REPORT ON ASSESSMENT OF WATER SOURCES FOR PIPE WATER SUPPLY SYSTEM AT PAIKGACHA MUNICIPALITY, KHULNA

SUBMITTED TO

WaterAid Bangladesh (WAB)

SUBMITTED BY

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EXECUTIVE SUMMARY

In the study area like in most part of the coastal belt the lack of adequate fresh drinking water is an acute problem. As the surface water is saline almost throughout the year, especially in the dry months when ponds, lakes and other man made water reservoirs are dried up, ground water becomes the only alternative source of fresh water for thousands of people. Bangladesh depends mainly on groundwater resources to meet its domestic demand for potable water. In addition, the coastal areas are also vulnerable to the anticipated impacts of climate changes like sea-level rises. Surface water of tidal rivers is also saline to brackish both in wet and dry seasons. The major objectives of the study was assessed using a combination of approach including; analysis of water quality for drinking purpose;

- Based on available literature and secondary data forecast about the ground water recharge situation of the study area
- Assess the capacity, performance and future potentials of the existing pipe water supply system
- Review the future demand considering consumption, capacity of the source and current supply
- Critically analyze the information and provide multiple options for providing safe drinking water to the citizens

Mixed method was considered to conduct this study; participatory techniques used in the study process includes, review of available documents and secondary data and information, series of field visits, Focus Group Discussions (FGD) with the users groups, Transect Walks and drilling works for observation five(5) well and geophysical borehole logging operation of drilling well. The water quality test of the collected sample of five observation test well.
Before installing any piped water supply system using ground water source following issues are important;

- Groundwater secondary data collection and review like; lithology, water quality, aquifer condition, Ground water recharge condition etc.
- Primary groundwater investigation (test well drilling, sediment classification, grain size analysis, aquifer boundary detection, aquifer thickness, assessment of ground water flow direction identification, Ground water recharge, Permeability, transmissibility, hydraulic gradient etc.)
- Existing pump well; water quality test & analysis
- Potential zone/area identification of well installation
- Discharge capacity calculation of the production well

The above similar types of investigation may not follow before installing the existing water plant. It is found from the study that; aquifer thickness in the water plant area only 30-35 ft which contains fine to very fine sand with mica these types of sandy layer is not good aquifer due to low permeability and transmissibility. The review of flow nets for these aquifers suggested that fresh groundwater discharge was small considering the permeability and transmissibility for the whole study area. Moreover the areas is covered by coastal saline expect Jessore route/ Jessore underground path. On the technical point of view water plant area not fit for large scale ground extraction bigger diameter production well. The number of three productions well technically is not expected with the small plant

area for large scale ground extraction to meet the water demand. Before groundwater extraction in any area some hydrogeological norms should be maintained but here such types of norms may not be maintain properly.

It is found from the study that; geophysical Resistivity data collected during the resistivity survey in the area shows good quality data and the interpretation of data suggests that the sequence below the soil is homogeneous composed with silty clay, clay and sand. The top unit shows resistivity in with a thickness of about 10 ft and represents the top clay-silt/sandy clay layer. Investigations on aquifer system and understanding of aquifer behavior; identification of the subsurface lithologic units, lateral and vertical extent of the aquifers, delineate fresh and saline groundwater interface in the coastal areas and characterization of the properties of aquifer sediments. On the basis of lithological characters, encounter in exploratory well and private installed different wells, subsurface formation can be divided into three zones. The top clay layer is mainly Alluvium of Recent to Quaternary. Sometimes silt clay and fine sand are also observed in the same zone. Thickness of this varies from 0 ft to 10ft .Highest thickness 10ft clay is observed test borehole. It is found just below the characterized by very fine to very fine sandy layer and its thickness is more or less 50ft. This zone is composed mainly light grayish fine to medium sand and its thickness (30-35ft from 70-110ft) up to 110ft. This zone is comparatively confined aquifer but not fit for the large scale extraction of pipe line water supply system. In some area this zone has connection with upper aquifer and this zone is mainly upper aquifer. Below the depth 110 ft which characterized by grayish fine to clay silt layer and its thickness is up to 1000ft (From secondary data; DPHE, Water board, Local driller & different gov. & non govt. agencies) .Water of this layer is highly contaminated by Iron, Arsenic and salinity. Static water level of this aquifer is 6ft of the study area.

Based on the available information and the geophysical investigations it is concluded that Paikgacha is located in an area, which is considered to have no any potential groundwater source for large scale water extraction. Water of the different layer is highly contaminated by Iron, Arsenic and salinity. Considering the geological investigation & water quality test result there is no safe groundwater source in the study areas. WaterAid & Paikgacha Municipality implemented piped water supply system people are enjoying with present water supply system including O& M. According to WaterAid Bangladesh; up to December a total of 1,107 families have been connected to the system. The municipality has a plan to cover 2000 households within 2020. To meet up the present & future water demand following study and operation are needed;

- Groundwater aquifer condition including water quality assessment towards Jessore Road (Paikgacha Municipality -Jessore Road)
- After properly completion of the assessment 3/4 Production well installed towards Jessore road and distance between two well at least 1 KM and well discharge not more than 10-20 thousand liter per hr.
- During assessment period need to direct supervision of Water Supply Engineer, Groundwater Expert and Sr. Hydrogeologist
- Considering the technical point of views Authority can extract groundwater from one production well
- The water treatment should be maintain proper/technical persons with maintenance log book
- Water quality should be tested periodically
- It is essential to get safe water to install a desalination plant with in the production well depth within 110 ft.

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1.0 INTRODUCTION

Bangladesh covers an area of 143,998sqkm and extends from 20-34'-N to 26-38'N and from 88-01'E to 92-56'. Maximum extension is about 440km in E-W direction and 760km NNW-SSE. Bangladesh is bordered by India in the west, north and east and by the Union of Myanmar in the South-east. Bangladesh is the largest deltaic land in the world, its north-eastern portion is attached hilly region (Himalayan and Arkan yeoma hills) and Bay of Bengal is on southern portion of Bangladesh.

Like other coastal areas, the shallow aquifer of ground water of most locations has the presence of iron and salinity higher than the acceptable limit. In few locations arsenic concentration is very close to the acceptable limit. There are limited suitable layers in deep aquifer. On the other hand, sources of some palatable water pockets were also found randomly. Therefore, it is imperative to know available ground water resources in that area to provide palatable and potable water to the dwellers. A pipe water supply system has been established in 2013 at town under the leadership of municipality authority and with the support from Water Aid and RDA.

According to the World Health Organization (WHO), water for human consumption should be sufficient, safe, accessible, and affordable. Bangladesh is working to achieve the target. Government of Bangladesh along with development partners are engaged with full strength. Water aid in collaboration with municipality and local partner NGO has taken a project to find out the water source both ground as well as surface water source for in the area of the Pourashava under Khulna district.

1.1 BACKGROUND OF THE STUDY AREA

The Pourashava consists of 9 wards bounded within 2.52 sq. km, is a 'B' grade municipality and total household are 4274 under Khunla distract. The location of the Paikgacha Pourashava is 22.583330N & 89.333330E. The dwellers are facing severe drinking water crisis due to presence of arsenic and iron. The water supply system of Paikgacha Pourashava and surrounding areas are depending mainly on groundwater source in few areas also use rain water as well as surface water. In the study city more than 95% supplied water is of groundwater used for domestic, industrial and commercial purposes. Maximum deep tube well extracting water from 100ft to 120ft depth but this water is contaminated by Arsenic,Iron and salinity . At the present time around total household are 4274 live in Paikgacha Pourashava area and day to day water demand is increasing. This increasing trend of groundwater abstraction is being continued with the rate of population growth and the corresponding water demand will be increase of the present water supply.

1.2 LOCATION, EXTENT AND ACCESSIBILITY

Paikgacha municipality is one of the municipalities in Upazila under Khulna district to ensure safe drinking water for their citizens and bounded within 2.52 sq. km, is a 'B' grade municipality and total household are 4274. Geologically area is situated in coastal region in Bangladesh and hydrogeologically area is under zone -5 (Holocene coastal plain).

The study area includes Paikgacha Upazila of Khulna District covering from 22025'N to 22054'N latitude to 89015'E to 89045'E. Annual average temperature is maximum 34.30C and minimum 20.80C. In the study area like in most part of the coastal belt the lack of adequate fresh drinking water is an acute problem. As the surface water is saline almost throughout the year, especially in the dry months when ponds lakes and other man made water reservoirs are dried up, ground water becomes the only alternative source of fresh water for thousands of people.

Water quality of the shallow aquifers is poor except in some isolated pockets. These pockets are of limited capacity. Previous hydro-geological investigations through exploratory drillings and electric geophysical loggings generated scattered information about the water quality in the shallow and deep aquifers in the study areas. Annual average rain fall is 1817mm.

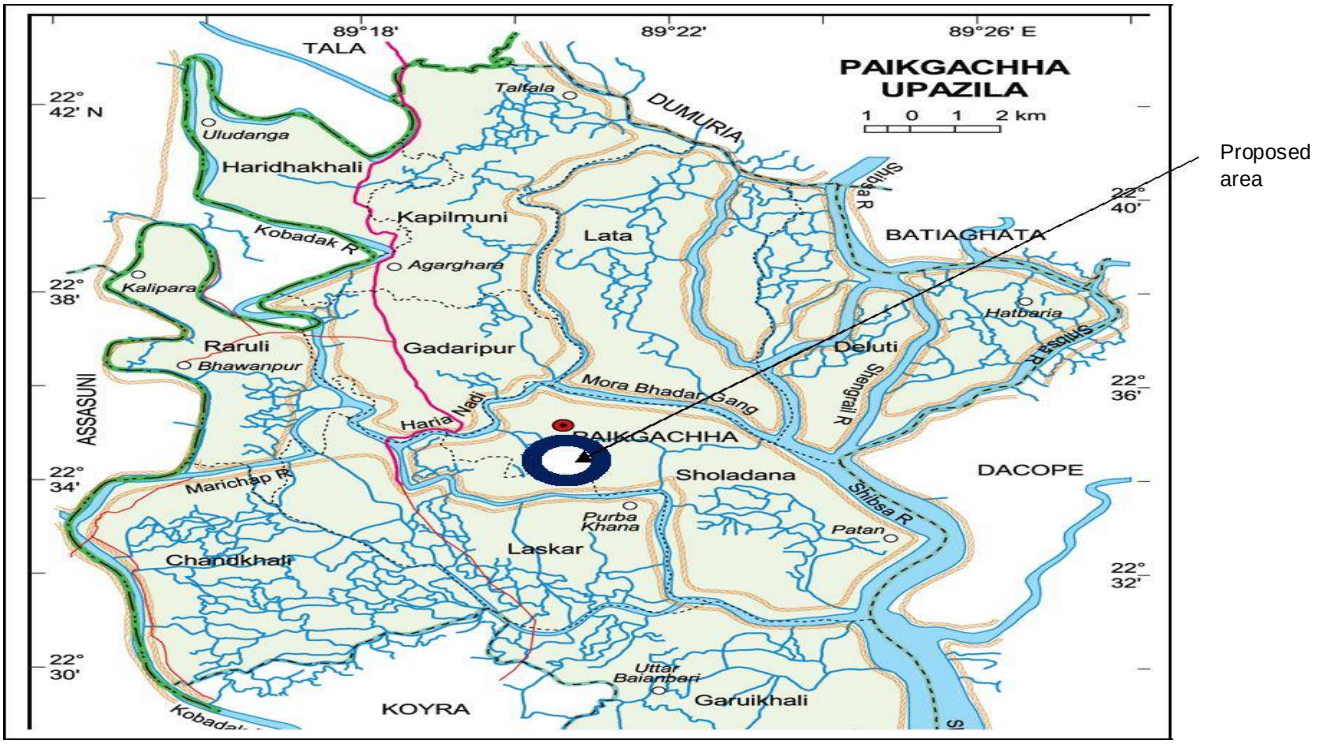


Figure-1 : Location map of the study area

2.0 PURPOSE OF THE ASSIGNMENT

The purpose of this assignment is to identify groundwater (shallow and deep aquifer) and also surface water source in the area of the municipality. In addition, one of the key purposes is to analyse the water quality for drinking purpose in line with the standard of WHO and Bangladesh of the identified aquifer and assess the potential capacity of the same aquifer to abstract water to supply through pipeline water supply. This study work is a part of the hydro-geological condition identification of Pourashava and the adjacent areas, using bore logs, surface electrical sounding, geophysical logging, water level data, pumping test data, water quality data of the installed shallow & deep aquifer deep tube wells etc. It is needed to carry out detailed hydro-geological investigation in Pourashava area, groundwater is the main source of portable water supply. In this connection Geological condition of Bangladesh and Hydro-geological condition study is also needed / helpful for the detailed study of hydro-geological investigation area. The ever increasing population, the use of the land for various construction purposes and also expansion of the city planning interrupt the natural recharge to the aquifer system from the land surface. This causes of minimum infiltration where as consumption is growing faster. Thus the annual withdrawal of groundwater is more than the annual recharge. Hence the less recharge in study has adversely affected the static water level of different aquifer (upper, intermediate & deeper aquifer) and the static water level is lowering down gradually in every year. More over Arsenic, Iron & hardness is comparatively is higher than Bangladesh Drinking Water Standard Level. So it is now important task to investigate the groundwater /hydro-geological condition in and around the Study area for future planning and for proper designing the deep tube well (well design, drilling procedure, well development testing, aquifer testing etc)as well as identify the aquifer condition, water reserve and find out the proper water uses procedure, system, develop water management etc.

2.1 SPECIFIC OBJECTIVES OF THE ASSIGNMENT

- Identify and assess the potential shallow and deep aquifer and surface water source by conducting Vertical Electro-magnetic survey (VES) or similar methods in the area of the municipality (Geophysical Logging machine).
- To prepare water sources map of that area with availability of water and potential abstraction period to meet demand of the dwellers using GIS map or any other suitable/similar procedure.
- Analysis of water quality for drinking purpose in line with the standard of WHO and Bangladesh of the identified aquifer and assess the potential capacity of the same aquifer to abstract water to supply through pipeline water supply.
- Based on available literature and secondary data, forecast about the ground water recharge situation of the study area.
- Assess the capacity, performance and future potentials of the existing pipe water supply

system
- Critically review the future demand considering consumption, capacity of the source and current supply.
- Critically analyze the information and provide multiple options for providing safe drinking water to the citizens.

2.2 UNDERSTANDING OF THE ASSIGNMENT

As we have understood from the brief ToR, Groundwater assessment by existing hydrogeological data (Secondary data of lithology, borelog, water quality report, aquifer thickness, hydrogeological map, Geological report from Geological Survey of Bangladesh etc and primary data test drilling report-Borelog, soil classification, water quality report, geophysical bore log resistivity, local information from DPHE, Local people opinion). The following are the core activities to be accomplished for achieving the objectives of the assignment:

- Secondary data collection of lithology, borelog, aquifer thickness, hydrogeological map, Geological report from Geological Survey of Bangladesh etc.
- Primary data test drilling report-Borelog, soil classification, water quality report, geophysical bore log resistivity, local information from DPHE, Local people opinion
- Identify and assess the potential shallow and deep aquifer and surface water source
- Identification (GW/Surface water/River) for the smooth fresh water supply of the scheme.
- Hydraulics study –transmissibity, permeability, yield measurement
- GW removal reserve assessment
- Indentify aquifer thickness
- Test well up to desire depth and operate resistivity ohm/m for water quality for aquifer identification
- Hydraulic status of Static water level, pump level with different discharge, depletion rate, Specific yield etc.
- Borehole geophysical resistivity operation
- Water sample collection, water quality test & analysis
- Water demand calculation for 2000 HH
- Ground water flow direction assessment of the scheme & surrounding areas
- Geological & hydrogeological cross section map preparation
- Report preparation and Shearing

3.0 METHODS OF THE INVESTIGATION

Detailed hydro-geological investigation work and to fulfill the objectives of the study work, relevant measurements of groundwater potentiality is carried out. The geological, litho logical, meteorological, hydro-geological and other data were collected from different concern Govt. office/Non Govt. Official /DPHE and agencies. These are analyzed to obtain a clear picture of hydro-geological condition of the study area. However, analyses based on the collected data are presented in different illustrations and graphs to have a better and quick authentic understanding of the hydro-geological situation. Require technical review considering to the scientific, environmental aspects, hydrogeology, subsurface lithology, groundwater level and flow direction, water quality,

acceptability, durability, seasonality etc. Preparation of maps, lithologic sections and reports analyzing and interpreting data as well as investigation and review findings also provide recommendations wherever applicable. Bore-log data-Borehole logging and water quality is evaluated to know a clear picture of hydrogeology of project area.

During the first phase the main task was collection and analysis of the bore logs from different concern Govt. office/Non Govt. Official /DPHE and agencies. The geological, lithological, meteorological, hydro-geological and other data were collected from different concern Govt. office/department agencies, university and research organizations. These are analyzed to obtain a clear picture of hydro-geological condition of the study area. However, analyses based on the collected data are presented in different illustrations and graphs to have a better and quick authentic understanding of the hydro-geological situation. This study is carried out following steps mentioned below-

3.1 FIELD WORK:

- To check the present geomorphic situation
- Extents of the surface water bodies
- Bore log collect from test well drilling, production deep tube well drilling and compared with other bore log in different areas.

Bore-log data, groundwater data and water quality are evaluated to know a clear picture of hydrogeology of Dhaka city area. The whole work is divided into three phases. During the first phase the main task were collection and analysis of the well logs.

- Recognition of lithology by dividing the bore-logs into several segments with respect to depth based on lithology.
- Comparison of the previously recognized lithology with the bore-log data.

During the second phase the activities included:

- Determination of lithology
- Interpretation of resistivity curves.
- Preparation of litho-log for each investigated wells.
- Preparation of geological cross sections.

During the third phase the main activities included:

- Based on the collected well data for preparation of the water table contour maps.
- Determine water table fluctuation.

- Preparing the panel diagrams using bore logs.
- Determine the aquifer location & aquifer thickness
- Find out the ground water recharge condition
- Find out the Hydraulics status transmissibity, permeability, yield measurement etc
- Static Water level of aquifer
- Sustainability of ground water & drawdown
- Relation between upper aquifer and lower aquifer
- Water quality & infiltration situation
- Finally, preparing hydrogeological maps to determine the thickness, extent and shape of the main aquifer at different places

3.2 DATA ACQUISITION AND SOURCE:

For the purpose of present hydro-geological investigation in proposed and adjacent areas, relevant data were collected from different organization:

- Meteorological data collected from Bangladesh Meteorological Department
- Groundwater water level collected from GWC,
- Bore log data were collected from DPHE BWDB, reputed water well drilling company.
- Water quality data from DPHE/NGO's/ Asia arsenic Network/NGO Forum collected water sample from drilling test well
- Resistivity (ohm/m), SP data from geophysical logging

3.3 DATA ANALYSIS:

Data have been analyzed by computer using different software,

a) Illustrator
b) Excel
c) Auto Cad

3.4 DATA PRESENTATION:

Collected all required hydro-geological data are to prepare graphs and tables to support and analysis the facts of interpretation, result and conclusion.

Major Task done

- Determine the aquifer location
- Determine the aquifer thickness
- Determine the numbers of aquifer
- Find out the ground water recharge condition
- Hydraulic Characteristics (Permeability, Transmissivity, Specific Yield ,Static Water level of particular aquifer, Drawdown level in different water discharge)
- Sustainability of ground water, Water quality, Infiltration situation

This study work is carried out first we discuss with Water Aid Bangladesh (WAB) authority detail on the proposed ToR about the for assessment of water sources for pipe water suppy system at municipality, khulna. Main issue of the discuss issues like; present status of the project area, existing water supply system, present ground water condition deliverable papers and other relevant issues. As per ToR , Islam Geo Soils Engineer (IGSE) will provide professional expert,
water well drilling equipments and required manpower at the project site. Islam Geo Soils Engineer (IGSE) will drill 2 to 3 test well as desire depth on the basis of hydrogeological concept, borehole geophysical logging operation. Besides Islam Geo Soils Engineer (IGSE) will collect necessary data on lithology, soil sample, ground water quality (existing well, water quality-Arsenic, Iron, salinity), hydrogeological /geological data etc. After completion all the relevant work. Prepare to draft report submission paper and presentation.

4.0 PHYSICAL INVESTIGATION: GEOGRAPHY

4.1 GEOGRAPHY

Geography of the study area includes mainly its topography and relief, drainage and water supply, population, culture, climate, vegetation etc. are as follows:

4.1.1 PHYSIOGRAPHIC CONDITION

Quaternary sediments deposited mainly by Ganges (Padma), Brahmaputra (Jamuna) and Meghna rivers and their numerous distributaries cover about three quarters of Bangladesh. The physiography and the drainage pattern of the alluvial plains in the central, northern and western regions considerable alterations in recent times. As per Rashid (1977) the major physiographic subdivisions are

1) Himalayan Piedmont Plain
2) Flood plains of the Tista Brahmaputra Jamuna Ganges and Meghna rivers
3) Barind Tract
4) Modhupur Tract
5) Foothills of the Shillong massif
6) Hoar Basin
7) Tippera Surface
8) Delta
9) Chittagong Hill Traces

As per physiographic map the project area is situated under Deltaic Plain and soil depositions are deposited by Deltaic & Tidal Deltaic environments. The deltaic deposits are sediments that are deposited on the active delta, which is defined as the area south of the Ganges River and mostly west of the Meghna estuary. Most of the delta is less than 15meters above the mean sea level and

the tidal zone is generally less than three (3) meters above the mean sea level. The delta is crossed by parallel south-southeast-trending distributary channels. The land gradient is approximately 1.00 meter per 20km. The historically stable delta front and presence of artefacts found below water table (Morgan and McIntire, 1959) suggest that large areas of the middle and lower delta are subsiding. The project area is under tidal delta deposited area and sea level is within 1.5 to 3.0m (reg. BSO)

4.2 LOCATION OF THE STUDY AREA

The study area includes Paikgacha Upazila of Khulna District covering from $22^0$25'N to $22^0$54'N latitude to $89^0$15'E to $89^0$45'E. Annual average temperature is maximum 34.3^0C and minimum 20.8^0C. In the study area like in most part of the coastal belt the lack of adequate fresh drinking water is an acute problem. As the surface water is saline almost throughout the year, especially in the dry months when ponds lakes and other man made water reservoirs are dried up, ground water becomes the only alternative source of fresh water for thousands of people.

4.3 TOPOGRAPHY AND RELIEF

The elevation of the study area ranges from 1.5 to 3.0 m above the MSL occurring maximum in the Zone point of Pourashava area and minimum towards sea area of about 2.0 m above the MSL. In the study area groundwater surface slope towards the south but the general slope is from the north towards the south.

4.4 DRAINAGE SYSTEM AND PATTERN

Almost flat and gradient is towards south direction and drainage system is also distributaries type.

4.5 POPULATION AND CULTURE

The Paikgacha Pourashava is B-Grade Pourashava and one of the fast growing Pourashava in the Khulna district and today occupying an area is 2.52sq.km. The people of this are a mainly Muslim, with some minor community Hindu. Study area is Pourashava that's why many different cultural people are come from different parts. Habitation is concentrated along natural and artificial levees because drainage facility of agricultural land. In Pourashava area cultivated land is reducing due to everyday new building is going to constructed and natural lake, pond, water bodies are fill up and developed many housing .

4.6 CLIMATE

The study City lies in the subtopics zone and is characterized by high temperature, medium temperature and medium rainfall often excessive humidity and fairly marked seasonal variations (Rashid 1977), and enjoys three distinct seasons: Winter (middle October to first week of March) which is cool and almost dry. Pre-monsoon (March to June) which was very hot and characterize periodic thunderous shower and monsoon and rainy season (June to October) which is warm and humid. About 80% or more of the annual precipitation occurs during this time. The recorded highest temperature during the summer is about 42ºC and lowest in winter is about 9^0C. Figure shows the climatic zone in Bangladesh (Modified after Rashid 1977).

4.7 RAINFALL

Study area and its adjacent (study area) is characterized by moderate rainfall with regional and seasonal variation. The average annual rain fall of the study area for the period of 2005-2015 is about 1400mm. However about 80% of the total rain falls occurs during monsoon with occasional with incursion of thunderstorms with heavy down pouring for several days. The rest 20% rainfalls occurs due to western and northwestern depression at winter and early summer time.

4.8 TEMPERATURE

The mean annual maximum and minimum temperature of the study and adjacent area are 41^oC and 9^oC respectively. The temperature record for the last 10years shows above the temperature varies distinctly seasonally. March, April and May are the hottest and December, January and February of every year are the coolest month. The summer season extend from March through May with a mean temperature about 35^o C. The monsoon begins June and continuous up to September with minimum temperature 30^o C with high humidity. The winter season begins November and extends through February. During winter, night temperature occasionally falls even below 6^o C with an average daily temperature less than 25^oC. Every year temperature is not same.

4.9 EVAPORATION

From last ten years 2000 to 2015 evaporations record, it is understood that large amount of water from open water bodies (River, pond, lake, low land, etc) soils and rainwater evaporates every year. It is clear that the evaporation is high during the month of March o May (varies from 96mm to 115mm) and during monsoon (June to October) the evaporation became moderate (89mm to

57mm monthly). (**Source-data from Metrological Department).**

4.10 HUMIDITY

In the last ten years (2000 to 2015), the highest humidity near about 88% was observed during the month of July. The lowest humidity close to 60% was found during the month of March. The monthly average rainfall, temperature, humidity and evaporation are the study and its adjacent area for the period 2002-2015. Rainfall is directly proportional to the temperature and humidity and inversely proportional to the evaporation. When the rainfall is low, humidity and temperature decrease but the evaporation increases (**Source-data from Metrological Department).**

4.11 VEGETATION

Study area is B-Grade Pourashava and around the total household are 4274 living in the Pourashava. Due to new construction for residence building, office and other purposes land is reduce. Steel some land in the Pourashava area is used for cultivation & fishing purposes.

5.0 PHYSICAL INVESTIGATION: GEOLOGY AND HYDROGEOLOGY

5.1 HYDROGEOLOGICAL CONDITION

Bangladesh is the largest deltaic land in the world, its north-eastern portion is attached hilly region (Himalayan and Arkanyeoma hills) and Bay of Bengal is on southern portion of Bangladesh. Detailed groundwater & hydro-geological investigation is very important for any county to mitigate human water demand. The optimum development and management of groundwater resource for mitigating human water demand, needs a detailed hydro-geological investigation of the water bearing formation, properties and characteristic(Bouwer 1978). Hydrogeological condition of any area depends on many parameters such as topography, geology, drainage pattern/system, rainfall, soil characteristics, recharge, discharge and hydraulic properties of the aquifer. Bangladesh is mostly a flat land formed by the three major/mighty rivers, namely the Ganges, the Brahmaputra and the Meghana. In the most part of Bangladesh favorable groundwater conditions occur mainly due to relatively high rainfall and recent geological condition and sedimentation. The occurrence, movement and storage of groundwater are influence by the sequence, lithology, thickness and structure of rock formation, the unconsolidated alluvial deposits of probably recent to sub recent age covers nearly all over the country. These sediments are generally thick most part of the country and as good bearing formation (Pitman 1982), Jones (1972) is recognized four major

groundwater areas in Bangladesh which is later modified by Hyde, 1979. According to this classification, following groundwater development areas are

a) Younger
b) Complex geology
c) Oldest alluvium
d) Coastal area

In Bangladesh, Quaternary sediments deposited by three mighty rivers consist primarily of alluvial and deltaic deposits can be divided into

a) Younger alluvium
b) Older alluvium and
c) Coastal alluvium

The younger or recent alluvium shows the best possibility for groundwater development. The area consists primarily of unconsolidated sediments with appreciable thickness of sands generally extending to a depth of more than a hundred meters. In Barind and Madhupur tracts the sediments are highly oxidized considered to be Pleistocene age and characteristically have a higher content of clay and silt than alluvial. The Recent and Pleistocene alluvial form the principal aquifers of the country. The recent alluvial, deltaic and marine sediments consist the coastal area are characterized by highly variable ground water conditions.

5.2 HYDROGEOLOGICAL SETTING OF BANGLADESH

Groundwater occurs in the extensive unconsolidated sedimentary aquifers all over the country and aquifer depth vary area basis. Bangladesh has been divided into various hydrogeological units (Hyde, 1987; UNDP, 1982; MPO, 1987). Ahmed (2003) simply classified whole the Bangladesh in 6 major hydro-geological units, these are:

Zone-01 Holocene Piedmont Plains

Zone-02 Holocene Deltaic & Flood Plains

Zone-03 Pleistocene Terraces

Zone-04 Holocene Depressions

Zone-05 Tertiary Hills and

Zone-06 Holocene coastal Plains

In Bangladesh , GW level of the shallow aquifer is very close to the surface and fluctuate with the annual recharge and discharge conditions, it also directly related with seasonal weather. It means water level rises during the monsoon (during heavy rain fall, flood, high water flow in the river etc) and declines during summer due to lake of water recharge in the aquifer and large scale irrigation abstractions. In Bangladesh a very little information is about groundwater table, its fluctuation rate, water recharge, water sources, pattern, behaviors of the deep aquifer (below 213m to 549m which under Dupitila Formation). It is perceived that groundwater is under artesian condition in the deep aquifer, water level fluctuation fashion annually is almost same as the upper aquifer (Zheng et al., 2005). In Bengal basin vertical movement found only in the few meters, normally groundwater moves horizontally in the lower part of the shallow aquifer (below30m to 213m and more depth) and in deep aquifer. Water flow movement is mainly from north to south and shallow water movement is also effected (influence) by presence of surface water bodies and irrigation abstractions, because in dry season huge amount of groundwater is used for irrigation & cultivation, moreover maximum industries extracted huge amount of water from groundwater by production deep tube well. As per Ravenscoft (2003) groundwater study in Bengal Basin three different water flow system found.

5.3 LITHOLOGICAL ANALYSIS OF THE STUDY AREA

The optimum development and management of groundwater resource for human demands, needs, a proper investigation of the water bearing formation, its properties and characteristics (Bouwer, 1978). Hydro-geological condition of any area depends on many parameters such as topography, geology, drainage system, rainfall, elevation, soil characteristics, recharge, drainage, discharge and hydraulic properties of the aquifer (Fetter, 1994).

5.4 LITHOLOGICAL ANALYSIS OF DIFFERENT BORE HOLE IN THE STUDY AREA

The distribution and movement of sub-surface geologic formation directly controlled the occurrence and movement of groundwater .The geologic formation has a marked influence on lateral and vertical movement of groundwater. Integrated studies of the evaluation of subsurface geologic formations are useful to understand the occurrence of groundwater bearing zone. The infiltration and percolation of groundwater are governed, in part by the character of the sub-surface formation. The deposition and thickness of water bearing horizons/aquifer and the country of the confining beds are particular importance on the development of groundwater exploration zone. In this study, twenty five lithologs are used to construct hydrostratigraphic cross-sections. Vertical distributions of groundwater on the basis of their lithological character are also inferred from those litho logs.

5.5 SUBSURFACE LITHOLOGY

The main objectives of the present study is to assess the of the study areas and to find out/delineate the potential zone of the aquifer, groundwater recharge status, confine aquifer thickness, vertical extension, groundwater movement, connectivity between upper and deeper aquifer, confine and unconfined aquifer, impermeable bed and its thickness, etc. For this purpose, on the basis of bore log data (From DPHE/NGO's/Drilling Company and other sources), hydrological cross-sections are drawn. After analyzing lithological character and position of water table, subsurface formation can be divided in to two zones and transect AA' (North South, Near the soral water treatment plant to Shipsa river), BB' (North-East Near the soral water treatment plant to Shipsa river Sr. Madrasha side) and CC' (South-East).

5.5.1 Northwest to southwest trending section AA (North-South):

On the basis of lithological characters, encounter in exploratory well and public installed different wells, subsurface formation can be divided into three zones.

Zone-01: The top clay layer is mainly Alluvium of Recent to Quaternary. Sometimes silt clay and fine sand are also observed in the same zone. Thickness of this varies from 0 ft to 10ft .Highest thickness 10ft clay is observed BH-01.

Zone-02: It is found just below the zone -01 which characterized by very fine to very fine sandy layer and its thickness is more or less 50ft is observed BH-01.Water of this layer is highly contaminated by Iron, Arsenic and salinity.

Zone-03: This zone (below zone -02) is composed mainly light grayish fine to medium sand and its thickness up to 110ft. In this portion soil grain size is medium and D_{10}= 0.17 to 0.20mm, D_{30}=0.27 to 0.28, D_{60}=0.30 to 0.32 $Cu=D_{60}/D_{10}$ below 2.00 which indicated that this zone is comparatively confined aquifer and better for production well installation. In some area this zone has connection with upper aquifer and this zone is mainly upper aquifer. Static water level of this aquifer is 6ft to 8ft area basis. Water of this layer is less contaminated by Iron, Arsenic and salinity is observed BH-01.

Zone-04: It is found just below the zone -03 which characterized by grayish fine to clayey silt layer and its thickness is upto 1000ft (From secondary data; DPHE, Water board, Local driller & different gov. & non govt. agencies) .Water of this layer is highly contaminated by Iron, Arsenic and salinity.

5.5.2 Northwest to southwest trending section AA (North-East):

On the basis of lithological characters, encounter in exploratory well and public installed different wells, subsurface formation can be divided into three zones.

Zone-01: The top clay layer is mainly Alluvium of Recent to Quaternary. Sometimes silt clay and fine sand are also observed in the same zone. Thickness of this varies from 0 ft to 10ft .Highest thickness 10ft clay is observed BH-01.

Zone-02: It is found just below the zone -01 which characterized by very fine to very fine sandy layer and its thickness is more or less 50ft is observed BH-01.Water of this layer is highly contaminated by Iron, Arsenic and salinity.

Zone-03: This zone (below zone -02) is composed mainly light grayish fine to medium sand and its thickness up to 110ft. In this portion soil grain size is medium and D_{10}= 0.17 to 0.20mm, D_{30}=0.27 to 0.28, D_{60}=0.30 to 0.32 Cu=D_{60}/D_{10} below 2.00 which indicated that this zone is comparatively confined aquifer and better for production well installation. In some area this zone has connection with upper aquifer and this zone is mainly upper aquifer. Static water level of this aquifer is 6ft to 8ft area basis. Water of this layer is less contaminated by Iron, Arsenic and salinity is observed BH-01.

Zone-04: It is found just below the zone -03 which characterized by grayish fine to clayey silt layer and its thickness is upto 1000ft (From secondary data; DPHE, Water board, Local driller & different gov. & non govt. agencies) .Water of this layer is highly contaminated by Iron, Arsenic and salinity.

5.5.3 Northwest to southwest trending section AA (South-East).

On the basis of lithological characters, encounter in exploratory well and public installed different wells, subsurface formation can be divided into three zones.

Zone-01: The top clay layer is mainly Alluvium of Recent to Quaternary. Sometimes silt clay and fine sand are also observed in the same zone. Thickness of this varies from 0 ft to 10ft .Highest thickness 10ft clay is observed BH-01.

Zone-02: It is found just below the zone -01 which characterized by very fine to very fine sandy layer and its thickness is more or less 50ft is observed BH-01.Water of this layer is highly contaminated by Iron, Arsenic and salinity.

Zone-03: This zone (below zone -02) is composed mainly light grayish fine to medium sand and its thickness up to 110ft. In this portion soil grain size is medium and D_{10}= 0.17 to 0.20mm, D_{30}=0.27 to 0.28, D_{60}=0.30 to 0.32 Cu=D_{60}/D_{10} below 2.00 which indicated that this zone is comparatively

confined aquifer and better for production well installation. In some area this zone has connection with upper aquifer and this zone is mainly upper aquifer. Static water level of this aquifer is 6ft to 8ft area basis. Water of this layer is less contaminated by Iron, Arsenic and salinity is observed BH-01.

Zone-04: It is found just below the zone -03 which characterized by grayish fine to clayey silt layer and its thickness is upto 1000ft (From secondary data; DPHE, Water board, Local driller & different gov. & non govt. agencies) .Water of this layer is highly contaminated by Iron, Arsenic and salinity.

5.6 GEOPHYSICAL LOGGING

During geophysical logging operation in five test well drilling point we found, Long normal resistivity value at 70 to 110ft depth is 20 to 30 ohm/m which indicate fine sand which means low transmissivity and permeability and sandy/aquifer layer thickness is only 30 to 35ft.

5.6.1 DESCRIPTION OF THE WORK

Test borehole has been completed at Pourashava of Khulna district in different location Hydrogeological & geological assessment for Piped water project under a WaSH project implemented by local partner NGO funded by Water Aid. Within the scope of work geophysical logging of the test borehole habitation for Piped Water Supply Scheme been carried out by the geophysical logging equipment. The support service was provided by the Islam Geo-Soil Engineer to run the logger Mr. S W M Phahlovi- Hydrogeologists and complete the logging work upon completion of the test borehole and necessary reporting. During the geophysical logging of test borehole, representative of Islam Geo Soil Engineers Mr. S W M Phahlovi- Hydrogeologist, Representative of local partner NGO.

A. INFORMATION OF TEST BOREHOLE

5.6.2 DRILLING AND INSTALLATION OF TEST TUBE WELL

The no five boreholes have been drilled up to 150ft below ground surface around the project study areas. The diameter of the borehole was 5.00 inches. From the start of drilling, the borehole was completed within the study period. After necessary preparation of the borehole, geophysical logging has been carried out. A test tube well of 1.5 inches diameter with GI pipe at the top, PVC lineup and PVC screen has been installed in the borehole. The depth of screen of test tube well was placed based on the findings of geophysical log data and the lithology of the borehole

5.6.3 BORELOG

During drilling, subsurface samples were collected after 10ft intervals and preserved. Any change of lithology of the sample within 10ft interval was also marked. After physical observation, lithology and color were described to produce the bore log up to the drilling depth. The lithology has been grossly described below:
The top is brownish clayey silt (top soil-L. br. clayey silt) up to the depth of 10'-0''ft from GL.

From 10ft to 50ft, lithology contains very fine to fine sand.

From 50ft to 110ft, light gray very fine sand to medium fine sand.

From 110ft to 150ft, lithology contains Gray clayey to silt.

From 50ft to 110ft, lithology is grossly medium to fine sand with medium dominating at the lower part and fine sand dominating at the upper part.

5.6.4 AQUIFER CONDITION

From the recorded lithology in the borelog of test drill hole, it can be seen that the aquifer conditions exist within the depth of drilling. As per geophysical logging report-resistivity, SP, Salinity from 50ft to 110ft medium sandy layer is comparatively confined aquifer and less saline concentration percentage is considering the Bangladesh Standard Limit. But this zone is comparatively confined aquifer but not fit for the large scale extraction of pipe line water supply system.

B. GEOPHYSICAL LOGGING OF TEST BOREHOLE

5.6.5 GEOPHYSICAL LOG

After completion of the total no of five borehole drilling, geophysical logging of the three boreholes have been carried out on 12th March 2016. Within the facilities of the geophysical logger, the borehole logging was completed up to the depth of 150ft. During the long run, the short (16") normal (SN), long (64") normal (LN) resistivity and self- potential's (SP) data were recorded mostly after 5 to 10ft intervals.

5.6.7 INTERPRETATION OF GEOPHYSICAL LOGGING DATA

The self- potential (mV) and resistivity (ohm-m) data are plotted against the recorded lithology in

the borelog of test drill hole for interpretation. In general, the long normal resistivity data are found indicative of formation resistivity of undisturbed zone while short normal resistivity data are influenced by the borehole face and the mud fluid. The SP along with resistivity data are found indicative of separation of layer boundary as changes by li-thology or formation water quality. During the log run, the data are found consistent with the recorded lithology except some variation.

Work: Geo-electrical Logging at Test Borehole

Project: Assessment of water sources for pipe water supply system at Paikgacha municipality, Khulna.

Date of logging: 12th March 2016.

Borehole diameter 5.00 inches Drilling completion: 3 days

Logging done by. Phahlovi- Hydrogeologist, Islam Geo Soil Engineers

Borehole Geo-electrical Logging Data (Bore Hole-01)

Depth (ft)	Self-Potential (mV)	Resistivity (ohm-m)	
		Short Normal (SN)	Long Normal (LN)
0-5	38	15.5	21.5
6-10	36	15.3	22.3
11-20	40.5	15.20	21.15
21-30	34	16.3	23.7
31-50	27	16.7	29.8
51-70	28	16.4	32.2
70-100	28	16.7	32.3
110-120	87	10.8	11.4
120-130	85	10.8	12.3
130-150	87	10.8	12.5

The geo-electric curves show different zones of resistively separation which are mainly influenced by the electrical conductivity of formation water. The changes of lithology as encountered and recorded in the bore log is also distinct by the. geo-electric curves. The lithological changes or the layer boundaries are mainly marked by the deflection of SP and resistivity curves. The main geo-electric log sections are given below:

Above 50ft depth

Higher deflection of SN & LN receptivity and +vc deflection of SP indicate formation with very fine grains with the formation water of comparatively low conductivity. The LN receptivity at this depth is 21.5 to 22.0 ohm-m.

From 70ft to 110ft depth

The lower deflection of SN & LN receptivity and +ve deflection of SP indicate formation with very fine grains. The very low LN receptivity indicates the formation water of high conductivity. The LN receptivity at this depth is 11.4 to 32.3 ohm-m.

From 110ft to 150ft depth

The lower deflection of SN & LN receptivity and +ve deflection of SP indicate formation with very fine grains. The very low LN receptivity indicates the formation water of high conductivity. The LN receptivity at this depth is 11.4 to 12.5 ohm-m.

Geo-electric log section and lithological boundary (Source-field data & chart prepared on log interpretation)

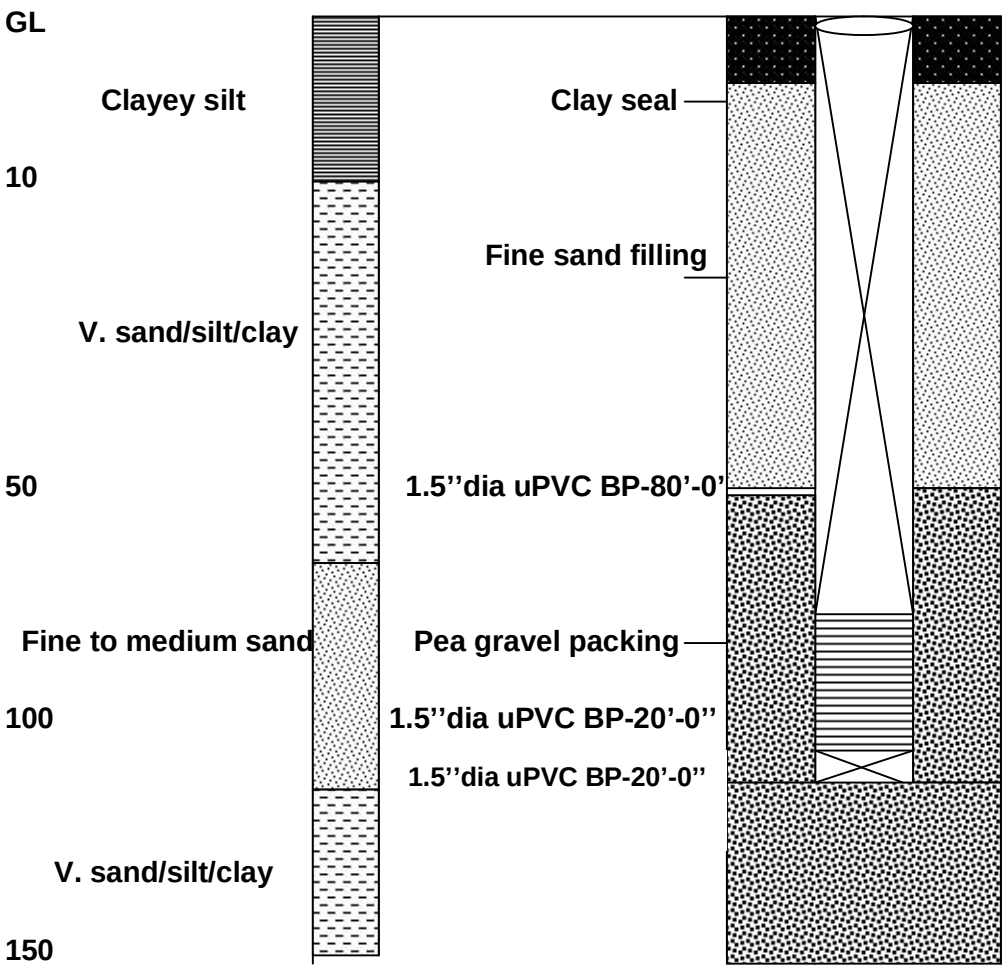
Depth (ft)	Layer lithology	Layer receptivity (ohm-m)	Approximate conductivity formation water (S/cm)	Aquifer/ aquitard	Water quality
GL to 10 ft	Clay	Casing pipe		Top soil	
10 to 50 ft	Very fine to fine sand	15.20 to 29.80	800- 1000	Upper aquifer	Water of this layer is highly contaminated by Iron, Arsenic and salinity

50-110 ft	Very fine sand & fine sand with medium sand;	16.4 to 32.40	4000 – 6000	Medium aquifer	This zone is comparatively confined aquifer but not fit for the large scale extraction
110 to 150ft	Clayey sand to silt	10.2 to 12.4	4000 – 6000	Layer of medium aquifer	Water of this layer is highly contaminated by Iron, Arsenic and salinity

5.6.8 Summary

Irrespective of grain sizes, the long normal resistivities are influenced by the presence of salinity in groundwater. From the formation resistivity's, approximate electric conductivity of formation water has been computed against each geo-electric log sections as mentioned above. Electric conductivities of groundwater show the vertical distribution of brackish - saline zone against the borehole lithology. From the SP and resistivity curves, lithological variations and layer boundaries are also demarcated in each geo-electric section. In terms of water quality, the vertical section (up to the logging depth) is separated at the depth up to 150ft by a probable aquitard or finer lithology comparatively fresh water aquifer (below 70ft up to 110 fit). The upper part of this saline zone (above 50ft depth) is slightly fresh which is probably due to flushing by rain water. But this zone is comparatively confined aquifer but not fit for the large scale extraction of pipe line water supply system.

5.6.9 TEST WELL DESIGN



Note:

Filter = from 70'-0''to 100', other two test well design is almost same.

(Source-field test drilling data)

5.6.10 GEOLOGICAL CROSS SECTION MAP AND PANEL DIAGRAM OF THE STUDY AREA

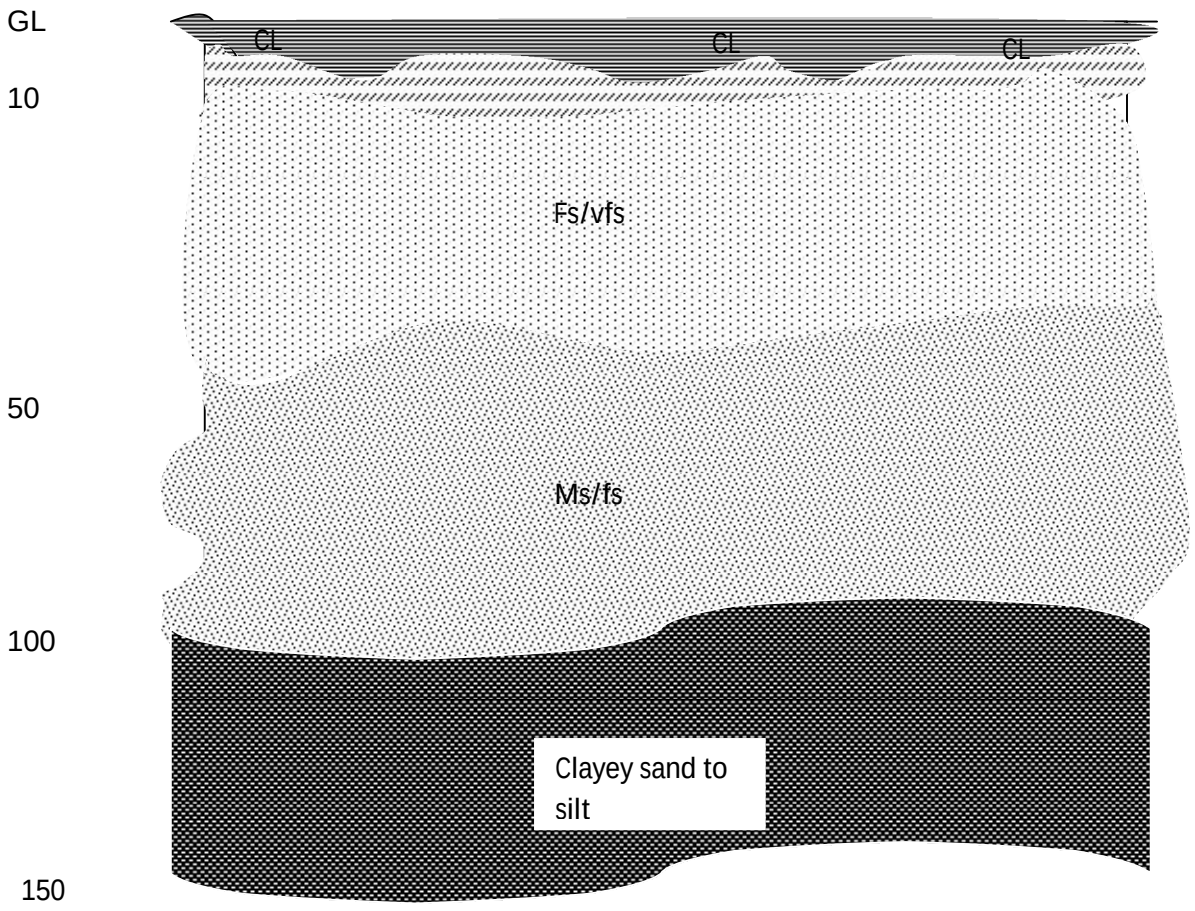


Figure-02: Geological Cross Section of the study area, Source-prepared on the basis of soil sample of test well drilling

Note: Below the layer of the 10 ft found the sand layer is contaminated by slightly Arsenic, Iron and salinity which confirmed by Geophysical electrical resistivity logging (ohm/m) operation report and same result is found at the Bore hole test tubewell water and also local information from DPHE/Local NGO's and water well drilling company and driller's. By stratigraphical & hydrogeological analysis is assumed that this area is under Tidal Delta deposited area and no impermeable layer is deposited

between upper and lower aquifer. Indicate that if huge volume of water will extracted from lower aquifer by production deep tube well then contaminated /brackish water may be saline intrusion. Water should be extracted by horizontal flow system and draw down should be minimum. Geological map which is published by American Geological Society and Geological Survey of Bangladesh that the study area is under Tidal Delta deposited area in context of Hydrogeological zoning system/divination.

5.7 GEOLOGY AND HYDROGEOLOGY

The study area is in the southern coastal belt and is entirely underlain by sandy alluvial sediments deposited by the early Ganges delta and is inter-bedded with discontinuous wedges of tidal clay and sands. The thickness of the Holocene sediments is probably at least several hundred meters in the area.

The litho-stratigraphy of the upper 300m of this formation is rather well known from numerous deep and shallow tube wells drilled in the area and mainly consists of medium to fine sands, clay, silty clay and sandy clay units. A continuous clay-silty clay layer of varying thickness varying from few centimeters to tens meters occurs at the top.

Throughout the study area no regular sequential succession occurs, rather it shows a heterogeneous mixture of clay, silt and sand. The top most layer is a clay dominant layer with varying thickness. The following layer is a complex mixture of medium and fine sands, silts and clays which can be considered as a shallow semi-confined aquifer. This shallow aquifer is made up of sand lenses at multiple levels inter-bedded with silts and clays having intersection in sand lenses to consider this as one complex hydraulic unit. Considerable variation in the thickness of these sediments is a characteristic of the deltaic depositional condition. The water of the upper aquifer is generally brackish or saline with few isolated fresh water pockets. The shallow aquifer is underlain by a confining clay and sandy clay band. **(Source- From general geology of Bangladesh & field investigation data)**

5.7.1 GROUNDWATER MOVEMENT

5.7.1.2 INTRODUCTION

Determining the elevation of the groundwater is one of the first steps of many hydrologic investigations. For example ‘‘elevation to water table’’ is an important consideration of investigations for groundwater contamination, design and construction of waste disposal site, and also for the

planning of water supplies. Among other hydrological parameters, water table contour maps are very important as they given an idea about the recharge, discharge and the flow direction. Thus it enables about the cost of drilling, construction and also the design of production deep tube wells. In study area groundwater levels are monitored by DPHE, different.

NGO's, and Asia Arsenic Network in some selective monitoring wells.Its adjacent areas well design is very critical due to Arsenic-Iron & Chloride. Saline water intrusion is now major problem in the southern portion. In the study area sandy layer within 100 to 150 ft depth is effected by Arsenic,Iron and salinity. People are taking their drinking water by installed hand tube well and their depth is almost 100ft to 150ft. More over underground transmissivity, permeability rate and aquifer thickness are different area to area and groundwater recharge conditions are also different area basis. In the study area , maximum lake, low land, rivers , canals are fill up and buildings area constructed and water infiltration rate is became very low more over water demand (drinking water, industrial water, etc) rapidly increase. Shrimp projects are also use huge volume of water (Beside of the Pourashava area).

5.7.1.3 OBSERVED GROUNDWATER TABLE

a.) Water table contour map of wet season

Water level is 6 to 10 ft found on the north side of the upper shallow aquifer (100ft to 150ft). Ground water flow is from north to south side.

b.) Water table contour map for the dry season

Water table contour map of the dry season October-January shows the more or less similar pattern. Due to low precipitation, infiltration, transmissivity, permeability in the dry season, the maximum values of static water level found at 10ft of upper aquifer (deep tube well). Lower depth of water table indicates the higher potentiality of groundwater and higher depth of water table is indicates the lower potentiality of groundwater.

c.) Groundwater table fluctuation of the study area

Change in storage, resulting from difference between supply and withdrawal of water cause water level to vary with a span of time the groundwater level fluctuation of an area is the difference between highest and lowest elevation of water table.

The rate of evaporation is high and most of the rivers receive groundwater from aquifer as base flow. As a result of all these natural and artificial withdrawal, the water declines sharply and reaches to

maximum depth in May and June. Rain starts in the pre-monsoon period and at the same time the recharge to the underground storage begins. The major artificial abstraction of groundwater is also stopped by this time and high relative humidity in the atmosphere reduces the rate of evaporation and evapo-transpiration. All these cause a gradual increase in the groundwater reservoir, which is reflected by the change in the water table.

5.7.1.4 DELINEATION OF GROUNDWATER MOVEMENT

Groundwater possesses energy in mechanical, thermal and chemical forms because of energy variation, groundwater forced to move one region to another in nature almost to eliminate these energy differentials (Todd, 1980).

In order to study the movement of groundwater effectively and accurately, it is necessary to have knowledge about the geological factors, viz, lithologic and structural sequence, thickness and their deposition patterns. Its permeability and other geologic factors pertaining to the character of groundwater bearing formation invariably control the movement of water. In this section, an effort has been made to determine the movement of groundwater on the basis of water head position.

6.0 WATER QUALITY TEST & ANALYSIS

6.1 INTRODUCTION

Paikgacha pouroshova is the highly saline contaminated area in the southern part of Bangladesh. Very large percent of shallow tube well is contaminated by arsenic, Iron and salinity. In these areas shallow and deep aquifer is contaminated by arsenic, iron and salinity. Before installing any tube well hydro geological and water quality survey is necessary for finding appropriate safe water source. This project conducted feasibility study for findings safe water source in suitable geological layer.

Sl.	Test Well Location	Pouroshova	Upazila	Depth (ft)	Date of Installation	Date of sampling
1	Near Soral Water Plant	Paikgacha	Paikgacha	150	18th March 2016	18th March 2016
2	Shibbbati	Paikgacha	Paikgacha	150	18th March 2016	18th March 2016

3	Football Pay Ground	Paikgacha	Paikgacha	150	18th March 2016	18th March 2016
4	Near Fosiar Residence	Paikgacha	Paikgacha	150	18th March 2016	18th March 2016
5	Senior Madraha	Paikgacha	Paikgacha	150	18th March 2016	18th March 2016

6.2 METHODOLOGY

Three test tube well installed in same depth at different areas and collected water sample for water quality analysis. Water quality analysis has been done NGO Forum for Public Health, Environmental Water Quality & Testing Laboratory, Dhaka. The following methods were using for water quality analysis.

Sl No	Parameter	Unit	Method
1	Chloride(Cl)	mg/L	Mohr's
2	Arsenic (As)	mg/L	HG-AAS
3	Iron (Fe)	mg/L	Flame-AAS

6.3 RESULTS AND DISCUSSION

According to water quality data 100ft shallow aquifer is safe from chloride (salinity), Arsenic and Salinity. Three test tube well water arsenic and iron concentration range is exceed than Bangladesh drinking water standard. (Source test result done by NGO Forum for Public Health Water quality testing laboratory, Dhaka, *** For the Coastal areas of Bangladesh, in case of non-availability of alternative sources value is 1000 mg/l according to the ITN-BUET)**

Sl No	Tested Parameter	Chloride (Cl)		Arsenic (As)		Iron (Fe)	
	Borehole Location	WHO Standard (250 mg/l)	Bangladesh Standard **(150-600* mg/l)**	WHO Standard (0.01 mg/l)	Bangladesh Standard (0.05 mg/l)	WHO Standard (0.3 mg/l)	Bangladesh Standard (0.3-1.0 mg/l)
1	Near Soral Water Point	1525		0.026		4.98	
2	Shibbati	854		0.007		5.54	
3	Football Play Ground	1586		0.017		6.05	
4	Near Fosiar Residence	1281		0.01		6.36	
5	Senior Madrasha	1525		2.55		0.013	

7.0 CONCLUSION & RECOMMENDATIONS

It is found from the study that; geophysical Resistivity data collected during the resistivity survey in the area shows good quality data and the interpretation of data suggests that the sequence below the soil is homogeneous composed with silty clay, clay and sand.

It is found just below the characterized by very fine to very fine sandy layer and its thickness is more or less 50ft. This zone is composed mainly light grayish fine to medium sand and its thickness up to 110ft. This zone is comparatively confined aquifer but not fit for the large scale extraction of pipe line water supply system. In some area this zone has connection with upper aquifer and this zone is mainly upper aquifer.

Based on the available information and the geophysical investigations it is concluded that Paikgacha is located in an area, which is considered to have no any potential groundwater source for large scale water extraction. Water of the different layer is highly contaminated by Iron, Arsenic and salinity. Considering the geological investigation & water quality test result there is no safe groundwater source in the study areas. WaterAid & Paikgacha Municipality implemented piped water supply system people are enjoying with present water supply system including O& M. According to WaterAid Bangladesh; up to December a total of 1,107 families have been connected to the system. To meet the present water demand for 1107 HH install 3/4 Production well towards Jessore road and distance maintain between two well at least 1 KM and well discharge not more than 10-15 thousand liter per hr. On the other hand to meet the future water demand for 2000HH is 120, 0000 liter/day (As 100 l/person/day & per HH 6 persons) install production well towards Jessore road with in the technical consideration. Water has to collect from production well to the treatment plant through pipe network before installing production well need to be proper hydrogeological investigation like; test well drilling, sediment classification, grain size analysis, aquifer boundary detection, aquifer thickness, assessment of ground water flow direction identification, Ground water recharge, Permeability, transmissibility, hydraulic gradient etc. After completion the treatment process distribute to the community level through pipe line. To meet up the present & future water demand following study and operation are needed;

- Groundwater aquifer condition including water quality assessment towards Jessore Road (Paikgacha Municipality -Jessore Road)
- After properly completion of the GW assessment 3/4 Production well installed towards Jessore road and distance between two well at least 1 KM and well discharge not more than 10-15 thousand liter per hr to meet up the present water demand
- During assessment period need to direct supervision of Water Supply Engineer, Groundwater Expert and Hydrogeologist
- Considering the technical point of views Authority can extract groundwater from one production well in water treatment area.
- The water treatment should be maintain proper/technical persons with maintenance log book
- Water quality should be tested periodically
- It is essential to get safe water to install a desalination plant with in the production well depth within 110 ft.