



Government of the People's Republic of Bangladesh
Ministry of Water Resources

**Water Resources Planning Organization
(WARPO)**

**Terms of Reference (ToR)
for**

"Hydrogeological Investigation and Mathematical Modeling"

Under the Project

জলবায়ু পরিবর্তনজনিত অভিযোজন ও মিঠা পানির প্রাপ্যতার জন্য দক্ষিণ-পশ্চিম
হাইড্রোলজিক্যাল অঞ্চলে ডু-তাস্তিক জরিপ এবং গাণিতিক মডেলের মাধ্যমে অ্যাকুইফার
ম্যাপিং প্রণয়ন

**(Aquifer Mapping through Hydrogeological Investigation and
Mathematical Modeling in South-West Hydrological Region for
Climate Change Adaptation and Freshwater Availability)**

December, 2025

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1. Introduction:

Bangladesh is the largest alluvial delta in the world formed from the Ganges-Brahmaputra-Meghna (GBM) river basin and facing a massive water resources challenges such as flood, flash flood, drought, contamination of water bodies, salinity intrusion in groundwater and surface water, arsenic contamination in groundwater, cyclone and tidal surges in coastal areas, water logging, river bank erosion, drainage congestion due to sedimentation of river channels etc. With dense population, water management is further complicated by diverse and conflicting interests among traditional livelihood activities including agriculture, fisheries, transportation, industries, and water supply, with which poverty is deeply intertwined.

The future Water resources management and development in Bangladesh will be a very complex issue due to future biophysical uncertainties and socioeconomic uncertainties (Bangladesh Delta Plan 2100, Inception report). Important biophysical uncertainties are sea level rise, changes in upstream flow and future extreme events. The increased uses of water especially through diversion and storage by the upper riparian country have already created a significant impact on the natural flow regime of South West hydrological Region in Bangladesh. Under these circumstances it is of paramount importance for the country to manage this critical resource in an integrated, basin-wise and strategic manner while ensuring stakeholder participation.

The National Water Management Plan (NWMP, 2004) has identified the seven fundamental areas of knowledge gaps which have to be considered for further study and analysis. The knowledge gaps are arsenic in groundwater, groundwater resources (it's use, quality, quantity and long term strategic implication), Climate Change, Natural Environmental water Resources, Long-term basin-wide water Resources Planning and Management. According to Bangladesh Water Act, 2013 Article 15.1, the Water Resource Planning Organization (WARPO) through the Executive Committee of National Water Resources Council will prepare the National Water Resources Plan considering the water resources availability up to mouza Level. Within each Hydrological Boundary it will be easy to investigate the water resources availability up to mouza Level based on IWRM framework at each Hydrological region in Bangladesh.

Water Resources Planning Organization (WARPO) is an apex organization under the Ministry of Water Resources (MoWR), dealing with nationwide water resources planning and is designated by the Bangladesh Water Act, 2013 as the nodal agency for coordinating IWRM. WARPO is mandated as the lead agency for implementation of the Act and its Rules and the regulation of water resources development. The National Water Policy (NWPo), 1999 also requires that WARPO will routinely update the water resources assessment of the country and monitor the state of water resources system so that the implementation,

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performance and the impacts of the National Water Management Plan (NWMP)/the National Water Resources Plan (NWRP) can adequately be addressed. Thus WARPO will implement the proposed project in compliance with the Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018 to protect the water sources and aquifers, and to develop sustainable water resources management in solving practical problems of water scarcity.

A detail analysis and modelling through a proven scientific tool will be required to enable the user to analyze and set the threshold limits for abstraction and usage considering future climate change and sustainability and for the enforcement to operationalize the Bangladesh Water Act, 2013 and its Rules. Numerous studies are conducted on groundwater depth fluctuation, recharge potentials and aquifer characteristics for the different regions on a broader scale revealing the vulnerability of the aquifer and groundwater resources. However, actual representation of the aquifer system and water budget based on hydrodynamic modelling is required to examine the present and future vulnerability scale. The Bangladesh Water Act, 2013 keeps the provision of determining the safe yield level of aquifer, and declaration of Water Stress Area for a specific period, which seeks a clear understanding of the state of water resources of the designated area to have proper monitoring of the implementation of the Bangladesh Water Rules, 2018.

Assessment and management of water resources could be done considering surface water and groundwater in isolation but this isolated approach would fail to address the integrated behavior of the land and water ecosystem, interaction between the surface and groundwater within the water ecosystem as well as water environment. To ensure the integrated management of resource base, a physically based distributed modelling system would be more realistic and appropriate over the traditional analytical approach. Mathematical model enables better understanding of the river-aquifer interaction, as well as, providing a tool that can be used to manage the water resources in the best possible way considering the relative contribution of the components on the water balance in the study area. The best option of future surface water and groundwater developments which will effectively utilize all available water resources with no or minimum negative environmental impacts is possible to find out through application of the surface water and groundwater interaction modelling technique. Therefore to ensure integrated management of water resources a physically based distributed modelling system would be more appropriate and realistic.

2. Project area

The Project will promote and facilitate the operationalization of the Bangladesh Water Act, 2013, and the Bangladesh Water Rules, 2018. Most activities will be focused on the implementation of the Act and its Rules, Integrated Water Resources Management (IWRM) interventions, and the assessment of the state of water resources within the administrative boundaries of 13 districts in the south-west hydrological region of Bangladesh (Figure 1).



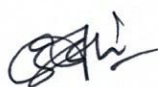
The active water management area will be precisely delineated during the Inception Period to align with Mouza boundaries.

The entire scope of hydrogeological investigation and modeling will be carried out under one (01) package. Table 1 presents the list of districts within this hydrological region.

Table 1: Project Area (13 Districts) within South-West Hydrological region

Sl. No.	Name of Division	Nos. & Names of District	Nos. of Upazilla	Nos. of Union	Nos. of Mouza
1.	Khulna	10 (Kushtia, Meherpur, Chuadanga, Jhenaidah, Magura, Narail, Jessore, Sathkhira, Khulna and Bagerhat)	59	581	6,673
2.	Dhaka	2 (Rajbari and Gopalganj)	10	109	1,475
3.	Barishal	1 (Pirojpur)	7	53	392
Total		13	76	743	8,540

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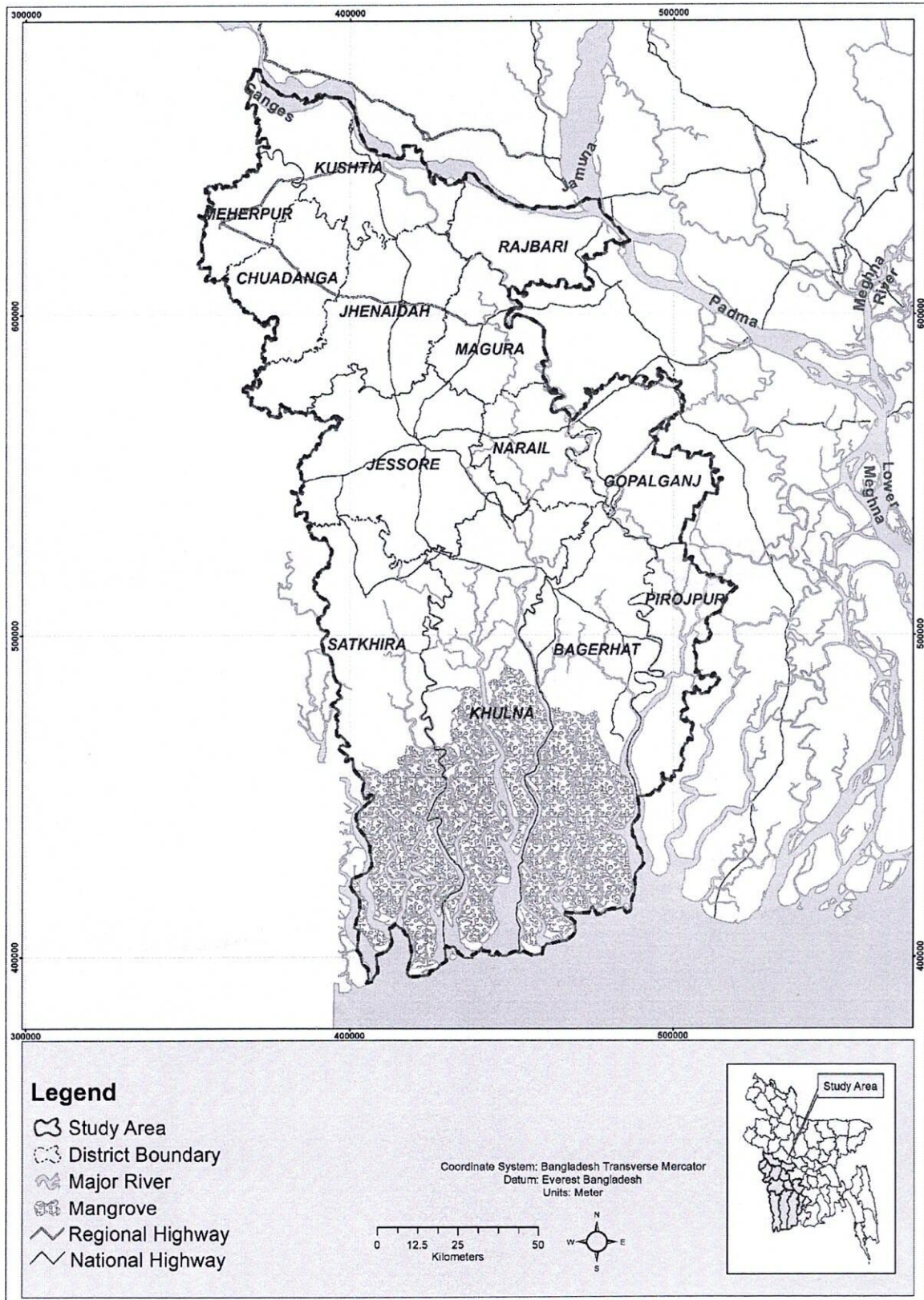


Fig. 1: Project area (13 Districts) within South-West hydrological region of Bangladesh

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3. Objectives

The main objective of this component is to investigate the hydrology, hydrogeology, aquifer system and assess the water availability and water quality for both the surface water and groundwater resources, prepare aquifer mapping, determine the safe yield level of the aquifer and identify the water stress area in the 13 districts of the South-West hydrological regions of Bangladesh for supporting operationalization of the Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018.

The specific objectives of this study are -

- (i) to investigate and provide necessary comprehensive data, map and information of the surface water and groundwater availability, quality, identify emerging contaminants and aquifer mapping of the study area;
- (ii) to identify the water sources and determine the safe yield level of aquifer up to union/mouza level and evaluate the trend of groundwater movement based on the recharge potential of the study area;
- (iii) to determine Water Stress Area (WSA) considering climate change impacts (salinity intrusion, sea level rise, movement of saline front etc.), present and future (For the years 2035, 2050, 2075, and 2100, based on Union/Mouza boundary) water availability, use, demand and quality of surface water and groundwater resources in the study area;
- (iv) To assess sector-wise future water demand for the years 2035, 2050, 2075, and 2100 considering population growth, socio-economic development, land use change, and climate change impacts within the study area.
- (v) to study the impacts of sea level rise due to climate change in the surface water as well as groundwater salinity distribution of the study area.
- (vi) to develop and disseminate appropriate strategies for conjunctive use of rainwater, surface water and groundwater to improve efficiency of resource utilization and minimum groundwater abstraction; and
- (vii) to update WARPO's Decision Support System (DSS) through data integration, technical assistance, system implementation, and institutional capacity development, thereby strengthening its functionality, operationalization, and long-term sustainability for effective integrated water resources planning and management.

4. Scope of Works

The major scope of works of the Consultants for this study will be (i) to assess the state of water resources through survey, field investigation, conceptual and numerical modelling; (ii) to conduct hydrogeological investigation for the mapping of the aquifer system and groundwater recharge for preparing aquifer mapping; (iii) to determine the safe yield level

of aquifer up to union/mouza level in the study area; (iv) to identify the Water Stress Area (WSA) considering climate change impacts, present and future water uses; and (v) to update and strengthen WARPO's DSS through data integration, technical support, system implementation, and capacity development for effective water resources planning and management.

Activities to perform:

- Collect hydrological, meteorological, hydro-geological, morphological data and Digital Elevation Model (DEM), groundwater level, water quality, aquifer properties and other necessary data from secondary sources as per required.
- Examine the present water use scenario, sectoral water demand, water quality, mechanism to increase surface water flow and groundwater recharge mechanism in the study area based on the above secondary data and the information obtained from Component-1 of this project in the Participatory Rural Appraisal (PRA) report.
- Conduct field cross section survey of the major rivers and their tributaries/distributaries and monitoring of surface water level & salinity, & measure discharge and sampling and analysis of river bed material.
- Coordinate with all vendors engaged in the project, including those responsible for Participatory Rural Appraisal (PRA) activities, the installation of monitoring wells, and the automation of monitoring wells, and shall ensure smooth communication, proper task alignment, and timely execution of activities among all involved parties.
- Supervise exploratory drilling and installing necessary groundwater monitoring wells to fill up data gap, and put older wells back into service to study and monitor groundwater level, quality, aquifer system and subsurface lithology of the study area.
- Ensure the quality and accuracy of lithological data collection during the installation of monitoring wells, with qualified hydrogeologist from the Consultant's team present on-site throughout drilling and lithological logging activities to verify and validate all geological information.
- Integrate the Installed observation well and well nests (clustered wells) to determine different hydro-geologic parameters in study area at varying depth and line well to observe the connectivity of shallow aquifer with the river.
- Carry out Geophysical Resistivity Survey (GPRS) through Vertical Electric Sounding (VES) study to formulate the composition and nature of the aquifer system in the study area.
- Perform pumping tests to investigate the hydraulic properties of the aquifer such as the specific storage, specific yield, porosity, transmissivity, hydraulic conductivity etc.

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- Integrate an automated groundwater monitoring system to provide real time data collection through installation of IoT sensor system by the vendor, and instant transfer to the cloud-based server at WARPO.
- Collect the water samples from river and aquifer, perform in-situ tests and laboratory tests to investigate surface water and groundwater quality through hydro-chemical analysis.
- Supervise and oversee the collection of water samples from monitoring wells, rivers, and aquifers, and shall conduct in-situ tests and laboratory analyses to assess surface water and groundwater quality through hydro-chemical evaluation. The Consultant shall ensure that all collected samples are submitted to the WARPO Laboratory for appropriate testing and analysis, and if any required tests cannot be performed at the WARPO Laboratory, the samples shall be sent to another recognized organization. The Consultant shall also maintain proper documentation of sampling procedures, chain-of-custody records, and laboratory results, and shall be responsible for providing all necessary test reagents required for sample analysis.
- Prepare aquifer mapping with GIS datasets depicting aquifer extent, thickness and continuity, WL trend, aquifer properties and water quality parameters.
- Develop/update hydrodynamic model, water balance model and rainfall-runoff model and any other model, if necessary, for the study area.
- Develop a groundwater model and coupling it with existing surface water model to develop surface water-groundwater interaction model for assessment and analysis of water resources availability in the study area.
- Develop the mathematical models of variable density groundwater flow and salt transport for the coastal belt in the study area.
- Downscaling of Global Climate Model (GCM) to identify the climate change impacts.
- Develop the Bay of Bengal (BoB) models to address the salinity in the sea due to Sea Level Rise (SLR).
- Evaluate the present and future surface water and groundwater availability, water quality, identify emerging contaminants and recharge mechanism and examine the impact of climate change on future water availability using the surface water-groundwater interaction model.
- Assess the water balance in the project area by estimating water demand for irrigation, industrial, and domestic uses, while accounting for the environmental flow requirements of rivers.
- Examine the movement of saline font considering SLR and dry season flow of Gorai river.

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- To assess the potential impacts on water resource management and the environment if dams or barrages are constructed for water retention in the Padma River and its tributaries within the project area.
- Determine and fix the safe yield level of aquifer up to union/mouza level of the study area based on water resources availability, use and recharge potential.
- Determine and identify the Water Stress Area (WSA) considering present and future (For the years 2035, 2050, 2075, and 2100, based on Union/Mouza boundary) water demand, availability and uses, climate change impacts, water quality and recharge potential in the study area.
- Determine sector-wise future water demand for the years 2035, 2050, 2075, and 2100 considering population growth, socio-economic development, land use change, and climate change impacts within the study area.
- Forecast water availability and sectoral water demand for the years 2035, 2050, 2075 and 2050 under projected climate change scenarios, socio-economic growth, and land-use change trends.
- Develop and disseminate appropriate strategies for conjunctive use of rainwater, surface water and groundwater to improve efficiency of resource utilization and minimum groundwater abstraction.
- Identify the areas for the possible conservation of surface water and groundwater as a source for safe drinking water and water-based habitats as per Section 2(5) of the Bangladesh Water Act, 2013;
- Identify appropriate techniques to address the economic and social problems arising from the scarcity of adequate and clean groundwater and surface water as per Bangladesh Delta Plan 2100,
- Develop and disseminate appropriate strategies for conjunctive use of rainwater, surface water and groundwater to improve efficiency of resource utilization and minimum groundwater abstraction.
- Update WARPO's Decision Support System (DSS) through data integration, technical assistance, system implementation, and institutional capacity development, thereby strengthening its functionality, operationalization, and long-term sustainability for effective integrated water resources planning and management.

5. Expected Output

The outputs of the study are as follows:

- Base map of the study area using updated information showing surface water and groundwater observation/ monitoring wells, alignments of roads, rivers and canals, wetlands, districts/upazilas/unions/mouzas etc;

- Map of the study area using updated information showing surface water and groundwater availability, uses, demand, groundwater level, aquifer properties, observation/ monitoring wells locations etc;
- Maps and charts based on analysis of the physical and chemical properties of groundwater and surface water in the project area according to different important agricultural practices (such as drinking, households, irrigation, fisheries, industry, commerce etc.);
- Aquifer mapping with GIS datasets showing aquifer geometry, aquifer properties, and geophysical parameters;
- An automated IoT sensor-based groundwater monitoring system linked to WARPO server;
- A coupled surface water-groundwater interaction model for assessment of groundwater and surface water resources in the study area;
- Charts and maps showing union/mouza-wise safe yield level of aquifer in the study area;
- Water stress mapping at the mouza level in accordance with the Bangladesh Water Act, 2013 and Bangladesh Water Rules, 2018;
- Maps showing Water Stress Area (WSA) considering present and future water availability and uses, water quality and recharge potential in the study area;
- To identify climate change impacts downscaling of Global Climate Model (GCM) to Regional Climate Model (RCM); and
- Updating, operationalization, and long-term sustainability of WARPO's Decision Support System (DSS) to support effective integrated water resources planning and management.

6. Data Collection and Methodology:

The approach of collecting required data on hydrological, meteorological, hydro-geological, morphological, cross section of the major rivers and their tributaries/distributaries, Digital Elevation Model (DEM), groundwater level, water quality, aquifer properties, lithological data, existing DTWs/STWs and monitoring wells, required field survey and investigation, pumping tests, laboratory tests are to be submitted by the Consultant before commencement of the study. The methodology to execute the mathematical modelling works and the Critical Path Method (CPM) analysis are also to be submitted by the Consultant before commencement of the study.

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7. Work Plan and Manning Schedule

The Work Plan and the manning schedules of the study for hydrogeological investigation and modelling Personnel are to be submitted by the Consultant before commencement of the study.

8. Duration of the Contract

The Consultant will be procured for a period of **30 (Thirty) months** from the date of commencement according to the Contract.

9. Major Deliverables

- Detail reports on water resources availability, water use, sectoral water demand, emerging contaminants, water quality in the study area.
- Detail reports on aquifer system, groundwater fluctuation, recharge potential and safe yield level of aquifer in the study area.
- Detail reports on Water Stress Area (WSA) considering present and future water availability and uses, climate change impacts, water quality and recharge potential in the study area.
- Detail report on appropriate strategies for conjunctive use of rainwater, surface water and groundwater resources.
- Detail report on addressing the salinity in the sea due to Sea Level Rise (SLR).
- Detail report on integrated plan for combating climate change and socio-economic development of coastal areas.
- Detailed report on the Decision Support System (DSS) to be established or updated at WARPO under this project, including its architecture, functionalities and operational guidelines.

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10. Professional inputs

Formation of an effective team of professionals is prerequisite for the successful completion of any assignment. This is particularly important in a project like the proposed study with the stipulated objectives. A very careful thought has, therefore, been given in forming the team composition with a number of national professionals. Thus, the team members have been selected considering their academic qualification, professional expertise and practical experience of conducting similar studies as well as the requirements described in Terms of References (ToR) and the individual tasks proposed under each position of the project. The assignment of the Consultants will require substantial experience in their respective fields.

The Consultants will be engaged under a single contract acting as one team of experts. It is estimated that for carrying out the above-mentioned study including relevant data collection and modelling tasks, a total of **270 man-months** of consulting services will be required for the project. The estimated staff requirements for the study have been given below in the following table:

Sl. No.	Description of the Position	Nos, of Consultants	Input (man-month)
1	Senior Water Management Expert/Team Leader	1	18
2	Senior Planning and Policy Experts	1	9
3	Senior Hydrologist	1	14
4	Hydrodynamic Modeller	1	14
5	Groundwater Modeller	2	32
6	Climate Change Modelling Expert	1	14
7	Hydrogeologist	3	36
8	GIS/RS Specialist	2	14
9	Software Developer	1	3
10	Hydrochemist	1	12
11	Survey Specialist	2	16
12	Data Analyst	2	24
13	Field coordinator	2	24
14	Lab Technician	1	24
15	Surveyor	2	16
	Total	23	270

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11. Qualification and Responsibilities of the Consultants

The educational qualification, required experiences and the tasks and responsibilities of each of the Consultants have been described in details in **Annexure - 1**.

12. Survey & Data Collection and Integration of Monitoring Wells with Automation

The Consultants have to carry out the following activities for survey and data collection, and Integration of Monitoring Wells with Automation:

A. Survey, Investigation & Data Collection (Integrated with NWRD & DSS System)

Sl. No.	Description of Items	Unit	Quantity
1	Data Collection (Available Hydrological, Meteorological, Hydro-geological etc) from secondary sources		
2	Cross-section Survey of Rivers, Canals etc.	Nos.	2,000
3	River Bed Material Sampling and Analysis	Nos.	120
4	Geophysical Resistivity Survey through Vertical Electric Sounding (VES)	Nos.	100
5	BM/RL Connection of Monitoring Well	Nos.	360
6	Installation of Seepage & Percolation Measurement Pipe	Nos.	100
7	Measurement of Seepage & Percolation	Nos.	100
8	Multi-parameter quality sensor Set (UV-vis Spectrometer, portable Multi-meter etc.)	Set	1
9	Collection of Satellite Image (upto date)	Nos.	
10	Capacity Building	Nos.	1
11	Service Charge, Logistics, Supporting Staff, Transportation, Field trip, Accommodation, Stationary, Printing, Reporting etc.		

Note: Capacity building under the “Survey, Investigation & Data Collection” section shall be conducted in accordance with Government rules and regulations, and funds will not be disbursed if the activities are not carried out.

13. Field & Laboratory Test

Sl. No.	Description of Items	Unit	Quantity
1	Pumping/Aquifer test	Nos.	55
2	Hydrochemical investigations and laboratory tests	Nos.	360

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14. Reporting Requirements

The following major Reports must be submitted after completion of the Modeling study:

- Detail reports on water resources availability, water use, sectoral water demand, emerging contaminants, water quality in the study area.
- Detail reports on aquifer system, groundwater fluctuation, recharge potential and safe yield level of aquifer in the study area.
- Detail reports on Water Stress Area (WSA) under shortage of water resources considering present and future water uses and climate change impacts in the study area.
- Detail reports on suitable artificial recharge structures, their types, storage capacity, efficiency and cost estimates.
- Detail report on appropriate strategies for conjunctive use of rainwater, surface water and groundwater resources.
- Detail report on addressing the salinity in the sea due to Sea Level Rise (SLR).
- Detail report on integrated plan for combating climate change and socio-social development of coastal areas.
- Detail reports on appropriate strategies considering socio-economic stress due to poor groundwater quantity and quality in accordance with Bangladesh Delta Plan 2100.
- Detailed report on the Decision Support System (DSS) to be established or updated at WARPO under this project, including its architecture, functionalities and operational guidelines.

In addition to the above Reports, the following reports need to be submitted time to time:

Sl. No.	Report	Deadline	Copies
1.	Inception Report	end of the 2 nd Month	15 Copies
2.	Progress Report- I	end of the 5 th Month	10 Copies
3.	Progress Report- II	end of the 8 th Month	10 Copies
4.	Mid Term Report	end of the 13 th Month	20 Copies
5.	Progress Report- III	end of the 19 st Month	10 Copies

6.	Progress Report- IV	end of the 23 rd Month	10 Copies
7.	Draft Final Report	end of the 27 th Month	20 Copies
8.	Final Report	end of the 29 th Month	25 Copies

15. Mode of Payments

All payment of the Consultants will be made through satisfactory completion of the work. All the reports must be approved by the Director General of WARPO before making any of the above payment. As per government rules, VAT and IT will be deducted from all of the payments to the Consultant. Reimbursable costs will be reimbursed upon completion of the specific reimbursable items. The consultant will get the payment as per the following schedule:

Invoice/ Bill No	% of Contract Amount	Against Deliverables
1 st Invoice	10%	On submission of Inception Report (End of 3 rd Month)
2 nd Invoice	10%	On submission of Progress Report – I (End of 6 th Month)
3 rd Invoice	10%	On submission of Progress Report – II (End of 9 th Month)
4 th Invoice	10%	On submission of Mid Term Report (End of 14 th Month)
5 th Invoice	10%	On submission of Progress Report – III (End of 20 th Month)
6 th Invoice	10%	On submission of Progress Report – IV (End of 24 th Month)
7 th Invoice	20%	On submission of Draft Final Report (End of 28 th Month)
8 th Invoice	20%	On submission of Final Report (End of 30 th Month)

16. Duties and Responsibilities

16.1 WARPO's Responsibilities

The Project Director (PD) will ensure that the objectives of the study as detailed in the Terms of References (ToR) are achieved within the agreed time schedule. The Project Director will in the context of the ToR direct the study process and supervise the execution of the study and monitor progress according to the said objectives. In particular, the Project Director will take necessary action in good time where such monitoring shows that outputs are not likely to be supplied at the required time. The Deputy Project Director and the specialised professionals of WARPO will assist the project team as required for the study. The Deputy

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Project Director; and WARPO District Office's Executive Engineer and his other professionals will closely monitor and evaluate the project work. The Consultants will be required to reschedule activities by taking consent from the Project Director if this becomes necessary.

The Project Director and the Deputy Project Director will ensure that the Consultants will have regular meetings with them to discuss technical and project management issues. Any unresolved issue should be taken up with the Director General, WARPO for appropriate solution. The Consultants will also report to Director General, WARPO regarding institutional strengthening support and other matters requiring specific guidance.

WARPO will be responsible for arranging the following facilities:

- All hydrological, hydrogeological, and meteorological data from the National Water Resources Database (NWRD) as per data dissemination policy of WARPO.
- Satellite images and previous reports available with WARPO.
- Provide assistance for arranging collection of data from other agencies, if needed.
- Make available information from other study components.

16.2 Consultant's Responsibilities

The Consultants shall work under the direct supervision of the Project Director (PD) of WARPO. The Consultants shall carry out the services as detailed in the "Scope of Works" and "Responsibilities of the Consultants" in the best interest of the study with reasonable care, skill and diligence with sound engineering, administrative and financial practices and shall be responsible to the executing agency (WARPO) for discharge of responsibilities. The Team Leader will be responsible to the Director General, WARPO for proper and timely execution of all the activities of the study mentioned in the ToR of the project.

The Consultants will be responsible for arranging the following facilities:

- Make necessary arrangements for site investigations and data collection as required for the study.
- Making necessary arrangement for site visit of WARPO project professionals during site investigations and data collection as required for the study.
- Survey, investigation, and data collection activities—such as cross-section surveys of rivers, canals, and similar features, as well as riverbed material sampling and analysis—shall be conducted at sites selected in consultation with the project Director.
- Discussion with WARPO to avoid any duplication in the data collection.

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- Handing over the collected data (primary and secondary) and study results to WARPO for their use and NWRD records.
- Making necessary arrangements for additional hydrological, meteorological, spatial, temporal, satellite images (GIS & remote sensing) and other necessary data collection from secondary source as needed for the study.
- Bearing the cost of data procurement and maps from BWDB, BADC, DPHE and others at Government rate.
- Carrying out activities as per scope of work and delivering the study report.
- Handing over the procured goods and equipment to WARPO after completion of the contract.
- Providing support staff including administrative and financial staff needed for the effective delivery of the services.
- Arranging both theoretical and on the job training for WARPO professionals on mathematical modelling as a matter of technology transfer.
- After completion of the project, all the technical support will be provided for maintenance and operation of monitoring wells and other components at least three (03) years with the supervision of WARPO.

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Qualification, Experience and Responsibilities of Consultants
'Hydrogeological Investigation and Mathematical Modeling'

Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Senior Water Management Expert/ Team Leader	01	He/she must have a Bachelor's degree, preferably with a Master's/PhD degree, in Civil Engineering/Water Resources Engineering/ Water Resources Management/Hydrology from a well reputed university.	<p>He/she must have minimum 20 years of working experience in water resources planning and management. He/she should have at least 15 years experience in mathematical modelling for water resources sector.</p> <p>He/she must have minimum 10 years of practical working experience in leading similar projects on water resources management and groundwater modelling and assessment and leading multi-disciplinary and multi-national teams in similar water resources management projects.</p>	<ul style="list-style-type: none"> ▪ Overall responsibility for hydrological investigation and modelling task of the project. ▪ Full responsibility for all aspects of planning, liaison and reporting for the modelling team. ▪ Supervise all aspects of project implementation and work in close cooperation with Project Director. ▪ Study and review of previous water resources development projects in the study area. ▪ Examine present water availability and use scenario and water demand in the study area. ▪ Identify data gaps, bottlenecks and suggest primary data collection, if required. ▪ Develop approach and methodology for data processing, analysis and modelling. ▪ Orient the conceptual model and strategic work plan to carry out the modelling activities. ▪ Coordinate and supervise the modelling and investigation tasks of other experts in the team or other works of the project. ▪ Prepare the final report on aquifer mapping and hydrogeological modelling activities. ▪ Maintain close contact with the Project Director for regular reporting of project activities.

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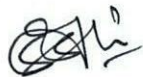
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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Senior Planning and Policy Experts	01	He/she must have a Bachelor's degree, preferably with a post graduate in Economics from any reputed university. Western university degree will get preference.	He/she must have minimum 15 years working experience in Project appraisal /Project Management in the Public sector, with 10 years in Development budget formulation, /Public Finance Management area.	<ul style="list-style-type: none"> ▪ The candidate must have familiarity with National Planning, Public Investment Management (PIM) and Budget Formulation, Monitoring, and Evaluation process/system. He/she should possess the following qualities: ▪ Excellent analytical and communications skills (Bangla and English) work effectively in team-based environment and under tight time constraints. ▪ Ability to provide the full range of operational assistance with independent responsibilities. ▪ Ability to build effective working relations with Client's and colleagues. ▪ Strong working experience in the field of Project Formulation and Project Management. ▪ Excellent knowledge of Government Budget process, ADP/RADP formulation related activities. ▪ In depth knowledge on project formulation and PIM related activities. ▪ Knowledge on reform mechanisms of the government specially PIM, GCRD. ▪ Experience of working as a Project Director. ▪ Experience in writing quality reports for high level policy makers.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Senior Hydrologist	01	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering/ Water Resources Management/Hydrology from a well reputed university.	He/she must have minimum 20 years of working experience in water resources management and hydrological analysis in water resources sector. He/she must have minimum 10 years of practical working experience in similar projects on water management, surface water modelling, aquatic resource management and flood risk management.	<ul style="list-style-type: none"> ▪ Study and review of previous water resources development projects in the study area. ▪ Review of surface water flows, static water resources availability, water use and demand in the study area. ▪ Process and analyze the hydrological data for water resources planning and flood management. ▪ Assess the relationship between rainfall, runoff, streamflow, evapotranspiration and soil water content. ▪ Undertake hydrological assessment to develop flood and drought management strategy. ▪ Develop rating curve for dry period. ▪ Estimate water yields, taking into account the utilization of surface water. ▪ Identify the potential water bodies for conservation as a source of potable water and aquatic habitat. ▪ Provide training to WARPO professionals on hydrological modelling. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Hydrodynamic Modeller	01	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering/ Computer Science & Engineering/Hydro-informatics from a well reputed university.	<p>He/she must have minimum 15 years of working experience in surface water modelling, 2D and 3D hydrodynamic modelling, numerical model coding and post-processing.</p> <p>He/she must have practical working experience in similar projects with organizing large geo-physical datasets, data assimilation techniques, pre-processing input datasets and post-processing model outputs, with excellent programming ability.</p>	<ul style="list-style-type: none"> ▪ Develop/Update the HD model for river flow assessment, rainfall-runoff model and any other model, if necessary, for the study area. ▪ Process and analyze the primary and secondary hydrological data for model set up. ▪ Develop and calibrate Water Balance model and specify boundary conditions. ▪ Assess the hydrographic conditions and hydrodynamics of rivers, lakes and reservoirs in the study area. ▪ Determine and fix the lowest safe yield level of aquifer in the study area. ▪ Develop approach and methodology for decision making on regulation on different usages of surface water. ▪ Provide training on hydrodynamic modelling. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Groundwater Modeller	02	He/she must have a Bachelor's degree, preferably with a Master's degree, in Civil Engineering/Water Resources Engineering/ Hydro-informatics/ Groundwater Modelling from a well reputed university.	<p>He/she must have minimum 15 years of working experience in developing groundwater flow models, integrated surface and groundwater models, numerical model coding and post-processing.</p> <p>He/she must have practical working experience in similar projects with organizing large geo-physical datasets, data assimilation techniques, pre-processing input datasets and post-processing model outputs, with excellent programming ability.</p>	<ul style="list-style-type: none"> ▪ Develop the Conceptual model to formulate the composition and nature of the aquifer system. ▪ Assist in collection, processing and analysis of all types of groundwater and aquifer related data. ▪ Formulate and guide field survey in conducting aquifer test or pumping test. ▪ Process and analyze the primary and secondary hydrological data for model set up. ▪ Develop and calibrate groundwater model from information relating to geological structure and aquifer properties. ▪ Simulate groundwater flow in aquifers including groundwater abstractions and interactions with river and other surface water bodies. ▪ Simulate groundwater levels and river flows for various scenarios such as changes in pumping rates, climate change scenarios. ▪ Carry out analysis of the groundwater recharge using groundwater models. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Climate Change Modelling Expert	01	He/she must have Master's Degree in Civil Engineering / Water Resources Engineering / Environmental Engineering / Environmental Science / Climate Science / Climate Change or related field from a reputed University.	He/she should have 15 years of working experience in climate science and modelling, hydrologic processes, environmental and disaster risk management. Experience in climate related projects is essential.	<ul style="list-style-type: none"> • Collect and review existing reports, data and information related to climate change for the study area. • Carry out trend analysis of climatic data. • Conduct climate modelling activities especially bias correction, downscaling models, interpretation. • Assist the team leader as and when required. • Contribute in reports. • Participate in the workshops.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Hydro-geologist	03	He/she must have a Bachelor's degree, preferably with a Master's degree, in Geology/Soil Science/ Hydrogeology/ Environmental Science from a well reputed university.	<p>He/she must have minimum 10 years of working experience in groundwater occurrence and movement, aquifer formation, groundwater hydraulics and groundwater recharge mechanism.</p> <p>He/she must have practical working experience in similar projects with hydro-geological investigation, aquifer mapping, groundwater sampling tests, pumping tests, design and commission of boreholes.</p>	<ul style="list-style-type: none"> ▪ Formulate specification of hydro-geological field investigation and survey. ▪ Assist in the collection, processing and analysis of all types of groundwater related data. ▪ Understand and interpret maps, geological data, historical evidence and models to build up the groundwater regime of the study area. ▪ Supervise installing necessary groundwater monitoring wells and borehole logs and put older wells back into service. ▪ Drill exploratory boreholes in order to obtain missing data. ▪ Perform groundwater sampling and in-situ quality tests at field sites using specialized instrumentation and equipment. ▪ Carry out hydro-geological investigation on site such as hydraulic aquifer tests or pumping tests and evaluate their results ▪ Bring the samples to the laboratory for testing. ▪ Monitor aquifer system, aquifer behavior and subsurface lithology of the study area. ▪ Assist the Team Leader to prepare aquifer mapping for the study area. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
GIS/RS Specialist	02	He/she must have a Bachelor's degree, preferably with a Master's degree, in Geography/Civil Engineering/Water Resources Engineering/ Urban and Regional Planning/ Environmental Science from a well reputed university.	<p>He/she must have minimum 10 years of working experience in GIS application, Satellite image processing, analyzing and designing projects using ESRI software (ArcGIS, ArcInfo Desktop, ArcSDE, ArcView) and other software (ERDAS Imagine).</p> <p>He/she must have practical experience in similar GIS related activities in producing GIS coverage, contour maps, Digital Elevation Model (DEM); building and maintaining GIS databases, analyzing spatial and non-spatial data.</p>	<ul style="list-style-type: none"> ▪ Acquire data/maps/reports from different primary and secondary sources. ▪ Design, create and maintain geospatial database and develop maps and aerial photography. ▪ Analyze and interpret results using standard GIS and RS tools and techniques. ▪ Produce GIS based geological and hydro-geological maps of the study area. ▪ Establish surface water and groundwater resources inventory which is compatible to GIS. ▪ Develop a GIS system based on the latest available aerial imagery base map of the boreholes and behavior of the groundwater. ▪ Map potential groundwater recharge areas and aquifer spatial coverage in different parts of the study area. ▪ Prepare GIS based maps of aquifer mapping, water stress areas and water zoning. ▪ Oversee data flow, management and distribution activities to support GIS. ▪ Provide training to WARPO professionals on GIS and RS. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Software Developer	01	He/she must have a Bachelor's degree in Computer Science/ Computer Science & Engineering/Electrical & Electronics Engineering/ Applied Physics from a well reputed university.	<p>He/she must have minimum 10 years of working experience in software development and computer programming, design and ICT activities for water related projects.</p> <p>He/she must have practical experience in similar projects in developing softwares with machine learning tools and LSTM models with excellent proficiency in C++/C#, Python, NetCDF and programming (PHP, XML, JavaScript) or other relevant languages.</p>	<ul style="list-style-type: none"> ▪ Contribution to the development of a dynamic cloud-based Decision Support Tool (DSS). ▪ Utilize machine learning for analyzing forecasting and data imputation. ▪ Design and implement features related to real-time ground and surface water, climate data, and historic information within the DSS. ▪ Collaborate with multi-disciplinary teams to integrate water-related data and functionalities into the system. ▪ Ensure the DSS aligns with project goals and effectively supports decision-making in water resource management. ▪ Upload all field survey data, GIS based maps and model results in the cloud-based server ▪ Preparation of User's and Technical manuals of the DSS ▪ Installation of the DSS at WARPO. ▪ Provide training to WARPO officials on the use and operation of the DSS ▪ Any activity assigned by the Project Director for the interest of the project ▪ Maintain close contact with the Project Director for briefing his/her output

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Hydro-chemist	01	He/she must have a Bachelor's degree, preferably with a Master's degree, in Chemistry/Applied Chemistry/ Hydrogeology from a well reputed university.	He/she must have minimum 8 years of working experience in groundwater management and groundwater quality analysis. He/she must have practical working experience in similar hydro-chemical investigation, groundwater sampling tests, laboratory tests of hydro-chemical parameters.	<ul style="list-style-type: none"> ▪ Assist in collection, processing and analysis of all types of groundwater quality data. ▪ Collect and analyse water samples for physical and chemical parameters and interpret their results in relation to sectoral water uses. ▪ Perform surface water & groundwater sampling at field sites using specialized instrumentation and equipment. ▪ Carry out hydro-chemical investigation and in-situ tests at field level and bring samples to the laboratory for testing. ▪ Responsible for quality analysis for surface water & groundwater at field level. ▪ Supervise the laboratory analysis of hydro-chemical parameters. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Survey Specialist	02	He/she must have a Bachelor's degree in Civil Engineering/Water Resources Engineering from a well reputed university.	<p>He/she must have minimum 8 years of working experience in river cross-section survey, sampling and field data collection.</p> <p>He/she must have practical working experience in similar field data collection, discharge measurement, water level gauge installation, river bed material sampling and measurement.</p>	<ul style="list-style-type: none"> ▪ Formulate realistic field data collection plan and schedule. ▪ Participate survey work to be conducted for field data collection. ▪ Lead and supervise the field data collection team with necessary safety measures. ▪ Conduct extensive cross-section survey of river course, distributaries, tributaries and other water channel on requirement. ▪ Water level gauge installation, reading arrangement, discharge and river bed material sampling and measurement. ▪ Inform the status and progress of the data collection activities regularly. ▪ Assist the Team leader in preparation of the detail survey report. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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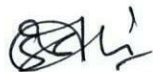


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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Data Analyst	02	He/she must have a Bachelor's degree in Computer Science/ Computer Science & Engineering/Electrical & Electronics Engineering/ Applied Physics/ Statistics/Applied Statistics/Data Management from a well reputed university.	He/she must have minimum 5 years of working experience in Information Technology, database management, data processing and analysis and statistical analysis of data. He/she must have practical experience in similar projects with data analysis of water level, rainfall, discharge and topographic data with excellent proficiency in statistical software (R, SPSS) and programming (XML, Javascript)	<ul style="list-style-type: none"> ▪ Acquire data/maps/reports from different primary and secondary sources. ▪ Analyze all types of primary and secondary data under guidance from the Team Leader. ▪ Analyze and interpret results using standard statistical tools and techniques. ▪ Design, create and maintain relational databases and data systems. ▪ Assist the Team Leader to preparation of reports by providing data and information. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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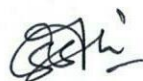


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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Field Coordinator	02	He/she must have a Bachelor's degree in any discipline from a well reputed university.	He/she must have minimum 5 years of working experience in fascilitating and arranging field data collection, field visits in similar projects at grass root level with multi-disciplinary and multi-cultural team.	<ul style="list-style-type: none"> ▪ Compile and analyse necessary information related to data collection. ▪ Assist the Survey team for field data collection as and when necessary. ▪ Coordinate and planning of all the field visits of the survey team. ▪ Arrange meetings and facilitate the workshop/ seminars in the study region. ▪ To assist the Team leader in coordinating all the field data collection programs. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1		2	3	4
Lab Technician	01	He/she must have a Bachelor's degree,preferably with a Master's degree, in Chemisty or in other relevant subject.	He/she must have minimum 5 years of working experience in groundwater management and groundwater quality analysis. He/she must have practical working experience in similar hydro-chemical investigation, groundwater sampling tests, laboratory tests of hydro-chemical parameters.	<ul style="list-style-type: none"> ▪ Assist in collection, processing and analysis of all types of groundwater quality data. ▪ Collect and analyse water samples for physical and chemical parameters and interpret their results in relation to sectoral water uses. ▪ Perform surface water & groundwater sampling at field sites using specialized instrumentation and equipment. ▪ Carry out hydro-chemical investigation and in-situ tests at field level and bring samples to the laboratory for testing. ▪ Responsible for quality analysis for surface water & groundwater at field level. ▪ Supervise the laboratory analysis of hydro-chemical parameters. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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Name of the Postion	Nos. of Postion	Educational qualification	Experience	Responsibilities
1	2	3	4	5
Surveyor	02	He/she must have a Diploma in Civil Engineering/Water Resources Engineering from a well reputed College/Institute.	He/she must have minimum 5 years of working experience in river cross-section survey, sampling and field data collection. He/she must have practical working experience in similar field data collection, discharge measurement, water level gauge installation, river bed material sampling and measurement.	<ul style="list-style-type: none"> ▪ Participate survey work to be conducted for field data collection. ▪ Supervise the field data collection team with necessary safety measures. ▪ Conduct extensive cross-section survey of river course, distributaries, tributaries and other water channel on requirement. ▪ Water level gauge installation, reading arrangement, discharge and river bed material sampling and measurement. ▪ Inform the status and progress of the data collection activities regularly. ▪ Assist the Team leader in preparation of the detail survey report. ▪ Any activity assigned by the Project Director for the interest of the project. ▪ Maintain close contact with the Project Director for briefing his/her output.

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জনজিমুল আলম
বৈজ্ঞানিক কর্মকর্তা/সঃ এঃ
পানি সম্পদ পরিকল্পনা সংস্থা
পানি সম্পদ মন্ত্রণালয়

Arif
29-12-25

Md. Arif Abedin
Senior Scientific Officer/
Executive Engineer
Water Resources Planning Organization
Ministry of Water Resources

Saidur
29.12.25

Kazi Saidur Rahman
Senior Scientific Officer
Water Resources Planning Organization
Ministry of Water Resources

M. Aminul Haque
29/12/25

Dr. M. Aminul Haque
Principal Scientific Officer
Water Resources Planning Organization
Ministry of Water Resources, Dhaka

M. Aminul Haque
29/12/25

মোহাম্মদ আলমগীর
মুখ্য বৈজ্ঞানিক কর্মকর্তা
পানি সম্পদ পরিকল্পনা সংস্থা
পানি সম্পদ মন্ত্রণালয়