bengal. Additionally studies suggest that, the increased withdrawal of ground water along the coastal belt of the State has hastened the intrusion of salinity in the fresh water reserves. The decrease of fresh water reserves in the coastal blocks has become a major concern that warrants immediate attention.

The intrusion of sea-water in the river basin systems in the southern tip of the State has been observed more acute during in the lean season, when availability of fresh water in the river reduces. The effect of salinity in ground water, has increased over the years, and efforts to check this will possibly be one of the biggest challenges, made more difficult with rising sea water levels and global warming.

All the blocks which are affected by Salinity are close the coastal belt. Apart from the sea level rise, the vulnerability of the coastal areas from recurrent cyclone accentuates the salinity of the soil and impact human wealth on a regular basis.

A total 57 blocks in 4 Districts (of Howrah, PurbaMedinipur, North 24 Parganas and South 24 Parganas) within the State is affected by salinity, as presented below:

Table 1-1: Salinity affected blocks in West Bengal

Sl. No	Name of District	¹ Salinity affected blocks	Nos. of blocks
1	Howrah	Panchla, Uluberia-I, Uluberia-II, Shyampur-I, Shyampur-II, Bagnan-I, Bagnan-II, Bally Jagacha	8
2	PurbaMedinipur	Contai-I, Deshpran, Contai-III, Ramnagar-I, Ramnagar-II, Tamluk, Nandakumar, Mahisadal, Sutahata, Haldia, Khejuri-I, Khejuri-II, Nandigram-I, Nandigram-II, Chandipur	15
3	North 24 Parganas	Hasnabad, Minakhan, Hingalganj, Sandeshkhali-I, Sandeshkhali-II	5
4	South 24 Parganas	Thakurpukur-Maheshtala, Bishnupur-I, II, Budge-Budge-I,II, Sonarpur, Jaynagar-I,II, Kultali, Baruipur, Bhangar-I,II, Canning,I-II, Basanti, Gosaba, Mograhat-I,II, Mandirbazar, Kulpi, Falta, Diamond Harbour-I,II, Mathurapur-I,II, Kakdwip, Namkhana, Sagar, Patharpratima	29

The District-wide Water Quality Action Plan provides an assessment of the existing situation, including prevailing coverage of piped water supply and available water resources. It includes interventions, challenges, risks and mitigation measures to prepare for a larger framework for priority funding and implementation of the projects for each identified District.

The present document deals with PurbaMedinipur (East Medinipur) , one of the target districts affected by salinity, declining ground water levels and vulnerability to climate change impact.

¹ Salinity measured as Chloride Concentration > 250mg/litre and TDS > 500mg/litre

1.2 Rationale for the Project

The Public Health Engineering Directorate (PHED), Government of West Bengal (GoWB) has launched its most ambitious plan, of covering the rural areas with Piped Water Supply and ensuring:

- Sustainable water supply of 70 lpcd (litres per capita per day) to each habitation in rural West Bengal.
- Drinking water security, with an objective of a complete shift from hand pump tube-wells in a phased manner to provision of individual house connections through conjunctive use of groundwater, surface-water and rain water harvesting.

Following the concerns of salinity intrusion and its criticality arising due to Climate Change and its hastening, the GoWB has taken initiative to identify sustainable and permanent solutions in the form of either surface water based piped water supply or new fresh groundwater reserves. Membrane based desalination plants (Reverse Osmosis) for existing saline sources provide a technical alternative, but are expensive and, consequently, need careful consideration before adoption on a wider scale..

There has been a paradigm shift in the way potable water supplies are being provided with inclusion of pond-based water supply systems, rain water harvesting, promoting conjunctive usage of water, augmenting / recharging and monitoring ground water reserves.

The PHED has already outlined pond based system and rainwater harvesting as possible means to surmount the concerns of salinity.

Ground water based piped water supply schemes with reverse osmosis (RO) desalination plant with non-conventional energy source is one technical alternative that is being explored.

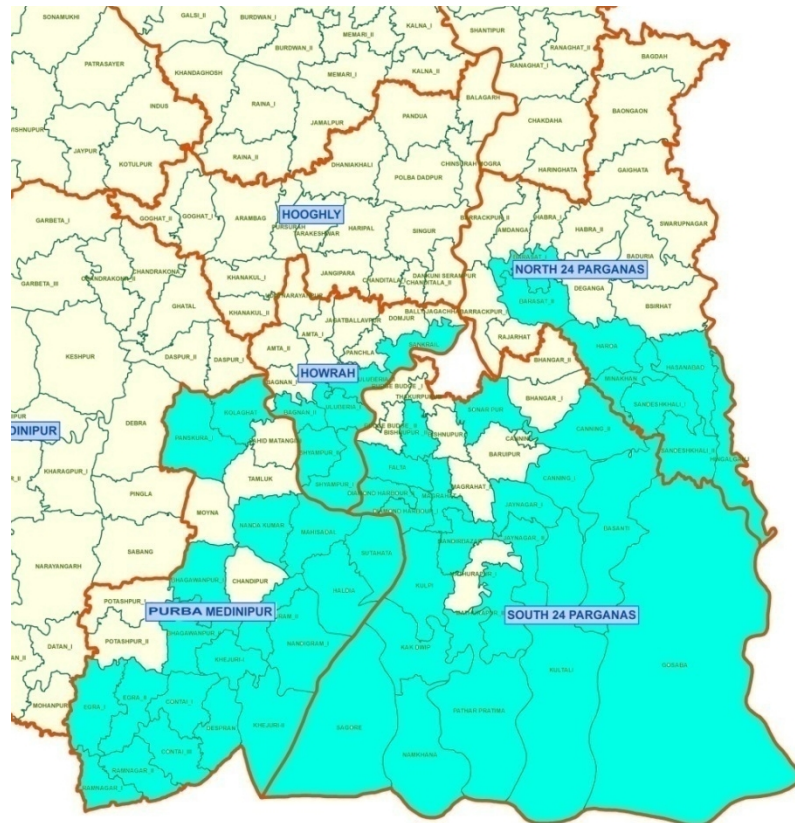


Figure 1: Districts affected by Salinity in West Bengal

1.3 Project Objectives

The primary objective of the NRDWP program as outlined by the MoDWS is to:

- To ensure, that every rural person has enough safe water for drinking, cooking and other domestic needs as well as livestock throughout the year including during natural disasters and,
- By 2022, every rural person in the country will have access to 70 lpcd within their household premises or at a horizontal or vertical distance of not more than 50 meters from their household without barriers of social or financial discrimination.

With the objective of providing safe and adequate water, the PHED has taken up its most ambitious plan of “VISION 2020”. The Vision incorporates among others:

- Ensuring sustainable water supply of 70 lpcd to each habitation in rural West Bengal.
- Ensuring drinking water security through a complete shift from hand pump tube-wells to piped water supply schemes in a phased manner, provision for house to house connection, conjunctive use of groundwater, surface-water and rain water harvesting.
- Delivery of services by the system for its entire design period of quality of water in conformity with the prescribed standards at both the supply and consumption points.
- Potability, reliability, sustainability, convenience, equity and consumer preference to be the guiding principles while planning for a community based water supply system
- To enable communities to monitor and maintain surveillance on their drinking water sources;
- To ensure that all schools and ²anganwadis have access to safe drinking water;
- To provide enabling environment for ³Panchayat Raj Institutions and local communities to manage their own drinking water sources and systems;
- To provide access to information through online reporting mechanism with information placed in public domain to bring in transparency, accountability and informed decision making.

Overall, the Project Objective is to meet the requirements of “VISION 2020”, endorsed by the GoWB and in line within the guidelines and implementation framework of NRDWP.

The West Bengal Drinking Water Sector Improvement Project (WBDSIP) is an initiative of the GoWB with funding from Asian Development Bank, to fulfill the overarching goals of VISION-2020. The development of sustainable water supplies in Purba Medinipur is a significant part of this WBDWSIP.

1.4 Scope of the Report

The scope of the Water Quality Action Plan for the District of Purba Medinipur is to identify all interventions needed to implement the program for water supply improvement. It should be considered as a live document, to be updated as and when new data is available.

²Anganwadi means "courtyard shelter" in Indian languages. Anganwadis were started by the Golas part of the Integrated Child Development Services program (In 1975) to combat child hunger and malnutrition. A typical Anganwadi centre provides basic health care in Indian villages.

³Panchayati Raj Institutions is a system of governance in which gram panchayats are the basic units of administration. The system has three levels: Village level is Gram Panchayat, Blocks level known as Block Samiti or Panchayat Samiti (block level), and District level known as Zila Parishad

As the ground water in select areas (primarily the coastal blocks) of PurbaMedinipuris affected with salinity and declining ground water levels, a comprehensive plan for judicious use of ground and surface water source is required.

This WQAP provides a broad framework for further developing the various WS Schemes that have already been developed and for providing sustainable potable water supplies to the remaining blocks of PurbaMedinipur

The WQAP looks into the prevailing ground water quality data from the different blocks including the tests carried out under the aegis of WSSO (Water and Sanitation Support Organization), and suggests preventive measures that are required to reduce the impact arising out of future ground water abstraction.

The MDWS has identified 5 strategic Objectives to achieve its goal:

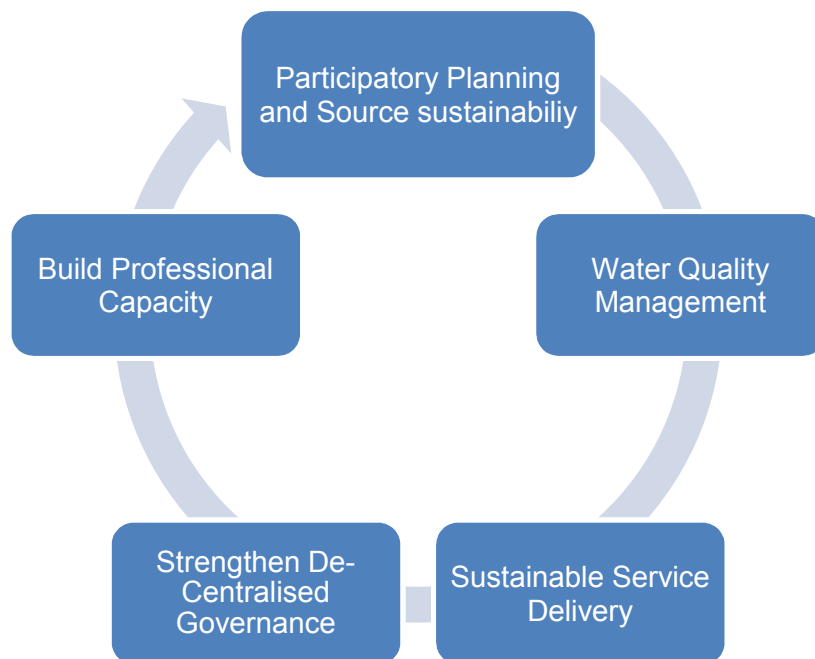


Figure 2: Strategic Objectives

As such, an initiative based on District wide approach has been taken in this “Drinking Water Quality Action Plan” to look at the overall issues related to water demand, available surface / sub-surface / ground water re-sources, and water quality, including any investigations required to prepare a strategy and broad frame-work for implementation and monitoring of sustainable Water Supply Schemes for PurbaMedinipur.

1.5 Project Stakeholders and Roles

The overall program will be managed and implemented by the PHED. , The Panchayati Raj Institutions (the District Councils, Block Samitis etc) will also have a significant role in the operation and maintenance of the water supply systems, since the mandate to overlook and manage the water distribution rests with the local communities, for which the formation of Village Water and Sanitation Committees has been initiated.

Successful implementation of the WBDWSIP requires close co-ordination between the various project stakeholders. The principal project stakeholders during implementation and thereafter for the project are shown below:

Public Health Engineering Department

Public Health Engineering Department (PHED) was created as an independent full-fledged Department in 1987. As per directives, PHED is responsible for managing the Water Supply & Sanitation within the State including undertaking programmes of implementation of water supply and sanitation services through the Public Health Engineering Directorate under its administrative control.

Currently, however, the Panchayet & Rural Development Department controls the Budget of Rural Sanitation and has been made the Nodal Department for Rural Sanitation. The Municipal Affairs and Urban Development Departments look after activities of Urban Sanitation and Sewerage Sector. Therefore, the primary activities of the PHED are now related to Rural and Urban Water Supply Sectors.

Panchayats & Rural Development Department

Panchayats & Rural Development Department of the Government of West Bengal is entrusted with the responsibility of constitution and framing policy related to functioning of the rural local self-government, i.e, the Panchayats, providing administrative support to the three tier panchayat system as well as implementation of various rural development programmes. The associated local Zilla Parishads (District level governance), Panchayet Samitis (Block level governance) and Gram Panchayet (Village level governance) will also be stakeholders.

Water Resources Investigation and Development Department

The objective of the Water Resources Investigation and Development Department (WRIDD) is to explore, utilize and conserve surface and ground Water in the State of West Bengal by application of Technology & Technical know-how to cater the increasing demand of fresh water as well as to prevent degradation of water quality. The WRIDD is the mother Department and has 6 Department under its fold namely:

Water Resources Development Directorate (WRDD)

- Command Area Development Authority (CADA)
- State Water Investigation Directorate (SWID)
- West Bengal Accelerated Development of Minor Irrigation Project (WBADMIP)
- West Bengal State Minor Irrigation Corporation Ltd (WBSMICL)
- West Bengal Agro Industries Corporation Ltd. (WBAICL)

The State Water and Investigation Directorate (SWID) is an important stakeholder, which is responsible for assessment of water resource within the State.

State Water Investigation Directorate (SWID)

SWID is responsible for carrying out investigation and quantitative & qualitative assessment of water resources in the State. It also shares expertise with various government developmental agencies in various groundwater and surface water projects for agriculture, industrial and drinking water development in the State including

augmentation of water resources through implementation of various conservation/artificial recharge schemes and its key roles are in:

- (a.) Periodical monitoring of groundwater level in different Blocks
- (b.) Periodical monitoring of surface water discharge in different rivers
- (c.) Groundwater Resources, Estimation and assessment
- (d.) Assessment of GW & SW quality with respect to space and time
- (e.) Delineation of aquifers containing salinity, arsenic, fluoride, iron and other heavy metals in groundwater
- (f.) Evaluation of aquifer parameters through analysis & pumping tests data
- (g.) Implementation of pilot schemes of artificial recharge to ground water,
- (h.) Generation of hydro-meteorological data & its interpretation.
- (i.) Preparation of District-wise and Block wise hydrogeological maps and groundwater resource feasibility maps.
- (j.) Geophysical investigation of groundwater
- (k.) Sharing technical expertise with to different Government Departments, Semi-Government Organizations, Local Self Bodies, Universities, WBSEB, Banks, individuals and groups of individuals in connection with surface water and groundwater development & management
- (l.) Implementation of "West Bengal Ground Water Resources (Management, Control & Regulation) Act, 2005" in the state of West Bengal.

[Irrigation and Waterways Department](#)

The Irrigation and Waterways Department is entrusted with the task of providing irrigation facilities, offering reasonable protection against flood, alleviating drainage congestion, arresting erosion, maintaining internal navigation channels and up-keeping the natural waterways in the state. Both the Kangsabati and Durgapur barrages are under the control of the Department. The department has implemented several major and medium irrigation projects, number of embankment schemes, town protection schemes, drainage schemes, anti-riverbank erosion schemes & anti sea-erosion schemes.

[Ministry of Drinking Water and Sanitation](#)

The Ministry of Drinking Water and Sanitation, as the reforms initiator of NRDWP and funding partner, has a principal stake in preparation, monitoring and implementation of schemes.

There are also a number of secondary stakeholders like: the Pollution Control Board; Public Works Department (which overlooks the district and major roads); the National Highway Authority of India (NHAI); Land and Land Reforms Department; and Geological Survey of India. These could play a significant role in and during the process of conceptualization, implementation of the Schemes including in the Operation and Maintenance.

The development of a comprehensive plan for drinking water supply at a district level is expected to have a number of stakeholders who will be involved in the challenges associated with its implementation.

Chapter 2 District Profile

2.1 Location and Project area

2.1.1 Location

The district of PurbaMedinipur is located in the south-western edge of the State of West Bengal, located within latitude 22°57'10"N to 21°36'35"N and longitude 88°12'40" E to 86°33'50" E. The district is bounded by Paschim (West) Medinipur on the West and north, the river Rupnarayan on the East and Bay of Bengal in the South. The district has been carved out of the erstwhile Medinipur district into PurbaMedinipur and PaschimMedinipur district on 1st January 2002.

The total area of PurbaMedinipur is 4736 Sq. Kms. As per the latest Census data (2011), the population of the district is 5,095,875.

The district has 25 Community Development Blocks, with 223 Gram Panchayats⁶, consisting of 2994 Villages and 5736 habitations.

The district has 5⁷ statutory towns and 20 census towns.

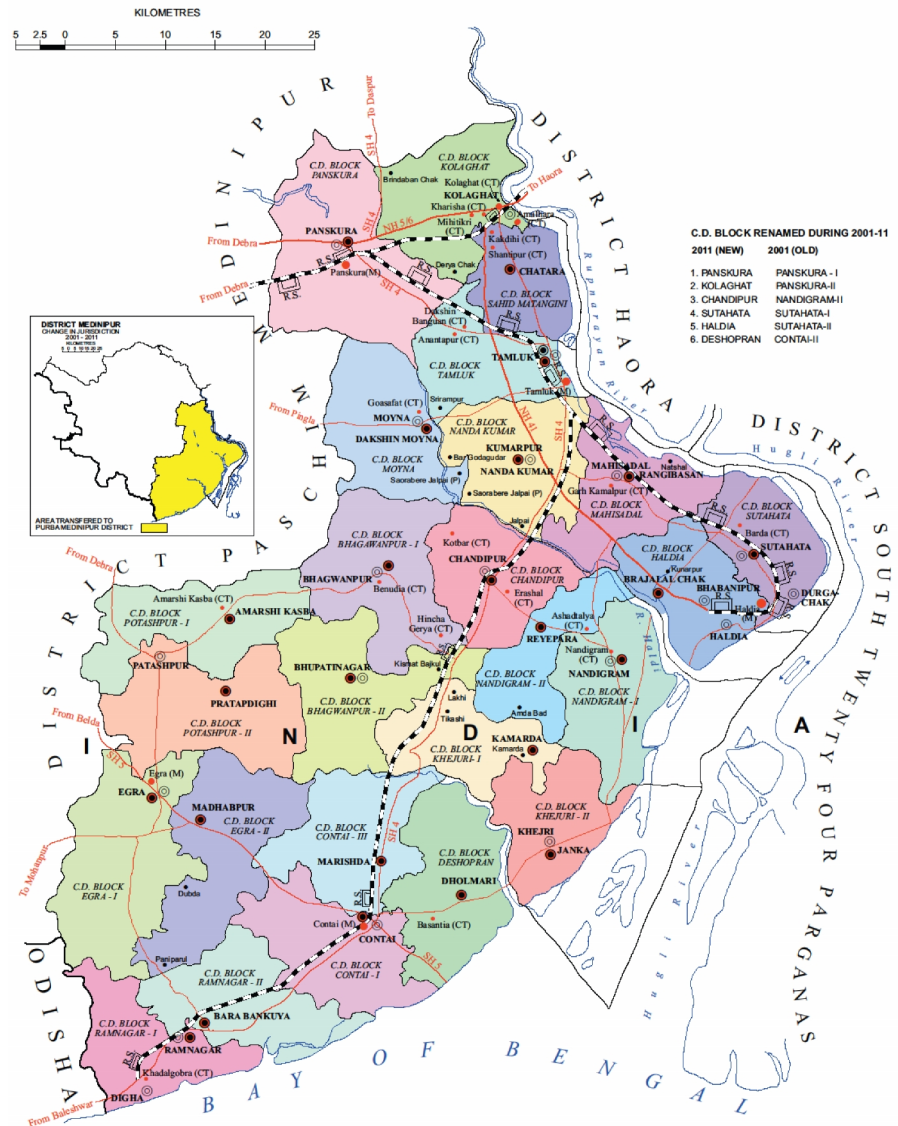


Figure 3: District Map of East Medinipur

⁴ District Census Handbook, Purba Medinipur-2011

⁵ District Census Handbook, Purba Medinipur-2011

⁶ Gram Panchayat is the organization of elected members of Gram Sabha of the village. A Gram Sabha consists of members that include every adult of the village or Gram.

⁷ Statutory with a municipality, corporation, cantonment board or notified town area committee notified by the State / Union Territory and governed by elected local

2.1.1 Administrative Setup

The District has 4 (four) sub-divisions, namely Tamluk, Haldia, Egra and Contai. The detail of the blocks including the statutory towns and census towns under each of the administrative sub-divisions is presented below:

Table 2-1: Administrative Sub-Division: PurbaMedinipur

Sl. No.	Sub-Division	Block Details	Statutory Town	Census Towns
1	Tamluk	Nandakumar, Moyna, Tamluk, ShahidMatangini, Panskura, Kolaghat and Chandipur	Panskura, Tamluk	Goasafat, Anantapur, DakshinBaguan, Kakdihi, Shantipur, Kolaghat, Amalhara, Mihitkiri, Kharisha, Kotbar and Ershal
2	Haldia	Mahisadal, Nandigram-I, Nandigram-II, Sutahata and Haldia	Haldia	GarhKamalpur, Nandigram, Ashadtalya, Barda
3	Egra	Bhagawanpur-I, Egra-I, Egra-II, Patashpur-I and II	Egra	Benudiya, HinchGerya
4	Contai	Contai-I, Deshopran, Contai-II, Khejuri-I, II, Ramnagar-I,II and Bhagawanpur-II	Contai	Basantia and Khadalgobra

2.1.2 Road Network and Connectivity

Layout map of PurbaMedinipur showing the major roads is shown below:

NH-41 (new number is NH-116) is entirely in PurbaMedinipur district and connects Kolaghat (NH-6) to Haldia, a total length of 116 Kms. National Highway-6 passes through the northern fringe of the district (passing Panskura and Kolaghat blocks).

SH-4 connects Digha Foreshore in Purba Medinipur to Jhalda in Purulia, passing through Contai Municipality, Nandakumar and Panskura Municipality. The total length is 466 Kms, of which 163 Kms is within Purba Medinipur. SH-5 connects Contai in Purba Medinipur to Rupnarayanpur in Bardhamann district, passing through Egra Municipality. The total length is 376 Kms, of which the 42 Kms is within Purba Medinipur district.



Figure 4: Road Connectivity: PurbaMedinipur

2.1.3 Climate

The climate of district is tropical. Average annual temperature varied from 10° C to 34°C. The mean monthly temperature over the past 4 years is tabled below:

Table 2-2: Average Monthly Temperature in Purba Medinipur

Month	⁸ Monthly Mean Temperature in °C									
	2010		2011		2012		2013		2014	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
January	24	12	25	13	25	15	25	17	26	13
February	28	19	28	17	29	17	28	16	28	17
March	31	24	31	22	31	23	32	28	31	22
April	33	27	32	25	33	26	33	25	34	26
May	33	27	33	26	34	27	33	27	34	27
June	33	28	32	27	34	28	33	27	34	28
July	32	27	32	27	32	27	..	..	32	27
August	32	27	31	26	32	26	..	..	32	27
September	32	26	31	26	..	..	33	26	33	27
October	31	24	33	24	32	23	31	24	33	24
November	31	21	30	19	29	19	..	..	30	18
December	26	14	30	10	26	14	27	19	27	14

Average annual rainfall varies in the district has varied from a low of 1244mm in 2010, to a high of 1729mm in 2014. The monthly rainfall from 2010 to 2014 is tabled below:

Table 2-3: Average Annual Rainfall in Purba Medinipur

Month	Average in mm	⁹ Average Rainfall in mm				
		2010	2011	2012	2013	2014
January	11	-	3	56	2	0
February	27	16	10	9	5	72
March	40	1	13	1	1	10
April	52	1	76	47	31	6
May	128	94	112	43	191	187
June	273	178	309	116	290	236
July	312	266	272	310	292	354
August	359	295	384	249	436	464
September	296	246	335	368	365	298
October	124	125	24	79	465	102
November	36	5	-	25	-	0
December	8	17	-	39	-	0
Total	1666	1244	1538	1342	2078	1729

⁸Source : Meteorological Department, Govt. of India

⁹Source : Meteorological Department, Govt. of India

2.2 Physiography

2.2.1 Topography

PurbaMedinipur district is part of the lower Indo-Gangetic Plain and Eastern coastal plains. Topographically, the district can be divided into two parts: (a) almost entirely flat plains on the west, east and north; and (b) the coastal plains on the south. The vast expanse of land is formed of alluvium and is composed of younger and coastal alluvial. The elevation of the project area ranges from 6m to 14m above mean sea level. The district has a long coastline of 65.5 km along its southern and south eastern boundary with the Bay of Bengal.

2.2.2 Soil Characteristics

Major part of the district is covered by alluvial soil except a narrow belt along the sea coast in the extreme south where saline soil saline-alkali soil, non-saline alkali soil and degraded alkali soils developed.

The soil of the district is alluvial type, as the district under coastal alluvium and its deposition. Soil of this region consists of different layers like sand, silt and clay. The district is situated on flood plains of the rivers Rupnarayan and river Haldi and therefore huge amount of clay is dominating in soil texture. Due to this specialty of soil, water logging in this region during monsoon is very common. Due to poor permeability, the soils are imperfect to poorly draining. The land use pattern of the area is affected to a large extent by this physical quality of the soils.

2.2.3 Land Use

The distribution of the particular types of land use in Purba Medinipur district depends largely on natural factors like the distribution of water and soil. It also depends on the traditional preferences and Government policies of zoning and land use planning decisions. Around 60 per cent of the total reported area of the district is under cultivation. Among food crops, paddy is the most widespread crop. The following table shows the land utilization statistics of the district for the last five years:

Table 2-4: Land-Use Characteristics in the district

Land Use	Area (in Acre)	Percentage
Urban / Rural Settlement	275711.41	26.9%
Sea Port	1946.58	0.2%
Brick Kiln	3165.87	0.3%
Industry	8472.11	0.8%
Tourism	1311.19	0.1%
Agricultural (Single Crop)	143645.65	14.0%
Agricultural (Double/ Multiple Crop)	476532.16	46.5%
Horticulture Plantation	18946.81	1.8%
Aquaculture	8113.62	0.8%
Forest / Social Forestry / Archaeological Site	4307.11	0.4%
Inland Natural	2120.01	0.2%
Waste-land	10393.03	1.0%
Salt Pan	3236.24	0.3%
Rivers / Lakes / Ponds / Tanks / Canals	66913.08	6.5%
Others	1074.28	0.1%

2.2.4 Rivers and River Basin System of Purba Medinipur

The drainage / river basin system of Purba Medinipur is controlled primarily by the Rupnarayan, Haldi, Rasulpur-Pichabani sub-basin and the Kaliaghai sub-basin.

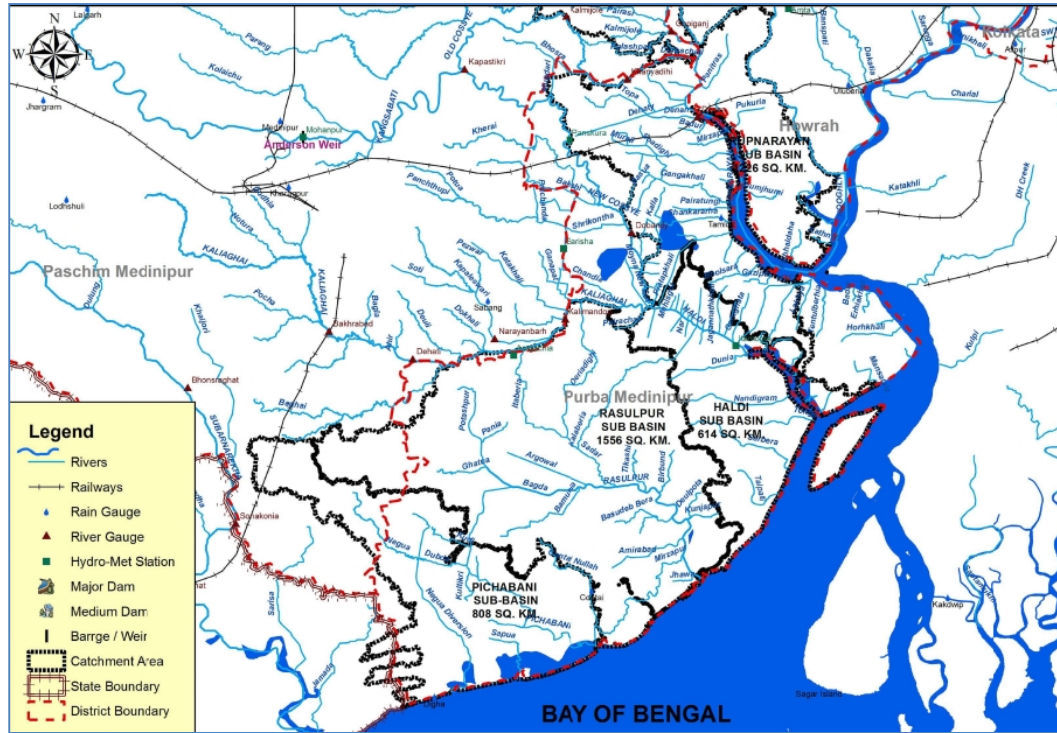


Figure 5: Rupnarayan-Haldi-Rasulpur-Pichabani Sub-basin¹⁰

Catchment map of the Kaliaghai sub-basin is also presented below:

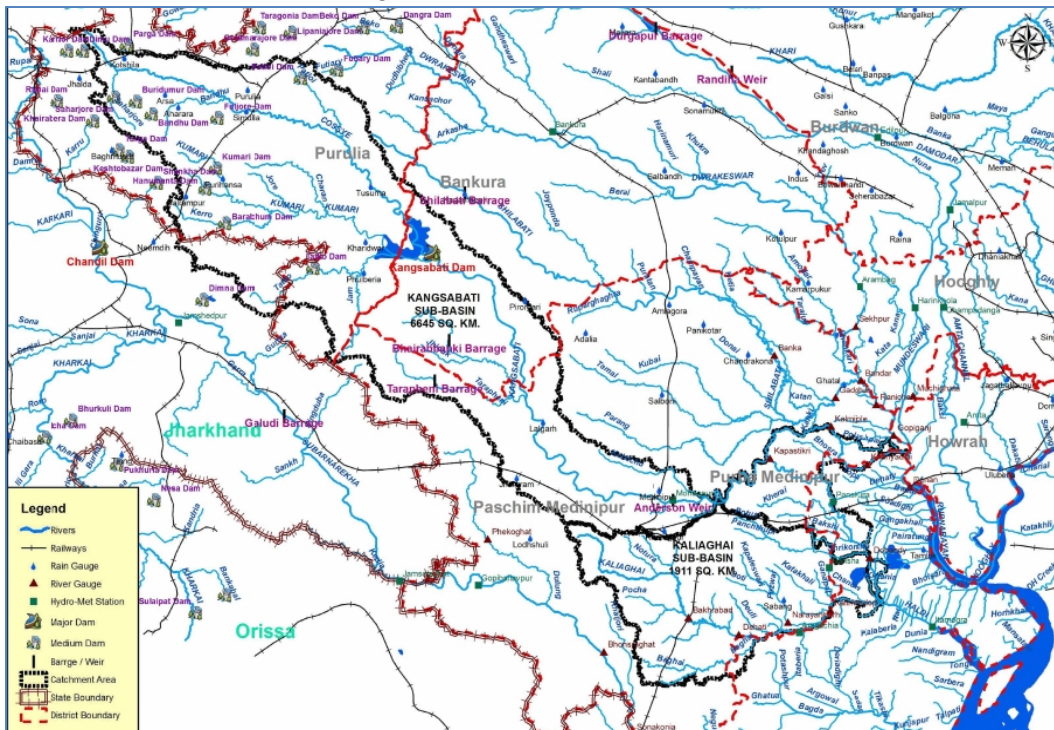


Figure 6: Kaliaghai Sub-Basin

¹⁰ Index I16- Map of Rupnarayan-Haldi-Rasulpur-Pichabani Sub-basin

The Rupnarayan flows through the north, north-eastern (NNE) fringe of the District separating it from Hooghly District.

Table 2-5: Major Rivers flowing through PurbaMedinipur

Sl. No	Name of River	¹¹ Catchment area (In Sq. Kms)	Length (In Kms)
1	Rupnarayan	1226	80
2	Kaliaghai	1913	121
3	Haldi	614	42
4	Rasulpur	1556	19
5	Pichabani	808	-

A brief account of the major rivers forming the river basin system in PurbaMedinipur is presented below:

2.2.4.1 Rupnarayan

The river is formed from the confluence of Shilabati and Dwarkeshwar at Bandar near Ghatal town of PaschimMedinipur district. The Shilabati (also known as Silai) emerges from hilly terrain of Chhota Nagpur Plateau in the Purulia district, traverses south-eastward through the districts of Bankura and PaschimMedinipur to meet with the Dwarakeswar river. The Dwarakeswar river (also known as Dhalkishore) originates from Tilboni hill of Chhota Nagpur Plateau in Purulia district and enters Bankura district near Chatna. It mainly flows south-eastward and after entering into Hooghly district it turns south near Arambag town. After receiving contributions from other minor tributaries, the Dwarakeswar finally joins with Shilabati to form the river Rupnarayan.

The Kana Dwarkeshwar, Polashpai, Durbachaty are the tributaries of the Rupnarayan. The Rupnarayan river is the main tributary of the Hooghly and receives tidal flow from Bay of Bengal, as well as flow from the major tributaries of Dwarkeshwar, Shilabati, Kangsabati, and Mundeshwar. It also receives flow from a number of drainage channels, like Kata Khal, Bakshi Khal, and Chandreshwar Khal of PaschimMediniur.

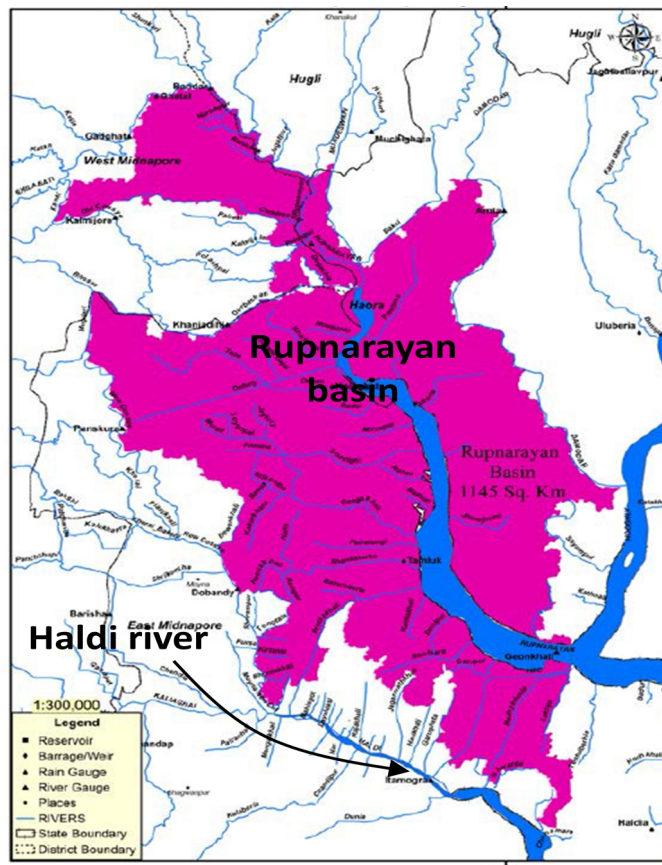


Figure 7: Rupnarayan basin

¹¹ Data Source: Annual Flood Report-2015, Issued by Irrigation and Waterways Directorate

2.2.4.2 Kangsabati and New Cossye

The Kangsabati River (also variously known as the Kasai and Cossye) rises at Murguma near Jhaldain the Chota Nagpur plateau. andflows through the districts of Purulia, Bankura and PaschimMedinipur in West Bengal before draining in the Bay of Bengal.

After entering the district of PaschimMedinipur it joins with combined streams of BhairabBanki and Tarafeni rivers and flows east in a tortuous course before it bifurcates into two rivers at Kapastikri.. The northern branch, known as Old Cossye, further bifurcates into two courses at Daspurin Paschim Medinipur. One course, named as Palaspai Khal, flows further east to outfall into the Rupnarayan and the main course, known as Durbachaty, flows south-easterly along the border of both Medinipur districts to also outfall into river Rupnarayan.

The New Cossye is a southern offshoot of the Kangsabati river which flows from Keshpurin a south-easterly direction to meet with river Kaliaghai at Dheubhanga , forming the river Haldi which then flows eastwards to the river Hooghly at Haldia. Kherai-Bakshikhal is the main tributary of river New Cossye. The total length of Kangsabati is around 465 km and the New Cossye is 108 Kms.

2.2.4.3 Kaliaghai

The river Kaliaghai trickles out from Dudhkundi of Jhargram in PaschimMedinipur district and flows south-easterly through PurbaMedinipur to meet the other arm of Kangsabati (New Cossye) to form Haldi. During the course of its journey, it is fed by the flow of its tributaries namely Kapaleswari, Deuli, Baghai and Chandia. The length of this river is 121 km.

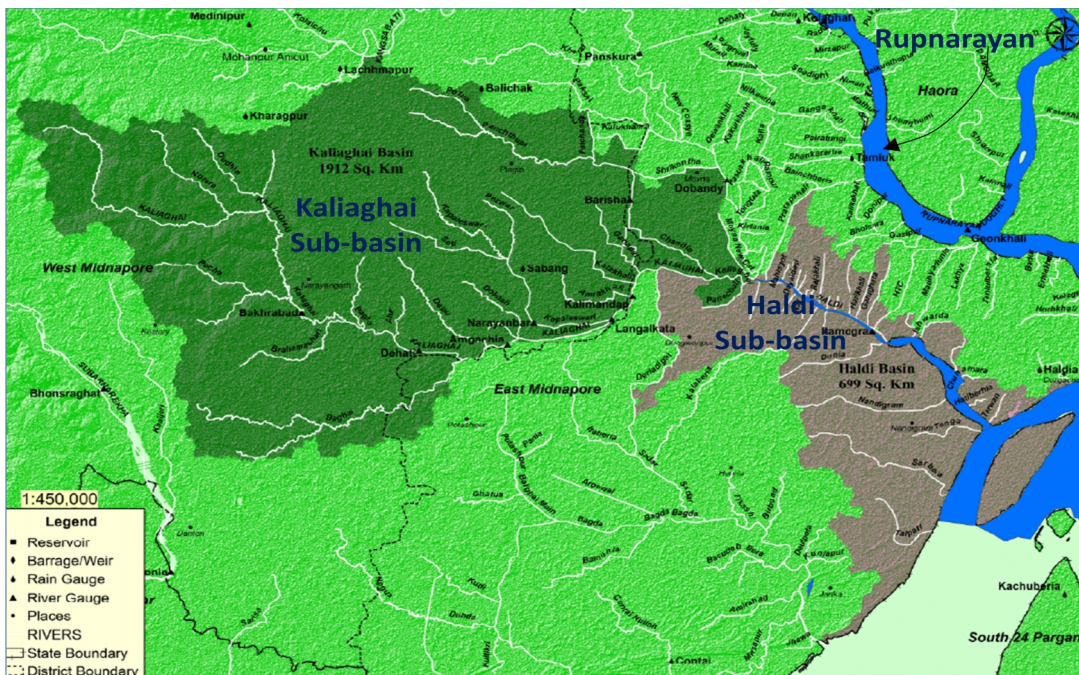


Figure 8: Kaliaghai-Haldi Sub-basin

2.2.4.4 Haldi River

River Haldi is formed by joining of New Cossye and Kaliaghai and after traversing south-eastwards outfalls into the river Hooghly near Haldia town. The river divides the PurbaMedinipur district into two parts; the northern part can be categorized as drainage area of Tamluk and the southern part can be categorized as Rasulpur-

Nandigram drainage area, except upper catchment discharges from Kaliaghai-New Cossye sub-basins.

The lower portion of the river Haldi is affected by over bank spills and drainage problem during the monsoon as entire stretch of 42 km of the river falls under the tidal influence of river Hooghly.

2.2.4.5 Rasulpur River

The river Rasulpur flows through the PaschimMedinipur and PurbaMedinipur. The river is formed by three streams namely Bagda, Sarpai and Madhakhali. It is the main drainage channel in Contai Sub-Division of PurbaMedinipur district. The river ultimately outfalls into the river Hooghly. The length of this river is 19 km.

2.2.4.6 Pichabani-Negua Channel

River Pichabani is the main drainage channel which is used to drain out rain water from Dubda basin under Egra block of PurbaMedinipur district. The river outfalls into the Bay of Bengal. The catchment area of the sub-basin is 808 Sq. Kms.

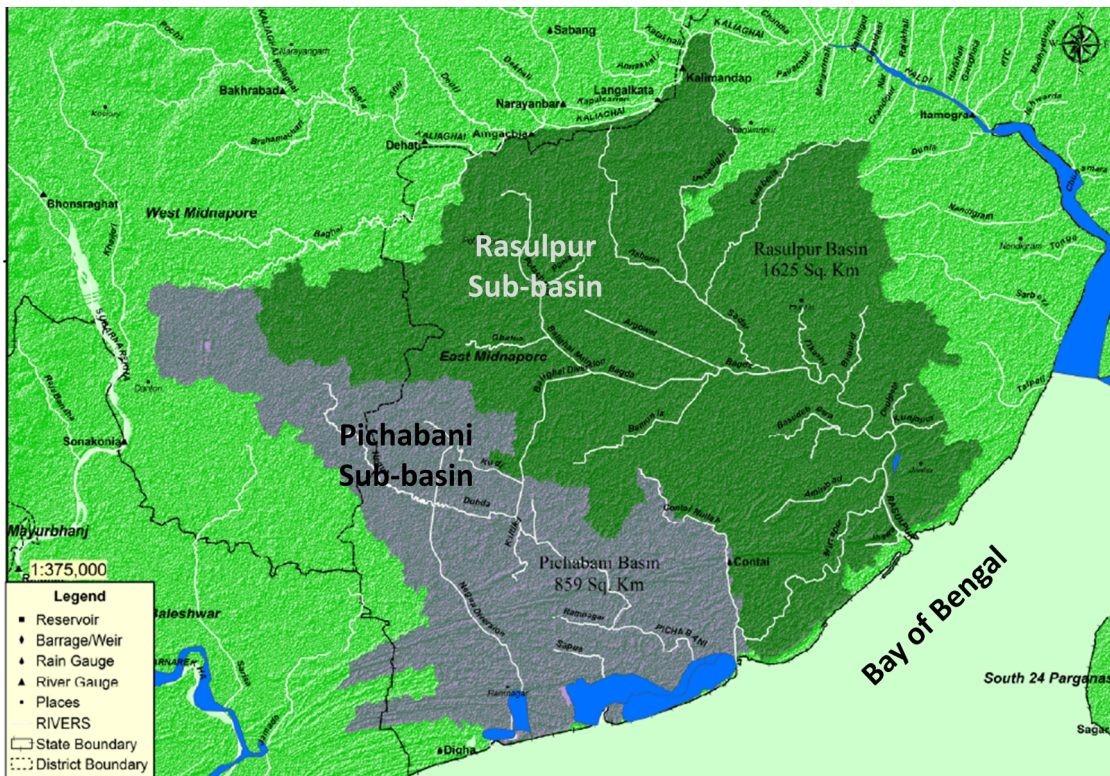


Figure 9: Rasulpur-Pichabani Sub-basin

2.2.5 River Water Quality-Rupnarayan

The State Pollution Control Board has a monitoring station on the Rupnarayan, near Geonkhali, at the confluence of River Hooghly. Monthly tests carried out are published in the website. The water quality parameters indicate an increase in the chloride (salinity) concentration during March to June, every year. The advent of the salinity in the river has increased over the years during the lean period. Summary of the critical water quality parameters, for the last one year is summed up below:

Table 2-6: Water Quality Parameters: Rupnarayan

Parameter	2017		2016									
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Coliform (MPN/100ml)	90000	11000	160000	35000	17000	90000	17000	24000	30000	22000	17000	90000
Fecal Coliform (MPN/100ml)	30000	3000	28000	14000	11000	30000	11000	8000	17000	14000	11000	22000
TDS (Mg/l)	460	476	3232	7980	7450	6940	2110	979	442	636	768	367
TSS (Mg/l)	450	132	526	414	740	1220	260	1160	668	577	336	166
Chloride(Mg/l)	127	121	1505	4080	4431	3403	882	322	68	191	313	35.7
BoD (Mg/l)	1.75	2.15	1.0	1.1	2.1	1.85	0.70	1.65	0.4	2.9	1.15	2.0
DO (Mg/l)	7.7	8.0	5.5	6.6	7.2	6.30	6.4	6.2	4.8	5.8	6.5	8.5
Conductivity (us/cm)	712	729	4770	11740	12200	10080	3630	1369	372	831	1171	630
Turbidity (NTU)	243	131	408	408	616	1026	387	428	554	508	268	176

2.2.6 Coastal Regulation Zone

Under the Environment Protection Act, 1986 of India, the Ministry of Environment and Forests (MoEF) issued a notification in February, 1991, for Regulation of activities in the coastal area. As per the notification, the coastal land up to 500m from the High Tide Line (HTL) and a stage of 100m along banks of creeks, estuaries, backwater and rivers subject to tidal fluctuations, is called the Coastal Regulation Zone(CRZ). West Bengal has a Coastal Zone of 220km (stretching from HTL to 500 m (as CRZ) inland and up to the landward extension of the successive series of older sand dune stretching up to Orissa Coast Canal in the western part).

In West Bengal, the coastal zone is divided into 2 coastal environments based on the amplitude of tidal waves (1) Macro tidal (tidal range >4m) and Meso tidal (tidal range 2m – 4m). The Medinipur (Digha-Sankarpur-Junput) coastal plain with rows of sandy dunes separated by clayey tidal flats from Sagar Island to Orissa border to the west is under Meso tidal environment.



Figure 10: Coastal Regulatory Zone: West Bengal

2.3 Geomorphology and Hydro-geology

2.3.1 Geomorphology

The district is characterised by gently sloping flat alluvial terrain, which gradually merges towards deltaic plain farther south. The elevation of land mass ranges from 10 m above mean sea level in the northern part to 3 to 4m above mean sealevel at the coast. After that the land gradually dips into the Bay of Bengal. In the vicinity of coast in Ramnagar and Contai blocks, a series of sand dunes stretching East-North-East to West-South-West direction are present, which is indicative of palaeo shoreline.

2.3.2 Geology

The district is underlain by unconsolidated alluvium sediments of Quaternary age, which is overlain by linear continuous beach ridges (sand dunes) deposited by the wave action of the sea along the present day coastline around Digha-Ramnagar-Contai. The thickness of the alluvial sediments increases towards east and southeast following the basin configuration. The Quaternary formation comprises newer alluvium of recent age and older alluvium of Pleistocene age. The older alluvium is restricted to the fringe area of the platform terrain towards west and northwest and is overlain by newer alluvium towards east, south and south east. The older alluvium comprises predominantly of yellow to reddish brown clays with kankar and ferruginous gravel and sand. fine to medium. The newer alluvium consists predominantly of clay with occasional intercalation of silt and fine sand and is light grey in colour. It is restricted to the coastal tract and marginal alluvium plains. The Quaternary sediments are underlain by semi-consolidated Tertiary sediments of Mio-Pliocene age. The Tertiary sediments comprises of alternations of graded sand-silt-clay sequence suggesting cyclic sedimentation. In contrast to Quaternaries the Tertiaries are grey in colour with deeper litho-facies being steel grey.

The subsurface correlation diagram prepared from the existing borehole data indicates that there is lateral facies variation often resulting in the coalescing of granular zones and / or their gradation zones silty / clayey beds towards east, south and southeast. The top of the Tertiary sediment is generally represented by grey clay. This grey clay-bed is persistent throughout the area and is considered as 'marker bed' which separates the upper litho system (Quaternary sediments) and lower litho system (Tertiary sediments). The quartzo-feldspathic unconsolidated Quaternary sediments vary considerably in thickness from 120m in the west to over 150m in the east and from 150m in the northwest to over 180m in the southeast. It is predominantly arenaceous in the north and northwest to mostly argillaceous in the south and southeast. The thickness of the newer alluvium varies between 10 and 60m in the northwest - southeast direction. The thickness of older alluvium varies between 50m in the northwest to over 90m in the southeast direction. The newer alluvium is devoid of any significance granular zones.

The semi-consolidated Tertiary sediments are most extensive and underlie the entire alluvial as well as coastal plains. The thickness of the Tertiary formation increases towards the coastal area being more than 300m. The depth of occurrence of different stratigraphic units as established by ground water exploration under Kasai-Subarnarekha Project (UNDP) is as follows:

Table 2-7 : The depth of occurrence of different stratigraphic units

Location	Depth of borehole (m bgl)	Quaternary Sediments		Tertiary sediments
		Newer alluvium	Older alluvium	
Negua	420.97	GL-18.00	18.00 - 57.00	57.00 -> 420.90
Sarasankha	413.62	GL-23.00	23.00-66.00	66.00 - >413.62
Bhagawanpur	250.00	GL-10.00	10.00-67.00	67.00 - >250.00
Kaoasaria	400.00	GL-54.00	54.00- 118.00	118.00 - >400.00
Narghat	249.55	GL-18.00	18.00- 70.00	70.00 - >249.55
Contai	400.55	GL-70.00	70.00 – 172.00	172.00 - >400.55
Shankarpur	251.00	GL 68.00	68.00 - 110.00	110.00 - >251.00
Junnut	251.00	GL- 65.00	65.00-107.00	107.00 - >251.20
Haldia	304.64	GL-90.00	90.00 – 150.00	150.00 - >304.64
Khejuria	401.37	GI-109.00	109.00 - 211.00	211.00.->401.37

2.3.3 Hydro-geology and Ground water potential

The Quaternary sediments are underlain by tertiary sediments. A 30-50mthick blanket of clay at the top is underlain by sand-clay sequence down to explored depth of 400m bgl. Ground water in the district occurs under semi-consolidated to confined condition in both the litho systems.

In general the area is underlain by a single aquifer in each litho system, which splits up into multiple aquifers with the intervening clay/sandy clay layers. In Quaternary sediments this single aquifer has been split up into two regionally extensive aquifers whereas in Tertiary sediments four such regionally extensive aquifers have come out from the single aquifer.

The hydro-geological map of Purba Medinipur is show below:

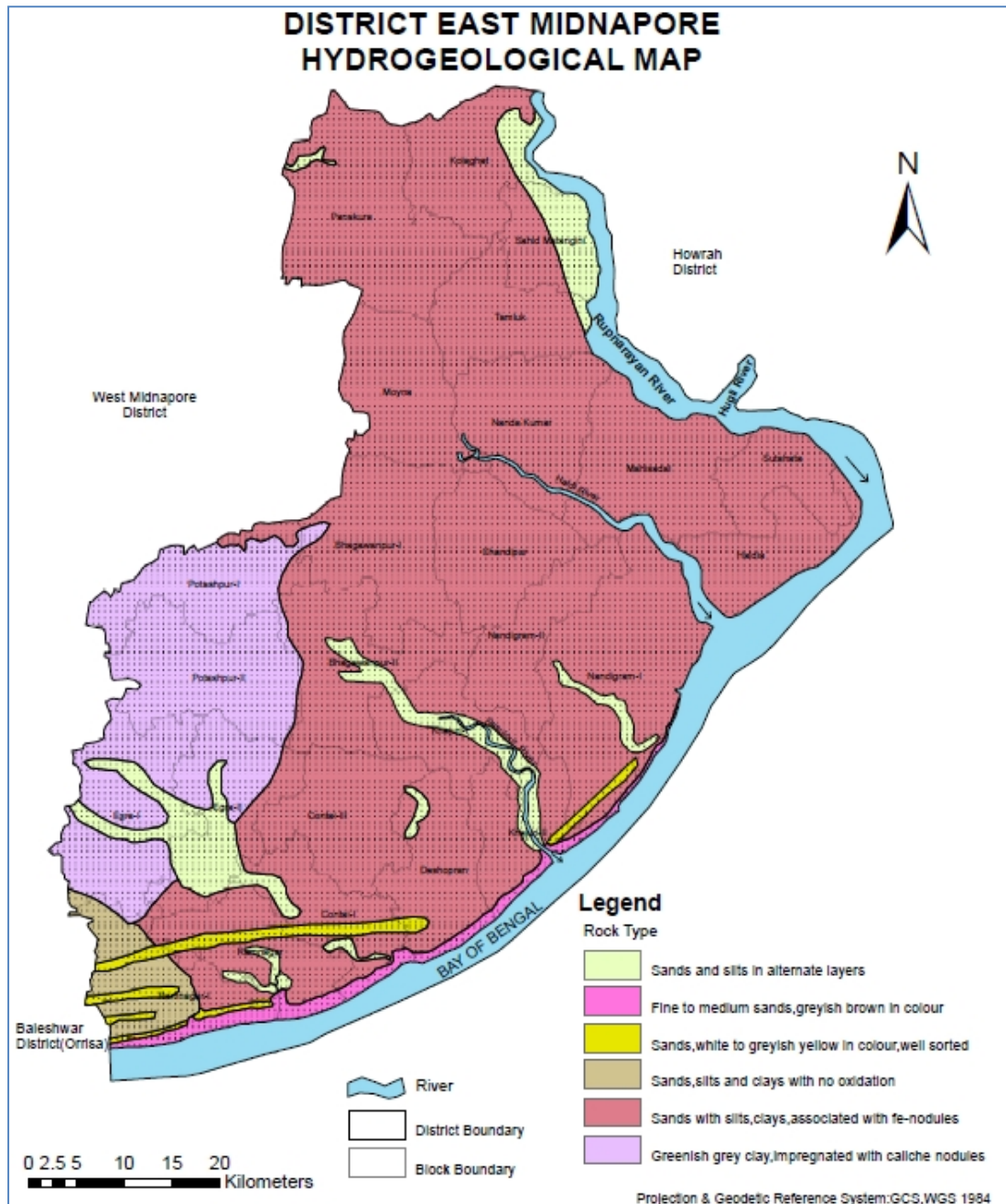


Figure 11: Hydro-geological Map of Purba Medinipur

2.3.4 Ground water potential

The Central Ground Water Board (CGWB), Eastern Region and State Water and Investigation Department (SWID), Government of West Bengal jointly evaluated the ground water resource for the nine blocks falling in the northern part of the district, excluding coastal blocks. The net ground water resources available and gross ground water drafts for the above blocks are tabled below:

Table 2-8: Dynamic ground water resource in blocks under unconfined condition

Sl. No	Block	Area in hectare	Net Ground Water availability (ham)	Gross Ground Water draft for all users (ham)	Stage of Groundwater development	Category
1	Bhagawanpur-I	17995	7852.84	3183	40.53	Safe
2	Bhagawanpur-II	17786	7086.09	1718	24.25	Safe
3	Egra- I	21480	9832.24	5709	58.06	Safe
4	Egra-II	21888	8990.86	2730	30.36	Safe
5	Moyna	14700	6407.25	1401	21.86	Semi-Critical
6	Panskura-I	24468	10017.35	2824	28.19	Safe
7	Panskura-II	15277	7244.33	1334	18.41	Safe
8	Potashpur- I	17169	7998.96	4286	53.58	Safe
9	Potashpur - II	18811	8910.93	5697	63.93	Safe
Total		169574	74340.54	28882	38.85	

The ground water in the coastal area occurs under semi-confined to confined condition in both the litho-systems and receives recharge from a distant area. As such, the exact amount of recharge is difficult to assess. However, an attempt was made by CGWB to evaluate the quantum of sub-surface outflow of groundwater through the deeper confined aquifers in the coastal blocks, as presented below:

Table 2-9 Sub-surface outflow of ground water from coastal blocks

Sl. No	Block	Average Transmissivity (T) (m ² /day)	Average Hydraulic gradient (I)	Maximum length of flow path (L) (km)	Annual ground water flow in (MCM)
1	Tamluk and ShahidMatangini	2000	1: 3294	20.27	4.492
2	Mahishadal and Nandakumar	2000	1: 5068	16.22	2.336
3	Sutahata and Haldia	2000	1: 4300	17.74	3.012
4	Nandigram-I, II and Chandipur	2000	1: 5447	17.74	2.377
5	Kheiuri-I &II	2000	1: 6000	14.19	1.726
6	Contai-I,II & III	2000	1: 5068	26.35	3.795
7	Ramnagar-I & II	2000	1: 6586	21.79	2.415
Total					20.15

A total of 20.15million cubic metres of ground water is flowing away from the deeper confined aquifers in the 16nos of blocks situated in the coastal belt.

2.4 Ground Water Availability

2.4.1 Depletion of Ground Water Levels

Within the nine non-coastal blocks, the stage of ground water development varies from 20% to 64%. Considering the falling trend of ground water level in both pre-monsoon and post-monsoon period as more than 5 cm/yr, the block of Moyna has been categorized as semi-critical.

Five of the sixteen coastal blocks, Tamluk-I, Mahishadal-I, Sutahata-I & II and Contai -III show declining trend (>5cm/lyr) in both pre monsoon and post monsoon period but Ramnagar shows only pre-monsoon falling trend (>5cm/yr). The ground

water draft in Tamluk, Mahishadal, Sutahata, Haldia and Contai-III blocks has exceeded the subsurface outflow of ground water through the deeper aquifers. Further ground water exploration needs to be restricted in these blocks.

Ground water development in the remaining 11 coastal blocks needs to be done very cautiously and logically considering the quantum of subsurface outflow through the deeper aquifers. Over exploitation of ground water from the deeper fresh water aquifer will create in equilibrium condition with the overlying and underlying saline aquifers, which may invite saline water into the fresh water aquifer.

2.4.2 Blocks Affected by Salinity

The chemical quality of ground water has been determined from the analysis of water samples collected during various hydro-geological studies, including the studies conducted upper Kasai-Subarnarekha (UNDP) Project as well as monitoring of National Hydrograph Net Work Stations. The analytical data indicates that ground water in upper litho system indicates CaMgHCO₃ (calcium magnesium bicarbonate) types in alluvial plain and mixed type in coastal plain but ground water in the lower litho system in both the areas shows variation in the quality. Ground waters in both the litho systems are neutral to mildly alkaline in alluvial area and mildly alkaline to distinctly alkaline in coastal area. All the chemical constituents are in general within permissible limits for human consumption, except the occurrence of iron, which exceeds the permissible limit in some places..

The most striking and interesting aspect from a quality point of view is that fresh ground water in coastal area occurs within a depth span of 120-300m bgl. The upper aquifers above 120mbgl contain saline water. In the Contai sub basin (around Contai town), which covers approximately 150 sq.km, the near surface aquifer is 5 to 12m thick and there are three to four other distinct aquifers within a depth of 250mbgl in the sub-basin and all these horizons contain saline water. Here the brackish/fresh water interface does not show any deterioration in quality with time, which is suggestive of poor flushing.

Table 2-10: Blocks in PurbaMedinipur affected by Salinity

Sl. No	Name of Block	Aquifer Potential and Chemical quality
1	Tamluk, SahidMatangini, Mahisadal, Nandakumar, Sutahata, Haldia, Nandigram-I, Nandigram-II, Chandipur, Khejuri-I and II	Upper aquifer within 120mbgl is brackish/ saline. Potential fresh aquifer is below 120 m bgl. The aquifer is under confined condition. HDTW tapping granular zone of 30-40m within depth of 300mbgl yield 100-200 m ³ /hr. Ground water is Na-Ca-Cl-HCO ₃ Type.
2	Contai-I, II and III	Upper aquifer within 120mbgl is brackish/saline. Potential fresh aquifer is below 120 m bgl. Aquifer is under confined condition. HDTW tapping granular zone of 30-40m within depth of 300mbelow ground level yield 100m ³ /hr.
3	Ramnagar-I, II	Ground water is fresh in dune sand down to depth of 12mbgl. Upper aquifer within 120mbgl is brackish/ saline. Potential fresh aquifer is below 120 m bgl. Aquifer is under confined condition. Ground water is Na-Ca-Ma-HCO ₃ -Cl type
4	Bhagawanpur I, II, Egra I, II, Moyna, Panskura-I,II, Potashpur I and II	Upper aquifer is unconfined to semi confined condition. 20-100mbgl tapped by LDTW having yield 15-30 m ³ /hr. HDTW tapping cumulative thickness

Sl. No	Name of Block	Aquifer Potential and Chemical quality
		of 30m within depth of 180m having yield of 60-150 m ³ /hr.

In Digha-Ramnagar area the sand dunes in the coastal area formed by sea contain fresh ground water. The dune sand alternating with thin clay and gravelly clay bed down to a depth of 6-8 mbgl forms a near surface aquifer. The top thick clay bed of the coastal aquifers, as discussed above, underlies this near surface aquifer. The near surface aquifer emerges under the sea on the continental shelf, thus sea water having easy access into this aquifer. The general gradient of the near surface aquifer is towards sea, but it was found that minor movements of the saline-fresh water contact were due to “to and fro” movement of the sea and further controlled by the ocean tides

2.5 Impact of Climate Change

Climate change, as studies suggest, may alter the distribution and quality of natural resources, enhance water insecurity, reduce agriculture productivity, enhance exposure to extreme weather events, and pose even unforeseen health risks. The observed effects of climate change on water services relate to:

- Reduction of potable water availability in the basins
- Reduction in dissolved oxygen content, mixing patterns and self-purification capacity. Increase in algal bloom.
- Intrusion of salinity in coastal aquifers
- Changes in water availability due to changes in precipitation and other related phenomena (evapo-transpiration, ground-water recharge).
- Increasing difficulty of flood control and reservoir utilisation during flooding season.
- Floods affecting water quality and water infrastructure integrity, increased fluvial erosion, draught affecting water availability and water quality

2.5.1 Impact of Climate Change on Water Availability

An estimate of water availability in the critically affected districts of West Bengal and per capita water availability, in terms of average monsoon and non-monsoon rainfall, available surface water availability, groundwater availability and flow of trans-boundary water into the state, as provided in the State Action Plan on Climate Change (SAPCC) is tabled below for reference.

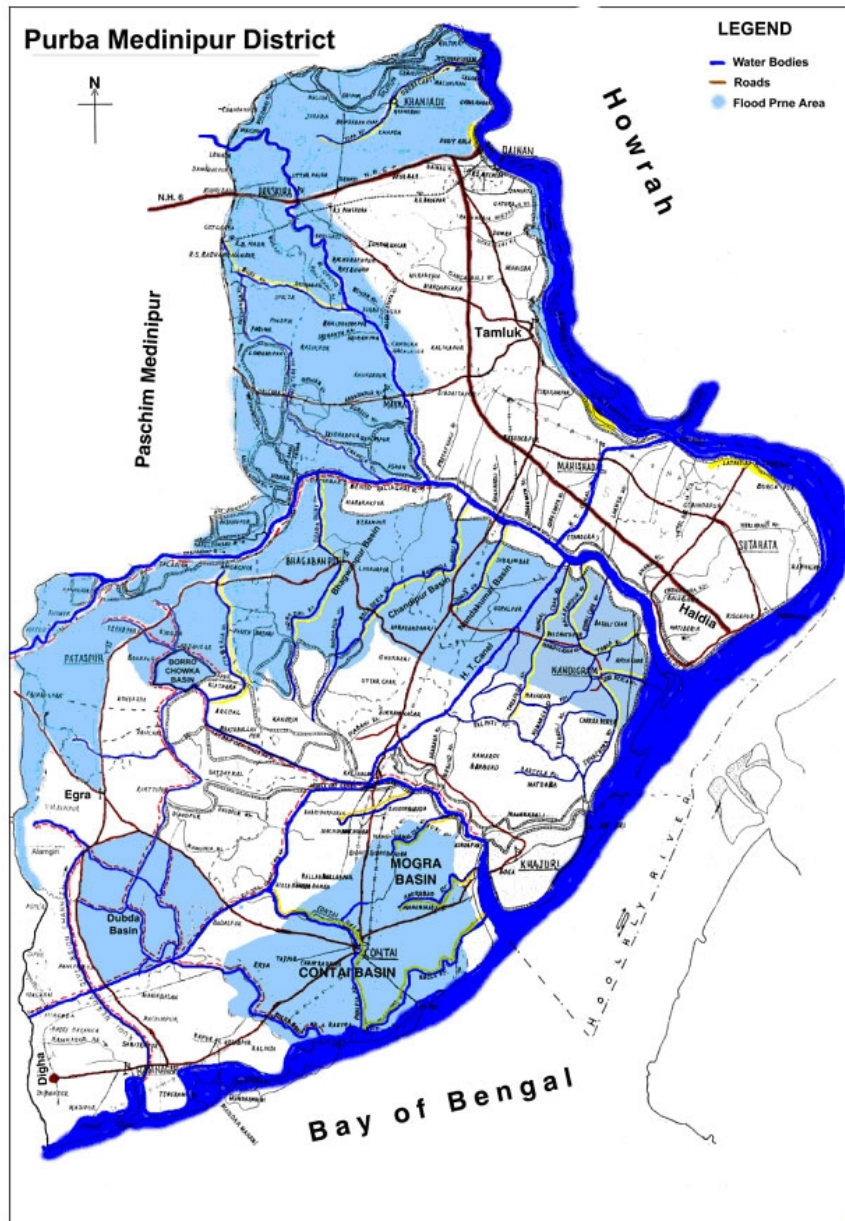
Table 2-7: Assessed Impact of Climate Change on Water Resources

District	Rainfall (mm)		Surface water (Bm ³)	Ground water (Bm ³)	Trans-boundary water	Per capita water as of 2001 m ³ /capita
	Monsoon	Non-monsoon				
Bankura	1159.7	387.5	2.06	2.09	13.35	1309.8
North 24 Paragans	1231.0	452.3	1.91	1.58	50.33	393.6
PurbaMednipur	1240.3	457.6	3.27	0.83	76.68	820.5
Murshidabad	1167.4	385.6	0.54	2.52	561.88	525.63
Haorah	1240.5	451.2	0.96	0.37	67.36	313.6
Hooghly	1208.2	441.4	0.59	1.70	65.28	457.6

The SAPCC categorized the districts into 4 divisions, Severe Scarcity: < 500m³ / capita, Water Scarcity: 500 – 1000 m³/capita, Water Stressed: 1000 – 1600 m³/capita and Water Sufficient: > 1600 m³/capita.

2.6 Disaster Management and Vulnerability

The PurbaMedinipur District is vulnerable to floods. The incidence of floods in the district occurs mostly when high flood discharges from upstream rivers (flowing



through Jharkhand alongwith those from the adjoining districts of the State) synchronize with high tides in river Rupnarayan, specifically during the month of August and September. The mapped flood prone areas within the district are shown here.

The other major threat of natural disaster faced by the district is from cyclones, since the district faces the Bay of Bengal. All the coastal blocks within the district are vulnerable to the cyclones, particularly during the monsoon season.

Figure 12: Flood Prone areas of PurbaMedinipur

2.7 Socio-Economic Status (Including Gender and Health)

2.7.1 Demographic Profile

The total population in rural and urban community development (CD) blocks in PurbaMedinipur is 5.095 million, belonging to 1.112 million households. The urban share of the total population of PurbaMedinipur District has increased from 8.3% in 2001 to 11.6% in 2011. The average household size in the district is 4.6, and the sex ratio for the overall population of the CD block in the district is 938 females per 1000 males. The sex ratio among the scheduled caste and schedule tribe is 943 and 969 respectively in the district.

An estimated 14.63% of the population in the CD blocks of the district comprises scheduled castes, while scheduled tribes constitute 0.55% of the total population.

The most important feature of PurbaMedinipur District is that it has recorded the highest Literacy Rate in the State at 87.0%, as per Census 2011, surpassing the state capital Kolkata.

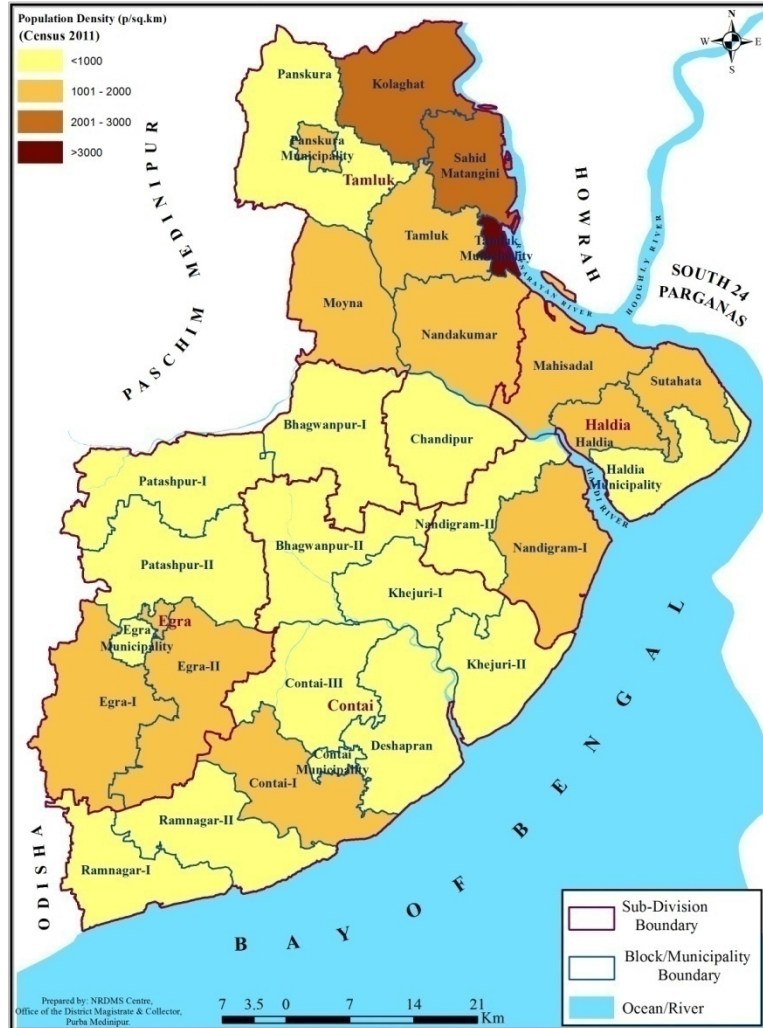


Figure 13: Population Density: PurbaMedinipur-Blocks

2.7.2 Economic Profile

Workforce participation in PurbaMedinipur is 37.5% overall, while the figures in rural areas are 38.1% and for urban areas is 32.8%. Cultivators constitute 18.1% of the main work force in the district, while the agricultural labourers constitute 36.8%.

2.7.3 Health and Gender

Available health and gender indicators from National Family Health Survey - 4 (2015 -16) of the Ministry of Health and Family Welfare, Govt. of India indicate the level of development of the district. The proportion of institutional births in rural areas of the district is 73%, close to the overall district average of 74.1%. Percentage of children who received full vaccination is high at 92.6% and 93.9% in the overall district and in its rural areas, respectively. Prevalence of diarrhoea among under-five age group children is reportedly 7.5% in the overall district and 7.1% in its rural areas. The proportion of women who were married at below 18 years of age in rural areas is 44.0%, while that in the overall district is 43.1%.

Chapter 3 Present Coverage of Water Supply

3.1 Commissioned Piped Water Supply Schemes

An assessment of the existing commissioned and ongoing piped water supply schemes has identified the Blocks that are presently uncovered with piped water supply. A map layout showing the commissioned and ongoing piped water supply schemes, in PurbaMedinipur is shown below:

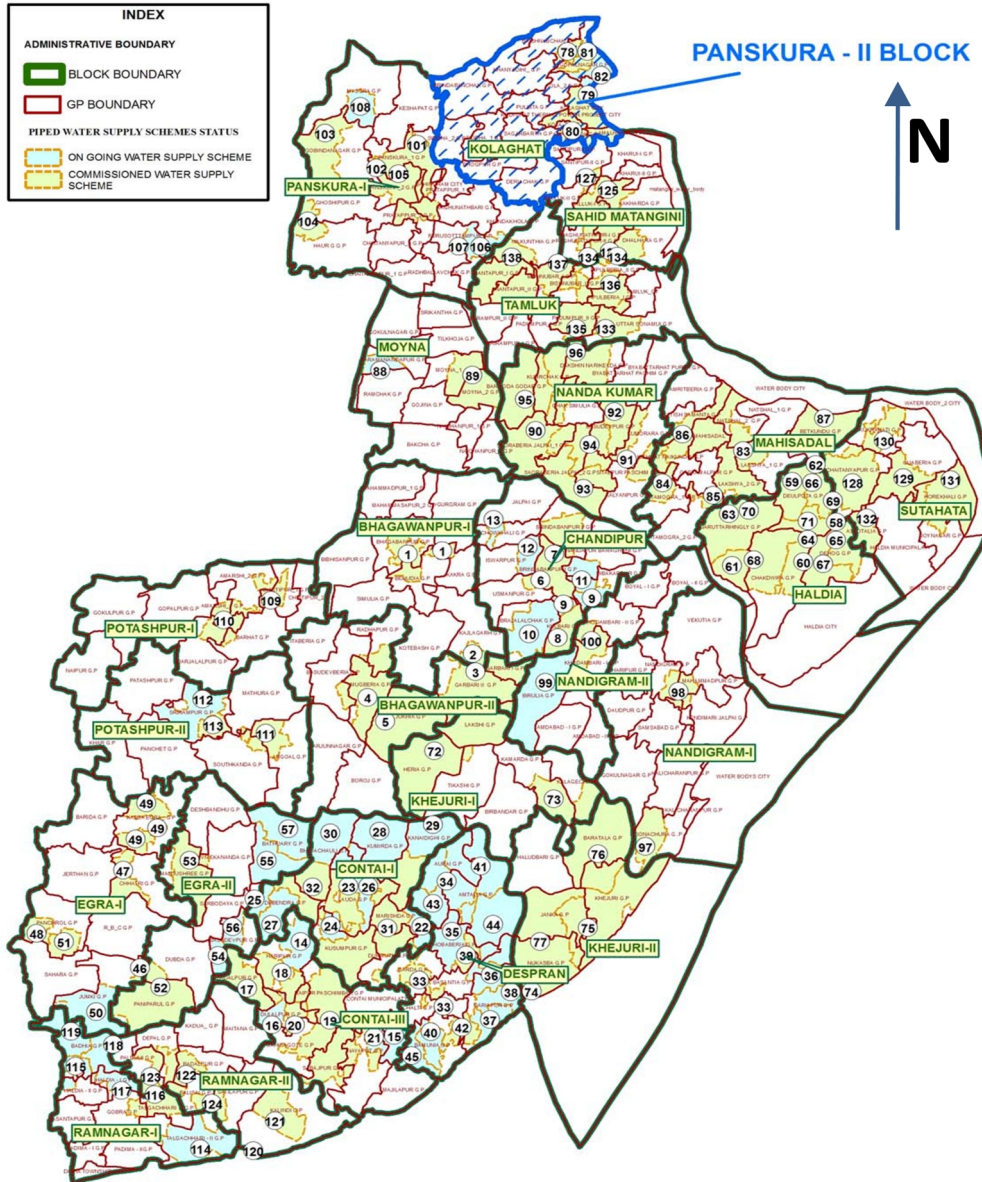


Figure 14: Piped WS schemes in PurbaMedinipur

3.1.1 Commissioned Schemes Based on Ground Water

As per records, in the PHED website, the total number of piped water supply schemes (PWSS) that have been commissioned in PurbaMedinipur is 86. The PWSS cover both single and multiple village schemes.. Details of the PWSS coverage of villages and year in which each was sanctioned Is presented below:

Table 3-1: PWSS Commissioned and Villages Covered

Sl. No	Name of Block	PWSS Commissioned	Villages Covered
1	Bhagawanpur-I	1	22
2	Bhagawanpur-II	2	40
3	Chandipur	2	19
4	Contai-I	1	4
5	Contai-III	2	17
6	Deshopran	5	45
7	Egra-I	4	19
8	Egra-II	1	9
9	Haldia	6	25
10	Khejuri-I	2	17
11	Khejuri-II	3	68
12	Kolaghat	5	12
13	Mahisadal	5	41
14	Moyna	2	10
15	Nandakumar	6	46
16	Nandigram-I	2	7
17	Nandigram-II	1	2
18	Panskura	4	28
19	Potashpur-I	3	37
20	Potashpur-II	2	15
21	Ramnagar - I	2	21
22	Ramnagar - II	5	26
23	SahidMatangini	2	13
24	Sutahata	4	42
25	Tamluk	6	87

Apart from the 78 PWSS listed above, 8 PWSS cover multiple blocks, details of which are shown below:

Table 3-2: PWSS Commissioned covering multiple Blocks

Sl. No	Name of Scheme	Name of Block covered	Villages Covered
1	Bajkul piped water supply scheme	Bhagawanpur-I, II	9
2	Improvement of Contai Saline Area (Zone-II) water supply scheme	Contai -I,III and Deshopran	115
3	Piped Water Supply Scheme for Pichabani-Contai Saline area (Zone-I)	Contai -I,III and Deshopran	112
4	Piped Water Supply Scheme for Anurai and adjoining mouzas	Contai - III, Deshopran	6
5	Paniparul Water Supply Scheme	Egra - I, Egra - II	15
6	Chaitanyapur Water Supply Scheme	Haldia, Sutahata	15
7	Sherkhanchak Water Supply Scheme	Khejuri - I, Khejuri - II	17
8	Ramnagar Water Supply Scheme	Ramnagar - I, II	12

3.1.2 Commissioned Schemes Based on Surface water sources

The PHED has commissioned only one surface water based piped water supply scheme in the District. This WS scheme involves raw water abstraction from river Rupnarayan at Geonkhali, a WTP of capacity 52.3 Mld and conveying the clear water to Haldia town. The scheme has been handed over to Haldia Development Authority for operation and maintenance.

3.2 Ongoing Water Supply Schemes

A total of 32 water supply schemes are presently ongoing in Purba Medinipur, of which 31 are based on ground water and one scheme is based on surface water from the river Rupnarayan.

3.2.1 Ground water based Schemes

The 31 ground water based schemes are presently ongoing in 15 blocks in the district and details are tabled below:

Table 3-3: Ongoing Ground water based PWSS-Purba Medinipur

Sl. No	Block Covered	Description / Scheme Name	Sanction Year	Design Year	Village Habitation Coverage	
					Village	Habitation Coverage
1	Bhagawanpur	Mahammadpur PWSS	2015-16	2040	3	3
2	Chandipur	PWSS for Saripur	2014-15	2039	2	4
		PWSS for Habichak	2014-15	2039	4	9
		PWSS for Kotbar	2014-15	2039	2	7
3	Contai-I	PWSS for Uttar Khasda & Adj. Mouzas	2012-13	2037	13	15
		PWSS for Damudarpur & Adj. Mouzas	2012-13	2037	6	6
		PWSS for Barchunfali & Its Adjoining Mouzas	2012-13	2036	14	17
		PWSS for Silampur & adj. Mouzas.	2012-13	2037	9	12
4	Contai-III	PWSS for Paschimbatya & adj. Mouzas	2010-11	2035	4	12
		Kanaidighi PWSS Scheme	2010-11	2035	2	7
		PWSS for Dhanghara & Adjoining Mouzas	2011-12	2035	21	45
5	Deshopran	Bara Subarananagar & Adj. Mouzas PWSS	2011-12	2035	9	9
		PWSS for Aladarput & Adj. Mouzas	2011-12	2036	11	11
6	Egra-I	PWSS for Chirulia - Chatla and Its Adjoining Mouzas	2012-13	2037	10	11
		PWSS for Tamalda	2014-15	2039	6	6
7	Mahisadal	Keshabpur Jalpai PWSS	2015-16	2041	5	17
		Lakshya PWSS	2015-16	2041	4	11
8	Moyna	Dona PWSS	2015-16	2040	9	28
9	Nanda Kumar	PWSS for Dakshin Dhalhara	2014-15	2039	5	10
		PWSS for Kolsar	2014-15	2039	1	2
		Guria PWSS	2015-16	2040	4	8
10	Nandigram-I	Mahammadpur PWSS	2015-16	2040	2	3
		Manikpur PWSS	2015-16	2040	7	9
		Tajpur PWSS	2015-16	2040	4	6
11	Nandigram-II	PWSS for Jalpai Part-II	2014-15	2039	1	4

Sl. No	Block Covered	Description / Scheme Name	Sanction Year	Design Year	Habitation Coverage	
					Village	
12	Panskura	PWSS forGograsKeshab Bar	2014-15	2039	4	4
		PWSSJagatpur	2014-15	2039	7	11
		PWSS forPurbaBakulda	2014-15	2039	3	8
13	Potashpur	KanakpurPWSS	2015-16	2040	5	14
14	Ramnagar-II	PWSS for Mandarmani& adj. Mouzas.	2012-13	2038	6	10
15	Tamluk	Srirampur PWSS	2015-16	2040	1	8

3.2.2 Surface water based Schemes

The proposed surface water based water supply scheme covers the entire block of Kolaghat (including one census town). The capacity of the WTP is 31 Mld and draws water from the river Rupnarayan. The project is expected to be commissioned in 2017.



Figure 15: Intake on the river Rupnarayan

3.3 Water Supply Coverage in Urban Areas

PHED has successfully completed 5 piped water supply schemes in the urban areas of PurbaMedinipur. These PWSS are for Haldia, Contai, Tamluk, Egra and Panskura. The piped water supply schemes in Egra and Panskura are being maintained by the respective municipality, Contai and Tamluk by the Municipal Engineering Directorate

and the surface based piped water scheme in Haldia is maintained by the Haldia Development Authority (HDA).

Table 3-4: Service Level Status of Statutory Towns: Purba Medinipur

Sl. No	Description of Indicators	Benchmark Standard	Service Level Status in Statutory Towns				
			Contai	Egra	Haldia	Panskura	Tamluk
1	Coverage of water supply connections	100%	10%	60%	70%	-	50%
2	Per capita supply of water (In Lpcd)	135	75	35	135	-	97
3	Extent of metering of water connections	100%	0%	0%	0%	-	0%
4	Extent of non-revenue water (NRW)	20%	90%	90%	-	-	15%
5	Continuity of water supply (Hrs/day)	24 Hrs	8Hrs	4 Hrs	6 Hrs	-	5 Hrs
6	Cost recovery in water supply services	100%	0%	-	25%	-	55%
7	Efficiency in collection of water supply related charges	100%	0%	-	25%	-	45%

3.4 Assessment of Existing Schemes

Based on the existing WS Schemes (Commissioned and ongoing), and from database of IMIS, the overall coverage of Piped Water Supply for the district is 37%. The coverage in each block varies from a low of 8% (in Khejuri block) to a high of 98% (in Kolaghat block). The details of PWS coverage block-wise is tabled below:

Table 3-5: Coverage of Blocks with PWS

Sl. No.	Block	Total No of Habitations			% of Coverage
		Total	With PWS	Without PWS	
1	Bhagabanpur-I	197	32	165	16%
2	Bhagabanpur-II	214	39	175	18%
3	Chandipur	185	60	125	32%
4	Contai-I	269	97	172	36%
5	Contai-III	401	299	102	75%
6	Deshapran	312	177	135	57%
7	Egra-I	156	38	118	24%
8	Egra-II	241	119	122	49%
9	Haldia	91	86	5	95%
10	Khejuri-I	193	15	178	8%
11	Khejuri-II	245	104	141	42%
12	Kolaghat	234	230	4	98%
13	Mahisadal	158	97	61	61%
14	Moyna	359	53	306	15%
15	Nandakumar	212	100	112	47%
16	Nandigram-I	203	26	177	13%
17	Nandigram-II	154	46	108	30%
18	Panskura-I	296	62	234	21%
19	Patashpur-I	401	48	353	12%
20	Potashpur-II	150	28	122	19%
21	Ramnagar-I	158	81	77	51%
22	Ramnagar-II	263	62	201	24%

Sl. No.	Block	Total No of Habitations			% of Coverage
		Total	With PWS	Without PWS	
23	Sahidmatangini	262	32	230	12%
24	Sutahata	177	93	84	53%
25	Tamluk	205	80	125	39%
Total		5736	2104	3632	37%

Chapter 4 Prevailing Sanitation System

4.1 Introduction

Sanitation practices in rural areas involve open defecation, pit latrines and pour flush toilets also. Availability of large tracts of land and ongoing practices of open defecation is still prevalent.

Swachh Bharat Mission (SBM)-Gramin has been initiated by the Government of India and is being implemented by the Ministry of Drinking Water and Sanitation for rural areas with the objective of:

- Bring an improvement in the general quality of life in rural areas by promoting cleanliness, hygiene and eliminating open defecation.
- Accelerate sanitation coverage in rural areas to achieve the vision of Swachh Bharat by 2 October 2019.
- Motivate communities and Panchayati Raj Institutions (PRIs) to adopt sustainable sanitation practices and facilities through creation of awareness and health education.
- Encourage cost effective and appropriate technologies for ecologically safe and sustainable sanitation.
- Develop where required, community managed sanitation systems focusing on scientific solid and liquid waste management systems for overall cleanliness in rural areas

The sanitation practices in PurbaMedinipur District are no different from other parts of West Bengal. Under the present Chapter, we glimpse upon the initiatives of the Government of West Bengal and prevailing toilet coverage to achieve the desired objectives underlaid within the premise of Swachh Bharat Mission (SBM)-Gramin.

4.2 Mission Nirmal Bangla

To accelerate sanitation movement under Swachh Bharat Mission, specifically the rural (Gramin) component, Government of West Bengal has set up a dedicated institution, 'Mission Nirmal Bangla' in the Panchayats & Rural Development Department. "Mission Nirmal Bangla" is aimed at bringing positive changes in the physical quality of life in the villages by promoting cleanliness, hygiene and elimination of open defecation.

The Mission has multi-layered activities intended to: reduce the loss of active workdays due to prevalence of diarrheal diseases among the wage seekers; reduce the drop out of children, especially girls, due to lack of appropriate toilet facilities in schools; and improve overall cleanliness in the villages, thereby contributing to improved environmental conditions.

To achieve the larger impacts on the villages and the community, the specific goal of the Mission is to transform all the villages of West Bengal to Open Defecation Free (ODF) villages by 2nd October 2019. Developing community managed solid and liquid management systems in the rural areas also features as priorities to improve overall cleanliness and environmental sanitation in the villages.

In effect, the MoDWS has articulated the definition of ODF as "the termination of fecal oral transmission", which is defined by:

- (a) No visible feces found in the environment/village
- (b) Every household as well as public/community institutions using safe technology option for disposal of feces. (Safe technology option means no contamination of surface soil, ground water or surface water; excreta inaccessible to flies or animals; no handling of fresh excreta; and freedom from odour and unsightly condition)"

4.3 Pre-Conditions for ODF

Having accepted that ODF is a step towards cleaner Sanitation practices, the pre-conditions that are essential under the Mission Nirmal Bangla and Swachh Bharat guidelines for achieving ODF include:

1. All households should have access to sanitary toilets, mostly within the premises and all members of the households should use toilets regularly.
2. All educational institutions (Primary/ Junior/ Secondary/ Higher Secondary Schools/ Madrasahs /other educational institutions/Colleges) should have toilets commensurate with roll strength, separately for the boys and the girls and all students and teachers should use the toilets while in the institution. Appropriate provision for privacy in management of menstrual hygiene and disposal of menstrual waste for the adolescent girl students in schools should be in place.
3. All Anganwadi Centers should have toilet facilities for children to develop hygienic habits among the young ones.
4. Community Sanitary Complexes should be ensured to cater to the need of the homeless and landless people, the commuters and the people spending time at the places of public congregation like markets/ hats/ bus stands.
5. Appropriate arrangements for disposal of solid and liquid waste through household-based, cluster-based and facility-based interventions in vulnerable places.
6. All households in the villages should have access to safe drinking water. People should be aware of safe handling practice of water for drinking and cooking and should regularly practice.
7. Everyone should be aware about washing hands with soap after defecation and handling child's excreta, before preparing food, taking food, feeding children and practice hand washing at critical times.
8. The general cleanliness in the villages should be visible
9. Panchayati Raj Institutions at every stage should propagate sustainable sanitation through effective IEC/ BCC and community mobilization activities.
10. Ecologically safe and sustainable, locally suitable, cost-effective technology for sanitation should be promoted.

The entire process of ODF, involves an internal system of verification with participatory involvement of all households in the community, based on which the village declares itself ODF. The ODF verification occurs in 3 levels, the Village (Gram Sansad), Gram Panchayet and Block level, with respect to specific checklists to be adhered to for at the household level and village level.

4.4 Toilet Coverage and Sanitation Scenario in the District

As per the data available from the website of ¹²SBM rural, all the 223 Gram panchayets (2988 villages) in the 25 blocks of PurbaMedinipur have already been confirmed as ODF verified.

¹²http://sbm.gov.in/sbmreport/Report/Physical/SBM_VillageODFMarkStatus.aspx

Chapter 5 District Criticality Assessment

5.1 Introduction

In rural areas potable water is primarily tapped from ground water, in the form of dug wells, hand pumps and shallow / deep tube wells. The rationale for abstraction of ground water is based on the significantly lower costs than developing surface water sources. Ground water usually requires less treatment than surface water (as turbidity and suspended solids are lower).

Most of the habitations continue to depend on ground water sources for their daily needs but they run the risk of getting affected either with declining ground water levels and or poor ground water quality (ground water being affected by iron or salinity in the case of Purba Medinipur). Unless such contamination is detected through laboratory tests the communities will not know that continued use of groundwater impacts health.

The present Chapter deals with the critical issues faced by the various Blocks within the district as regards available water quantity and quality.

5.2 Blocks affected by salinity

Ground water in the blocks is affected by salinity to varying degrees. The coastal blocks are more vulnerable and salinity intrusion is higher in comparison to the remaining blocks. The blocks where ground water is affected by salinity have been categorized based on the severity and tabled below:

Table 5-1: Blocks affected by Salinity

Sl. No	Ground water affected by Salinity	Name of Blocks	Number of Blocks
1	Severe	Contai-I, II and III, Ramnagar-I, II	5
2	Moderate	Tamluk, Sahid Matangini, Mahisadal, Nandakumar, Sutahata, Haldia, Nandigram-I, Nandigram-II, Chandipur, Khejuri-I and II	11
3	Mildly affected	Bhagawanpur I, II, Egra I, II, Moyna, Panskura-I, II, Potashpur I and II	9

5.3 Blocks affected by declining ground water levels

The ground water resources as assessed by the Central Ground Water Board are categorized into 4 categories (¹³Safe, Semi-Critical, Critical and Over-Exploited). The assessment for ground water development is based on two criteria –(a) stage of ground water development, and (b) long-term of pre and post monsoon water levels. The long term ground water level trends are computed generally for the period of 10 years. The details of criteria categorization for assessment are presented below:

¹³Category, - 'Safe' areas have ground water potential for development; 'Semi-critical' areas is where cautious groundwater development is recommended; 'Critical' areas; and 'Over-exploited' areas, where there should be intensive monitoring and evaluation and future ground water development be linked with water conservation measures.

Table 5-2: Categorization of Ground Water Development

Sl. No	Stage of Ground Water Development	Significant long term decline		Category
		Pre-monsoon	Post monsoon	
1	<=70%	No	No	Safe
2	>70% and <=90%	No	No	Safe
		Yes / No	No / Yes	Semi-critical
3	>90% and <=100%	Yes / No	No / Yes	Semi-critical
		Yes	Yes	Critical
4	>100%	Yes / No	No / Yes	Over-Exploited
		Yes	Yes	Over-Exploited

As per the CGWB report, ground water exploration needs to be restricted in the 5 coastal blocks of Tamluk-I, Mahishadal-I, Sutahata-I & II and Contai-III, considering declining ground water levels. For the remaining 11 coastal blocks, caution is to be exercised with the ground water exploration. Among the other blocks, Moyna has been categorized as semi-critical considering declining ground water levels. Based on the available data of the CGWB, the blocks have been arranged in the order of ground water development potential. The criticality of the blocks with respect to ground water development and potential is presented below:

Table 5-3: Blocks affected by declining ground water levels

Sl. No	Ground water development potential	Name of Blocks	Number of Blocks
1	Poor	Tamluk, Mahishadal, Sutahata, Haldia and Contai -III	5
2	Poor to medium	Moyna, , SahidMatangini, Nandakumar, Nandigram-I, II and Chandipur, Kheiyuri-I &II, Contai-I,II, Ramnagar-I & II	12
3	Medium to High	Bhagawanpur-I, II, Egra-I,II, Panskura-I,II, Potashpur-I,II	8

5.4 Criticality assessment of blocks

To make an overall assessment of criticality, all the blocks in the district have been arranged in terms of the extent of ground water affected by salinity and ground water development. The arranged matrix as regards criticality of the Blocks with respect to overall water quality and availability is presented below:

Table 5-4: Critically affected blocks

Sl. No	Ground water affected by Salinity	Ground water potential		
		Poor	Poor to Medium	Medium to High
1	Severe	Contai-III	Contai-I,II,Ramnagar-I, II	
2	Moderate	Tamluk, Mahisadal, Sutahata, Haldia,	Nandigram-I, Nandigram-II, Chandipur,Khejuri-I and II, SahidMatangini, Nandakumar,	
3	Unaffected (Mildly affected)		Moyna	Bhagawanpur I, II, Egra I, II,Panskura-I,II, Potashpur I and II

Chapter 6 Planning for Piped WS System By PHED

6.1 Piped WS Scheme

The PHED has contemplated piped water supply to 4 blocks of Nandakumar, Chandipur, Nandigram-I and Nandigram-II. The overall improvement plan is to tap the surface water from River Rupnarayan at Nandakumar block, and treat the water close to the bank of the river. The treated water is then to be pumped to centrally located ground storage reservoirs (cum booster pumping stations) in each of the blocks, for further pumping and distribution.

An overall concept plan of the proposal is presented below:

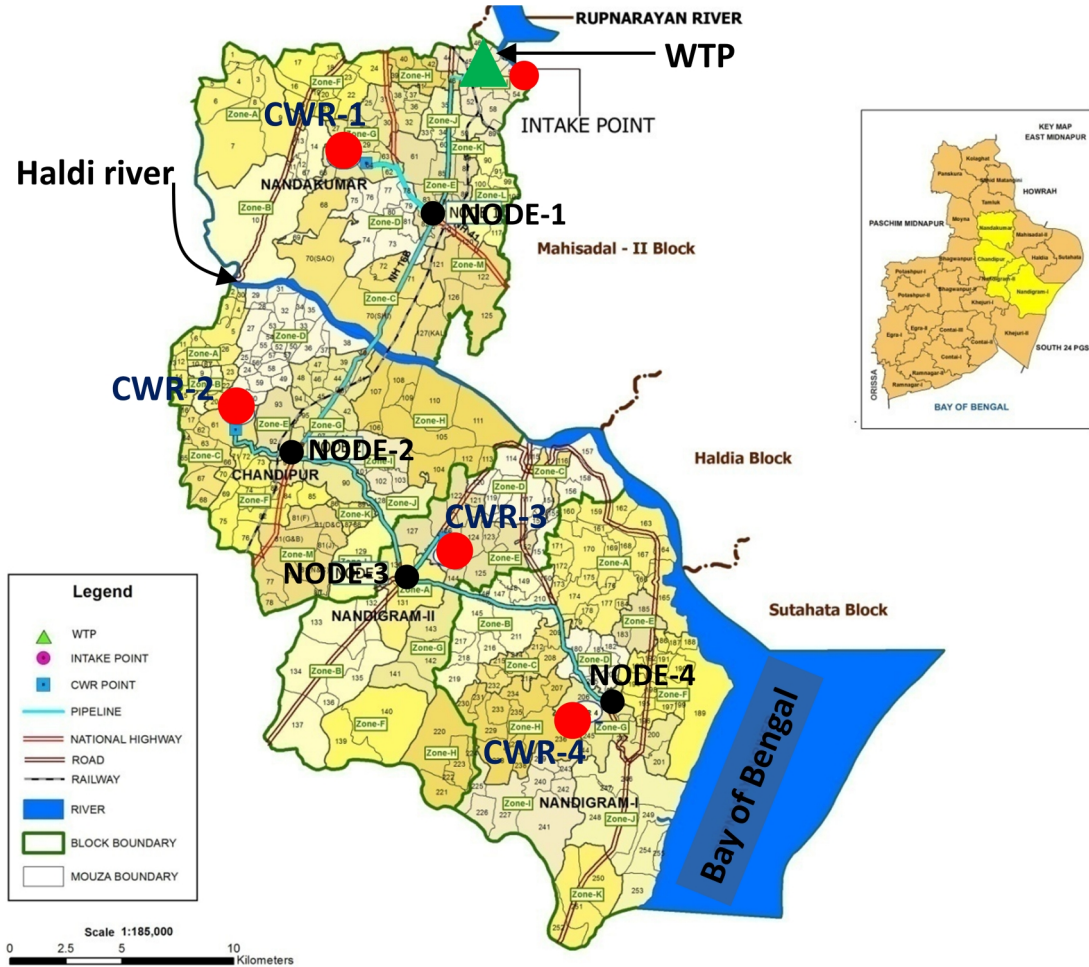


Figure 16: Bulk Water Supply System-Concept Plan

Tentative assessment of the alignment indicated that the length of the Transmission main to be around 50 Kms.

6.2 Components of the Schemes

A brief discussion of the Water Supply Components for the project is discussed in the sub-sections herein.

6.2.1 Raw water Intake

The proposed Intake location is in-between the proposed Panskura WTP and the existing Geonkhali WTP. The Panskura WTP is 27 kms, upstream of the Intake location proposed for the sub-project, whereas the Geonkhali WTP is located 14 Kms downstream of the proposed Intake location. A Google-earth map showing the location of the Panskura WTP, existing WTP at Geonkhali and the WTP site proposed under the sub-project is shown below:



Figure 17: Proposed Intake Location

The raw water quality at the location (particularly in the summer months) needs to be tested to confirm to assess the Impact of Salinity during the lean season and in particularly during high tide.

6.2.1 Capacity of WTP

Based on the assessed abstraction, a phased schedule for construction of WTP to meet the ultimate demand of 124.2 Mld in 2050 is appropriate. The general PHED guidelines suggest construction of a WTP for a period of 15 years with a daily working period of 20 hours.

Most of the PHED WTPs and the GLSR cum Booster PS will have backup power facility (standby generator). As such, to optimize the capacity of the WTP, a plan for construction and subsequent augmentation of the WTP is worked out below:

Table 6-1: Water Abstraction Plan

Sl. No	Description	Water Abstraction Plan (In Mld)		
		In 2020	In 2035	In 2050
1	Assessed Gross Water Demand	77.4	98.0	124.2
2	Water abstraction from existing ground water sources	10.20	10.20	0
3	Assessed Surface Water Demand requirement	67.2	87.8	124.2
4	Desired Output	68.0	88.0	125.0

Sl. No	Description	Water Abstraction Plan (In Mld)		
		In 2020	In 2035	In 2050
5	Recommended Capacity of WTP (20 Hours)	84	84	126
6	Working hours	16.2	21.0	19.9

As such, it is proposed to have a WTP with a modular approach, of 84mldcapacity in the 1st phase in two modules of 42 Mld each to be augmented by another module of 42 Mld capacity in the 2nd Phase.

6.2.2 Storage Reservoirs

The ground level storage reservoirs cum booster PS are proposed to be constructed in each of the blocks to pump the treated water to the zonal overhead storage reservoirs for further distribution. As such, 4 number GLSRs (one for each of the block of Nandakumar, Chandipur, Nandigram-I and II, and identified hereinafter as GLSR-I, II, III and IV) are proposed. These reservoirs are proposed to be located in easily accessible areas and positioned such that the length of the primary transmission main from the WTP and pumping costs are optimised.

Each of the blocks is divided into a number of Gram Panchayets. The Water Supply Zones have been primarily based on these Gram Panchayets, for effective distribution. Treated water will be supplied to an individual OHR acting as a service reservoir for the zone and water will then be supplied to the consumers through adequately designed distribution network.

6.2.3 Infrastructure and Logistics

The operation and maintenance of the schemes will require trained manpower and staff for the supply to be effectively monitored and managed. Provision has been made for residential quarters for all operation and maintenance staff as the piped water supply schemes will operate on a 24x7 basis.

It is intended to have suitable accommodation arrangements for staff, deployed for the:

- Water Treatment Plants and
- Booster Pumping Stations

Some of the O&M personnel who would directly be involved for day and night service are to be provided with accommodation. In some places, it shall be necessary to provide with Guard sheds and camp accommodation for security/police personnel.

6.2.4 Operation and Maintenance Services

PHED will have to carry out the O&M activities for the initial stage years at the source, treatment and transmission main sites. From the OHRs downstream, the VWSC, and/or Panchayat /Local bodies will be involved for O & M activities for the different distribution systems in their respective jurisdictions. In order to ensure implementation of common policy and co-ordinate action on operation and maintenance, a project level committee shall have to be set up comprising of members from all sectors involved in O&M activities.

PHED in collaboration with local bodies, NGOs, schools etc. will arrange for necessary IEC & HRD activities to impart training to the VWSC and Panchayat /local bodies who will be involved in the O & M activities.

The cost of Operation & Maintenance for the selected 4 blocks is estimated at Rs 46.15 Crore (US\$7.15 million) per year. Cost of 1000 litre of water is worked out to Rs.11.50. (US\$0.18/m³)

6.3 Block Cost Estimates of the proposed Schemes

6.3.1 Basis of Estimation

The Cost Estimates have been arrived by sourcing the rates from the prevailing Schedule of Rates (SoR), published by the PHE Department, Government of West Bengal, including market rates for items, which are not available in the SoR.

Block Costs have also been considered for relevant work items and drawn up for similar works related to Civil, Electrical and Mechanical works as per ongoing practices of PHE Department. The Estimated Costs have been derived considering Electrical-Mechanical Costs to be 25% of Civil Costs.¹⁴

The Estimated Costs includes Contingency (@ 3% of the Civil Costs), lump sum costs for IEC activities and land costs.

6.3.2 Summary Wise Cost Estimate

The capital cost of the scheme is arrived considering all aspects and all the components described earlier. **Capital Cost** of the project comes to **Rs. 811.38** Crore (US\$125 million). The Costs include contingencies @3% out of which civil components comes to **Rs. 643.08** Crore and Mechanical components come to **Rs. 160.77** Crore (US\$24.9 million). Per capita cost considering (2011), present (2016) and design (2050) population comes to Rs.11,373 (US\$176.19), Rs.9828 (US\$152.25), and Rs.7471 (US\$115.74) respectively.

¹⁴The SOR provides for M&E costs at 25% of the Civil Cost only. This is considered very low for Water Treatment Plant and similar works where M&E costs might well equal or be greater than the Civil Works cost, particularly where extensive SCADA facilities are provided.

Chapter 7 Conservation and Demand Management

7.1 Introduction

Water Conservation and Demand Management are key components related to Water Security. Indiscriminate ground water development is accelerating ground water depletion due to dependence on use of ground water for agriculture and potable use, especially in monsoon failures). In order to tackle the burgeoning problem of water level decline, it is necessary to take up schemes for water conservation and artificial recharge of ground water as a priority.

The need for Water Conservation and Demand Management in PurbaMedinipur gains significance, since the coastal blocks are acutely affected by salinity.

Water Conservation involves a range of measures including: provisional storage; water harvesting; water re-use; waste-water recycling; and protection of water bodies. Primarily, water conservation measures are source related and ensuring reliability of source through various adaptive means. In contrast Demand Management is more related to end usage / consumption and its control / regulation.

The relevance of water conservation and demand management acquires more significance, since availability of fresh water reserves is a key issue plaguing the District. In this Chapter, we describe some measures related to water conservation and demand management including steps initiated in PurbaMedinipur, primarily related to conservation.

7.2 Water Conservation

7.2.1 Jal Dharo-Jal Bharo programme

In order to combat the alarming situation in respect of both Ground and Surface water scenario in the state, "Jal Dharo-Jal Bharo" program was launched during 2011-12 for preservation of precious water resources. The Water Resources Investigation & Development Department and GoWB has taken the important role for large scale harvesting of rain water as well as arresting surface runoff for improvement and availability of precious water resources through construction and management of Minor Irrigation structures.

The objective of the "Jal Dharo-Jal Bharo" programme is to harvest rain water in all kinds of water bodies viz, tanks, ponds, reservoirs, canals and underground artificial recharge through rooftop rain water harvesting. For conservation and storage, rain water/surface run-off is arrested in derelict/silted tanks after proper de-siltation mainly for irrigation purposes.

The Department of Water Resources Investigation & Development is not only executing water harvesting structures under different plan funding but is also engaged in re-excavation of tanks and other water bodies under MGNREGA programme in convergence with P&RD Department, Govt of West Bengal. Different types of structures like check dams, water harvesting tanks and surface flow minor irrigation schemes are being constructed for arresting surface run-off *vis-a-vis* utilisation of stored water for irrigation/other purpose.

As per records available, 145,743 water bodies/retention structures have been created/renovated out of which 40,893 equivalent ponds have been created by WRI&DD. 104,850 water bodies have been created/renovated in convergence with P&RD Department and 311 tanks have been created/renovated by WRI&DD under

MGNREGA. The assets created under "Jal Dharo Jal Bharo" by WRDD and under the convergence program with P&RD department, Government of West Bengal for PurbaMedinipur district is 17,031 (14,659-P&RD, 2,358-WRDD).

7.2.2 Initiatives by PHED

Comprehensive ground water prospects maps are available with the PHED, developed by Geo-informatics & Remote sensing cell, sponsored under Rajiv Gandhi National Drinking Water Mission, Department of Drinking Water and Sanitation (DDWS) and available at <http://www.wbphed.gov.in/main/index.php/hgm-maps>

7.3 Demand Management and Strategies

Water Demand Management relies on a range of measures (tools and techniques) which can be divided into:

- (a) Operational Measures
- (b) Socio-political Measures and
- (c) Economic Measures

The various adoptive strategies for Water Demand Management shall depend on:

- Increasing system efficiency and
- Increasing end usage efficiency

We look at the various likely measures that could be adopted under the present scenario for the District.

7.3.1 Operational Measures

The operational measures to manage demand may involve:

- Active Leakage Detection and repair through Pressure and Flow monitoring
- Recycling of Filter Backwash and Re-use
- Water metering and or flow regulating / restricting devices for water rationing (through Orifices) for equitable supply

The NRDWP guidelines, as part of mandatory requirements, have indicated the need for SCADA (Supervisory Control and Data Acquisition) as one of the provisions to be considered for all Schemes to minimize water losses for mega-schemes of value more than Rs.20 Crores (US\$3.1 million). It may be clarified that the emphasis is to have a comprehensive data acquisition and monitoring system (Flow and Pressure monitoring) which will allow the assessment of leakage losses.

As a part of the mandate, the NRDWP also places clear guidelines on the need for recycling / re-use of filter-bed washed water. Such, provisions are to be integrated for all surface water source bulk water schemes so as to increase the available water and meet additional demand.

Water metering, including flow regulating / restricting devices, is a key system component in monitoring and regulating water consumption. All such devices add capital cost to the WS system and require careful understanding but they can provide significant returns on the investment.. Prevailing Water Supply system designs have been operative on Stand-post basis for the communities, and as such the need for metering never made economic sense. However, water metering can be exercised at a village / habitation level or even on commercial / institutional usage (Schools, Government Offices) etc with significant benefits from water loss reduction.

7.3.2 Socio-Political Measures

The Socio-political means of demand management can be categorized as:

- Policies and Guidelines of the Centre / State Government to specify standards on Service level norms
- Effective Public / Stakeholder Awareness in reducing water wastage
- Judicious usage of Water Use restrictions during periods of water shortages.

In so far as the policies are concerned, the basic minimum service level of potabledrinking water supply service in rural areas (In India) that was adhered to since the inception under ARWSP (Accelerated Rural Water Supply Program) was 40 lpcd. The vision in the larger context under 12th five year plan is to cover all rural households @ 70 Lpcd.

An interim measure of 55 lpcd has been considered in due cognizance that planning from 40 lpcd to 70 lpcd would require sizeable investment and infrastructural changeover. The NRDWP's goal is however set for a per capita supply of 70 lpcd. This however does not limit any individual State to adopt a higher per capita supply rate (of 100 lpcd). VISION 2020 for West Bengal emphasizes on a per capita supply level of 70 lpcd for design of system components. This consideration is based on the availability of water and has been the basis for designing system components in all the districts and is expected to remain the same.

The proposition of Tariff has been suggested under the NRDWP guidelines. The Tariff collection from every household and management of water supply scheme at the Gram Panchayet (GP) level shall be carried out by the Village and Water Sanitation Committee, (VWSC). The Public / Stakeholder Awareness to carry out awareness activities on water related issues are to be conducted by the VWSC.

A key element in demand management is education of consumers so that they can understand the benefits of reliable water supply delivered to the household. Receiving such benefits involves responsibilities in not wasting water, for example through turning off taps when not required. This responsible use ensures that there is sufficient water for all concerned and also minimises the cost of supply. This cost saving will impact directly on the consumers through smaller tariff payments.

7.3.3 Economic Measures

Economic techniques may depend on incentives such as rebates, tax credits to allow for higher consumption and disincentives such as real costs, penalties etc.

Based on the operational costs, there must be provisions thought of to define adequate means to cover the recurring costs of operating and maintaining the system. Water subsidy maybe an option, but there must be logical justification to support the subsidy in case the consumptions / usage are more.

A higher cost of water (say, above Rs 10 per Kl, US\$0.015/m³) might be difficult to manage politically, but this is below the basic cost of O&M. It is clear that economic measures have co-linkages with social and political ramifications. The NRDWP guidelines advise the implementation of a water tariff plan to balance the issues. A decision on the appropriate tariff requires further participatory stakeholder consultation and engagement to arrive at a definitive way forward.

Chapter 8 Water Quality Action Plan

8.1 Introduction

The Uniform Drinking Water Quality Monitoring Protocol, published by the MoDWS, advocates the need for improved monitoring and surveillance through effective Water Quality Testing, Mapping and Information Sharing, with emphasis on the WHO Guidelines for Drinking Water Quality, which state that *“The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer”*.

Such approaches have been defined as the Water Safety Plan (WSP). The WSP is a comprehensive approach to consistently ensure the safety and acceptability of drinking water supply on a sustainable basis. More importantly, it allows for preventive / proactive approaches to minimize / eliminate perceived risks due to water contamination.

While it is beyond doubt that the WSSO Unit has performed exceedingly well in terms of Water Quality Monitoring and Surveillance including GIS based Mapping, it is felt that there is a need to address various perceived risks in the drinking water supply system that could effectively reduce / minimize any contamination of the water sources.

It is understood that most of the rural habitations presently depend on ground water for their daily needs. For the district of Purba Medinipur, the most critical issues relate to salinity intrusion due to ground water exploitation, depletion of ground water levels and increased threat of salinity in the river water sources due to climate change impact.

A Water Quality Action Plan is required to address relevant issues both on a short term basis and on a long term sustainable basis. The overarching goal however for the Water Quality Action Plan is to have safe and sustainable surface / ground water based piped water supply schemes as the permanent solution.

8.2 Participatory Planning and Source Sustainability

One of the key issues of the Water Quality Action plan relates to water security and as such participatory planning based on source sustainability. Based on the available data/information, it is quite clear, that apart from the issues of ground water quality (e.g. risks due to salinity intrusion), depletion of ground water reserves need to be carefully monitored.

8.3 Water Quality Management

8.3.1 Existing Water Quality Monitoring and Surveillance System

The Department of Drinking Water and Sanitation had identified Water Quality Management as one of the Key Strategic Objectives to meet its goal of adequate and safe drinking water for every rural person. The basic premise of Water Quality Management was outlined on 4 fundamental approaches:

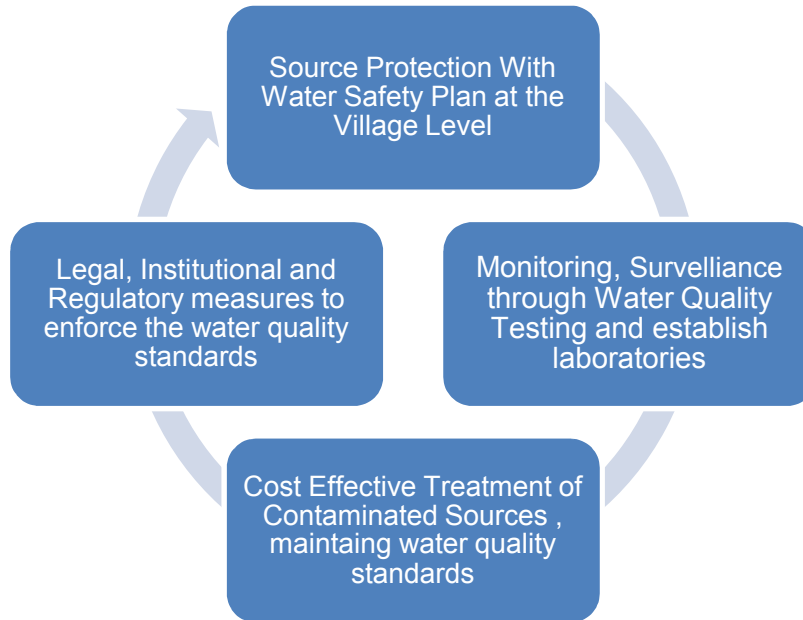


Figure 18: Approach to Water Quality Management

The Water and Sanitation Support Organization (WSSO) was thus formed within the PHED to propagate and fulfill the overarching objectives of National Rural Drinking Water Programme. An outline of the prevailing Water Quality Monitoring and Surveillance system is presented below.

8.3.1.1 Water Quality Monitoring Setup under PHED

The PHED maintains 137 laboratories across the State and has liaisons with another 81 Laboratories managed by Non Governmental Organizations (NGO's) for performing water quality tests periodically. It maintains a comprehensive record of water quality across the various district.

Table 8-1: Water Testing Laboratories for WQM

Sl. No	District	Laboratories Managed By:		
		PHED	NGO	Total
1	Bankura	11	5	16
2	Bardhaman	13	6	19
3	Birbhum	6	4	10
4	Coochbehar	4	3	7
5	DakshinDinajpur	3	2	5
6	Darjeeling	4	1	5
7	Hooghly	4	5	9
8	Howrah	2	3	5
9	Jalpaiguri	4	3	7
10	Maldah	6	3	9

Sl. No	District	Laboratories Managed By:		
		PHED	NGO	Total
11	Murshidabad	13	7	20
12	Nadia	6	5	11
13	North 24 Parganas	11	7	18
14	PashimMedinipur	14	7	21
15	PurbaMedinipur	9	7	16
16	Purulia	13	4	17
17	South 24 Parganas	11	7	18
18	Uttar Dinajpur	3	2	5
Total		137	81	218

The Laboratories have been classified as General Laboratories, Arsenic Laboratories, Fluoride Laboratories, and Salinity Laboratories depending on water quality and the required type of tests to be carried out, considering that select districts have ground water contaminated with arsenic, fluoride and salinity.

8.3.1.2 Water Quality testing laboratories in PurbaMedinipur

Of the 16 laboratories in PurbaMedinipur, 9 are managed by PHED, whereas another 7 laboratories are managed by NGOs. The details of the laboratories within the District are presented below:

Table 8-2: List of Laboratories in PurbaMedinipur District

Sl. No:	Laboratory Name	Managed By	Situated at	Jurisdiction
1	AbhyudayaHaldia	NGO	Haldia	Mahisadal, Sutahata, Haldia
2	Gram Mangal	NGO	Potashpur – II	Potashpur – I, Potashpur – II and Egra-I
3	Lokajagaran RKMLP Gram Unnayan Kendra	NGO	Nandigram-II	Nandigram-I, Nandigram-II, Khejuri-II
4	Sri Ramakrishna GucchaSamity	NGO	Bhagawanpur-I	Moyna, Bhagawanpur-I, Khejuri-I
5	TamraliptaGuchchhaSamity	NGO	Nanda Kumar	
6	Vivekananda KalyanParishad	NGO	Bhagawanpur-I	
7	Vivekananda YuvaParishad	NGO	Egra-II	
8	Contai WTP Lab	PHED	Contai-I	Contai-I; Deshopran
9	Erashal W/S Scheme Office, Head Work Site,	PHED	Panskura	Panskura
10	Haldia Sub-Division PHE Offic	PHED	Sutahata	Sutahata
11	Kolaghat W/S Scheme, Head Work Site	PHED	Nandigram-II	Nandigram-II
12	Kudi W/S Scheme, Head Work Site	PHED	Egra-I	Egra-I
13	Moyna W/S Scheme Office, Head Work Site	PHED	Moyna	Moyna
14	Purbamedinipur District Lab, Tamluk	PHED	Tamluk Town	Panskura, Kolaghat, ShahidMatangini
15	Ramnagar W/S Scheme	PHED	Ramnagar-I	Ramnagar-I
16	Serkhanchak W/S Scheme, Head Work Site	PHED	Khejuri-II	Khejuri-II

8.3.2 Key Issues

Water Quality Testing and Validation: The primary concern for water quality testing is the selection of parameters to be tested for raw water. Concerns related to ground water contamination are largely unnoticed in comparison to surface water sources, for which laboratories carry out more regular checks. However, with growing concerns on use of pesticide, increased level of contamination of surface as well as ground water, setting up specific testing parameters for each laboratory is essential. It is important to ensure that all laboratories are equipped appropriately to detect contaminants and are certified under the NABL scheme. A frame-work for testing select contaminants at periodical intervals coupled with assessment of other potential contaminants is also required.

The other water quality issue that is of concern is confirmation / validation of a newly identified contamination (whether with Fluoride or any other contaminant) in the water source that is tested. It may-be acknowledged that errors in water quality analysis do occur, although rarely. As such a system of checks and balances to confirm / validate newly identified contamination needs to be re-checked and validated, prior to confirmation.

Establishing New Laboratories: One of the key issues related to the water quality monitoring is the adequacy of the laboratories in handling water quality tests. Different water sources may require different testing regimes with different water quality parameters for surface water and groundwater sources..

In PurbaMedinipur, a key parameter is the salinity (chloride content) in the ground and surface water and this needs to be monitored carefully. The raw water sources in the coastal blocks are particularly vulnerable to increase in salinity concentration. Water quality surveillance can be effectively monitored only with testing laboratories in close proximity. As such the disposition of the laboratories may need to be adapted to suit the source being tapped and thus allow for improved monitoring.

Cost Effective means of Treatment:

Meeting water quality targets for surface / ground water based source is a critical issue, particularly since the available water sources are affected by salinity. Conventional treatment measures will fail when salinity levels are beyond permissible limits. The available alternatives, including desalination, are expensive. The best option is to preserve fresh water reserves, through flood diversion and storage systems.

Sanitary Management and Surveillance: Since existing water resources are spread out within the Blocks, it is important to assess current sanitation practices and ensure that proper hygienic sanitation management is implemented.

Specific actions for ensuring that the habitations and villages are and/or remain open defecation free (ODF) may be required, including ensuring proper solid and liquid disposal waste management system, where not already in place.

The practice of recycle and re-use of industrial and municipal waste-water also needs to be explored and implemented as a part of resource generation.

8.4 Sustainable Service Delivery

Sustainable service delivery requires improved monitoring, optimizing operational and maintenance costs and ensuring service reliability. For surface water sources, the onus will be the PHED to maintain the Bulk Water Supply Scheme; while for the ground water based schemes operated and maintained by the rural communities the onus will be on the Village Water and Sanitation Committees.

8.4.1 Providing Household level Service Connection

Prevailing practice at habitation level results in water wastage and reduced serviceability. A household level service connection means ownership of the service connection by the consumer and associated responsibility for it. This should lead to improved service reliability, with the participatory involvement of consumers and an appropriate tariff structure. Local communities, through VWSCs or similar, will be able to utilize district metering in order to manage their own distribution systems and minimise system losses.

8.4.1 24x7 Pressurized Water Supply System

The benefits of a continuous pressurised system for water supply are well known. Most of the habitations to be serviced are located far from their water sources / treatment plants. The clear water will be pumped to local storage reservoirs, usually overhead reservoirs (OHRs), from where the village level supply is distributed.

A SCADA system can be utilised to monitor and/or control both the bulk water supply and the local distribution network. The bulk water supplier can then identify loss of pressure and other data which enables leakage points to be located as well as allowing remote control of pumping and reservoir storage levels.

Storage reservoirs can be fitted with automatic water level controllers to provide information for control of upstream pumping. Distribution networks should be formed into district metering areas (DMAs) to allow for monitoring of loss of pressure and leakage. The costs of flow/pressure loggers and or transmitters are usually nominal compared to the costs saved by minimizing/reducing water wastage and water loss. Through careful monitoring of the complete water supply network it is possible to operate and maintain a successful 24x7 water supply system.

8.4.2 Rain water harvesting and Pond based system

Rain water harvesting is another appropriate manner of water conservation and can be linked to artificial recharge of the aquifers, thus mitigating any potential shortage in ground water reserves. The conservation of rain water will save a good quantum of water being withdrawn from ground water.

The creation of ponds can serve as fresh water reserves. Although significant area under the District is under agricultural land, the local population can be encouraged to explore the options for rejuvenating and creating ponds and preserving water bodies, which can serve as source of drinking water.

8.5 Conclusion and Way Forward

The Water Quality Action Plan is a guideline for implementation of the necessary activities required to ensure sustainable and uncontaminated water supplies are available to all the communities within the Purba Medinipur District and ensure that the objectives as enshrined in "VISION 2020" are achieved.

Some of the select action areas that are deemed necessary under the backdrop of the District Water Quality Action Plan are discussed below:

Table 8-3: Water Quality Action Plan

Sl. No	Activity / Component	Objective	Action Plan
--------	----------------------	-----------	-------------

Sl. No	Activity / Component	Objective	Action Plan
1	Comprehensive piped water supply scheme for blocks affected by Salinity	Determine options for sustainable water supplies to each block, through surface / ground water resources with treatment options.	<ul style="list-style-type: none"> – Monitoring of ground water levels with regards to Salinity and depletion of ground water levels. – Hydrological studies on river basin system to assess intrusion of salinity.
2	Water Quality Monitoring with Laboratories	To ensure consistent and reliable testing facilities	<p>Framework for Water Quality Testing and Testing regimen for:</p> <ul style="list-style-type: none"> – River water with specific emphasis on salinity during lean season and tidal effects. – Ground water based sources <p>Determine extent to which laboratories are NABL accredited and take necessary steps to improve reliability</p>
3	Sustainable Service Delivery	Potable drinking water to be provided in sufficient quantity and as per desired quality, equitably.	<p>Provision for household level service connections to ensure, comprehensive coverage.</p> <p>Design considerations for 24x7 supply system.</p> <p>Increase service reliability with provision of piped water grid.</p>
4	Assessment of existing and on-going water supply schemes in PurbaMedinipur, based on ground water	Monitoring of salinity levels, with ground water levels and abstraction.	<p>Consider integration into other surface water fed schemes.</p> <p>Evaluate treatment system with Reverse Osmosis (RO) desalination Plants and their effectiveness over long term periods.</p>
5	Develop water supply schemes for areas not covered by existing designs	Ensure that the whole District is covered with sustainable piped water supply systems by 2022	<p>Assess water source sustainability on long term basis.</p> <p>Emphasis on rain water harvesting, pond based system, flood diversion and storage to reduce ground water abstraction</p> <p>Ground water modelling to assess salinity intrusion, including hydrological / salinity modelling for rivers.</p>
6	Check all schemes meet social and environmental safeguards criteria	Enable schemes to be appropriate for international funding and will be socially sustainable	<p>Undertake socio-economic and environmental surveys of habitations.</p> <p>Conduct stakeholder consultations</p> <p>Undertake willingness to pay surveys or assess alternative funding mechanisms</p>
7	Check schemes comply with GOI and norms	Ensure that schemes may proceed without undue process delay	PHED and others to check compliance with all norms.
8	Development Operation and	Ensure sustainability	Meet with relevant institutions and other stakeholders to determine

Sl. No	Activity / Component	Objective	Action Plan
	Maintenance Plan	of project	responsibility and accountability for O&M
9	Prepare financial and economic assessment of proposed schemes	Ensure schemes are viable and affordable on a sustainable basis	Analyze existing institutional and financial models and suggest appropriate models for West Bengal
10	Prepare detailed designs and bid documents for proposed schemes	Invite competent Contractors to bid for scheme construction	Recruit design consultants, as necessary
11	Construct and commission proposed schemes	Implementation of schemes to provide safe and sustainable water supply to benefit communities throughout the District	Selection of contractors and supervision consultants.

This draft Water Quality Action Plan is intended to be a living document requiring updating and amendment from time to time. It contains a summary of the extensive available data on the existing and proposed water supply schemes for PurbaMedinipur, which may be used as guidance during the preparation of feasibility studies for proposed water supply schemes within the district. It should be regarded as a useful reference work and not a definitive document when assessing the requirements for long term sustainable solutions.

The various activities referred to in this draft Action Plan, including comprehensive studies and investigations, will be taken up in due course with participative institutions in preparation of Feasibility Reports and subsequent Detail Designs.

Timely implementation of these activities will help considerably towards achieving the aims of the VISION 2020.