添付資料２　地下水調査報告書

Japan International Cooperation Agency (JICA)

Feasibility Study of Bheramara Combined Cycle Power Plant, Bheramara, Kushtia

Groundwater Investigation – Field Study

DRAFT FINAL REPORT

SUBMITTED BY

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1.0 Introduction

Japan International Cooperation Agency (JICA) appointed **Tokyo Electric Power Services Company Ltd. (TEPSCO),** a Tokyo based engineering/consulting company joint venture with **Tokyo Electric Power Company (TEPCO),** an electric power utility company known as **JV of TEPSCO/TEPCO** (**JICA Study Team)** to perform a feasibility study on Bheramara Combined Cycle Power Station in Bangladesh. The JICA Study Team has appointed **Engineers Associates Ltd. (EAL)** as Local Consultant to carry out Ground Water Investigation at Bheramara CCPP area for finding availability of adequate amount of ground water for the make up water of cooling tower of proposed power station. In this regard, a contract was signed between TEPSCO and EAL on **August 10, 2008.**

To know the present groundwater situation of the proposed Bheramara Power Plant area, a groundwater investigation has been carried out. Under this porgramme, the field study part included implementing physical works to evaluate the local aquifers present in the area. The physical works consists of drilling, electric logging, tube well installation, recording of all data and pump test. The data have been analyzed to define the hydrogeological condition, aquifer properties and water quality of the area.

Draft Final Report on the groundwater investigation at Bheramara site has been prepared based on this field study.

2.0 Purpose of Groundwater Investigation

The purpose of groundwater investigation in the area of the proposed site is to obtain information on the baseline situation of aquifer condition present in the area. The information will be used to address the following main issues:

a) reliable availability of groundwater by evaluating local aquifer system,

b) evaluation of technical realization of adequate groundwater abstraction (i.e. 1,300 m3/h) by well field(s) design,

c) evaluation of groundwater quality, and

d) evaluation of any impact on the existing wells surrounding the proposed site.

In order to solve the above issues, groundwater investigation is planned to carry out physical works such as well drilling, pumping test, water quality analysis etc. This field study will provide necessary information related to hydrogeology, local aquifer system and aquifer properties.

3.0 Scope of Work

The groundwater investigation - field study includes the following physical works:

- Test drilling and analysis
- Drilling, installation and development of pumping well
- Drilling and installation of observation wells
- Geo-electrical logging of boreholes
- Recording of pumping test (Step Drawdown Test & Continuous Pumping Test of 72 hours duration and Recovery)
- Field water quality monitoring, water sampling and laboratory analysis
- Evaluating results and reporting

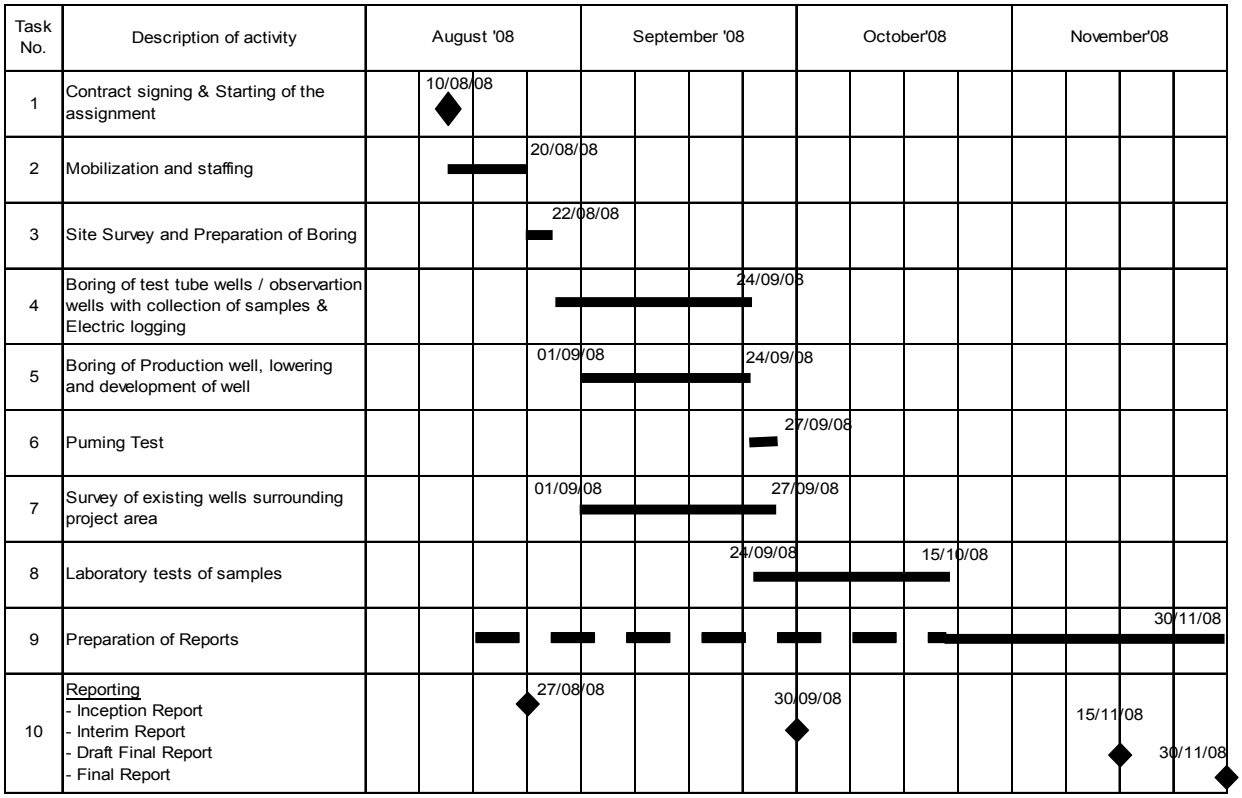
4.0 Investigation Programme

The groundwater investigation programme, a part of the EIA study for the proposed Bheramara Combined Cycle Power Plant, Bheramara, Kushtia, is initiated by TEPSCO personnel of Japan and representatives from EAL, Dhaka through discussion with the Superintending Engineer of DPHE Ground Water Circle, Dhaka. A request was made from the Project Director of Bheramara 450 MW CC Power Plant, Bangladesh Power Development Board, Dhaka to the Superintending Engineer of DPHE Ground Water Circle requesting for providing necessary assistance and equipment support to carry out the study.

4.1 Investigation Plan

With a view to achieving the purpose, a work programme was secheduled to carry out the groundwater investigation – field study at the Bheramara power station area. Work schedule for groundwater investigation at Bheramara Power Station is given below:

Work schedule for groundwater investigation at Bheramara Power Station



4.2 Investigation Team

The Groundwater Investigation - field study work has been carried out by the team of DPHE experts and EAL's personnel.

5.0 Methodology

The following activities/tasks have been followed for groundwater investigation:

Task-1: Mobilization, staffing and preparation of boring of Observation Wells

Task-2: Work supervision of observation well drilling, collection of drilling samples and recording in the log sheet, packeting and leveling of samples for sieve analysis

Task-3: Electric logging of boreholes of observation well

Task-4: Observation well installation in the borehole, development and recording of well discharge and field checking of water quality

Task-6: Analysis of sand samples in the laboratory

Task-5: Mobilization, staffing and preparation of boring of Pumping Well

Task-6: Work supervision of pumping well drilling, collection of drilling samples and recording in the log sheet, making borelog, installation of well fixture materials in the borehole, shrouding and development

Task-7: Pumping test arrangement and recording during 72 hours continuous pumping, recovery and step-drawdown test.

Task 8: Field checking of water quality and water sampling for laboratory analysis

Task-9: Preparation of reports.

6.0 Groundwater Investigation-Field Study

6.1 Location

The proposed site of the Bheramara Combined Cycle power plant is located in 12 Dag Village of Bahirchar Paschim Mouza (*Mouza Geocode 902*) of Bahirchar Union (*Union Geocode 27*) of Bheramara Upazila (*Upazila Geocode 15*) of Kushtia District (*District Geocode 50*). The site is situated beside the south-eastern side of the river Padma. There are two project sites in the project area. One is 'Site-A' and the other is 'Site-B". The two areas are situated within the periphery of Bangladesh Power Development Board (BPDB) area.

The location of the proposed groundwater investigation site is situated within the project area and about 500 meter west of the river Padma. The investigated area falls between the latitude of N24^{0}02′45″ & N24^{0}03′15″ and longitude of E89^{0}00′45″ & N24^{0}01′15″ and covers approximate an area of 0.63 km^2. The investigation site and well locations are shown in **Figure-1 & 2 of Annexure-I.**

6.2 Physiography

The groundwater investigation area lies within the physiographic division of Ganges river floodplain and consists of meander river deposits. The subsurface distributions of aquifers and aquitards are related to depositional environment of sedimentary formations of Bangladesh. Their occurrence – lateral and vertical can be seen within the geomorphologic units and major landforms. An overview of physiographic divisions of Bangladesh is shown in **Figure-3 of Annexure-I**.

6.3 Well Sitting

The land of the investigated area is not yet developed by the Bangladesh Power Development Board. The area is mainly occupied by trees and bushes, cultivated lands, canals of GK Project, ponds & other water bodies, and homesteads of villages towards the northern and eastern sides. On the basis

of existing site condition, the location of wells was selected before commencing the drilling programme.

The site of the pumping well was selected inside Site-A and beside canal of GK Project so that water from the well can be discharged into the canal during pumping test.

The site of test drilling or test tube well was about 16m from pumping well towards west. It was envisaged that the pumping well would be constructed on the basis of subsurface information and result of test drilling. The site was nearer to pumping well so that only little variation of lithology may occur.

The sites of other observation wells were selected radially from pumping well towards east, west, north and southerly direction. They were at certain intervals from the pumping well as specified in the TOR and approximately 75m, 200m and 400m apart from pumping well.

During well sitting, the geographical co-ordinates of each site was observed by GPS and recorded. The sites were easily accessible in field condition. The coordinates, approximate aerial distances & directions of observation wells from pumping well and landmark of each site are shown in **Table-1.**

Table-1: Information of location of wells

Well Identification	Geographical coordinates		Aerial distance and direction of OWs from PW-01	Landmark
	Longitude	Latitude		
PW-01	E 89001′00.5″	N 24002′59.4″	--	Beside canal of GK Project
TTW/OW-01	E 89000′59.9″	N 24002′59.4″	16.98 m west of PW-01	On mud road and beside canal of GK Project
OW-02	E 89001′00″	N 24002′56″	74.35 m south of PW-01	Beside culvert of canal of GK Project
OW-03	E 89001′03.4″	N 24002′59″	82.79 m east of PW-01	Beside foot road
OW-04	E 89001′02.6″	N 24003′00.7″	71.51 m north of PW-01	On mud road and beside canal of GK Project
OW-05	E 89000′55″	N 24002′57.5″	166.01 m west of PW-01	At PP old Jame Mosque compound
OW-06	E 89000′59.5″	N 24002′52.9″	201.90 m south of PW-01	On mud road and beside canal of GK Project
OW-07	E 89001′07.7″	N 24002′59.1″	203.63 m east of PW-01	Near rear gate of ‘F’ type coloney
OW-08	E 89001′04.4″	N 24003′02.6″	147.75 north of PW-01	Near Majid’s shop, 12 Dag Village
OW-09	E 89000′46.7″	N 24003′00.3″	390.94 m west of PW-01	Near highway
OW-10	E 89000′57.7″	N 24002′45.7″	428.80 m south of PW-01	On mud road and beside canal of GK Project
OW-11	E 89001′14.8″	N 24002′59.1″	404.10 m east of PW-01	East of mosque of ‘F’ type coloney
OW-12	E 89001′07″	N 24003′10″	374.30 m north of PW-01	At house of Mr. Bishu, 12 Dag Village

6.4 Physical Work

6.4.1 Types of Tube Well

Within the groundwater investigation programme, the following three different types of boring/tube well have been constructed which are referred to this report as follows:

1. Test drilling/tubewell or observation well (TTW/OW), drilled by water jetting technique and equiped with 38 mm diameter PVC, and hand operating pump to develop the well and measuring discharge.
2. Pumping well (PW) drilled by reverse circulation and equipped with 150 mm diameter PVC screen/blind pipe and 350 mm diameter MS pump housing, and motor driven submersible pump for pumping.
3. Observation well (OW), drilled by water jetting technique and equipped with 38 mm diameter PVC, and hand operating pump to develop the well and measuring discharge.

6.4.2 Test drilling

Borelog:

A test drilling has been completed upto a depth of 100m at the selected site. The subsurface information was recorded from test drilling samples and electrical logging of the borehole. During progress of boring, washed samples were collected after 3m intervals and any change of samples if occurs within 3m interval was also marked. After physical observation of the samples, a borelog has been prepared which is described by the type of lithology and colour. The borelog classifies the aquifer system of the investigated area.

Geo-electrical log:

The information of geo-electrical logging of test borehole has been obtained during the log run. It was defined by self-potential and resistivity of long normal and short normal data. During the log run, the specific resistence of each formation as obtained by the logger against depth was converted to resistivity. The self-potential (mV), long normal resistivity (ohm-m) and short normal resistivity (ohm-m) data were plotted against recorded lithology in the borelog for interpretation.

After completion of drilling, geo-electric logging of the boreholes of observation wells was carried out in boreholes of TTW/OW-01 and OW-06 to OW-12. Within the facilities of the geo-electrical logger, the borehole logging was completed upto the depth of about 95m. During the log run the resistivity (short normal & long normal) and self-potential data were recorded mostly after 1.5 to 3.0 meter intervals.

Test Tube Well:

A test tube well with a short length of well screen was installed in the borehole. On the basis of the information of borelog and electrical log, the screen of tube well was placed at the most suitable depth to be representative of the water quality and discharge. After completion, the test tube well was developed to obtain sufficient discharge and quick response to water table changes. The discharge and water quality of the well was recorded in the site.

The borelog, well information, electric log & data and water quality are shown in **Annexure-II**. The information of test tube well is in **Table-2**.

Table-2: Summary information of TTW/OW-01

Well ID	Total depth of boring (m)	Electrical logging of borehole	Total depth of well from GL (m)	Depth of screen from GL	Well discharge (litre/minute)	Water quality			
						Temp. (^{0}C)	Electric conductivity (EC) (µS/cm)	Total dissolved solid (TDS) (mg/l)	Iron (Fe) (mg/l)
TTW/ OW-01	100	SP and Res.	83.84	79.27 – 82.32	36	30.6	470	230	1.80

Sand analysis:

Sieve analysis of sand samples from test drilling (TTW/OW-01) was carried out which was based on the type of lithology recorded in the borelog. The results are provided in **Annexure-II.**

6.4.3 Observation well

The drilling, electric logging of boreholes, recording of drilling samples, preparation of borelogs, installation of wells and sand analysis of observation wells were completed. The depths of observation wells were defined on the basis of the aquifer condition encountered in test drilling and borelog of each observation wells. After installation, the wells were developed, water quality tested and discharge measured.

The borelog, well information, electric log & data and water quality are shown in **Annexure-III.**

6.4.4 Pumping well

On the basis of the available aquifer condition as encountered in test drilling and results of sieve analysis of test drilling sand samples, the drilling and design of fixture material of PW-01 was prepared. The length of housing pipe, well screen, slot size, diameter of well & drill hole and size of shrouding (gravel pack) material were so proposed to obtain a well discharge of more than 150 m^3/hr as specified in the TOR. It was also envisaged that the pump-motor will remain submerged under water at this pumping rate of continuous pumping of 72 hours as specified.

The borelog and well information are shown in **Annexure-IV**.

7.0 Findings

7.1 Borelog

The borelogs of test drilling, pumping well and observation wells describe lithological information of the groundwater investigated area. Geo-electrical logs of boreholes also show consistent information as with the lithology of

borelogs. The gross lithology shows dominantly sandy formation over silty or clayey fractions.

7.2 Aquifer Condition

The subsurface information reveals two hydrostratigraphic units upto the depth of 100.62 meter.

The upper aquitard is the top unit, which is composed of clay & silt at the upper part and very fine sand & silt at the lower part. The depth of this unit is 3.05 to 12.19 meter below ground surface.

The aquifer unit lies below the upper aquitard and continues upto the drilling depth. The upper part of the aquifer unit is composed of mainly fine and medium sandy fractions. The depth of this aquifer part is 24.39 to 48.78 meter below ground surface.

The main aquifer part lies below the upper finer aquifer part. It comprises mainly interlayer of medium to fine and coarser sand fractions. The bottom part is coarse sand and gravel with occasional medium to fine sands. The base is unknown but probably continues below 100.61 meter.

7.3 Geo-electrical Logging of Borehole

7.3.1 Geo-electrical log

The self-potential (mV) and resistivity (Ω-m) data are plotted against recorded lithology in the borelog to produce the electric logs of the boreholes for interpretation. The distributions of electric logs cover most of the area of groundwater investigation both horizontally and vertically.

7.3.2 Interpretation of Geo-electrical Logging Data

The data obtained from the electric logs of boreholes are found consistent with the recorded lithology. The long normal resistivity data are found indicative of formation resistivity of undisturbed zone while the short normal resistivity data are influenced by the borehole face and drilling fluid.

A deflection of short normal resistivity at the lower part (below the depth of about 85 to 90m) against coarser sandy formation indicates influence of drilling mud density in the borehole. This influence on resistivity is also indicated by the self-potential values.

The geo-electrical curves show different zones of resistivity separation against each formation and formation boundary. The resistivities of different layers as computed from long normal resistivity data are shown in the **Table-3.** Only little deviation can be seen between each geo-electric section and recorded layers boundary in the borelog.

Table–3: Geo-electrical Log Sections.

Depth (m)	Layer resistivity (Ω-m)	Borehole lithology	Aquifer conditions
0 – 15.24	36.60 – 86.70	Clay, silty clay, silt and very fine sand & silt	Upper auitard
15.24 – 45.73	33.80 – 114.20	Fine and medium sand	Upper aquifer part
below 27.44 to 45.73	37.60 – 161.00	Medium to fine sand, coarse sand and occasional gravel	Main aquifer part

Irrespective of grain sizes, the upper aquifer part is found comparatively low resistive than that of the main aquifer part. This is due to presence of finer fraction in the upper aquifer part. This infers existence of better water quality in terms of groundwater conductivity and TDS content.

7.4 Geological Sections

To reveal the horizontal and vertical extensions of the hydrostratigraphic units, two geological cross sections have been drawn. The cross sections include information of borelogs within the groundwater investigated area. The west to east geological section contains information of borelogs of OW-09, OW-05, TTW/OW-01, PW-01, OW-03, OW-07 and OW-11. The south-north geological section contains information of borelogs of OW-10, OW-02, PW-01, OW-04, OW-08 and OW-12.

The section lines and geological cross sections are shown in **Annexure-V.**

7.5 Well Installation

The main aquifer part has been screened for groundwater abstraction. In the pumping well, the well screen is placed at the depth of 47.71 to 85.39 meter below ground surface and the well is shrouded to obtain expected yield with minimum entrance resistance to flow. The screens of TTW and all observation wells, except OW-03, are placed at the middle of the main aquifer part. The screen of OW-3 is placed at the upper finer aquifer part, i.e 45.43 to 48.48 meter below ground surface. Summary information of tubewells are shown in **Table-4.**

Table-4: Information of hydrostratigraphic units and tubewells installed within the groundwater investigated area.

Well ID	Depth of upper aquitard below gs (m)	Depth of upper part of aquifer below gs (m)	Depth of main part of aquifer below gs (m)	Total depth of boring below gs (m)	Height of well casing above gs (m)	Total depth of well below gs (m)	Depth of screen below gs (m)	Dicharge
PW-01	6.09	36.58	not defined	92.68	0.46	86.91	42.71–85.39	**159.00-163.30** (m^3/h)
TTW/ OW-01	12.19	36.58	not defined	100.00	0.305	83.84	79.27–82.32	36 l/s
OW-02	9.14	42.68	not defined	100.00	0.305	84.15	79.58–82.63	36 l/s
OW-03	6.09	30.48	not defined	100.61	0.305	50.00	45.43–48.48	32 l/s
OW-04	6.09	48.78	not defined	101.22	0.305	77.75	73.18–76.23	37 l/s
OW-05	3.04	27.43	not defined	100.61	0.305	83.84	79.27–82.32	36 l/s
OW-06	12.19	36.58	not defined	100.00	0.305	76.22	71.65–74.70	36 l/s
OW-07	6.09	42.68	not defined	100.61	0.305	76.83	71.65–74.70	31 l/s
OW-08	6.09	36.58	not defined	100.61	0.305	77.75	73.18–76.23	32 l/s
OW-09	6.09	24.39	not defined	100.00	0.305	76.22	71.65–74.70	36 l/s
OW-10	6.09	42.68	not defined	100.61	0.305	74.70	70.13–73.18	37 l/s
OW-11	6.09	36.58	not defined	100.00	0.305	79.27	74.70–77.75	35 l/s
OW-12	6.09	42.68	not defined	100.00	0.305	79.88	75.31–78.36	38 l/s

8.0 Water Quality

After sufficient development and pumping of observation wells, the water quality was tested in the site. The parameters tested were temperature, electrical conductivity, total dissolved solids and iron content. The **Table-5** shows the water quality of OW-02 to OW-12.

Water sample from pumping well PW-01 was tested in the environmental laboratory of Bangladesh University of Engineering & Technology (BUET). The water was sampled during the end of pumping test. The **Table-6** shows the water quality of PW-01.

Table-5: Water quality of observation wells.

Well ID	Water quality			
	Temp. (^{0}C)	Electric conductivity (EC) (µS/cm)	Total dissolved solid (TDS) (mg/l)	Iron (Fe) (mg/l)
OW-02	29.1	440	210	1.0
OW-03	30.9	466	200	1.0
OW-04	30.2	410	200	1.2
OW-05	31.0	378	180	1.0
OW-06	28.0	485	210	0.6
OW-07	30.9	520	250	1.4
OW-08	30.1	400	190	1.2
OW-09	28.0	485	210	0.6
OW-10	29.1	408	200	0.4
OW-11	30.1	360	170	1.0
OW-12	30.2	411	209	0.9

Table-6: Water quality of pumping well PW-01.

Sl. No.	Water Quality Parameters	Unit	Concentrations Present
1.	pH		7.48
2.	Colour (Filtered)	Pt. Co. Unit	9.0
3.	Turbidity	NTU	0.96
4.	Alkalinity	mg./L	266
5.	Chloride	mg./L	15
6.	Total Hardness	mg./L	290
7.	Total Iron	mg./L	0.12
8.	Manganese	mg./L	0.505
9.	Nitrate-Nitrogen	mg./L	0.40
10.	Fluoride	mg./L	0.56
11.	Total Dissolved Solids, TDS Total Suspended Solids TSS	mg./L mg./L	364 6
12.	Arsenic	mg./L	<0.001
13.	Total Coliform,TC	Nr./100ml	24
14.	Faecal Coliform,FC	Nr./100ml	6
15.	Sulphate, SO4	mg./L	18.4
16.	Silica, SiO2	mg./L	37.6
17.	Electrical Conductivity, EC	µS/cm	567

9.0 Pumping Test

The pumping tests were carried out to determine the hydraulic properties of the aquifer and the performance characteristics of the pumping well. The type of pumping tests were:

a) Step drawdown test and

b) Constant discharge test by continuous pumping for 72 hours.

9.1 Step Drawdown Test

The step drawdown test was carried out on 20 September 2008. During this test the pumping well was pumped at various discharges in four steps without stopping the pump. In each step, the duration of pumping was 90 minutes and a total accumulative time of pumping was 360 minutes. The discharge of pumping well was increased by approximately 25 m^3/h in each successive step. The pumping was carried out by a submersible pump and free water flow was controlled by throttling a sluice valve in the delivery line. The water flow from the well was measured by an orifice meter and monitored by the water head in the piezometric tube. Throughout each step, discharge of pumping well was set fairly constant and water levels inside the well were recorded with time. Before start, static water level in the well, and at the end of the test, recovered water levels with time were also recorded. The recorded water levels data of step drawdown test are given in **Annexure-VI**.

9.1.1 Analysis of Step Drawdown Test Data

From the records of discharge and water levels in the pumping well during step drawdown test, the drawdown data of different rates of abstraction and residual drawdown data from recovery are plotted against time. These data were analyzed to evaluate the performance characteristics of the pumping well and aquifer response at different discharge condition.

An analysis of step drawdown test data of pumping well is shown in **Table-5.** The graphical presentation of step drawdown test data along with recovery is shown in **Figure-1.**

Table-5: Analysis of step drawdown test data.

Duration of pumping	Discharge (Q)	Static Water Level (SWL)	Pumping Water Level (PWL)	Drawdown (s)	Specific Capacity	s/Q	Aquifer Loss (BQ)	Well Loss (CQ^2)	Total drawdown ($BQ+CQ^2$)
(minute)	(m^3/h)	(m)	(m)	(m)	(m^3/h/m)	(m/m^3/h)	(m)	(m)	(m)
		3.424							
90	106.19		5.060	1.636	64.91	0.015406	1.579	0.063	1.642
90	128.11		5.420	1.996	64.18	0.015580	1.905	0.092	1.997
90	158.20		5.935	2.511	63.00	0.015872	2.352	0.140	2.493
90	181.77		6.300	2.876	63.20	0.015822	2.703	0.185	2.888

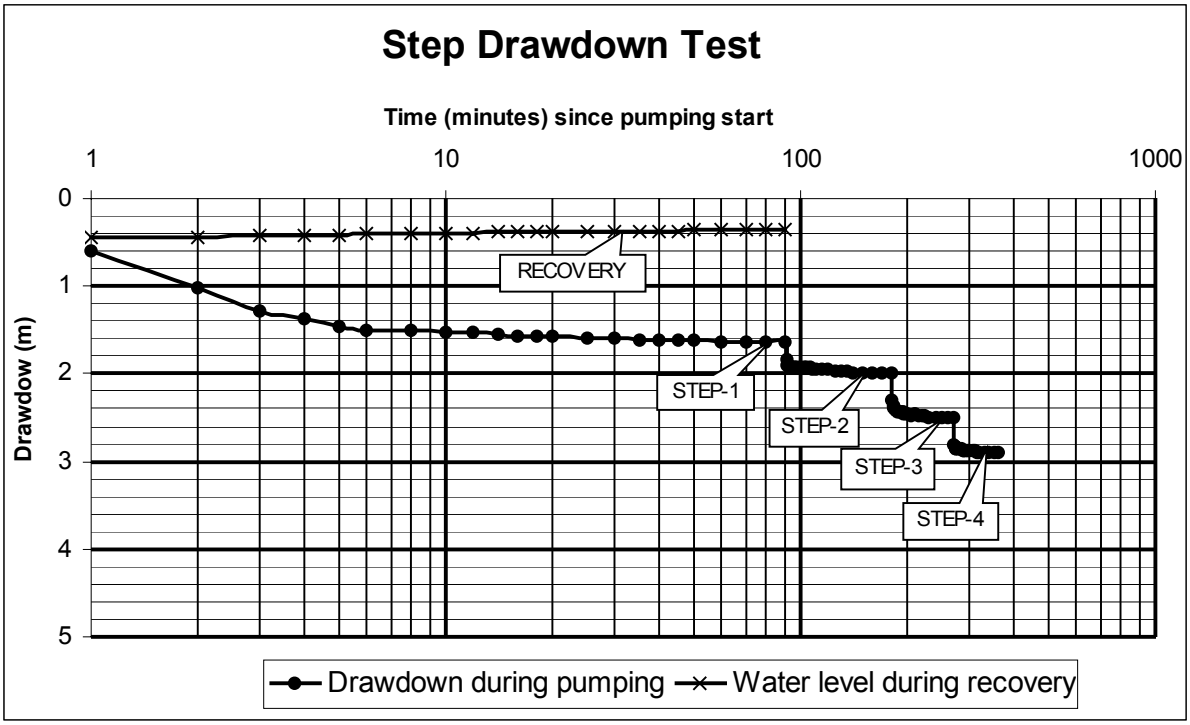


Figure-1: Time-drawdown data plot of step drawdown test.

The specific capacity of the pumping well varies from 63 to 64.91 m^3/h/m of drawdown and show small decrease in relation to drawdown even two times increasing the initial discharge. The well does not indicate any rapid deterioration in well performance produce by higher pumping rates.

The well performance graph shows specific drawdown (**Figure–2**) and head losses to total drawdown (**Figure-3**). From the specific drawdown graph, the part of the drawdown due to aquifer loss (laminar flow loss) and the part of the drawdown due to well loss (turbulent flow loss) components can be derived for every particular well discharge. In all discharge steps, the well loss components are found lower than the aquifer loss components.

It may be concluded that the losses due to turbulent flow are comparatively small. In respect to the head loss attributed to laminar flow, the pumping well was found quite efficient to aquifer response during pumping.

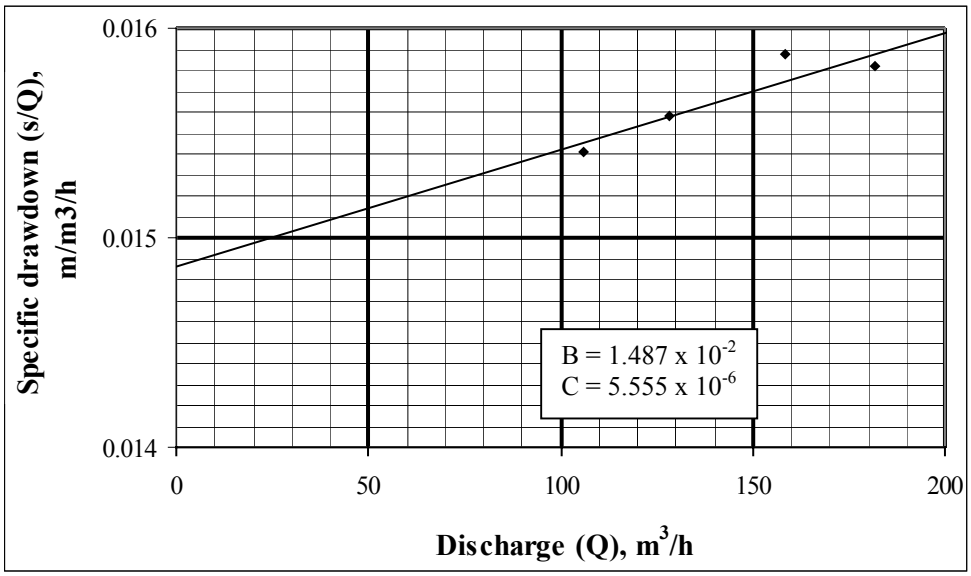


Figure-2: Specific drawdown vs discharge of pumping well.

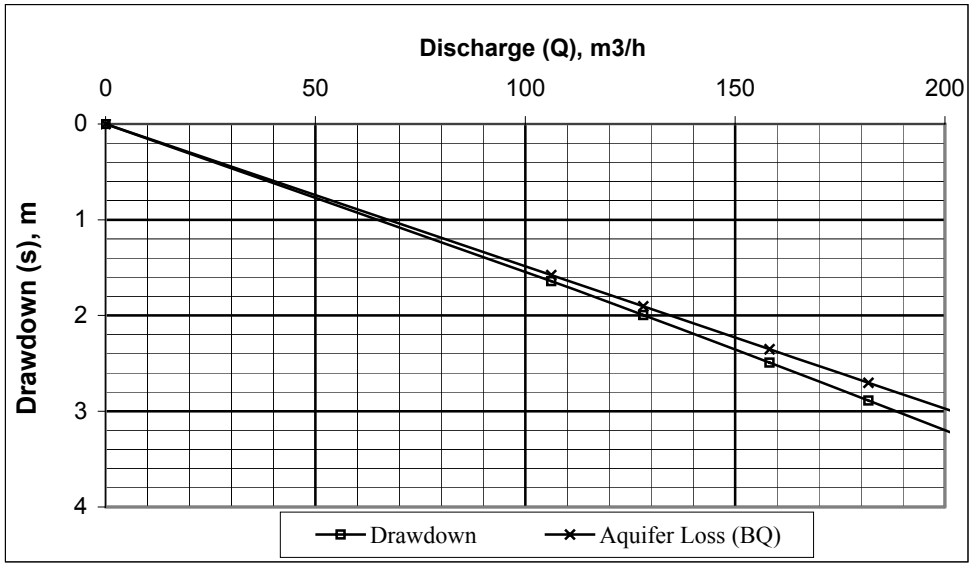


Figure-3: Head losses at different discharge steps of pumping well.

9.2 Continuous Pumping Test

The aquifer test or the continuous pumping test was carried out by pumping the PW-01 at a discharge of about **159 m^3/h** which was held constant throughout the test. A 72 hours pumping with recovery at the end of pumping were recorded from 21 to 24 September 2008. In order to derive maximum amount of information, this long term test was planned. During pumping discharge was measured by orifice meter and held constant throughout the test by monitoring water head in the piezometric tube. The discharge rate of the pumping well was so selected to produce measurable drawdown in all observation wells. During pumping, water levels in pumping well and all

observation wells were recorded by sounders from top of well casing pipe above gl.

The recording of water level data during continuous pumping test ware carried out as follows:

a) Static Water Levels (SWL) in all wells at preset time before pumping started.

b) 72 hours continuous recording of change of water levels in the pumping well and 12 observation wells at preset time intervals.

c) After stop of continuous pumping, records of recovered water levels in the pumping well and 3 nearest observation wells at preset time intervals until water levels were fully recovered.

The recorded water level data during continuous pumping and recovery are shown in **Annexure-VI**.

9.2.1 Analysis of Continuous Pumping Test Data

To obtain an overview of the nature of the cone of depression and how far the water level will affect due to continuous pumping, the recorded maximum drawdowns in all observation wells and pumping well are plotted on arithmetic graph paper **(Figure-4 to 7).**

Well ID	Distance from PW-01 (m)	Static Water Level below well head (m)	Pumping Water Level below well head (m)	Drawdown (m)
PW-01	0.00	3.520	6.100	2.580
OW-03	82.79	3.490	3.834	0.344
OW-07	203.63	2.662	2.900	0.238
OW-11	404.10	2.028	2.218	0.190

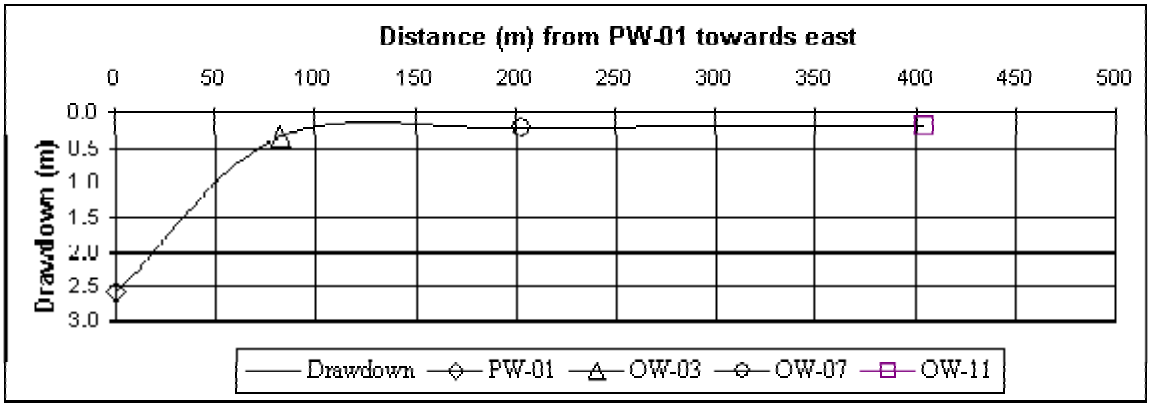


Figure-4: Two-dimensional view showing maximum drawdown with distance toward east from pumping well.

Well ID	Distance from PW-01 (m)	Static Water Level below well head (m)	Pumping Water Level below well head (m)	Drawdown (m)
PW-01	0.00	3.520	6.100	2.580
OW-04	71.51	3.780	4.115	0.335
OW-08	147.75	2.030	2.280	0.250
OW-12	374.30	2.770	2.986	0.216

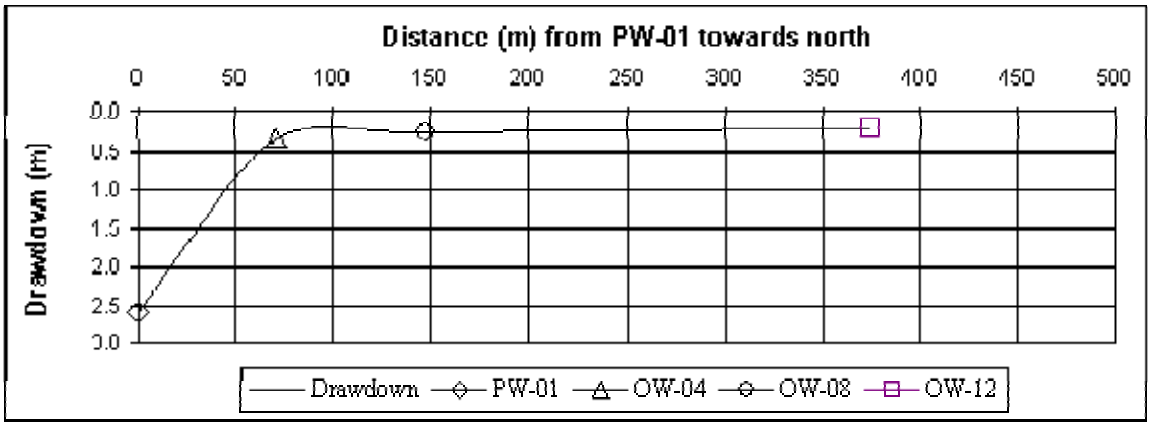


Figure-5: Two-dimensional view showing maximum drawdown with distance toward north from pumping well.

Well ID	Distance from PW-01 (m)	Static Water Level below well head (m)	Pumping Water Level below well head (m)	Drawdown (m)
PW-01	0.00	3.520	6.100	2.580
TTW/OW-01	16.98	3.890	4.520	0.630
OW-05	166.01	2.190	2.462	0.272
OW-09	390.94	1.370	1.586	0.216

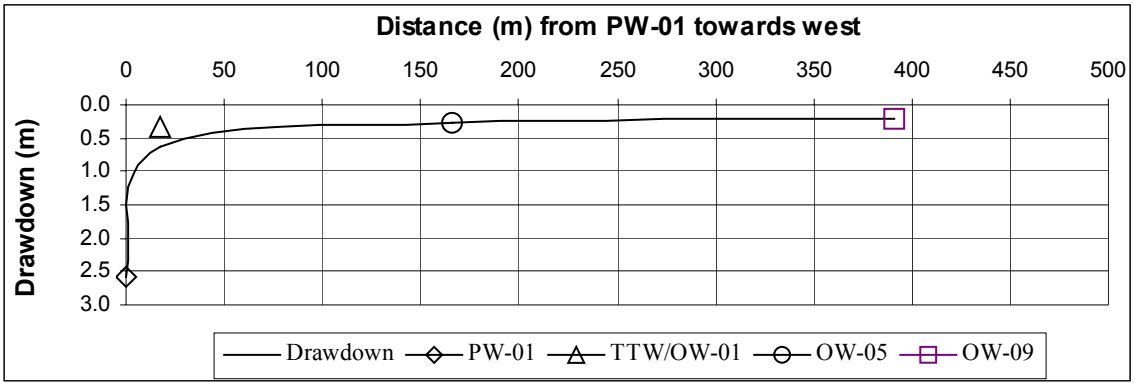


Figure-6: Two-dimensional view showing maximum drawdown with distance toward west from pumping well

Well ID	Distance from PW-01 (m)	Static Water Level below well head (m)	Pumping Water Level below well head (m)	Drawdown (m)
PW-01	0.00	3.520	6.100	2.580
OW-02	74.35	2.705	3.040	0.335
OW-06	201.90	3.600	3.962	0.362
OW-10	428.80	2.346	2.464	0.118

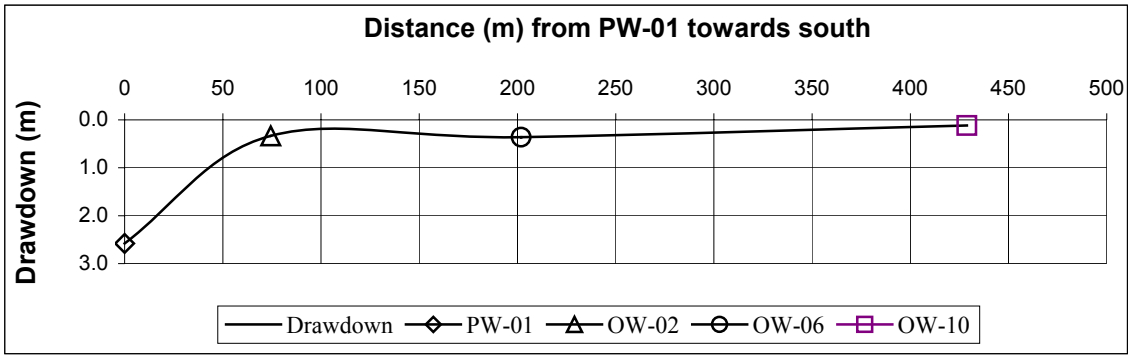


Figure-7: Two-dimensional view showing maximum drawdown with distance toward south from pumping well.

From the maximum drawdown recorded in each well, the following features about the nature of groundwater flow towards the pumping well are observed.

a) Before pumping stopped maximum drawdown in each well was recorded.

b) Drawdown curve passes through the observation wells forms the cone of depression of pumping well.

c) The recorded drawdowns at a distance of about 400m from pumping well are 0.19m towards east, 0.216m towards north, 0.216m towards west and 0.118m towards south. It indicates that the drawdown will be very minimum beyond this distance with the same rate of groundwater withdrawal.

d) Groundwater flow towards pumping well screen converges almost within about 75m from pumping well.

9.2.2 Aquifer Properties

The aquifer type and the hydraulic properties of aquifer are determined by interpretation of pump test data as recorded for pumping well and observation wells. The aquifer geometry and type of lithology can be seen from the geological cross sections. The groundwater table lies within few meters from the ground surface.

The time-drawdown curves of observation wells exhibit the characteristics of both typical S-shaped curve of unconfined aquifer and Theis-type-curve shaped of confined aquifer.

The aquifer properties determined by using Theis (1935) confined type curve matching method are given in **Table-6**.

Table-6: Estimated aquifer properties determined from pumping test data by using Theis confined curve type matching method.

Observation Well	T (m^2/d)	S	K (m/d)
OW-1	6063	0.001	60.6
OW-2	7509	0.007	75.1
OW-3	7509	0.006	75.1
OW-4	8537	0.004	85.4
OW-5	6894	0.007	68.9
OW-6	3058	0.004	30.6
OW-7	6894	0.007	68.9
OW-8	7195	0.019	72.0
OW-9	4495	0.009	45.0
OW-10	5110	0.028	51.1
OW-11	5810	0.006	58.1
OW-12	6063	0.007	60.6

Figure-8 illustrates matching of the data of observation well OW-09 for determining aquifer parameter using Theis curve matching method.

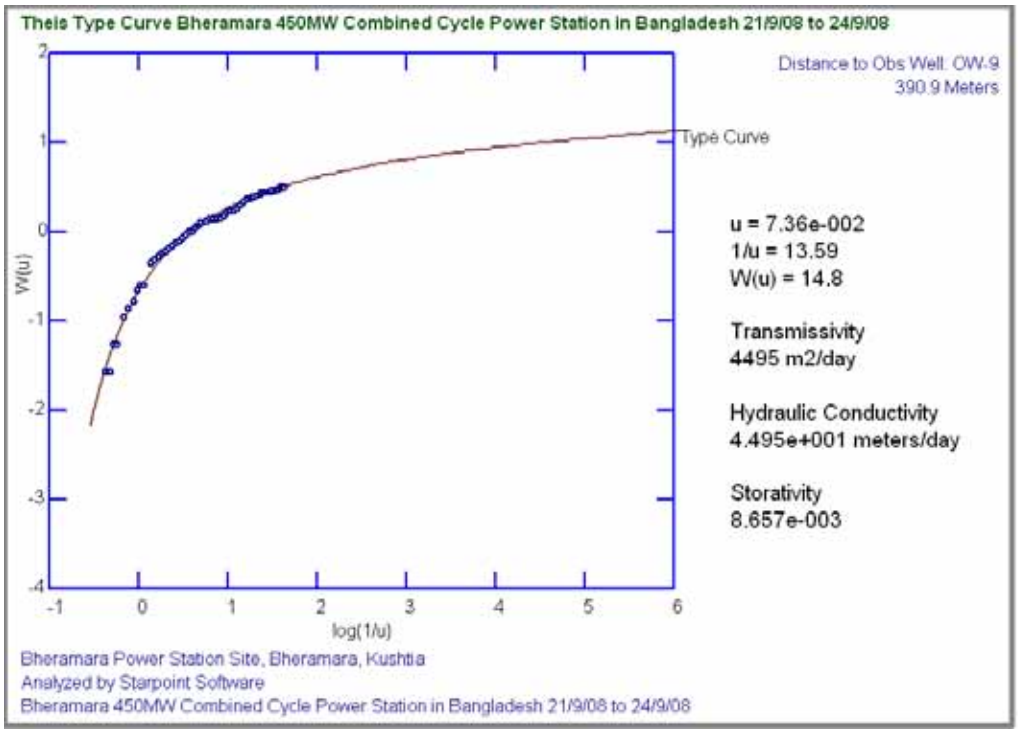


Figure-8: Time drawdown data of OW-09 matched with Theis type curve.

The aquifer properties determined by using Neumann (1972, 1974) curve matching method are given in **Table-7**. Early time-drawdown data and late time-drawdown data were matches separately.

Table-7: Estimated aquifer properties determined from pumping test data by using Neumann curve fitting method.

Obs. Well	Early				Late				Average		
	T (m^2/d)	S	Kh (m/d)	Kv (m/d)	T (m^2/d)	Sy	Kh (m/d)	Kv (m/d)	T (m^2/d)	Kh (m/d)	Kv (m/d)
OW-1	2498	0.008	25.0	8.7	2498	0.40	25.0	8.66	2498	25.0	8.7
OW-2	4929	0.005	49.2	8.9	3168	0.16	31.7	5.73	4049	15.9	7.3
OW-3	4929	0.003	49.3	7.2	3168	0.14	31.7	4.62	4049	40.5	5.9
OW-4	4605	0.003	46.1	9.0	3391	0.12	33.9	6.63	3998	40.0	7.8
OW-5	5275	0.004	52.8	7.7	4302	0.04	43.0	6.24	4789	47.9	7.0
OW-6	3755	0.003	37.6	9.2	4019	0.02	40.2	0.10	3887	38.9	4.7
OW-7	4451	0.004	44.5	4.3	4605	0.02	46.1	4.44	4528	45.3	4.4
OW-8	7667	0.011	76.7	3.5	4929	0.04	49.3	2.26	6298	63.0	2.9
OW-9	2333	0.005	23.3	6.1	4451	0.02	44.5	1.17	3392	33.9	3.6
OW-10	5275	0.022	52.8	1.2	5099	0.04	51.0	1.11	5187	51.9	1.1
OW-11	6692	0.005	66.9	4.1	4764	0.02	47.6	2.92	5728	57.3	3.5
OW-12	5841	0.005	58.4	1.7	4302	0.02	43.0	1.23	5072	50.7	1.4

The matching of the data of observation well OW-02 for determining aquifer parameter using Neumann curve matching technique is illustrated in **Figure-9.**

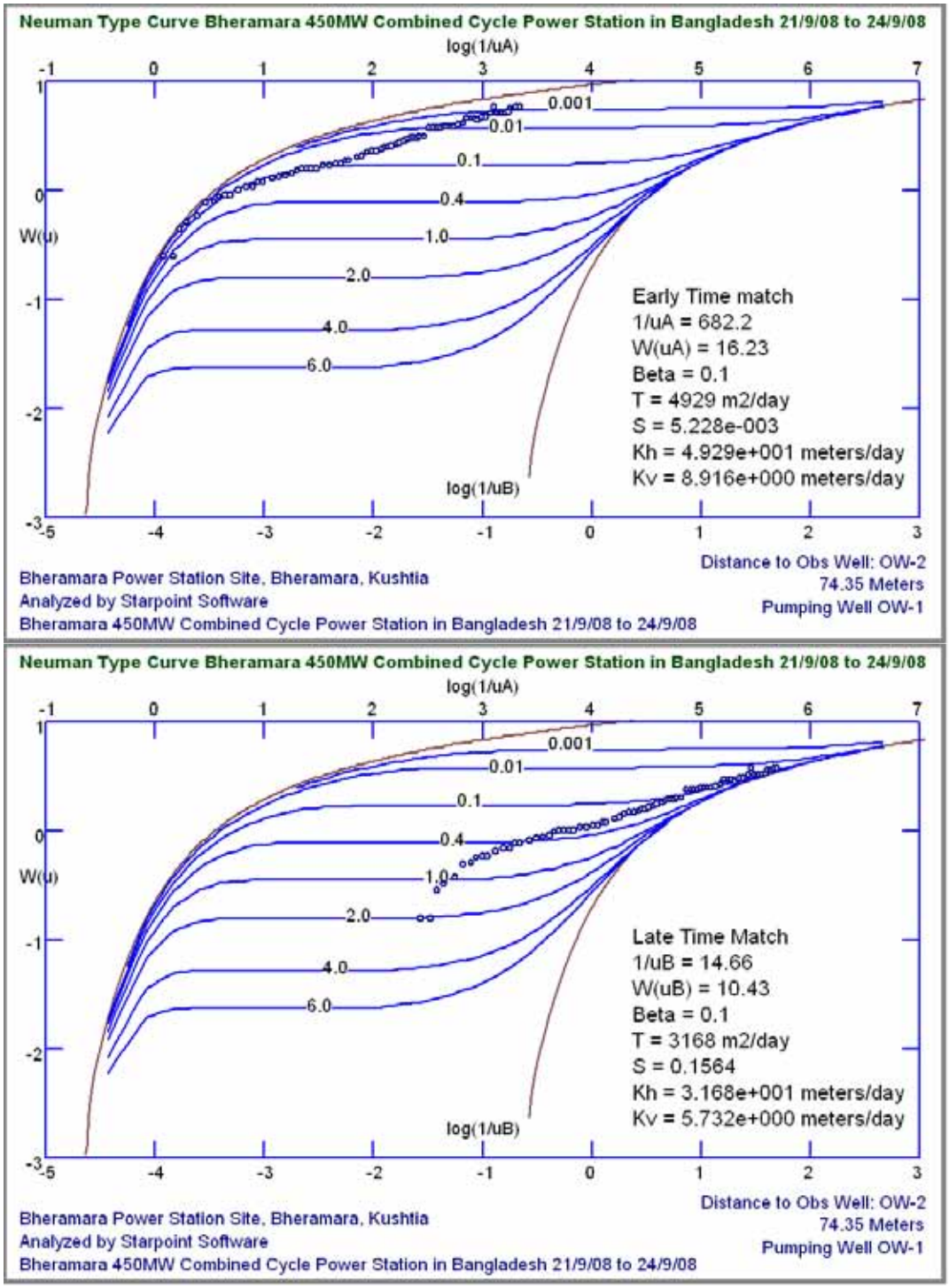


Figure-9 Analyzing time-drawdown data of OW-02 using Neumann curve matching technique.

The **table-8** shows the estimated values of aquifer properties and their average as determined from the Theis and Neumann curve matching techniques.

Table-8: Summary of aquifer propertied determined from pump test data.

Theis method	Transmissivity,T (m2/d)		Storativity, S		Hydraulic conductivity, K (m/d)	
	Varies	Average	Varies	Average	Varies	Average
	3058 - 8537	6261	0.001 - 0.028	0.009	30.6 - 85.4	62.6

Neumann method	Transmissivity,T (m2/d)		Storativity, S		Hydraulic conductivity, K_h (m/d)	
	Varies	Average	Varies	Average	Varies	Average
	2498 - 6298	4456	0.003 - 0.022	0.007	15.9 - 63.0	42.5
			Specific yield (S_y)			
			0.02 - 0.40	0.09		

The co-efficient of permeability or hydraulic conductivity (K) are calculated from grain size analysis of drilling sand samples. The average values vary from 21.51 to 24.36 m/d. These values are for washed sediment samples of the jetted wells and only a rough estimation of the aquifer permeability. Grain size analysis of aquifer materials from various depths show that the uniformity coefficient (Uc) generally ranges from 1.57 to 5.67. The Uc values of sand samples of the main part of the aquifer indicate more uniform grading of the sands. Based on the sediment classification system, the average particle size of the main aquifer part is more medium sized than that of the upper aquifer part.

10.0 Conclusions

The results of groundwater investigation carried out so far are described in different sections of the findings. The geo-hydrological information obtained from the boreholes and wells are found well consistent with the surrounding part. The depth of the aquifer as encountered in all drillings may be more extended vertically as the depth could not be defined.

The wells constructed for the investigation are found efficient in response to aquifer pumping. The drawdowns recorded in pumping well and observation wells are found small in terms of pumping well discharge. This is also reflected in well specific capacity of pumping well at different pumping rates.

The aquifer properties determined from the recorded pump test data analysis are the estimation of different aquifer parameters. The obtained values are found well acceptable for the study area. But these values largely depend on the effective thickness of the aquifer.

ANNEXURE

ANNEXURE-I

WELL LAYOUT, TOPOMAP WITH WELL LOCATION, PHYSIOGRAPHY OF BANGLADESH

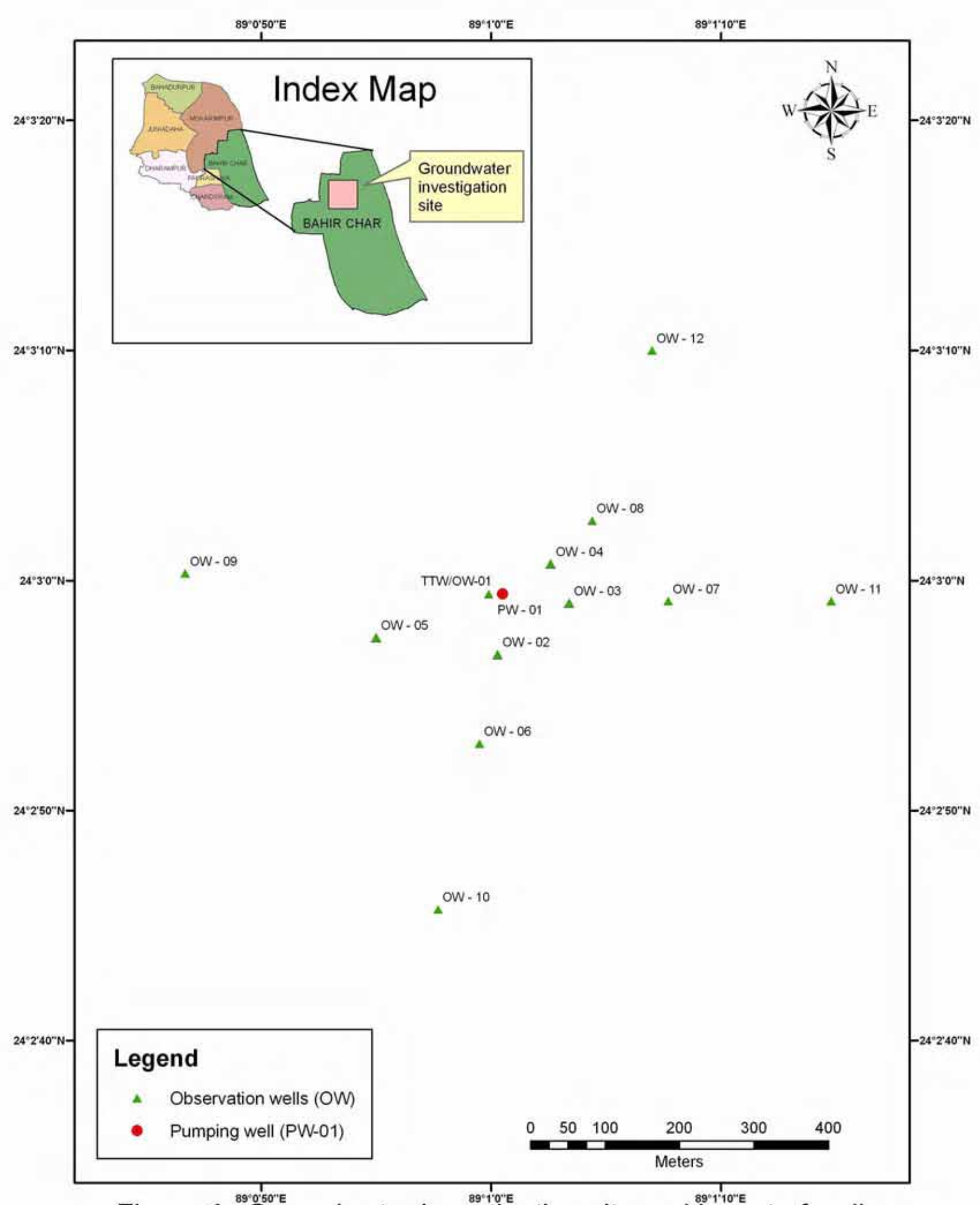
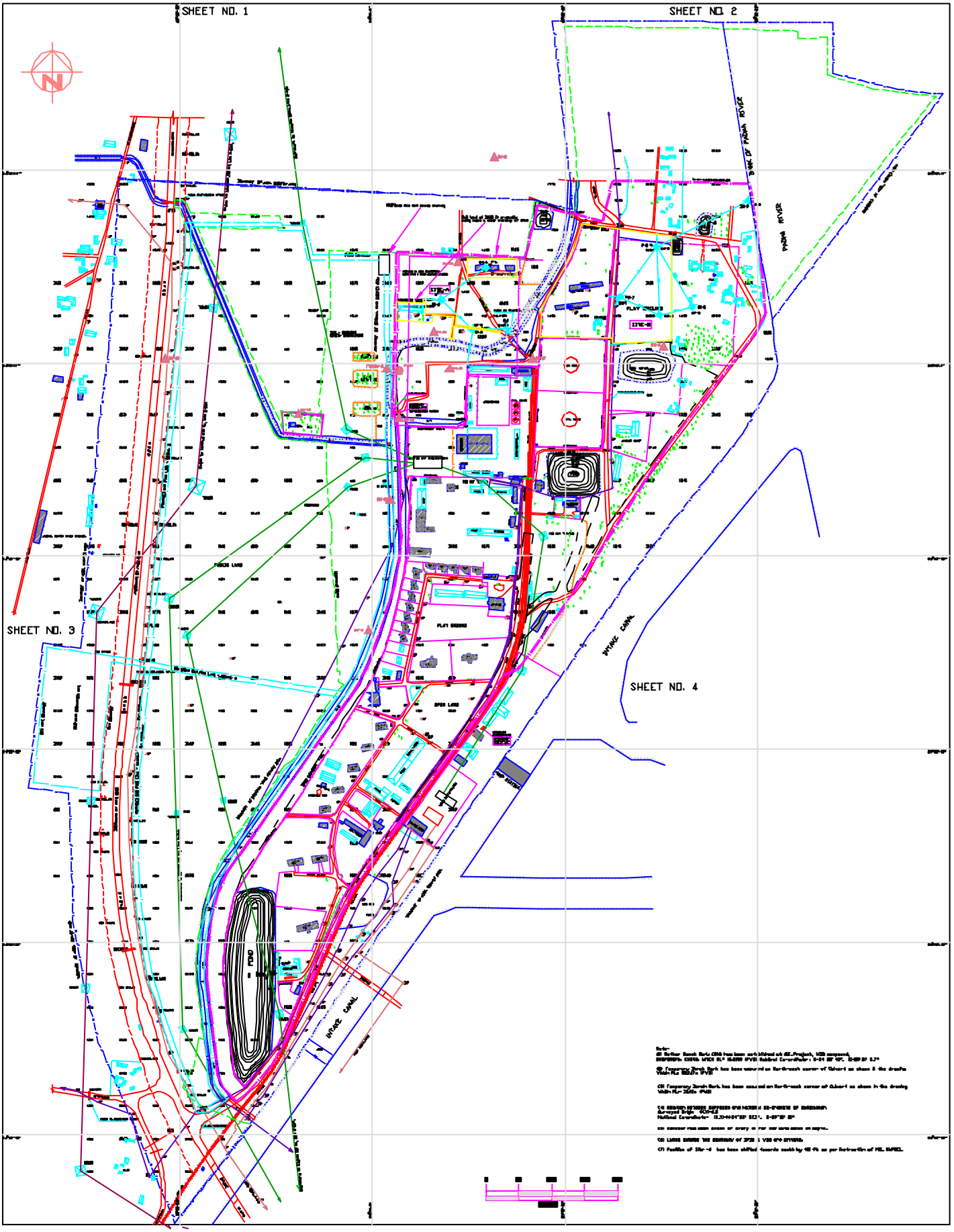


Figure-1 : Groundwater investigation site and layout of wells



CONSULTANT	TOKYO ELECTRIC POWER SERVICES CO. LTD.		NORTH WEST POWER GENERATION COMPANY LTD. (NWPGCL)
LEGAL ASSISTANT	ENGINEERING ASSOCIATES LTD.		PROJECT NAME: JICA STUDY ON ASHUGANJ SHAHJIBAZAR COMBINED CYCLE POWER STATION
			TITLE: TOPOGRAPHIC MAP OF SHAHJIBAZAR POWER STATION AREA (KEY MAP)

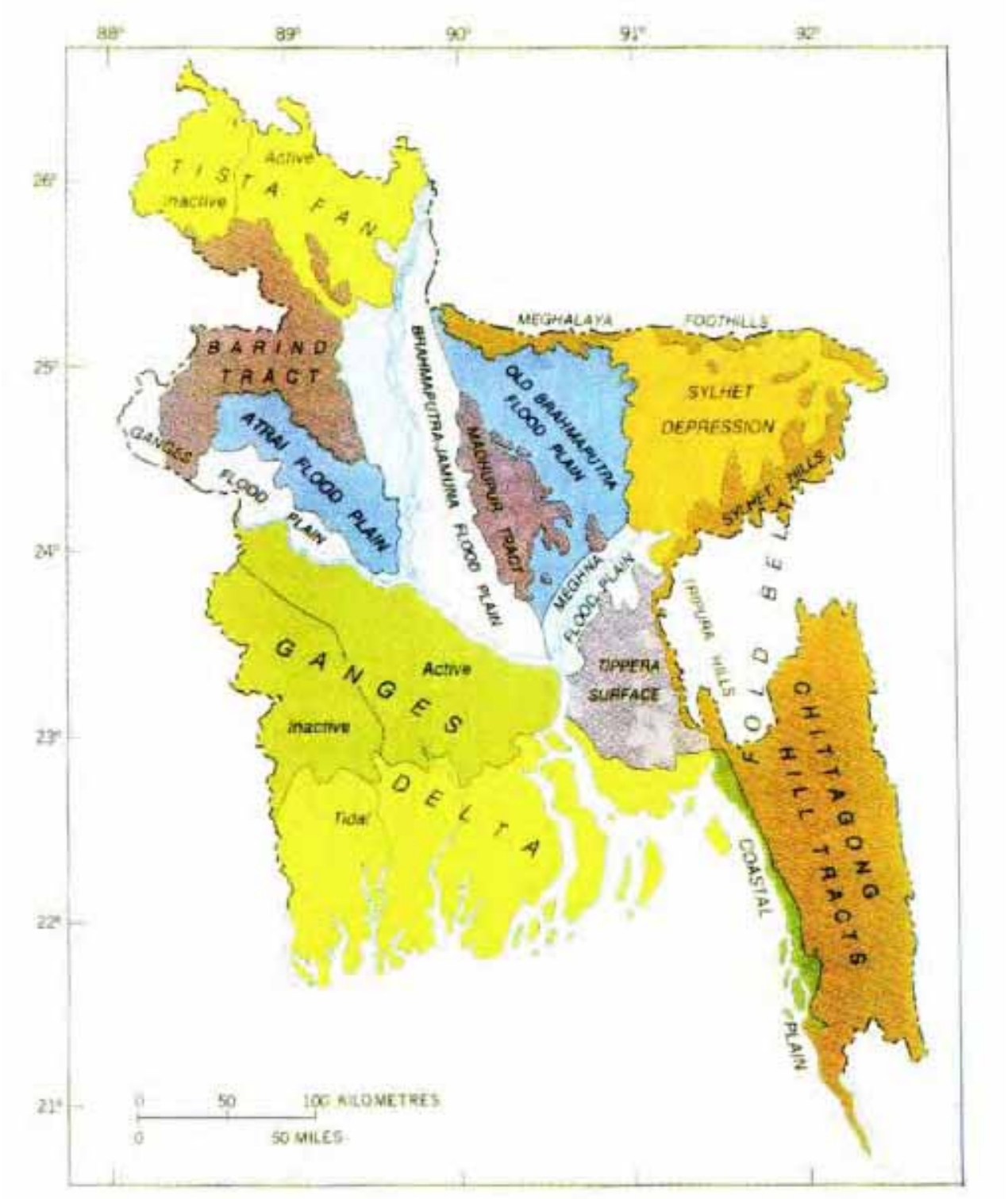


Figure 3: Physiographic divisions of Bangladesh.

ANNEXURE-II

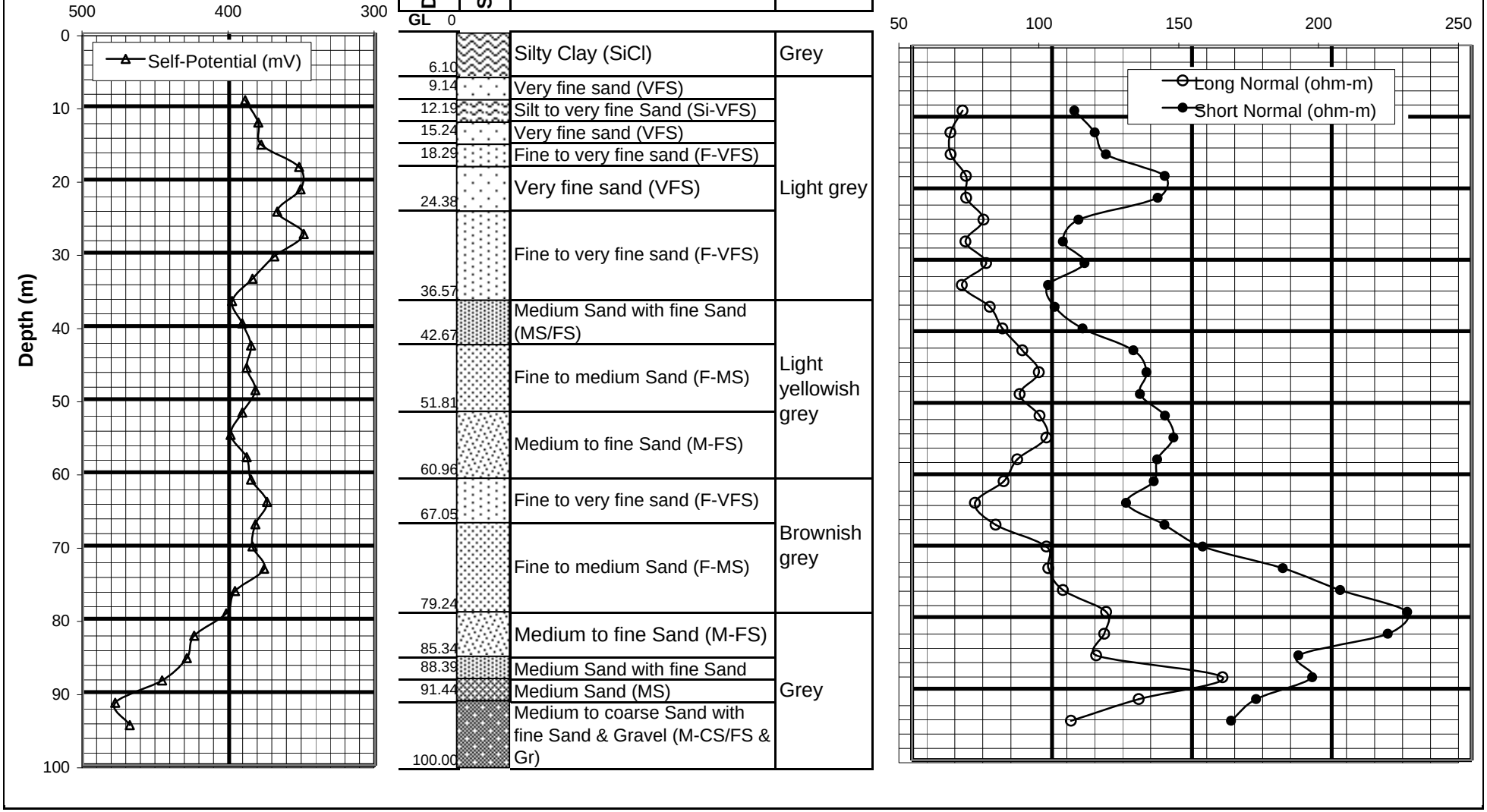
BORELOG, ELECTRIC LOG & DATA AND GRAIN SIZE ANALYSIS OF TTW/OW-01

ANNEXURE - II

Figure-1 Borehole Geo-electrical Log of TTW/OW-1

Borehole Electrical Log

Work: Geo-electrical logging of borehole TTW/OW-01 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}00'59.9? N24^{0}02'59.4? (16m west of PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 24 August 2008** **Date of logging: 24 August 2008**	**Logging done by: DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



Depth (m)	Symbol	Lithology	Colour
GL 0			
6.10		Silty Clay (SiCl)	Grey
9.14		Very fine sand (VFS)	Light grey
12.19		Silt to very fine Sand (Si-VFS)	
15.24		Very fine sand (VFS)	
18.29		Fine to very fine sand (F-VFS)	
24.38		Very fine sand (VFS)	
36.57		Fine to very fine sand (F-VFS)	
42.67		Medium Sand with fine Sand (MS/FS)	Light yellowish grey
51.81		Fine to medium Sand (F-MS)	
60.96		Medium to fine Sand (M-FS)	
67.05		Fine to very fine sand (F-VFS)	Brownish grey
79.24		Fine to medium Sand (F-MS)	
85.34		Medium to fine Sand (M-FS)	Grey
88.39		Medium Sand with fine Sand	
91.44		Medium Sand (MS)	
100.00		Medium to coarse Sand with fine Sand & Gravel (M-CS/FS & Gr)	

ANNEXURE - II

Table-1: Borehole Geo-electrical Logging data of OW-01

Work: Geo-electrical logging of borehole TTW/OW-01
Project: Bheramara 450 MW CC Power Plant
Location: E 89^{0}00'59.9? N 24^{0}02'59.4? (16m west of PW)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 24 August 2008

Borehole Electrical Logging Data

Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Silty Clay (SiCl)	Grey	3.05			
		6.10			
Very fine sand (VFS)	Light grey	9.15	389.00	68.10	108.00
Silt to very fine Sand (Si-VFS)		12.20	380.00	63.70	115.30
Very fine sand (VFS)		15.24	378.00	63.80	119.30
Fine to very fine sand (F-VFS)		18.29	352.00	69.30	140.30
Very fine sand (VFS)		21.34	351.00	69.40	137.80
		24.39	367.00	75.50	109.50
Fine to very fine sand (F-VFS)		27.44	349.00	69.10	103.90
		30.49	369.00	76.50	111.70
		33.54	384.00	67.80	98.60
		36.59	398.00	77.80	101.00
Medium Sand with fine Sand (MS/FS)	Light yellowish grey	39.63	391.00	82.30	111.00
		42.68	385.00	89.40	129.10
Fine to medium Sand (F-MS)		45.73	388.00	95.30	133.80
		48.78	382.00	88.50	131.50
		51.83	391.00	95.60	140.40
Medium to fine Sand (M-FS)		54.88	399.00	98.00	143.40
		57.93	388.00	87.60	137.60
		60.98	385.00	82.70	136.40
Fine to very fine sand (F-VFS)	Brownish grey	64.02	374.00	72.50	126.50
		67.07	382.00	79.90	140.20
Fine to medium Sand (F-MS)		70.12	384.00	98.00	153.90
		73.17	376.00	98.70	182.50
		76.22	396.00	103.90	203.00
		79.27	402.00	119.40	227.00
Medium to fine Sand (M-FS)	Grey	82.32	424.00	118.70	220.00
		85.37	429.00	115.80	188.10
Medium Sand with fine Sand		88.41	446.00	161.00	193.00
Medium Sand (MS)		91.46	478.00	131.00	173.00
Medium to Coarse Sand with Fine Sand & Gravel		94.51	468.00	106.80	164.00
		97.56			
		100.00			

Annexure-II

Figure-2: Borehole and well information of TTW/OW-1

Borelog, Well fixture and Water Quality

Work: Drilling and well fixture installation of TTW/OW-01
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9? N24^{0}02'59.4? (16m west of PW-01)
Drilling completion: 22 to 24 August 2008

Depth (m)	Symbol	Lithology	Colour	Well fixture
GL 0				0.305m GL
6.09		Silty Clay (SiCl)	Grey	
9.14		Very fine sand (VFS)	Light grey	
12.19		Silt to very fine Sand (Si-VFS)		
15.24		Very fine sand (VFS)		
18.29		Fine to very fine sand (F-VFS)		
24.39		Very fine sand (VFS)		
36.58		Fine to very fine sand (F-VFS)		
42.68		Medium Sand with fine Sand (MS/FS)	Light yellowish grey	
51.82		Fine to medium Sand (F-MS)		
60.97		Medium to fine Sand (M-FS)		
67.07		Fine to very fine sand (F-VFS)	Brownish grey	
79.26		Fine to medium Sand (F-MS)		80.95m
85.36		Medium to fine Sand (M-FS)	Grey	84.00m Screen
88.41		Medium Sand with fine Sand (MS/FS)		85.52m
91.46		Medium Sand (MS)		
100.00		Medium to Coarse Sand with Fine Sand & Gravel		

Temperature (T): 30.6^{0}C

Electric Conductivity (EC): 470 µS/cm

Total Dissolved Solid (TDS): 230 mg/l

Iron (Fe): 1.80 mg/l

Discharge: 36 l/m

Drill hole diameter: 108mm
Well diameter: 38 mm
Well fixture material: PVC with GI at top Well screen: PVC (Robo) screen

Annexure-II

Summary of grain size analysis of TTW/OW-01

Work: Summary analysis of sand samples of TTW/OW-01
Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

SUMMARY OF GRAIN SIZE ANALYSIS

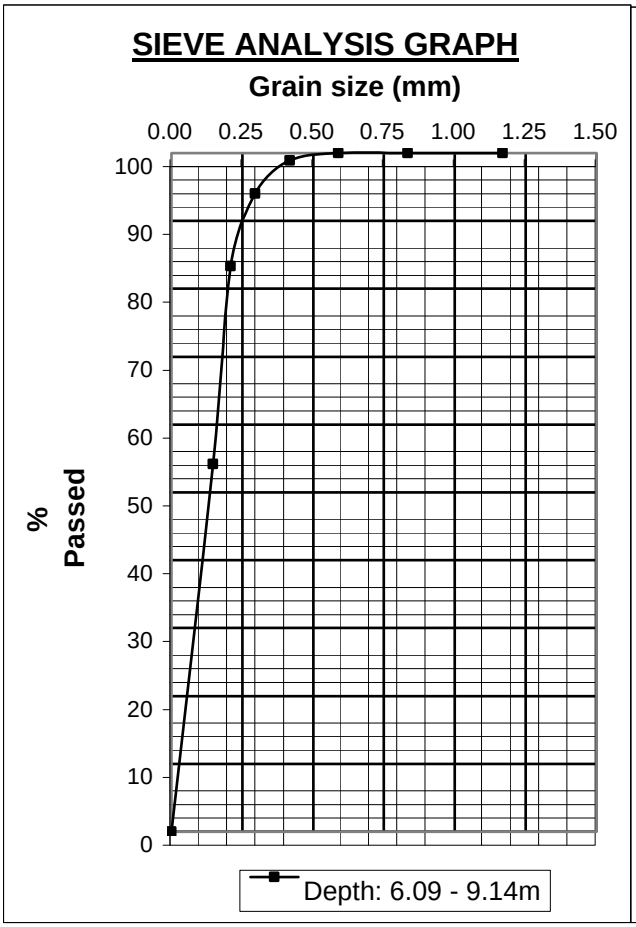
Depth (m)	Thickness (m)	Average Sand Size	Particle size dia. in mm				Uniformity coefficient (Uc)	Sorting by size	Fineness modulus (F)	Particle size (%)		
			D_{10}	D_{30}	D_{50}	D_{60}				Fine sand	Medium sand	Coarse sand
0.00 - 6.09	6.10	Silty Clay										
6.09 - 9.14	3.05	Very fine Sand	0.03	0.08	0.14	0.16	5.33	Unsorted formation	0.52	90	10	--
9.14 - 12.19	3.05	Silt-Very Fine Sand										
12.19 - 15.24	3.05	Very fine Sand	0.03	0.10	0.15	0.17	5.62	Unsorted formation	0.62	87	13	--
15.24 - 18.29	3.05	Fine to very fine Sand	0.05	0.14	0.18	0.19	3.80		0.76	84	16	--
18.29 - 24.39	6.10	Very fine Sand	0.03	0.10	0.15	0.17	5.67		0.62	87	13	--
24.39 - 36.58	12.20	Fine to very fine Sand	0.06	0.15	0.18	0.19	3.17		0.79	66	34	--
36.58 - 42.68	6.10	Medium Sand with fine Sand	0.20	0.27	0.34	0.38	1.90	Sorted formation	1.68	22	62	16
42.68 - 51.82	9.15	Fine to medium Sand	0.18	0.24	0.29	0.32	1.78		1.46	32	60	8
51.82 - 60.97	9.15	Medium to fine Sand	0.19	0.27	0.32	0.35	1.84		1.58	12	82	6
60.97 - 67.07	6.10	Fine to very fine Sand	0.09	0.17	0.20	0.22	2.44		0.31	75	25	--
67.07 - 79.26	12.20	Fine to medium Sand	0.21	0.26	0.31	0.33	1.57		1.52	25	70	5
79.26 - 85.36	6.10	Medium to fine Sand	0.19	0.27	0.31	0.34	1.79		1.58	25	70	5
85.36 - 88.41	3.05	Medium sand with fine Sand	0.21	0.26	0.31	0.33	1.57		1.52	28	68	4
88.41 - 91.46	3.05	Medium Sand	0.20	0.29	0.36	0.40	2.00		1.73	20	60	20
91.46 - 100.00	8.54	Medium to coarse Sand with fine Sand & Gravel	0.21	0.37	0.48	0.51	2.43		2.10	12	43	45
Total:	100.00											

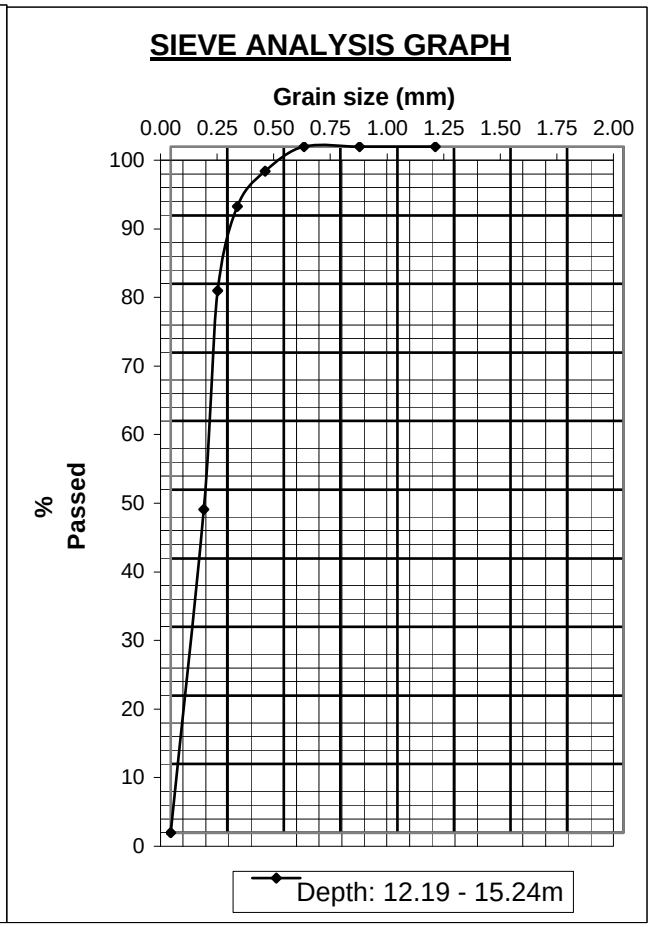
Annexure-II
Analysis of sand samples of TTW/OW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: TTW/OW-01 Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 6.09 - 9.14m				Depth: 12.19 - 15.24m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
20	**0.833**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
30	**0.589**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
40	**0.417**	0.37	1.11	1.11	**98.89**	1.23	3.55	3.55	**96.45**
50	**0.295**	1.62	4.84	5.95	**94.05**	1.78	5.13	8.68	**91.32**
70	**0.208**	3.59	10.73	16.67	**83.33**	4.28	12.34	21.02	**78.98**
100	**0.147**	9.77	29.19	45.86	**54.14**	11.04	31.83	52.85	**47.15**
Pan	**0.000**	18.12	54.14	100.00	**0.00**	16.35	47.15	100.00	**0.00**
Total		33.47	100.00			34.68	100.00		



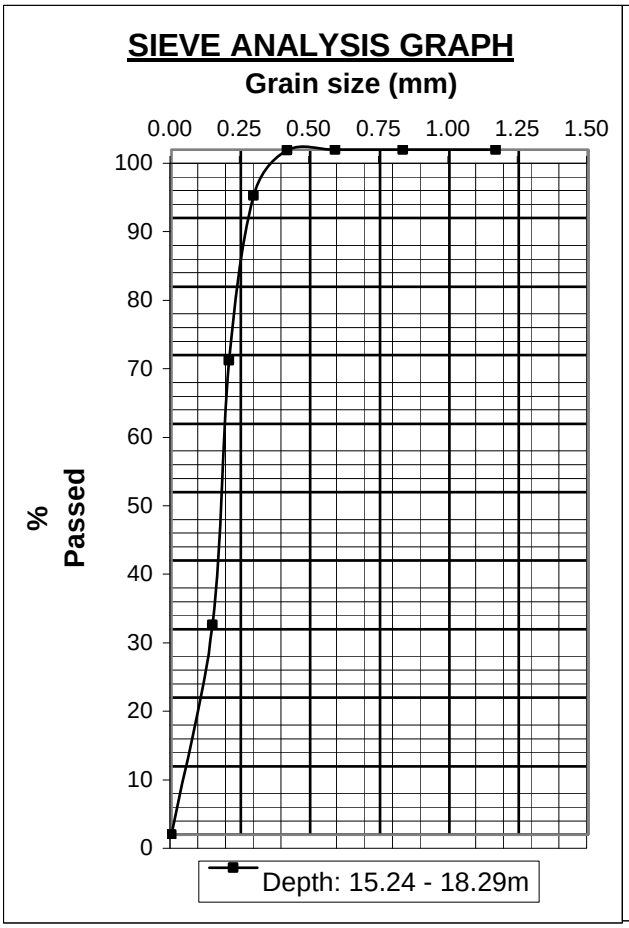


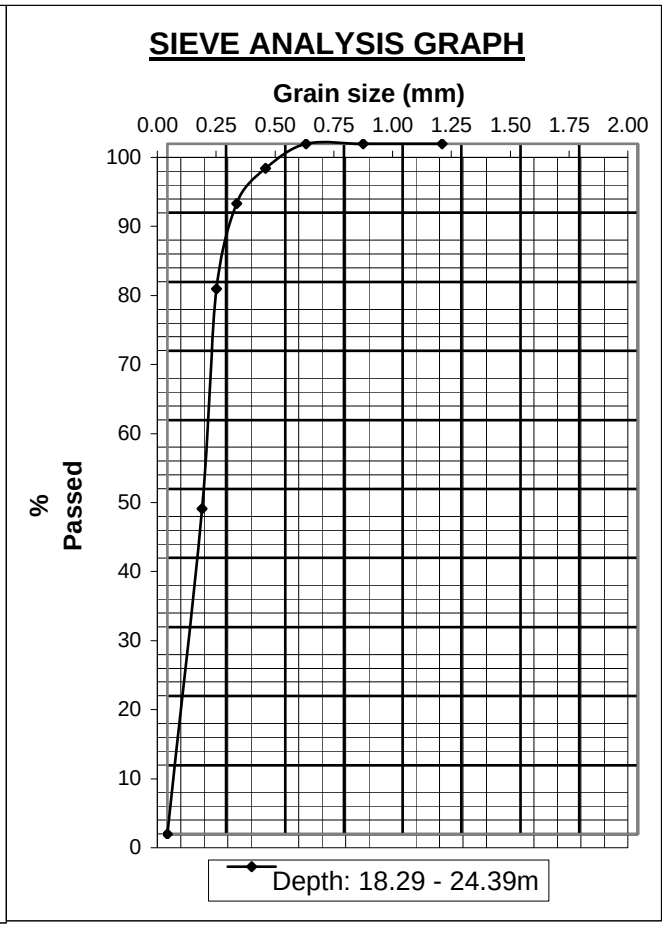
Annexure-II
Analysis of sand samples of TTW/OW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: TTW/OW-01 Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 15.24 - 18.29m				Depth: 18.29 - 24.39m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
20	**0.833**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
30	**0.589**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
40	**0.417**	0.06	0.11	0.11	**99.89**	1.23	3.55	3.55	**96.45**
50	**0.295**	3.45	6.58	6.70	**93.30**	1.78	5.13	8.68	**91.32**
70	**0.208**	12.62	24.08	30.78	**69.22**	4.28	12.34	21.02	**78.98**
100	**0.147**	20.23	38.60	69.38	**30.62**	11.04	31.83	52.85	**47.15**
Pan	**0.000**	16.05	30.62	100.00	**0.00**	16.35	47.15	100.00	**0.00**
Total		52.41	100.00			34.68	100.00		



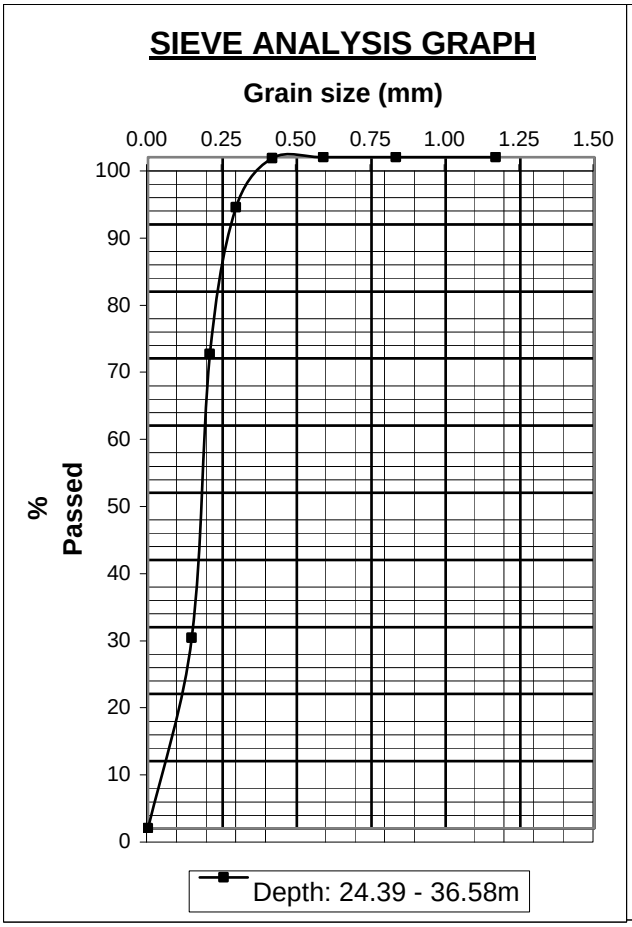


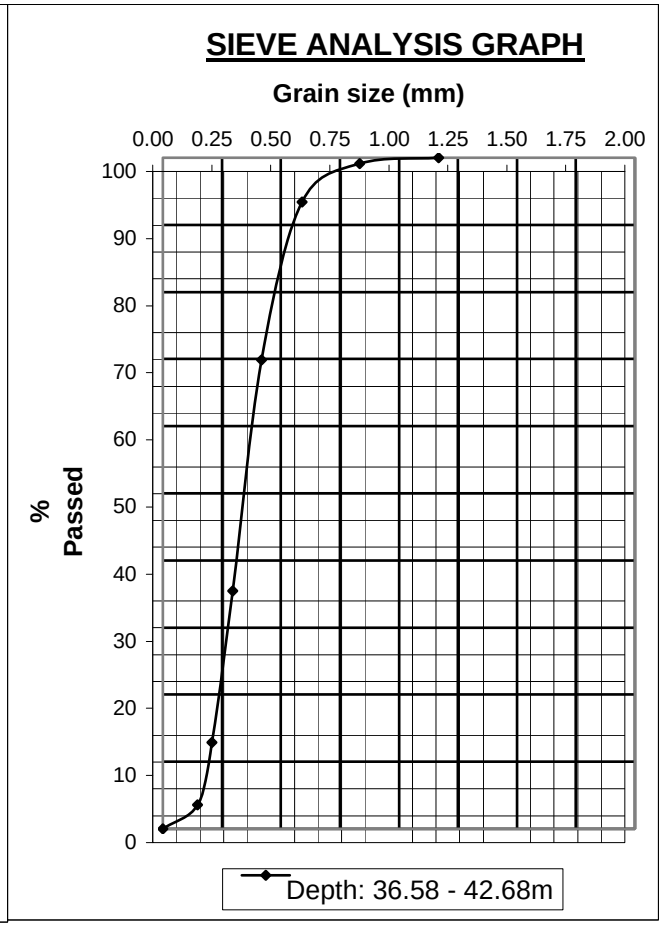
Annexure-II
Analysis of sand samples of TTW/OW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: TTW/OW-01 Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 24.39 - 36.58m				Depth: 36.58 - 42.68m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
20	**0.833**	0.00	0.00	0.00	**100.00**	0.49	0.86	0.86	**99.14**
30	**0.589**	0.00	0.00	0.00	**100.00**	3.76	6.63	7.49	**93.37**
40	**0.417**	0.08	0.15	0.15	**99.85**	12.83	22.62	30.11	**69.89**
50	**0.295**	4.04	7.36	7.51	**92.49**	19.55	34.46	64.57	**35.43**
70	**0.208**	11.96	21.80	29.31	**70.69**	12.78	22.53	87.10	**12.90**
100	**0.147**	23.20	42.29	71.60	**28.40**	5.27	9.29	96.39	**3.61**
Pan	**0.000**	15.58	28.40	100.00	**0.00**	2.05	3.61	100.00	**0.00**
Total		54.86	100.00			56.73	100.00		



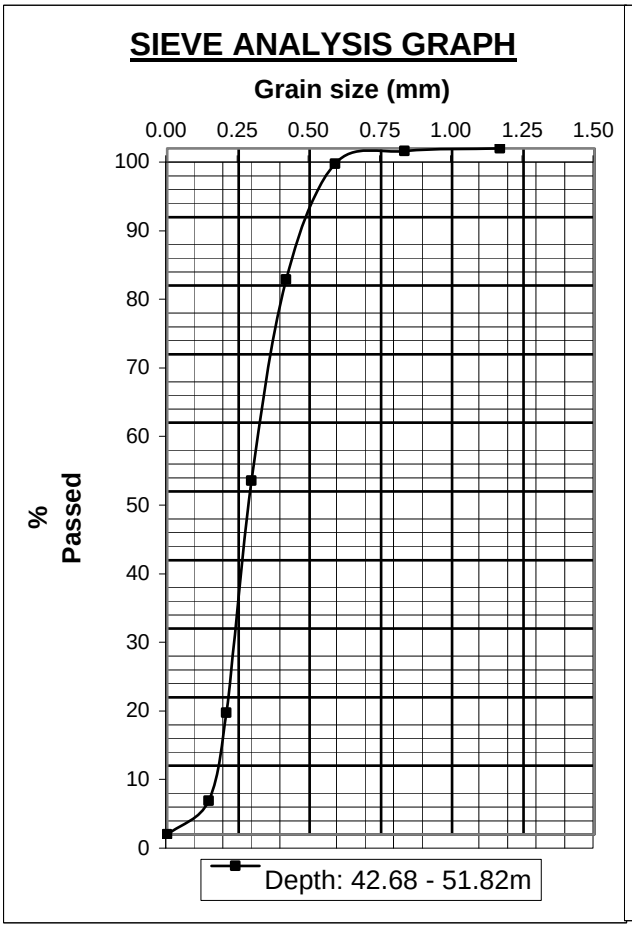


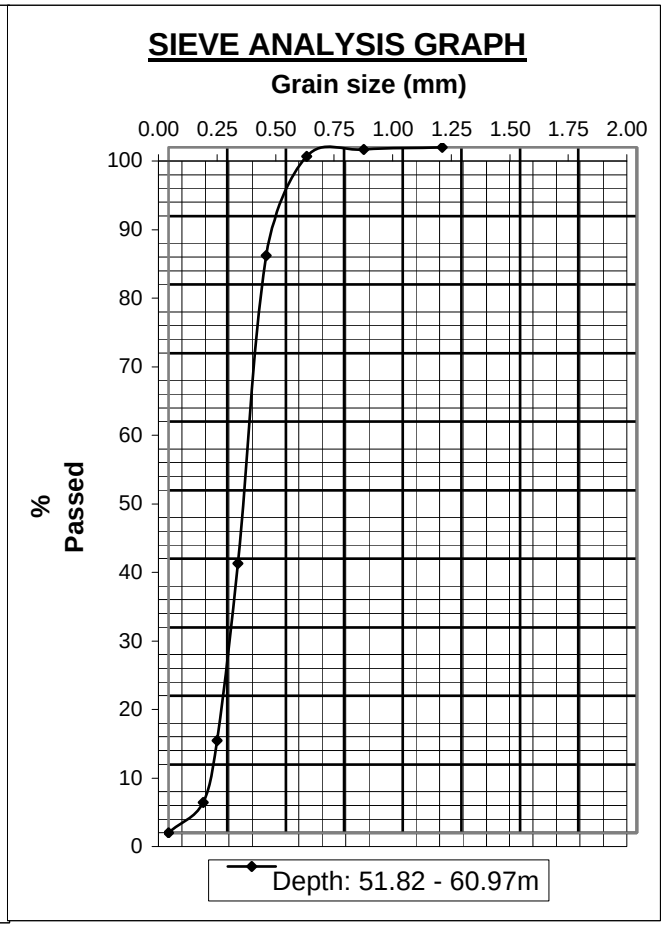
Annexure-II
Analysis of sand samples of TTW/OW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: TTW/OW-01 Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 42.68 - 51.82m				Depth: 51.82 - 60.97m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
20	**0.833**	0.19	0.38	0.38	**99.62**	0.20	0.28	0.28	**99.72**
30	**0.589**	1.14	2.27	2.65	**97.73**	0.93	1.32	1.61	**98.68**
40	**0.417**	8.29	16.52	19.17	**80.83**	9.97	14.17	15.78	**84.22**
50	**0.295**	14.71	29.31	48.48	**51.52**	31.63	44.95	60.73	**39.27**
70	**0.208**	16.98	33.83	82.31	**17.69**	18.15	25.80	86.53	**13.47**
100	**0.147**	6.42	12.79	95.10	**4.90**	6.37	9.05	95.58	**4.42**
Pan	**0.000**	2.46	4.90	100.00	**0.00**	3.11	4.42	100.00	**0.00**
Total		50.19	100.00			70.36	100.00		





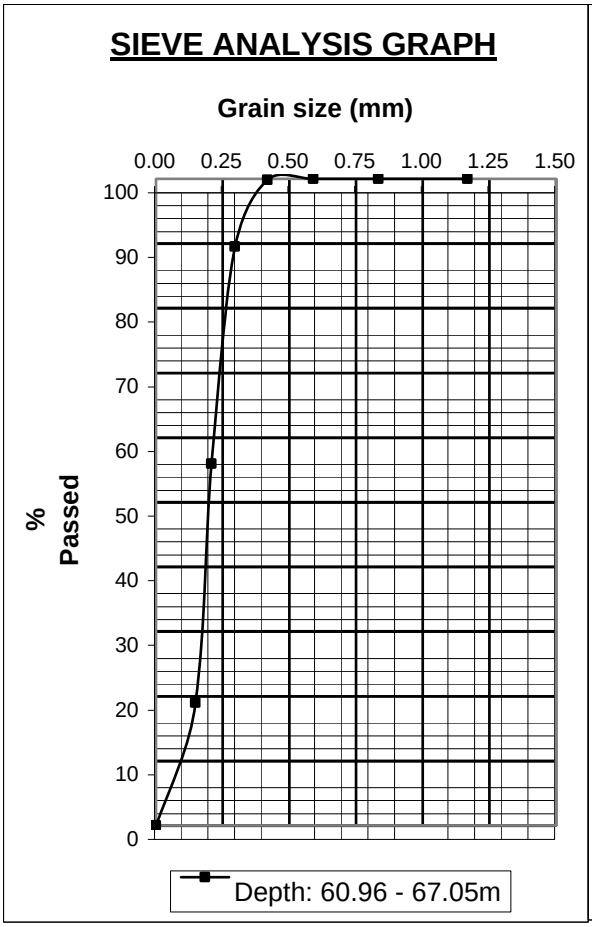
Annexure-II (6 of 9)
Analysis of sand samples of TTW/OW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: TTW/OW-01 Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

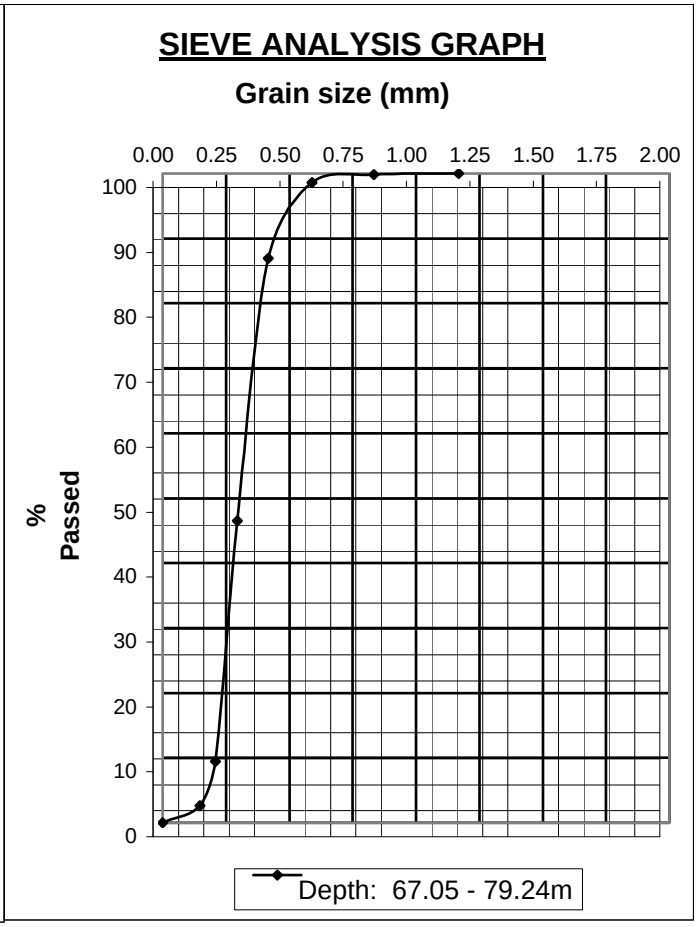
SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 60.96 - 67.05m				Depth: 67.05 - 79.24m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
20	**0.833**	0.00	0.00	0.00	**100.00**	0.12	0.15	0.15	**99.85**
30	**0.589**	0.00	0.00	0.00	**100.00**	1.11	1.43	1.59	**98.57**
40	**0.417**	0.09	0.14	0.14	**99.86**	8.91	11.50	13.09	**86.91**
50	**0.295**	6.87	10.33	10.47	**89.53**	31.30	40.40	53.49	**46.51**
70	**0.208**	22.34	33.60	44.07	**55.93**	28.71	37.06	90.55	**9.45**
100	**0.147**	24.56	36.94	81.00	**19.00**	5.27	6.80	97.35	**2.65**
Pan	**0.000**	12.63	19.00	100.00	**0.00**	2.05	2.65	100.00	**0.00**
Total		66.49	100.00			77.47	100.00		

SIEVE ANALYSIS GRAPH



SIEVE ANALYSIS GRAPH

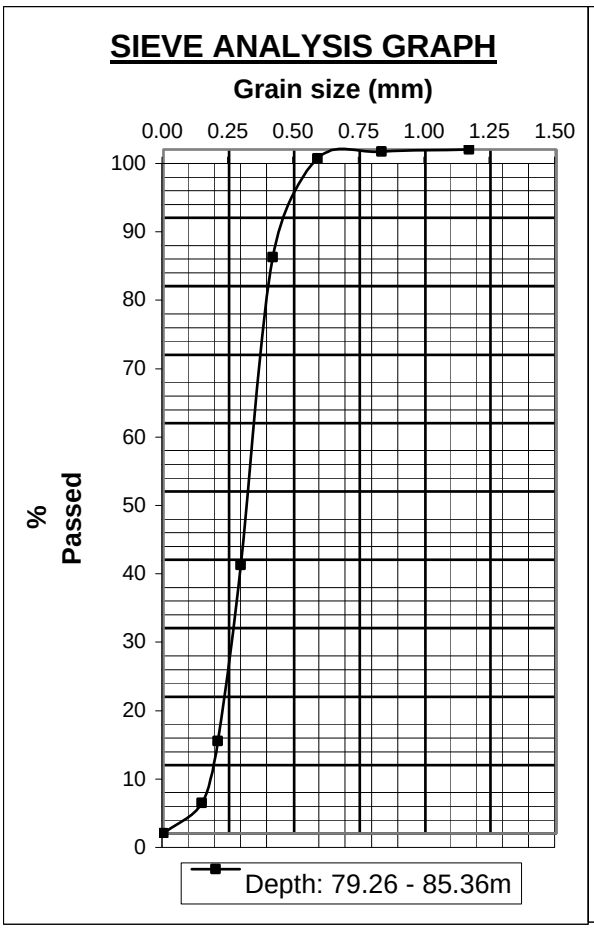


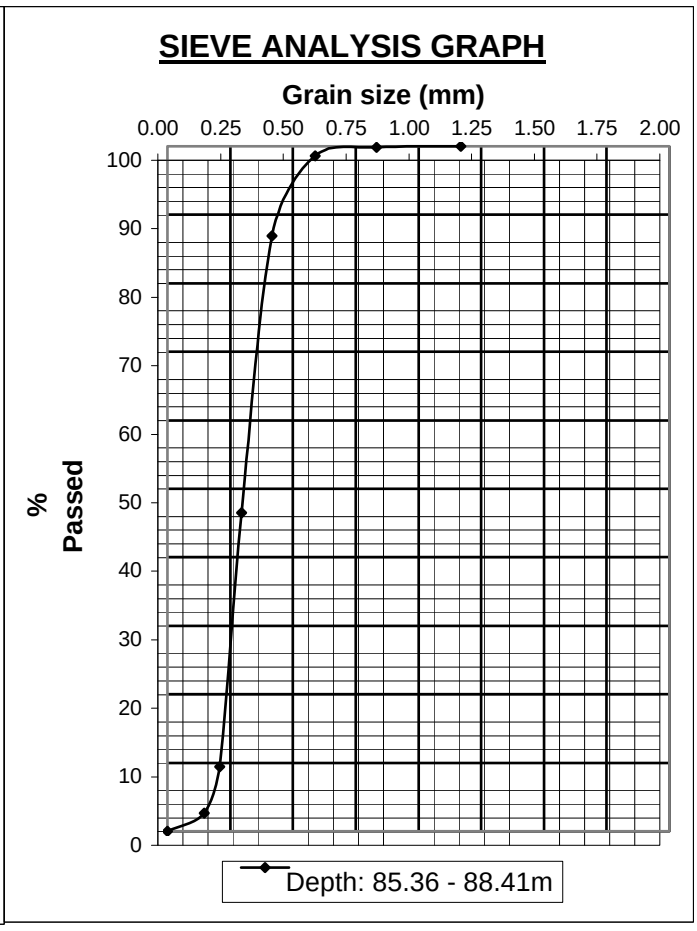
Annexure-II (7 of 9)
Analysis of sand samples of TTW/OW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: TTW/OW-01 Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 79.26 - 85.36m				Depth: 85.36 - 88.41m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	0.00	0.00	0.00	**100.00**
20	**0.833**	0.20	0.28	0.28	**99.72**	0.12	0.15	0.15	**99.85**
30	**0.589**	0.93	1.32	1.61	**98.68**	1.11	1.43	1.59	**98.57**
40	**0.417**	9.97	14.17	15.78	**84.22**	8.91	11.50	13.09	**86.91**
50	**0.295**	31.63	44.95	60.73	**39.27**	31.30	40.40	53.49	**46.51**
70	**0.208**	18.15	25.80	86.53	**13.47**	28.71	37.06	90.55	**9.45**
100	**0.147**	6.37	9.05	95.58	**4.42**	5.27	6.80	97.35	**2.65**
Pan	**0.000**	3.11	4.42	100.00	**0.00**	2.05	2.65	100.00	**0.00**
Total		70.36	100.00			77.47	100.00		



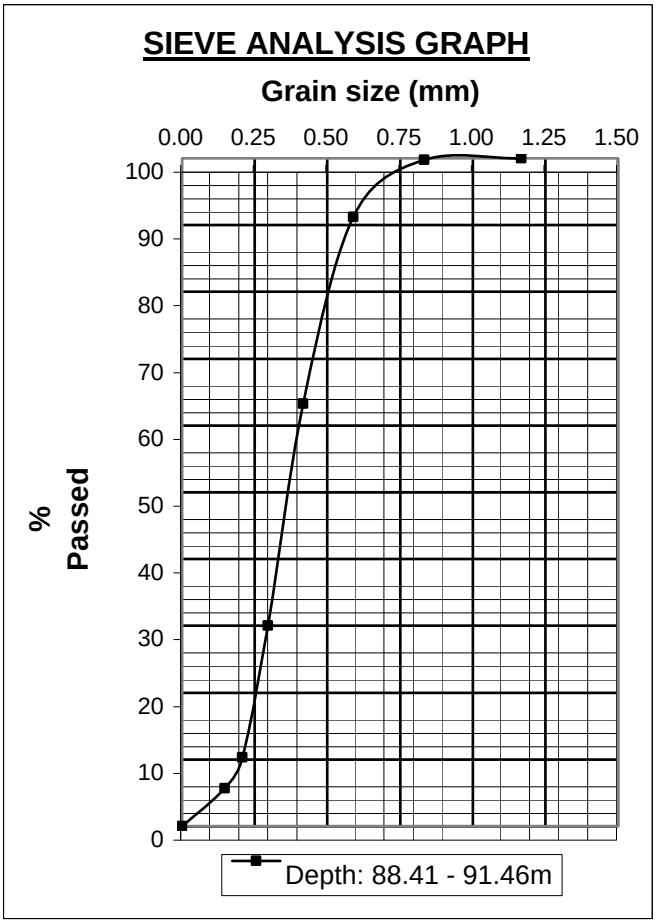


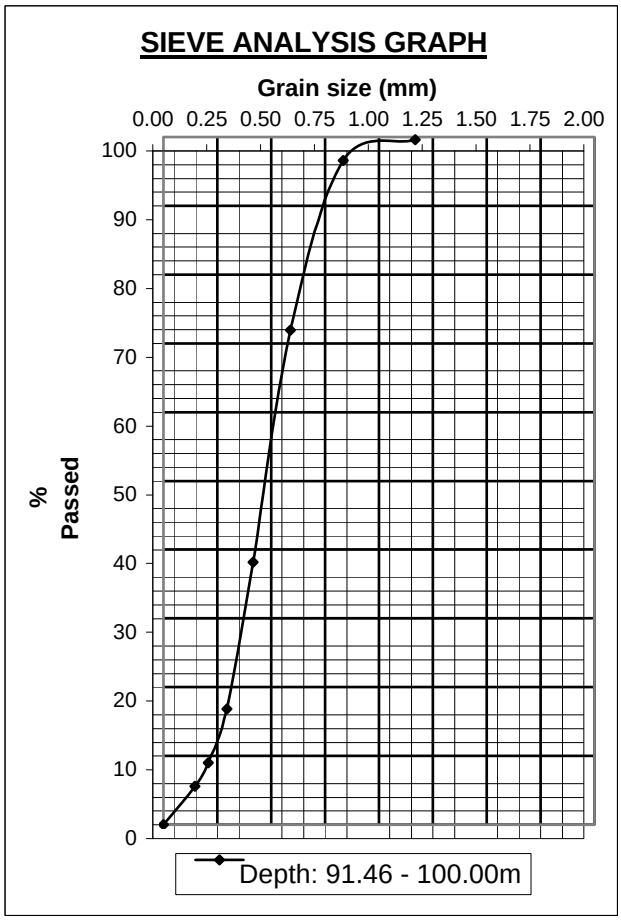
Annexure-II
Analysis of sand samples of TTW/OW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: TTW/OW-01 Depth of drilling: 100m Drilling completion: 22 to 24 August 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)
Date of analysis: 28 to 31 August 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 88.41 - 91.46m				Depth: 91.46 - 100.00m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0	0.00	0.00	**100.00**	0.33	0.40	0.40	**99.60**
20	**0.833**	0.12	0.28	0.28	**99.72**	2.79	3.39	3.79	**96.61**
30	**0.589**	3.83	8.82	9.09	**91.18**	23.09	28.06	31.85	**71.94**
40	**0.417**	12.01	27.65	36.74	**63.26**	24.69	30.01	61.86	**38.14**
50	**0.295**	14.42	33.20	69.94	**30.06**	17.56	21.34	83.20	**16.80**
70	**0.208**	8.59	19.77	89.71	**10.29**	6.41	7.79	90.99	**9.01**
100	**0.147**	2.01	4.63	94.34	**5.66**	2.79	3.39	94.39	**5.61**
Pan	**0.000**	2.46	5.66	100.00	**0.00**	4.62	5.61	100.00	**0.00**
Total		43.44	100.00			82.28	100.00		





Annexure-II

Table-2: Hydraulic conductivity or co-efficient of permeability (k) of TTW/OW-01

Work: Calculation of hydraulic conductivity or co-efficient of permeability (k) from sieve analysis of sand samples of TTW/OW-01
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.9?N24^{0}02'59.4?(16m west of PW-01)

Hydraulic conductivity or co-efficient of permeability (k)

Depth (m)	Thickness (m)	Average Sand Size	D_{10}	D_{60}	Uniformity coefficient (Uc)	Sorting by size	**k (m/s) (Hazen 1893)**
0.00 - 6.09	6.10	Silty Clay					
6.09 - 9.14	3.05	Very fine Sand	0.03	0.16	5.33	Unsorted formation	
9.14 - 12.19	3.05	Silt-Very Fine Sand					
12.19 - 15.24	3.05	Very fine Sand	0.03	0.17	5.62	Unsorted formation	**9.90E-06**
15.24 - 18.29	3.05	Fine to very fine Sand	0.05	0.19	3.80		**2.75E-05**
18.29 - 24.39	6.10	Very fine Sand	0.03	0.17	5.67		**9.90E-06**
24.39 - 36.58	12.20	Fine to very fine Sand	0.06	0.19	3.17		**3.96E-05**
36.58 - 42.68	6.10	Medium Sand with fine Sand	0.20	0.38	1.90	Sorted formation	**4.40E-04**
42.68 - 51.82	9.15	Fine to medium Sand	0.18	0.32	1.78		**3.56E-04**
51.82 - 60.97	9.15	Medium to fine Sand	0.19	0.35	1.84		**3.97E-04**
60.97 - 67.07	6.10	Fine to very fine Sand	0.09	0.22	2.44		**8.91E-05**
67.07 - 79.26	12.20	Fine to medium Sand	0.21	0.33	1.57		**4.85E-04**
79.26 - 85.36	6.10	Medium to fine Sand	0.19	0.34	1.79		**3.97E-04**
85.36 - 88.41	3.05	Medium sand with fine Sand	0.21	0.33	1.57		**4.85E-04**
88.41 - 91.46	3.05	Medium Sand	0.20	0.40	2.00		**4.40E-04**
91.46 - 100.00	8.54	Medium to coarse Sand with fine Sand & Gravel	0.21	0.51	2.43		**4.85E-04**
Total:	87.80						

Minimum:	0.03	0.17	1.57		**9.90E-06**
Maximum:	0.21	0.51	5.62		**4.85E-04**
Average:	0.14	0.30	2.74		**2.82E-04**
Transmissivity (T), m^2/sec					**2.47E-02**

Note: *Hydraulic Conductivity (k) varies in proportion to square of effective grain size (10% passing grain size, D_{10}. A good average for natural sands is given by Allan Hazen (1893) as $k = (11)10^3 (D_{10})^2$ with k expressed in m/sec and 10% passing diameter D_{10} in meters. Transmissivity (T) is derived by multiplying k with aquifer thickness.*

ANNEXURE-III

BORELOG, ELECTRIC LOG & DATA AND WATER QUALITY OF OBSERVATION WELLS (OW-02 TO OW-12)

Annexure-III (page 1 to 26)

Figure-1: Borehole and well information of OW-2

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-02
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.26? N24^{0}02'56.7? (75m south of PW-01)
Drilling completion: 24 to 26 August 2008

Depth (m)	Symbol	Lithology	Colour	Well fixture
GL 0				0.305m GL
6.09		Clay (Cl)	Grey	
9.14		Sandy Clay (SCl)		
12.19		Very fine Sand (VFS)		
18.29		Fine to medium Sand (F-MS)	Light brown	
30.48		Fine Sand (FS)	Grey	
42.68		Fine to medium Sand (F-MS)		
48.78		Medium Sand (MS)		
85.36		Medium to coarse Sand (M-CS)	Yellowish brown	79.58m 82.63m Screen 84.15m
91.46		Coarse Sand (CS)	Grey	
100.00		Coarse Sand with Gravel (CS/Gr)		

Water Quality (*Field Test*)

Temperature (T): 29.1^{0}C

Electric Conductivity (EC): 440 µS/cm

Total Dissolved Solid (TDS): 210 mg/l

Iron (Fe): 1.0 mg/l

Discharge: 36 l/m

Drill hole diameter: 108mm
Well diameter: 38 mm
Well fixture material: PVC with GI at top Well screen: PVC (Robo) screen

Figure-1: Borehole and well information of OW-3

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-03
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'03.4? N24^{0}02'59? (75m east of PW-01)
Drilling completion: 01 to 03 September 2008

Depth (m)	Symbol	Lithology	Colour	Well fixture	Water Quality (*Field Test*)
GL 0				0.305m GL	**Temperature (T): 30.9^{0}C**
3.04		Clay (Cl)	Grey		**Electric Conductivity (EC):** 466 µS/cm
6.09		Sandy Clay (SCl)			
18.29		Very fine Sand (VFS)			**Total Dissolved Solid (TDS):** 200 mg/l
24.39		Sandy Clay (SCl)			**Iron (Fe)**: 1.0 mg/l
30.48		Fine Sand (FS)			
51.82		Medium Sand (MS)	Light brown	45.43m 48.48m Screen 50.00m	**Discharge:** 32 l/m
79.26		Medium to coarse Sand (M-CS)			**Drill hole diameter:** 108mm **Well diameter:** 38 mm **Well fixture material:** PVC with GI at top Well screen: PVC (Robo) screen
94.52		Medium Sand (MS)	Grey		
100.61		Coarse Sand with Gravel (CS/Gr)			

Figure-1: Borehole and well information of OW-4

Borelog Well fixture

Work: Drilling and well fixture installation of OW-04
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'02.6? N24^{0}03'00.7? (75m north of PW-01)
Drilling completion: 26 to 28 August 2008

Depth (m)	Symbol	Lithology	Colour	Well fixture
GL 0				0.305m GL
6.09		Clay (Cl)	Grey	
12.19		Very fine Sand (VFS)		
21.34		Medium Sand (MS)	Light brown	
24.39		Fine to medium Sand (F-MS)	Grey	
33.53		Fine Sand (FS)		
37.50		Fine to medium Sand (F-MS)		
38.41		Silty Clay (SiCl)		
48.78		Fine to medium Sand (F-MS)		
70.12		Medium to coarse Sand (M-CS)	Light brown	
73.17		Medium Sand (MS)	Grey	73.18m
79.26		Medium to coarse Sand (M-CS)		76.23m Screen
85.36		Fine Sand (FS)		77.75m
101.22		Coarse Sand (CS)		

Water Quality (*Field Test*)

Temperature (T): 30.2^{0}C

Electric Conductivity (EC): 410 µS/cm

Total Dissolved Solid (TDS): 200 mg/l

Iron (Fe): 1.2 mg/l

Discharge: 37 l/m

Drill hole diameter: 108mm
Well diameter: 38 mm
Well fixture material: PVC with GI at top Well screen: PVC (Robo) screen

Figure-1: Borehole and well information of OW-5

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-05
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'55? N24^{0}02'57.5? (125m west of PW-01)
Drilling completion: 03 to 05 September 2008

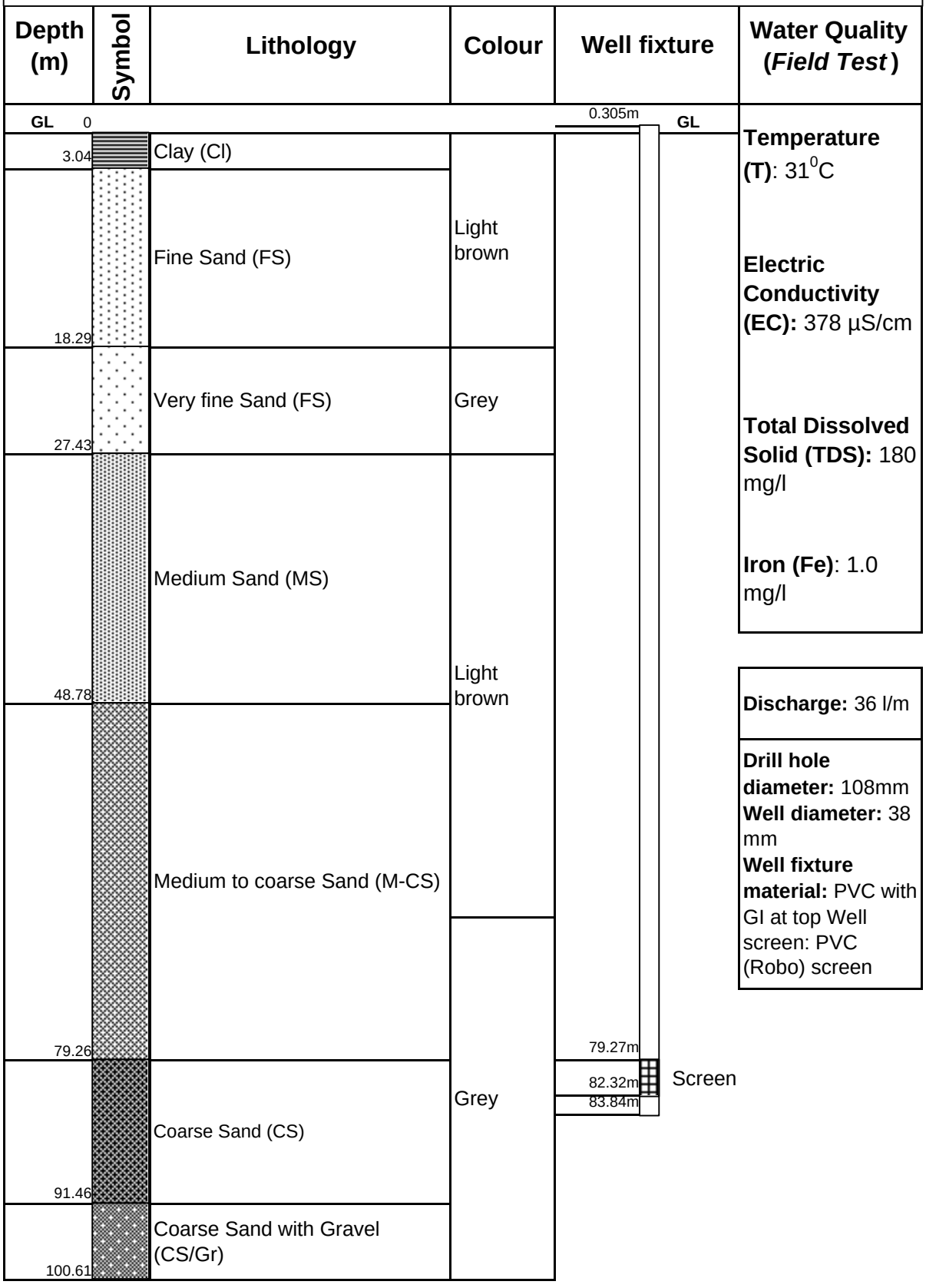


Figure-1: Borehole and well information of OW-6

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-06
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'59.5? N24^{0}02'52.9? (200 m south of PW-01)
Drilling completion: 05 to 07 September 2008

Depth (m)	Symbol	Lithology	Colour	Well fixture
GL 0				0.305m GL
9.14		Clay (Cl)	Light brown	
12.19		Sandy Clay (SCl)		
18.29		Fine to medium Sand (F-MS)		
36.58		Medium Sand (MS)		
39.63		Medium to coarse Sand (M-CS)		
45.73		Coarse Sand (CS)		
67.07		Medium to coarse Sand (M-CS)		
79.26		Fine to medium Sand (F-MS)	Grey	71.65m, 74.70m, 76.22m Screen
85.36		Fine Sand (FS)		
91.46		Fine to medium Sand (F-MS)		
100.00		Coarse Sand with Gravel (CS/Gr)		

Water Quality (*Field Test*)

Temperature (T): 28^{0}C

Electric Conductivity (EC): 485 µS/cm

Total Dissolved Solid (TDS): 210 mg/l

Iron (Fe): 0.6 mg/l

Discharge: 34 l/m

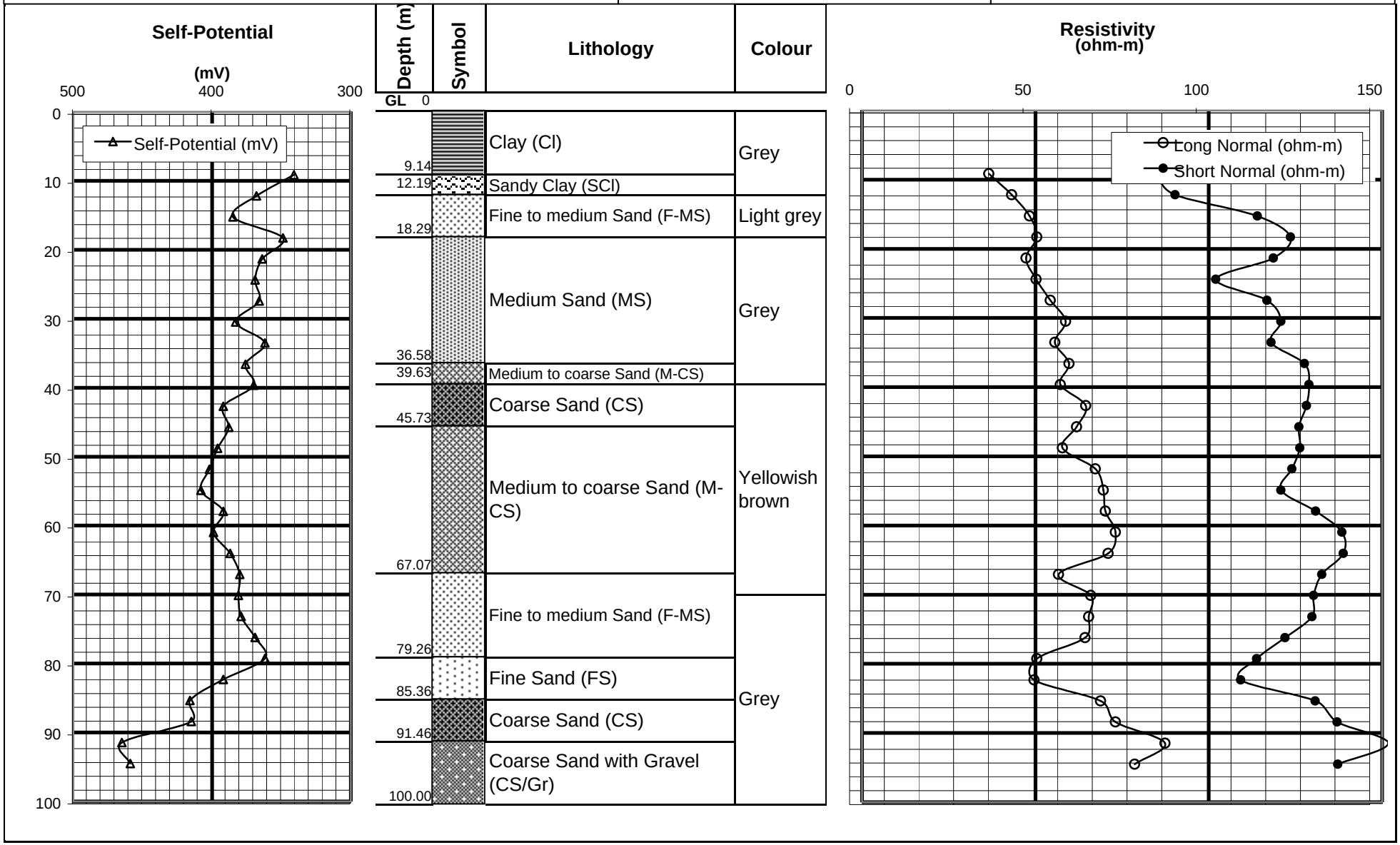
Drill hole diameter: 108mm
Well diameter: 38 mm
Well fixture material: PVC with GI at top Well screen: PVC (Robo) screen

ANNEXURE - III (Page 1 to 26)

Figure-1: Borehole Geo-electrical Log of OW-6

Borehole Electrical Log

Work: Geo-electrical logging of borehole OW-06 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}00'59.5? N24^{0}02'52.9? (200m south of PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 07 Sept. 2008** **Date of logging: 07 September 2008**	**Logging done by:DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



ANNEXURE - III (Page 1 to 26)

Table-1: Borehole Geo-electrical Logging data of OW-01

Work: Geo-electrical logging of borehole OW-06
Project: Bheramara 450 MW CC Power Plant
Location: E 89^{0}00'59.5? N 24^{0}02'52.9? (200 m south of PW)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 07September 2008

Borehole Electrical Logging Data

Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Clay (Cl)	Light brown	3.05			
		6.10			
		9.15	341.00	36.60	84.40
Sandy Clay (SCl)		12.20	368.00	43.20	90.30
Fine to medium Sand (F-MS)		15.24	385.00	48.30	114.00
		18.29	349.00	50.40	123.60
Medium Sand (MS)		21.34	364.00	47.30	118.60
		24.39	369.00	50.20	102.00
		27.44	366.00	54.30	116.80
		30.49	383.00	58.70	120.80
		33.54	362.00	55.60	118.00
		36.59	376.00	59.70	127.60
Medium to coarse Sand (M-CS)		39.63	370.00	57.20	128.90
Coarse Sand (CS)		42.68	392.00	64.50	128.20
		45.73	388.00	61.90	126.00
Medium to coarse Sand (M-CS)		48.78	396.00	57.80	126.30
		51.83	402.00	67.30	124.00
		54.88	408.00	69.60	120.80
		57.93	392.00	70.20	130.80
		60.98	399.00	73.10	138.40
		64.02	387.00	71.00	138.80
		67.07	380.00	56.70	132.60
Fine to medium Sand (F-MS)	Grey	70.12	381.00	66.00	130.20
		73.17	379.00	65.40	129.80
		76.22	369.00	64.30	122.00
		79.27	362.00	50.40	113.80
Fine Sand (FS)		82.32	392.00	49.60	109.20
		85.37	416.00	68.80	130.70
Fine to medium Sand (F-MS)		88.41	415.00	73.10	137.00
		91.46	465.00	87.40	151.80
Coarse Sand with Gravel (CS/Gr)		94.51	459.00	78.60	137.20
		97.56			
		100.00			

Figure-1: Borehole and well information of OW-7

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-07
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'07.7? N24^{0}02'59.1? (200m east of PW-01)
Drilling completion: 09 to 11 September 2008

Depth (m)	Symbol	Lithology	Colour	Well fixture
GL 0				0.305m GL
6.09		Clay (Cl)	Light brown	
18.29		Fine to medium Sand (F-MS)	Grey	
21.34		Coarse Sand (CS)		
27.43		Fine to medium Sand (F-MS)		
39.63		Medium Sand (MS)		
42.68		Fine Sand (FS)	Yellowish brown	
45.73		Medium to coarse Sand (M-CS)		
60.97		Coarse Sand (CS)		
85.36		Fine to medium Sand (F-MS)	Grey	71.65m 74.70m Screen 76.83m
97.56		Medium to coarse Sand (M-CS)		
100.61		Coarse Sand with Gravel (CS/Gr)		

Water Quality (*Field Test*)

Temperature (T): 30.9^{0}C

Electric Conductivity (EC): 520 µS/cm

Total Dissolved Solid (TDS): 250 mg/l

Iron (Fe): 1.4 mg/l

Discharge: 31 l/m

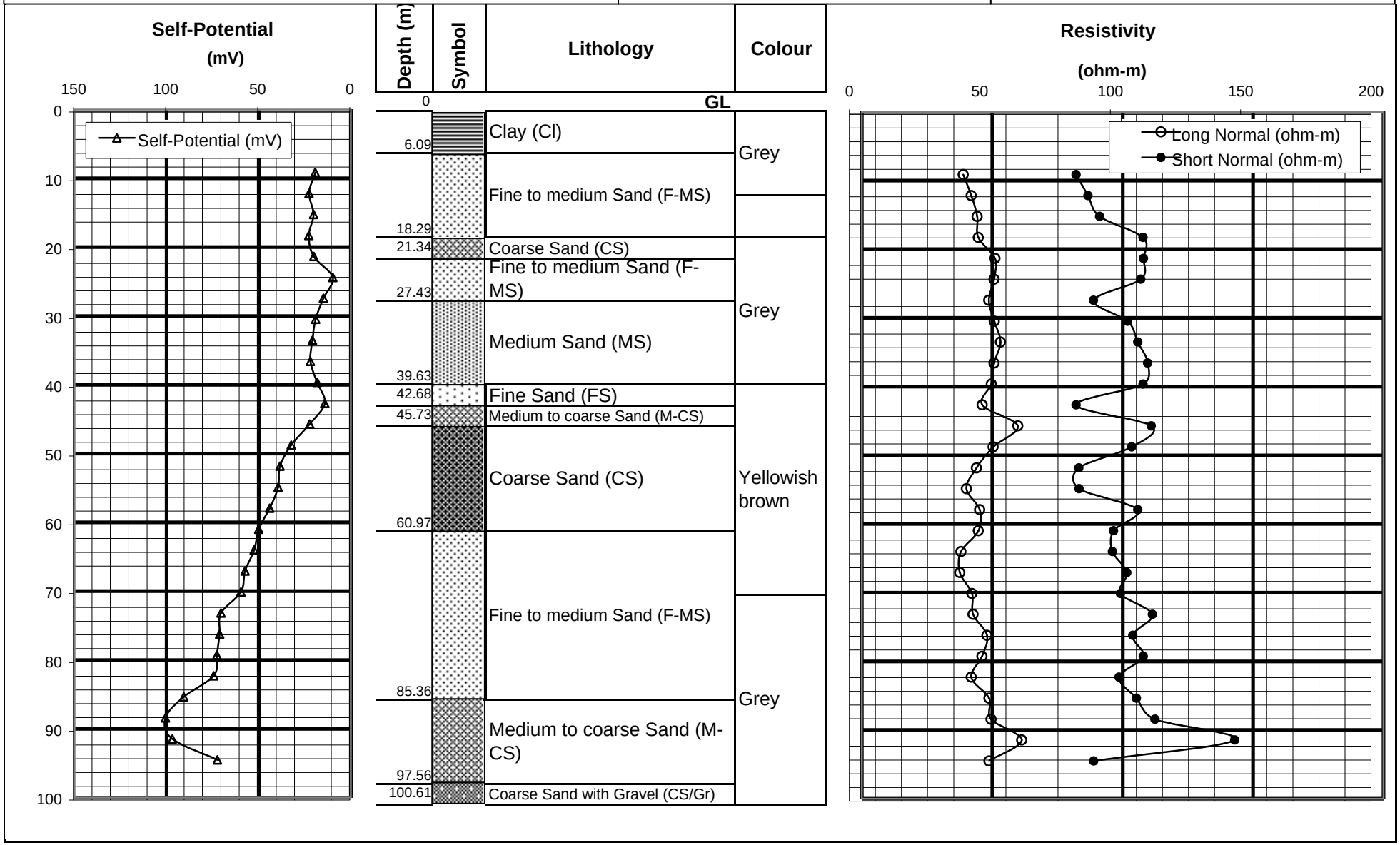
Drill hole diameter: 108mm
Well diameter: 38 mm
Well fixture material: PVC with GI at top Well screen: PVC (Robo) screen

ANNEXURE - III (Page 1 to 26)

Figure-1: Borehole Geo-electrical Log of OW-7

Borehole Electrical Log

Work: Geo-electrical logging of borehole OW-07 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}01'07.7? N24^{0}02'59.1? (200m east of PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 11 Sept. 2008** **Date of logging: 11 September 2008**	**Logging done by:DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



ANNEXURE - III (Page 1 to 26)

Table-1: Borehole Geo-electrical Logging data of OW-07

Work: Geo-electrical logging of borehole OW-07
Project: Bheramara 450 MW CC Power Plant
Location: E 89^{0}01'07.7?N 24^{0}02'59.1?(200 m east of PW-01)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 11September 2008

Borehole Electrical Logging Data

Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Clay (Cl)	Light brown	3.05			
		6.10			
Fine to medium Sand (F-MS)	Grey	9.15	19.30	38.90	82.20
		12.20	22.65	42.00	86.70
		15.24	20.22	44.20	91.20
		18.29	22.80	44.70	107.80
Coarse Sand (CS)		21.34	20.10	51.10	108.00
Fine to medium Sand (F-MS)		24.39	9.78	50.70	107.00
		27.44	14.86	48.70	88.80
Medium Sand (MS)		30.49	19.15	50.80	101.90
	Yellowish brown	33.54	20.84	53.20	105.80
		36.59	22.00	50.70	109.60
		39.63	18.20	49.70	107.80
Fine Sand (FS)		42.68	14.19	46.20	82.20
Medium to coarse Sand (M-CS)		45.73	22.30	59.80	111.00
Coarse Sand (CS)		48.78	32.40	50.40	103.50
		51.83	38.50	44.00	83.20
		54.88	39.50	40.10	83.30
		57.93	44.10	45.20	105.80
		60.98	50.00	44.70	96.50
Fine to medium Sand (F-MS)	Grey	64.02	52.50	38.00	96.10
		67.07	57.50	37.60	101.60
		70.12	59.70	42.20	99.20
		73.17	70.50	42.70	111.40
		76.22	71.21	48.00	103.90
		79.27	72.70	46.10	107.90
		82.32	74.40	42.00	98.60
		85.37	90.70	48.80	105.30
Medium to coarse Sand (M-CS)		88.41	100.60	49.60	112.40
		91.46	96.90	61.30	143.00
		94.51	72.40	48.80	88.90
		97.56			
Coarse Sand with Gravel		100.00			

Figure-1: Borehole and well information of OW-8

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-08
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'04.4? N24^{0}03'02.6? (200m north of PW-01)
Drilling completion: 28 to 30 August 2008

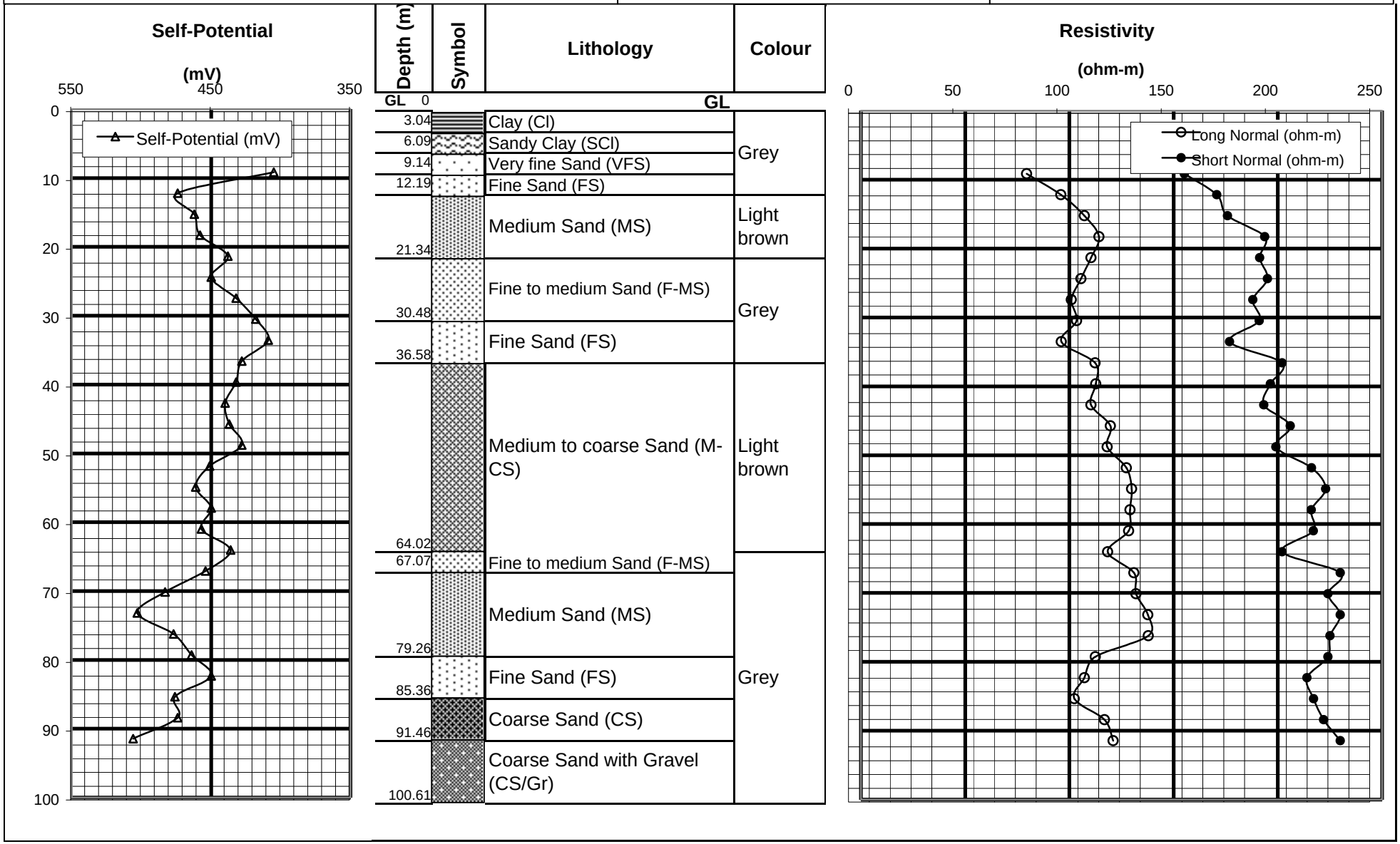
Depth (m)	Symbol	Lithology	Colour	Well fixture	Water Quality (*Field Test*)
GL 0				0.305m GL	**Temperature (T)**: 30.1^{0}C **Electric Conductivity (EC):** 400 µS/cm **Total Dissolved Solid (TDS):** 190 mg/l **Iron (Fe)**: 1.2 mg/l
3.04		Clay (Cl)	Grey		
6.09		Sandy Clay (SCl)			
9.14		Very fine Sand (VFS)			
12.19		Fine Sand (FS)			
21.34		Medium Sand (MS)	Light brown		
30.48		Fine to medium Sand (F-MS)	Grey		
36.58		Fine Sand (FS)			
64.02		Medium to coarse Sand (M-CS)	Light brown		**Discharge:** 32 l/m **Drill hole diameter:** 108mm **Well diameter:** 38 mm **Well fixture material:** PVC with GI at top Well screen: PVC (Robo) screen
67.07		Fine to medium Sand (F-MS)	Grey		
73.18m					
76.23m		Medium Sand (MS)		Screen	
77.75m					
79.26					
85.36		Fine Sand (FS)			
91.46		Coarse Sand (CS)			
100.61		Coarse Sand with Gravel (CS/Gr)			

ANNEXURE - III (Page 1 to 26)

Figure-1: Borehole Geo-electrical Log of OW-8

Borehole Electrical Log

Work: Geo-electrical logging of borehole OW-08 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}01'04.4? N24^{0}03'02.6? (200m northof PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 30 August 2008** **Date of logging: 30 August 2008**	**Logging done by:DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



ANNEXURE - III (Page 1 to 26)

Table-1: Borehole Geo-electrical Logging data of OW-01

Work: Geo-electrical logging of borehole OW-08
Project: Bheramara 450 MW CC Power Plant
Location: E $89^0$01'04.4?N $24^0$03'02.6?(200 m north of PW)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 30August 2008

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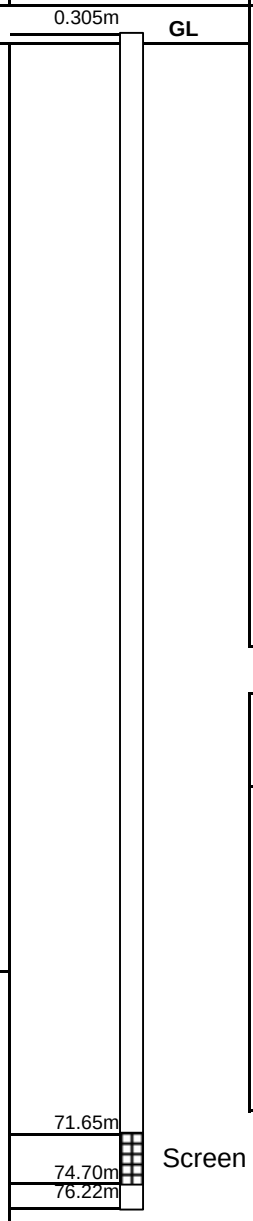
Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Clay (Cl)	Grey	3.05			
Sandy Clay (SCl)		6.10			
Very fine Sand (VFS)		9.15	405.00	79.50	155.20
Fine Sand (FS)		12.20	474.00	95.90	170.70
Medium Sand (MS)	Light brown	15.24	462.00	107.20	175.90
		18.29	458.00	114.20	193.70
		21.34	438.00	110.40	191.30
Fine to medium Sand (F-MS)	Grey	24.39	450.00	105.60	195.00
		27.44	432.00	101.00	188.00
		30.49	418.00	103.50	191.10
Fine Sand (FS)		33.54	409.00	96.20	176.80
		36.59	428.00	112.40	202.00
Medium to coarse Sand (M-CS)	Light brown	39.63	432.00	112.70	196.50
		42.68	440.00	110.40	193.30
		45.73	437.00	119.70	206.00
		48.78	428.00	118.20	199.10
		51.83	451.00	127.30	216.20
		54.88	461.00	129.90	223.00
		57.93	450.00	129.10	216.00
		60.98	457.00	128.40	217.00
		64.02	436.00	118.40	202.00
Fine to medium Sand (F-MS)	Grey	67.07	454.00	131.00	230.00
Medium Sand (MS)		70.12	483.00	132.00	224.00
		73.17	503.00	137.60	230.00
		76.22	477.00	137.90	225.00
		79.27	464.00	112.50	224.00
Fine Sand (FS)		82.32	450.00	107.20	214.00
		85.37	476.00	102.40	217.20
Coarse Sand (CS)		88.41	474.00	116.80	222.00
		91.46	506.00	121.00	230.00
Coarse Sand with Gravel (CS/Gr)		94.51	485.00	115.30	203.00
		97.56			
		100.61			

Figure-1: Borehole and well information of OW-09

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-09
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'46.7? N24^{0}03'00.3? (400 m west of PW-01)
Drilling completion: 13 to 15 September 2008

Depth (m)	Symbol	Lithology	Colour
GL 0			
3.04		Clay (Cl)	Light brown
6.09		Silty Clay (SiCl)	
12.19		Very fine Sand (VFS)	
24.39		Fine to medium Sand (F-MS)	
45.73		Medium to coarse Sand (M-CS)	
51.82		Medium Sand (MS)	
85.36		Medium to coarse Sand (M-CS)	Grey
94.51		Coarse Sand with Gravel (CS/Gr)	
100.00		Medium to coarse Sand (M-CS)	



Water Quality (*Field Test*)

Temperature (T): 28^{0}C

Electric Conductivity (EC): 485 µS/cm

Total Dissolved Solid (TDS): 210 mg/l

Iron (Fe): 0.6 mg/l

Discharge: 36 l/m

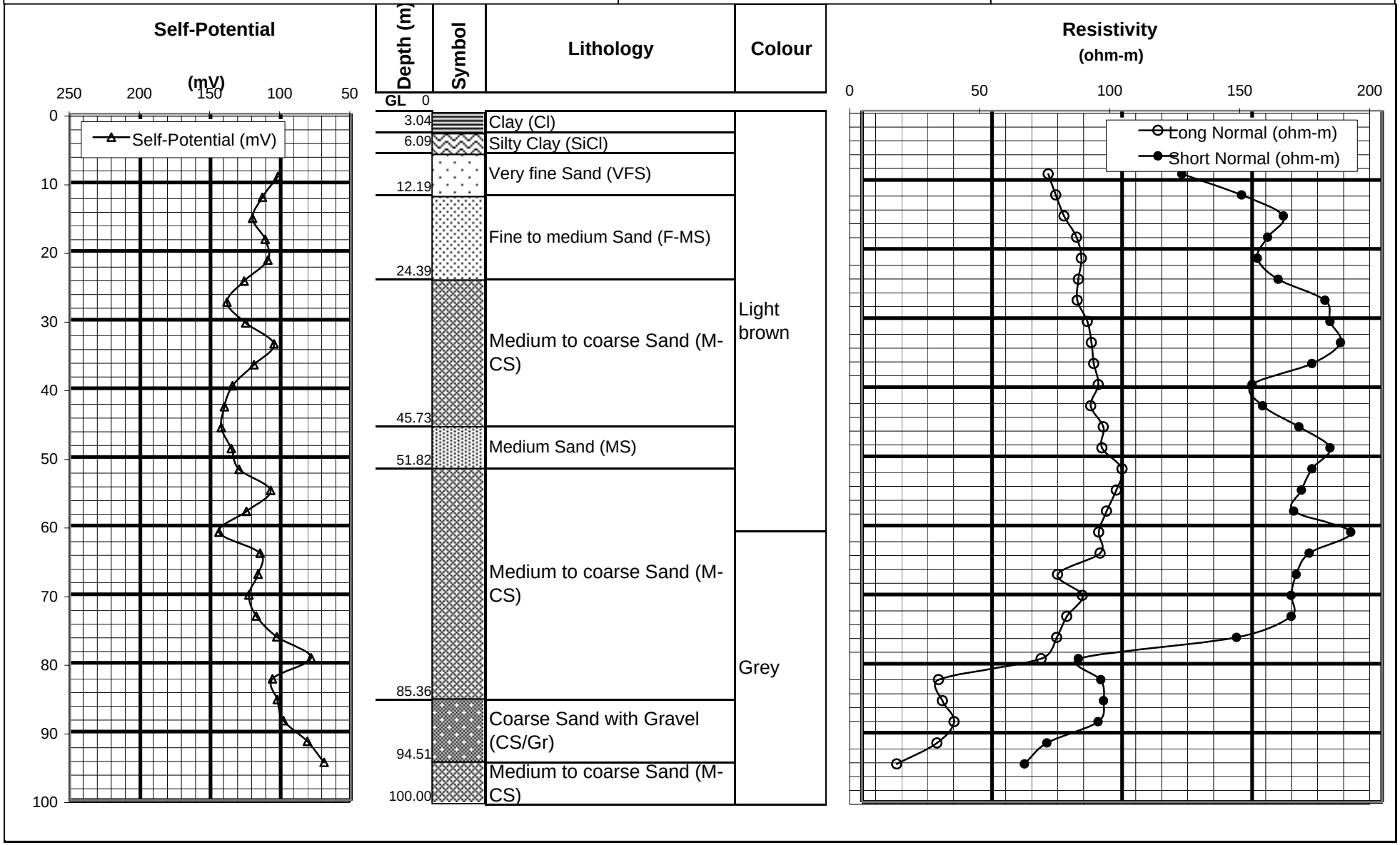
Drill hole diameter: 108mm
Well diameter: 38 mm
Well fixture material: PVC with GI at top Well screen: PVC (Robo) screen

ANNEXURE - III (Page 1 to 26)

Figure-1: Borehole Geo-electrical Log of OW-09

Borehole Electrical Log

Work: Geo-electrical logging of borehole OW-09 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}00'46.7? N24^{0}03'00.3? (400m west of PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 15 Sept. 2008** **Date of logging: 15 September 2008**	**Logging done by:DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



ANNEXURE - III (Page 1 to 26)

Table-1: Borehole Geo-electrical Logging data of OW-01

Work: Geo-electrical logging of borehole OW-09
Project: Bheramara 450 MW CC Power Plant
Location: E $89^0$00'46.7?N $24^0$03'00.3?(400 m west of PW)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 15 September 2008

Borehole Electrical Logging Data

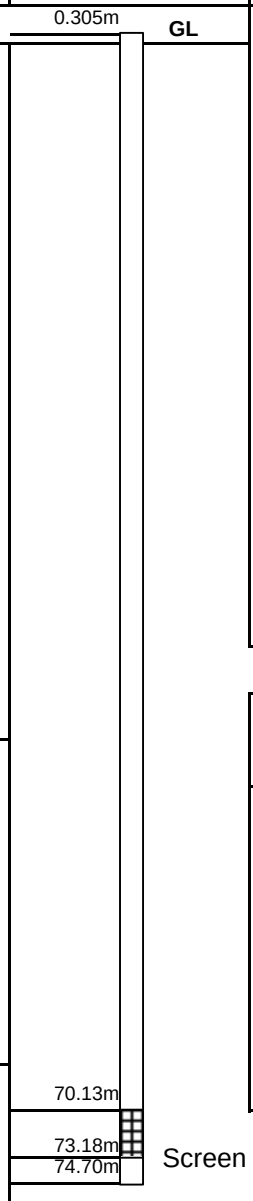
Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Clay (Cl)	Light brown	3.05			
Silty Clay (SiCl)		6.10			
Very fine Sand (VFS)		9.15	102.00	71.60	123.00
		12.20	113.00	74.50	146.00
Fine to medium Sand (F-MS)		15.24	120.00	77.70	162.00
		18.29	111.00	82.50	156.00
		21.34	109.10	84.40	152.00
		24.39	126.00	83.20	160.00
Medium to coarse Sand (M-CS)		27.44	138.20	82.80	178.00
		30.49	125.00	86.60	180.00
		33.54	104.80	88.20	184.00
		36.59	119.00	89.10	173.00
		39.63	134.40	90.90	150.00
		42.68	140.00	88.00	154.00
		45.73	142.30	92.80	168.00
Medium Sand (MS)		48.78	135.20	92.30	180.00
		51.83	129.70	100.00	173.00
Medium to coarse Sand (M-CS)		54.88	107.10	97.80	169.00
		57.93	124.40	94.00	166.00
		60.98	143.90	91.00	188.00
	Grey	64.02	114.70	91.60	172.00
		67.07	116.10	75.20	167.00
		70.12	122.60	84.70	165.00
		73.17	117.50	78.70	165.00
		76.22	102.80	74.90	144.00
		79.27	78.40	68.90	83.20
		82.32	105.90	29.40	91.80
		85.37	102.50	30.90	92.90
Coarse Sand with Gravel (CS/Gr)		88.41	98.00	35.40	90.80
		91.46	81.00	28.80	71.10
		94.51	69.00	13.40	62.50
Medium to coarse Sand (M-CS)		97.56			
		100.00			

Figure-1: Borehole and well information of OW-10

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-10
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}00'57.7? N24^{0}02'45.7? (400 m south of PW-01)
Drilling completion: 07 to 09 September 2008

Depth (m)	Symbol	Lithology	Colour
GL 0			
3.04		Clay (Cl)	Light brown
6.09		Silty Clay (SiCl)	
15.24		Fine to medium Sand (F-MS)	
24.39		Medium Sand (MS)	
27.43		Fine to medium Sand (F-MS)	
30.48		Medium Sand (MS)	
42.68		Fine to medium Sand (F-MS)	
51.82		Medium Sand (MS)	Yellowish brown
54.87		Fine to medium Sand (F-MS)	
79.26		Medium to coarse Sand (M-CS)	Grey
85.36		Fine to medium Sand (F-MS)	
100.61		Medium to coarse Sand (M-CS)	



Temperature (T): 29.1^{0}C

Electric Conductivity (EC): 408 µS/cm

Total Dissolved Solid (TDS): 200 mg/l

Iron (Fe): 0.4 mg/l

Discharge: 37 l/m

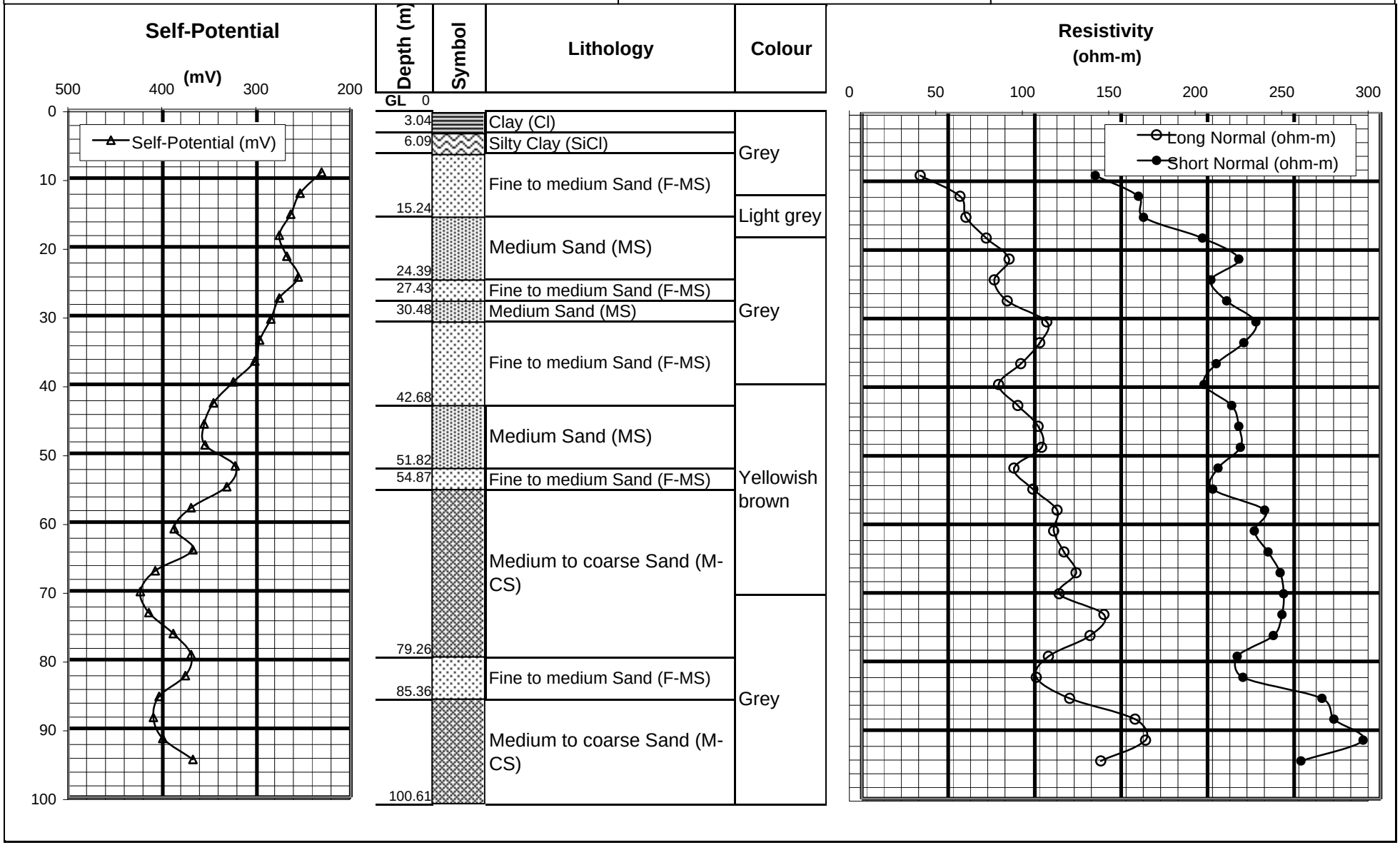
Drill hole diameter: 108mm
Well diameter: 38 mm
Well fixture material: PVC with GI at top Well screen: PVC (Robo) screen

ANNEXURE - III (Page 1 to 26)

Figure-1: Borehole Geo-electrical Log of OW-10

Borehole Electrical Log

Work: Geo-electrical logging of borehole OW-10 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}00'57.7? N24^{0}02'45.7? (400m south of PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 09 Sept. 2008** **Date of logging: 09 September 2008**	**Logging done by:DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



ANNEXURE - III (Page 1 to 26)

Table-1: Borehole Geo-electrical Logging data of OW-01

Work: Geo-electrical logging of borehole OW-10
Project: Bheramara 450 MW CC Power Plant
Location: E 89^{0}00'57.7?N 24^{0}02'45.7?(400 m south of PW)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 09September 2008

Borehole Electrical Logging Data

Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Clay (Cl)	Light brown	3.05			
Silty Clay (SiCl)		6.10			
Fine to medium Sand (F-MS)		9.15	231.00	33.80	135.00
		12.20	254.00	56.80	160.00
		15.24	264.00	60.20	163.00
Medium Sand (MS)		18.29	276.00	72.00	197.00
		21.34	268.00	85.30	218.00
		24.39	256.00	76.60	202.00
Fine to medium Sand (F-MS)		27.44	276.00	84.20	211.00
Medium Sand (MS)		30.49	285.00	107.00	228.00
Fine to medium Sand (F-MS)		33.54	297.00	103.00	221.00
		36.59	302.00	92.00	205.00
		39.63	325.00	79.20	198.00
		42.68	346.00	90.20	214.00
Medium Sand (MS)		45.73	356.00	102.00	218.00
	Yellowish brown	48.78	355.00	104.00	219.00
		51.83	323.00	88.00	206.00
Fine to medium Sand (F-MS)		54.88	332.00	99.00	203.00
Medium to coarse Sand (M-CS)		57.93	370.00	113.00	233.00
		60.98	388.00	111.00	227.00
		64.02	368.00	117.00	235.00
		67.07	408.00	124.00	242.00
	Grey	70.12	424.00	114.20	244.00
		73.17	415.00	140.10	243.00
		76.22	389.00	132.00	238.00
		79.27	370.00	108.00	217.20
Fine to medium Sand (F-MS)		82.32	376.00	101.00	220.40
		85.37	404.00	120.30	266.20
Medium to coarse Sand (M-CS)		88.41	410.00	158.00	273.00
		91.46	400.00	164.10	290.00
		94.51	368.00	138.20	254.00
		97.56			
		100.61			

Figure-1: Borehole and well information of OW-11

Borelog and Well fixture

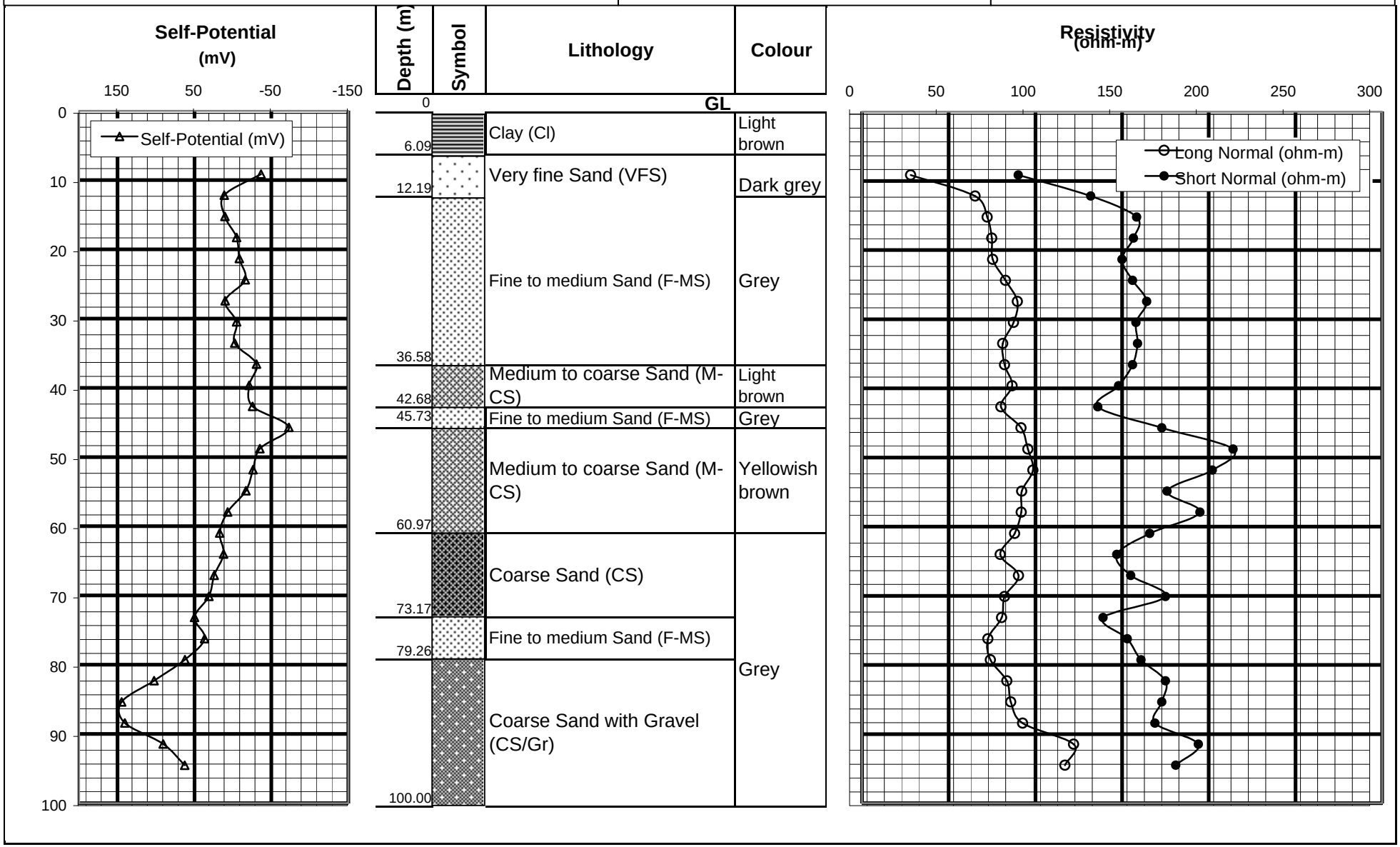
Work: Drilling and well fixture installation of OW-11
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'14.8? N24^{0}02'59.1? (400 m east of PW-01)
Drilling completion: 11 to 13 September 2008

Depth (m)	Symbol	Lithology	Colour	Well fixture	Water Quality (*Field Test*)
GL 0				0.305m GL	**Temperature (T)**: 30.1^{0}C
6.09		Clay (Cl)	Light brown		
12.19		Very fine Sand (VFS)	Dark grey		**Electric Conductivity (EC):** 360 µS/cm
36.58		Fine to medium Sand (F-MS)	Grey		**Total Dissolved Solid (TDS):** 170 mg/l
42.68		Medium to coarse Sand (M-CS)	Light brown		**Iron (Fe)**: 1.0 mg/l
45.73		Fine to medium Sand (F-MS)	Grey		**Discharge:** 35 l/m
60.97		Medium to coarse Sand (M-CS)	Yellowish brown		**Drill hole diameter:** 108mm **Well diameter:** 38 mm **Well fixture material:** PVC with GI at top Well screen: PVC (Robo) screen
73.17		Coarse Sand (CS)	Grey	74.70m Screen	
79.26		Fine to medium Sand (F-MS)		77.75m	
100.00		Coarse Sand with Gravel (CS/Gr)		79.27m	

Figure-1: Borehole Geo-electrical Log of OW-11

Borehole Electrical Log

Work: Geo-electrical logging of borehole OW-11 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}01'14.8? N24^{0}02'59.1? (400m east of PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 13 Sept. 2008** **Date of logging: 13 September 2008**	**Logging done by:DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



ANNEXURE - III (Page 1 to 26)

Table-1: Borehole Geo-electrical Logging data of OW-01

Work: Geo-electrical logging of borehole OW-11
Project: Bheramara 450 MW CC Power Plant
Location: E $89^0$01'14.8?N $24^0$02'59.1?(400 m east of PW)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 13September 2008

Borehole Electrical Logging Data

Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Clay (Cl)	Light brown	3.05			
		6.10			
Very fine Sand (VFS)	Dark grey	9.15	-36.40	28.10	90.20
		12.20	11.22	65.20	132.00
Fine to medium Sand (F-MS)	Grey	15.24	10.34	72.20	158.40
		18.29	-4.65	74.90	156.60
		21.34	-8.42	75.40	150.00
		24.39	-16.08	82.80	156.00
		27.44	10.10	89.60	164.20
		30.49	-4.78	87.40	158.00
		33.54	-2.31	81.20	159.00
		36.59	-30.64	82.30	156.00
Medium to coarse Sand (M-CS)	Light brown	39.63	-21.08	86.60	148.00
		42.68	-25.40	80.20	136.00
Fine to medium Sand (F-MS)	Grey	45.73	-72.70	91.80	173.00
Medium to coarse Sand (M-CS)	Yellowish brown	48.78	-35.10	95.70	214.00
		51.83	-26.20	98.60	202.00
		54.88	-16.85	92.20	176.00
		57.93	6.98	91.90	195.00
		60.98	17.23	88.10	166.00
Coarse Sand (CS)	Grey	64.02	12.33	79.80	147.00
		67.07	24.30	90.30	155.00
		70.12	31.30	82.20	175.00
		73.17	50.10	80.60	139.00
Fine to medium Sand (F-MS)		76.22	36.82	72.60	153.00
		79.27	62.31	74.10	161.00
Coarse Sand with Gravel (CS/Gr)		82.32	102.40	83.60	175.00
		85.37	144.60	85.80	173.00
		88.41	140.70	92.70	169.00
		91.46	90.80	122.00	194.00
		94.51	62.80	117.00	181.00
		97.56			
		100.00			

Figure-1: Borehole and well information of OW-12

Borelog and Well fixture

Work: Drilling and well fixture installation of OW-12
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'07? N24^{0}03'10? (400 m north of PW-01)
Drilling completion: 30 August to 01 September 2008

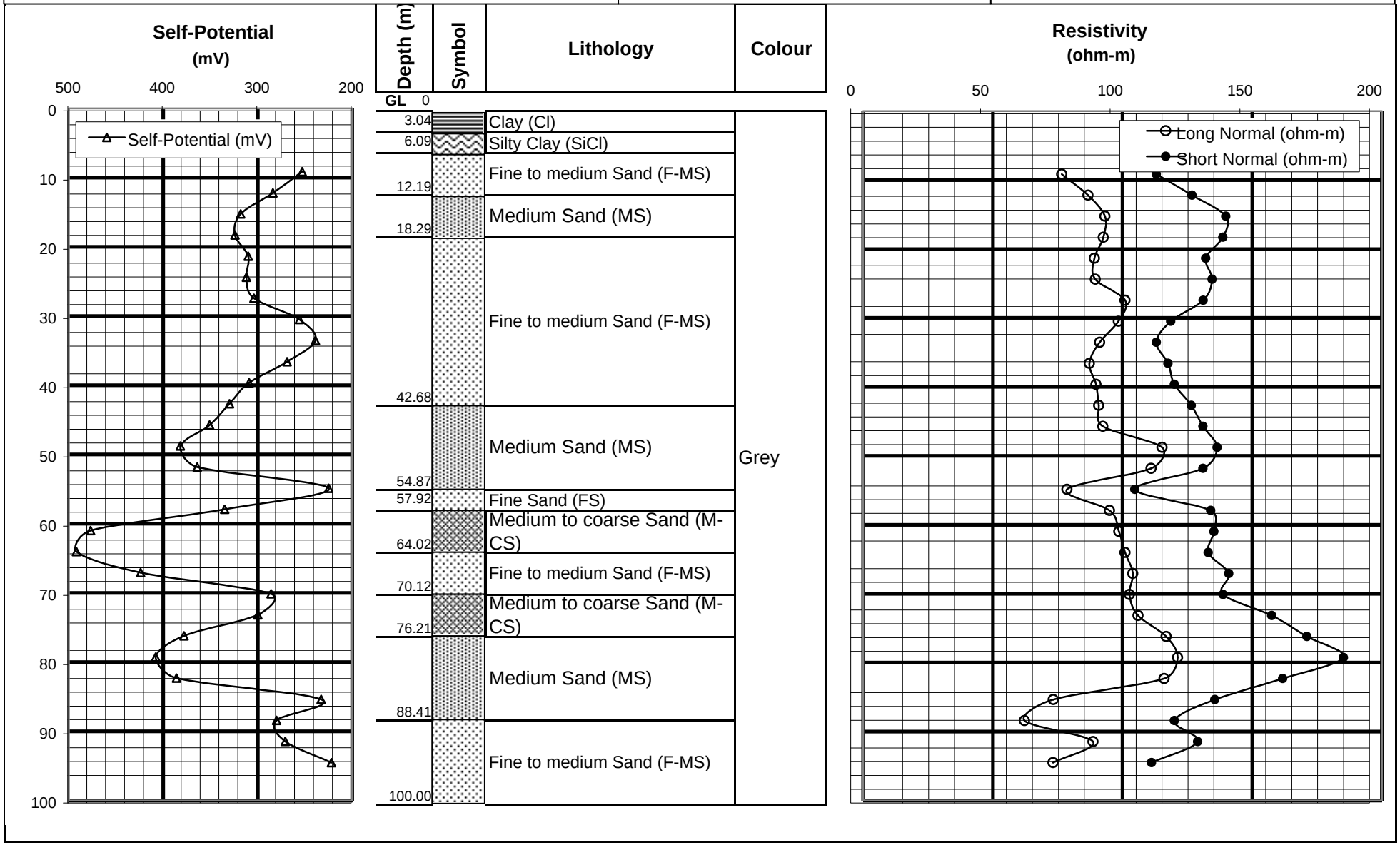
Depth (m)	Symbol	Lithology	Colour	Well fixture	Water Quality (*Field Test*)
GL 0				0.305m GL	**Temperature (T)**: 30.2^{0}C **Electric Conductivity (EC):** 411 µS/cm **Total Dissolved Solid (TDS):** 209 mg/l **Iron (Fe)**: 0.9 mg/l
3.04		Clay (Cl)	Grey		
6.09		Silty Clay (SiCl)			
12.19		Fine to medium Sand (F-MS)			
18.29		Medium Sand (MS)			
42.68		Fine to medium Sand (F-MS)			**Discharge:** 38 l/m
54.87		Medium Sand (MS)			**Drill hole diameter:** 108mm **Well diameter:** 38 mm **Well fixture material:** PVC with GI at top Well screen: PVC (Robo) screen
57.92		Fine Sand (FS)			
64.02		Medium to coarse Sand (M-CS)			
70.12		Fine to medium Sand (F-MS)			
76.21		Medium to coarse Sand (M-CS)		75.31m Screen	
88.41		Medium Sand (MS)		78.36m 79.88m	
100.00		Fine to medium Sand (F-MS)			

ANNEXURE - III (Page 1 to 26)

Figure-1: Borehole Geo-electrical Log of TTW/OW-1

Borehole Electrical Log

Work: Geo-electrical logging of borehole OW-12 **Project: Bheramara 450 MW CC Power Plant** **Location: E89^{0}01'07? N24^{0}03'10? (400m north of PW-01)**	**Borehole diameter: 108mm** **Drilling completion: 01 Sept. 2008** **Date of logging: 01 September 2008**	**Logging done by:DPHE Ground Water Division, Dhaka** **Logger: ABEM Terrameter SAS 300C**



ANNEXURE - III (Page 1 to 26)

Table-1: Borehole Geo-electrical Logging data of OW-01

Work: Geo-electrical logging of borehole OW-12
Project: Bheramara 450 MW CC Power Plant
Location: E 89^{0}00'59.5?N 24^{0}02'52.9?(200 m south of PW)
Logging done by: DPHE Ground Water Division, Dhaka
Logger: ABEM Terrameter SAS 300C
Date of logging: 07September 2008

Borehole Electrical Logging Data

Borelog	Colour	Depth (m)	Self-Potential (mV)	Long Normal Resistivity (ohm-m)	Short Normal Resistivity (ohm-m)
		0.00			
Clay (Cl)	Light brown	3.05			
		6.10			
		9.15	253.00	76.60	113.00
Sandy Clay (SCl)		12.20	284.00	86.70	126.80
Fine to medium Sand (F-MS)		15.24	318.00	93.20	139.80
		18.29	324.00	92.60	138.70
Medium Sand (MS)		21.34	310.00	89.20	132.10
		24.39	312.00	89.50	134.50
		27.44	304.00	101.00	131.10
		30.49	256.00	98.40	118.60
		33.54	239.00	91.20	113.00
		36.59	269.00	87.20	117.50
Medium to coarse Sand (M-CS)		39.63	309.00	89.80	120.00
Coarse Sand (CS)		42.68	330.00	90.80	126.50
		45.73	351.00	92.40	131.00
Medium to coarse Sand (M-CS)		48.78	382.00	115.20	136.50
		51.83	364.00	111.00	131.00
		54.88	225.00	78.60	104.80
		57.93	335.00	95.00	134.00
		60.98	477.00	98.60	135.20
		64.02	492.00	101.00	133.00
		67.07	424.00	104.00	141.00
Fine to medium Sand (F-MS)	Grey	70.12	286.00	102.60	138.80
		73.17	300.00	106.00	157.50
		76.22	378.00	116.80	171.10
		79.27	408.00	121.20	185.20
Fine Sand (FS)		82.32	386.00	116.00	161.80
		85.37	233.00	73.30	135.60
Fine to medium Sand (F-MS)		88.41	280.00	62.20	120.00
		91.46	271.00	88.60	129.00
Coarse Sand with Gravel (CS/Gr)		94.51	222.00	73.20	111.20
		97.56			
		100.00			

ANNEXURE-IV

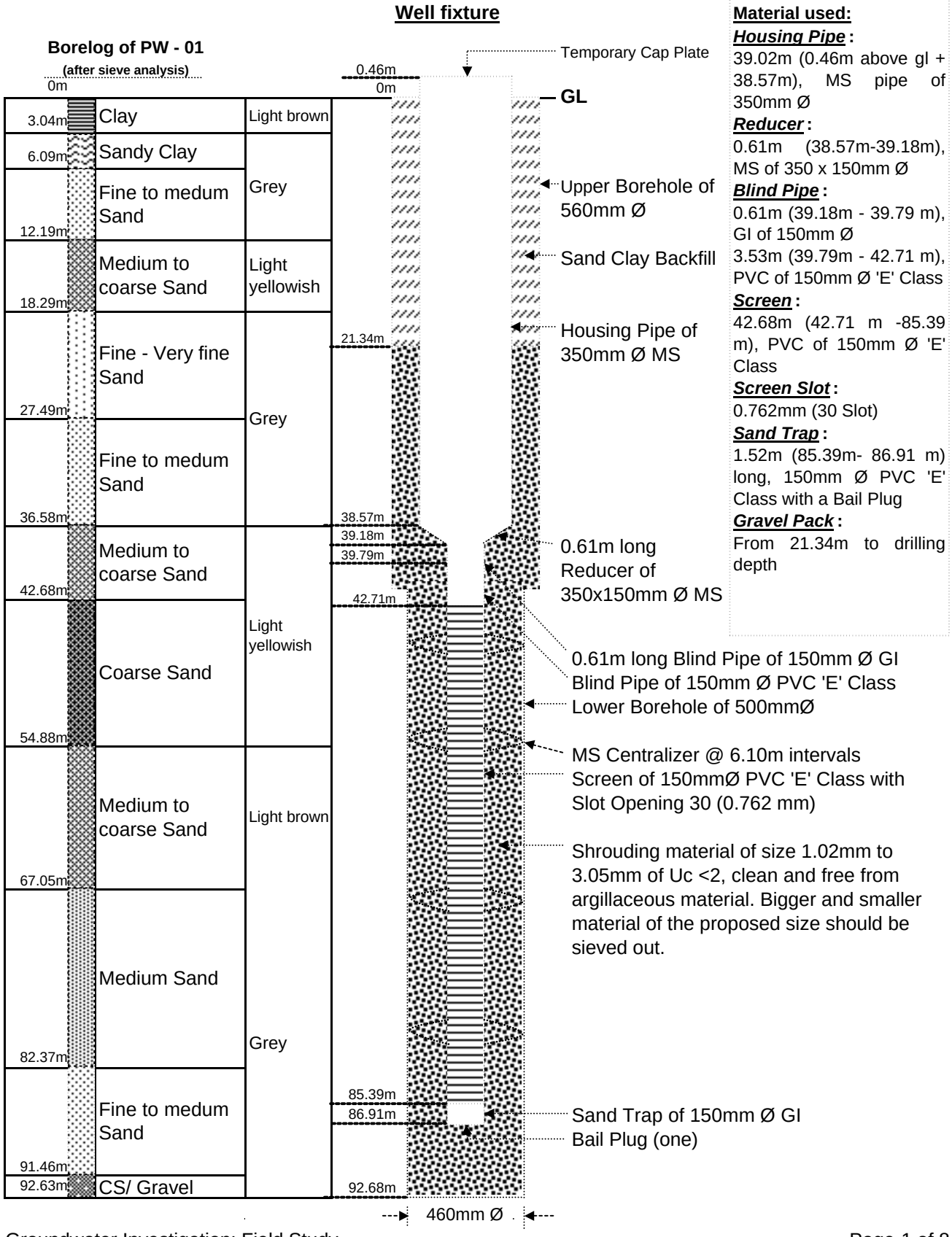
BORELOG, WELL INFORMATION AND GRAIN SIZE ANALYSIS OF PW-01

Annexure - IV

Figure-1: Borehole and well information of pumping well (PW-01)

PUMPING WELL (PW-01)

Work: Drilling & well fixture installation of Pumping Well (PW-01) of 350x150 mm dia., shrouded
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5? N24^{0}02'59.4? (inside-'Site-A' and beside canal of GK Project)
Drilling completion: 24 August to 09 September 2008
Well installation: 09 September to 10 September 2008



Material used:

***Housing Pipe*:**
39.02m (0.46m above gl + 38.57m), MS pipe of 350mm Ø

***Reducer*:**
0.61m (38.57m-39.18m), MS of 350 x 150mm Ø

***Blind Pipe*:**
0.61m (39.18m - 39.79 m), GI of 150mm Ø
3.53m (39.79m - 42.71 m), PVC of 150mm Ø 'E' Class

***Screen*:**
42.68m (42.71 m -85.39 m), PVC of 150mm Ø 'E' Class

***Screen Slot*:**
0.762mm (30 Slot)

***Sand Trap*:**
1.52m (85.39m- 86.91 m) long, 150mm Ø PVC 'E' Class with a Bail Plug

***Gravel Pack*:**
From 21.34m to drilling depth

Annexure-IV

Table-2: Summary of grain size analysis of PW-01

Work: Summary analysis of sand samples of PW-01
Depth of drilling: 92.68m Drilling completion: 24 August to 09 September 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5?N24^{0}02'59.4?(inside-'Site-A' and beside canal of GK Project)
Date of analysis: 04 to 06 September 2008

SUMMARY OF GRAIN SIZE ANALYSIS

Depth (m)	Thickness (m)	Average Sand Size	Particle size dia. in mm				Uniformity coefficient (Uc)	Sorting by size	Fineness modulus (F)	Particle size (%)		
			D_{10}	D_{30}	D_{50}	D_{60}				Fine sand	Medium sand	Coarse sand
0.00												
3.05	3.05	Clay										
6.10	3.05	Sandy Clay										
12.20	6.10	Fine to medum Sand	0.10	0.19	0.24	0.27	2.70		1.18	54	39	7
18.29	6.09	Medium to coarse Sand	0.18	0.30	0.40	0.45	2.50	Unsorted formation	1.88	22	52	26
27.44	9.15	Fine to very fine Sand	0.05	0.14	0.18	0.19	3.80		0.80	80	20	--
36.59	9.15	Fine to medium Sand	0.13	0.21	0.28	0.31	2.38	Sorted formation	1.41	42	48	10
42.68	6.09	Medium to coarse Sand	0.13	0.25	0.36	0.42	3.23		1.73	30	45	25
54.88	12.20	Coarse Sand	0.19	0.34	0.45	0.50	2.63	Unsorted formation	2.15	18	43	39
67.07	12.19	Medium to coarse Sand	0.18	0.29	0.40	0.45	2.50		1.86	23	48	29
82.32	15.25	Medium Sand	0.18	0.26	0.34	0.39	2.17	Sorted formation	1.63	28	54	18
91.46	9.14	Fine to medium Sand	0.12	0.21	0.29	0.32	2.67	Unsorted formation	1.43	39	50	11
92.68	1.22	Coarse Sand with Gravel	0.18	0.27	0.37	0.42	2.33	Sorted formation	1.85	26	48	26
	86.58											

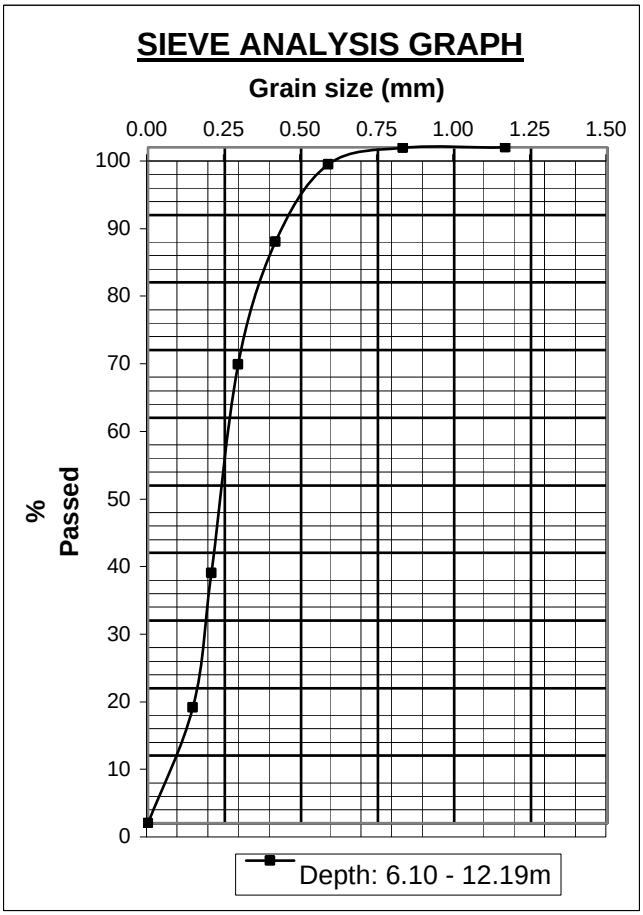
Annexure-IV

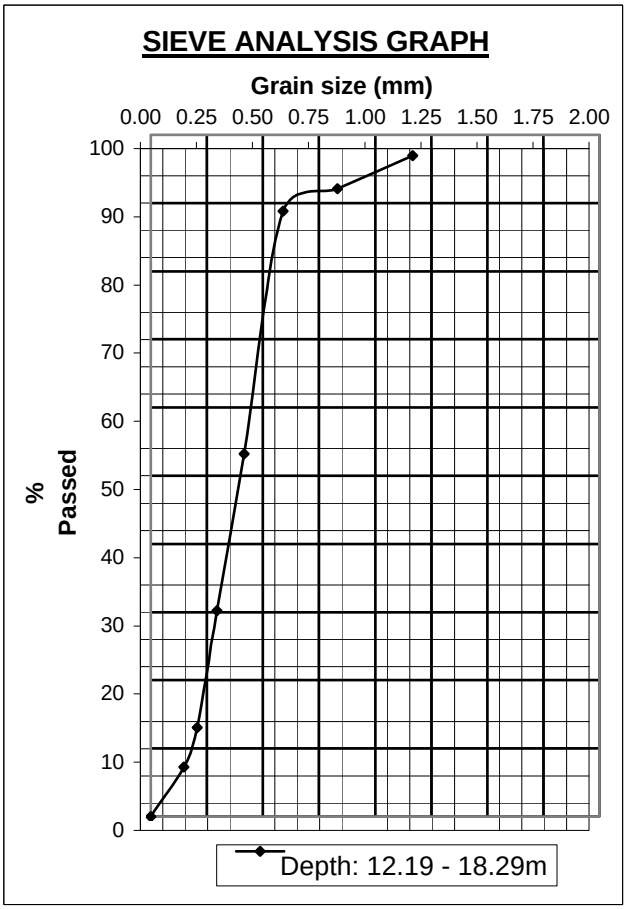
Figure-2.1: Analysis of sand samples of PW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: PW-01 Depth of drilling: 92.68m Drilling completion: 24 August to 09 September 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5?N24^{0}02'59.4?(inside-'Site-A' and beside canal of GK Project)
Date of analysis: 04 to 06 September 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 6.10 - 12.19m				Depth: 12.19 - 18.29m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	2.21	3.08	3.08	**96.92**
20	**0.833**	0.06	0.08	0.08	**99.92**	5.68	7.92	11.00	**92.08**
30	**0.589**	1.82	2.51	2.60	**97.49**	8.02	11.18	22.17	**88.82**
40	**0.417**	8.21	11.34	13.94	**86.06**	17.64	24.59	46.76	**53.24**
50	**0.295**	13.16	18.18	32.12	**67.88**	16.55	23.07	69.83	**30.17**
70	**0.208**	22.34	30.86	62.98	**37.02**	12.30	17.14	86.97	**13.03**
100	**0.147**	14.40	19.89	82.87	**17.13**	4.12	5.74	92.71	**7.29**
Pan	**0.000**	12.40	17.13	100.00	**0.00**	5.23	7.29	100.00	**0.00**
Total		72.39	100.00			71.75	100.00		





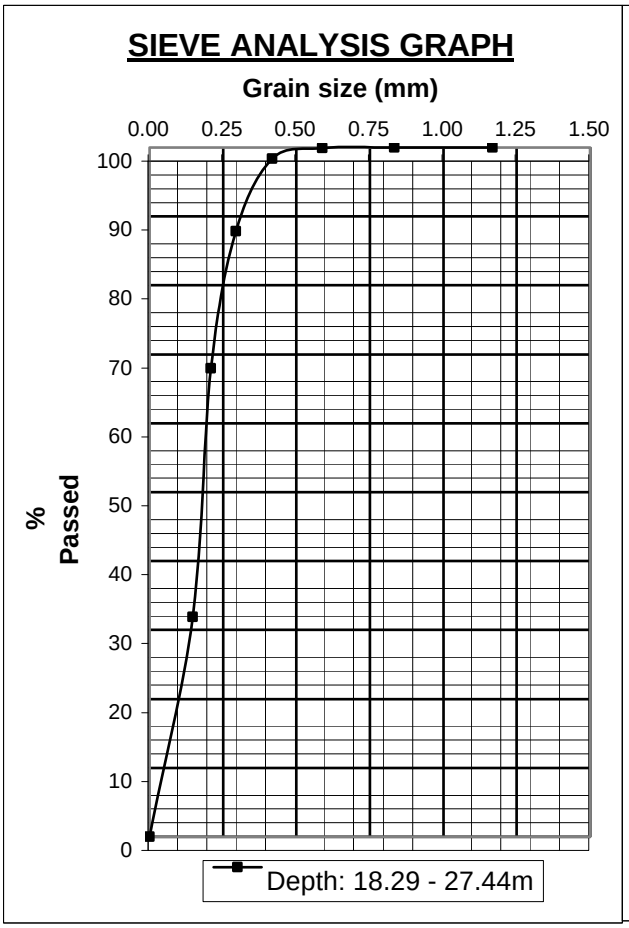
Annexure-IV

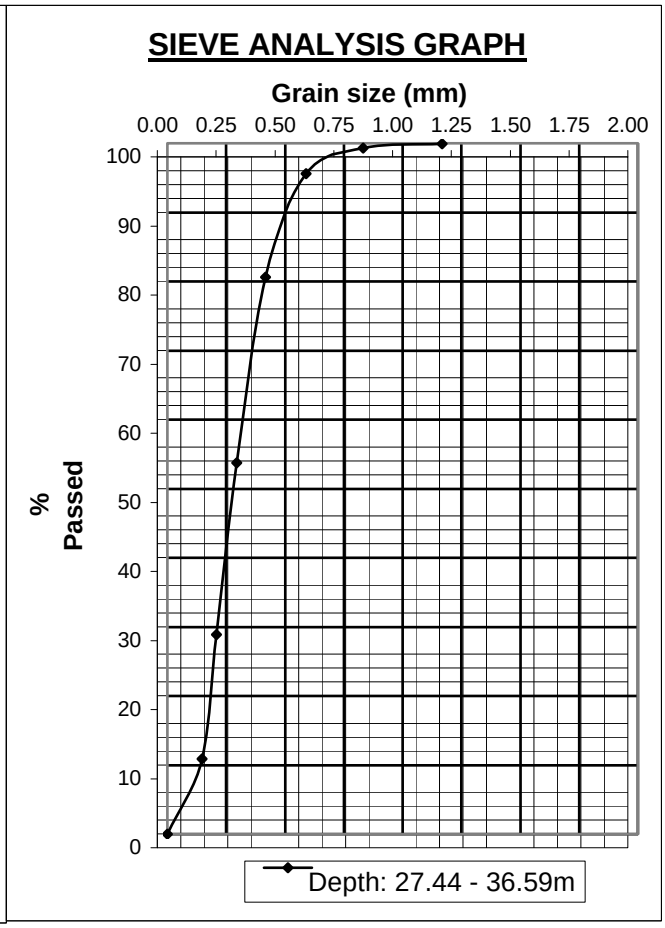
Figure-2.2: Analysis of sand samples of PW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: PW-01 Depth of drilling: 92.68m Drilling completion: 24 August to 09 September 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5?N24^{0}02'59.4?(inside-'Site-A' and beside canal of GK Project)
Date of analysis: 04 to 06 September 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 18.29 - 27.44m				Depth: 27.44 - 36.59m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.00	0.00	0.00	**100.00**	0.08	0.11	0.11	**99.89**
20	**0.833**	0.00	0.00	0.00	**100.00**	0.54	0.71	0.82	**99.29**
30	**0.589**	0.06	0.10	0.10	**99.90**	3.36	4.43	5.25	**95.57**
40	**0.417**	0.97	1.54	1.63	**98.37**	10.69	14.11	19.36	**80.64**
50	**0.295**	6.62	10.49	12.12	**87.88**	20.36	26.87	46.23	**53.77**
70	**0.208**	12.59	19.94	32.06	**67.94**	18.84	24.86	71.10	**28.90**
100	**0.147**	22.77	36.07	68.13	**31.87**	13.65	18.02	89.11	**10.89**
Pan	**0.000**	20.12	31.87	100.00	**0.00**	8.25	10.89	100.00	**0.00**
Total		63.13	100.00			75.77	100.00		





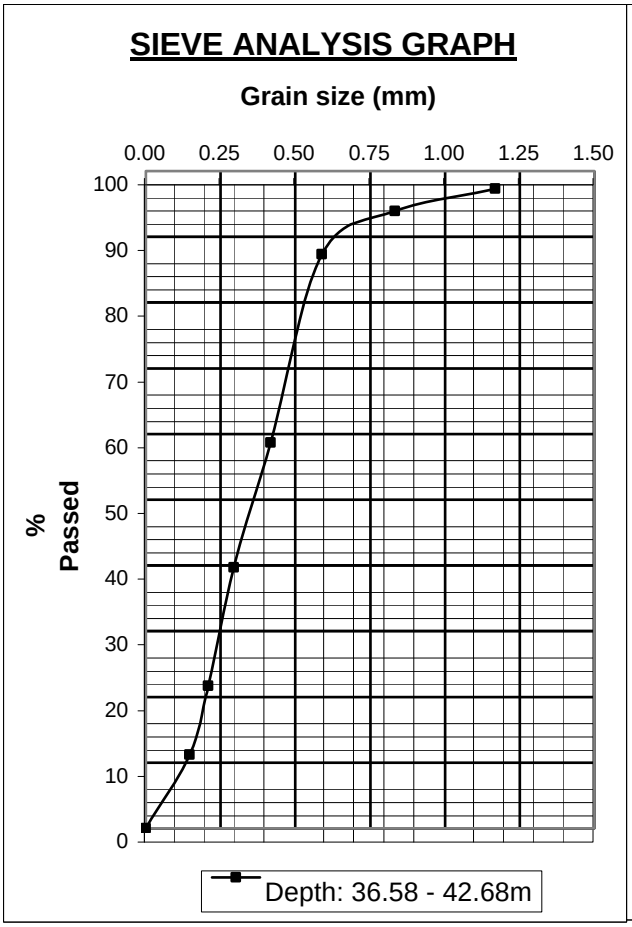
Annexure-IV

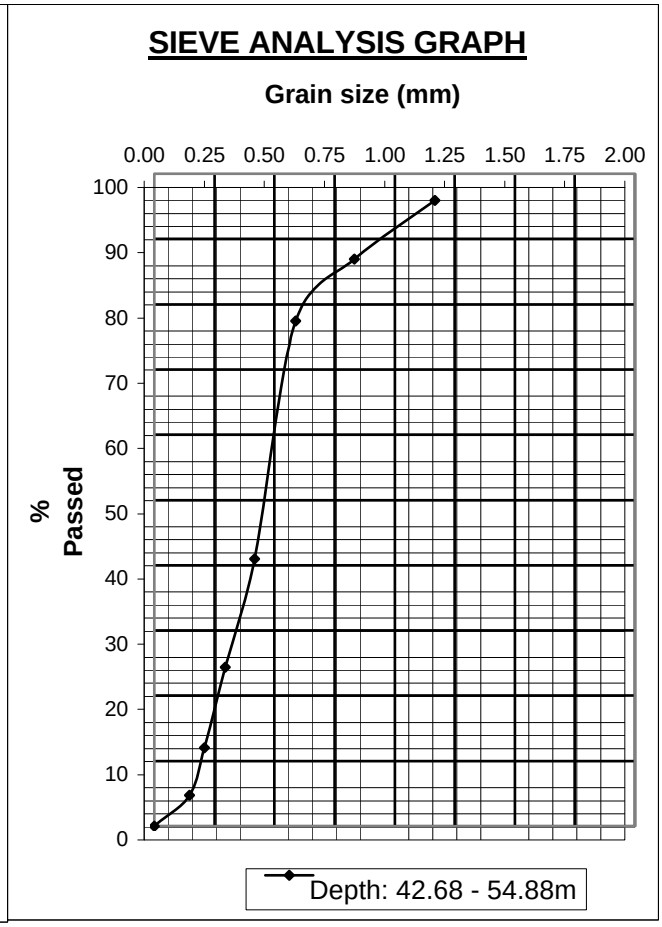
Figure-2.3: Analysis of sand samples of PW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: PW-01 Depth of drilling: 92.68m Drilling completion: 24 August to 09 September 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5?N24^{0}02'59.4?(inside-'Site-A' and beside canal of GK Project)
Date of analysis: 04 to 06 September 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 36.58 - 42.68m				Depth: 42.68 - 54.88m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	2.47	2.65	2.65	**97.35**	3.30	4.06	4.06	**95.94**
20	**0.833**	5.65	6.07	8.73	**93.93**	10.66	13.12	17.18	**86.88**
30	**0.589**	11.77	12.65	21.38	**87.35**	18.35	22.58	39.76	**77.42**
40	**0.417**	18.56	19.95	41.32	**58.68**	15.65	19.26	59.02	**40.98**
50	**0.295**	17.66	18.98	60.30	**39.70**	13.50	16.61	75.63	**24.37**
70	**0.208**	16.81	18.07	78.37	**21.63**	10.02	12.33	87.96	**12.04**
100	**0.147**	9.71	10.44	88.80	**11.20**	5.91	7.27	95.24	**4.76**
Pan	**0.000**	10.42	11.20	100.00	**0.00**	3.87	4.76	100.00	**0.00**
Total		93.05	100.00			81.26	100.00		





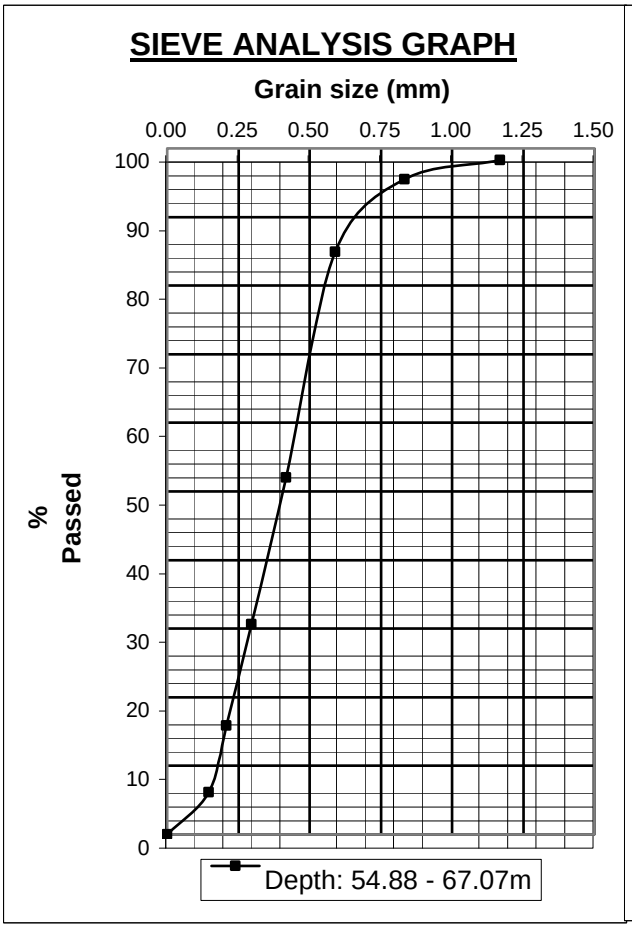
Annexure-IV

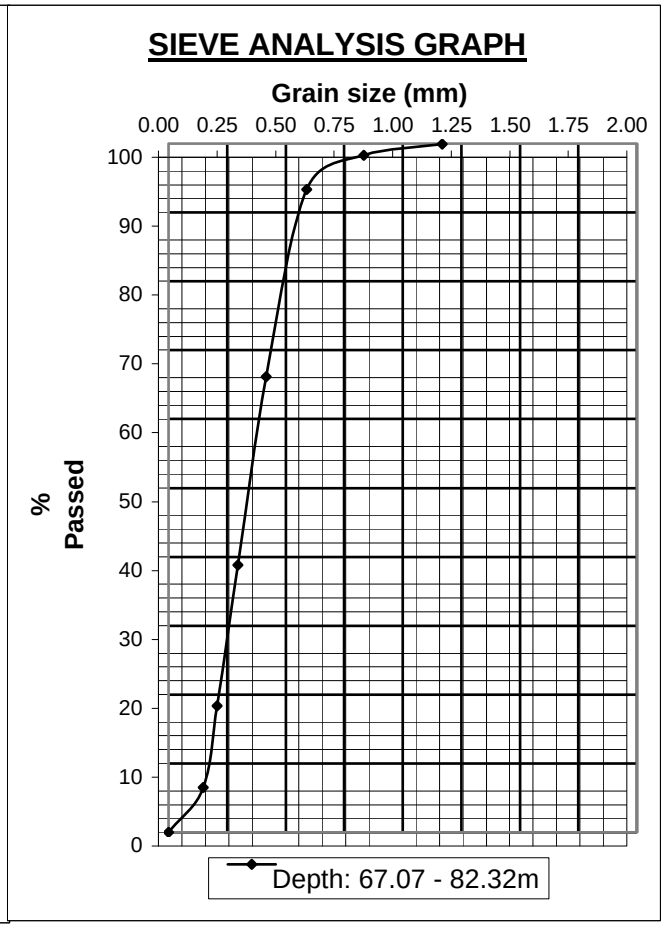
Figure-2.4: Analysis of sand samples of PW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: PW-01 Depth of drilling: 92.68m Drilling completion: 24 August to 09 September 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5?N24^{0}02'59.4?(inside-'Site-A' and beside canal of GK Project)
Date of analysis: 04 to 06 September 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 54.88 - 67.07m				Depth: 67.07 - 82.32m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	1.18	1.72	1.72	**98.28**	0.03	0.04	0.04	**99.96**
20	**0.833**	3.08	4.50	6.22	**95.50**	1.18	1.68	1.72	**98.32**
30	**0.589**	10.32	15.07	21.30	**84.93**	4.66	6.63	8.35	**93.37**
40	**0.417**	18.29	26.72	48.01	**51.99**	17.92	25.49	33.84	**66.16**
50	**0.295**	14.62	21.36	69.37	**30.63**	19.21	27.33	61.17	**38.83**
70	**0.208**	10.11	14.77	84.14	**15.86**	14.40	20.48	81.65	**18.35**
100	**0.147**	6.65	9.71	93.85	**6.15**	8.32	11.83	93.49	**6.51**
Pan	**0.000**	4.21	6.15	100.00	**0.00**	4.58	6.51	100.00	**0.00**
Total		68.46	100.00			70.30	100.00		



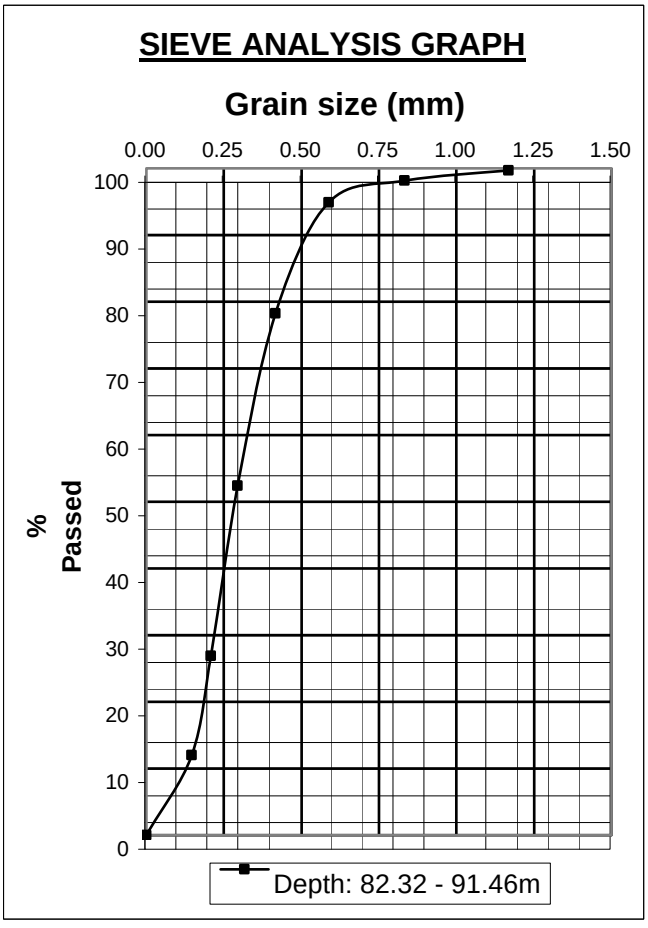


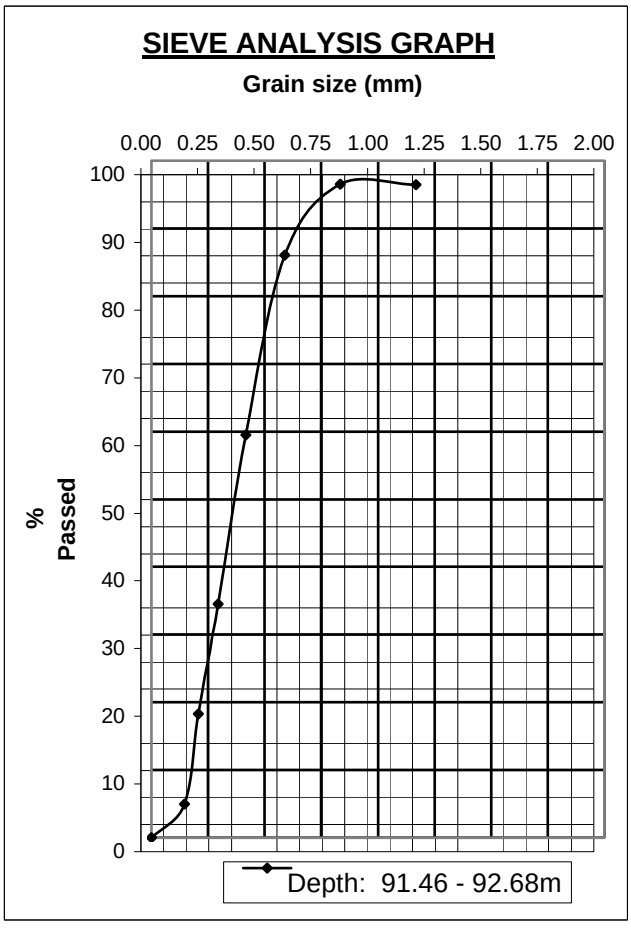
Annexure-IV
Figure-2.5: Analysis of sand samples of PW-01

Work: Analysis of sand samples at DPHE, Groundwater Division, Dhaka
Source: PW-01 Depth of drilling: 92.68m Drilling completion: 24 August to 09 September 2008
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5?N24^{0}02'59.4?(inside-'Site-A' and beside canal of GK Project)
Date of analysis: 04 to 06 September 2008

SIEVE ANALYSIS OF SAND SAMPLES

Mesh No	Sieve Size (mm)	Depth: 82.32 - 91.46m				Depth: 91.46 - 92.68m			
		Material Retained			Material Passed	Material Retained			Material Passed
		Weight (gm)	Fractional (%)	Cumulative (%)	% finer	Weight (gm)	Fractional (%)	Cumulative (%)	% finer
16	**1.168**	0.20	0.28	0.28	**99.72**	2.64	3.56	3.56	**96.44**
20	**0.833**	1.28	1.80	2.08	**98.20**	2.56	3.45	7.02	**96.55**
30	**0.589**	3.65	5.14	7.23	**94.86**	10.32	13.93	20.94	**86.07**
40	**0.417**	10.33	14.55	21.77	**78.23**	14.48	19.54	40.49	**59.51**
50	**0.295**	18.33	25.82	47.59	**52.41**	18.52	24.99	65.48	**34.52**
70	**0.208**	18.11	25.51	73.10	**26.90**	12.04	16.25	81.73	**18.27**
100	**0.147**	10.56	14.87	87.97	**12.03**	9.89	13.35	95.07	**4.93**
Pan	**0.000**	8.54	12.03	100.00	**0.00**	3.65	4.93	100.00	**0.00**
Total		71.00	100.00			74.10	100.00		





Annexure-IV

Table-1: Hydraulic conductivity or co-efficient of permeability (k) of PW-01

Work: Calculation of hydraulic conductivity or co-efficient of permeability (k) from sieve analysis of sand samples of PW-01
Project: Bheramara 450 MW Combined Cycle Power Plant, Bheramara, Kushtia
Location: E89^{0}01'00.5?N24^{0}02'59.4?(inside-'Site-A' and beside canal of GK Project)

Hydraulic conductivity or co-efficient of permeability (k)

Depth (m)	Thickness (m)	Average Sand Size	D_{10}	D_{60}	Uniformity coefficient (Uc)	Sorting by size	**k (m/s) (Hazen 1893)**
0.00							
3.05	3.05	Clay					
6.10	3.05	Sandy Clay					
12.20	6.10	Fine to medum Sand	0.10	0.19	2.70	Unsorted formation	**1.10E-04**
18.29	6.09	Medium to coarse Sand	0.18	0.30	2.50		**3.56E-04**
27.44	9.15	Fine to very fine Sand	0.05	0.14	3.80		**2.75E-05**
36.59	9.15	Fine to medium Sand	0.13	0.21	2.38	Sorted formation	**1.86E-04**
42.68	6.09	Medium to coarse Sand	0.13	0.25	3.23	Unsorted formation	**1.86E-04**
54.88	12.20	Coarse Sand	0.19	0.34	2.63		**3.97E-04**
67.07	12.19	Medium to coarse Sand	0.18	0.29	2.50		**3.56E-04**
82.32	15.25	Medium Sand	0.18	0.26	2.17	Sorted formation	**3.56E-04**
91.46	9.14	Fine to medium Sand	0.12	0.21	2.67	Unsorted formation	**1.58E-04**
92.68	1.22	Coarse Sand with Gravel	0.18	0.27	2.33	Sorted formation	**3.56E-04**
	92.68						

Minimum:		**0.05**	**0.14**	**2.17**		**1.10E-04**
Maximum:		**0.19**	**0.34**	**3.80**		**3.97E-04**
Average:		**0.14**	**0.25**	**2.69**		**2.49E-04**
Transmissivity (T),						**2.31E-02**

Note: *Hydraulic Conductivity (k) varies in proportion to square of effective grain size (10% passing grain size, D_{10}. A good average for natural sands is given by Allan Hazen (1893) as $k = (11)10^3 (D_{10})$ with k expressed in m/sec and 10% passing diameter D_{10} in meters. Transmissivity (T) is derived by multiplying k with aquifer thickness.*

ANNEXURE-V

SECTION LINES AND GEOLOGICAL CROSS SECTIONS

Project: Bheramara 450 MW CC Power Plant, Bheramara, Kushtia
Location: Groundwater Investigation Site.

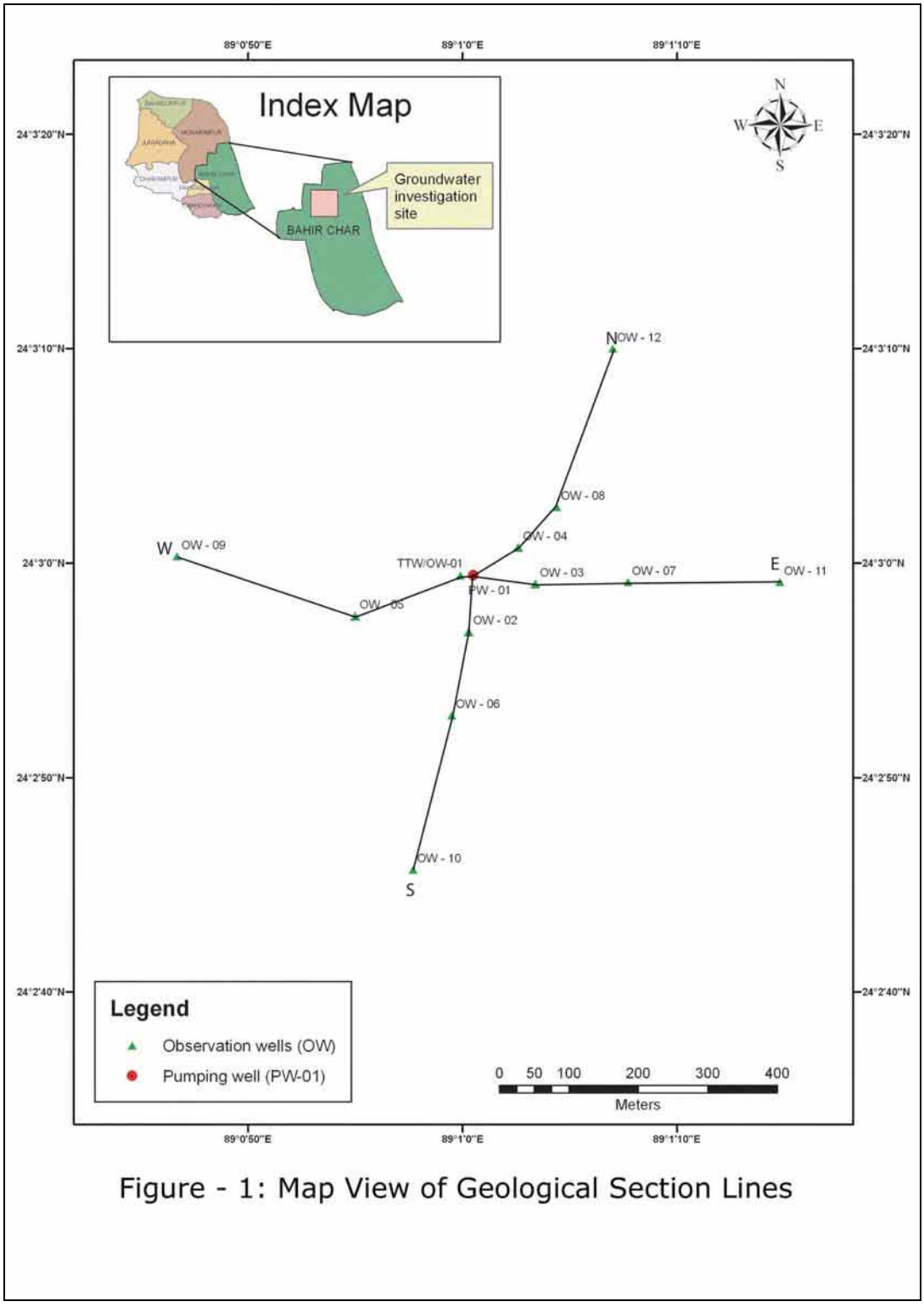
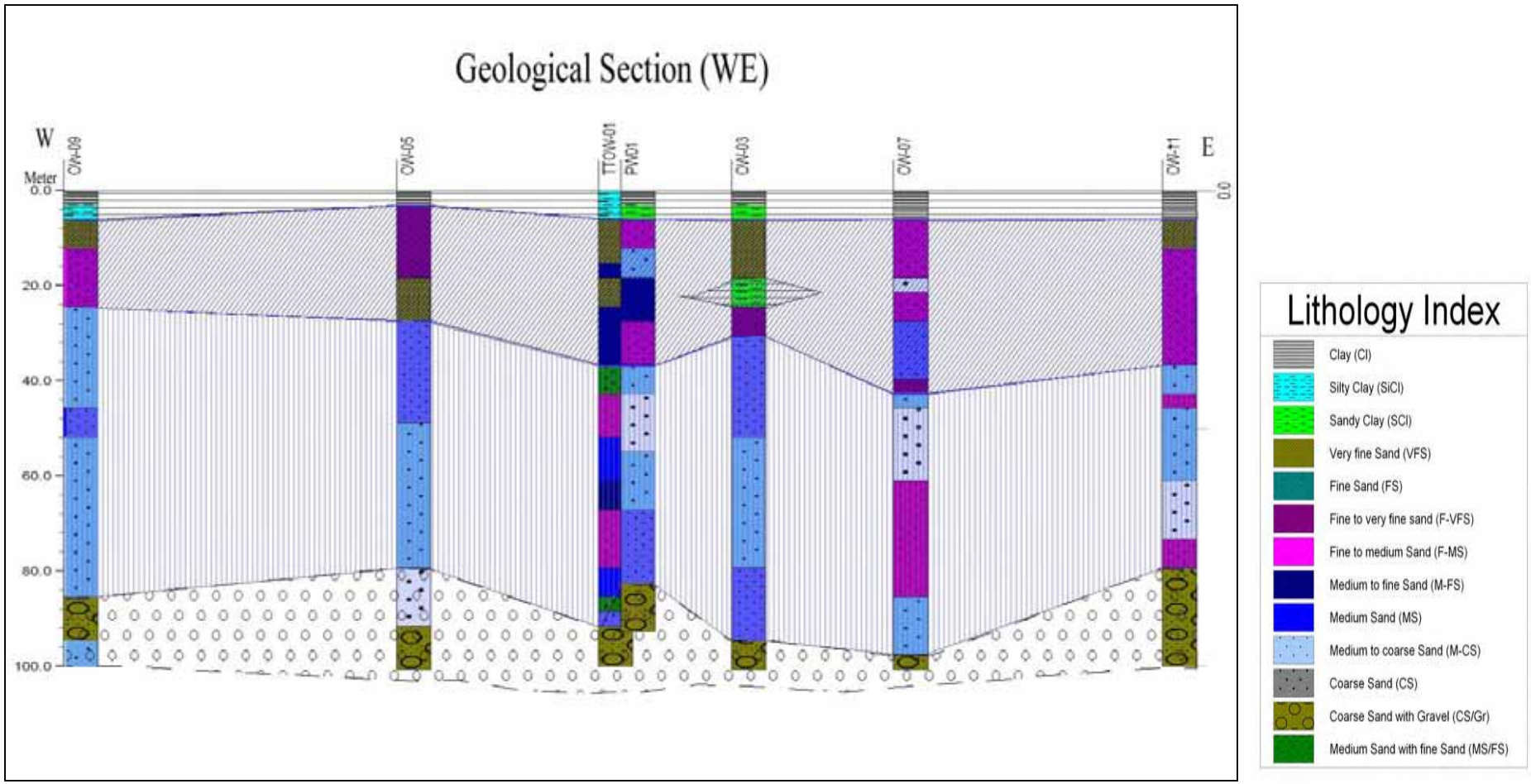


Figure - 1: Map View of Geological Section Lines

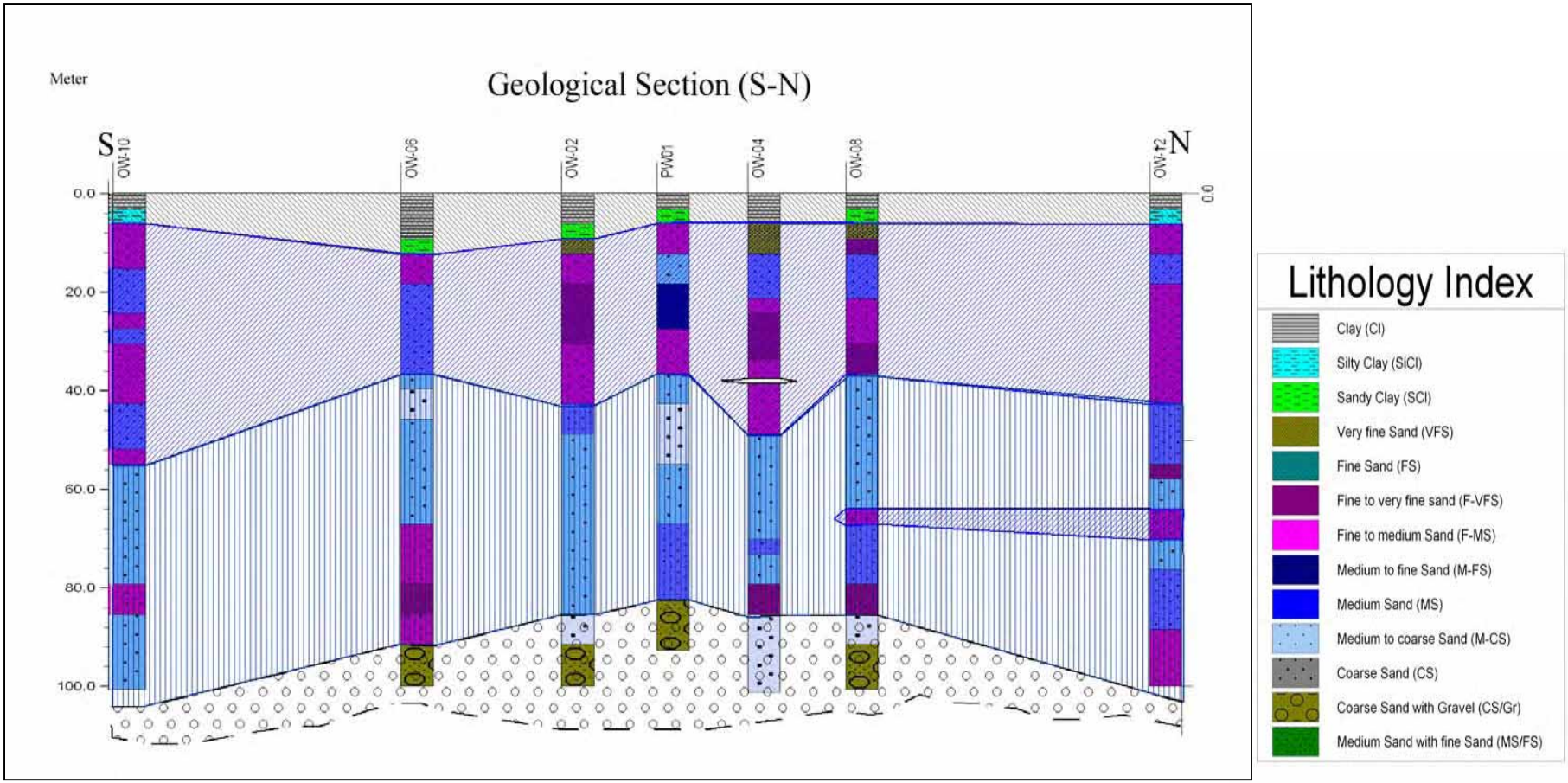
ANNEXURE – V (Page 2 to 3)
Figure – 2: Geological Section from West to East

Project: Bheramara 450 MW CC Power Plant, Bheramara, Kushtia
Location: Groundwater Investigation Site.



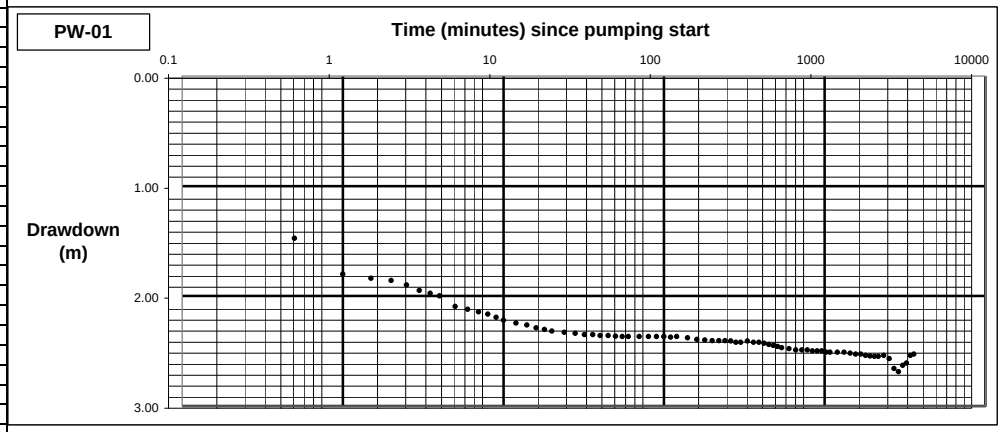
ANNEXURE – V (Page 3 to 3)
Figure – 3: Geological Section from South to North

Project: Bheramara 450 MW CC Power Plant, Bheramara, Kushtia
Location: Groundwater Investigation Site.



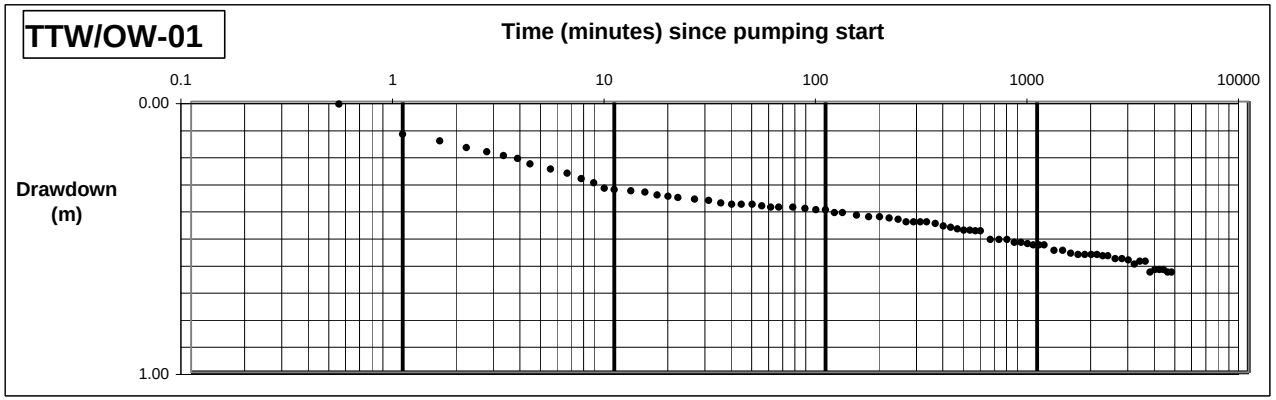
ANNEXURE-VI
PUMPING TEST DATA

PW-01							
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)	Discharge (m3/hr)	Remark
21.09.08	10:00 AM	0.5	3.52	4.995	1.475	159.00	
	10:05 AM	1	3.52	5.320	1.800	159.00	
		1.5	3.52	5.360	1.840	159.00	
		2	3.52	5.380	1.860	159.00	
		2.5	3.52	5.420	1.900	159.00	
		3	3.52	5.470	1.950	159.00	
		3.5	3.52	5.495	1.975	159.00	
		4	3.52	5.520	2.000	159.00	
		5	3.52	5.615	2.095	159.00	
		6	3.52	5.640	2.120	159.00	
		7	3.52	5.665	2.145	159.00	
		8	3.52	5.685	2.165	159.00	
		9	3.52	5.715	2.195	159.00	
		10	3.52	5.740	2.220	159.00	
		12	3.52	5.765	2.245	159.00	
		14	3.52	5.785	2.265	159.00	
		16	3.52	5.810	2.290	159.00	
		18	3.52	5.825	2.305	159.00	
		20	3.52	5.840	2.320	159.00	
		24	3.52	5.850	2.330	159.00	
		28	3.52	5.860	2.340	159.00	
		32	3.52	5.870	2.350	159.00	
		36	3.52	5.870	2.350	159.00	
		40	3.52	5.880	2.360	159.00	
		45	3.52	5.880	2.360	159.00	
		50	3.52	5.885	2.365	159.00	
		55	3.52	5.890	2.370	159.00	
21.09.08	11:00 AM	**60**	3.52	5.890	2.370	159.00	
		70	3.52	5.890	2.370	159.00	
		80	3.52	5.890	2.370	159.00	
		90	3.52	5.890	2.370	159.00	
		100	3.52	5.890	2.370	159.00	
		110	3.52	5.895	2.375	159.00	
21.09.08	12:00 PM	**120**	3.52	5.890	2.370	159.00	
		140	3.52	5.900	2.380	159.00	
		160	3.52	5.915	2.395	159.00	
		180	3.52	5.920	2.400	159.00	
		200	3.52	5.925	2.405	159.00	
		220	3.52	5.925	2.405	159.00	
		240	3.52	5.925	2.405	159.00	
		260	3.52	5.930	2.410	159.00	
		280	3.52	5.940	2.420	159.00	
21.09.08	3:00 PM	**300**	3.52	5.940	2.420	159.00	
		330	3.52	5.930	2.410	159.00	
		360	3.52	5.940	2.420	159.00	
		390	3.52	5.940	2.420	159.00	
		420	3.52	5.950	2.430	159.00	
		450	3.52	5.960	2.440	159.00	
		480	3.52	5.970	2.450	159.00	
		510	3.52	5.980	2.460	159.00	
21.09.08	7:00 PM	**540**	3.52	5.990	2.470	159.00	
		600	3.52	6.000	2.480	159.00	
		660	3.52	6.010	2.490	159.00	
		720	3.52	6.010	2.490	159.00	
		780	3.52	6.010	2.490	159.00	
		840	3.52	6.020	2.500	159.00	



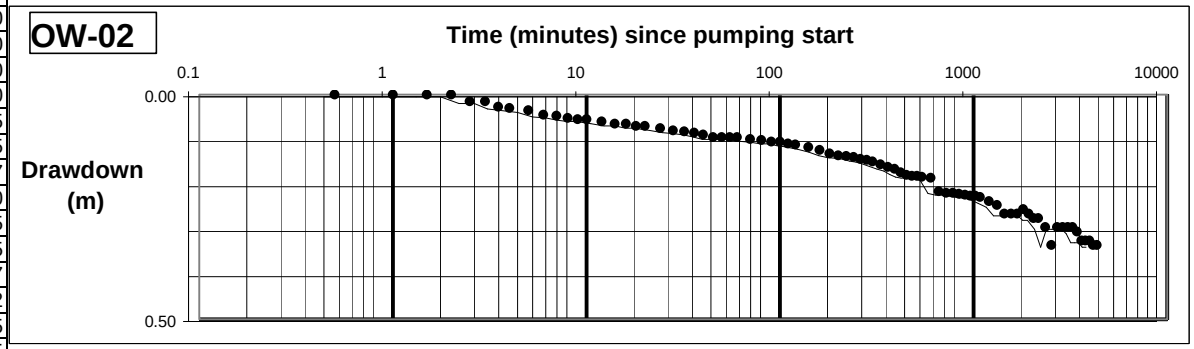
PW-01							
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**	**Discharge (m3/hr)**	**Remark**
22.09.08	1:00 AM	900	3.52	6.020	2.500	159.00	
		960	3.52	6.020	2.500	159.00	
		1020	3.52	6.030	2.510	159.00	
22.09.08	4:00 AM	**1080**	3.52	6.030	2.510	159.00	
		1200	3.52	6.030	2.510	159.00	
		1320	3.52	6.030	2.510	159.00	
		1440	3.52	6.040	2.520	159.00	
		1560	3.52	6.050	2.530	159.00	
		1680	3.52	6.050	2.530	159.00	
		1800	3.52	6.060	2.540	159.00	
		1920	3.52	6.065	2.545	159.00	
		2040	3.52	6.070	2.550	159.00	
22.09.08	10:00 PM	**2160**	3.52	6.070	2.550	159.00	
23.09.08	1:00 AM	2340	3.52	6.060	2.540	**163.30**	Pump stopped for 2/4 minutes at
		2520	3.52	6.090	2.570	**163.30**	about 11:50pm due to mechanical
		2700	3.52	6.180	2.660	**163.30**	
		2880	3.52	6.210	2.690	**163.30**	
23.09.08	1:00 PM	3060	3.52	6.150	2.630	**160.77**	Pump stopped for 2/3 minutes at
		3240	3.52	6.130	2.610	159.00	about 12:30pm due to replacement
		3420	3.52	6.060	2.540	**162.04**	
		3600	3.52	6.050	2.530	**162.04**	
24.09.08	1:00 AM	3780	3.52	6.050	2.530	**162.04**	
		3960	3.52	6.040	2.520	**162.04**	
		4140	3.52	6.090	2.570	**163.30**	
24.09.08	10:00 AM	**4320**	3.52	6.100	2.580	**163.30**	

TTW/OW-01					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	10:00 AM	0.5	3.890	3.900	0.010
	10:05 AM	1	3.890	4.010	0.120
		1.5	3.890	4.035	0.145
		2	3.890	4.060	0.170
		2.5	3.890	4.075	0.185
		3	3.890	4.090	0.200
		3.5	3.890	4.100	0.210
		4	3.890	4.120	0.230
		5	3.890	4.140	0.250
		6	3.890	4.155	0.265
		7	3.890	4.175	0.285
		8	3.890	4.190	0.300
		9	3.890	4.210	0.320
		10	3.890	4.215	0.325
		12	3.890	4.220	0.330
		14	3.890	4.225	0.335
		16	3.890	4.235	0.345
		18	3.890	4.240	0.350
		20	3.890	4.245	0.355
		24	3.890	4.250	0.360
		28	3.890	4.255	0.365
		32	3.890	4.265	0.375
		36	3.890	4.270	0.380
		40	3.890	4.270	0.380
		45	3.890	4.270	0.380
		50	3.890	4.275	0.385
		55	3.890	4.280	0.390
21.09.08	11:00 AM	**60**	3.890	4.280	0.390
		70	3.890	4.280	0.390
		80	3.890	4.285	0.395
		90	3.890	4.290	0.400
		100	3.890	4.290	0.400
		110	3.890	4.300	0.410
21.09.08	12:00 PM	**120**	3.890	4.300	0.410
		140	3.890	4.310	0.420
		160	3.890	4.315	0.425
		180	3.890	4.315	0.425
		200	3.890	4.320	0.430
		220	3.890	4.325	0.435
		240	3.890	4.335	0.445
		260	3.890	4.335	0.445
		280	3.890	4.335	0.445
21.09.08	3:00 PM	**300**	3.890	4.335	0.445
		330	3.890	4.340	0.450
		360	3.890	4.350	0.460
		390	3.890	4.355	0.465
		420	3.890	4.360	0.470
		450	3.890	4.365	0.475
		480	3.890	4.365	0.475
		510	3.890	4.368	0.478



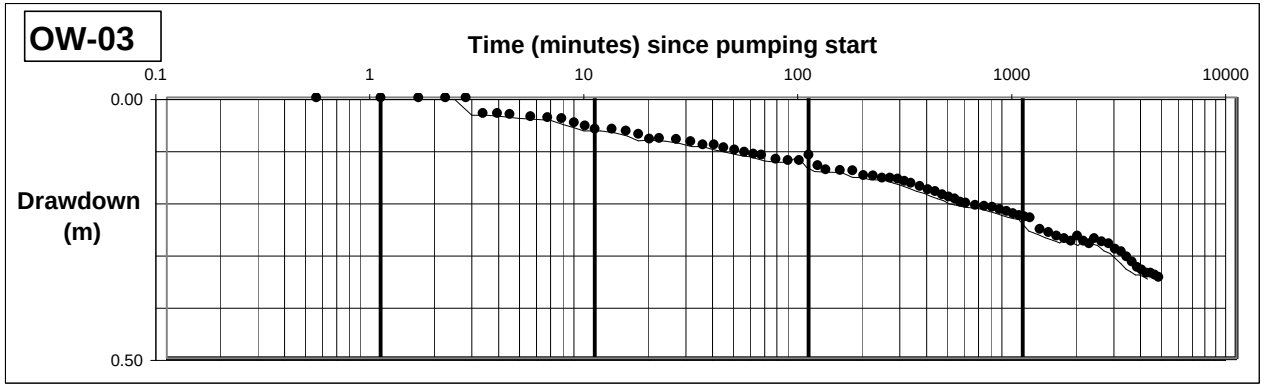
TTW/OW-01					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	7:00 PM	**540**	3.890	4.368	0.478
		600	3.890	4.400	0.510
		660	3.890	4.400	0.510
		720	3.890	4.400	0.510
		780	3.890	4.410	0.520
		840	3.890	4.410	0.520
22.09.08	1:00 AM	900	3.890	4.415	0.525
		960	3.890	4.420	0.530
		1020	3.890	4.420	0.530
22.09.08	4:00 AM	**1080**	3.890	4.420	0.530
		1200	3.890	4.440	0.550
		1320	3.890	4.440	0.550
		1440	3.890	4.450	0.560
		1560	3.890	4.455	0.565
		1680	3.890	4.455	0.565
		1800	3.890	4.455	0.565
		1920	3.890	4.455	0.565
		2040	3.890	4.460	0.570
22.09.08	10:00 PM	**2160**	3.890	4.460	0.570
23.09.08	1:00 AM	2340	3.890	4.470	0.580
		2520	3.890	4.470	0.580
		2700	3.890	4.475	0.585
		2880	3.890	4.490	0.600
23.09.08	1:00 PM	3060	3.890	4.480	0.590
		3240	3.890	4.480	0.590
		3420	3.890	4.520	0.630
		3600	3.890	4.510	0.620
24.09.08	1:00 AM	3780	3.890	4.510	0.620
		3960	3.890	4.510	0.620
		4140	3.890	4.520	0.630
24.09.08	10:00 AM	**4320**	3.890	4.520	0.630

OW-02					
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	10:00 AM	0.5	2.705	2.705	0.000
	10:05 AM	1	2.705	2.705	0.000
		1.5	2.705	2.705	0.000
		2	2.705	2.705	0.000
		2.5	2.705	2.720	0.015
		3	2.705	2.720	0.015
		3.5	2.705	2.732	0.027
		4	2.705	2.735	0.030
		5	2.705	2.740	0.035
		6	2.705	2.750	0.045
		7	2.705	2.752	0.047
		8	2.705	2.757	0.052
		9	2.705	2.760	0.055
		10	2.705	2.760	0.055
		12	2.705	2.765	0.060
		14	2.705	2.770	0.065
		16	2.705	2.770	0.065
		18	2.705	2.775	0.070
		20	2.705	2.775	0.070
		24	2.705	2.780	0.075
		28	2.705	2.785	0.080
		32	2.705	2.787	0.082
		36	2.705	2.790	0.085
		40	2.705	2.794	0.089
		45	2.705	2.800	0.095
		50	2.705	2.800	0.095
		55	2.705	2.800	0.095
21.09.08	11:00 AM	**60**	2.705	2.800	0.095
		70	2.705	2.804	0.099
		80	2.705	2.806	0.101
		90	2.705	2.810	0.105
		100	2.705	2.810	0.105
		110	2.705	2.814	0.109
21.09.08	12:00 PM	**120**	2.705	2.816	0.111
		140	2.705	2.822	0.117
		160	2.705	2.828	0.123
		180	2.705	2.836	0.131
		200	2.705	2.840	0.135
		220	2.705	2.842	0.137
		240	2.705	2.844	0.139
		260	2.705	2.848	0.143
		280	2.705	2.850	0.145
21.09.08	3:00 PM	**300**	2.705	2.854	0.149
		330	2.705	2.860	0.155
		360	2.705	2.866	0.161
		390	2.705	2.870	0.165
		420	2.705	2.878	0.173
		450	2.705	2.884	0.179
		480	2.705	2.886	0.181
		510	2.705	2.886	0.181



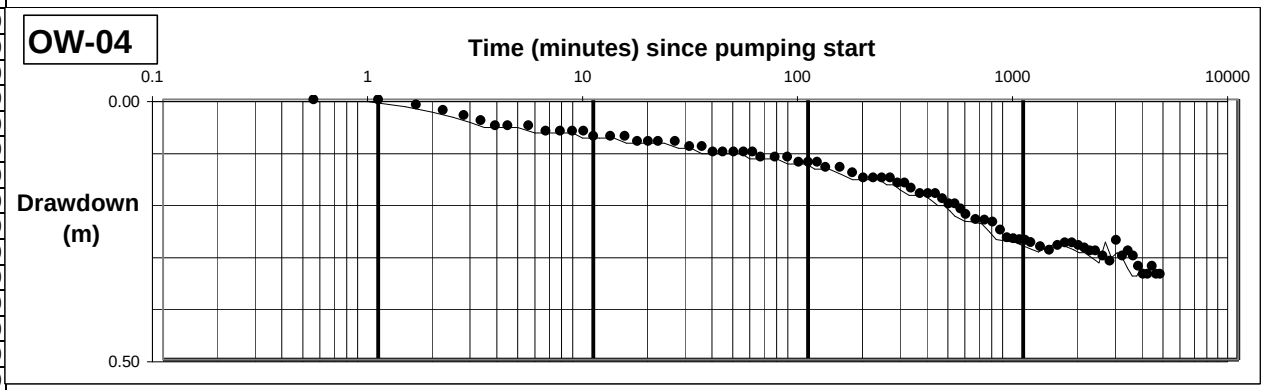
OW-02					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	7:00 PM	**540**	2.705	2.888	0.183
		600	2.705	2.890	0.185
		660	2.705	2.920	0.215
		720	2.705	2.924	0.219
		780	2.705	2.924	0.219
		840	2.705	2.926	0.221
22.09.08	1:00 AM	900	2.705	2.928	0.223
		960	2.705	2.930	0.225
		1020	2.705	2.930	0.225
22.09.08	4:00 AM	**1080**	2.705	2.933	0.228
		1200	2.705	2.942	0.237
		1320	2.705	2.951	0.246
		1440	2.705	2.970	0.265
		1560	2.705	2.970	0.265
		1680	2.705	2.970	0.265
		1800	2.705	2.960	0.255
		1920	2.705	2.970	0.265
		2040	2.705	2.980	0.275
22.09.08	10:00 PM	**2160**	2.705	2.980	0.275
23.09.08	1:00 AM	2340	2.705	3.000	0.295
		2520	2.705	3.040	0.335
		2700	2.705	3.000	0.295
		2880	2.705	3.000	0.295
23.09.08	1:00 PM	3060	2.705	3.000	0.295
		3240	2.705	3.000	0.295
		3420	2.705	3.010	0.305
		3600	2.705	3.030	0.325
24.09.08	1:00 AM	3780	2.705	3.030	0.325
		3960	2.705	3.030	0.325
		4140	2.705	3.040	0.335
24.09.08	10:00 AM	**4320**	2.705	3.040	0.335

OW-03					
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	10:00 AM	0.5	3.49	3.490	0.000
	10:05 AM	1	3.49	3.490	0.000
		1.5	3.49	3.490	0.000
		2	3.49	3.490	0.000
		2.5	3.49	3.490	0.000
		3	3.49	3.520	0.030
		3.5	3.49	3.520	0.030
		4	3.49	3.522	0.032
		5	3.49	3.526	0.036
		6	3.49	3.528	0.038
		7	3.49	3.530	0.040
		8	3.49	3.538	0.048
		9	3.49	3.544	0.054
		10	3.49	3.550	0.060
		12	3.49	3.550	0.060
		14	3.49	3.554	0.064
		16	3.49	3.560	0.070
		18	3.49	3.569	0.079
		20	3.49	3.568	0.078
		24	3.49	3.570	0.080
		28	3.49	3.574	0.084
		32	3.49	3.580	0.090
		36	3.49	3.580	0.090
		40	3.49	3.586	0.096
		45	3.49	3.590	0.100
		50	3.49	3.594	0.104
		55	3.49	3.598	0.108
21.09.08	11:00 AM	**60**	3.49	3.600	0.110
		70	3.49	3.608	0.118
		80	3.49	3.610	0.120
		90	3.49	3.610	0.120
		100	3.49	3.600	0.110
		110	3.49	3.620	0.130
21.09.08	12:00 PM	**120**	3.49	3.628	0.138
		140	3.49	3.629	0.139
		160	3.49	3.630	0.140
		180	3.49	3.639	0.149
		200	3.49	3.640	0.150
		220	3.49	3.644	0.154
		240	3.49	3.644	0.154
		260	3.49	3.646	0.156
		280	3.49	3.650	0.160
21.09.08	3:00 PM	**300**	3.49	3.654	0.164
		330	3.49	3.660	0.170
		360	3.49	3.666	0.176
		390	3.49	3.670	0.180
		420	3.49	3.676	0.186
		450	3.49	3.680	0.190
		480	3.49	3.684	0.194
		510	3.49	3.690	0.200



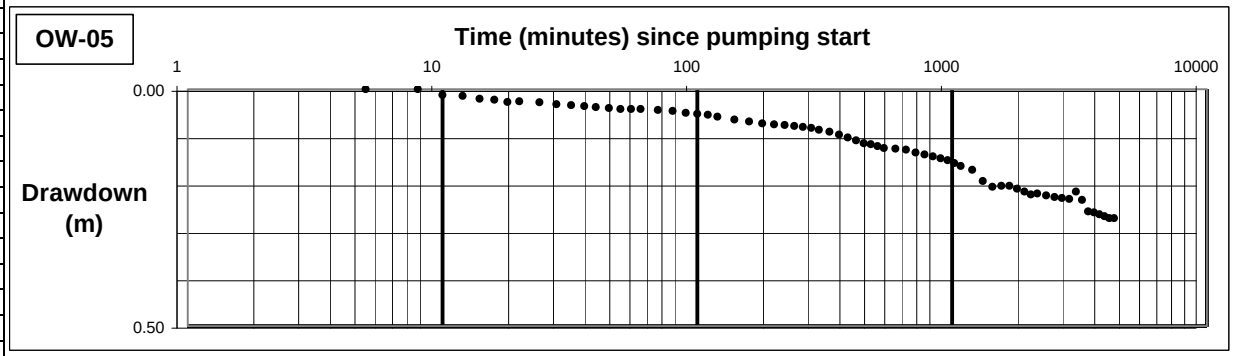
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	7:00 PM	**540**	3.49	3.692	0.202
		600	3.49	3.696	0.206
		660	3.49	3.698	0.208
		720	3.49	3.700	0.210
		780	3.49	3.704	0.214
		840	3.49	3.708	0.218
22.09.08	1:00 AM	900	3.49	3.712	0.222
		960	3.49	3.716	0.226
		1020	3.49	3.718	0.228
22.09.08	4:00 AM	**1080**	3.49	3.720	0.230
		1200	3.49	3.742	0.252
		1320	3.49	3.748	0.258
		1440	3.49	3.755	0.265
		1560	3.49	3.760	0.270
		1680	3.49	3.765	0.275
		1800	3.49	3.755	0.265
		1920	3.49	3.765	0.275
		2040	3.49	3.770	0.280
22.09.08	10:00 PM	**2160**	3.49	3.760	0.270
23.09.08	1:00 AM	2340	3.49	3.766	0.276
		2520	3.49	3.770	0.280
		2700	3.49	3.780	0.290
		2880	3.49	3.785	0.295
23.09.08	1:00 PM	3060	3.49	3.795	0.305
		3240	3.49	3.805	0.315
		3420	3.49	3.815	0.325
		3600	3.49	3.820	0.330
24.09.08	1:00 AM	3780	3.49	3.826	0.336
		3960	3.49	3.826	0.336
		4140	3.49	3.830	0.340
24.09.08	10:00 AM	**4320**	3.49	3.834	0.344

OW - 4					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	10:00 AM	0.5	3.780	3.780	0.000
	10:05 AM	1	3.780	3.780	0.000
		1.5	3.780	3.790	0.010
		2	3.780	3.800	0.020
		2.5	3.780	3.810	0.030
		3	3.780	3.820	0.040
		3.5	3.780	3.830	0.050
		4	3.780	3.830	0.050
		5	3.780	3.830	0.050
		6	3.780	3.840	0.060
		7	3.780	3.840	0.060
		8	3.780	3.840	0.060
		9	3.780	3.840	0.060
		10	3.780	3.850	0.070
		12	3.780	3.850	0.070
		14	3.780	3.850	0.070
		16	3.780	3.860	0.080
		18	3.780	3.860	0.080
		20	3.780	3.860	0.080
		24	3.780	3.860	0.080
		28	3.780	3.870	0.090
		32	3.780	3.870	0.090
		36	3.780	3.880	0.100
		40	3.780	3.880	0.100
		45	3.780	3.880	0.100
		50	3.780	3.880	0.100
		55	3.780	3.880	0.100
21.09.08	11:00 AM	**60**	3.780	3.890	0.110
		70	3.780	3.890	0.110
		80	3.780	3.890	0.110
		90	3.780	3.900	0.120
		100	3.780	3.900	0.120
		110	3.780	3.900	0.120
21.09.08	12:00 PM	**120**	3.780	3.910	0.130
		140	3.780	3.910	0.130
		160	3.780	3.920	0.140
		180	3.780	3.930	0.150
		200	3.780	3.930	0.150
		220	3.780	3.930	0.150
		240	3.780	3.930	0.150
		260	3.780	3.940	0.160
		280	3.780	3.940	0.160
21.09.08	3:00 PM	**300**	3.780	3.950	0.170
		330	3.780	3.960	0.180
		360	3.780	3.960	0.180
		390	3.780	3.960	0.180
		420	3.780	3.970	0.190
		450	3.780	3.980	0.200
		480	3.780	3.980	0.200
		510	3.780	3.990	0.210



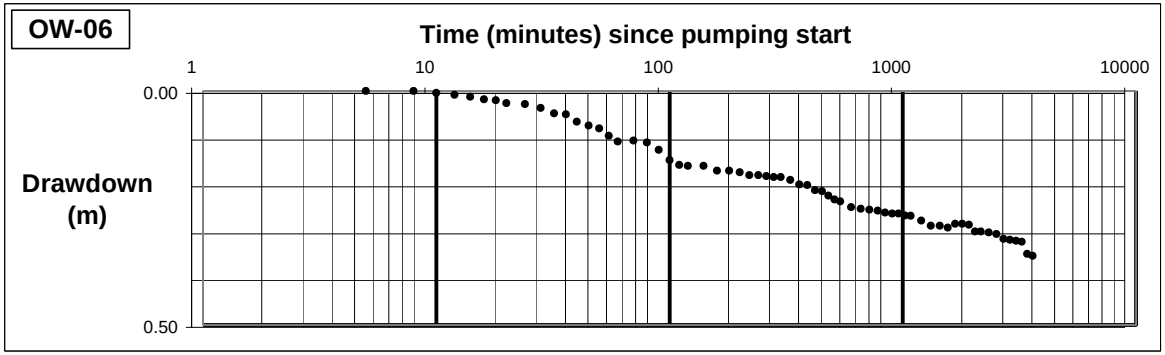
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	7:00 PM	**540**	3.780	4.000	0.220
		600	3.780	4.010	0.230
		660	3.780	4.011	0.231
		720	3.780	4.015	0.235
		780	3.780	4.030	0.250
		840	3.780	4.045	0.265
22.09.08	1:00 AM	900	3.780	4.047	0.267
		960	3.780	4.049	0.269
		1020	3.780	4.050	0.270
22.09.08	4:00 AM	**1080**	3.780	4.054	0.274
		1200	3.780	4.062	0.282
		1320	3.780	4.069	0.289
		1440	3.780	4.060	0.280
		1560	3.780	4.055	0.275
		1680	3.780	4.055	0.275
		1800	3.780	4.060	0.280
		1920	3.780	4.065	0.285
		2040	3.780	4.070	0.290
22.09.08	10:00 PM	**2160**	3.780	4.070	0.290
23.09.08	1:00 AM	2340	3.780	4.080	0.300
		2520	3.780	4.090	0.310
		2700	3.780	4.050	0.270
		2880	3.780	4.080	0.300
23.09.08	1:00 PM	3060	3.780	4.070	0.290
		3240	3.780	4.080	0.300
		3420	3.780	4.100	0.320
		3600	3.780	4.115	0.335
24.09.08	1:00 AM	3780	3.780	4.115	0.335
		3960	3.780	4.100	0.320
		4140	3.780	4.115	0.335
24.09.08	10:00 AM	**4320**	3.780	4.115	0.335

OW-05					
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	10:00 AM	0.5	**2.190**	2.190	0.000E+00
	10:05 AM	5	**2.190**	2.190	0.000E+00
		8	**2.190**	2.190	0.000E+00
		10	**2.190**	2.202	1.200E-02
		12	**2.190**	2.204	1.400E-02
		14	**2.190**	2.210	2.000E-02
		16	**2.190**	2.212	2.200E-02
		18	**2.190**	2.217	2.700E-02
		20	**2.190**	2.216	2.600E-02
		24	**2.190**	2.218	2.800E-02
		28	**2.190**	2.222	3.200E-02
		32	**2.190**	2.224	3.400E-02
		36	**2.190**	2.226	3.600E-02
		40	**2.190**	2.228	3.800E-02
		45	**2.190**	2.230	4.000E-02
		50	**2.190**	2.232	4.200E-02
		55	**2.190**	2.232	4.200E-02
21.09.08	11:00 AM	**60**	**2.190**	2.232	4.200E-02
		70	**2.190**	2.234	4.400E-02
		80	**2.190**	2.236	4.600E-02
		90	**2.190**	2.240	5.000E-02
		100	**2.190**	2.242	5.200E-02
		110	**2.190**	2.244	5.400E-02
21.09.08	12:00 PM	**120**	**2.190**	2.248	5.800E-02
		140	**2.190**	2.254	6.400E-02
		160	**2.190**	2.258	6.800E-02
		180	**2.190**	2.262	7.200E-02
		200	**2.190**	2.264	7.400E-02
		220	**2.190**	2.266	7.600E-02
		240	**2.190**	2.268	7.800E-02
		260	**2.190**	2.270	8.000E-02
		280	**2.190**	2.272	8.200E-02
21.09.08	3:00 PM	**300**	**2.190**	2.276	8.600E-02
		330	**2.190**	2.280	9.000E-02
		360	**2.190**	2.286	9.600E-02
		390	**2.190**	2.292	1.020E-01
		420	**2.190**	2.298	1.080E-01
		450	**2.190**	2.304	1.140E-01
		480	**2.190**	2.306	1.160E-01
		510	**2.190**	2.310	1.200E-01
21.09.08	7:00 PM	**540**	**2.190**	2.314	1.240E-01
		600	**2.190**	2.316	1.260E-01
		660	**2.190**	2.318	1.280E-01
		720	**2.190**	2.324	1.340E-01
		780	**2.190**	2.328	1.380E-01
		840	**2.190**	2.332	1.420E-01



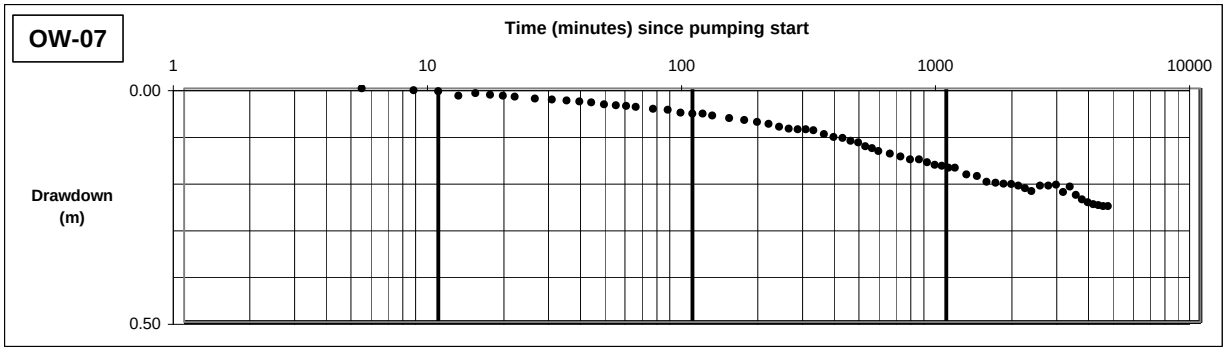
OW-05					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
22.09.08	1:00 AM	900	**2.190**	2.336	1.460E-01
		960	**2.190**	2.340	1.500E-01
		1020	**2.190**	2.346	1.560E-01
22.09.08	4:00 AM	**1080**	**2.190**	2.352	1.620E-01
		1200	**2.190**	2.360	1.700E-01
		1320	**2.190**	2.384	1.940E-01
		1440	**2.190**	2.396	2.060E-01
		1560	**2.190**	2.394	2.040E-01
		1680	**2.190**	2.394	2.040E-01
		1800	**2.190**	2.400	2.100E-01
		1920	**2.190**	2.406	2.160E-01
		2040	**2.190**	2.412	2.220E-01
22.09.08	10:00 PM	**2160**	**2.190**	2.410	2.200E-01
23.09.08	1:00 AM	2340	**2.190**	2.414	2.240E-01
		2520	**2.190**	2.418	2.280E-01
		2700	**2.190**	2.420	2.300E-01
		2880	**2.190**	2.422	2.320E-01
23.09.08	1:00 PM	3060	**2.190**	2.406	2.160E-01
		3240	**2.190**	2.424	2.340E-01
		3420	**2.190**	2.448	2.580E-01
		3600	**2.190**	2.450	2.600E-01
24.09.08	1:00 AM	3780	**2.190**	2.454	2.640E-01
		3960	**2.190**	2.458	2.680E-01
		4140	**2.190**	2.462	2.720E-01
24.09.08	10:00 AM	**4320**	**2.190**	2.462	2.720E-01

OW-06					
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	10:00 AM	0.5	**3.600**	3.600	0.000E+00
	10:05 AM	5	**3.600**	3.600	0.000E+00
		8	**3.600**	3.600	0.000E+00
		10	**3.600**	3.604	4.000E-03
		12	**3.600**	3.608	8.000E-03
		14	**3.600**	3.612	1.200E-02
		16	**3.600**	3.618	1.800E-02
		18	**3.600**	3.620	2.000E-02
		20	**3.600**	3.626	2.600E-02
		24	**3.600**	3.628	2.800E-02
		28	**3.600**	3.636	3.600E-02
		32	**3.600**	3.648	4.800E-02
		36	**3.600**	3.650	5.000E-02
		40	**3.600**	3.666	6.600E-02
		45	**3.600**	3.674	7.400E-02
		50	**3.600**	3.680	8.000E-02
		55	**3.600**	3.696	9.600E-02
21.09.08	11:00 AM	**60**	**3.600**	3.708	1.080E-01
		70	**3.600**	3.706	1.060E-01
		80	**3.600**	3.710	1.100E-01
		90	**3.600**	3.726	1.260E-01
		100	**3.600**	3.748	1.480E-01
		110	**3.600**	3.758	1.580E-01
21.09.08	12:00 PM	**120**	**3.600**	3.760	1.600E-01
		140	**3.600**	3.760	1.600E-01
		160	**3.600**	3.770	1.700E-01
		180	**3.600**	3.770	1.700E-01
		200	**3.600**	3.774	1.740E-01
		220	**3.600**	3.780	1.800E-01
		240	**3.600**	3.780	1.800E-01
		260	**3.600**	3.782	1.820E-01
		280	**3.600**	3.784	1.840E-01
21.09.08	3:00 PM	**300**	**3.600**	3.784	1.840E-01
		330	**3.600**	3.790	1.900E-01
		360	**3.600**	3.800	2.000E-01
		390	**3.600**	3.801	2.010E-01
		420	**3.600**	3.812	2.120E-01
		450	**3.600**	3.814	2.140E-01
		480	**3.600**	3.824	2.240E-01
		510	**3.600**	3.832	2.320E-01
21.09.08	7:00 PM	**540**	**3.600**	3.836	2.360E-01
		600	**3.600**	3.848	2.480E-01
		660	**3.600**	3.852	2.520E-01
		720	**3.600**	3.854	2.540E-01
		780	**3.600**	3.856	2.560E-01
		840	**3.600**	3.860	2.600E-01



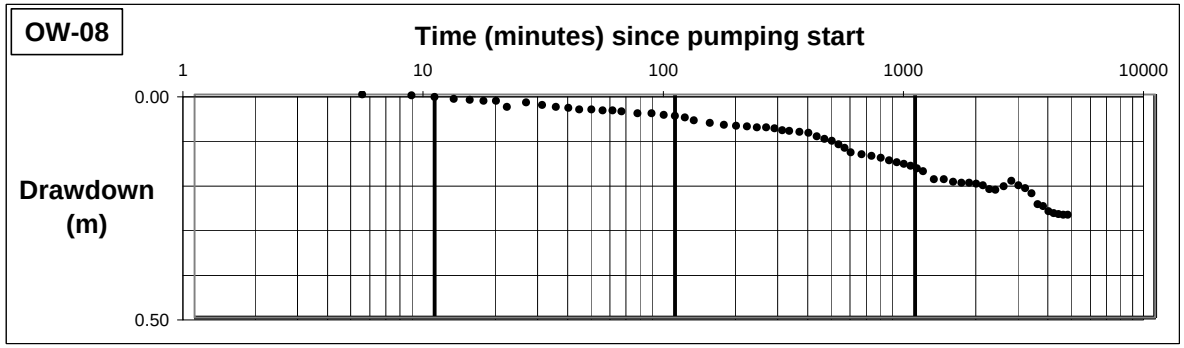
OW-06					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
22.09.08	1:00 AM	900	**3.600**	3.862	2.620E-01
		960	**3.600**	3.862	2.620E-01
		1020	**3.600**	3.866	2.660E-01
22.09.08	4:00 AM	**1080**	**3.600**	3.867	2.670E-01
		1200	**3.600**	3.877	2.770E-01
		1320	**3.600**	3.888	2.880E-01
		1440	**3.600**	3.888	2.880E-01
		1560	**3.600**	3.892	2.920E-01
		1680	**3.600**	3.884	2.840E-01
		1800	**3.600**	3.884	2.840E-01
		1920	**3.600**	3.886	2.860E-01
		2040	**3.600**	3.900	3.000E-01
22.09.08	10:00 PM	**2160**	**3.600**	3.900	3.000E-01
23.09.08	1:00 AM	2340	**3.600**	3.902	3.020E-01
		2520	**3.600**	3.906	3.060E-01
		2700	**3.600**	3.916	3.160E-01
		2880	**3.600**	3.918	3.180E-01
23.09.08	1:00 PM	3060	**3.600**	3.920	3.200E-01
		3240	**3.600**	3.922	3.220E-01
		3420	**3.600**	3.948	3.480E-01
		3600	**3.600**	3.952	3.520E-01
24.09.08	1:00 AM	3780	**3.600**	3.956	3.560E-01
		3960	**3.600**	3.958	3.580E-01
		4140	**3.600**	3.962	3.620E-01
24.09.08	10:00 AM	**4320**	**3.600**	3.962	3.620E-01

OW-07					
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	10:00 AM	0.5	2.662	2.662	0.000E+00
	10:05 AM	5	2.662	2.662	0.000E+00
		8	2.662	2.666	4.000E-03
		10	2.662	2.668	6.000E-03
		12	2.662	2.678	1.600E-02
		14	2.662	2.672	1.000E-02
		16	2.662	2.676	1.400E-02
		18	2.662	2.678	1.600E-02
		20	2.662	2.680	1.800E-02
		24	2.662	2.684	2.200E-02
		28	2.662	2.686	2.400E-02
		32	2.662	2.688	2.600E-02
		36	2.662	2.690	2.800E-02
		40	2.662	2.692	3.000E-02
		45	2.662	2.696	3.400E-02
		50	2.662	2.698	3.600E-02
		55	2.662	2.700	3.800E-02
21.09.08	11:00 AM	**60**	2.662	2.702	4.000E-02
		70	2.662	2.706	4.400E-02
		80	2.662	2.708	4.600E-02
		90	2.662	2.714	5.200E-02
		100	2.662	2.716	5.400E-02
		110	2.662	2.716	5.400E-02
21.09.08	12:00 PM	**120**	2.662	2.720	5.800E-02
		140	2.662	2.726	6.400E-02
		160	2.662	2.730	6.800E-02
		180	2.662	2.734	7.200E-02
		200	2.662	2.738	7.600E-02
		220	2.662	2.744	8.200E-02
		240	2.662	2.748	8.600E-02
		260	2.662	2.750	8.800E-02
		280	2.662	2.750	8.800E-02
21.09.08	3:00 PM	**300**	2.662	2.752	9.000E-02
		330	2.662	2.760	9.800E-02
		360	2.662	2.766	1.040E-01
		390	2.662	2.768	1.060E-01
		420	2.662	2.774	1.120E-01
		450	2.662	2.778	1.160E-01
		480	2.662	2.786	1.240E-01
		510	2.662	2.790	1.280E-01
21.09.08	7:00 PM	**540**	2.662	2.796	1.340E-01
		600	2.662	2.802	1.400E-01
		660	2.662	2.808	1.460E-01
		720	2.662	2.814	1.520E-01
		780	2.662	2.814	1.520E-01
		840	2.662	2.820	1.580E-01



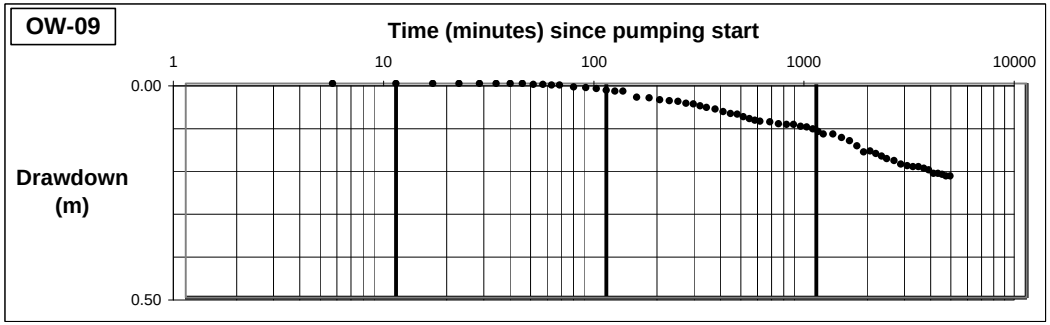
OW-07					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
22.09.08	1:00 AM	900	2.662	2.826	1.640E-01
		960	2.662	2.828	1.660E-01
		1020	2.662	2.832	1.700E-01
22.09.08	4:00 AM	**1080**	2.662	2.832	1.700E-01
		1200	2.662	2.846	1.840E-01
		1320	2.662	2.850	1.880E-01
		1440	2.662	2.862	2.000E-01
		1560	2.662	2.864	2.020E-01
		1680	2.662	2.866	2.040E-01
		1800	2.662	2.867	2.050E-01
		1920	2.662	2.870	2.080E-01
		2040	2.662	2.876	2.140E-01
22.09.08	10:00 PM	**2160**	2.662	2.882	2.200E-01
23.09.08	1:00 AM	2340	2.662	2.870	2.080E-01
		2520	2.662	2.870	2.080E-01
		2700	2.662	2.868	2.060E-01
		2880	2.662	2.884	2.220E-01
23.09.08	1:00 PM	3060	2.662	2.872	2.100E-01
		3240	2.662	2.890	2.280E-01
		3420	2.662	2.900	2.380E-01
		3600	2.662	2.906	2.440E-01
24.09.08	1:00 AM	3780	2.662	2.910	2.480E-01
		3960	2.662	2.912	2.500E-01
		4140	2.662	2.914	2.520E-01
24.09.08	10:00 AM	**4320**	2.662	2.914	2.520E-01

OW-08					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	10:00 AM	0.5	**2.030**	2.030	0.000E+00
	10:05 AM	5	**2.030**	2.030	0.000E+00
		8	**2.030**	2.032	2.000E-03
		10	**2.030**	2.036	6.000E-03
		12	**2.030**	2.040	1.000E-02
		14	**2.030**	2.042	1.200E-02
		16	**2.030**	2.044	1.400E-02
		18	**2.030**	2.044	1.400E-02
		20	**2.030**	2.058	2.800E-02
		24	**2.030**	2.048	1.800E-02
		28	**2.030**	2.054	2.400E-02
		32	**2.030**	2.058	2.800E-02
		36	**2.030**	2.060	3.000E-02
		40	**2.030**	2.064	3.400E-02
		45	**2.030**	2.064	3.400E-02
		50	**2.030**	2.066	3.600E-02
		55	**2.030**	2.066	3.600E-02
21.09.08	11:00 AM	**60**	**2.030**	2.068	3.800E-02
		70	**2.030**	2.072	4.200E-02
		80	**2.030**	2.072	4.200E-02
		90	**2.030**	2.076	4.600E-02
		100	**2.030**	2.078	4.800E-02
		110	**2.030**	2.082	5.200E-02
21.09.08	12:00 PM	**120**	**2.030**	2.088	5.800E-02
		140	**2.030**	2.094	6.400E-02
		160	**2.030**	2.098	6.800E-02
		180	**2.030**	2.100	7.000E-02
		200	**2.030**	2.102	7.200E-02
		220	**2.030**	2.104	7.400E-02
		240	**2.030**	2.104	7.400E-02
		260	**2.030**	2.106	7.600E-02
		280	**2.030**	2.110	8.000E-02
21.09.08	3:00 PM	**300**	**2.030**	2.112	8.200E-02
		330	**2.030**	2.114	8.400E-02
		360	**2.030**	2.116	8.600E-02
		390	**2.030**	2.124	9.400E-02
		420	**2.030**	2.130	1.000E-01
		450	**2.030**	2.134	1.040E-01
		480	**2.030**	2.142	1.120E-01
		510	**2.030**	2.150	1.200E-01



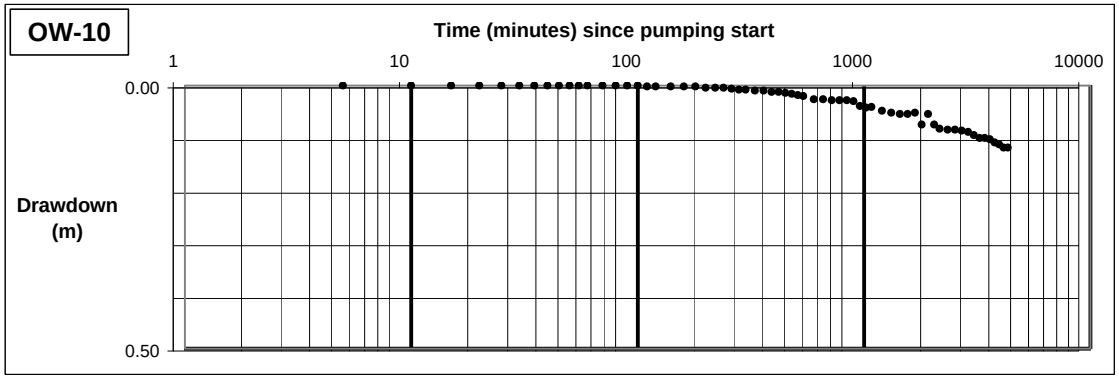
OW-08					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	7:00 PM	**540**	**2.030**	2.160	1.300E-01
		600	**2.030**	2.164	1.340E-01
		660	**2.030**	2.168	1.380E-01
		720	**2.030**	2.172	1.420E-01
		780	**2.030**	2.178	1.480E-01
		840	**2.030**	2.182	1.520E-01
22.09.08	1:00 AM	900	**2.030**	2.186	1.560E-01
		960	**2.030**	2.190	1.600E-01
		1020	**2.030**	2.196	1.660E-01
22.09.08	4:00 AM	**1080**	**2.030**	2.202	1.720E-01
		1200	**2.030**	2.220	1.900E-01
		1320	**2.030**	2.220	1.900E-01
		1440	**2.030**	2.226	1.960E-01
		1560	**2.030**	2.228	1.980E-01
		1680	**2.030**	2.228	1.980E-01
		1800	**2.030**	2.230	2.000E-01
		1920	**2.030**	2.234	2.040E-01
		2040	**2.030**	2.242	2.120E-01
22.09.08	10:00 PM	**2160**	**2.030**	2.244	2.140E-01
23.09.08	1:00 AM	2340	**2.030**	2.236	2.060E-01
		2520	**2.030**	2.224	1.940E-01
		2700	**2.030**	2.234	2.040E-01
		2880	**2.030**	2.240	2.100E-01
23.09.08	1:00 PM	3060	**2.030**	2.252	2.220E-01
		3240	**2.030**	2.276	2.460E-01
		3420	**2.030**	2.280	2.500E-01
		3600	**2.030**	2.292	2.620E-01
24.09.08	1:00 AM	3780	**2.030**	2.296	2.660E-01
		3960	**2.030**	2.298	2.680E-01
		4140	**2.030**	2.300	2.700E-01
24.09.08	10:00 AM	**4320**	**2.030**	2.300	2.700E-01

OW-09					
Date	Clock time	Time (min)	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)
21.09.08	10:00 AM	0.5	**1.370**	1.370	0.000E+00
	10:05 AM	5	**1.370**	1.370	0.000E+00
		10	**1.370**	1.370	0.000E+00
		15	**1.370**	1.370	0.000E+00
		20	**1.370**	1.370	0.000E+00
		25	**1.370**	1.370	0.000E+00
		30	**1.370**	1.370	0.000E+00
		35	**1.370**	1.370	0.000E+00
		40	**1.370**	1.370	0.000E+00
		45	**1.370**	1.372	2.000E-03
		50	**1.370**	1.372	2.000E-03
		55	**1.370**	1.374	4.000E-03
21.09.08	11:00 AM	**60**	**1.370**	1.374	4.000E-03
		70	**1.370**	1.378	8.000E-03
		80	**1.370**	1.380	1.000E-02
		90	**1.370**	1.382	1.200E-02
		100	**1.370**	1.386	1.600E-02
		110	**1.370**	1.388	1.800E-02
21.09.08	12:00 PM	**120**	**1.370**	1.388	1.800E-02
		140	**1.370**	1.402	3.200E-02
		160	**1.370**	1.404	3.400E-02
		180	**1.370**	1.408	3.800E-02
		200	**1.370**	1.410	4.000E-02
		220	**1.370**	1.412	4.200E-02
		240	**1.370**	1.416	4.600E-02
		260	**1.370**	1.418	4.800E-02
		280	**1.370**	1.422	5.200E-02
21.09.08	3:00 PM	**300**	**1.370**	1.426	5.600E-02
		330	**1.370**	1.430	6.000E-02
		360	**1.370**	1.436	6.600E-02
		390	**1.370**	1.440	7.000E-02
		420	**1.370**	1.442	7.200E-02
		450	**1.370**	1.448	7.800E-02
		480	**1.370**	1.452	8.200E-02
		510	**1.370**	1.456	8.600E-02
21.09.08	7:00 PM	**540**	**1.370**	1.458	8.800E-02
		600	**1.370**	1.460	9.000E-02
		660	**1.370**	1.464	9.400E-02
		720	**1.370**	1.466	9.600E-02
		780	**1.370**	1.466	9.600E-02
		840	**1.370**	1.470	1.000E-01
22.09.08	1:00 AM	**900**	**1.370**	1.472	1.020E-01
		960	**1.370**	1.476	1.060E-01
		1020	**1.370**	1.482	1.120E-01
22.09.08	4:00 AM	**1080**	**1.370**	1.488	1.180E-01
		1200	**1.370**	1.488	1.180E-01
		1320	**1.370**	1.496	1.260E-01
		1440	**1.370**	1.504	1.340E-01
		1560	**1.370**	1.516	1.460E-01
		1680	**1.370**	1.530	1.600E-01
		1800	**1.370**	1.528	1.580E-01
		1920	**1.370**	1.534	1.640E-01
		2040	**1.370**	1.540	1.700E-01



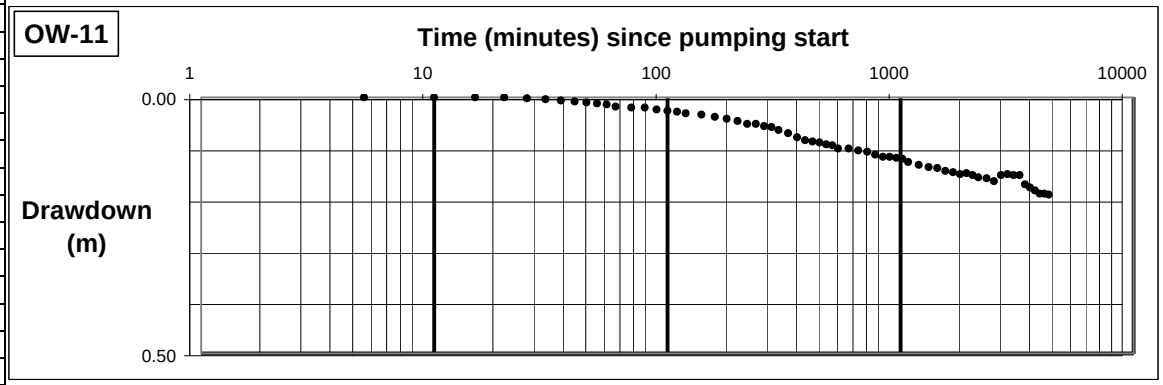
OW-09					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
22.09.08	10:00 PM	**2160**	**1.370**	1.546	1.760E-01
23.09.08	1:00 AM	2340	**1.370**	1.550	1.800E-01
		2520	**1.370**	1.558	1.880E-01
		2700	**1.370**	1.562	1.920E-01
		2880	**1.370**	1.564	1.940E-01
23.09.08	1:00 PM	3060	**1.370**	1.564	1.940E-01
		3240	**1.370**	1.568	1.980E-01
		3420	**1.370**	1.572	2.020E-01
		3600	**1.370**	1.580	2.100E-01
24.09.08	1:00 AM	3780	**1.370**	1.580	2.100E-01
		3960	**1.370**	1.582	2.120E-01
		4140	**1.370**	1.586	2.160E-01
24.09.08	10:00 AM	**4320**	**1.370**	1.586	2.160E-01

OW-10					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	10:00 AM	0.5	**2.346**	2.346	0.000E+00
	10:05 AM	5	**2.346**	2.346	0.000E+00
		10	**2.346**	2.346	0.000E+00
		15	**2.346**	2.346	0.000E+00
		20	**2.346**	2.346	0.000E+00
		25	**2.346**	2.346	0.000E+00
		30	**2.346**	2.346	0.000E+00
		35	**2.346**	2.346	0.000E+00
		40	**2.346**	2.346	0.000E+00
		45	**2.346**	2.346	0.000E+00
		50	**2.346**	2.346	0.000E+00
		55	**2.346**	2.346	0.000E+00
21.09.08	11:00 AM	**60**	**2.346**	2.346	0.000E+00
		70	**2.346**	2.346	0.000E+00
		80	**2.346**	2.346	0.000E+00
		90	**2.346**	2.346	0.000E+00
		100	**2.346**	2.346	0.000E+00
		110	**2.346**	2.348	2.000E-03
21.09.08	12:00 PM	**120**	**2.346**	2.348	2.000E-03
		140	**2.346**	2.348	2.000E-03
		160	**2.346**	2.348	2.000E-03
		180	**2.346**	2.348	2.000E-03
		200	**2.346**	2.350	4.000E-03
		220	**2.346**	2.350	4.000E-03
		240	**2.346**	2.350	4.000E-03
		260	**2.346**	2.352	6.000E-03
		280	**2.346**	2.354	8.000E-03
21.09.08	3:00 PM	**300**	**2.346**	2.354	8.000E-03
		330	**2.346**	2.356	1.000E-02
		360	**2.346**	2.356	1.000E-02
		390	**2.346**	2.358	1.200E-02
		420	**2.346**	2.358	1.200E-02
		450	**2.346**	2.360	1.400E-02
		480	**2.346**	2.362	1.600E-02
		510	**2.346**	2.364	1.800E-02
21.09.08	7:00 PM	**540**	**2.346**	2.366	2.000E-02
		600	**2.346**	2.372	2.600E-02
		660	**2.346**	2.372	2.600E-02
		720	**2.346**	2.374	2.800E-02
		780	**2.346**	2.374	2.800E-02
		840	**2.346**	2.374	2.800E-02
22.09.08	1:00 AM	900	**2.346**	2.376	3.000E-02
		960	**2.346**	2.385	3.900E-02
		1020	**2.346**	2.388	4.200E-02



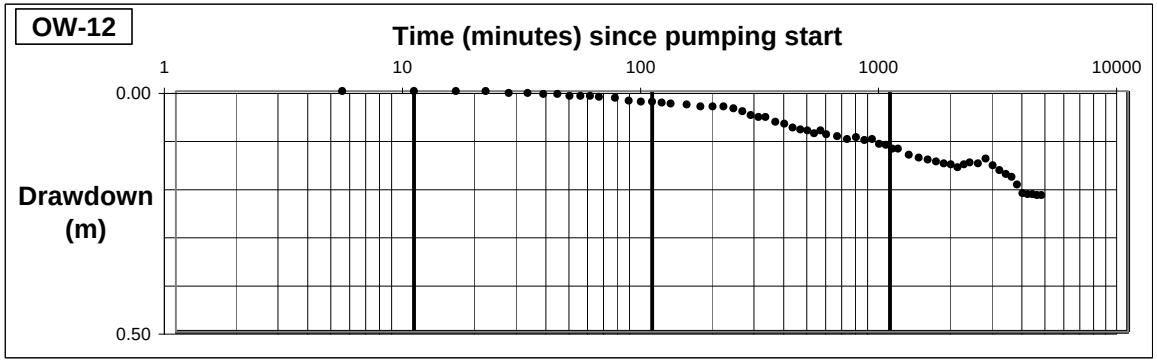
OW-10					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
22.09.08	4:00 AM	**1080**	**2.346**	2.387	4.100E-02
		1200	**2.346**	2.394	4.800E-02
		1320	**2.346**	2.398	5.200E-02
		1440	**2.346**	2.400	5.400E-02
		1560	**2.346**	2.400	5.400E-02
		1680	**2.346**	2.398	5.200E-02
		1800	**2.346**	2.420	7.400E-02
		1920	**2.346**	2.400	5.400E-02
		2040	**2.346**	2.420	7.400E-02
22.09.08	10:00 PM	**2160**	**2.346**	2.428	8.200E-02
23.09.08	1:00 AM	2340	**2.346**	2.430	8.400E-02
		2520	**2.346**	2.430	8.400E-02
		2700	**2.346**	2.432	8.600E-02
		2880	**2.346**	2.434	8.800E-02
23.09.08	1:00 PM	3060	**2.346**	2.440	9.400E-02
		3240	**2.346**	2.446	1.000E-01
		3420	**2.346**	2.446	1.000E-01
		3600	**2.346**	2.448	1.020E-01
24.09.08	1:00 AM	3780	**2.346**	2.454	1.080E-01
		3960	**2.346**	2.458	1.120E-01
		4140	**2.346**	2.464	1.180E-01
24.09.08	10:00 AM	**4320**	**2.346**	2.464	1.180E-01

OW-11					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	10:00 AM	0.5	**2.028**	2.028	0.000E+00
	10:05 AM	5	**2.028**	2.028	0.000E+00
		10	**2.028**	2.028	0.000E+00
		15	**2.028**	2.028	0.000E+00
		20	**2.028**	2.028	0.000E+00
		25	**2.028**	2.030	2.000E-03
		30	**2.028**	2.032	4.000E-03
		35	**2.028**	2.034	6.000E-03
		40	**2.028**	2.036	8.000E-03
		45	**2.028**	2.038	1.000E-02
		50	**2.028**	2.040	1.200E-02
		55	**2.028**	2.042	1.400E-02
21.09.08	11:00 AM	**60**	**2.028**	2.046	1.800E-02
		70	**2.028**	2.048	2.000E-02
		80	**2.028**	2.048	2.000E-02
		90	**2.028**	2.052	2.400E-02
		100	**2.028**	2.054	2.600E-02
		110	**2.028**	2.056	2.800E-02
21.09.08	12:00 PM	**120**	**2.028**	2.059	3.100E-02
		140	**2.028**	2.062	3.400E-02
		160	**2.028**	2.066	3.800E-02
		180	**2.028**	2.070	4.200E-02
		200	**2.028**	2.074	4.600E-02
		220	**2.028**	2.080	5.200E-02
		240	**2.028**	2.080	5.200E-02
		260	**2.028**	2.084	5.600E-02
		280	**2.028**	2.086	5.800E-02
21.09.08	3:00 PM	**300**	**2.028**	2.092	6.400E-02
		330	**2.028**	2.098	7.000E-02
		360	**2.028**	2.106	7.800E-02
		390	**2.028**	2.112	8.400E-02
		420	**2.028**	2.114	8.600E-02
		450	**2.028**	2.116	8.800E-02
		480	**2.028**	2.120	9.200E-02
		510	**2.028**	2.122	9.400E-02
21.09.08	7:00 PM	**540**	**2.028**	2.128	1.000E-01
		600	**2.028**	2.128	1.000E-01
		660	**2.028**	2.132	1.040E-01
		720	**2.028**	2.134	1.060E-01
		780	**2.028**	2.140	1.120E-01
		840	**2.028**	2.144	1.160E-01
22.09.08	1:00 AM	900	**2.028**	2.144	1.160E-01
		960	**2.028**	2.146	1.180E-01
		1020	**2.028**	2.148	1.200E-01



OW-11					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
22.09.08	4:00 AM	**1080**	**2.028**	2.154	1.260E-01
		1200	**2.028**	2.160	1.320E-01
		1320	**2.028**	2.164	1.360E-01
		1440	**2.028**	2.166	1.380E-01
		1560	**2.028**	2.172	1.440E-01
		1680	**2.028**	2.174	1.460E-01
		1800	**2.028**	2.178	1.500E-01
		1920	**2.028**	2.176	1.480E-01
		2040	**2.028**	2.180	1.520E-01
22.09.08	10:00 PM	**2160**	**2.028**	2.184	1.560E-01
23.09.08	1:00 AM	2340	**2.028**	2.186	1.580E-01
		2520	**2.028**	2.192	1.640E-01
		2700	**2.028**	2.180	1.520E-01
		2880	**2.028**	2.178	1.500E-01
23.09.08	1:00 PM	3060	**2.028**	2.180	1.520E-01
		3240	**2.028**	2.180	1.520E-01
		3420	**2.028**	2.198	1.700E-01
		3600	**2.028**	2.204	1.760E-01
24.09.08	1:00 AM	3780	**2.028**	2.210	1.820E-01
		3960	**2.028**	2.216	1.880E-01
		4140	**2.028**	2.216	1.880E-01
24.09.08	10:00 AM	**4320**	**2.028**	2.218	1.900E-01

OW-12					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
21.09.08	10:00 AM	0.5	**2.770**	2.770	0.000E+00
	10:05 AM	5	**2.770**	2.770	0.000E+00
		10	**2.770**	2.770	0.000E+00
		15	**2.770**	2.770	0.000E+00
		20	**2.770**	2.770	0.000E+00
		25	**2.770**	2.774	4.000E-03
		30	**2.770**	2.774	4.000E-03
		35	**2.770**	2.776	6.000E-03
		40	**2.770**	2.776	6.000E-03
		45	**2.770**	2.780	1.000E-02
		50	**2.770**	2.780	1.000E-02
		55	**2.770**	2.780	1.000E-02
21.09.08	11:00 AM	**60**	**2.770**	2.782	1.200E-02
		70	**2.770**	2.784	1.400E-02
		80	**2.770**	2.790	2.000E-02
		90	**2.770**	2.792	2.200E-02
		100	**2.770**	2.792	2.200E-02
		110	**2.770**	2.794	2.400E-02
21.09.08	12:00 PM	**120**	**2.770**	2.796	2.600E-02
		140	**2.770**	2.798	2.800E-02
		160	**2.770**	2.802	3.200E-02
		180	**2.770**	2.802	3.200E-02
		200	**2.770**	2.802	3.200E-02
		220	**2.770**	2.806	3.600E-02
		240	**2.770**	2.812	4.200E-02
		260	**2.770**	2.820	5.000E-02
		280	**2.770**	2.824	5.400E-02
21.09.08	3:00 PM	**300**	**2.770**	2.824	5.400E-02
		330	**2.770**	2.834	6.400E-02
		360	**2.770**	2.838	6.800E-02
		390	**2.770**	2.846	7.600E-02
		420	**2.770**	2.850	8.000E-02
		450	**2.770**	2.852	8.200E-02
		480	**2.770**	2.858	8.800E-02
		510	**2.770**	2.852	8.200E-02
21.09.08	7:00 PM	**540**	**2.770**	2.860	9.000E-02
		600	**2.770**	2.864	9.400E-02
		660	**2.770**	2.870	1.000E-01
		720	**2.770**	2.866	9.600E-02
		780	**2.770**	2.872	1.020E-01
		840	**2.770**	2.870	1.000E-01
22.09.08	1:00 AM	900	**2.770**	2.880	1.100E-01
		960	**2.770**	2.882	1.120E-01
		1020	**2.770**	2.890	1.200E-01



OW-12					
Date	**Clock time**	**Time (min)**	**Static Water Level (m)**	**Pumping Water Level (m)**	**Drawdown (m)**
22.09.08	4:00 AM	**1080**	**2.770**	2.890	1.200E-01
		1200	**2.770**	2.902	1.320E-01
		1320	**2.770**	2.908	1.380E-01
		1440	**2.770**	2.912	1.420E-01
		1560	**2.770**	2.916	1.460E-01
		1680	**2.770**	2.920	1.500E-01
		1800	**2.770**	2.922	1.520E-01
		1920	**2.770**	2.928	1.580E-01
		2040	**2.770**	2.922	1.520E-01
22.09.08	10:00 PM	**2160**	**2.770**	2.918	1.480E-01
23.09.08	1:00 AM	2340	**2.770**	2.920	1.500E-01
		2520	**2.770**	2.910	1.400E-01
		2700	**2.770**	2.924	1.540E-01
		2880	**2.770**	2.934	1.640E-01
23.09.08	1:00 PM	3060	**2.770**	2.942	1.720E-01
		3240	**2.770**	2.948	1.780E-01
		3420	**2.770**	2.964	1.940E-01
		3600	**2.770**	2.982	2.120E-01
24.09.08	1:00 AM	3780	**2.770**	2.984	2.140E-01
		3960	**2.770**	2.984	2.140E-01
		4140	**2.770**	2.986	2.160E-01
24.09.08	10:00 AM	**4320**	**2.770**	2.986	2.160E-01