5.5 General Water Quality

5.5.1 Purpose

To evaluate the groundwater resources for a safe drinking water supply, it is very important to investigate not only arsenic but also other groundwater quality parameters in the groundwater. The analysis of general groundwater quality can provide hydrochemical characteristics of the groundwater as well as basic information of the safety of the groundwater. Attention should be paid particularly on some substances that will have a health impact by drinking.

In this subchapter, at first the general characteristics of deep groundwater and shallow groundwater taken from the newly constructed observation wells/holes and the improved deep wells are mentioned. Then the relationships between the arsenic and other water quality parameters are examined. The safety of deep groundwater is also evaluated by the monitoring data of general water quality. The quality of deep groundwater is also evaluated comparing with the quality of shallow groundwater and pond water. The results of the general water quality analysis done in the study are evaluated by comparison with the Bangladeshi drinking water standard and the WHO guideline value for drinking water.

5.5.2 Methodology

The groundwater samples for general water quality analysis were collected from newly constructed observation wells/holes, existing wells, and existing ponds. The samples were systematically collected during the survey. The methods of sampling, numbering, quality control, etc. were well planned and performed.

1) Sampling and Analysis Procedures

a. Procedure of Field Work for Water Quality Analysis

The operative procedure for collecting the samples used for water quality analysis, based on the Japanese Testing Method of Drinking Water, has been standardized as shown hereunder, starting from the method to clean the sample containers.

Especially, a Standard Operating Procedure (SOP), setting fieldwork standards for important operations, has been established in writing.

b. Cleaning the sample containers

Sample containers consist of polyethylene bottles with ground stoppers, which can be sealed hermetically. They must be thoroughly washed before use so that the tests can be carried out properly.

Washing of polyethylene bottles with ground stoppers is carried out as follows:

(a) Before use, first wash the bottles using regular tap water, and then wash them again with distilled water.

(b) After step (a), wash with warm nitric acid (1+10: HNO3 diluted in as much as 10 times its volume of water) or warm hydrochloric acid (1+5), fill the bottles to the brim with nitric acid (1+65), seal hermetically and leave for at least 16 hours. Wash thoroughly with distilled water.

(c) After the sample containers have been washed, drain all water, seal hermetically and keep until the collection of samples.

c. Fieldwork Procedure

The fieldwork procedure for water quality analysis is as follows

(a) [Hand pump well]

Remove stagnant water in the tube by lifting water by pump (approx. 5 min.).

[Production well]

If the pump is stopped, operate it for approx. 5 min to remove stagnant water.

[Pond water]

Sample water from the center of the pond.

(b) While pumping as noted in (a), fill in the required item in the field survey sheet.

(c) Measure As (arsenic) and dissolved iron (Fe^{2+}) using the field kit.

(d) Measure water quality parameters of pH, ORP, EC and the temperature. Read the pH, EC and temperature values after each value has become stable. For ORP, read the value after becoming stable.

d. Water Sampling Procedure

The water samples for laboratory analysis were collected during the field survey. The samples for arsenic were brought into the JICA Study Team laboratory. For others than arsenic, the samples were carried into a laboratory in Dhaka as soon as possible after sampling. The sampling procedure is as follows:

In case a sample contains suspended solids, shake it well in order to mix it uniformly before collecting a sample for testing. All sample bottles shall be rinsed beforehand with the sampled water.

Add 0.5 ml of conc. hydrochloric acid (for arsenic analysis grade) to 250 ml of the sample to be used for arsenic testing in order to lower its pH to approximately 1, and then store in a cool dark place.

Samples to be used for the following tests should be kept in a cool dark place: chemical oxygen demand (COD), ammonium ion, nitrous acid ion, nitric acid ion, cyanide, hardness, TDS, sulfate ion, chloride ion, bicarbonate ion, and fluoride ion.

Concerning samples to be used for testing the following metal elements, the pH should be lowered to about 1 by adding 20 ml of nitric acid to 2.5 l of the sample, and the samples should be stored in a dark cool place: copper, zinc, lead, cadmium, nickel, chrome, mercury, sodium, potassium, calcium, magnesium, etc.

Concerning samples to be used for testing dissolved arsenic, dissolved iron and dissolved manganese, filter at the site immediately after collecting a sample, through a filter paper with a 0.45μm mesh by applying a vacuum (if filtration is difficult because of water condition, pre-filter using a 5 C filter paper), discard the first 50 ml of filtrate and keep the rest of the filtrate as a sample, then lower the pH to about 1 by adding 2.5 ml of nitric acid to 250 ml of the dissolved iron and dissolved manganese sample. In case of dissolved arsenic, add 0.5 ml of hydrochloric acid instead and all types of samples are stored in a dark cool place.

2) Laboratory Analysis and Analytical Parameters

The laboratory analysis was carried out by the Plasma Plus Application &Research Laboratory. The analysis methods were based on the Standard Methods for the Examination of Water and Wastewater, 20th edition. Analytical parameters and the standard numbers of testing method are shown in Table 5.5.1.

Table 5.5.1 Analytical parameters and the standard numbers

Analytical parameters	**Standard No**	**Analytical parameters**	**Standard No**
PH	4500 H^+ B	Sodium	3111 B
Temperature	Thermometric method	Potassium	3111 B
Electric conductivity	Electrometric method	Dissolved iron	3111 B
Hardness	Titrimetric method	Dissolved manganese	3111 B
TDS	2540 C	Calcium	3111 B
COD	5220	Magnesium	3111 B
Ammonium	Nessler's method	Cadmium	3113A, 3113B
Nitrite	4500 NO_2^- B	Total chromium	3113A, 3113B
Nitrate	APHA-4500	Copper	3113A, 3113B
Sulfate	4500 SO_4^{2-}	Lead	3113A, 3113B
Chloride	Turbidity of silver-chloride method	Mercury	3112B
Bicarbonate	Titrimetric method	Nickel	3113A, 3113B
Fluoride	4500 F^- D	Zinc	3111C
Cyanide	4500 CN^- E		

3) Quality Control

Quality control of laboratory analysis was done as follows:

a. Checking correctness of analyses

a.1. Anion-cation balance

The anion and cation sums, expressed as milliequivalents per liter, must balance because all water samples are electrically neutral. The calculation is as follows:

$$\%\text{balance} = 100 \times \frac{\sum cations - \sum anions}{\sum cations + \sum anions}$$

a.2. Measured TDS and calculated TDS

The measured total dissolved solids concentration must be higher than the calculated one because of the minor ion parameter. On the other hand, if the measured TDS is more than 20% higher than the calculated one, the low ion sum is suspected. The acceptable ratio is as follows:

$$1.0 < \frac{measuredTDS}{calculatedTDS} < 1.2$$

where:

$$\text{calculated TDS} = 0.6 \times HCO3^{-} + Na^{+} + K^{+} + Ca^{2+} + Mg^{2+} + Cl^{-} + SO4^{2-} + NO3^{-} + F^{-}$$

a.3. Measured EC and ion sums

Both the anion and cation sums should be 1/100 of the measured EC. The acceptable ratio is as follows:

0.9 $\times$ measured EC < $100 \times$ anion (or cation) sum, meq/L < 1.1 $\times$ measured EC

a.4. Calculated TDS and measured EC

The acceptable ratio is as follows:

Calculated TDS / measured EC = 0.55-0.7

b. Quality Control samples

In addition to checking the correctness of analyses, quality control samples were incorporated in the laboratory analysis samples. For the laboratory analysis, duplicate samples and field blank samples were collected from fields and tested in the Plasma Plus laboratory for data quality assurance.

5.5.3 General Characteristics of Groundwater Quality

1) Deep Observation Wells/Holes in Pourashava

The results of the laboratory chemical analysis for Observation Wells samples were shown in Table 1.6.2 in the **Data Report**. From these data, some general characteristics for deep groundwater (hereafter deep groundwater is indicated by the Sample Codes, “OW-“ and “OH-###-4-“) are found as mentioned below.

The most notable characteristic of the samples is reducing state. 95% of the samples are less than 200 mV. Fe and Mn concentrations are high in almost samples. 83.3% of the samples contain more than 1 mg/l of Fe and 59.1% have more than 0.1 mg/l of Mn. NO_3 and NO_2 are low or lower than PQL in all samples from Observation Wells. On the other hand, NH_4 concentrations are rarely high. About 3.0% of samples contain more than 1 mg/l of NH_4. Almost all SO_4 results (98.5%) show below PQL. These data (Fe, Mn, NO_3, NO_2, NH_4, SO_4) also indicate that the groundwater of Observation Wells is in a strongly reducing state.

EC values are almost always (96.7%) less than 100 mS/m. From the results of EC, samples are likely to be almost fresh groundwater. High EC values (almost excess 100 mS/m samples) are distributed in Jessore, the southern part of the study area. pH values are almost always near 7, however, values around 8 are also found in Chuadanga.

Trace elements and heavy metals in samples are generally low. All samples contain less than 50 mg/l of Mg. 97.5% of the samples have below 1 mg/l of F. All samples have below PQL of Cd and Cr. 92.4% of the samples are below PQL in Cu. 92.4% of samples are below PQL in CN. 89.3% of the samples are below PQL in Pb. 98.5% of the samples are below PQL in Hg. 99.2% of the samples are below 0.01 mg/l in Ni. 89.4% of the samples are below 0.01 mg/l in Zn.

COD is also low in the samples. 87.9% of the samples are below PQL in COD. High concentrations of COD (over 20 mg/l) are presented in the samples of the pumping test for Observation Wells. Some COD values may be affected by contamination at the pumping test.

a. Deep Groundwater in Chuadanga Pourashava

Some relatively high concentrations of NO_3 (over 0.5 mg/l) are distributed in samples from CH-1 and CH-2 sites. However, NO_2 is mostly the same as the other districts. Relatively high concentrations of Pb (up to 0.0072 mg/l) are found in samples of the pumping test in CH -2, though mostly high concentrations of Pb are distributed in Jhenaidah. Some high concentrations of Zn (up to 0.17 mg/l) are found in samples of the pumping test in JH-1. Some Zn values may be affected by contamination at the pumping test.

b. Deep Groundwater in Jhenaidah Pourashava

It is notable that some high concentrations of SO_4 are found in Jhenaidah and are distributed in samples from 150 m in depth (OH-JH1-3-), although almost all SO_4 results in Observation Wells (95.8%) are below PQL. Some high concentrations of Zn (up to 0.17 mg/l) are found in samples of the pumping test in JH-1. Some relatively high concentrations of Pb (up to 0.013 mg/l) are distributed in samples of the pumping test in JH-1 and JH-2.

c. Deep Groundwater in Jessore Pourashava

The most notable characteristics in Jessore are high concentrations of Na (up to 160 mg/l) and Cl (up to 59 mg/l). It seems to be caused by salinity. Concentrations of Mn in Jessore are relatively higher than the other 2 districts. Furthermore, the result of each Observation Hole in

Jessore shows variation by depth. The results of Mn at shallow depths show relatively higher than deep ones. Depths of 50, 100, 150 and 300 m in JS-1 site samples show 1.7, 0.93, 0.96 and 0.65 mg/l (OH-JS1-1-SIP-140 min. to OH-JS1-4-SIP-140 min) of Mn, respectively. JS-2 site also shows the same tendency as JS-1. Some high concentrations of COD (up to 180 mg/l) are found in samples of the pumping test in JS-1. As Mn in Jessore, results of COD concentrations at shallow depths show relatively higher than at deep ones.

2) Deep Observation Holes in Model Rural Areas

The results of the laboratory chemical analysis in deep observation holes, which were initially drilled as core boring and later converted into observation holes, are shown in Table 1.4.2 in the **Data Report**. From these data, some general characteristics are observed as mentioned below.

All samples of Core Borings show a near neutral range of pH. Its range is 6.90 to 7.88. The most notable characteristic of the samples is the reducing state. All samples have less than 180 mV of ORP. Fe and Mn concentrations are relatively high in Core Borings. 57.1% of samples contain more than 1 mg/l of Fe and 47.6% contain more than 0.1 mg/l of Mn. NO_3 and NO_2 levels are low or lower than PQL in all samples of Core Borings. On the other hand, NH_4 levels are high in many samples. 47.6% of the samples contain more than 1 mg/l of NH_4. All SO_4 results show below PQL. These data (Fe, Mn, NO_3, NO_2, NH_4, SO_4) also indicate that groundwater in the study area is in a reducing state.

EC values are all less than 100 mS/m. From the results of EC, samples are likely to be almost fresh groundwater. Trace elements and heavy metals in samples are generally low. All samples contain less than 45 mg/l of Mg. All samples contain below 1 mg/l of F. All samples contain below PQL of Cd and Cr. 81.0% of the samples contain below PQL of Cu. 95.2% of the samples contain below PQL of CN. All samples are below PQL of Pb. All samples are below PQL of Hg. 95.2% of the samples contain below 0.01 mg/l of Ni. 90.5% of the samples are below 0.01 mg/l of Zn. COD concentrations are also low in samples. 71.4% of the samples are below PQL of COD.

a. Bara Dudpatila Village, Chuadanga District

Concentrations of Mn are relatively higher (up to 0.51 mg/l) than the other 2 districts. However, the results are sometimes fluctuant. Fe levels are also relatively higher (up to 15 mg/l) than the other 2 districts. However, CB-CDBd-0 m shows extremely high concentrations of Fe. It may be due to the casing pipe of the Core Boring tube well rather than natural sources in the deep aquifer. Concentrations of NO_3 are lower than the other 2 districts and are all below PQL. On the other hand, concentrations of NH_4 are relatively higher (up to 1.8 mg/l) than the other 2 districts

b. Krishna Chandrapur Village, Jhenaidah District

Generally, the chemical characteristics of the Core Boring in Krishna Chandrapur show that of fresh groundwater. However, it is notable that CB-JHKc-1 m to 2 m are likely to show some influence of salinity such as high concentrations of Na, Cl, and F (up to 200 mg/l, 96 and 0.6 mg/l, respectively) and low concentrations of HCO_3, Ca, and Mg. The cause is unknown for now.

c. Rajnagar Bankabarsi Village, Jessore District

The most notable characteristics in the village are relatively high concentrations of Na (up to 140 mg/l) and Cl (up to 45 mg/l) because of salinity. Hardness results are stable and lower (up to 43.1 mg/l) than the other 2 sites. Concentrations of Mn are relatively lower (up to 0.20 mg/l) than the other 2 districts. However, the data from the last 2 monitorings show 0.1 mg/l and over of Mn although the other 2 sites' data also show some increase in Mn. Concentrations of Fe in the village are lower than the other 2 districts. All results show less than 1 mg/l. Concentrations of HCO_3, Ca and Mg are lower than the other 2 districts. The results show up to 351, 27 and 17 mg/l, respectively. Concentrations of F are stable and relatively higher (up to 0.41 mg/l) than the other 2 districts. Some high concentrations of NO_2 (up to 2.2 mg/l) are found in Rajnagar Bankabarsi though the other 2 districts' results are all below PQL.

3) Improved Deep Wells in the Model Rural Areas

The results of the laboratory chemical analysis for Improved Deep Well samples were shown in Table 1.5.2 in the **Data Report**. From these data, some general characteristics are observed as mentioned below.

All samples of Improved Deep Well show a near neutral range of pH. Its range is 6.84-7.95. pH results in Bankabarsi are relatively higher (up to 7.95) than the other 2 districts. ORP values are relatively low and have some variation. Its range is between 27.9 to 284 mV. EC shows from 45.5 to 106 mS/m. NO_3, NO_2 are low or lower PQL in almost all the samples of Improved Deep Wells. On the other hand, NH_4 are high in many samples. 63.0% of samples contain more than 1 mg/l of NH_4. Fe and Mn concentrations are relatively high in Improved Deep Wells. 69.4% of the samples contain more than 1 mg/l of Fe and 63.9% contain more than 0.1 mg/l of Mn. All SO_4 results are below PQL. These data (Fe, Mn, NO_3, NO_2, NH_4, SO_4) also indicate that groundwater in the study area is in a reducing state.

Trace elements and heavy metals in samples are generally low. All samples contain 30 mg/l or below of Mg. All samples contain below 0.5 mg/l of F. All samples are below PQL of Cd and Cr. 88.9% of the samples are below PQL of Cu. All samples contain below 0.03 mg/l of CN. 77.8% of the samples are below PQL of Pb. All samples are below PQL of Hg. 97.2% of the samples contain below 0.01 mg/l of Ni. 88.9% of the samples contain below 0.1 mg/l of Zn.

COD concentrations are also low in the samples. 88.9% of the samples are below PQL of COD.

a. Bara Dudpatila Village, Chuadanga District

Concentrations of Zn are relatively higher (up to 0.18 mg/l) than the other 2 districts. However, the results are sometimes fluctuant. Na is relatively lower (up to 18 mg/l) than the other 2 districts. NO_3 is relatively higher (up to 3.8 mg/l) than the other 2 districts. High concentrations (up to 2.5 mg/l) of NO_2 are also found in Dudpatila. On the other hand, NH_4 concentrations are relatively lower than other 2 districts.

b. Krishna Chandrapur Village, Jhenaidah District

EC values are higher than the other 2 districts. The results show up to 106 mS/m. TDS and hardness are higher than the other 2 districts. The results show up to 608 and 164 mg/l respectively. IM-JHKc-1-0 m to 3 m show extremely high concentrations of Fe (from 3.2 to 9.8 mg/l). Concentrations of HCO_3, Ca and Mg in Chandrapur are relatively higher than the other 2 districts. The results show up to 557, 130 and 30 mg/l respectively.

c. Rajnagar Bankabarsi Village, Jessore District

Results of pH in Rajnagar Bankabarsi are higher than the other 2 districts. pH in Bankabarsi is from 7.05 to 7.95. PH for the other 2 districts shows from 6.84 to 7.23. The most notable characteristics in Bankabarsi are relatively high concentrations of Na (up to 71 mg/l) and Cl (up to 13 mg/l) because of salinity. Hardness results are stable and lower (up to 58.1 mg/l) than the other 2 sites. Some high concentrations of NO_2 (up to 2.0 mg/l) are found in Bankabarsi though the other 2 districts' results are all below PQL. It is notable that some results of NH_{34} are extremely high (up to 8.4 mg/l) in Bankabarsi though the other 2 districts' results are relatively low. Concentrations of Fe in Bankabarsi are relatively lower (up to 1.5 mg/l) than the other 2 districts. Concentrations of HCO_3, Ca and Mg in Bankabarsi are relatively lower than the other 2 districts. The results show up to 328, 41 and 19 mg/l respectively.

4) Existing Wells in the Study Area

As mentioned in Chapter 4.4, a total of 30 existing wells among the 300 exiting wells were elected to perform the general water quality analysis. The samples were collected in the rainy season and the dry season. The results of the laboratory chemical analysis for the Existing Wells Survey were shown in Table 1.1.3 to 1.1.4 in the **Data Report**. From these data, some general characteristics are observed as mentioned below.

The constituents of the Existing Wells Survey are the existing wells (35 to 50 m in depth) and production wells (85 to 135 m in depth). All samples show a near neutral range of pH. Its range is 6.2 to 8.3. High EC value sites (EW-JARj-R-[85], EW-JKPj-R-[102]) are found in the southern part of Jessore (up to 258 mS/m in the rainy season, up to 227 mS/m in the dry season). Other EC values are in the range between 26.6 and 112 mS/m (Figure 5.5.1). High TDS values (up to 1,650 mg/l in the rainy season, up to 1,450 mg/l in the dry season) are shown in the same sites of high EC (Figure 5.5.2). Other TDS values are in the range between 170 and 718 mg/l. High Na and Cl are also found from the same sites of high EC (up to 400 mg/l, 570 mg/l respectively, Figures 5.5.3 and 5.5.4). These data (EC, TDS, Na, Cl) show that these 2 sites are affected by salinity. One result of an existing well shows extremely high concentrations of NO_3 (180 mg/l) in the southern part of Jessore. However others show low concentrations (up to 16 mg/l). Some high concentrations of NO_2 (up to 4.2 mg/l) are found from existing wells. As compared with production wells, NO_3 and NO_2 concentrations in existing wells are higher (Figures 5.5.5 and 5.5.6). NH_4 concentrations are extremely high (up to 20 mg/l) for both existing wells and production wells. Fe concentrations are high in samples from existing wells (up to 11 mg/l). Though individual data fluctuates, Fe in existing wells is higher than production wells on the whole. 65.0% of all samples (existing wells and production wells) contain more than 1 mg/l of Fe (Figure 5.5.7). Mn concentrations are also high in all existing wells and production wells (up to 1.5 mg/l). 90.0% of all samples (existing wells and production wells) are more than 0.1 mg/l of Mn. The NH_4 concentrations are high in the dry season (Figure 5.5.8). These data (NO_3, NO_2, NH_4, Fe, Mn) indicate that the groundwater of existing wells and production wells are in a reducing state. However, some high concentrations of SO_4 are also found in existing wells and production wells (up to 46 mg/l, 30 mg/l respectively).

Trace elements and heavy metals in samples are generally low but some results show high concentrations of them. It can be said that the concentrations in production wells are lower than existing wells on the whole. Regarding Cd, 23.9% of the samples for existing wells are above PQL though all samples for production wells show below PQL. In the case of Cr, 50.0% of the samples from existing wells are above PQL though all samples for production wells show below PQL. Regarding Pb, 19.6% of the samples from existing wells are above PQL though all samples for production wells show below PQL. Concerning Ni, 60.9% of the samples for existing wells are above PQL though only 7.1% of the samples for production wells show below PQL (Figure 5.5.9). It is notable that Zn concentrations in production wells are higher than existing wells on the whole (Figure 5.5.10). The difference of aquifers used is one possibility. Another possibility is contamination from the facility such as the pipeline.

High COD concentrations are found in samples from existing wells (up to 160 mg/l) though all samples from production wells show below PQL

5) Existing Wells in the Model Rural Areas

The results of the laboratory chemical analysis for the groundwater of existing wells in the Model Rural Villages were shown in Table 1.2.1 to 1.2.7 in the **Data Report**. From each village, five (5) groundwater samples were collected and analyzed. From these data, some general characteristics are observed as mentioned below.

All samples show a near neutral range of pH. Its range is 6.83 to 7.82. High EC values are shown in Rajnagar Bankabarsi village (up to 297 mS/m). The other 2 villages show lower EC from 38.6 to 160 mS/m. High TDS values are shown in Rajnagar Bankabarsi village (up to 1,700 mg/l). The other 2 villages show lower TDS from 372 to 618 mg/l. High concentrations of NO_2 are found from Bara Dudpatila village (up to 4.0 mg/l) though the other 2 villages show at most 0.3 mg/l of NO_2. NH_4 are high in many samples in all 3 villages. 73.3% of the samples contain more than 1 mg/l of NH_4. Fe concentrations are high in 3 villages. 60.0% of the samples contain more than 1 mg/l of Fe. Mn concentrations are high in Bara Dudpatila and Krishna Chandrapur Village. 70.0% of the samples of 2 villages contain more than 0.1 mg/l of Mn. In Rajnagar Bankabarsi village, all results of Mn show below PQL. Two results of SO_4 (BS-CDBd-EW-060, BS-JSRb-EW-048) show high concentrations although others are below PQL.

Trace elements and heavy metals in the samples are generally low but some results show high concentrations of them. Samples in Rajnagar Bankabarsi village show high Mg concentrations (from 38 to 47 mg/l) though the other 2 villages show low concentrations of that. All samples in 3 villages have below 0.6 mg/l of F. All samples are below PQL of Cd. 93.3% of the samples are below PQL of Cr. 80.0% of the samples are below PQL of Cu. All samples are below 0.02 mg/l of CN. Two results exceed 0.01 mg/l of Pb. All samples are below PQL of Hg. 93.3% of the samples are below 0.025 mg/l of Ni. 93.3% of the samples are below PQL of Zn. Some high concentrations (up to 44 mg/l) of COD are found in Krishna Chandrapur and Rajnagar Bankabarsi villages.

6) Existing Pond Water in the Model Rural Areas

Although pond water is not groundwater, the results of the general water quality analysis carried out for pond water in the model rural areas are mentioned here for the purpose of comparison with groundwater quality. The results of the laboratory chemical analysis for pond water of Model Rural Villages were shown in Table 1.2.8 in the **Data Report**. From these data, some general characteristics are observed as mentioned below.

It is notable that the results of pond water are distinctive from groundwater. This difference seems to have occurred due to oxidation through contact with air. Contamination caused by human activity is another possible reason of this. High Concentrations of NO_3 and NO_2 (up to 42 mg/l, 6.6 mg/l respectively) are found in Chandrapur, and Bankabarsi villages. In Dudpatila, though only 2 samples, NO_3 and NO_2 are below PQL (Figures 5.5.11 and 5.5.12). On the other hand, concentrations of NH_4 are lower than in shallow groundwater (Figure 5.5.13). 85.2% of the pond water contains below 1.0 mg/l of NH_4. Concentrations of SO_4 (up to 8.0 mg/l), K (up to 62 mg/l) and F (up to 3.6 mg/l) are higher than in shallow groundwater (Figures 5.5.14, 5.5.15, and 5.5.16). Na (up to 46 mg/l) is slightly higher than in Krishna Chandrapur and Bara Dudpatila villages, but lower than in Rajnagar Bankabarsi village.

Trace elements and heavy metals in samples are generally low but some results show high concentrations of them. 88.9% of the samples show below 15 mg/l of Mg (Figure 5.5.17). Fe concentrations are below PQL in the pond water (Figure 5.5.18). Mn concentrations near the Bangladeshi standard value were detected in samples from the pond water in Krishna Chandrapur village, whereas the shallow groundwater in Bara Dudpatila village and some wells in Krishna Chandrapur village is highly contaminated by Mn (Figure 5.5.19). Total hardness is higher in the shallow groundwater (Figure 5.5.20). Ca concentrations in pond water are less than the Bangladeshi standard value but all the samples of shallow groundwater exceed the standard (Figure 5.5.21). All samples are below PQL of Cd and Cr. 88.9% of the samples are below PQL of Cu (up to 0.0070 mg/l). All samples contain below 0.06 mg/l of CN. All samples are below PQL of Pb, Hg and Ni. 85.2% of the samples are below PQL of Zn.

COD shows high concentrations (up to 78 mg/l). 37.0% of the samples exceed 20 mg/l of COD (Figure 5.5.22). This high concentration may be due to contamination by human activity.

5.5.4 Monitoring Results of General Groundwater Quality

1) Trilinear Diagram Analysis

a. Pourashava Observation Wells/Holes

a.1. CH-1 Site [Poshu Hat, Chuadanga Pourashava]

Figure 5.5.23 shows the trilinear diagram of observation well/holes at CH-1 site. The general groundwater quality was analyzed for the samples before the pumping test and during the pumping test, and the samples from monthly monitoring. For the observation well, the sample during the pumping test was collected 48 hours after the pumping started. For the observation holes, the samples were collected twice: 30 minutes and 140 minutes after the pumping started.

From the diamond-shaped diagram, all the samples are plotted on the left-hand side, showing (Ca+Mg) - HCO_3 type groundwater. In cations, Ca is the major component, occupying more than 50% of the total meq/l. In anions, more than 90% of the total meq/l are occupied by HCO_3. In the Ch-1 well, the sample from before the pumping test shows a slightly different chemical composition in cations, but the samples during the pumping test and monitoring are plotted in almost the same domain in the cation diagram. The samples from observation holes during the pumping test show that the percentage of Ca in cations increased and that of (Na+K) decreased with time.

a.2. CH-2 Site [Girls College, Chuadanga Pourashava]

Figure 5.5.24 shows the trilinear diagram of observation well/holes at CH-2 site. The general groundwater quality was analyzed for the samples before the pumping test and during the pumping test, and the samples from monthly monitoring. For the observation well, the sample during the pumping test was collected 48 hours after the pumping started. For the observation holes, the samples were collected twice: 30 minutes and 140 minutes after the pumping started.

From the diamond-shaped diagram, all the samples are plotted on the left-hand side, showing (Ca+Mg) - HCO_3 type groundwater. In cations, Ca is the major component in most samples, occupying more than 50% of the total meq/l. However, the percentages of Mg to the total cations increased in the samples collected in June and August 2001. In anions, more than 90% of the total meq/l are occupied by HCO_3.

In the Ch-2 well, the percentages of (Na+K) in cations are relatively stable, ranging from 8 to 20% of the total meq/l. However, the percentages of Mg and Ca greatly vary during the monitoring period. Higher Mg and lower Ca was observed in June and August. The samples of observation holes during the pumping test show that the percentage of Ca in cations increased and that of (Na+K) decreased with time.

a.3 JH-1 Site [Arabpur, Jhenaidah Pourashava]

Figure 5.5.25 shows the trilinear diagram of observation well/holes at JH-1 site. The general groundwater quality was analyzed for the samples before the pumping test and during the pumping test, and the samples from monthly monitoring. For the observation well, the sample during the pumping test was collected 48 hours after the pumping started. For the observation holes, the samples were collected twice: 30 minutes and 140 minutes after the pumping started.

From the diamond-shaped diagram, all the samples are plotted on the left-hand side, showing (Ca+Mg) - HCO_3 type groundwater. In cations, Ca is the major component in most samples, occupying more than 50 to 75 % of the total meq/l. However, the percentages of Ca decreased below 40%in July and September 2001. In anions, more than 90% of the total meq/l are occupied by HCO_3.

In the Jh-1 well, the percentages of Mg in cations are relatively stable, ranging from 30 to 45% of the total meq/l. However, the percentages of Ca and (Na+K) vary relatively greatly during the monitoring period. Higher (Na+K) and lower Ca was observed in July and September. The samples from observation holes during the pumping test show that the percentage of Ca in cations increased with time particularly in Jh-1-1 and Jh-1-2 holes.

a.4 JH-2 Site [Hamdah, Jhenaidah Pourashava]

Figure 5.5.26 shows the trilinear diagram of observation well/holes at JH-2 site. The general groundwater quality was analyzed for the samples before the pumping test and during the pumping test, and the samples from monthly monitoring. For the observation well, the sample during the pumping test was collected 48 hours after the pumping started. For the observation holes, the samples were collected twice: 30 minutes and 140 minutes after the pumping started.

From the diamond-shaped diagram, all the samples are plotted on the left-hand side, showing (Ca+Mg) - HCO_3 type groundwater. In cations, Ca is the major in the observation holes, however, Mg became the major cation in Jh-2 well in the samples from August 2001. In anions, more than 90% of the total meq/l are occupied by HCO_3.

In the Jh-2 well, the percentages of Ca in cations were more than 50% of the total meq/l until the pumping test time, but in the monitoring period the percentage decreased to 30 to 40%. The samples of observation holes during the pumping test show that the percentage of Ca in cations increased with time, particularly in Jh-2-4 and Jh-2-2 holes.

a.5. JS-1 Site [Ghop, Jessore Pourashava]

Figure 5.5.27 shows the trilinear diagram of observation well/holes at JS-1 site. The general groundwater quality was analyzed for the samples before the pumping test and during the pumping test, and the samples from monthly monitoring. For the observation well, the sample during the pumping test was collected 48 hours after the pumping started. For the observation holes, the samples were collected twice: 30 minutes and 140 minutes after the pumping started.

From the diamond-shaped diagram, most of the samples are plotted on the left-hand side, showing (Ca+Mg) - HCO_3 type groundwater. However, the plotted domain is located slightly lower than that of Chuadanga and Jhenaidah samples. The sample of Js-1-4 before pumping test shows (Na+K) - HCO_3 type. In cations, Ca is the major in the observation holes, ranging from 30 to 60 % of the total meq/l. The percentage of Na is relatively higher than that of Chuadanga and Jhenaidah, ranging from 15 to 45% of the total meq/l. In anions, more than 84% of total meq/l are occupied by HCO_3.

In the Jh-2 well, the percentage of Ca in cations was more than 48% until the pumping test time, but it decreased below 40% in August and September. In October, the Ca percentage again showed more than 45% of the total meq/l in cations. The samples of observation holes during the pumping test show that the percentage of Ca in cations increased with time particularly in Js-1-4 hole.

a.6. JS-2 Site [Kharki, Jessore Pourashava]

Figure 5.5.28 shows the trilinear diagram of observation well/holes at JS-2 site. The general groundwater quality was analyzed for the samples before the pumping test and during the pumping test, and the samples from monthly monitoring. For the observation well, the sample during the pumping test was collected 48 hours after the pumping started. For the observation holes, the samples were collected twice: 30 minutes and 140 minutes after the pumping started.

From the diamond-shaped diagram, most of the samples are plotted on the left-hand side, showing (Ca+Mg) - HCO_3 type groundwater. However, the plotted domain is located slightly lower than that of Chuadanga and Jhenaidah samples. The sample of Js-2-4 before the pumping test shows (Na+K) - HCO_3 type. In cations, it is characterized that the Mg percentage shows a relatively narrow range of variation, ranging from 20 to 30% for most samples. On the other hand, the percentages of (Na+K) and Ca range from 10 to 65% and 19 to 60%, respectively. In anions, more than 80% of the total meq/l are occupied by HCO_3. However, compared with JS-1 site, the Cl percentage is slightly higher in JS-2 site.

In the Jh-2 well, the percentage of Mg in cations slightly increased in September 2001. The samples of deep groundwater taken from Js-2 well and Js-2-4 hole show a slightly different chemical composition from shallow groundwater, having higher (Na+K) and lower Ca. The samples of observation holes during the pumping test show that the percentage of Ca in cations increased with time, particularly in Js-2-4 hole.

b. Deep Observation Holes in the Model Rural Areas

Figure 5.5.29 shows the trilinear diagram of deep groundwater taken from the observation holes in the model rural areas. The general groundwater quality was analyzed in the monthly monitoring program.

From the diamond-shaped diagram, it is evaluated that the deep groundwater in Bara Dudpatila village shows a (Ca+Mg) - HCO_3 type of chemical composition. On the other hand, the deep groundwater in Rajnagar Bankabarsi village shows to be (Na+K) - HCO_3 type. The deep groundwater in Krishna Chandrapur generally shows to be (Ca+Mg) - HCO_3 type but showed to be (Na+K) - HCO_3 type in June and July 2001.

In cations, (Na+K) is always less than 20% in Bara Dudpatila village; But the Mg percentage jumped up more than 50% in August. The cations of the deep groundwater in Krishna Chandrapur are characterized by a higher percentage of Ca. The groundwater in Rajnagar Bankabarsi is rich in (Na+K). In anions, more than 80% of the total meq/l are occupied by HCO_3. However, the samples from Rajnagar Bankabarsi and one sample from Krishna Chandrapur have Cl percentages of 10 to 20% and 27%, respectively.

c. Improved Deep Wells in the Model Rural Areas

c.1. Bara Dudpatila Village, Chuadanga District

Figure 5.5.30 shows the trilinear diagram of groundwater taken from the improved deep wells in Bara Dudpatila village. The general groundwater quality was analyzed in the monthly monitoring program.

From the diamond-shaped diagram, the deep groundwater in Bara Dudpatila village shows a (Ca+Mg) - HCO_3 type of chemical composition.

In cations, Ca is dominant, occupying 60 to 70%. The percentages of (Na+K) and Mg, are 5 to 15% and 20 to 30%, respectively. In anions, more than 97% of the total meq/l are occupied by

HCO_3.

During the monitoring, the changes in cation composition can be traced as shown in the figure. From the figure, the change of Type-C well is different from the other wells, indicating that the mechanical sealing method employed in the well may be not functioning properly.

c.2. Krishna Chandrapur Village, Jhenaidah District

Figure 5.5.31 shows the trilinear diagram of groundwater taken from the improved deep wells in Krishna Chandrapur village. The general groundwater quality was analyzed in the monthly monitoring program.

From the diamond-shaped diagram, the deep groundwater shows a (Ca+Mg) - HCO_3 type of chemical composition.

In cations, Ca is dominant, occupying 60 to 70%. The percentages of (Na+K) and Mg are 5 to 15% and 18 to 27 %, respectively. In anions, more than 97% of the total meq/l are occupied by HCO_3.

During the monitoring, the changes in cation composition can be traced as shown in the figure. From the figure, the composition of Type-A well in March 2001 is different from the other wells. In addition, the composition of Type-B well in June is different from the others. Although the plots of the three (3) wells showed a similar pattern from February to March, the difference from the 2nd month of the monitoring suggest that the effectiveness of sealing or other reasons such as the difference of water use conditions may have caused the slight difference in water quality.

c.3. Rajnagar Bankabarsi Village, Jessore District

Figure 5.5.32 shows the trilinear diagram of groundwater taken from the improved deep wells in Rajnagar Bankabarsi village. The general groundwater quality was analyzed in the monthly monitoring program.

From the diamond-shaped diagram, the deep groundwater shows a type between (Ca+Mg) - HCO_3 and (Na+K) - HCO_3 in chemical composition.

In cations, (Na+K) is slightly high, occupying 40 to 50%. The percentages of Ca and Mg, are 27 to 37% and 20 to 30 %, respectively. In anions, more than 92% of the total meq/l are occupied by HCO_3.

During the monitoring, the changes in cation composition can be traced as shown in the figure. From the figure, the changes in cation composition of the three (3) wells show similar patterns, indicating that the effectiveness of the sealing methods have no significant difference.

2) Changes in Groundwater Level and Groundwater Quality

a. Pourashava Observation Wells/Holes

a.1. CH-1 Site [Poshu Hat, Chuadanga Pourashava]

Figure 5.5.33 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, Fe, and HCO_3) in Ch-1 observation well.

The stiff diagrams show that there is no significant change in chemical composition; however, the size of the diagrams is slightly smaller when the water level declined. In the high water period from September to October, the concentration of Ca and HCO_3 increased.

The graphs of As concentration and HCO_3 concentration show similar patterns; however, it should be noted that the dissolved iron was high when the arsenic level was low.

Figure 5.5.34 shows the changes in groundwater level with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in Ch-1 observation well.

The NH_4 concentration was above 1.0 mg/l in February 2001, but it gradually declined from March to June. The concentration slightly increased from September to October. The Mn concentration was lower than 0.1 mg/l from February to April, but it showed more than 0.3 mg/l from June. In October it went up to above 0.8 mg/l.

a.2. CH-2 Site [Girls College, Chuadanga Pourashava]

Figure 5.5.35 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, Fe, and HCO_3) in Ch-2 observation well.

The stiff diagrams show that the sizes of the diagrams are smaller from June to September particularly when the groundwater level slightly declined on the way to reaching the highest water level in October. The samples from June and August show smaller concentration of Ca. In October, the concentration of Ca and HCO_3 increased.

Although the As concentration in the well is very small, there is an inversely proportional relationship between As and Fe. The HCO_3 curve resembles the curve of Fe.

Figure 5.5.36 shows the changes in groundwater level with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in Ch-2 observation well.

The NH_4 concentration was below 0.5 mg/l until September 2001, but it rose up to more than 1.0 mg/l in October. The Mn concentration was higher than 0.3 mg/l in March, but it showed below 0.1 mg/l from April to October.

a.3. JH-1 Site [Arabpur, Jhenaidah Pourashava]

Figure 5.5.37 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, Fe, and HCO_3) in Jh-1 observation well.

The stiff diagrams show that the sizes of the diagrams are smaller from July to September when the water level rose and started to decline. The decrease in Ca is particularly observed. In

October, the concentration of Ca and HCO_3 increased.

Although the As concentration became smaller than 0.01 mg/l from June, the Fe concentration greatly fluctuated between 2 and 10 mg/l irregularly. The HCO_3 concentration decreased from 490 mg/l in April to 360 mg/l in July. The changing pattern of HCO_3 is similar to that of As concentrations.

Figure 5.5.38 shows the changes in groundwater level with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in Jh-1 observation well.

The NH_4 concentration was smaller than 0.2 mg/l and had a tendency to decrease over time. The Mn concentration was higher than 0.1 mg/l from April to August, but it declined below 0.05 mg/l in September and October.

a.4. JH-2 Site [Hamdah, Jhenaidah Pourashava]

Figure 5.5.39 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, Fe, and HCO_3) in Jh-2 observation well.

The stiff diagrams show that the sizes of the diagrams are smaller from July to September when the water level rose and started to decline. The decrease in Ca is particularly observed. In Jh-2 well, the size is still smaller in October.

Although the As concentration became smaller than 0.01 mg/l from July, the changing patterns of As, Fe and HCO_3 show similar patterns. The Fe concentration was above 2.0 mg/l in June, but it declined below 0.5 mg/l in July. It again went up to 1.8 mg/l, and then declined below 0.5 mg/l. The HCO_3 concentration was as high as 460 mg/l in June, but it decreased below 300 mg/l in July and August.

Figure 5.5.40 shows the changes in groundwater level with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in Jh-2 observation well.

The NH_4 concentration was smaller than 0.2 mg/l and decreased over time. The Mn concentration was always below 0.05 mg/l.

a.5. JS-1 Site [Ghop, Jessore Pourashava]

Figure 5.5.41 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, Fe, and HCO_3) in Js-1 observation well.

The stiff diagrams show that the shapes of the diagrams are similar over time.

Although the As concentration was always smaller than 0.004 mg/l, the level decreased from September to November. However, the Fe concentration was still high above 0.8 mg/l in September. The HCO_3 concentration decreased in August at 430 mg/l, and then it went up to nearly 500 mg/l in October.

Figure 5.5.42 shows the changes in groundwater level with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in Js-1 observation well.

The NH_4 concentration was smaller than 0.2 mg/l from August to October. The Mn concentration was increasing from 0.13 mg/l in July to 1.2 mg/l in October.

a.6. JS-2 Site [Kharki, Jessore Pourashava]

Figure 5.5.43 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, Fe, and HCO_3) in Js-2 observation well.

The stiff diagrams show that the shapes of the diagrams are similar over time.

Although the As concentration was always smaller than 0.002 mg/l, the level decreased from September to October. However, the Fe concentration increased from 0.86 mg/l in August to 10.0 mg/l in September. The HCO_3 concentration also increased from 429 mg/l in August to 507 mg/l in September.

Figure 5.5.44 shows the changes in groundwater level with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in Js-2 observation well.

The NH_4 concentration declined from 0.38 to below 0.1 mg/l from August to October. The Mn concentration was high in September at 2.3 mg/l.

2) Deep Observation Holes in the Model Rural Areas

a. Bara Dudpatila Village, Chuadanga District

Figure 5.5.45 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, NH_4, Fe, and Mn) in Ch-CB-2 observation hole.

The stiff diagrams show that the size of the diagrams is small when the groundwater level was lowest in the dry season. But the size became larger from June to August when water level went up.

The As concentration was always smaller than 0.01 mg/l and there is no significant correlation with the groundwater level change. The NH_4 concentration declined from 1.76 mg/l in January to 0.72 mg/l in April. But a slight increase in NH_4 concentrations was observed from June to August. The Fe concentration was very high at 15 mg/l in April. But the value declined to 1.0 mg/l in April and then ranged from 2.5 to 4 mg/l. The Mn concentration once decreased below 0.1 mg/l in March and April, but increased up to 0.5 mg/l in July.

b. Krishna Chandrapur Village, Jhenaidah District

Figure 5.5.46 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, NH_4, Fe, and Mn) in Jh-CB-2 observation hole.

The stiff diagrams show that the shapes of the diagrams changed in June and July, showing (Na+K) dominated in cations and Cl concentrations increased in anions. However, from August to November the shape returned to Ca-HCO_3 type.

The As concentration exceeded the Bangladeshi standard value of 0.05 mg/l from August and then reached 0.1 mg/l in November. The NH_4 concentration also went up from 0.12 mg/l in July to 1.57 mg/l in August. From September the value ranged from 1.2 to 1.5 mg/l. The Fe concentration jumped up to above 3.0 mg/l in July, and then ranged from 2.0 to 3.0 mg/l. The Mn concentration gradually increased from May to October. It was below 0.1 mg/l in May and June, but the value reached 0.24 mg/l in October.

c. Rajnagar Bankabarsi Village, Jessore District

Figure 5.5.47 shows the changes in groundwater level with stiff diagrams and groundwater quality (As, NH_4, Fe, and Mn) in Js-CB-2 observation hole.

The stiff diagrams show that the (Na+K) - HCO_3 type all the time, and the size of the diagrams are also almost stable.

The As concentration was very low in the observation hole. The NH_4 concentration was below 0.2 mg/l from May to August, but it rose from September and exceeded 1.0 mg/l in October. The Fe concentration was below 0.3 mg/l from May to August. But the value exceeded 0.3 mg/l in September and October. The Mn concentration was low from May to September, but it reached 0.1 mg/l in October.

d. Improved Deep Wells in the Model Rural Areas

d.1. Bara Dudpatila Village, Chuadanga District

Figure 5.5.48 shows the changes in arsenic concentrations with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in the improved deep wells in Bara Dudpatila village.

The arsenic concentrations in all three (3) wells were above the Bangladeshi standard value of 0.05 mg/l. They rose from July to September and declined from October to December.

The general groundwater quality was analyzed for the samples taken from March to June 2001. The stiff diagrams show that the groundwater is Ca - HCO_3 type. The shape and the size of the diagrams are almost the same and did not change during the period. In the period, NH_4 concentrations varied from 0 to 2.0 mg/l. In June, all the improved wells had NH_4 concentrations above 1.5 mg/l. The Fe concentrations are generally high in the wells. It was more than 5.0 mg/l in Type-C well. From April to June, the concentrations ranged from 2.0 to 3.0 mg/l. The Mn concentrations tend to increase from March to June. The values ranged from 0.1 to 0.3 mg/l.

d.2. Krishna Chandrapur Village, Jhenaidah District

Figure 5.5.49 shows the changes in arsenic concentrations with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in the improved deep wells in Krishna Chandrapur village.

The arsenic concentrations in all three (3) wells exceeded the Bangladeshi standard value of 0.05 mg/l from July to September.

The general groundwater quality was analyzed for the samples taken from February to June 2001. The stiff diagrams show that the groundwater is Ca - HCO_3 type. The shape and the size of the diagrams are almost the same and did not change during the period. In the period, NH_4 concentrations increased greatly particularly in Type-A and Type-C wells. The rise in concentrations started March in Type-A well. In Type-C well, the concentration significantly increased from May to June. In June, the NH_4 concentrations of Type-A and Type-C wells show 4.0 to 5.0 mg/l, whereas the value of Type-B well is 1.5 mg/l. The Fe concentration of Type-A well is also the highest among the three (3) wells. The Type-A well had more than 6.0 mg/l from March to June. The concentration of Type-C slightly increased to 4.0 mg/l in June. The concentration in Type-B well is almost stable, showing about 2.0 mg/l. The Mn concentration is also high in Type-A well, showing 0.3 to 0.5 mg/l in May to June. The concentrations in Type-B and Type-C wells are below 0.2 mg/l, but they tended to increase from April to June.

d.3. Rajnagar Bankabarsi Village, Jessore District

Figure 5.5.50 shows the changes in arsenic concentrations with stiff diagrams and groundwater quality (NH_4, Fe, and Mn) in the improved deep wells in Rajnagar Bankabarsi village.

The arsenic concentrations in all the three (3) wells were much lower than the WHO guideline value of 0.01 mg/l.

The general groundwater quality was analyzed for the samples taken from November 2000 to March 2001. The stiff diagrams show that the groundwater is (Na+K) - HCO_3 type. The shape and the size of the diagrams slightly changed in January 2001 but stayed almost the same for the rest of the period.

In the period, NH_4 concentrations were very high in January 2001, ranging from 6 to 9 mg/l. But the values declined to below 0.5 mg/l in February and showed 1.10, 1.18, and 0.18 mg/l in Type-A well, Type-B well, and Type-C well, respectively. The Fe concentrations were also high in January 2001, exceeding 1.2 mg/l. But they declined in February and slightly increased in March. The Mn concentrations were also high in January 2001, exceeding 0.15 mg/l. But from February to March, the values were below 0.1 mg/l.

5.5.5 Relations between Arsenic and General Quality Parameters

Based on the arsenic concentrations and other water quality parameters analyzed for the newly constructed observation wells/holes by the monthly monitoring program, the relationship of arsenic concentrations and water quality parameters were examined.

1) Relation of HCO_3 to As, Fe, Eh and pH

Figure 5.5.51 shows the relationship between bicarbonate and As, Fe, Eh and pH in the observation well/holes. In the study area, the concentrations of HCO_3 are generally high, ranging from 200 to 550 mg/l. The groundwater samples having As concentrations more than 0.05 mg/l show HCO_3 concentrations ranging from 280 to 510 mg/l. The samples contaminated by arsenic have 1 to 6 mg/l of dissolved iron. There is a tendency that HCO_3 concentrations increase with decreasing Eh values. A clearer correlation between HCO_3 values and pH values are found in the figure, showing HCO_3 values increase with decreasing pH. The samples contaminated by arsenic are plotted on the lower part of graph d) in the figure.

2) Relation of Fe to As, NH_4, Fe, Eh and pH

Figure 5.5.52 shows the relationship between dissolved iron and As, NH_4, Eh and pH in the observation well/holes. In the study area, the concentrations of Fe are generally high, ranging from 0 to 17 mg/l. The groundwater samples having As concentrations of more than 0.05 mg/l show Fe concentrations ranging from 1 to 6 mg/l. From the NH_4 - Fe plots shown in graph b), the samples contaminated by As have higher values of both Fe and NH_4. Graph c) shows that the Fe concentration increases with decreasing Eh. Most samples having Fe concentrations from 5 to 15 mg/l show Eh values from -20 to +100 mV. However, the contaminated samples by As are limited in the upper-left part of the graph. The relation between Fe and pH shows an inversely proportional correlation. As shown in graph d), the samples having more than 5 mg/l in Fe show 6.8 to 7.5 in pH.

3) Relation of Fe to As, NH_4, Fe, Eh and pH

Figure 5.5.53 shows the relationship between calcium and As, Mg, Eh and pH in the observation well/holes. In the study area, the concentrations of Ca range from 0 to 130 mg/l. The groundwater samples having As concentrations of more than 0.05 mg/l show Ca concentrations ranging from 60 to 150 mg/l. From the Mg - Ca plots shown in graph b), the samples contaminated by As have higher values of Ca and relatively lower values of Mg, indicating that the arsenic does not originate from mica weathering even though the core samples in the study area showed the grains are rich in mica. Graph c) shows that the samples contaminated by As are plotted in the upper left domain of the graph, showing the samples having relatively higher values of Eh and Ca. The pH-Ca plots clearly show that Ca concentrations increase with decreasing pH. The area of samples contaminated by arsenic is concentrated in the lower part of graph d).

4) Relation of NH_4 to As, HCO_3, Eh and pH

Figure 5.5.54 shows the relationship between ammonium and As, HCO_3, Eh and pH in the observation well/holes. In the study area, the concentrations of NH_4 range from 0 to 8.1 mg/l. The groundwater samples having As concentrations more than 0.05 mg/l show NH_4 concentrations ranging from 0 to 4.5 mg/l. From the HCO_3 - NH_4 plots shown in graph b), two

(2) groups of samples having higher value of As are identified. One has NH_4 values from 1 to 2 mg/l with HCO_3 values around 500 mg/l. The other has NH_4 values from 0 to 5 mg/l with HCO_3 values of 300 to 350 mg/l. As shown in graph c), there is no significant correlation between Eh and NH_4. However, the samples containing more than 2 mg/l of NH_4 are limited to having Eh values from 80 to 200 mV. The samples contaminated by arsenic are plotted in the upper left domain of the graph. The pH-NH_4 plot shows that there are two (2) groups of samples having values of NH_4 higher than 2 mg/l. One group has pH values from 6.8 to 7.2, and the other has pH values from 7.6 to 7.8. The samples contaminated by arsenic are concentrated in the former group.

5) Relation of COD to As, NH_4, Eh and pH

Figure 5.5.55 shows the relationship between COD and As, NH_4, Eh and pH in the observation well/holes. In the study area, the concentrations of COD range from 0 to 170 mg/l. The groundwater samples having As concentrations of more than 0.05 mg/l show COD concentrations ranging from 0 to 70 mg/l. From the NH_4 - COD plots shown in graph b), highly contaminated samples with more than 0.1 mg/l of As have COD values from 40 to 70 mg/l and NH_4 values from 1 to 4.5 mg/l. Graph c) shows that the samples having more than 50 mg/l in COD have Eh values from 0 to 70 mV, indicating that very high values of COD occur only under particular groundwater conditions. The relation between COD and arsenic concentrations suggest that the occurrence of arsenic may be related to the existence of organic materials.

5.5.6 Comparison with Bangladesh Standard and WHO Guideline

1) Observation Wells/Holes in Pourashava

The results of the laboratory chemical analysis were compared with the Standard for Drinking Water in Bangladesh and the WHO Guideline Values for Drinking Water. The following descriptions show the results of observation wells/holes that have more than the Standard or the Guideline values.

a. Nitrite (NO_2)

Nitrite is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. Such oxidation and reduction occurr in groundwater. The toxicologic significance of nitrosation reactions in vivo and in the natural environment is the subject of much current concern and research.

The Standard in Bangladesh and the WHO Guideline for nitrite are 1 and 3 mg/l, respectively. High NO_2 concentrations exceeding the Standard in Bangladesh (=1 mg/l) are found in samples from 6 observation holes in Jessore (OH-JS2-3-SIP-140 min), Jhenaidah (OH-JH1-2-SIP-140 min, OH-JH1-3-BP) and Chuadanga (OH-CH1-1-BP, OH-CH2-1-BP, OH-CH2-2-SIP-30 to 140 min). NO_2 concentrations exceeding the WHO Guideline (=3 mg/l) are not found in any of the results.

From these results, it can be said that NO_2 contamination is mainly distributed in shallow aquifers.

b. Ammonia (NH_4)

Ammonia is present naturally in surface and wastewaters. Its concentration is generally low in groundwater because it adsorbs in soil particles and is not leached readily from soils. Therefore if high concentrations of NH_4 occur, it can be said that it is produced by some human activities.

Ammonia is not of immediate health relevance, and no health-based guideline value by WHO has been proposed. Instead, a level of 1.5 mg/l likely to give rise to consumer complaints has been proposed. The Standard in Bangladesh is 0.5 mg/l. High NH_4 concentrations exceeding the Standard in Bangladesh (=0.5 mg/l) are found in samples from 9 out of 30 observation wells/holes in Jessore (OH-JS2-3-BP), Jhenaidah (OH-JH1-2-BP to SIP-30 min, OH-JH1-3-SIP-30 to 140 min) and Chuadanga (OW-CH1-1-BP to 48h, OH-CH1-1-SIP-30 to 140 min, OH-CH1-2-SIP-140 min, OH-CH1-3-BP to SIP-140 min, OW-CH2-6 m, OH-CH2-1-BP to SIP-140 min). High NH_4 concentrations exceeding the WHO Guideline (=1.5 mg/l) are found in samples from 2 observation holes out of 30 observation wells/holes in Jessore (OH-JS2-3-BP) and Chuadanga (OH-CH2-1-SIP-30 to 140 min).

From these results, it can be said that NH_4 contamination is mainly distributed in shallow aquifers at Chuadanga and Jhenaidah sites.

c. Dissolved Manganese (Mn)

Manganese is associated with iron minerals, and occurs in ocean, fresh waters, and soils. The aqueous chemistry of manganese is similar to that of iron. The common aqueous species are the reduced Mn^{2+} and the oxidized Mn^{4+}. Since groundwater in Bangladesh is usually anoxic, any soluble Mn in groundwater is in the reduced state (Mn^{2+}). Upon exposure to air, groundwater containing Mn will precipitate black MnO_2. High concentration of Mn therefore cause stains in water pipeline, laundry, and cooking utensils. On the other hand, Mn is considered an essential trace element for plants and animals.

The Standard in Bangladesh and the WHO Guideline for Mn are 0.1 and 0.5 mg/l, respectively. 75.8% of Mn samples exceed the Standard in Bangladesh and 32.5% of the samples exceed the WHO Guideline. In the case of deep groundwater (300 m in depth), 22.4% of the samples exceed the Standard. The high Mn concentrations are mainly distributed in Jessore.

The results show some correlation with iron concentrations. Moreover, the results of Mn show some correlation with As concentrations.

d. Dissolved Iron (Fe)

Iron occurs in minerals such as hematite, magnetite, taconite, and pyrite. Since groundwater in Bangladesh is usually anoxic, any soluble iron in groundwater is in the ferrous state (Fe^{2+}). On exposure to air, ferrous iron is oxidized to the ferric state (Fe^{3+}) to form red, insoluble hydrated ferric oxide. It is observed frequently when samples are collected in the field. High concentrations of Fe in groundwater therefore cause stains in water pipeline, laundry, and cooking utensils, and impact the taste and color of foods.

The Standard in Bangladesh is 0.3 to 1 mg/l. No health-based Guideline value by WHO has been proposed. Instead, a level of 0.3 mg/l likely to give rise to consumer complaints is proposed. Almost all the results of Fe (up to 18 mg/l) exceed these criteria. 83.3% of Fe samples exceed the Standard in Bangladesh and 96.7% of samples exceed the WHO Guideline. The high Mn concentrations are mainly distributed in Jessore.

The results show some correlation with Mn. Moreover, the results of Fe show some correlation with As concentrations.

e. Calcium (Ca)

Calcium is necessary in plant and animal nutrition and is an essential component of bones, shells, and plant structures. The presence of calcium in groundwater results from limestone, dolomite, etc.

The Standard in Bangladesh is 75 mg/l. A WHO guideline value has not been set so far because Ca is no health threat. High Ca concentrations exceeding the Standard in Bangladesh (=75 mg/l) are found in samples from 24 out of 30 observation wells/holes in Jessore (OW-JS1 - BP to 48h, OW-JS1 - 3 m to 5 m, OH-JS1-1 - BP to SIP-140 min, OH-JS1-2 - BP to SIP-140 min, OH-JS1-3 - SIP-30 to 140 min, OH-JS1-4 - SIP-30 to 140 min, OW-JS2 - 2 m to 4 m, OH-JS2-1 - BP to SIP-140 min, OH-JS2-2 - BP to SIP-140 min, OH-JS2-3 - SIP30 to 140 min), Jhenaidah (OW-JH1 - BP to 1 m, OW-JH1 - 3 m, OW-JH1 - 5 m to 7 m, OH-JH1-2 - BP to SIP-140 min, OH-JH1-3 - BP to SIP-140 min, OH-JH1-4 - BP to SIP-140 min, OW-JH2 - BP to 48h, OH-JH2-1 - BP to SIP-140 min, OH-JH2-2 - BP to SIP-140 min, OH-JH2-3 - BP to SIP-140 min, OH-JH2-4 - SIP-30 to 140 min) and Chuadanga (OW-CH1 - BP to 8 m, OH-CH1-3 - SIP-30 to 140 min, OH-CH1-4 - SIP-BP to 140 min, OW-CH2 - BP to 1 m, OW-CH2 - 7 m, OH-CH2-2 - SIP-30 min, OH-CH2-4 - BP to SIP-140 min).

As a result, quite a lot of samples from both shallow and deep aquifers exceed this criterion.

f. Magnesium (Mg)

Magnesium occurs usually in the minerals magnesite and dolomite. The common aqueous species is Mg^{2+}. Magnesium is one of the important contributors to the hardness of groundwater. Magnesium is an essential element in chlorophyll and in red blood cells. Some salts of magnesium are toxic by ingestion or inhalation.

The Standard in Bangladesh is 30 to 35 mg/l. A guideline by WHO has not been set so far because Mg is no health threat.

High Mg concentrations exceeding the Standard in Bangladesh (= Max 35 mg/l) are found in samples from 4 out of 30 observation wells/holes in Jessore (OW-JS2 - 1 m) and Jhenaidah (OW-JH1 - BP to 1 m, OW-JH1 - 4 m, OW-JH1 - 6 m to 7 m, OH-JH1-4 - BP to SIP-140 min, OW-JH2 - BP to 48h, OW-JH2 - 3 m, OW-JH2 - 5 m to 6 m).

As Ca, some samples from both shallow and deep aquifers exceed this criterion.

g. Fluoride (F)

Fluoride occurs naturally in minerals such as fluorite, cryolite, fluorapatite, etc. Inorganic fluorine compounds are used in the production of aluminium, and fluoride is released during the manufacture and use of phosphate fertilizers, which contain up to 4% of fluorine.

The Standard in Bangladesh and the WHO Guideline for F are 1 and 1.5 mg/l respectively. High F concentrations exceeding the Standard in Bangladesh (= 1 mg/l) are found in samples from 3 observation holes out of 30 observation wells/holes in Jessore (OH-JS1-2 - BP to 30 min, OH-JS2-4 - BP). High F concentrations exceeding the Guideline of WHO (= 1.5 mg/l) are found in one (1) observation hole in Jessore (OH-JS2-4 - BP).

h. Lead (Pb)

Lead occurs naturally in the minerals galena and serusite. The common aqueous species of Lead are Pb^{2+}, hydroxide and carbonate complex. Pb is nonessential for plants and animals. It is toxic by ingestion and is a cumulative poison.

The Standard in Bangladesh and the WHO Guideline for Pb are 0.05 and 0.01 mg/l, respectively. High Pb concentrations exceeding the Standard in Bangladesh (= 0.05 mg/l) are not found in the collected samples. However, concentrations above the WHO Guideline (= 0.01 mg/l) are found in samples from 4 out of 30 observation wells/holes in Jhenaidah (OW-JH1 - 48h, OH-JH1-1 - SIP-140 min, OH-JH1-4 - BP, OH-JH2-4 - BP).

2) Deep Observation Holes in Model Rural Areas

The results of the laboratory chemical analysis are compared with the Standard for Drinking Water in Bangladesh and the WHO Guideline Values for Drinking Water. The following descriptions show the results of Core Borings that have exceeded the Standard or the Guideline.

a. Nitrite (NO_2)

The Standard in Bangladesh and the WHO Guideline for nitrite are 1 and 3 mg/l respectively. High NO_2 concentrations (up to 2.2 mg/l) exceeding the Standard of Bangladesh (= 1 mg/l) are found in samples from Rajnagar Bankabarsi Core Boring site (CB-JSRb - 2 m, CB-JSRb - 6 m).

High NO_2 concentrations exceeding the WHO Guideline (= 3 mg/l) are not found in any of the results.

It can be said that NO_2 contamination is distributed in Rajnagar Bankabarsi village but is not so serious.

b. Ammonia (NH_4)

Ammonia is not of immediate health relevance, and no health-based guideline value by WHO has been proposed. Instead a level of 1.5 mg/l likely to give rise to consumer complaints has been proposed. The Standard in Bangladesh is 0.5 mg/l. High NH_4 concentrations (up to 1.8 mg/l) exceeding the Standard in Bangladesh (= 0.5 mg/l) are found in samples from Rajnagar Bankabarsi (CB-JSRb - 4 m to 5 m), Krishna Chandrapur (CB-JHKc - 1 m, CB-JHKc - 3 m to 6 m) and all samples from Bara Dudpatila. High NH_4 concentrations exceeding the WHO Guideline (= 1.5 mg/l) are found in samples from Krishna Chandrapur (CB-JHKc - 3 m, CB-JHKc - 6 m) and Bara Dudpatila (CB-CDBd - 0 m).

From these results, it can be said that some NH_4 contamination is found in the Core Borings.

c. Dissolved Manganese (Mn)

The Standard in Bangladesh and the WHO Guideline for Mn are 0.1 and 0.5 mg/l, respectively. 0.1 mg/l and over of Mn are found in Rajnagar Bankabarsi (CB-JSRb - 5 m to 6 m), Krishna Chandrapur (CB-JHKc - 2 m to 6 m) and Bara Dudpatila (CB-CDBd - 0 m to 1 m, CB-CDBd - 4 m to 6 m). Only one (1) sample (CB-CDBd-5 m, 0.51 mg/l) exceeds the Guideline by WHO.

d. Dissolved Iron (Fe)

The Standard in Bangladesh for Fe is 0.3 to 1 mg/l. No health-based Guideline value by WHO has been proposed for Fe. Instead a level of 0.3 mg/l likely to give rise to consumer complaints has been proposed by WHO. High Fe concentrations (up to 15 mg/l) exceeding the Standard in Bangladesh (= 1 mg/l) are found in samples from Krishna Chandrapur (CB-JHKc-0 m, CB-JHKc-2 m to 6 m) and Bara Dudpatila (CB-CDBd-0 m to 2 m, CB-CDBd-4 m to 6 m). Concentrations exceeding the WHO Guideline (= 0.3 mg/l) are found in 76% of samples.

e. Calcium (Ca)

The Standard in Bangladesh for Ca is 75 mg/l. A WHO Guideline has not been set so far because Ca is not a health threat. High Ca concentrations exceeding the Standard in Bangladesh (= 75 mg/l) are found in samples from Krishna Chandrapur (CB-JHKc-0 m, CB-JHKc-3 m to 6 m) and Bara Dudpatila (CB-CDBd-0 m to 1 m, CB-CDBd-4 m to 6 m). None of the samples from Rajnagar Bankabarsi exceed the Standard.

f. Magnesium (Mg)

The Standard in Bangladesh for Mg is 30 to 35 mg/l. A WHO Guideline has not been set so far because Mg is not a health threat. High Mg concentrations exceeding the Standard in Bangladesh (=Max 35 mg/l) are found only in Bara Dudpatila (CB-CDBd-1 m, 43 mg/l).

g. Sodium (Na)

Sodium salts (e.g., sodium chloride) are found in virtually all food (the main source of daily exposure) and drinking water. Although concentrations of sodium in potable water are typically less than 20 mg/l, they can greatly exceed this in some countries.

The Standard in Bangladesh for Na is 200 mg/l. A WHO Guideline has not been set so far because Na is not a health threat. Instead a level of 200 mg/l likely to give rise to consumer complaints has been proposed by WHO. High Na concentrations exceeding the Standard in Bangladesh and the WHO Guideline are found in only one (1) sample from Krishna Chandrapur (CB-JHKc-1 m, 200 mg/l).

3) Proved Deep Wells in the Model Rural Areas

The results of the laboratory chemical analysis are compared with the Standard for Drinking Water in Bangladesh and the WHO Guideline Values for Drinking Water. The following descriptions show the results of Improved Deep Well that have exceeded the Standard or the Guideline.

a. Nitrite (NO_2)

The Standard in Bangladesh and the WHO Guideline for nitrite are 1 and 3 mg/l, respectively. High NO_2 concentrations (up to 2.5 mg/l) exceeding the Standard in Bangladesh (= 1 mg/l) are found in samples from Rajnagar Bankabarsi (IM-JSRb-2-2 m, IM-JSRb-3-2 m to 3 m) and Bara Dudpatila (IM-CDBd-1-2 m, IM-CDBd-2-1 m to 2 m). However, high NO_2 concentrations exceeding the WHO Guideline (= 3 mg/l) are not found in any of the results.

It can be said that some NO_2 contamination is found in Rajnagar Bankabarsi and Bara Dudpatila but it not so serious.

b. Ammonia (NH_4)

Ammonia is not of immediate health relevance, and no health-based guideline value by WHO has been proposed. Instead a level of 1.5 mg/l likely to give rise to consumer complaints has been proposed. The Standard in Bangladesh is 0.5 mg/l.

High NH_4 concentrations (up to 8.4 mg/l) exceeding the Standard in Bangladesh (= 0.5 mg/l) are found in many samples. 77.8% of samples exceed this criterion. High NH_4 concentrations exceeding the WHO Guideline (= 1.5 mg/l) are also found in all villages. 55.6% of the samples exceed the Guideline. Compared with the observation wells/holes and core boring, NH_4 concentrations of the improved deep wells are higher and may cause some consumer complaints such as taste or odor for drinking purposes.

c. Dissolved Manganese (Mn)

The Standard in Bangladesh and the WHO Guideline for Mn are 0.1 and 0.5 mg/l respectively. 0.1 mg/l and over of Mn (up to 0.46 mg/l) are found in many samples. 63.9% of the samples exceed this criterion. However, no sample exceeds the Guideline by WHO. This contamination is not so serious.

d. Dissolved Iron (Fe)

The Standard in Bangladesh for Fe is 0.3 to 1 mg/l. No health-based Guideline value by WHO has been proposed for Fe. Instead a level of 0.3 mg/l likely to give rise to consumer complaints has been proposed by WHO. High Fe concentrations (up to 9.8 mg/l) exceeding the Standard in Bangladesh (= 1 mg/l) are found in many samples. 69.4% of the samples exceed this criterion. Fe concentrations exceeding the WHO Guideline (= 0.3 mg/l) are also found in many samples. 88.9% of the samples exceed this Guideline.

e. Calcium (Ca)

The Standard in Bangladesh for Ca is 75 mg/l. A WHO Guideline has not set so far because Ca is no health threat. High Ca concentrations (up to 130 mg/l) exceeding the Standard in Bangladesh (= 75 mg/l) are found in all samples of Krishna Chandrapur and Bara Dudpatila. None of the samples from Rajnagar Bankabarsi exceed the Standard.

f. Lead (Pb)

The Standard in Bangladesh and the WHO Guideline for Pb are 0.05 mg/l and 0.01 mg/l respectively. High Pb concentrations exceeding the Standard in Bangladesh (= 0.05 mg/l) have not been found in the collected samples. However, some high concentrations exceed the WHO Guideline (= 0.01 mg/l) are found in Rajnagar Bankabarsi (IM-JSRb-3-0 m) and Bara Dudpatila (IM-CDBd-1-0 m).

4) Existing Wells in the Study Area

The results of the laboratory chemical analysis are compared with the Standard for Drinking Water in Bangladesh and the WHO Guideline Values for Drinking Water. The following descriptions show the results of the general water quality analysis at 30 existing wells in the 300 Existing Wells Survey that have exceeded the Standard or the Guideline.

a. Total dissolved solid (TDS)

TDS comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and small amounts of organic matter that are dissolved in water. TDS in drinking water originate from natural sources, sewage, urban run-off, and industrial wastewater. Salts used for road de-icing in some countries may also contribute to the TDS content in drinking water. Concentrations of TDS in water vary considerably in different geological regions owing to differences in the solubilities of minerals.

The Standard in Bangladesh and the WHO Guideline for TDS are both 1,000 mg/l. Four (4) results (2 sites) of existing wells show extremely high (up to 1,650 mg/l) values of TDS. It exceeds the Standard in Bangladesh (1,000 mg/l) and the WHO Guideline. All samples for production wells are below these criteria.

b. Nitrate (NO_3)

Nitrate is a naturally occurring ion that is a part of the nitrogen cycle. Nitrate is used mainly in inorganic fertilizers, and sodium. The nitrate concentration in groundwater and surface water is normally low but can reach high levels as a result of agricultural runoff, refuse dump runoff, or contamination by human or animal wastes. The toxicity of nitrate to humans is mainly attributable to its reduction to nitrite.

The Standard in Bangladesh and the WHO Guideline for nitrate are 10 and 50 mg/l respectively. 4.3% of the results for existing wells (up to 180 mg/l) exceed the Standard in Bangladesh (= 10 mg/l). 2.2% of the results for existing wells exceed the WHO Guideline (= 50 mg/l). All samples from production wells are below these criteria.

c. Nitrite (NO_2)

The Standard in Bangladesh and the WHO Guideline for NO_2 are 1 and 3 mg/l, respectively. 10.7 % of the results for existing wells (up to 4.2 mg/l) exceed the Standard in Bangladesh (= 1 mg/l). One of the samples from production wells exceeds the Standard. 8.7 % of the results for existing wells exceed the WHO Guideline (= 3 mg/l). All samples for production wells are below the Guideline.

d. Ammonia (NH_4)

Ammonia is not of immediate health relevance, and no health-based guideline value has been proposed by WHO. Instead, a level of 1.5 mg/l likely to give rise to consumer complaints has been proposed. The Standard in Bangladesh is 0.5 mg/l. 65.2 % of the results for existing wells (up to 12 mg/l) and 64.3 % of the results for production wells (up to 8.2 mg/l) exceed the Standard in Bangladesh (= 0.5 mg/l). 65.2 % of the results for existing wells and 50.0 % of the results for production wells exceed the WHO Guideline (= 1.5 mg/l).

e. Dissolved Manganese (Mn)

The Standard in Bangladesh and the WHO Guideline for Mn are 0.1 and 0.5 mg/l respectively. 87.0% of the results for existing wells (up to 1.5 mg/l) and 85.7% of the results for production wells (up to 0.75 mg/l) exceed the Standard in Bangladesh (= 0.1 mg/l). 52.2 % of the results for existing wells exceed the WHO Guideline (= 0.5 mg/l). 35.7% of the results for production wells exceed the WHO Guideline.

f. Dissolved Iron (Fe)

The Standard in Bangladesh for Fe is 0.3 to 1 mg/l. No health-based guideline value for Fe has been proposed by WHO. Instead, a level of 0.3 mg/l likely to give rise to consumer complaints has been proposed by WHO. 32.6% of the results for existing wells (up to 11 mg/l) and 57.1% of the results for production wells (up to 2.6 mg/l) exceed the Standard in Bangladesh (=1 mg/l). 89.1% of the results for existing wells and 78.6% of the results for production wells exceed the WHO Guideline (= 0.3 mg/l).

g. Chloride (Cl)

Cl in drinking water originates from natural sources, sewage and industrial effluents, and saline intrusion. The main source of human exposure to chloride is the addition of salt to food, and the intake from this source is usually greatly in excess of that from drinking water. Excessive chloride concentrations increase the rate of corrosion of metals in the distribution system, depending on the alkalinity of the water. This can lead to increased concentrations of metals in the supply.

The Standard in Bangladesh for Cl is 150 to 600 mg/l. No health-based guideline value for Cl has been proposed by WHO. Instead, a level of 250 mg/l likely to give rise to consumer complaints is proposed by WHO. No results for existing wells or production wells (up to 570 mg/l) exceed the Standard in Bangladesh (= 600 mg/l). 4.3% of the results for existing wells exceed the WHO Guideline (= 250 mg/l). No results for production wells exceed the WHO Guideline.

h. Bicarbonate (HCO_3)

Bicarbonate is one of the functional constituents of Alkalinity, which is significant in many uses and treatment of natural waters and wastewaters. Bicarbonate alkalinity is present if phenolphthalein alkalinity is less than half the total alkalinity. Bicarbonate is a major Anion in groundwater.

The Standard in Bangladesh for HCO_3 is 600 mg/l. No guideline value by WHO has been proposed for HCO_3. 4.3% of the results for existing wells (up to 720 mg/l) exceed the Standard in Bangladesh (= 600 mg/l).

i. Calcium (Ca)

The Standard in Bangladesh for Ca is 75 mg/l. A WHO guideline value has not been set so far because Ca is not a health threat. 76.1% of the results for existing wells (up to 160 mg/l) and 85.7% of the results for production wells (up to 110 mg/l) exceed the Standard in Bangladesh (= 75 mg/l).

j. Magnesium (Mg)

The Standard in Bangladesh for Mg is maximum 35 mg/l. A WHO guideline value has not been set so far. 6.5% of the results for existing wells (up to 45 mg/l) and 7.1% of the results for production wells (up to 35 mg/l) exceed the Standard in Bangladesh (= 35 mg/l).

k. Sodium (Na)

The Standard in Bangladesh of Na is 200 mg/l. A WHO guideline value has not been set so far because Na is not a health threat. Instead, a level 200 mg/l likely to give rise to consumer complaints has been proposed by WHO. 6.5% of the results for existing wells (up to 400 mg/l) exceed the Standard in Bangladesh (= 35 mg/l). No result for production wells exceeds the Standard in Bangladesh.

l. Fluoride (F)

The Standard in Bangladesh and the WHO guideline for F are 1 and 1.5 mg/l respectively. 15.2% of the results for existing wells (up to 1.7 mg/l) exceed the Standard in Bangladesh (= 1 mg/l). No result for production wells exceeds the Standard in Bangladesh. 2.2% of results for existing wells exceed the WHO Guideline (= 1.5 mg/l). No results for production wells exceed the WHO Guideline.

m. Cadmium (Cd)

Cd is used in the steel industry and in plastics. Cadmium compounds are widely used in batteries. Cadmium is released to the environment in wastewater, and diffuse pollution is caused by contamination from fertilizers and local air pollution. Contamination in drinking water may also be caused by impurities in the zinc of galvanized pipes and solders and some metal fittings. The Standard in Bangladesh and the WHO Guideline for F are 0.005 and 0.003 mg/l, respectively. 10.9% of the results for existing wells (up to 0.0079 mg/l) exceed the Standard in Bangladesh (= 0.005 mg/l). No result for production wells exceeds the Standard in Bangladesh. 17.4% of results for existing wells exceed the WHO Guideline (= 0.003 mg/l). No results for production wells exceed the WHO Guideline.

n. Total Chromium (Cr)

Chromium is widely distributed in the earth's crust. It can exist in valences of +3 to +6. Cr^{3+} would be expected to form strong complexes with amines, and be adsorbed by clay minerals. Cr^{6+} has been shown to be carcinogenic by inhalation and is corrosive to tissue. In general, food appears to be the major source of intake.

The Standard in Bangladesh is 0.05 mg/l. A WHO guideline value has not been set so far for total Cr. 45.7% of the results for existing wells exceed the Standard in Bangladesh (= 0.05 mg/l). No result for production wells exceeds the Standard in Bangladesh.

o. Lead (Pb)

The Standard in Bangladesh and the WHO Guideline for Pb are 0.05 and 0.01 mg/l, respectively. No results for existing wells and production wells exceed the Standard in Bangladesh (= 0.05 mg/l). 13.0% of the results (up to 0.037 mg/l) for existing wells exceed the WHO Guideline (= 0.01 mg/l). 7.1% of the results for production wells exceed the WHO Guideline.

p. Nickel (Ni)

Nickel is used mainly in the production of stainless steel and nickel alloys. Food is the dominant source of nickel exposure in the non-smoking, non-occupationally exposed population; water is generally a minor contributor to the total daily oral intake. However, there is heavy pollution due to the use of certain types of kettles and non-resistant material in wells, or water that has stood for an extended time in water pipes.

The Standard in Bangladesh and the WHO Guideline for Ni are 0.1 and 0.02 mg/l, respectively. No results for existing wells and production wells exceed the Standard in Bangladesh (= 0.1 mg/l). 26.1% of the results for existing wells (up to 0.069 mg/l) exceed the WHO Guideline (= 0.02 mg/l). No result for production wells exceeds the WHO Guideline.

q. Chemical Oxygen Demand (COD)

COD is defined as the amount of a specified oxidant that reacts with the sample under controlled terms of its oxygen equivalence. COD is often used as a measurement of pollutants in wastewater and natural waters.

The Standard in Bangladesh is 4 mg/l. A WHO guideline value has not been set so far. 19.6% of the results for existing wells exceed the Standard in Bangladesh (= 4 mg/l). No result for production wells exceeds the Standard in Bangladesh.

5) Existing Wells and Pond in the Model Rural Areas

The results of the laboratory chemical analysis are compared with the Standard for Drinking Water in Bangladesh and the WHO Guideline Values for Drinking Water. The following descriptions show the results of the Model Village Survey that have exceeded the Standard or the Guideline.

a. Total dissolved solid (TDS)

The Standard in Bangladesh and the WHO Guideline for TDS are both 1,000 mg/l.
In shallow groundwater in Rajnagar Bankabarsi, all TDS values show extremely high (up to 1,700 mg/l). They exceed the Standard in Bangladesh (= 1,000 mg/l) and the WHO Guideline.

b. Nitrate (NO_3)

The Standard in Bangladesh and the WHO Guideline for nitrate are 10 and 50 mg/l respectively. 14.8% of the pond water (up to 42 mg/l) and 26.7% of the shallow groundwater (up to 23 mg/l) exceed the Standard in Bangladesh (= 10 mg/l). High NO_3 concentrations exceeding the WHO Guideline (= 50 mg/l) are not found in any of the results.

c. Nitrite (NO_2)

The Standard in Bangladesh and the WHO Guideline for NO_2 are 1 and 3 mg/l, respectively. 11.1% of the pond water (up to 6.6 mg/l) and 26.7% of the shallow groundwater (up to 4.0 mg/l) exceed the Standard in Bangladesh (= 1 mg/l). 7.4% of the pond water (up to 6.6 mg/l) and 20.0% of the shallow groundwater (up to 4.0 mg/l) exceed the WHO Guideline (= 50 mg/l).

d. Ammonia (NH_4)

Ammonia is not of immediate health relevance, and no health-based guideline value by WHO has been proposed. Instead, a level of 1.5 mg/l likely to give rise to consumer complaints is proposed. The Standard in Bangladesh is 0.5 mg/l. 33.3% of the pond water (up to 4.8 mg/l) and 73.3% of the existing wells (up to 27 mg/l) exceed the Standard in Bangladesh (= 0.5 mg/l). 7.4% of the pond water (up to 4.8 mg/l) and 73.3% of the existing wells (up to 27 mg/l) exceed he WHO Guideline (= 1.5 mg/l).

e. Dissolved Manganese (Mn)

The Standard in Bangladesh and the WHO Guideline for Mn are 0.1 and 0.5 mg/l respectively. 14.8% of the pond water (up to 0.16 mg/l) and 46.7% of the shallow groundwater (up to 1.1 mg/l) exceed the Standard in Bangladesh (= 0.1 mg/l). 26.7% of the shallow groundwater (up to 1.1 mg/l) exceeds the WHO Guideline (= 0.5 mg/l). No sample of pond water exceeds the WHO Guideline.

f. Dissolved Iron (Fe)

The Standard in Bangladesh for Fe is 0.3 to 1 mg/l. No health-based guideline value by WHO has been proposed for Fe. Instead, a level of 0.3 mg/l likely to give rise to consumer complaints has been proposed by WHO. 73.3% of the shallow groundwater (up to 8.2 mg/l) exceeds the Standard in Bangladesh (= 1 mg/l). All samples of the existing wells (up to 8.2 mg/l) exceed the WHO Guideline (= 0.3 mg/l). No sample of the pond water exceeds the Standard in Bangladesh or the WHO Guideline.

g. Calcium (Ca)

The Standard in Bangladesh for Ca is 75 mg/l. A WHO guideline value has not been set so far because Ca is no health threat. All samples of shallow groundwater (up to 120 mg/l) exceed the Standard in Bangladesh (= 75 mg/l). None of the pond water samples exceed the Standard.

h. Magnesium (Mg)

The Standard in Bangladesh for Mg is maximum 35 mg/l. A WHO guideline value has not been set so far. All samples of shallow groundwater in Rajnagar Bankabarsi village (up to 47 mg/l) exceed the Standard in Bangladesh. None of the samples of pond water or existing wells from the other 2 villages exceed the Standard.

i. Sodium (Na)

The Standard in Bangladesh for Na is 200 mg/l. A WHO guideline value has not been set so far because Na is not a health threat. Instead, a level of 200 mg/l likely to give rise to consumer complaints has been proposed by WHO. All samples of shallow groundwater in Rajnagar Bankabarsi village (up to 410 mg/l) exceed the Standard in Bangladesh (200 mg/l) and the WHO Guideline (200 mg/l). None of the pond water or shallow groundwater samples from the other 2 villages exceed the Standard or the Guideline.

j. Potassium (K)

K is an essential element in both plant and human nutrition, and occurs in groundwater as a result of mineral dissolution, from decomposing plant material, and from agricultural runoff. The common aqueous species is K^+. Unlike Na, it doesn't remain in solution, but is assimilated by plants and is incorporated into a number of clay-mineral structures.

The Standard in Bangladesh is 12 mg/l. A guideline value by WHO has not been set so far because K is not a health threat. 20.0% of the pond water in Rajnagar Bankabarsi (up to 62 mg/l) exceeds the Standard in Bangladesh (= 12 mg/l). However, the pond water of the other 2 villages and all samples of shallow groundwater are below the Standard in Bangladesh.

k. Fluoride (F)

The Standard in Bangladesh and the WHO Guideline for F are 1 and 1.5 mg/l, respectively. High concentrations of F (up to 3.6 mg/l) are found in the pond water of Krishna Chandrapur and Rajnagar Bankabarsi Villages.

l. Total Chromium (Cr)

The Standard in Bangladesh is 0.05 mg/l. A WHO guideline value has not been set so far for total Cr. A high Cr concentration (0.066 mg/l) exceeding the Standard in Bangladesh (= 0.05 mg/l) is found in shallow groundwater from Bara Dudpatila.

m. Lead (Pb)

The Standard in Bangladesh and the WHO Guideline for Pb are 0.05 and 0.01 mg/l, respectively. High Pb concentrations above the Standard in Bangladesh (= 0.05 mg/l) are not found in any of the collected samples. However, some high concentrations exceeding the WHO Guideline (= 0.01 mg/l) are found in Chandrapur and Dudpatila.

n. Chemical Oxygen Demand (COD)

The Standard in Bangladesh is 4 mg/l. A guideline value by WHO has not been set so far. 37.0% of the pond water and 26.7% of the shallow groundwater exceed the criterion.

5.5.7 Re-analysis of Water Quality for Observation Holes of Which Hand Pumps are to be Installed, and Instruction on Their Use

In order to ensure the safe use of the observation holes to be installed with hand pumps by the Study Team in the Pourashava and Model rural areas, their water quality was re-analyzed for re-confirmation. Seven observation holes, which were not in excess of the WHO guideline value for As throughout all the monitoring, were selected for hand pump installation out of all fifteen observation holes (not including those in Brahmakati, installed for the supplemental survey). The samples of the seven observation holes were collected in mid-September 2002. The results of the water quality re-analysis in Japan and instruction on the use of observation holes based on the results were as follows.

1) Results of water quality re-analysis

a. Methods of analysis

The methods of analysis done in Japan are shown in the table below.

Analytical parameters	Analytical methods	Analytical parameters	Analytical methods
pH	Electrode method (A)	Sodium	ICP spectrophotometry
Temperature	Thermometer	Potassium	Flame spectrophotometry (B)
Electric conductivety	Electrode method (A)	Dissolved iron	Atomic absorption spectrophotometry (A)
Hardness	EDTA titration (A)	Dissolved manganese	Atomic absorption spectrophotometry (A)
TDS	Gravimetric method (B)	Calcium	ICP spectrophotometry (B)
COD	K2Cr2O7 titration (B)	Magnesium	ICP spectrophotometry (B)
Ammonium	Ion chromatography (B)	Cadmium	Atomic absorption spectrophotometry (A)
Nitrite	Adsorption spectrophotometry (A)	Total chromium	Atomic absorption spectrophotometry (A)
Nitrate		Copper	Atomic absorption spectrophotometry (A)
Sulfate	Ion chromatography (A)	Lead	ICP spectrophotometry (B)
Chloride	Ion chromatography (A)	Mercury	Atomic absorption spectrophotometry (A)
Bicarbonate	Infrared absorbing analysis (B)	Nickel	ICP spectrophotometry (B)
Fluoride	Adsorption spectrophotometry (A)	Zinc	Atomic absorption spectrophotometry (A)
Cyanide	Adsorption spectrophotometry (A)	Arsenic	Atomic absorption spectrophotometry (A)

A = the Test Methods of Drinking Water B = JIS-K-0102

b. Results of water quality

The results of the field measurement and laboratory analysis in Japan are shown in Table 5.5.17. The results are mostly in agreement with the results of the entrusted local laboratory in Bangladesh. It can be said that the results of the local analysis in Bangladesh are reliable.

In these results, some points that need to be considered in comparing the Bangladesh standards and WHO guidelines are mentioned below

As levels do not exceed the Bangladesh standard (=0.05mg/l). However, two of the seven samples slightly exceeded the WHO guideline (=0.01mg/l) both with a value of 0.011mg/l. As for Mn levels, five of the seven samples exceeded the Bangladesh standard (=0.1mg/l). Of those, two were over the WHO health guideline (=0.5 mg/l) with values of 0.60 mg/l and 0.50 mg/l respectively. As for Fe levels, six of the seven samples exceeded the Bangladesh standard (=1 mg/l) and the WHO health guideline (=0.3 mg/l). Some samples also exceeded the Bangladesh standard for NO2,Ca, Mg and COD. Heavy metals such as Cd, Total-Cr, Cu, CN, Pb, Hg and Ni were all below PQL.

These results show the following. The As levels of the two observation holes (OH-Jh2-4, OH-Ch1-4) that exceeded the WHO guideline had not exceeded the guideline during the monitoring. However, they showed slightly higher levels of As. The direct cause of the two observation holes exceeding the WHO guideline value may be the seasonal change in concentrations (In general, the results of monitoring show that high As concentrations tend to be seen in the rainy season) or the tendency of As concentrations to gradually increase, but it is unclear.

The Bangladesh standard of 0.1 mg/l for Mn is, according to the WHO guideline, set as a level likely to give rise to consumer complaints such as stained laundry or bad taste. Mn concentrations that exceeded the WHO health guideline value (＝0.5 mg/l) were found in only two of the measured samples, and were from the same wells containing As concentration above the WHO guideline value. All of the samples showed high iron concentrations that may be a problem in terms of taste, smell, etc, however will not have a direct impact on health. As for the one site (1.7 mg/l) that exceeded the Bangladesh standard value (＝1 mg/l) for NO2, it is below the WHO health guideline value (＝3 mg/l). Furthermore, it is common in Japan to set the standard for nitrogen concentrations including both NO2 and NO3 as “nitrogen as nitric acid and nitrogen as nitrous acid”. Based on the Water Works Law in Japan, for example, the drinking water quality standard for nitrogen is 10 mg/l. Ca, Mg and COD are also not parameters that have a negative impact on health.

2) Measures taken by the Study Team for well use based on the results of water quality measurements

Based on the above results of the water quality re-analysis, the Study Team took the following measures regarding the use of the seven wells.

(1) As for the two wells OH-Jh2-4 (Jhenaidah) and OH-Ch1-4 (Chuadanga) that exceeded the WHO guideline values for As and Mn, hand pumps have already been installed by the Study Team, but they have not been dismantled in consideration of their convenience to residents. However, the Study Team has ensured that the wells are not used for drinking purposes by marking them with yellow paint to indicate the water is not safe to drink. In addition, they have instructed residents that they can continue to use the well for the purposes other than drinking.

(2) Hand pumps have also been installed at all the other wells. As iron concentrations are generally high and the oxidation-reduction potential (Eh value) is low, the reduction of iron and/or Mn concentrations in the water due to oxidation can be expected to some degree. The Study Team has instructed the residents to leave

fetched water overnight or longer when using it for drinking purposes.

(3) In order to ensure the residents fully understand the method of proper well use, the Study Team gave instruction to the residents directly on site as they fetched water. They also gave the results of these measurement to keypersons, such as the village leader or the owners of the land where the wells had been installed, and made sure they had a good understanding of the situation. Moreover, they instructed the residents to contact DPHE if any problems concerning water quality, etc. arose in future.

As for the counterparts from the DPHE head office, the Study Team notified the measurement results to them and explained the above well use measures in order to obtain their agreement in advance. They also gave a similar explanation to the Executive Engineer, Sub-Assistant Engineer and Sub-Divisional Engineer from the DPHE local offices and Thana offices in Chuadanga, Jhenaidah and Jessore. Furthermore, as emphasized in the seminar in September, DPHE was requested once again to conduct monitoring whenever they have the opportunity in future.

5.5.8 Evaluation of General Water Quality

1) Observation Wells/Holes in Pourashava

Generally, it can be said that groundwater in the deep aquifer in the observation wells/holes shows good water quality. Though some parameters mentioned above exceed the criteria, other toxicoid parameters such as heavy metals, cadmium, chromium, copper, and mercury are almost all below the criteria in Bangladesh and WHO or below the quantization limits of analysis.

Regarding Fe, a number of results are above the criteria. However, the WHO guidelines for Fe are just levels likely to give rise to consumer complaints. No health-based guideline values are proposed for Fe. This contamination originated from minerals naturally occurring in groundwater in a reducing state.

As with Fe, health-based guideline values have not been set by WHO for Ca and Mg though some results exceed the Standard in Bangladesh. This contamination by Fe, Ca, and Mg is not likely to be a serious problem.

Regarding Mn, some high concentrations are found. However, the concentrations in deep groundwater are lower than in shallow groundwater. 77.6% of the deep groundwater is below the Standard by WHO.

Regarding NH_4 and NO_2, some results exceed the criteria. However, almost all exceeding results are distributed in the shallow aquifer. The deep aquifer of 300 m in depth is likely to be less contaminated. No interpretation of the contamination source of NH_4 and NO_2 is possible with this study. However, it may be an indication of the movement of fertilizers, manures and livestock wastes into shallow groundwater.

2) Deep Observation Holes in Model Rural Areas

Generally, it can be said that groundwater in the deep aquifer (300 m depth) of Core Borings shows good water quality. Though some parameters mentioned above exceed the criteria, other toxicoid parameters such as heavy metals are almost all below the Bangladesh and WHO criteria or below the quantization limits of analysis.

As for Mn, only one sample exceeds the WHO guidelines though some results exceed the Standard in Bangladesh. This contamination originated from minerals naturally occurring in groundwater in a reducing state.

As for Fe, three samples exceed the Standard in Bangladesh. However, no health-based guideline value is proposed by WHO. As with Mn, this contamination originated from minerals naturally occurring in groundwater in a reducing state.

As with Fe, health-based guideline values for Ca and Mg have not been set by WHO though some samples exceed the Standard in Bangladesh. This contamination by Fe, Mn, Ca, and Mg is not likely to be a serious problem.

As for NO_2, two samples exceed the Standard in Bangladesh. However, none exceeds the WHO Guideline.

Regarding NH_4, some results exceed the Standard in Bangladesh. However, no health-based guideline value has been proposed by WHO though the level likely to give rise to consumer complaints has been proposed by WHO. Therefore, this contamination is not likely to be a serious problem.

Compared with the shallow groundwater in the same village, some parameters of Core Borings show lower concentrations. Figures 5.5.56 to 5.5.59 show some examples in Rajnagar Bankabarsi. In the case of Pb, though some contamination is found in shallow groundwater in Bara Dudpatila and Krishna Chandrapur villages, results of Core Borings show no contamination.

These results show that deep groundwater is likely to be potable. Even though some parameters of deep groundwater exceed the criteria and some are influenced by salinity, it seems to be acceptable.

3) Improved Deep Wells in the Model Rural Areas

The actual depths of Improved Deep Wells are between 300 m (Deep tube well, i.e. Observation Well, Core Borings) and around 50 m (shallow tube well , i.e. existing tube well).

Generally, it can be said that groundwater in Improved Deep Wells shows relatively good water quality. Though some parameters mentioned above exceed the criteria, other toxicoid parameters such as heavy metals, cadmium, chromium, copper, and mercury are almost all below the Bangladesh and WHO criteria or below the quantization limits of analysis.

Regarding Fe, a number of results are above the criteria. However, the WHO guidelines for Fe are just levels likely to give rise to consumer complaints. No health-based guideline values are proposed for Fe. This contamination originated from minerals naturally occurring in groundwater in a reducing state.

As with Fe, a health-based guideline value for Ca has not been set by WHO though some results exceed the Standard in Bangladesh. This contamination by Fe and Ca, is not likely to be a serious problem.

Regarding Mn, some high concentrations exceeding the Standard in Bangladesh (up to 2.5 mg/l) are found. However, all results are below the WHO Guideline.

Regarding NO_2, some results exceed the Standard in Bangladesh (up to 0.46 mg/l). However, all results are below the WHO Guideline.

Regarding NO_3, all results are below the Standard in Bangladesh and the WHO Guideline.

Regarding COD, relatively high concentrations are found in Bankabarsi and Chandrapur. 16.7% of the results (up to 39 mg/l) are above the PQL.

Water quality of Improved Deep Well is generally good, but some parameters show higher concentrations like shallow groundwater. For example, high concentrations of NH_4 are found in many samples of Improved Deep Well. They are also found in many samples from shallow tube wells. As with shallow tube wells, Improved Deep Well also may be contaminated by fertilizers, manure and livestock waste. There is another possible source of the contamination of NH_4. Cow dung was used in the installation of Improved Deep Wells. Therefore, this may have caused the contamination of NH_4.

4) Existing Wells in the Study Area

As mentioned earlier, the groundwater in existing wells indicates a reducing state on the whole. Almost all samples characterize fresh water though some samples show salinity.

It is notable that some contamination in existing wells has been found. From the viewpoint of potability, groundwater in existing wells often shows some contamination. Not only As contamination, but other parameters of water quality need to be carefully checked.

For example, as for N-related water quality parameters such as NO_3, NO_2, and NH_4, NO_3 and NO_2 concentrations in the rainy season are higher than that of the dry season overall (as shown before in Figures 5.5.5 and 5.5.6). On the other hand, NH_4 concentrations in the rainy season are lower than in the dry season (as shown in Figure 5.5.8). Some oxidation-reduction reactions are likely to happen among the three parameters. Although there is no health-based guideline value for NH_4 by WHO, high NH_4 concentrations may give rise to consumer complaints such as odor or taste. Furthermore, NH_4 in water is an indicator of possible bacterial, sewage, and animal waste pollution.

Other seasonal changes are also observed for some metals such as Cd, total-Cr, Ni (see Figure 5.5.9), and Zn (see Figure 5.5.10).

5) Pond Water in the Model Rural Areas

Since it contains low concentrations of As, pond water is a possible water resource for areas where other alternative water resources are limited. Due to the oxidation state, some water quality parameters show lower concentrations than shallow groundwater such as heavy metals, Fe, Mn, hardness, Ca, Mg and so on.

However, some other parameters show higher concentrations than shallow groundwater. High COD is a serious problem for potability. It shows that pond water may be contaminated from the surface of pond. There also seems to be other contamination caused from the surface of the pond. As a result, sanitary protection and treatment of raw water are essential for the use of pond water for drinking purposes.

The volume of drinking water is also likely to be limited, though this is not a problem of water quality.

Reference

Jerome O. Nriagu (1994): *Arsenic in the environment part 1*

AWWA (American Water Works Association): *Standard method for the examination of water & wastewater, 20th edition*

Table 5.5.2 Results of Observation Well and Hole (1/7)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction /FAAS	Extraction /FAAS	SP	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Jessore1																												
OW-JS1-BP	16-Jul-01	7.32	29.4	54.5	102	349	<PQL	<PQL	0.22	0.26	<PQL	6.7	8.4	475	80	22	51	5.2	0.27	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0071	<PQL	<PQL
OW-JS1-48h	19-Jul-01	7.31	28.7	54.4	98.6	348	<PQL	<PQL	0.21	0.13	<PQL	0.66	15	456	77	21	52	5.3	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JS1-1M	19-Aug-01	7.27	30.0	58.3	89.9	373	<PQL	<PQL	<PQL	0.69	<PQL	8.4	9.5	429	65	25	66	4.8	0.20	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JS1-2M	15-Sep-01	7.13	28.2	60.5	104	387	<PQL	<PQL	<PQL	[illegible]	<PQL	8.8	7.4	488	71	33	63	4.9	0.24	<PQL	<PQL	0.0082	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JS1-3M	16-Oct-01	7.20	30.0	82.8	109	530	<PQL	<PQL	0.14	1.2	<PQL	5.5	10	497	82	28	55	5.6	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JS1-4M	07-Nov-01	7.43	26.9	81.8	115	524	<PQL	<PQL	<PQL	0.63	<PQL	13	8.3	456	82	33	51	5.0	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JS1-5M	06-Dec-01	7.22	24.7	80.5	117	515	<PQL	<PQL	0.28	0.57	<PQL	8.9	7.3	460	84	33	52	4.6	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS1-1-BP	20-Jul-01	7.17	29.7	57.0	106	364	<PQL	<PQL	0.21	4.3	<PQL	3.7	5.0	475	86	20	54	3.2	0.41	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0087	27
OH-JS1-1-SIP-30min	20-Jul-01	7.23	29.6	52.6	102	337	<PQL	<PQL	<PQL	2.8	<PQL	2.5	5.8	418	82	19	33	2.7	0.34	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS1-1-SIP-140min	20-Jul-01	7.34	29.6	51.1	105	327	<PQL	<PQL	0.17	1.7	<PQL	1.0	7.9	418	85	20	28	2.6	0.33	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS1-2-BP	20-Jul-01	7.26	29.9	70.0	112	448	<PQL	<PQL	0.25	4.6	<PQL	7.1	30	570	91	21	110	4.6	1.1	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.015	77
OH-JS1-2-SIP-30min	20-Jul-01	7.32	29.7	58.3	107	373	<PQL	<PQL	0.18	2.2	<PQL	3.5	5.0	456	86	21	51	3.9	1.4	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	27
OH-JS1-2-SIP-140min	20-Jul-01	7.33	29.4	51.3	101	328	<PQL	<PQL	0.14	0.93	<PQL	2.6	4.1	481	80	21	28	3.5	0.39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS1-3-BP	20-Jul-01	7.91	29.3	41.7	56.2	267	<PQL	<PQL	0.17	<PQL	<PQL	<PQL	3.0	285	35	21	38	3.9	0.41	<PQL	<PQL	0.0079	<PQL	<PQL	<PQL	0.0070	0.0053	<PQL
OH-JS1-3-SIP-30min	20-Jul-01	7.20	29.8	59.8	122	383	<PQL	<PQL	0.15	2.9	<PQL	6.9	13	551	100	22	51	4.5	0.53	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	130
OH-JS1-3-SIP-140min	20-Jul-01	7.40	29.8	53.9	113	345	<PQL	<PQL	0.21	0.96	<PQL	4.7	2.8	475	91	22	42	3.8	0.34	<PQL	<PQL	0.0072	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS1-4-BP	20-Jul-01	8.86	29.7	43.3	25.9	377	<PQL	<PQL	0.13	<PQL	<PQL	<PQL	28	266	9.8	16	83	5.3	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS1-4-SIP-30min	20-Jul-01	7.35	29.3	55.2	101	353	<PQL	<PQL	0.11	1.3	<PQL	4.7	9.9	475	80	20	65	4.7	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS1-4-SIP-140min	20-Jul-01	7.30	29.3	55.7	99.3	357	<PQL	<PQL	0.14	0.65	<PQL	3.1	12	475	79	21	66	4.9	0.28	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	27

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.2 Results of Observation Well and Hole (2/7)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction /FAAS	Extraction /FAAS	SP	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Jessore2																												
OW-JS2-BP	02-Aug-01	7.59	28.2	62.2	90.3	398	0.51	0.31	0.12	0.35	<PQL	2.9	54	439	67	23	78	4.3	0.36	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	38
OW-JS2-48h	05-Aug-01	7.56	28.1	61.2	90.2	391	<PQL	<PQL	0.38	0.13	<PQL	0.86	59	429	67	23	80	4.0	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	38
OW-JS2-1M	11-Sep-01	7.19	28.0	63.3	109	405	<PQL	<PQL	<PQL	2.3	<PQL	10	42	507	73	36	80	4.9	0.25	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JS2-2M	18-Oct-10	7.24	29.9	94.8	110	607	<PQL	<PQL	<PQL	0.55	<PQL	6.3	47	507	82	28	75	6.2	0.34	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JS2-3M	08-Nov-01	7.99	27.1	89.8	113	575	<PQL	<PQL	0.37	0.74	<PQL	15	40	456	81	32	67	4.5	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	38
OW-JS2-4M	05-Dec-01	7.24	24.3	89.4	113	572	<PQL	<PQL	0.22	0.65	<PQL	15	35	460	80	33	80	4.4	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS2-1-BP	06-Aug-01	7.19	28.5	58.0	113	371	<PQL	<PQL	<PQL	2.9	<PQL	3.4	4.6	453	88	25	42	1.7	0.50	<PQL	<PQL	0.010	0.010	0.0058	<PQL	<PQL	0.0085	38
OH-JS2-1-SIP-30min	06-Aug-01	7.37	28.6	54.1	107	346	<PQL	<PQL	<PQL	1.7	<PQL	1.8	3.0	429	83	24	28	1.3	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0074	<PQL
OH-JS2-1-SIP-140min	06-Aug-01	7.46	28.8	53.2	108	340	<PQL	<PQL	<PQL	1.1	<PQL	1.3	4.6	429	84	24	27	1.3	0.39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	26
OH-JS2-2-BP	06-Aug-01	7.23	28.7	57.4	114	368	<PQL	<PQL	<PQL	3.2	<PQL	5.2	3.5	468	89	25	31	3.1	0.44	<PQL	<PQL	0.0066	0.020	<PQL	<PQL	0.0053	<PQL	76
OH-JS2-2-SIP-30min	06-Aug-01	7.27	29.1	56.7	111	363	<PQL	<PQL	<PQL	1.1	<PQL	4.0	1.9	439	87	24	33	3.1	0.45	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	38
OH-JS2-2-SIP-140min	06-Aug-01	7.35	29.1	55.4	108	355	<PQL	<PQL	<PQL	0.58	<PQL	2.9	3.9	429	84	24	21	2.5	0.40	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	38
OH-JS2-3-BP	06-Aug-01	7.50	29.4	56.0	93.1	359	1.4	0.60	1.6	0.39	<PQL	0.92	14	429	70	23	43	4.3	0.38	<PQL	<PQL	<PQL	<PQL	0.0051	<PQL	0.0083	0.012	38
OH-JS2-3-SIP-30min	06-Aug-01	7.28	29.3	58.6	105	375	2.5	<PQL	<PQL	0.95	<PQL	2.1	10	429	82	23	39	4.0	0.39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	38
OH-JS2-3-SIP-140min	06-Aug-01	6.94	29.3	43.2	107	277	1.5	1.5	<PQL	0.72	<PQL	2.2	6.7	350	84	24	31	3.8	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS2-4-BP	06-Aug-01	7.62	29.3	80.1	65.0	513	<PQL	<PQL	<PQL	0.29	<PQL	3.4	15	507	43	22	160	4.4	0.40	<PQL	<PQL	<PQL	0.050	<PQL	<PQL	0.012	<PQL	180
OH-JS2-4-SIP-30min	06-Aug-01	7.23	29.2	50.9	93.1	325	0.41	<PQL	<PQL	0.20	<PQL	2.8	46	350	66	23	77	4.2	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JS2-4-SIP-140min	06-Aug-01	7.49	29.4	65.1	92.9	417	0.30	0.040	<PQL	0.19	<PQL	2.0	49	429	70	23	80	4.0	0.34	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.2 Results of Observation Well and Hole (3/7)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Jhenaidah1																												
OW-JH1-BP	18-Apr-01	7.25	24.8	76.8	141	492	0.46	<PQL	<PQL	0.18	<PQL	15	3.3	489	100	38	14	4.3	0.32	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.060	<PQL
OW-JH1-48h	21-Apr-01	7.22	25.3	78.2	146	501	0.41	<PQL	0.11	0.10	<PQL	3.6	1.5	499	110	38	14	3.8	0.25	<PQL	<PQL	<PQL	<PQL	0.011	<PQL	0.0063	0.016	<PQL
OW-JH1-1M	11-Jun-01	7.36	31.0	59.9	114	299	<PQL	<PQL	<PQL	0.19	<PQL	9.6	5.7	452	78	35	17	4.1	0.27	<PQL	<PQL	<PQL	<PQL	0.0065	<PQL	<PQL	0.0060	<PQL
OW-JH1-2M	04-Jul-01	7.96	28.5	44.2	69.6	283	<PQL	<PQL	0.17	0.091	<PQL	4.3	4.0	365	46	24	35	5.1	0.21	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH1-3M	12-Aug-01	7.30	29.3	51.6	105	330	<PQL	<PQL	<PQL	0.15	<PQL	9.9	2.6	371	77	27	27	3.6	0.28	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH1-4M	15-Sep-01	7.72	28.5	47.4	79.0	303	<PQL	<PQL	<PQL	<PQL	<PQL	2.6	4.4	371	43	36	36	3.9	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH1-5M	19-Oct-01	7.43	29.7	76.0	110	487	<PQL	<PQL	<PQL	<PQL	<PQL	7.5	1.5	449	80	30	19	4.9	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH1-6M	10-Nov-01	7.25	27.1	82.5	143	528	<PQL	<PQL	<PQL	0.35	<PQL	18	2.4	494	100	41	21	3.7	0.28	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH1-7M	07-Dec-01	7.26	24.7	79.8	147	510	<PQL	<PQL	0.11	0.32	6.6	17	2.6	500	100	42	21	3.5	0.37	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH1-1-BP	22-Apr-01	7.34	25.2	46.3	92.6	296	1.0	0.53	<PQL	0.35	13	2.6	3.3	269	68	25	15	3.0	0.50	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH1-1-SIP-30min	22-Apr-01	7.31	25.4	47.4	90.8	303	0.79	0.65	<PQL	0.33	<PQL	2.9	5.3	269	74	17	11	2.6	0.51	<PQL	<PQL	<PQL	<PQL	0.0097	<PQL	<PQL	<PQL	<PQL
OH-JH1-1-SIP-140min	22-Apr-01	7.27	25.4	47.8	91.0	306	0.68	0.65	<PQL	0.31	<PQL	2.9	8.5	273	74	17	11	2.6	0.53	<PQL	<PQL	0.0061	<PQL	0.011	<PQL	<PQL	<PQL	<PQL
OH-JH1-2-BP	22-Apr-01	7.25	25.4	60.2	109	385	0.69	<PQL	0.61	0.40	<PQL	3.6	2.6	371	85	24	18	4.0	0.29	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0094	<PQL
OH-JH1-2-SIP-30min	22-Apr-01	7.16	25.5	60.7	115	388	1.8	0.090	0.51	0.25	<PQL	2.5	3.7	371	92	24	14	3.7	0.35	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.13	<PQL
OH-JH1-2-SIP-140min	22-Apr-01	7.17	25.3	62.6	121	401	1.2	1.4	0.42	0.25	<PQL	2.2	3.7	371	96	25	12	3.8	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.014	<PQL
OH-JH1-3-BP	22-Apr-01	7.10	25.0	65.6	125	420	1.6	1.1	0.22	<PQL	19	4.2	7.0	387	99	27	15	4.6	0.35	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH1-3-SIP-30min	22-Apr-01	7.26	25.6	65.5	128	419	1.4	<PQL	0.78	0.15	17	2.2	7.2	390	100	26	14	4.1	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.015	<PQL
OH-JH1-3-SIP-140min	22-Apr-01	7.15	25.6	65.2	127	417	1.2	<PQL	0.78	0.14	15	1.9	4.5	390	100	26	14	4.2	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.011	<PQL
OH-JH1-4-BP	22-Apr-01	7.16	25.5	73.9	137	473	0.24	<PQL	<PQL	0.089	<PQL	3.6	1.1	480	99	38	13	4.4	0.34	<PQL	<PQL	<PQL	<PQL	0.013	<PQL	0.0092	0.0063	<PQL
OH-JH1-4-SIP-30min	22-Apr-01	7.14	25.2	75.8	138	485	0.26	<PQL	<PQL	<PQL	<PQL	2.3	1.5	488	99	38	13	4.6	0.29	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0069	<PQL	<PQL
OH-JH1-4-SIP-140min	22-Apr-01	7.20	25.0	75.2	140	481	0.36	<PQL	0.13	<PQL	<PQL	2.3	2.4	493	100	38	11	3.8	0.33	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0057	0.17	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.2 Results of Observation Well and Hole (4/7)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/FAAS	Extraction/FAAS	Extraction/FAAS	SP	Extraction/FAAS	Extraction/FAAS	Extraction/FAAS	Extraction/FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Jhenaidah2																												
OW-JH2-BP	03-Jun-01	7.30	31.3	61.5	134	307	<PQL	0.10	<PQL	0.096	<PQL	7.8	2.7	467	97	37	14	3.9	0.36	<PQL	<PQL	0.0085	<PQL	<PQL	<PQL	<PQL	0.0086	<PQL
OW-JH2-48h	06-Jun-01	7.64	30.7	61.2	135	306	<PQL	<PQL	0.18	<PQL	<PQL	2.3	9.3	456	98	36	15	4.1	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH2-1M	03-Jul-01	7.99	29.0	36.8	49.6	236	<PQL	<PQL	0.13	<PQL	<PQL	<PQL	3.2	272	26	23	14	5.4	0.17	<PQL	<PQL	0.011	<PQL	<PQL	<PQL	<PQL	<PQL	27
OW-JH2-2M	13-Aug-01	7.91	29.6	36.8	62.5	235	<PQL	<PQL	<PQL	<PQL	<PQL	0.56	1.7	234	36	27	18	3.6	0.17	<PQL	<PQL	<PQL	<PQL	0.0068	<PQL	<PQL	0.0090	<PQL
OW-JH2-3M	14-Sep-01	7.77	28.2	42.5	71.7	272	<PQL	<PQL	<PQL	<PQL	<PQL	1.8	4.8	312	36	35	21	11	0.21	<PQL	<PQL	0.0069	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH2-4M	18-Oct-01	7.91	29.8	47.0	57.0	301	<PQL	<PQL	<PQL	<PQL	<PQL	0.40	2.2	279	28	29	15	5.1	0.27	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0074	<PQL
OW-JH2-5M	05-Nov-01	7.38	26.8	71.3	122	457	<PQL	<PQL	0.15	0.12	<PQL	9.2	4.5	418	83	39	15	3.6	0.25	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-JH2-6M	04-Dec-01	7.88	24.4	49.1	76.7	314	<PQL	<PQL	<PQL	0.092	<PQL	1.5	3.9	284	39	37	14	4.0	0.20	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH2-1-BP	07-Jun-01	7.32	31.4	52.1	99.7	260	0.52	<PQL	<PQL	1.3	<PQL	1.9	7.5	357	82	18	38	3.8	0.33	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0089	<PQL	<PQL
OH-JH2-1-SIP-30min	07-Jun-01	7.34	31.0	46.4	92.6	232	2.2	<PQL	0.13	0.81	<PQL	1.4	5.5	276	77	15	18	3.8	0.33	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH2-1-SIP-140min	07-Jun-01	7.40	31.4	49.9	101	250	0.74	<PQL	<PQL	0.63	<PQL	1.8	6.7	336	85	16	20	3.1	0.39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH2-2-BP	07-Jun-01	7.26	31.4	61.8	99.1	309	<PQL	<PQL	0.35	1.4	<PQL	2.6	21	363	81	18	55	4.8	0.51	<PQL	<PQL	0.0055	0.011	<PQL	<PQL	<PQL	0.011	<PQL
OH-JH2-2-SIP-30min	07-Jun-01	7.45	31.2	54.1	104	270	0.43	<PQL	0.13	0.98	<PQL	1.7	11	361	86	18	34	4.1	0.40	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0090	<PQL
OH-JH2-2-SIP-140min	08-Jun-01	7.38	31.6	53.9	99.3	270	0.51	0.20	0.13	0.78	<PQL	1.1	8.8	285	83	16	15	4.1	0.34	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH2-3-BP	08-Jun-01	7.38	32.0	58.3	127	291	1.2	<PQL	0.14	0.63	<PQL	13	3.2	399	110	22	19	4.3	0.33	<PQL	<PQL	<PQL	0.016	0.0058	<PQL	0.0053	0.0076	<PQL
OH-JH2-3-SIP-30min	08-Jun-01	7.28	31.3	60.3	123	302	1.1	0.64	0.12	0.59	<PQL	2.1	3.4	427	100	22	23	4.2	0.34	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH2-3-SIP-140min	08-Jun-01	7.19	31.5	37.9	123	190	<PQL	0.47	0.12	0.47	<PQL	1.9	2.5	222	100	22	18	4.1	0.23	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH2-4-BP	08-Jun-01	7.88	31.2	49.0	53.8	245	<PQL	<PQL	0.11	<PQL	<PQL	0.47	16	304	25	29	48	5.5	0.27	<PQL	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	<PQL	<PQL
OH-JH2-4-SIP-30min	08-Jun-01	7.17	31.6	57.8	112	289	0.46	0.26	<PQL	0.72	<PQL	3.0	2.8	346	82	29	36	5.3	0.33	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-JH2-4-SIP-140min	08-Jun-01	7.09	31.5	41.4	121	207	<PQL	0.26	<PQL	0.37	<PQL	2.3	1.7	247	90	31	22	4.3	0.20	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.2 Results of Observation Well and Hole (5/7)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Chuadanga1																												
OW-CH1-BP	01-Jan-01	7.22	23.2	81.7	122	523	<PQL	0.16	0.65	0.29	<PQL	1.0	3.0	475	120	3.0	23	4.0	0.29	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH1-48h	22-Feb-01	7.27	23.9	84.1	155	538	<PQL	<PQL	1.1	<PQL	<PQL	0.77	2.3	492	130	29	18	3.5	0.30	<PQL	<PQL	<PQL	0.017	<PQL	<PQL	0.0057	<PQL	<PQL
OW-CH1-1M	26-Mar-01	7.41	26.6	56.0	88.1	359	<PQL	<PQL	0.48	<PQL	<PQL	1.2	2.0	315	67	21	19	7.5	0.11	<PQL	<PQL	<PQL	0.023	<PQL	<PQL	<PQL	0.0078	<PQL
OW-CH1-2M	26-Apr-01	7.26	25.1	64.9	133	415	0.29	<PQL	0.42	<PQL	<PQL	1.6	1.5	410	100	28	10	6.3	0.16	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0052	<PQL	<PQL
OW-CH1-3M	14-Jun-01	7.24	31.2	63.4	136	317	0.59	<PQL	<PQL	0.32	<PQL	2.1	<PQL	476	110	24	19	4.7	0.23	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0084	<PQL
OW-CH1-4M	05-Jul-01	7.32	28.9	52.5	146	336	0.73	<PQL	0.11	0.35	<PQL	1.7	2.2	481	130	20	20	5.3	0.23	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH1-5M	14-Aug-01	7.05	29.4	46.1	141	295	0.52	<PQL	<PQL	0.33	<PQL	2.7	1.4	351	90	24	13	3.6	0.23	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0065	<PQL
OW-CH1-6M	12-Sep-01	7.18	27.1	54.9	153	352	<PQL	<PQL	0.26	0.70	<PQL	1.5	1.9	488	130	27	10	3.5	0.21	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH1-7M	15-Oct-01	7.32	29.8	82.9	157	530	<PQL	<PQL	0.34	0.87	<PQL	2.6	0.73	507	130	26	10	4.7	0.31	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH1-8M	08-Nov-01	7.24	27.0	61.9	156	396	<PQL	<PQL	0.37	0.49	<PQL	3.7	1.4	494	130	29	15	3.9	0.25	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-CH1-1-BP	04-Feb-01	7.27	23.6	42.0	57.9	269	1.4	1.0	<PQL	0.52	<PQL	6.0	6.1	213	45	13	30	3.6	0.28	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	31
OH-CH1-1-SIP-30min	25-Feb-01	7.11	25.0	45.1	78.7	289	<PQL	<PQL	0.59	0.24	<PQL	1.8	2.0	259	64	15	17	4.5	0.29	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0060	<PQL	27
OH-CH1-1-SIP-140min	25-Feb-01	7.23	24.0	46.7	80.0	299	<PQL	<PQL	0.71	0.16	<PQL	1.9	1.5	259	65	15	14	3.4	0.27	<PQL	<PQL	<PQL	0.014	<PQL	<PQL	0.0082	<PQL	29
OH-CH1-2-BP	04-Feb-01	7.37	24.5	37.1	57.1	237	<PQL	<PQL	0.44	0.17	<PQL	0.73	3.4	194	45	12	16	3.5	0.24	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	0.0073	<PQL	<PQL
OH-CH1-2-SIP-30min	25-Feb-01	7.20	24.6	41.3	71.4	265	<PQL	<PQL	0.47	0.13	<PQL	1.6	1.3	241	58	13	13	3.7	0.27	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	0.0051	0.0066	<PQL
OH-CH1-2-SIP-140min	25-Feb-01	7.22	24.8	42.0	73.7	269	<PQL	<PQL	0.52	0.10	<PQL	1.4	0.87	241	61	13	12	3.7	0.32	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	0.0068	<PQL	<PQL
OH-CH1-3-BP	04-Feb-01	7.57	23.9	50.7	76.9	324	1.4	0.64	0.70	0.14	5.5	3.0	14	259	59	18	31	3.6	0.27	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	31
OH-CH1-3-SIP-30min	25-Feb-01	7.15	25.3	58.8	98.9	376	<PQL	0.20	0.83	0.33	<PQL	2.4	4.1	324	79	19	28	3.7	0.32	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	<PQL	<PQL	<PQL
OH-CH1-3-SIP-140min	25-Feb-01	7.12	24.8	58.2	99.4	373	<PQL	0.020	0.82	0.21	<PQL	1.9	2.2	333	80	20	19	3.7	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0052	0.0060	<PQL
OH-CH1-4-BP	04-Feb-01	7.35	24.1	74.8	101	479	<PQL	<PQL	0.24	0.090	<PQL	6.9	19	389	74	26	58	4.5	0.21	<PQL	<PQL	<PQL	0.014	<PQL	<PQL	0.0095	<PQL	31
OH-CH1-4-SIP-30min	25-Feb-01	7.01	25.2	85.0	145	544	<PQL	<PQL	0.47	0.40	<PQL	2.3	4.9	500	120	28	43	4.1	0.31	<PQL	<PQL	<PQL	0.019	<PQL	<PQL	0.0050	0.031	<PQL
OH-CH1-4-SIP-140min	25-Feb-01	6.98	27.4	86.0	148	550	<PQL	<PQL	0.46	0.28	<PQL	2.1	2.7	490	120	27	22	4.8	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0060	0.070	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.2 Results of Observation Well and Hole (6/7)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction /FAAS	Extraction /FAAS	SP	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg CaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg CaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Chuadanga2																												
OW-CH2-BP	18-Mar-01	7.22	28.3	77.9	114	499	0.42	0.28	0.13	0.34	<PQL	4.2	11	418	92	22	24	6.2	0.18	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0088	0.040	<PQL
OW-CH2-1M	29-Apr-01	7.30	24.7	64.8	127	415	0.84	<PQL	0.22	<PQL	<PQL	9.1	7.6	410	96	31	11	4.6	0.17	<PQL	<PQL	0.0089	<PQL	<PQL	<PQL	0.0053	0.012	<PQL
OW-CH2-2M	16-Jun-01	8.49	30.8	32.1	39.3	160	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	7.9	190	14	25	13	4.0	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH2-3M	07-Jul-01	7.57	28.4	41.8	82.6	268	0.22	<PQL	0.14	0.084	<PQL	0.75	8.3	319	62	21	17	5.5	0.19	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH2-4M	16-Aug-01	7.93	29.6	39.5	59.4	253	<PQL	<PQL	<PQL	<PQL	<PQL	0.32	6.7	254	36	23	13	3.7	0.15	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH2-5M	13-Sep-01	7.62	28.1	43.3	88.1	277	<PQL	<PQL	0.15	<PQL	<PQL	3.7	8.0	306	59	30	12	3.6	0.17	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH2-6M	17-Oct-01	7.61	29.8	57.9	90.8	371	<PQL	<PQL	1.2	<PQL	<PQL	2.2	4.7	332	64	27	12	5.1	0.25	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OW-CH2-7M	05-Nov-01	7.41	27.1	66.6	121	426	<PQL	<PQL	0.18	0.15	<PQL	9.7	6.2	380	89	33	13	3.7	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
OH-CH2-1-BP	16-Mar-01	7.15	28.8	59.5	90.7	381	2.6	2.7	1.2	0.50	<PQL	4.5	1.4	315	72	18	20	4.8	0.42	<PQL	<PQL	<PQL	0.017	0.0058	<PQL	0.0058	0.032	66
OH-CH2-1-SIP-30min	16-Mar-01	7.07	29.4	60.4	91.2	386	<PQL	0.020	4.4	0.48	<PQL	4.8	1.7	320	73	18	16	4.4	0.23	<PQL	<PQL	<PQL	0.025	0.0072	<PQL	<PQL	0.013	39
OH-CH2-1-SIP-140min	16-Mar-01	7.19	29.2	59.1	89.6	378	<PQL	<PQL	3.4	0.45	<PQL	4.9	1.9	315	71	19	15	4.4	0.32	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	0.0052	0.031	51
OH-CH2-2-BP	16-Mar-01	7.45	28.9	62.0	85.7	397	1.2	<PQL	0.14	0.32	<PQL	1.8	19	300	68	17	32	5.5	0.35	<PQL	<PQL	0.0055	0.014	<PQL	<PQL	<PQL	0.012	27
OH-CH2-2-SIP-30min	16-Mar-01	7.34	28.7	60.3	91.9	386	0.87	1.0	0.19	0.15	<PQL	1.6	15	303	75	17	26	5.7	0.37	<PQL	<PQL	<PQL	0.022	<PQL	<PQL	0.0061	<PQL	33
OH-CH2-2-SIP-140min	16-Mar-01	7.24	28.9	59.6	90.5	382	1.4	1.2	0.12	0.16	<PQL	1.4	10	305	73	18	19	4.9	0.33	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	0.0060	<PQL	39
OH-CH2-3-BP	17-Mar-01	7.26	28.7	53.5	81.4	343	0.78	0.34	0.12	0.18	<PQL	1.5	2.4	300	64	17	20	4.4	0.28	<PQL	<PQL	<PQL	0.013	0.0066	<PQL	<PQL	0.017	<PQL
OH-CH2-3-SIP-30min	17-Mar-01	7.26	28.7	55.7	86.9	356	1.0	0.050	0.14	<PQL	<PQL	1.3	3.9	292	70	17	15	4.0	0.34	<PQL	<PQL	<PQL	0.020	<PQL	<PQL	<PQL	0.031	<PQL
OH-CH2-3-SIP-140min	17-Mar-01	7.29	28.6	54.9	87.8	352	0.86	0.52	0.43	<PQL	<PQL	1.3	2.1	296	70	18	18	4.1	0.34	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	0.0073	0.019	<PQL
OH-CH2-4-BP	17-Mar-01	7.25	29.2	74.6	104	477	0.23	<PQL	<PQL	0.19	<PQL	5.1	10	407	82	22	37	6.6	0.24	<PQL	<PQL	<PQL	<PQL	0.0054	<PQL	0.0062	<PQL	<PQL
OH-CH2-4-SIP-30min	17-Mar-01	7.19	28.4	75.5	109	483	0.23	0.12	<PQL	0.16	<PQL	3.4	8.4	407	87	22	24	5.6	0.20	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	0.0059	<PQL	<PQL
OH-CH2-4-SIP-140min	17-Mar-01	7.30	28.0	76.1	112	487	<PQL	0.25	<PQL	0.081	<PQL	2.2	10	407	90	22	19	5.5	0.18	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0064	0.0068	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.2 Results of Observation Well and Hole (7/7)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction /FAAS	Extraction /FAAS	SP	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Extraction /FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Jessore3																												
OW-BM-CP-48h	12-Mar-02	8.33	25.8	65.4	28.1	419	<PQL	<PQL	1.4	<PQL	<PQL	0.57	6.2	361	19	9.5	120	2.0	0.42	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Excess of WHO guideline Excess of Bangladesh Standard Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.3 Results of Core Boring

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Jessore																												
CB-JSRb-0M	09-May-01	7.87	30.1	57.2	40.5	366	2.0	<PQL	<PQL	<PQL	<PQL	0.23	34	336	24	17	94	4.2	0.32	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	39
CB-JSRb-1M	21-Jun-01	7.91	31.1	59.2	38.0	296	1.9	2.2	0.16	<PQL	<PQL	0.26	29	338	23	15	100	4.7	0.34	<PQL	<PQL	0.0073	<PQL	<PQL	<PQL	0.012	0.0087	<PQL
CB-JSRb-2M	09-Jul-01	8.01	28.7	48.0	40.5	307	1.7	<PQL	0.15	<PQL	<PQL	<PQL	45	324	27	14	110	5.4	0.40	<PQL	<PQL	0.0082	<PQL	<PQL	<PQL	0.037	0.0062	27
CB-JSRb-3M	20-Aug-01	7.91	29.9	56.1	36.5	357	1.8	<PQL	<PQL	<PQL	<PQL	<PQL	30	312	20	15	140	3.6	0.36	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
CB-JSRb-4M	11-Sep-01	7.94	28.2	53.5	39.4	342	<PQL	0.97	0.84	<PQL	<PQL	0.39	25	347	23	17	97	3.6	0.41	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
CB-JSRb-5M	16-Oct-01	8.06	29.7	66.4	40.2	425	1.6	0.25	1.1	0.10	<PQL	0.32	26	351	24	16	94	4.2	0.39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
CB-JSRb-6M	07-Nov-01	7.88	27.0	66.4	43.1	425	0.49	1.9	<PQL	0.20	<PQL	0.70	21	342	27	16	86	3.7	0.36	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Jhenaidah																												
CB-JHKc-0M	05-May-01	7.35	31.3	65.4	138	419	2.0	<PQL	<PQL	<PQL	<PQL	1.8	8.1	505	110	29	35	6.1	0.22	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0071	0.011	27
CB-JHKc-1M	17-Jun-01	8.78	31.0	86.4	5.78	432	<PQL	<PQL	0.70	<PQL	<PQL	<PQL	96	442	4.3	1.5	200	2.4	0.60	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	39
CB-JHKc-2M	08-Jul-01	8.01	28.1	58.0	81.8	371	1.7	<PQL	0.12	0.12	<PQL	3.7	38	443	68	14	110	4.0	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
CB-JHKc-3M	15-Aug-01	7.27	29.2	63.0	138	403	<PQL	<PQL	1.6	0.10	<PQL	2.4	7.0	507	110	23	25	4.3	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0097	<PQL	<PQL
CB-JHKc-4M	11-Sep-01	7.17	28.0	58.5	147	374	<PQL	<PQL	1.2	0.17	<PQL	2.5	2.9	517	120	29	20	3.9	0.20	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0052	<PQL
CB-JHKc-5M	16-Oct-01	7.23	29.6	87.7	159	561	<PQL	<PQL	1.4	0.24	<PQL	2.7	2.2	513	130	26	19	4.8	0.22	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
CB-JHKc-6M	09-Nov-01	7.29	27.3	85.7	151	548	<PQL	<PQL	1.5	0.28	<PQL	5.3	1.8	513	122	29	27	4.0	0.17	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
Chuadanga																												
CB-CDBd-0M	30-Jan-01	7.01	24.4	82.2	124	526	<PQL	<PQL	1.8	0.25	<PQL	15	1.8	481	90	34	24	3.8	0.16	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0051	<PQL	<PQL
CB-CDBd-1M	27-Feb-01	7.12	23.2	80.4	141	514	<PQL	<PQL	1.4	0.17	<PQL	2.1	1.3	481	98	43	18	3.9	0.23	<PQL	<PQL	0.0088	<PQL	<PQL	<PQL	0.0061	0.0067	<PQL
CB-CDBd-2M	26-Mar-01	7.41	27.9	62.0	165	397	<PQL	<PQL	1.1	<PQL	<PQL	6.9	1.7	353	70	23	22	6.7	0.17	<PQL	<PQL	0.0054	0.013	<PQL	<PQL	0.012	<PQL	39
CB-CDBd-3M	27-Apr-01	7.98	24.9	43.7	67.6	279	<PQL	<PQL	0.72	<PQL	<PQL	0.79	1.3	273	35	33	14	4.7	0.11	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.11	39
CB-CDBd-4M	23-Jun-01	7.33	31.0	63.4	124	317	<PQL	<PQL	0.92	0.46	<PQL	3.5	0.73	459	94	30	16	4.8	0.16	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
CB-CDBd-5M	10-Jul-01	7.28	29.1	52.5	128	336	<PQL	<PQL	1.2	0.51	<PQL	3.5	2.5	475	110	23	27	4.2	0.22	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
CB-CDBd-6M	18-Aug-01	7.29	29.6	58.7	122	375	<PQL	<PQL	1.2	0.39	<PQL	2.6	0.77	488	96	26	16	4.5	0.18	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Excess of WHO guideline　Excess of Bangladesh Standard　Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.4 Results of Improved Deep Tubewell(1/2)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Jessore																												
IM-JSRb-1-0M	26-Nov-00	7.79	24.0	60.4	48.1	387	<PQL	<PQL	4.1	<PQL	<PQL	0.27	9.4	333	31	17	53	3.5	0.37	<PQL	<PQL	<PQL	0.017	0.0076	<PQL	<PQL	<PQL	<PQL
IM-JSRb-1-1M	03-Jan-01	7.63	24.0	62.4	55.5	399	<PQL	<PQL	5.9	0.20	<PQL	1.3	9.3	317	39	16	55	3.6	0.35	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
IM-JSRb-1-2M	06-Feb-01	7.73	25.7	58.2	56.2	373	1.6	<PQL	<PQL	<PQL	<PQL	0.21	11	315	37	19	71	3.1	0.39	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	<PQL	<PQL	<PQL
IM-JSRb-1-3M	27-Mar-01	7.83	28.4	56.3	56.0	360	<PQL	<PQL	1.1	<PQL	<PQL	0.73	13	315	39	17	69	5.8	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.095	<PQL
IM-JSRb-2-0M	26-Nov-00	7.80	23.6	63.2	47.3	404	<PQL	0.13	2.4	<PQL	<PQL	0.21	5.5	320	30	17	53	3.4	0.42	<PQL	<PQL	<PQL	0.025	<PQL	<PQL	0.010	<PQL	<PQL
IM-JSRb-2-1M	03-Jan-01	7.67	24.0	62.1	54.5	398	1.7	<PQL	8.4	0.17	<PQL	1.3	12	328	38	16	53	3.5	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0075	<PQL	<PQL
IM-JSRb-2-2M	06-Feb-01	7.72	23.6	56.9	55.1	364	1.5	1.5	<PQL	<PQL	<PQL	<PQL	11	315	36	19	68	3.1	0.40	<PQL	<PQL	<PQL	0.014	0.0061	<PQL	<PQL	<PQL	<PQL
IM-JSRb-2-3M	27-Mar-01	7.88	28.1	56.7	55.7	363	<PQL	<PQL	1.1	<PQL	<PQL	0.66	12	298	39	17	66	5.7	0.31	<PQL	<PQL	<PQL	<PQL	0.0066	<PQL	<PQL	0.017	<PQL
IM-JSRb-3-0M	26-Nov-00	7.45	23.9	64.0	50.0	410	<PQL	<PQL	2.7	0.16	<PQL	0.62	4.2	320	32	17	49	4.7	0.46	<PQL	<PQL	<PQL	0.015	0.015	<PQL	0.0059	<PQL	39
IM-JSRb-3-1M	03-Jan-01	7.45	23.8	61.5	55.7	393	2.3	0.15	6.7	0.20	<PQL	1.5	8.5	315	40	16	50	3.7	0.43	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0064	<PQL	<PQL
IM-JSRb-3-2M	06-Feb-01	7.46	24.3	56.9	57.8	364	2.4	2.0	<PQL	<PQL	<PQL	0.41	7.3	305	40	18	66	2.8	0.45	<PQL	<PQL	<PQL	0.017	<PQL	<PQL	<PQL	0.015	<PQL
IM-JSRb-3-3M	27-Mar-01	7.61	28.0	56.0	58.1	358	1.6	1.5	0.18	<PQL	<PQL	0.71	8.4	296	41	17	66	5.9	0.49	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.026	<PQL
Jhenaidah																												
IM-JHKc-1-0M	28-Feb-01	7.16	24.6	94.9	162	608	<PQL	<PQL	0.75	0.20	<PQL	3.2	0.87	546	130	29	29	4.9	0.31	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0098	<PQL	27
IM-JHKc-1-1M	24-Mar-01	6.99	27.5	59.6	152	382	<PQL	<PQL	4.0	0.24	<PQL	7.8	1.1	555	130	22	23	8.6	0.22	<PQL	<PQL	<PQL	0.017	<PQL	<PQL	<PQL	0.030	<PQL
IM-JHKc-1-2M	1st-May-01	7.26	30.9	68.2	153	437	<PQL	<PQL	5.4	0.46	<PQL	9.8	1.7	557	120	30	26	6.2	0.27	<PQL	<PQL	<PQL	0.018	<PQL	<PQL	<PQL	<PQL	<PQL
IM-JHKc-1-3M	17-Jun-01	7.21	30.8	68.6	149	343	<PQL	<PQL	4.5	0.35	<PQL	6.2	2.8	524	120	25	26	5.1	0.18	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	27
IM-JHKc-2-0M	28-Feb-01	7.07	23.7	90.4	162	578	<PQL	<PQL	1.7	<PQL	<PQL	1.5	2.0	500	130	29	27	4.5	0.24	<PQL	<PQL	<PQL	0.011	<PQL	<PQL	<PQL	<PQL	<PQL
IM-JHKc-2-1M	24-Mar-01	7.21	27.6	89.3	146	572	<PQL	<PQL	1.2	<PQL	<PQL	2.3	3.6	509	120	22	23	6.7	0.21	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	0.0073	0.10	<PQL
IM-JHKc-2-2M	1st-May-01	7.08	24.7	81.1	164	519	0.81	<PQL	1.6	<PQL	<PQL	2.3	2.4	532	130	30	14	4.8	0.16	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0062	0.072	<PQL
IM-JHKc-2-3M	17-Jun-01	7.23	30.9	66.0	144	330	<PQL	<PQL	1.5	0.10	<PQL	1.9	2.6	535	120	24	19	4.5	0.15	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
IM-JHKc-3-0M	28-Feb-01	6.79	24.1	94.5	163	605	<PQL	<PQL	1.3	0.14	<PQL	3.6	1.3	555	130	29	27	4.9	0.33	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	<PQL	<PQL	35
IM-JHKc-3-1M	24-Mar-01	7.11	27.6	87.3	146	559	<PQL	<PQL	1.8	<PQL	<PQL	2.5	3.1	505	120	21	22	6.7	0.31	<PQL	<PQL	0.0050	0.014	<PQL	<PQL	0.0087	0.036	<PQL
IM-JHKc-3-2M	1st-May-01	7.04	24.6	81.9	164	524	3.6	<PQL	2.1	<PQL	<PQL	3.6	1.1	525	130	30	14	5.3	0.18	<PQL	<PQL	0.0062	<PQL	0.0052	<PQL	<PQL	0.053	39
IM-JHKc-3-3M	17-Jun-01	7.09	30.9	65.9	146	330	<PQL	<PQL	4.7	0.18	<PQL	3.7	1.5	523	120	26	23	4.9	0.27	<PQL	<PQL	0.015	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.4 Results of Improved Deep Tubewell(2/2)

Analyte		pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method		pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit			Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Date of sampling	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Chuadanga																												
IM-CDBd-1-0M	14-Mar-01	7.01	28.2	62.5	100	400	<PQL	<PQL	1.5	0.32	<PQL	5.1	1.4	342	82	18	14	5.1	0.38	<PQL	<PQL	<PQL	0.010	<PQL	<PQL	0.0070	<PQL	<PQL
IM-CDBd-1-1M	14-Apr-01	7.22	26.0	57.8	116	370	3.8	<PQL	1.6	0.25	<PQL	2.6	0.93	357	92	23	6.8	3.2	0.39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.12	<PQL
IM-CDBd-1-2M	17-May-01	7.23	31.3	50.2	102	321	2.6	1.0	0.11	0.19	<PQL	2.8	1.8	346	80	22	12	4.2	0.34	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
IM-CDBd-1-3M	23-Jun-01	7.26	30.9	51.1	101	256	<PQL	<PQL	1.8	0.29	<PQL	2.9	<PQL	353	82	20	18	3.8	0.35	<PQL	<PQL	0.0063	<PQL	<PQL	<PQL	<PQL	0.0059	<PQL
IM-CDBd-2-0M	14-Mar-01	7.07	28.2	61.9	102	396	<PQL	<PQL	1.7	0.16	<PQL	3.2	0.81	348	83	19	13	5.6	0.47	<PQL	<PQL	<PQL	0.020	<PQL	<PQL	0.0052	0.066	<PQL
IM-CDBd-2-1M	14-Apr-01	7.15	25.7	55.4	112	355	2.6	2.3	<PQL	0.20	<PQL	2.5	1.0	341	90	22	6.9	3.2	0.32	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.15	<PQL
IM-CDBd-2-2M	17-May-01	7.23	31.3	50.0	101	320	2.7	2.5	<PQL	0.15	<PQL	2.1	1.6	333	80	21	12	4.2	0.40	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	<PQL	0.0092	<PQL
IM-CDBd-2-3M	23-Jun-01	7.27	31.0	51.3	99.5	257	<PQL	<PQL	1.7	0.24	<PQL	2.6	<PQL	348	81	18	13	3.3	0.37	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
IM-CDBd-3-0M	14-Mar-01	7.14	28.1	61.7	100	395	2.7	<PQL	<PQL	0.12	<PQL	2.5	1.3	326	82	18	13	5.3	0.39	<PQL	<PQL	<PQL	<PQL	0.0104	<PQL	<PQL	<PQL	<PQL
IM-CDBd-3-1M	14-Apr-01	7.72	24.9	54.6	109	350	2.9	<PQL	1.3	0.22	<PQL	2.4	1.7	351	87	22	6.8	3.1	0.36	<PQL	<PQL	<PQL	<PQL	0.0093	<PQL	<PQL	0.18	<PQL
IM-CDBd-3-2M	17-May-01	7.42	31.2	50.4	100	322	<PQL	<PQL	1.0	0.13	<PQL	2.2	1.7	341	80	21	15	3.1	0.37	<PQL	<PQL	<PQL	0.014	<PQL	<PQL	<PQL	<PQL	<PQL
IM-CDBd-3-3M	23-Jun-01	7.29	31.0	51.2	95.8	256	<PQL	<PQL	1.7	0.23	<PQL	2.4	1.4	342	78	17	9.9	4.0	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.5 Results of 300 Existing Well Survey (Rainy Season)

Analyte	pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method	pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/FAAS	Extraction/FAAS	Extraction/FAAS	SP	Extraction/FAAS	Extraction/FAAS	Extraction/FAAS	Extraction/FAAS	Titration
Practical Quantitation Limit	0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit		Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Existing Well																											
EW-HJMd-R-[19]	7.00	26.4	70.2	166	449	0.80	<PQL	4.6	0.20	<PQL	13	1.8	460	140	31	21	1.9	0.53	<PQL	<PQL	<PQL	<PQL	0.013	<PQL	0.022	<PQL	<PQL
EW-JJDa-R-[38]	7.10	26.3	71.9	124	460	1.2	0.20	<PQL	0.91	<PQL	<PQL	10	460	100	27	34	1.3	1.1	<PQL	0.036	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-CDNt-R-[43]	7.00	26.3	101	193	646	16	2.8	0.11	0.45	36	0.57	43	500	160	34	26	3.6	0.48	0.0019	0.061	<PQL	<PQL	0.012	<PQL	0.048	<PQL	<PQL
EW-CDHw-R-[73]	7.20	26.2	68.3	141	437	0.36	0.26	3.4	0.93	<PQL	0.44	1.5	400	120	22	43	3.7	0.59	<PQL	0.050	<PQL	<PQL	0.017	<PQL	0.030	<PQL	<PQL
EW-JARj-R-[85]	7.20	26.3	158	75.6	1010	0.24	<PQL	0.11	0.44	<PQL	0.25	220	720	54	21	290	0.81	1.0	<PQL	0.066	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-JBBs-R-[117]	7.10	26.1	52.3	119	334	<PQL	<PQL	1.6	0.76	<PQL	<PQL	2.3	320	99	20	9.0	1.6	0.50	0.0023	0.087	<PQL	<PQL	<PQL	<PQL	0.040	<PQL	<PQL
EW-HJNI-R-[147]	7.20	26.3	54.1	94.2	346	<PQL	<PQL	0.12	0.56	<PQL	0.36	20	340	69	25	15	1.4	0.61	<PQL	0.11	<PQL	0.017	<PQL	<PQL	0.0063	<PQL	<PQL
EW-HHHr-R-[26]	7.28	22.9	73.1	138	468	<PQL	0.25	<PQL	0.88	18	0.74	21	402	110	27	14	2.6	0.33	<PQL	0.10	<PQL	0.013	<PQL	<PQL	<PQL	<PQL	<PQL
EW-CJUt-R-[31]	7.10	26.6	51.7	115	331	1.1	<PQL	0.13	0.27	<PQL	0.59	6.8	340	110	6.1	21	1.4	0.40	<PQL	0.13	<PQL	0.015	<PQL	<PQL	0.047	<PQL	<PQL
EW-CCSk-R-[35]	7.00	26.4	59.9	74.9	383	1.4	<PQL	<PQL	0.64	<PQL	1.5	14	200	53	22	11	3.1	0.43	0.0051	0.14	<PQL	0.014	0.030	<PQL	0.069	0.051	<PQL
EW-HTKt-R-[46]	8.30	26.4	26.6	154	170	1.4	<PQL	0.11	0.20	6.5	1.2	13	360	130	23	8.0	3.4	0.52	0.0027	0.14	<PQL	0.010	<PQL	<PQL	0.035	0.024	<PQL
EW-CAAI-R-[72]	7.10	26.2	91.2	167	584	1.7	<PQL	0.10	0.38	8.2	0.92	26	460	140	25	19	4.0	0.35	0.0030	0.14	<PQL	0.014	<PQL	<PQL	0.038	0.011	<PQL
EW-HKRg-R-[74]	6.80	26.2	69.5	93.8	445	2.7	<PQL	<PQL	0.21	<PQL	5.0	15	240	82	12	16	1.9	0.40	0.0035	0.17	<PQL	<PQL	<PQL	<PQL	0.022	<PQL	<PQL
EW-JSBn-R-[88]	6.80	26.4	65.1	93.0	417	2.5	<PQL	0.11	0.36	<PQL	3.2	14	280	69	24	11	2.2	0.48	0.0039	0.17	<PQL	<PQL	<PQL	<PQL	0.048	0.047	<PQL
EW-HMNt-R-[95]	6.90	26.2	77.2	128	494	0.76	<PQL	3.2	0.36	<PQL	3.5	4.4	440	100	25	10	3.6	0.37	0.0052	0.17	<PQL	<PQL	<PQL	<PQL	0.026	<PQL	<PQL
EW-JKPj-R-[102]	6.80	26.1	258	164	1650	180	42	12	<PQL	<PQL	3.0	330	460	120	45	170	8.9	1.2	0.0073	0.18	<PQL	<PQL	<PQL	<PQL	0.065	0.016	160
EW-JHNn-R-[105]	6.70	26.0	63.0	107	403	11	3.2	0.10	0.14	<PQL	7.3	1.2	280	84	23	12	3.0	0.53	0.0076	0.20	0.0086	0.012	<PQL	<PQL	0.057	<PQL	39
EW-JMDk-R-[124]	7.10	23.0	93.3	48.1	467	<PQL	<PQL	4.6	<PQL	<PQL	2.2	53	420	13	35	95	4.8	1.1	0.0079	0.19	<PQL	<PQL	<PQL	<PQL	0.043	<PQL	39
EW-HSFI-R-[133]	6.90	25.8	65.7	117	420	0.30	<PQL	<PQL	0.69	7.6	0.34	2.4	360	90	27	16	1.3	0.50	<PQL	0.20	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-JJlc-R-[170]	7.10	25.8	40.1	125	257	0.71	<PQL	<PQL	0.74	<PQL	0.50	11	504	93	31	48	1.2	0.63	<PQL	0.21	<PQL	<PQL	<PQL	<PQL	0.0059	0.024	79
EW-HSAb-R-[177]	6.90	26.1	88.3	48.5	565	0.31	<PQL	0.11	0.76	<PQL	<PQL	24	340	33	15	52	2.7	0.49	<PQL	0.22	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-JMCl-R-[201]	6.20	26.2	78.0	109	499	3.1	<PQL	5.6	0.098	<PQL	2.6	94	280	83	27	27	3.0	0.64	<PQL	0.22	<PQL	<PQL	<PQL	<PQL	<PQL	0.015	<PQL
EW-JCPt-R-[207]	6.80	26.0	72.6	112	465	8.5	3.6	<PQL	0.30	<PQL	2.4	10	360	87	25	13	4.2	0.47	<PQL	0.22	<PQL	<PQL	<PQL	<PQL	0.0063	<PQL	<PQL
Production Well																											
EW-HTKt-R(PTW-2)	7.14	23.6	68.7	119	440	0.89	0.21	0.11	0.68	7.2	0.25	13	410	87	33	17	1.8	0.62	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.021	<PQL
EW-CCCd-R(PTW-2B)	7.09	23.5	69.3	123	444	<PQL	<PQL	1.1	0.19	<PQL	1.1	35	360	97	26	19	3.2	0.55	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-HJJn-R(PTW-3)	7.01	23.4	54.1	73	346	2.9	0.24	0.27	0.43	7.6	<PQL	4.1	340	61	12	24	2.1	0.56	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.019	<PQL
EW-JJJs-R(PTW-15)	7.09	23.2	101	114	644	<PQL	<PQL	0.10	0.29	8.9	0.73	110	480	82	31	59	2.7	0.41	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.053	<PQL
EW-HMMh-R(PTW-1)	7.12	23.7	53.0	102	339	4.5	0.17	1.2	<PQL	<PQL	1.5	3.0	330	83	20	8.7	2.8	0.27	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.069	<PQL
EW-HKKl-R(PTW-2)	7.12	23.6	67.8	111	434	7.4	1.1	<PQL	0.50	<PQL	0.48	16	380	86	25	10	2.2	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.054	<PQL
EW-HSSl-R(PTW-1)	7.09	23.4	75.4	128	483	<PQL	<PQL	0.18	<PQL	<PQL	<PQL	4.6	490	93	35	32	3.2	0.39	<PQL	<PQL	<PQL	0.010	<PQL	<PQL	<PQL	0.028	<PQL

Excess of WHO guideline　　Excess of Bangladesh Standard　　Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.6 Results of 300 Existing Well Survey (Dry Season)

Analyte	pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method	pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit	0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit		Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Existing Well																											
EW-HJMd-D-[19]	6.72	24.6	83.7	118	536	<PQL	<PQL	12	0.18	<PQL	8.1	1.1	448	96	22	10	2.6	0.35	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-JJDa-D-[38]	7.14	24.4	81.3	102	520	0.31	0.020	6.6	1.5	<PQL	0.84	4.5	456	72	31	40	1.7	1.3	<PQL	<PQL	<PQL	<PQL	0.010	<PQL	0.0062	0.037	<PQL
EW-CDNt-D-[43]	7.09	23.7	100	161	642	2.0	3.3	7.8	0.68	46	3.4	13	463	130	30	36	4.0	0.58	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	33
EW-CDHw-D-[73]	7.13	23.6	68.5	119	438	<PQL	<PQL	13	1.3	<PQL	3.3	3.0	426	100	18	30	3.4	0.40	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-JARj-D-[85]	7.11	24.4	184	66.2	1180	<PQL	0.020	7.1	0.42	<PQL	[illegible]	240	700	48	18	330	1.3	1.0	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0072	<PQL	<PQL
EW-JBBs-D-[117]	6.93	23.8	58.6	84.6	375	<PQL	<PQL	9.2	0.23	<PQL	1.3	0.71	315	69	16	4.3	2.1	0.43	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	0.0077	<PQL	<PQL
EW-HJNl-D-[147]	7.19	24.5	60.6	78.9	388	<PQL	<PQL	4.7	0.52	<PQL	1.2	2.2	328	59	20	12	1.7	0.55	<PQL	<PQL	<PQL	<PQL	0.0094	<PQL	0.0053	<PQL	<PQL
EW-HHHr-D-[26]	7.13	24.6	78.7	107	504	<PQL	0.47	7.4	0.98	20	2.5	18	383	90	17	7.8	2.9	0.41	<PQL	<PQL	<PQL	0.014	0.012	<PQL	<PQL	<PQL	<PQL
EW-CJUt-D-[31]	7.24	23.8	61.1	109	391	0.98	0.64	6.5	0.42	<PQL	1.4	7.7	319	90	19	15	3.8	0.28	<PQL	<PQL	<PQL	0.014	<PQL	<PQL	<PQL	<PQL	<PQL
EW-CCSk-D-[35]	7.16	24.1	65.8	112	421	1.5	0.26	8.4	1.0	<PQL	2.6	12	324	93	19	4.3	3.6	0.28	<PQL	<PQL	<PQL	0.010	<PQL	<PQL	<PQL	<PQL	<PQL
EW-HTKl-D-[46]	7.45	23.9	70.0	104	445	<PQL	<PQL	5.6	0.18	7.2	2.1	24	352	86	19	1.5	3.9	0.46	<PQL	<PQL	<PQL	0.015	<PQL	<PQL	<PQL	<PQL	<PQL
EW-CAAl-D-[72]	7.42	24.1	90.7	150	581	1.4	0.020	6.3	0.74	14	2.5	24	410	120	25	22	3.9	0.31	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0057	<PQL	<PQL
EW-HKRg-D-[74]	7.11	24.5	77.0	110	493	1.8	1.2	7.1	0.26	<PQL	4.9	14	387	89	21	8.6	2.7	0.31	<PQL	<PQL	<PQL	0.010	<PQL	<PQL	<PQL	0.017	<PQL
EW-JSBn-D-[88]	6.89	24.3	60.5	96.0	387	<PQL	<PQL	9.7	0.45	<PQL	2.7	11	333	76	20	10	1.8	0.35	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.020	<PQL
EW-HMNt-D-[95]	6.85	24.5	81.1	105	520	<PQL	<PQL	11	0.28	8.1	4.7	1.9	444	80	24	19	3.2	0.26	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0072	<PQL	30
EW-JKPj-D-[102]	7.03	24.4	227	119	1450	<PQL	<PQL	20	0.41	<PQL	1.3	570	546	82	37	400	6.7	1.7	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0064	0.10	85
EW-JHNn-D-[105]	6.87	24.2	66.0	98.7	423	<PQL	<PQL	[illegible]	0.44	<PQL	[illegible]	1.1	370	79	20	10	2.6	0.20	<PQL	<PQL	<PQL	0.016	0.0070	<PQL	<PQL	<PQL	<PQL
EW-JMDk-D-[124]	6.93	24.7	105	98.8	672	<PQL	<PQL	15	0.46	<PQL	2.6	50	463	69	30	81	3.8	0.57	<PQL	<PQL	<PQL	<PQL	0.011	<PQL	0.0066	<PQL	24
EW-HSFl-D-[133]	7.21	23.7	70.7	115	453	<PQL	<PQL	8.2	1.0	<PQL	0.26	3.0	389	94	21	24	1.2	0.45	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-JJlc-D-[170]	7.13	24.5	92.8	109	594	<PQL	<PQL	4.9	1.2	<PQL	1.2	15	481	79	30	59	1.3	0.70	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0052	0.013	<PQL
EW-HSAb-D-[177]	7.07	23.8	100	138	627	<PQL	<PQL	5.9	0.93	<PQL	0.42	22	463	110	31	37	2.5	0.48	<PQL	<PQL	<PQL	0.011	<PQL	<PQL	0.0092	<PQL	<PQL
EW-JMCl-D-[201]	6.81	24.5	75.6	97.9	484	<PQL	<PQL	16	0.45	<PQL	1.7	0.98	407	77	21	21	2.6	0.28	<PQL	<PQL	<PQL	<PQL	0.037	<PQL	<PQL	<PQL	24
EW-JCPt-D-[207]	7.01	24.9	77.8	117	499	<PQL	<PQL	11	0.43	<PQL	3.1	9.2	407	99	18	11	3.9	0.32	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0079	<PQL	<PQL
Production Well																											
EW-HTKl-D-(PTW-2)	7.05	24.6	77.7	107	497	<PQL	<PQL	7.6	0.75	<PQL	[illegible]	12	416	79	28	24	2.8	0.57	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-CCCD-D-(PTW-2B)	7.01	24.0	81.9	111	524	0.95	<PQL	8.2	0.60	30	[illegible]	45	352	92	19	22	4.3	0.55	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
EW-HJJn-D-(PTW-3)	6.99	24.5	63.9	91.0	409	<PQL	0.050	7.2	0.46	<PQL	1.6	3.1	333	73	18	14	3.3	0.28	<PQL	<PQL	<PQL	<PQL	0.021	<PQL	<PQL	<PQL	<PQL
EW-JJJs-D-(PTW-15)	7.03	24.6	112	111	718	<PQL	<PQL	4.8	0.20	<PQL	1.4	110	444	82	29	92	3.5	0.41	<PQL	<PQL	<PQL	0.010	<PQL	<PQL	<PQL	0.0055	<PQL
EW-HMMh-D-(PTW-1)	7.08	24.0	59.7	91.1	382	1.8	<PQL	7.7	0.23	<PQL	2.0	3.8	305	77	14	8.3	3.9	0.24	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	<PQL	0.016	<PQL
EW-HKKl-D-(PTW-2)	7.32	24.5	77.4	114	495	0.91	0.35	8.1	0.12	<PQL	2.6	3.6	426	92	21	6.1	2.7	0.26	<PQL	<PQL	<PQL	0.018	0.047	<PQL	<PQL	0.015	<PQL
EW-HSSl-D-(PTW-1)	6.99	23.9	93.0	147	595	0.83	<PQL	8.2	0.62	<PQL	0.67	5.7	509	110	33	29	3.3	0.44	<PQL	<PQL	0.0081	<PQL	<PQL	<PQL	0.0061	0.0087	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.7 Results of Baseline Survey (Existing Well)

Analyte	pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method	pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit	0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit		Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
BS-CDBd-EW-006	6.95	23.9	79.3	122	508	23	3.9	<PQL	0.83	<PQL	[illegible]	33	455	110	20	16	5.8	0.53	<PQL	<PQL	0.032	0.016	0.0060	<PQL	0.020	<PQL	<PQL
BS-CDBd-EW-050	7.04	24.5	58.2	119	372	2.3	4.0	<PQL	1.1	<PQL	2.4	4.6	376	97	22	16	4.3	0.41	<PQL	0.066	0.012	<PQL	0.0092	<PQL	<PQL	<PQL	<PQL
BS-CDBd-EW-060	7.15	25.3	63.0	116	403	<PQL	<PQL	4.3	1.1	14	2.9	9.5	394	94	23	6.5	2.5	0.42	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
BS-CDBd-EW-115	7.15	24.3	49.6	126	317	12	1.7	<PQL	0.29	<PQL	1.0	25	350	110	20	14	3.4	0.34	<PQL	<PQL	<PQL	<PQL	0.014	<PQL	0.0068	<PQL	<PQL
BS-CDBd-EW-168	7.09	24.3	52.2	98.5	334	16	2.7	<PQL	0.85	<PQL	1.0	1.3	350	85	13	6.7	2.0	0.57	<PQL	<PQL	<PQL	0.010	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JDCc-EW-044	7.01	23.1	76.8	155	492	11	0.27	2.5	0.40	<PQL	2.6	1.7	512	120	32	11	3.4	0.22	<PQL	<PQL	<PQL	0.012	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JDCc-EW-060	7.08	23.7	74.4	128	476	<PQL	<PQL	6.7	0.18	<PQL	8.2	37	420	100	28	14	3.9	0.40	<PQL	0.054	0.016	<PQL	0.014	<PQL	0.029	<PQL	<PQL
BS-JDCc-EW-091	6.92	23.7	74.7	119	478	<PQL	<PQL	9.4	<PQL	<PQL	0.48	4.8	455	89	30	16	2.6	0.30	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	39
BS-JDCc-EW-092	7.29	24.2	64.5	117	413	0.26	<PQL	2.6	<PQL	<PQL	0.44	1.7	411	94	23	12	1.2	0.32	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	39
BS-JDCc-EW-093	7.07	23.5	73.8	138	472	<PQL	<PQL	1.7	<PQL	<PQL	0.31	1.3	473	110	26	15	3.9	<PQL	<PQL	<PQL	<PQL	0.014	<PQL	<PQL	<PQL	<PQL	39
BS-JSRb-EW-001	7.26	24.9	251	122	1600	<PQL	<PQL	2.8	<PQL	<PQL	0.73	320	595	80	42	350	3.8	0.38	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.022	<PQL	44
BS-JSRb-EW-012	7.09	25.3	247	153	1580	<PQL	<PQL	2.0	<PQL	<PQL	[illegible]	540	510	110	47	300	8.2	0.37	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0069	0.0051	<PQL
BS-JSRb-EW-026	7.01	23.0	246	117	1570	<PQL	<PQL	2.4	<PQL	<PQL	2.5	370	608	79	38	360	6.5	0.59	<PQL	<PQL	0.0056	<PQL	<PQL	<PQL	0.016	<PQL	<PQL
BS-JSRb-EW-035	6.87	24.1	199	155	1270	<PQL	<PQL	2.7	<PQL	<PQL	3.7	300	757	110	42	260	6.3	0.41	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.010	<PQL	<PQL
BS-JSRb-EW-048	7.28	25.3	267	135	1710	<PQL	<PQL	3.8	<PQL	6.6	4.2	490	569	93	42	410	7.7	0.33	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.016	<PQL	<PQL

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.8 Results of Baseline Survey (Pond)

Analyte	pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD
Method	pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	SP	FAAS	SP	FAAS	SP	Titration	FAAS	FAAS	FAAS	FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	SP	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Extraction/ FAAS	Titration
Practical Quantitation Limit	0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
Unit		Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
BS-CDBd-P-01	7.54	23.7	23.8	39.4	152	<PQL	<PQL	0.45	<PQL	<PQL	<PQL	7.5	140	32	7.5	13	6.5	0.35	<PQL	<PQL	<PQL	0.029	<PQL	<PQL	<PQL	<PQL	<PQL
BS-CDBd-P-02	7.10	23.4	11.1	19.9	71.1	<PQL	<PQL	0.34	<PQL	<PQL	<PQL	4.1	67.8	17	2.9	2.7	5.1	0.33	<PQL	<PQL	<PQL	0.033	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JDCc-P-01	7.36	23.6	35.0	28.5	224	42	5.8	4.8	<PQL	7.4	<PQL	7.5	184	25	14	24	4.3	2.0	<PQL	<PQL	<PQL	0.018	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JDCc-P-02	7.39	23.9	15.8	34.2	101	2.8	0.020	1.1	0.10	<PQL	<PQL	3.5	87.5	34	0.20	4.1	7.1	1.4	<PQL	<PQL	<PQL	0.046	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JDCc-P-03	7.05	23.7	25.0	34.5	160	18	1.2	2.6	0.16	7.3	<PQL	5.0	123	32	2.0	7.4	2.0	3.6	<PQL	<PQL	0.0070	0.052	<PQL	<PQL	0.0056	<PQL	39
BS-JDCc-P-04	7.41	23.8	38.9	16.6	249	0.82	0.030	0.82	<PQL	<PQL	<PQL	2.3	219	14	13	31	7.0	0.63	<PQL	<PQL	<PQL	0.029	<PQL	<PQL	0.0054	<PQL	78
BS-JDCc-P-05	7.47	24.2	30.3	23.4	194	1.8	0.10	0.18	0.096	<PQL	<PQL	3.9	175	20	13	8.2	7.1	0.26	<PQL	<PQL	<PQL	0.019	<PQL	<PQL	<PQL	<PQL	78
BS-JSRb-P-01	7.72	24.1	30.0	24.9	192	1.2	<PQL	0.20	<PQL	6.9	<PQL	11	131	20	4.8	18	6.0	0.34	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0077	<PQL
BS-JSRb-P-02	7.32	22.4	32.8	39.6	210	<PQL	<PQL	0.41	<PQL	<PQL	<PQL	8.4	156	30	9.7	20	4.5	0.49	<PQL	<PQL	<PQL	0.029	0.011	<PQL	0.0090	0.0093	38
BS-JSRb-P-03	7.88	24.3	37.2	34.8	238	<PQL	<PQL	0.21	<PQL	7.1	<PQL	28	144	27	7.8	38	2.2	0.34	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	<PQL	0.011	<PQL
BS-JSRb-P-04	7.95	23.9	35.7	45.0	228	0.80	0.070	0.68	<PQL	<PQL	<PQL	24	144	31	14	21	9.7	0.31	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JSRb-P-05	7.30	23.7	48.4	41.0	310	<PQL	<PQL	0.30	<PQL	7.4	<PQL	52	136	30	11	46	4.0	0.44	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	0.0059	<PQL	<PQL
BS-JSRb-P-06	7.80	23.5	86.6	75.0	618	0.31	<PQL	0.51	<PQL	7.9	<PQL	5.6	256	55	7.3	46	14	1.9	<PQL	<PQL	<PQL	0.014	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JSRb-P-07	7.80	23.1	35.8	43.8	229	1.4	<PQL	0.78	<PQL	<PQL	<PQL	24	152	31	7.2	15	30	0.27	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JSRb-P-08	7.40	23.0	57.2	36.7	366	<PQL	<PQL	1.1	<PQL	6.1	<PQL	59	184	26	11	44	48	2.2	<PQL	<PQL	<PQL	0.013	<PQL	<PQL	0.0079	<PQL	<PQL
BS-JSRb-P-09	7.50	22.7	48.8	48.3	312	<PQL	<PQL	0.34	<PQL	6.8	<PQL	59	192	37	12	26	7.6	0.31	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0062	<PQL	<PQL
BS-JSRb-P-10	7.70	23.1	64.8	63.6	415	0.23	<PQL	0.33	<PQL	<PQL	<PQL	97	208	47	17	43	7.4	0.33	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JSRb-P-11	7.56	23.7	29.0	36.1	188	<PQL	<PQL	0.44	0.086	<PQL	<PQL	2.9	140	30	5.9	11	5.9	0.30	<PQL	<PQL	<PQL	0.018	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JSRb-P-12	7.57	23.7	45.7	27.8	292	<PQL	<PQL	0.36	<PQL	5.8	<PQL	25	175	24	4.3	29	62	0.47	<PQL	<PQL	<PQL	0.036	<PQL	<PQL	<PQL	<PQL	78
BS-JSRb-P-13	7.43	23.4	29.7	44.0	190	3.8	0.43	0.25	<PQL	6.8	<PQL	4.3	158	34	9.9	6.9	6.3	0.39	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JSRb-P-14	6.97	24.3	40.8	41.5	261	16	6.6	0.19	<PQL	<PQL	<PQL	36	140	32	9.8	32	5.0	0.49	<PQL	<PQL	<PQL	0.017	<PQL	<PQL	0.0056	<PQL	39
BS-JSRb-P-15	7.61	24.2	48.5	25.8	310	2.4	0.10	0.45	<PQL	<PQL	<PQL	39	171	19	6.4	41	2.4	0.48	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0081	<PQL	39
BS-JSRb-P-16	7.57	22.5	25.4	37.5	163	13	0.95	0.59	<PQL	<PQL	<PQL	4.8	140	30	7.0	11	3.5	1.1	<PQL	<PQL	<PQL	0.015	<PQL	<PQL	<PQL	<PQL	<PQL
BS-JSRb-P-17	7.02	22.4	44.5	35.8	285	2.0	0.27	0.23	<PQL	5.8	<PQL	26	158	26	9.4	34	2.4	2.4	<PQL	<PQL	<PQL	0.031	<PQL	<PQL	<PQL	<PQL	78
BS-JSRb-P-18	7.40	22.6	55.2	57.0	353	4.8	0.64	0.25	<PQL	8.0	<PQL	38	223	40	17	37	40	0.50	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0061	<PQL	39
BS-JSRb-P-19	7.17	21.9	23.2	38.6	148	7.1	0.72	0.38	<PQL	7.7	<PQL	2.8	122	36	2.5	5.7	7.0	0.59	<PQL	<PQL	<PQL	0.034	<PQL	<PQL	0.0051	<PQL	78
BS-JSRb-P-20	7.42	22.7	43.9	20.3	281	1.5	0.11	<PQL	<PQL	<PQL	<PQL	25	210	14	16	34	5.3	0.36	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.0080	<PQL	<PQL

Excess of WHO guideline Excess of Bangladesh Standard Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (1/12)

Ch-1

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	0.77	67	3.0	10	<0.005	<0.005
Maximum (mg/l)		0.16	1.1	0.87	16	130	29	23	<0.005	0.0057
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.034	0.39	0.36	4.5	114	23	16	<0.005	0.0051
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.025	0.30	0.26	2.7	111	20	15	<0.005	0.0051
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/2	2/2	1/2	1/2	2/2	0/2	0/2	0/2	0/2
	Monitoring	0/8	0/8	6/8	8/8	7/8	0/8	0/8	0/8	0/8
	Total	0/10	2/10	7/10	9/10	9/10	0/10	0/10	0/10	0/10
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/2	0/2	0/2	2/2	-	-	0/2	0/2	0/2
	Monitoring	0/8	0/8	2/8	8/8	-	-	0/8	0/8	0/8
	Total	0/10	0/10	2/10	10/10	-	-	0/10	0/10	0/10

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (2/12)

Ch-1-4

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	0.24	0.090	2.1	74	26	22	<0.005	0.005
Maximum (mg/l)		<0.02	0.47	0.40	6.9	120	28	58	<0.005	0.0095
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.39	0.26	3.8	105	27	41	<0.005	0.0068
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.37	0.22	3.2	102	27	38	<0.005	0.0066
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/3	0/3	2/3	3/3	2/3	0/3	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	2/3	3/3	2/3	0/3	0/3	0/3	0/3
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/3	0/3	0/3	3/3	-	-	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	0/3	3/3	-	-	0/3	0/3	0/3

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (3/12)

Ch-2

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	<0.2	14	21	11	<0.005	<0.005
Maximum (mg/l)		0.28	1.2	0.34	9.7	96	33	24	<0.005	0.0088
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.053	0.27	0.12	3.8	64	26	14	<0.005	0.0055
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.028	0.18	0.10	1.9	56	26	14	<0.005	0.0054
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/1	0/1	1/1	1/1	1/1	0/1	0/1	0/1	0/1
	Monitoring	0/7	1/7	1/7	4/7	2/7	0/7	0/7	0/7	0/7
	Total	0/8	1/8	2/8	5/8	3/8	0/8	0/8	0/8	0/8
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/1	0/1	0/1	1/1	-	-	0/1	0/1	0/1
	Monitoring	0/7	0/7	0/7	6/7	-	-	0/7	0/7	0/7
	Total	0/8	0/8	0/8	7/8	-	-	0/8	0/8	0/8

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (4/12)

Ch-2-4

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	0.081	2.2	82	22	19	<0.005	0.0059
Maximum (mg/l)		0.25	<0.1	0.19	5.1	90	22	37	0.0054	0.0064
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.13	0.10	0.14	3.6	87	22	27	0.0051	0.0062
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.084	0.10	0.13	3.4	87	22	26	0.0051	0.0062
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/3	0/3	2/3	3/3	3/3	0/3	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	2/3	3/3	3/3	0/3	0/3	0/3	0/3
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/3	0/3	0/3	3/3	-	-	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	0/3	3/3	-	-	0/3	0/3	0/3

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (5/12)

Jh-1

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	2.6	43	24	14	<0.005	<0.005
Maximum (mg/l)		<0.02	0.17	0.35	18	110	42	36	0.011	0.0063
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.11	0.17	9.8	82	35	23	0.0059	0.0051
Logarithmic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.11	0.15	8.0	78	34	21	0.0056	0.0051
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/2	0/2	1/2	2/2	2/2	2/2	0/2	0/2	0/2
	Monitoring	0/7	0/7	4/7	7/7	5/7	4/7	0/7	0/7	0/7
	Total	0/9	0/9	5/9	9/9	7/9	6/9	0/9	0/9	0/9
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/2	0/2	0/2	2/2	-	-	0/2	1/2	0/2
	Monitoring	0/7	0/7	0/7	7/7	-	-	0/7	0/7	0/7
	Total	0/9	0/9	0/9	9/9	-	-	0/9	1/9	0/9

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (6/12)

Jh-1-4

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	2.3	99	38	11	<0.005	0.0057
Maximum (mg/l)		<0.02	0.13	0.089	3.6	100	38	13	0.013	0.0092
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.11	0.083	2.8	99	38	13	0.0077	0.0072
Logarithmic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.11	0.083	2.7	99	38	13	0.0069	0.0071
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/3	0/3	0/3	3/3	3/3	3/3	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	0/3	3/3	3/3	3/3	0/3	0/3	0/3
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/3	0/3	0/3	3/3	-	-	0/3	1/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	0/3	3/3	-	-	0/3	1/3	0/3

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (7/12)

Jh-2

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	<0.2	26	23	14	<0.005	<0.005
Maximum (mg/l)		0.100	0.18	0.12	9.2	98	39	21	0.0068	<0.005
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.030	0.12	0.089	3.0	56	33	16	0.0052	<0.005
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.024	0.12	0.088	1.5	48	33	16	0.0052	<0.005
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/2	0/2	0/2	2/2	2/2	2/2	0/2	0/2	0/2
	Monitoring	0/6	0/6	1/6	3/6	1/6	3/6	0/6	0/6	0/6
	Total	0/8	0/8	1/8	5/8	3/8	5/8	0/8	0/8	0/8
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/2	0/2	0/2	2/2	-	-	0/2	0/2	0/2
	Monitoring	0/6	0/6	0/6	5/6	-	-	0/6	0/6	0/6
	Total	0/8	0/8	0/8	7/8	-	-	0/8	0/8	0/8

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (8/12)

Jh-2-4

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	0.47	25	29	22	<0.005	<0.005
Maximum (mg/l)		0.26	0.11	0.72	3.0	90	31	48	0.012	<0.005
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.18	0.10	0.39	1.9	66	30	35	0.0072	<0.005
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.11	0.10	0.28	1.5	57	30	34	0.0066	<0.005
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/3	0/3	2/3	2/3	2/3	0/3	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	2/3	2/3	2/3	0/3	0/3	0/3	0/3
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/3	0/3	1/3	3/3	-	-	0/3	1/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	1/3	3/3	-	-	0/3	1/3	0/3

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (9/12)

Js-1

Practical Quantitation Limit		*0.02*	*0.1*	*0.08*	*0.2*	*0.5*	*0.05*	*0.05*	*0.005*	*0.005*
WHO Guideline		*3*	*1.5*	*0.5*	*0.3*	*-*	*-*	*200*	*0.01*	*0.02*
Bangladesh Standard		*1*	*0.5*	*0.1*	*1*	*75*	*35*	*200*	*0.05*	*0.1*
Parameter		**NO_2**	**NH_4**	**Mn**	**Fe**	**Ca**	**Mg**	**Na**	**Pb**	**Ni**
Minimum (mg/l)		<0.02	<0.1	0.13	0.66	65	21	51	<0.005	<0.005
Maximum (mg/l)		<0.02	0.28	1.2	13	84	33	66	<0.005	0.0071
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.16	0.66	7.5	77	28	56	<0.005	0.0053
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.15	0.53	5.8	77	27	56	<0.005	0.0053
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/2	0/2	2/2	1/2	2/2	0/2	0/2	0/2	0/2
	Monitoring	0/5	0/5	5/5	5/5	3/5	0/5	0/5	0/5	0/5
	Total	0/7	0/7	7/7	6/7	5/7	0/7	0/7	0/7	0/7
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/2	0/2	0/2	2/2	-	-	0/2	0/2	0/2
	Monitoring	0/5	0/5	5/5	5/5	-	-	0/5	0/5	0/5
	Total	0/7	0/7	5/7	7/7	-	-	0/7	0/7	0/7

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (10/12)

Js-1-4

Practical Quantitation Limit		*0.02*	*0.1*	*0.08*	*0.2*	*0.5*	*0.05*	*0.05*	*0.005*	*0.005*
WHO Guideline		*3*	*1.5*	*0.5*	*0.3*	*-*	*-*	*200*	*0.01*	*0.02*
Bangladesh Standard		*1*	*0.5*	*0.1*	*1*	*75*	*35*	*200*	*0.05*	*0.1*
Parameter		**NO_2**	**NH_4**	**Mn**	**Fe**	**Ca**	**Mg**	**Na**	**Pb**	**Ni**
Minimum (mg/l)		<0.02	0.11	<0.08	<0.2	9.76	16.14	64.79	<0.005	<0.005
Maximum (mg/l)		<0.02	0.14	1.3	4.7	80	21	83	<0.005	<0.005
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.13	0.68	2.7	56	19	71	<0.005	<0.005
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.13	0.41	1.4	40	19	71	<0.005	<0.005
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/3	0/3	2/3	2/3	2/3	0/3	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	2/3	2/3	2/3	0/3	0/3	0/3	0/3
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/3	0/3	2/3	2/3	-	-	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	2/3	2/3	-	-	0/3	0/3	0/3

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (11/12)

Js-2

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	0.13	0.86	67	23	67	<0.005	<0.005
Maximum (mg/l)		0.31	0.38	2.3	15	82	36	80	<0.005	<0.005
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.068	0.22	0.79	8.4	75	29	77	<0.005	<0.005
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.032	0.18	0.55	5.8	75	29	77	<0.005	<0.005
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/2	0/2	2/2	1/2	0/2	0/2	0/2	0/2	0/2
	Monitoring	0/4	0/4	4/4	4/4	3/4	1/4	0/4	0/4	0/4
	Total	0/6	0/6	6/6	5/6	3/6	1/6	0/6	0/6	0/6
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/2	0/2	0/2	2/2	-	-	0/2	0/2	0/2
	Monitoring	0/4	0/4	4/4	4/4	-	-	0/4	0/4	0/4
	Total	0/6	0/6	4/6	6/6	-	-	0/6	0/6	0/6

Table 5.5.9 Summarized results of Observation Wells and holes in Pourshava exceeding Bangladesh standard and WHO guideline (12/12)

Js-2-4

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	0.19	2.0	43	22	77	<0.005	<0.005
Maximum (mg/l)		0.040	<0.1	0.29	3.4	70	23	160	<0.005	0.012
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.027	<0.1	0.22	2.7	59	23	106	<0.005	0.0072
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.025	<0.1	0.22	2.7	58	23	100	<0.005	0.0066
No. of samples above BG Standard / No. of Total samples	Pumping Test	0/3	0/3	3/3	3/3	0/3	0/3	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	3/3	3/3	0/3	0/3	0/3	0/3	0/3
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	0/3	0/3	0/3	3/3	-	-	0/3	0/3	0/3
	Monitoring	-	-	-	-	-	-	-	-	-
	Total	0/3	0/3	0/3	3/3	-	-	0/3	0/3	0/3

Table 5.5.10 Summarized results of Observation Wells and holes in Model Rural Areas exceeding Bangladesh standard and WHO guideline (1/3)

Ch-CB

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	0.72	<0.08	0.79	35	23	14	<0.005	<0.005
Maximum (mg/l)		<0.02	1.8	0.51	15	110	43	27	<0.005	0.012
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	1.2	0.28	4.9	85	30	20	<0.005	0.0062
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		<0.02	1.1	0.22	3.4	80	29	19	<0.005	0.0059
No. of samples above BG Standard / No. of Total samples	Pumping Test	-	-	-	-	-	-	-	-	-
	Monitoring	0/7	7/7	5/7	6/7	5/7	1/7	0/7	0/7	0/7
	Total	0/7	7/7	5/7	6/7	5/7	1/7	0/7	0/7	0/7
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	-	-	-	-	-	-	-	-	-
	Monitoring	0/7	1/7	1/7	7/7	-	-	0/7	0/7	0/7
	Total	0/7	1/7	1/7	7/7	-	-	0/7	0/7	0/7

Table 5.5.10 Summarized results of Observation Wells and holes in Model Rural Areas exceeding Bangladesh standard and WHO guideline (2/3)

Jh-CB

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO_2	NH_4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	0.20	4.3	1.5	19	<0.005	<0.005
Maximum (mg/l)		<0.02	1.6	0.28	5.3	130	29	200	<0.005	0.010
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.95	0.15	2.6	95	22	62	<0.005	0.0060
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		<0.02	0.62	0.14	2.0	68	16	41	<0.005	0.0058
No. of samples above BG Standard / No. of Total samples	Pumping Test	-	-	-	-	-	-	-	-	-
	Monitoring	0/7	5/7	5/7	6/7	5/7	0/7	1/7	0/7	0/7
	Total	0/7	5/7	5/7	6/7	5/7	0/7	1/7	0/7	0/7
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	-	-	-	-	-	-	-	-	-
	Monitoring	0/7	2/7	0/7	6/7	-	-	1/7	0/7	0/7
	Total	0/7	2/7	0/7	6/7	-	-	1/7	0/7	0/7

Table 5.5.10 Summarized results of Observation Wells and holes in Model Rural Areas exceeding Bangladesh standard and WHO guideline (3/3)

Js-CB

Practical Quantitation Limit		0.02	0.1	0.08	0.2	0.5	0.05	0.05	0.005	0.005
WHO Guideline		3	1.5	0.5	0.3	-	-	200	0.01	0.02
Bangladesh Standard		1	0.5	0.1	1	75	35	200	0.05	0.1
Parameter		NO2	NH4	Mn	Fe	Ca	Mg	Na	Pb	Ni
Minimum (mg/l)		<0.02	<0.1	<0.08	<0.2	20	14	86	<0.005	<0.005
Maximum (mg/l)		2.2	1.1	0.20	0.70	27	17	140	<0.005	0.037
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		0.78	0.36	0.10	0.33	24	16	103	<0.005	0.011
Logarithminc Avarage assuming <PQL data has PQL value (mg/l)		0.19	0.22	0.094	0.30	24	16	102	<0.005	0.0075
No. of samples above BG Standard / No. of Total samples	Pumping Test	-	-	-	-	-	-	-	-	-
	Monitoring	2/7	2/7	1/7	0/7	0/7	0/7	0/7	0/7	0/7
	Total	2/7	2/7	1/7	0/7	0/7	0/7	0/7	0/7	0/7
No. of samples above WHO Guideline / No. of Total samples	Pumping Test	-	-	-	-	-	-	-	-	-
	Monitoring	0/7	0/7	0/7	3/7	-	-	0/7	0/7	1/7
	Total	0/7	0/7	0/7	3/7	-	-	0/7	0/7	1/7

Table 5.5.11 Results of Improved wells exceeding Bangladesh standard and WHO guideline

Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
WHO Guideline		-	-	-	-	1000	50	3	1.5	0.5	250	0.3	250	-	-	-	200	-	1.5	0.003	-	2	0.07	0.01	0.001	0.02	3	-
Bangladesh Standard		6.5-8.5	-	-	200-500	1000	10	1	0.5	0.1	400	1	600	600	75	35	200	12	1	0.005	0.05	1	0.1	0.05	0.05	0.1	5	4
Parameter		pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Minimum (mg/l)		6.79	23.6	50.0	47.3	256	<0.2	<0.02	<0.1	<0.08	<5	<0.2	<0.6	296	30	16	6.8	2.8	0.15	<0.0015	<0.025	<0.005	<0.01	<0.005	<0.001	<0.005	<0.005	<20
Maximum (mg/l)		7.88	31.3	94.9	164	608	3.8	2.5	8.4	0.46	<5	9.8	13	557	130	30	71	8.6	0.49	<0.0015	<0.025	0.015	0.025	0.015	<0.001	0.010	0.176	39
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		7.34	27.1	64.5	104	399	1.0	0.33	2.1	0.17	<5	2.5	4	396	82	21	31	4.6	0.34	<0.0015	<0.025	0.0054	0.012	0.0057	<0.001	0.0057	0.030	22
Logarithmic Avarage assuming <PQL data has PQL value (mg/l)		7.34	27.0	63.3	95.0	389	0.51	0.047	1.1	0.14	<5	1.7	2.6	386	72	21	24	4.4	0.32	<0.0015	<0.025	0.0052	0.012	0.0055	<0.001	0.0055	0.012	21
No. of samples above BG Standard / No. of Total samples	Chuadanga	0/12	-	-	0/12	0/12	0/12	3/12	8/12	12/12	0/12	12/12	0/12	0/12	12/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12
	Jhenaidah	0/12	-	-	0/12	0/12	0/12	0/12	12/12	7/12	0/12	12/12	0/12	0/12	12/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	4/12
	Jessore	0/12	-	-	0/12	0/12	0/12	3/12	8/12	4/12	0/12	3/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	0/12	1/12
	Total	0/36	-	-	0/36	0/36	0/36	6/36	28/36	23/36	0/36	27/36	0/36	0/36	24/36	0/36	0/36	0/36	0/36	0/36	0/36	0/36	0/36	0/36	0/36	0/36	0/36	5/36
No. of samples above WHO Guideline / No. of Total samples	Chuadanga	-	-	-	-	0/12	0/12	0/12	6/12	0/12	0/12	12/12	0/12	-	-	-	0/12	-	0/12	0/12	-	0/12	0/12	1/12	0/12	0/12	0/12	-
	Jhenaidah	-	-	-	-	0/12	0/12	0/12	8/12	0/12	0/12	12/12	0/12	-	-	-	0/12	-	0/12	0/12	-	0/12	0/12	0/12	0/12	0/12	0/12	-
	Jessore	-	-	-	-	0/12	0/12	0/12	6/12	0/12	0/12	8/12	0/12	-	-	-	0/12	-	0/12	0/12	-	0/12	0/12	1/12	0/12	0/12	0/12	-
	Total	-	-	-	-	0/36	0/36	0/36	20/36	0/36	0/36	32/36	0/36	-	-	-	0/36	-	0/36	0/36	-	0/36	0/36	2/36	0/36	0/36	0/36	-

Table 5.5.12 Results of Existing wells exceeding Bangladesh standard and WHO guideline

Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
WHO Guideline		-	-	-	-	1000	50	3	1.5	0.5	250	0.3	250	-	-	-	200	-	1.5	0.003	-	2	0.07	0.01	0.001	0.02	3	-
Bangladesh Standard		6.5-8.5	-	-	200-500	1000	10	1	0.5	0.1	400	1	600	600	75	35	200	12	1	0.005	0.05	1	0.1	0.05	0.05	0.1	5	4
Parameter		pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Minimum (mg/l)		6.20	22.9	26.6	48.1	170	<0.2	<0.02	<0.1	<0.08	<5	<0.2	0.71	200	13	6.1	1.5	0.81	0.20	<0.0015	<0.025	<0.005	<0.01	<0.005	<0.001	<0.005	<0.005	<20
Maximum (mg/l)		8.30	26.6	258	193	1650	180	4.2	20	1.5	46	11	570	720	160	45	400	8.9	1.7	0.0079	0.22	0.0086	0.018	0.047	<0.001	0.069	0.10	160
Arithmetic Avarage assuming <PQL data has PQL value (mg/l)		7.06	24.8	82	113	525	4.5	0.39	5.0	0.50	7.6	2.0	39	402	89	24	42	2.9	0.53	0.0021	0.069	0.0051	0.011	0.0078	<0.001	0.014	0.014	25.5
Logarithmic Avarage assuming <PQL data has PQL value (mg/l)		7.05	24.8	76.6	109	488	0.64	0.055	1.6	0.39	6.2	1.3	11	392	84	23	21	2.6	0.47	0.0018	0.046	0.0051	0.011	0.0063	<0.001	0.0087	0.0088	22.7
No. of samples above BG Standard / No. of Total samples	Rainy Season	1/30	-	-	0/30	2/30	3/30	5/30	9/30	25/30	0/30	13/30	0/30	1/30	23/30	2/30	1/30	0/30	4/30	5/30	21/30	0/30	0/30	0/30	0/30	0/30	0/30	4/30
	Dry Season	0/30	-	-	0/30	2/30	0/30	2/30	30/30	30/30	0/30	26/30	0/30	1/30	24/30	1/30	2/30	0/30	3/30	0/30	0/30	0/30	0/30	0/30	0/30	0/30	0/30	5/30
	Total	0/60	-	-	0/60	4/60	3/60	7/60	39/60	55/60	0/60	39/60	0/60	2/60	47/60	3/60	3/60	0/60	7/60	5/60	21/60	0/60	0/60	0/60	0/60	0/60	0/60	9/60
No. of samples above WHO Guideline / No. of Total samples	Rainy Season	-	-	-	-	2/30	1/30	3/30	7/30	10/30	0/30	23/30	1/30	-	-	-	1/30	-	0/30	8/30	-	0/30	0/30	4/30	0/30	14/30	0/30	-
	Dry Season	-	-	-	-	2/30	0/30	1/30	30/30	13/30	0/30	29/30	1/30	-	-	-	2/30	-	1/30	0/30	-	0/30	0/30	6/30	0/30	0/30	0/30	-
	Total	-	-	-	-	4/60	1/60	4/60	37/60	23/60	0/60	52/60	2/60	-	-	-	3/60	-	1/60	8/60	-	0/60	0/60	10/60	0/60	14/60	0/60	-

Table 5.5.13 Results of Existing Wells in Model Rural Areas exceeding Bangladesh standard and WHO guideline

Practical Quantitation Limit		0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
WHO Guideline		-	-	-	-	1000	50	3	1.5	0.5	250	0.3	250	-	-	-	200	-	1.5	0.003	-	2	0.07	0.01	0.001	0.02	3	-
Bangladesh Standard		6.5-8.5	-	-	200-500	1000	10	1	0.5	0.1	400	1	600	600	75	35	200	12	1	0.005	0.05	1	0.1	0.05	0.05	0.1	5	4
Parameter		pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Minimum (mg/l)		6.87	23.0	49.6	98.5	317	<0.2	<0.02	<0.1	<0.08	<5	0.31	1.3	350	79	13	6.5	1.2	<0.1	<0.0015	<0.025	<0.005	<0.01	<0.005	<0.001	<0.005	<0.005	<20
Maximum (mg/l)		7.29	25.3	267	155	1710	23	4.0	27	1.1	14	8.2	540	757	120	47	410	8.2	0.59	<0.0015	0.066	0.032	0.016	0.014	<0.001	0.029	0.0051	44
Arithmetic Avarage assuming <PQL data has PQL Value (mg/l)		7.08	24.2	125	128	800	4.4	0.84	4.4	0.36	5.7	2.2	140	482	99	30	120	4.4	0.38	<0.0015	0.030	0.0080	0.011	0.0066	<0.001	0.011	0.0050	25
Logarithmic Avarage assuming <PQL data has PQL value (mg/l)		7.08	24.2	101	127	649	0.75	0.090	1.5	0.20	5.4	1.5	23	471	98	28	36	3.9	0.35	<0.0015	0.028	0.0065	0.011	0.0060	<0.001	0.0087	0.0050	24
No. of samples above BG Standard / No. of Total samples	Chuadanga	0/5	-	-	0/5	0/5	3/5	4/5	1/5	5/5	0/5	3/5	0/5	0/5	5/5	0/5	0/5	0/5	0/5	0/5	1/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5
	Jhenaidah	0/5	-	-	0/5	0/5	1/5	0/5	5/5	2/5	0/5	2/5	0/5	0/5	5/5	0/5	0/5	0/5	0/5	0/5	1/5	0/5	0/5	0/5	0/5	0/5	0/5	3/5
	Jessore	0/5	-	-	0/5	5/5	0/5	0/5	5/5	0/5	0/5	4/5	0/5	2/5	5/5	5/5	5/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	0/5	1/5
	Total	0/15	-	-	0/15	5/15	4/15	4/15	11/15	7/15	0/15	9/15	0/15	2/15	15/15	5/15	5/15	0/15	0/15	0/15	2/15	0/15	0/15	0/15	0/15	0/15	0/15	4/15
No. of samples above WHO Guideline / No. of Total samples	Chuadanga	-	-	-	-	0/5	0/5	2/5	1/5	4/5	0/5	5/5	0/5	-	-	-	0/5	-	0/5	0/5	-	0/5	0/5	1/5	0/5	1/5	0/5	-
	Jhenaidah	-	-	-	-	0/5	0/5	0/5	5/5	0/5	0/5	5/5	0/5	-	-	-	0/5	-	0/5	0/5	-	0/5	0/5	1/5	0/5	1/5	0/5	-
	Jessore	-	-	-	-	5/5	0/5	0/5	5/5	0/5	0/5	5/5	5/5	-	-	-	5/5	-	0/5	0/5	-	0/5	0/5	0/5	0/5	1/5	0/5	-
	Total	-	-	-	-	5/15	0/15	2/15	11/15	4/15	0/15	15/15	5/15	-	-	-	5/15	-	0/15	0/15	-	0/15	0/15	2/15	0/15	3/15	0/15	-

Table 5.5.14 Results of Pond Water in the Model Rural Areas exceeding Bangladesh standard and WHO guideline

Practical Quantitation Limit	.0	0 Deg C	0.02	0.5	0.13	0.2	0.02	0.1	0.08	5	0.2	0.6	20	.0.5	0.05	0.05	0.1	0.1	0.0015	0.025	0.005	0.01	0.005	0.001	0.005	0.005	20
WHO Guideline	-	-	-	-	1000	50	3	1.5	0.5	250	0.3	250	-	-	-	200	-	1.5	0.003	-	2	0.07	0.01	0.001	0.02	3	-
Bangladesh Standard	6.5-8.5	-	-	200-500	1000	10	1	0.5	0.1	400	1	600	600	75	35	200	12	1	0.005	0.05	1	0.1	0.05	0.05	0.1	5	4
Parameter	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD
Minimum (mg/l)	6.97	21.9	11.1	16.6	71.1	<0.2	<0.02	<0.1	<0.08	<5	<0.2	2.3	67.8	14	0.20	2.7	2.0	0.26	<0.0015	<0.025	<0.005	<0.01	<0.005	<0.001	<0.005	<0.005	<20
Maximum (mg/l)	7.95	24.3	96.6	75.0	618	42	6.6	4.8	0.16	8.0	<0.2	97	256	55	17	46	62	3.6	<0.0015	<0.025	0.0070	0.052	0.011	<0.001	0.0090	0.011	78
Arithmetic Avarage assuming <PQL data has PQL Value (mg/l)	7.46	23.4	39.0	37.5	250	4.5	0.64	0.68	0.085	6.0	<0.2	22	161	29	9.0	24	12	0.83	<0.0015	<0.025	0.0051	0.020	0.0052	<0.001	0.0057	0.0055	34
Logarithmic Avarage assuming <PQL data has PQL value (mg/l)	7.48	23.4	35.7	35.4	229	1.1	0.084	0.44	0.084	5.9	<0.2	13	155	28	7.1	19	7.1	0.59	<0.0015	<0.025	0.0051	0.018	0.0051	<0.001	0.0056	0.0054	29
No of samples above BG Standard / No. of Total samples	0/27	-	-	0/27	0/27	4/27	3/27	9/27	2/27	0/27	0/27	0/27	0/27	0/27	0/27	0/27	5/27	7/27	0/27	0/27	0/27	0/27	0/27	0/27	0/27	0/27	10/27
No of samples above WHO Guideline / No. of Total samples	-	-	-	-	0/27	0/27	2/27	2/27	0/27	0/27	0/27	0/27	-	-	-	0/27	-	5/27	0/27	-	0/27	0/27	1/27	0/27	0/27	0/27	-

Table 5.5.15(1/2) Deep wells (300m in depth) – Explanation of samples containing general water quality parameters exceeding standard values

Samples taken from deep groundwater observation holes/wells in Pourashava and deep groundwater observation holes in model villages

Item	Standard value (mg/l)		Remarks	No. of samples exceeding the standard	Conditions of occurrence
NO_2	Bangladesh	1	･The Bangladesh value is lower than the WHO value. ･The WHO guideline value is based on health. impact	2	Sporadically found in observation holes of model village in Jessore.
	WHO	3		0	
NH_3	Bangladesh	0.5	･The Bangladesh value is lower than the WHO value. ･A WHO guideline value based on health has not been set. The standard (1.5mg/l) is based on a level that is likely to give rise to complaints due to taste, odor, etc.	17	Continually found in observation holes of model villages in Jhenaidah and Chuadanga. Sporadically found in other observation wells/holes.
	WHO	(1.5)*		3	
Mn	Bangladesh	0.1	･The Bangladesh value is lower than the WHO value. ･The WHO guideline value of 0.5mg/l is a health- based value; a standard of 0.1mg/l has been set based on a level likely to give rise to complaints due to taste, odor , etc.	50	Sporadically found in observation holes of the model villages in Chuadanga. Continually found in other observation wells/holes.
	WHO	0.5		15	
Fe	Bangladesh	1	･WHO has not set a health-based guideline value. The standard (.0.3mg/l) is based on a level that is likely to give rise to complaints due to taste, odor, etc.	67	Continually found in all observation wells/holes..
	WHO	(0.3)*		79	

*The WHO guideline values placed in "( )" are levels likely to give rise to complaints due to taste, odor, etc. The others are health-based guideline values.

Table 5.5.15(2/2) Deep wells (300m in depth) – Explanation of samples containing general water quality parameters exceeding standard values

Samples taken from deep groundwater observation holes/wells in Pourashava and deep groundwater observation holes in model villages

Item	Standard value (mg/l)		Remarks	No. of samples exceeding the standard	Conditions of occurrence
Ca	Bangladesh	75	・A WHO guideline value based on health has not been set.	52	Continually found in all observation wells/holes.
	WHO	–		–	
Mg	Bangladesh	35	・A WHO guideline value based on health has not been set.	16	Distributed in concentration areas in observation wells of Jhenaidah.
	WHO	–		–	
Na	Bangladesh	200	・A WHO guideline value based on health has not been set.	1	Only found in one sample from an observation hole in a model village in Jhenaidah.
	WHO	–		–	
Pb	Bangladesh	0.05	・The Bangladesh standard is higher than the WHO value	0	Sporadic.
	WHO	0.01	・A WHO guideline value based on health has been set.	3	
Ni	Bangladesh	0.1	・The Bangladesh standard is higher than the WHO value	0	Only found in one sample from an observation hole in a model village in Jessore.
	WHO	0.02	・A WHO guideline value based on health has been set.	1	
COD	Bangladesh	4	・A WHO guideline value based on health has not been set.	13	Sporadic.
	WHO	–		–	

Table 5.5.16 Deep wells (300m in depth) – Explanation of samples containing general water quality parameters exceeding standard values

Samples taken from deep groundwater observation holes/wells in Pourashava and deep groundwater observation holes in model villages

Item	Presumed method of treatment	Remarks
NO_2	None in particular.	･Exceeds the Bangladesh standard but is less than 3mg/l, impact on human body is small
NH_3	None in particular.	･No impact on the human body
Mn	Coagulating sedimentation by oxidizing agent (Cl_2、$KMnO_4$) and filtering	･Considering water quality conditions in Bangladesh, it would be difficult to find groundwater sources with Mn levels less than 0.1mg/l. ･Removal of Mn is difficult. Removal by aeration without chemicals is less effective than for Fe ･The previously mentioned method could meet the standard of 0.5mg/l, but is economically and operationally difficult.
Fe	Aeration filtration	･There are many observation holes that continually exceed the Bangladesh standard but they do not impact health. ･With the previously mentioned method, many water sources are thought to be able to achieve iron levels of 1mg/l.
Ca	Coagulating sedimentation by alkali treatment	･There are many observation holes that continually exceed the Bangladesh standard but they do not impact health. ･The previously mentioned treatment method would be economically and operationally difficult
Mg	Coagulating sedimentation by alkali treatment	･There are observation wells in concentrated areas that exceed the Bangladesh standard but they do not impact health ･The previously mentioned treatment method would be economically and operationally difficult
Na	None in particular.	･It is thought that complaints about the taste will arise but there is no impact on health.
Pb	Coagulating filtration	･Although levels slightly exceed the WHO value, they are not over the Bangladesh standard. ･Because of the low concentration, complete removal by treatment is difficult.
Ni	Coagulation filtration	･Although levels slightly exceed the WHO value, they are not over the Bangladesh standard. ･Because of the low concentration, complete removal by treatment is difficult.
COD	Biological treatment+ nitrification and denitrification	･The high COD concentrations are because groundwater in Bangladesh is in a highly reducing state.

Table 5.5.17 Results of Observation Holes (Re-analysis)

Sample No	Date	EC (mS/m)	pH	ORP(Eh)	Temp(℃)
OH-JS1-4	15-Sep-02	88.8	7.14	78.5	26.2
OH-JS2-4	15-Sep-02	90.2	7.16	77.4	26.3
CB-JSRb	16-Sep-02	66.1	7.47	94.4	26.3
OH-JH2-4	13-Sep-02	82.5	6.89	111	26.1
OH-CH1-4	14-Sep-02	87.2	7.14	70.5	26.2
OH-CH2-4	14-Sep-02	73.5	7.16	95.5	26.2
CB-CDBd	13-Sep-02	90.4	7.35	124	26.3

Analyte	pH	Temperature	Conductivity	Hardness	TDS	Nitrate	Nitrite	Ammonium	Dissolved Mn	Sulfate	Dissolved Fe	Chloride	Bicarbonate
Method	pH meter	Thermo meter	Conductivity meter	Standard	Standard	SP	SP	IC	FAAS	IC	FAAS	Titration	IR
Practical Quantitation Limit			1	1	10	0.1	0.1	0.1	0.1	1	0.2	0.1	0.5
Unit		Deg C	mS/m	mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg $CaCO_3$/L
Sample No	pH	Temp	EC	Hardness	TDS	NO_3	NO_2	NH_4	Mn	SO_4	Fe	Cl	HCO_3
OH-JS1-4	7.4	22.5	81.9	310	470	<PQL	<PQL	<PQL	0.40	<PQL	3.6	7.3	520
OH-JS2-4	7.3	22.5	81.9	300	510	<PQL	<PQL	<PQL	0.30	<PQL	2.1	37	473
CB-JSRb	7.8	22.5	62.3	140	320	<PQL	1.7	<PQL	<PQL	<PQL	<PQL	18	360
OH-JH2-4	7.1	22.5	75.8	420	450	<PQL	<PQL	<PQL	0.60	2	3.2	1.4	463
OH-CH1-4	7.3	22.5	76.0	390	450	<PQL	<PQL	0.2	0.50	<PQL	3.4	0.9	488
OH-CH2-4	7.4	22.5	72.6	380	430	<PQL	<PQL	0.1	0.30	<PQL	2.3	4.2	454
CB-CDBd	7.2	22.5	81.4	380	490	<PQL	<PQL	0.4	<PQL	<PQL	[illegible]	1.2	509

Analyte	Calcium	Magnesium	Sodium	Potassium	Fluoride	Cadmium	Total Cr	Copper	Cyanide	Lead	Mercury	Nickel	Zinc	COD	As
Method	FAAS	FAAS	FAAS	FAAS	SP	FAAS	FAAS	FAAS	SP	FAAS	FAAS	FAAS	FAAS	Titration	FAAS
Practical Quantitation Limit	0.5	0.5	0.5	0.5	0.05	0.005	0.02	0.01	0.01	0.01	0.0005	0.06	0.01	2	0.001
Unit	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Sample No	Ca	Mg	Na	K	F	Cd	Cr	Cu	CN	Pb	Hg	Ni	Zn	COD	As
OH-JS1-4	53	32	48	5.0	0.11	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.01	4	0.002
OH-JS2-4	57	29	88	4.8	0.18	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.02	3	0.002
CB-JSRb	26	25	91	3.3	0.15	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.02	5	<PQL
OH-JH2-4	81	32	19	4.3	0.15	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.05	<PQL	0.011
OH-CH1-4	81	32	16	4.8	0.10	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.01	3	0.011
OH-CH2-4	71	30	15	4.5	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.02	3	0.002
CB-CDBd	62	38	17	4.3	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	<PQL	0.18	<PQL	0.001

Excess of WHO guideline   Excess of Bangladesh Standard   Excess of both Bangladesh Standard and WHO guideline

(The values were determined as exceeding the standards before rounding off)

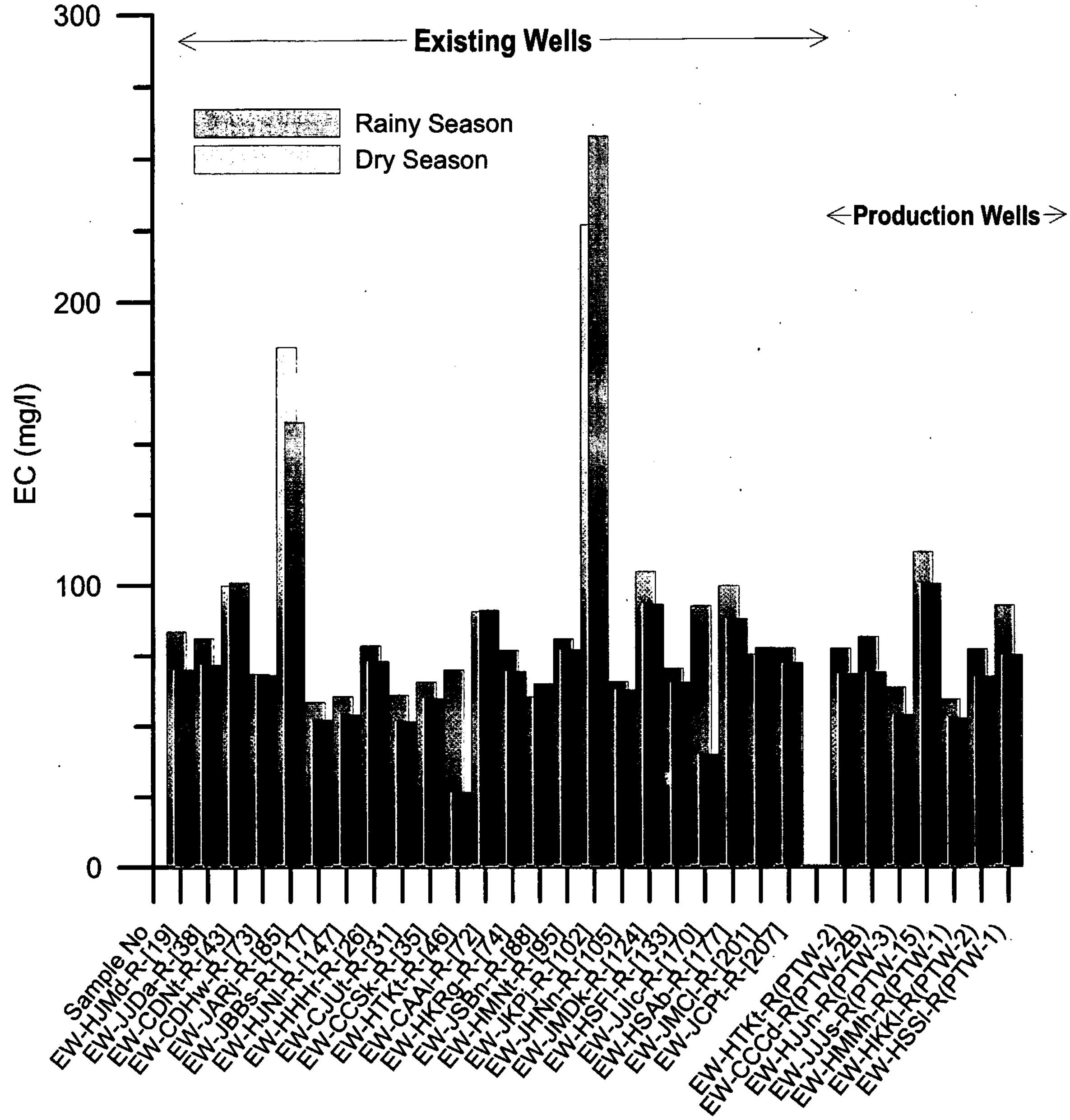

Figure 5.5.1	EC Data Comparison between Rainy Season and Dry Season for Existing Wells

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

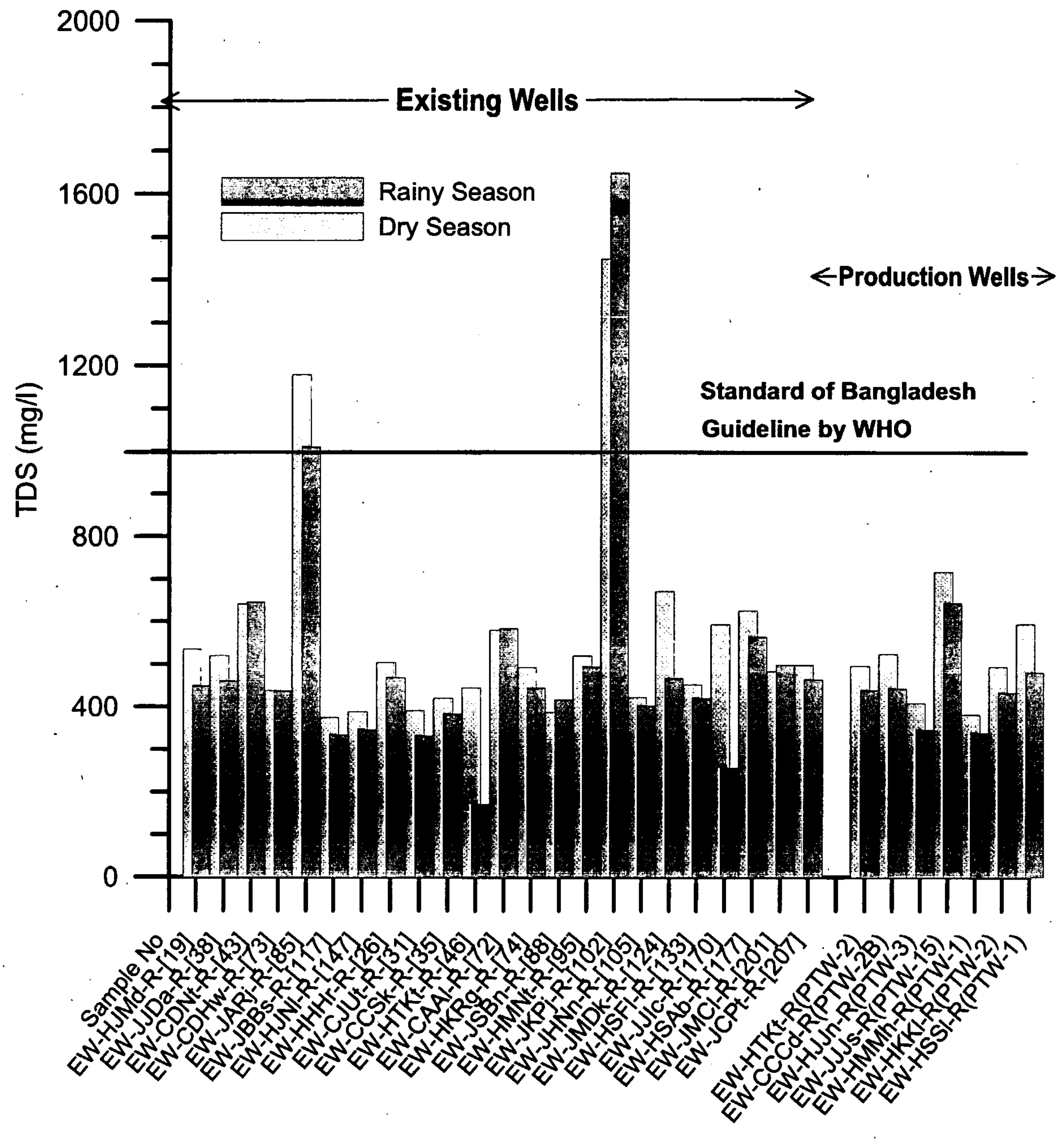

Figure 5.5.2	TDS Data Comparison between Rainy Season and Dry Season for Existing Wells

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

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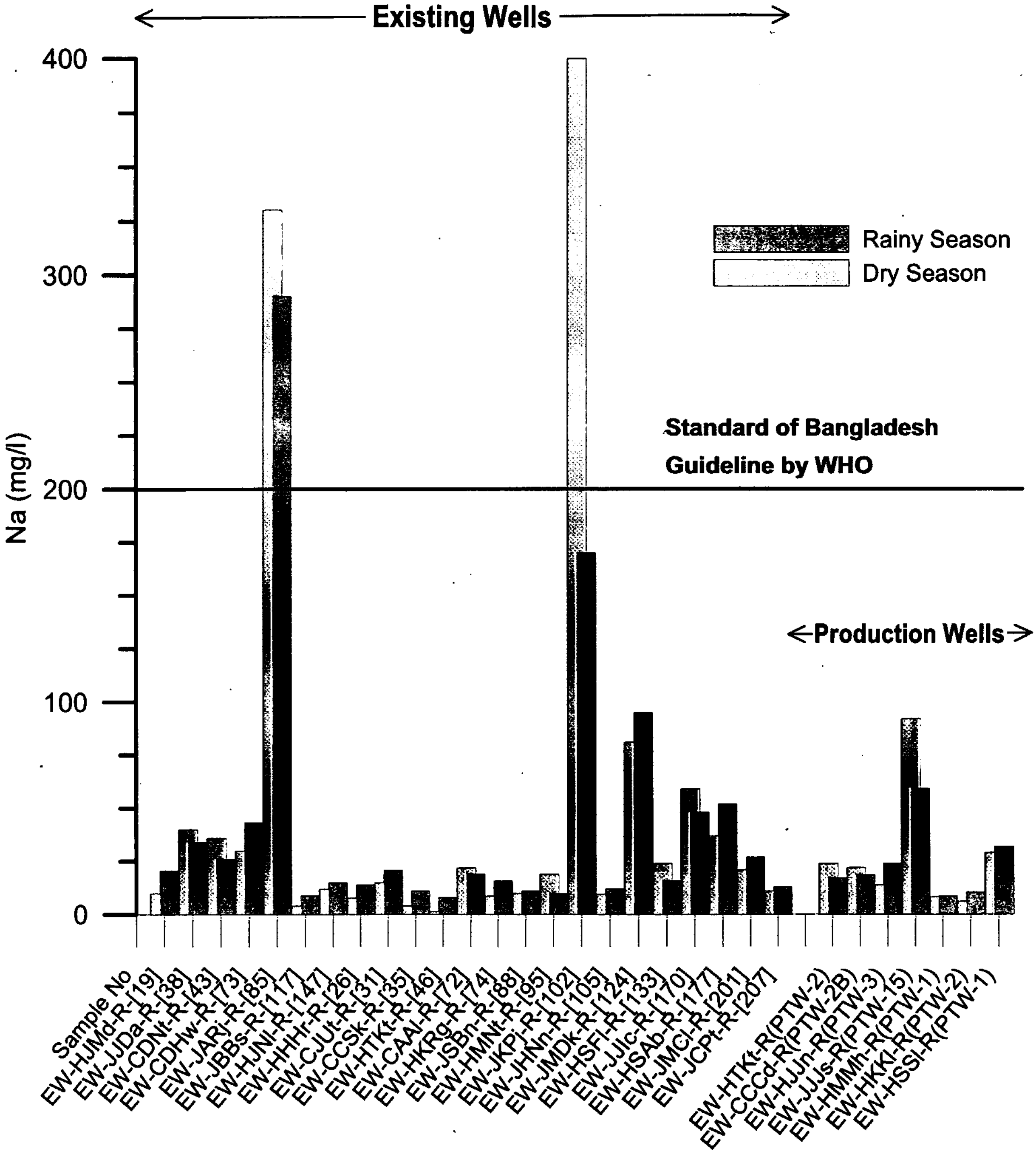

Figure 5.5.3	Na Data Comparison between Rainy Season and Dry Season for Existing Wells

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

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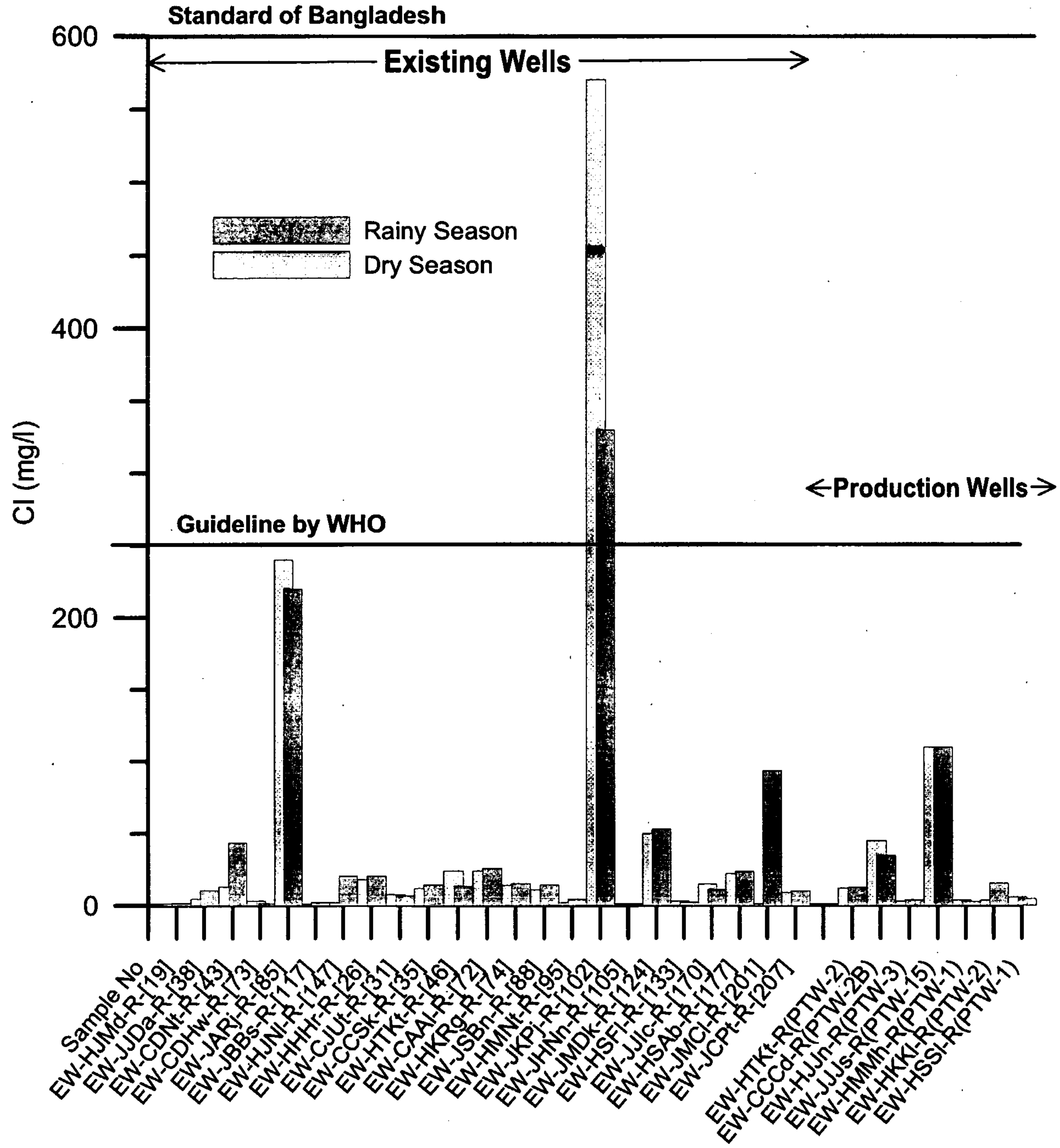


Figure 5.5.4	Cl Data Comparison between Rainy Season and Dry Season for Existing Wells
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

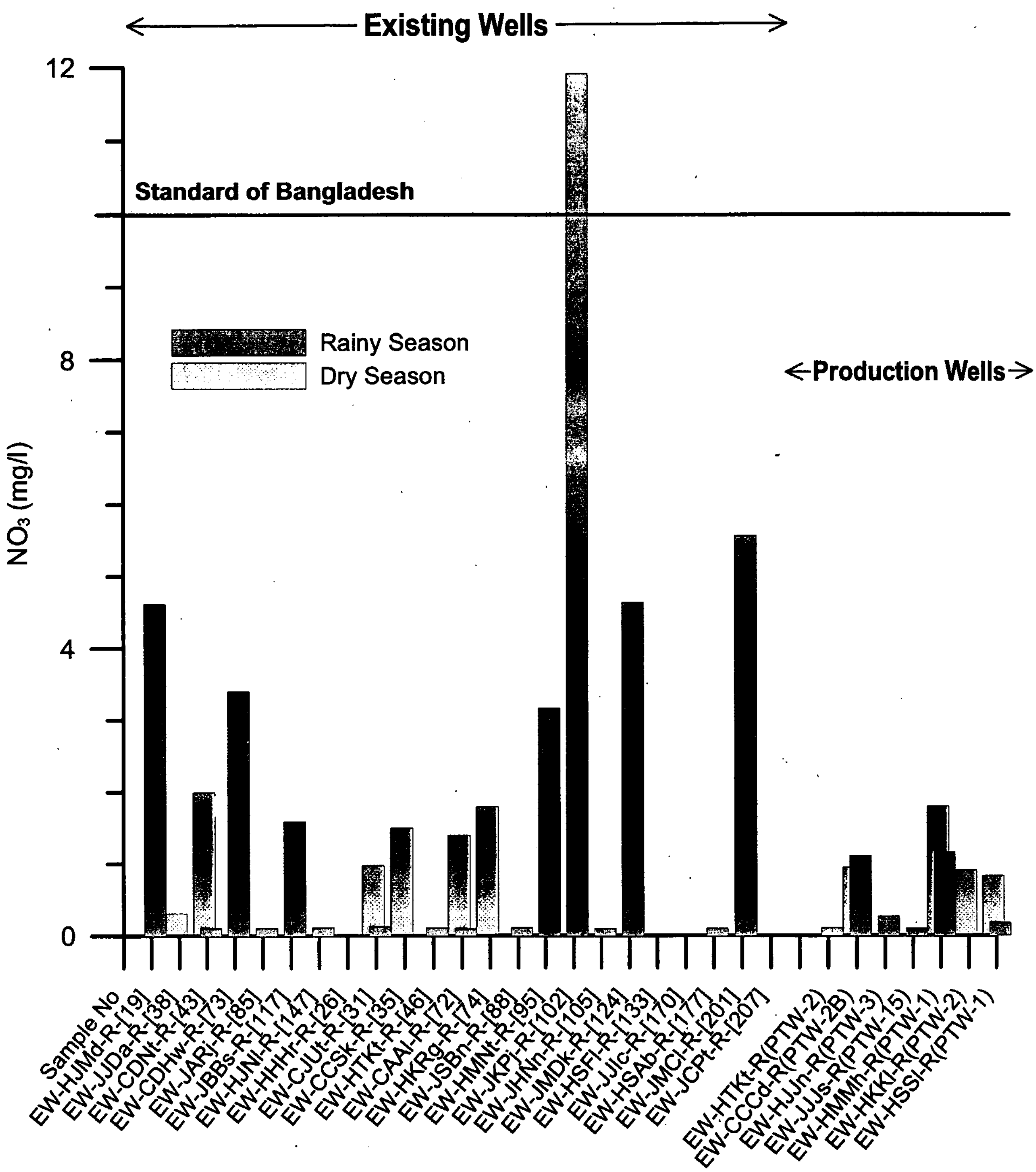


Figure 5.5.5	**NO_3 Data Comparison between Rainy Season and Dry Season for Existing Wells**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

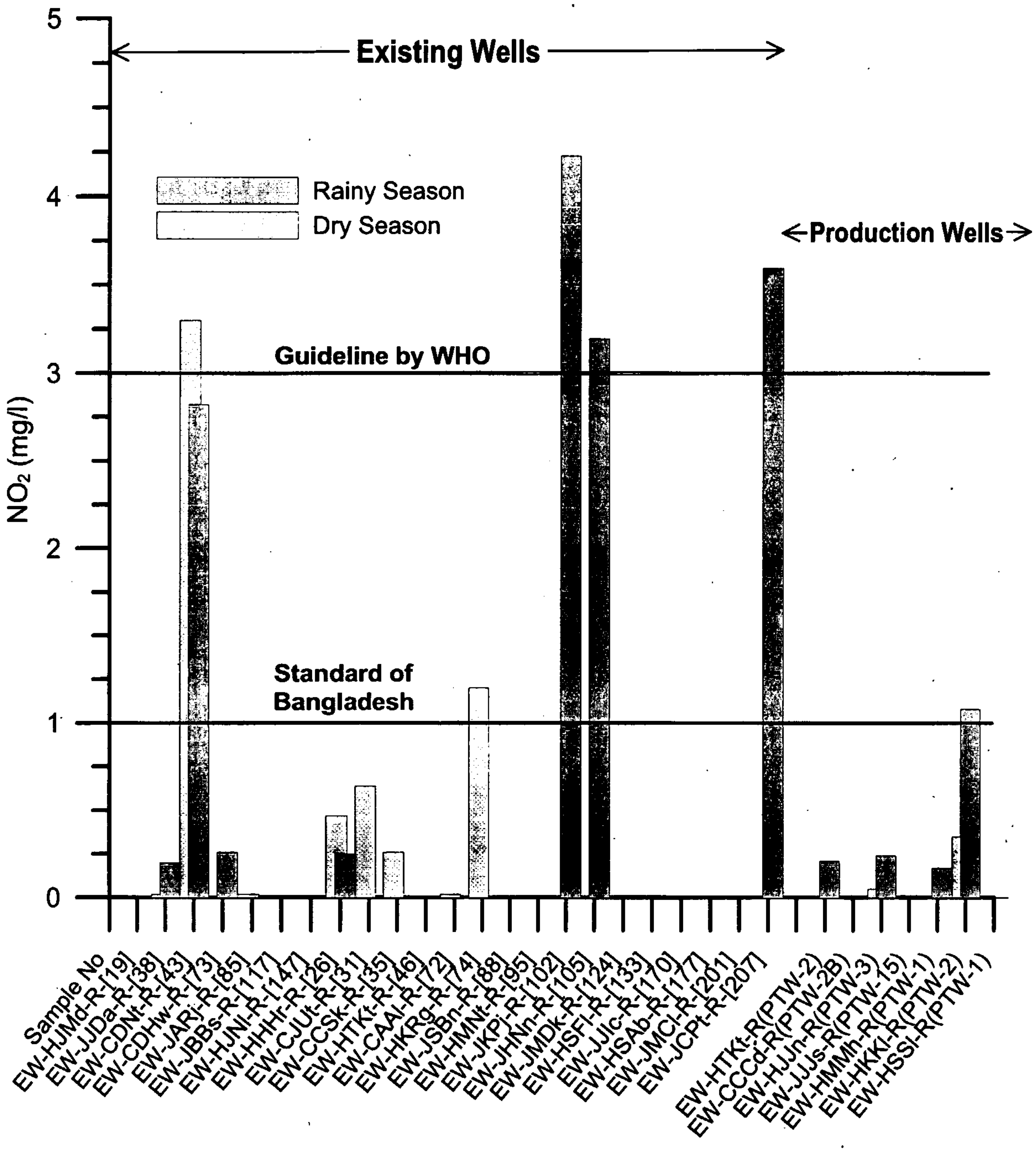


Figure 5.5.6	NO_2 Data Comparison between Rainy Season and Dry Season for Existing Wells
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

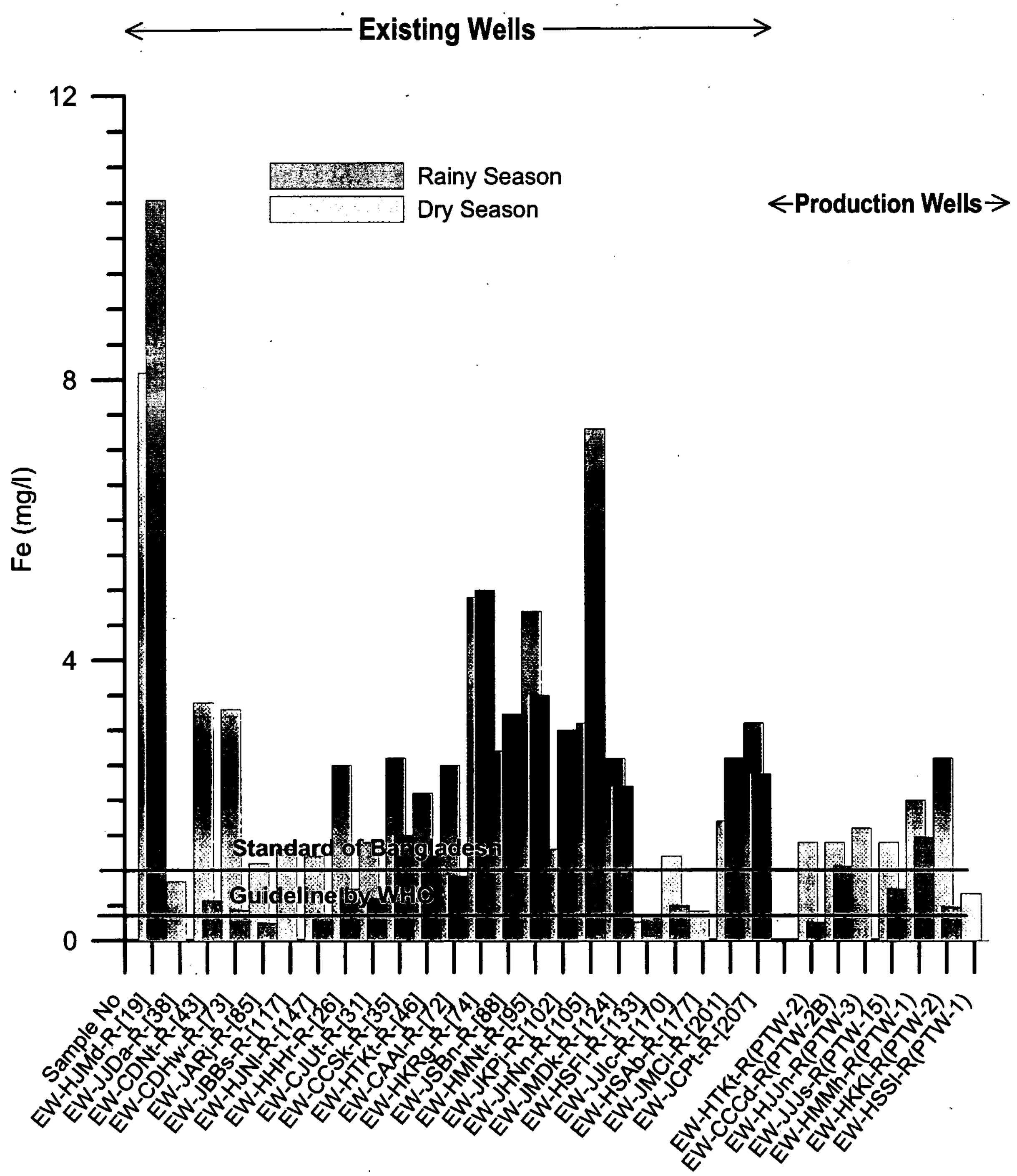


Figure 5.5.7	Fe Data Comparison between Rainy Season and Dry Season for Existing Wells
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

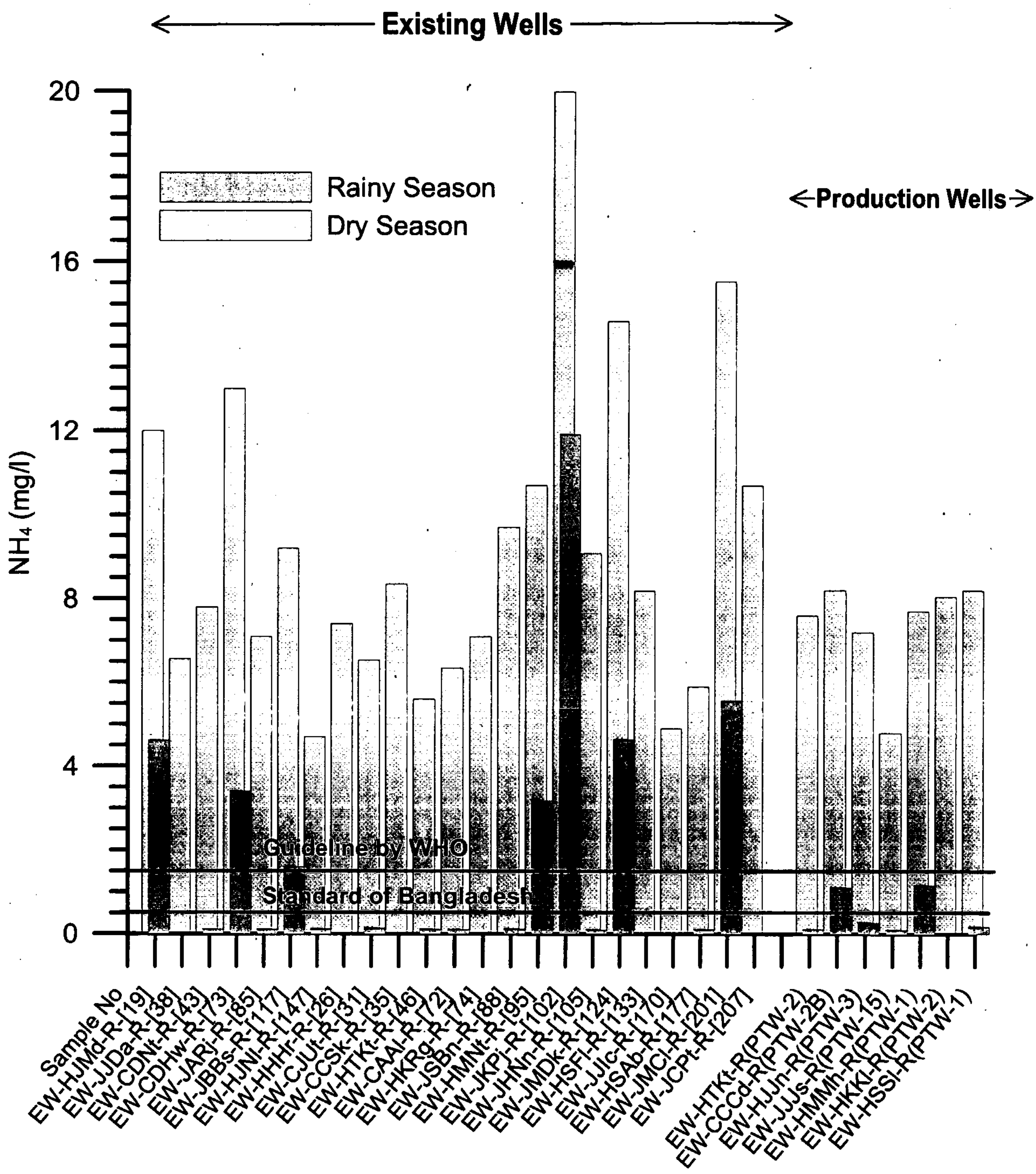


Figure 5.5.8	**NH_4 Data Comparison between Rainy Season and Dry Season for Existing Wells**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

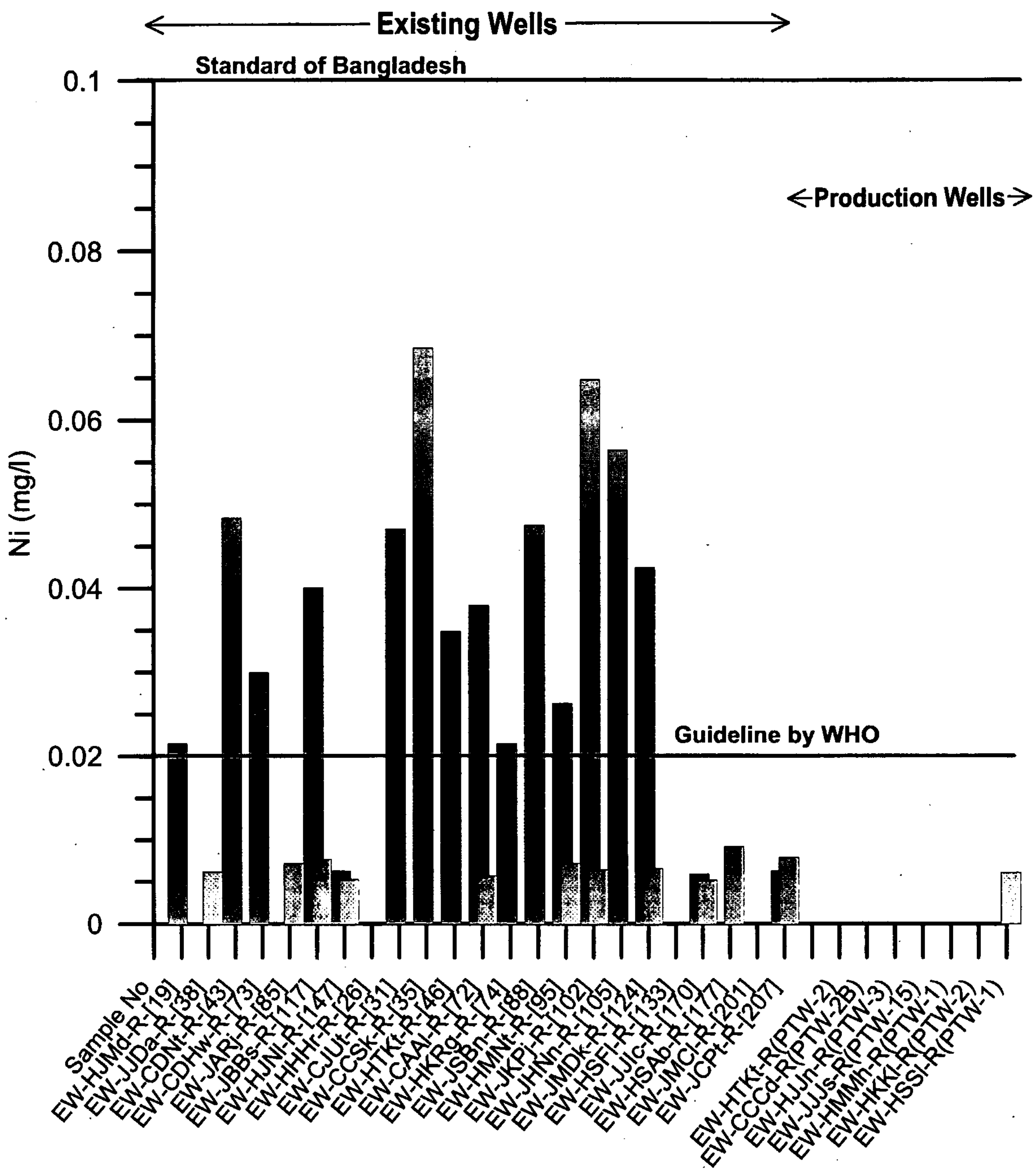


Figure 5.5.9	Ni Data Comparison between Rainy Season and Dry Season for Existing Wells
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

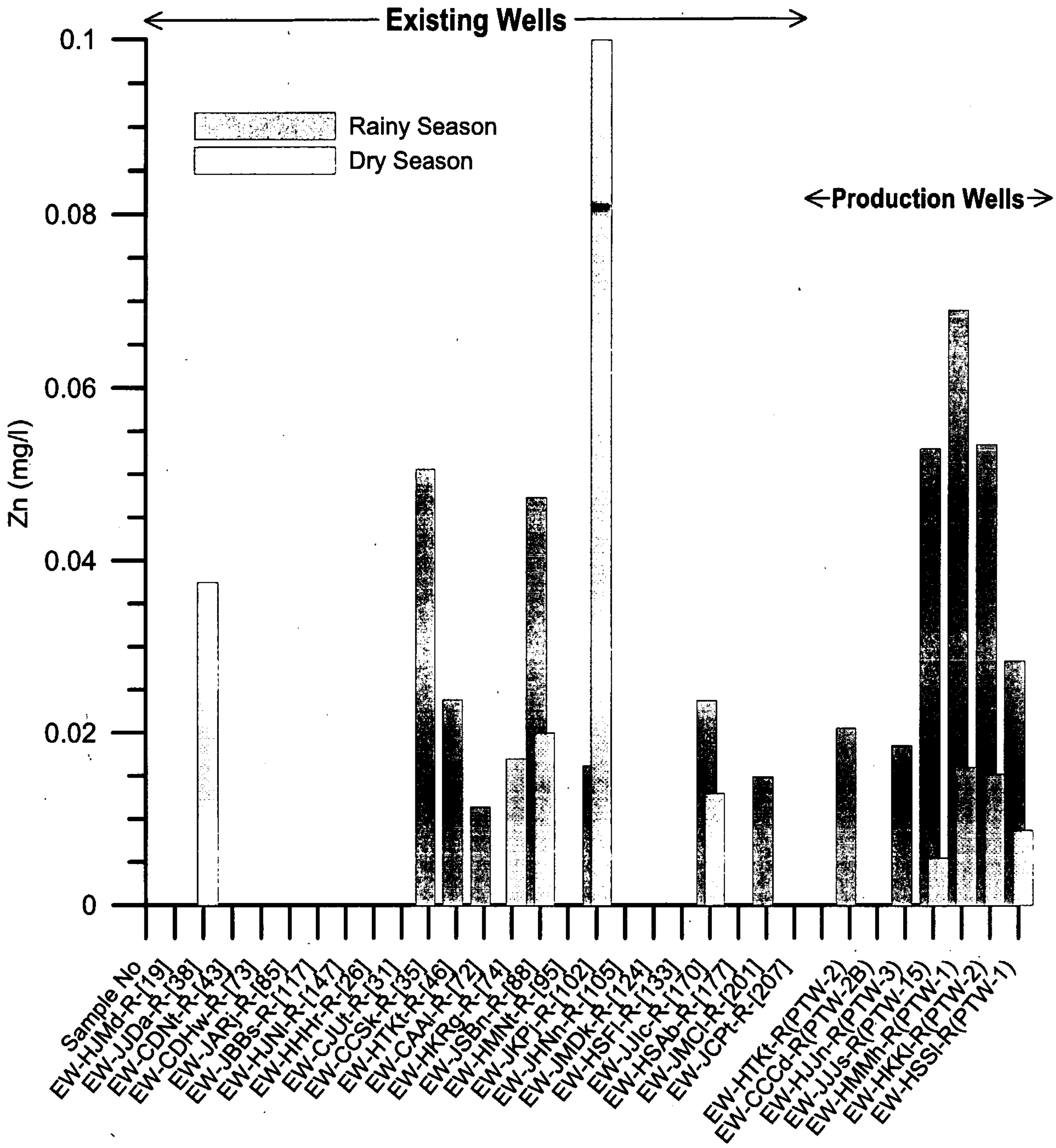


Figure 5.5.10	Zn Data Comparison between Rainy Season and Dry Season for Existing Wells

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

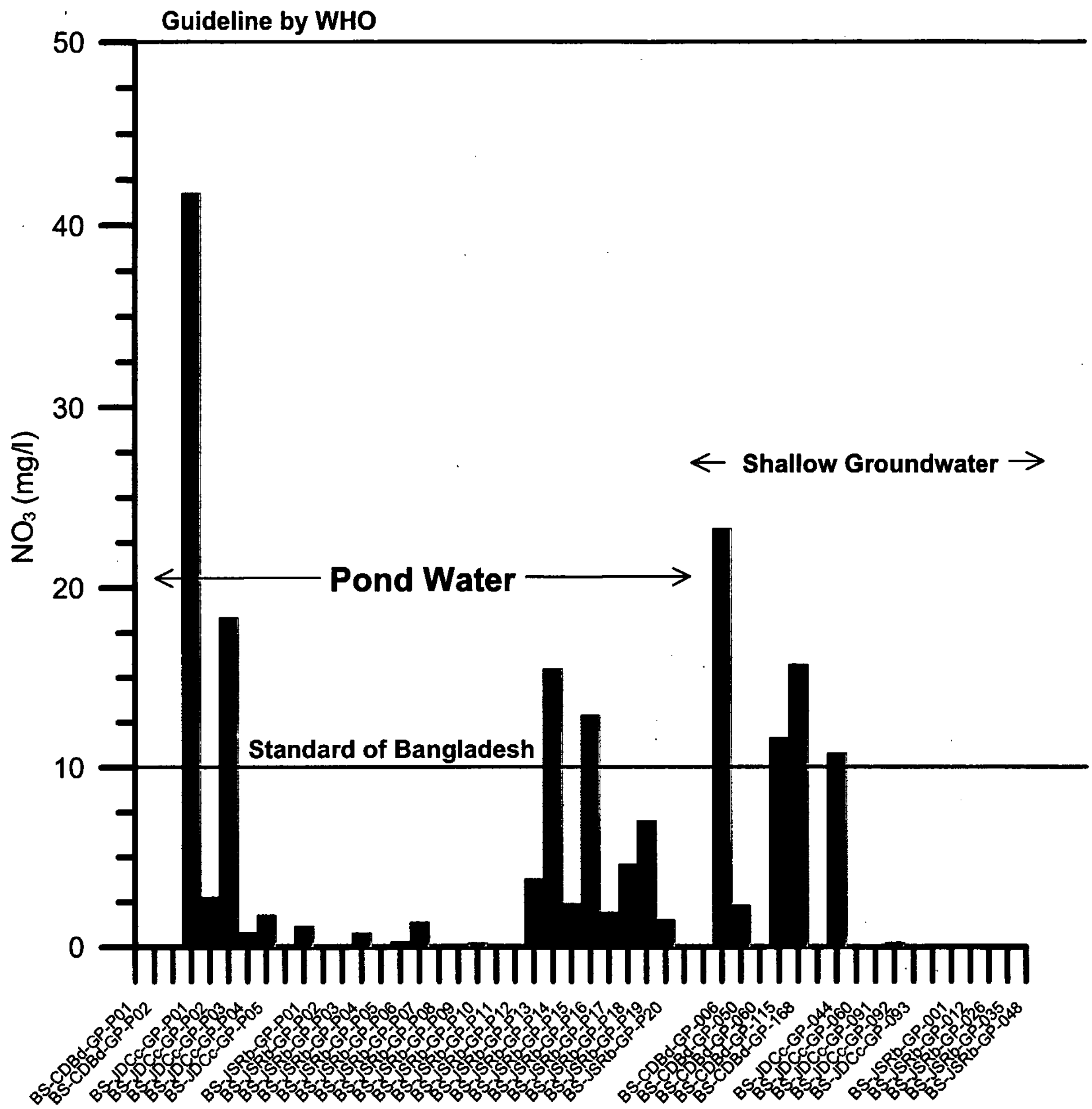


Figure 5.5.11	NO_3 Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

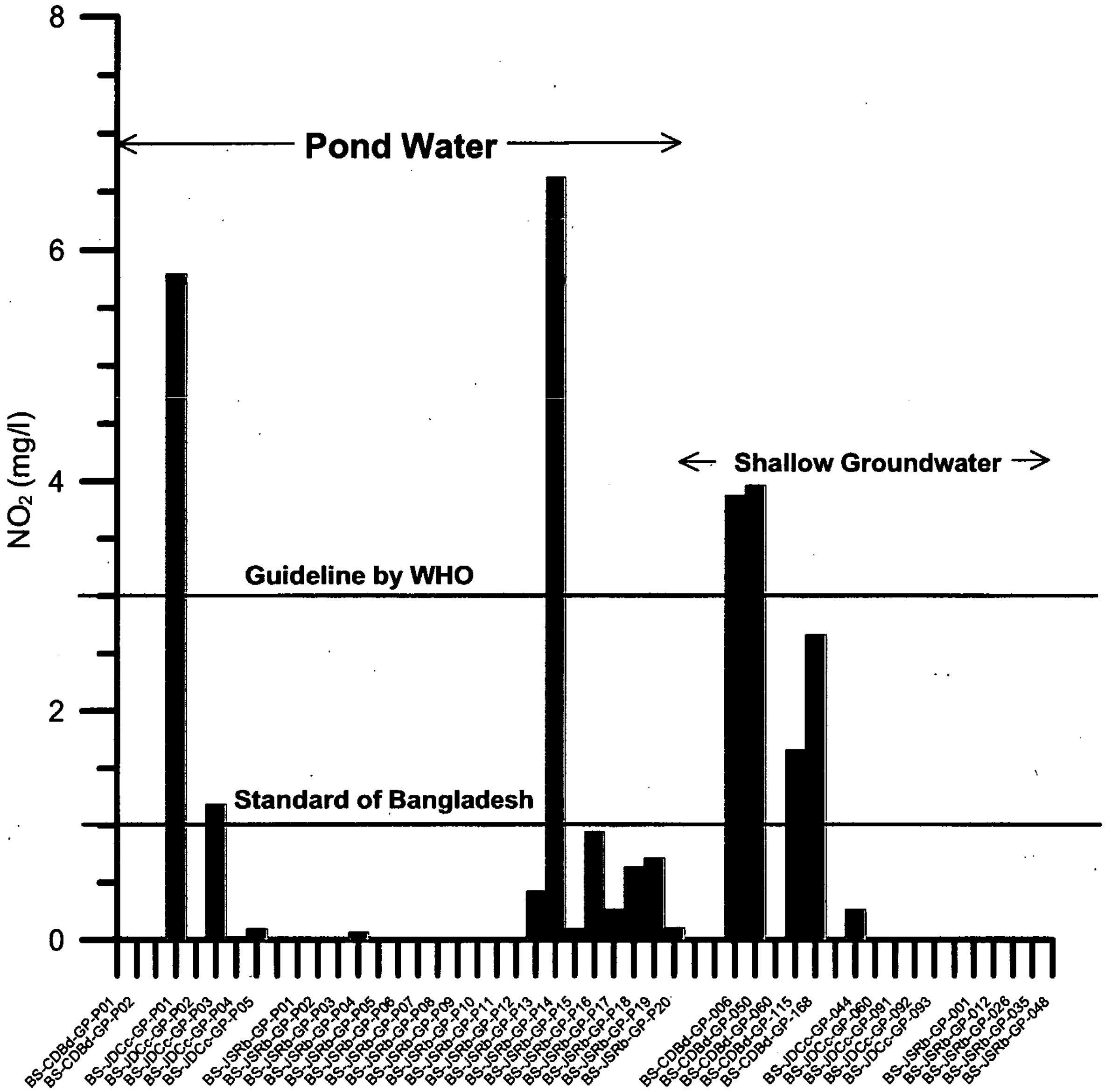


Figure 5.5.12	NO_2 Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

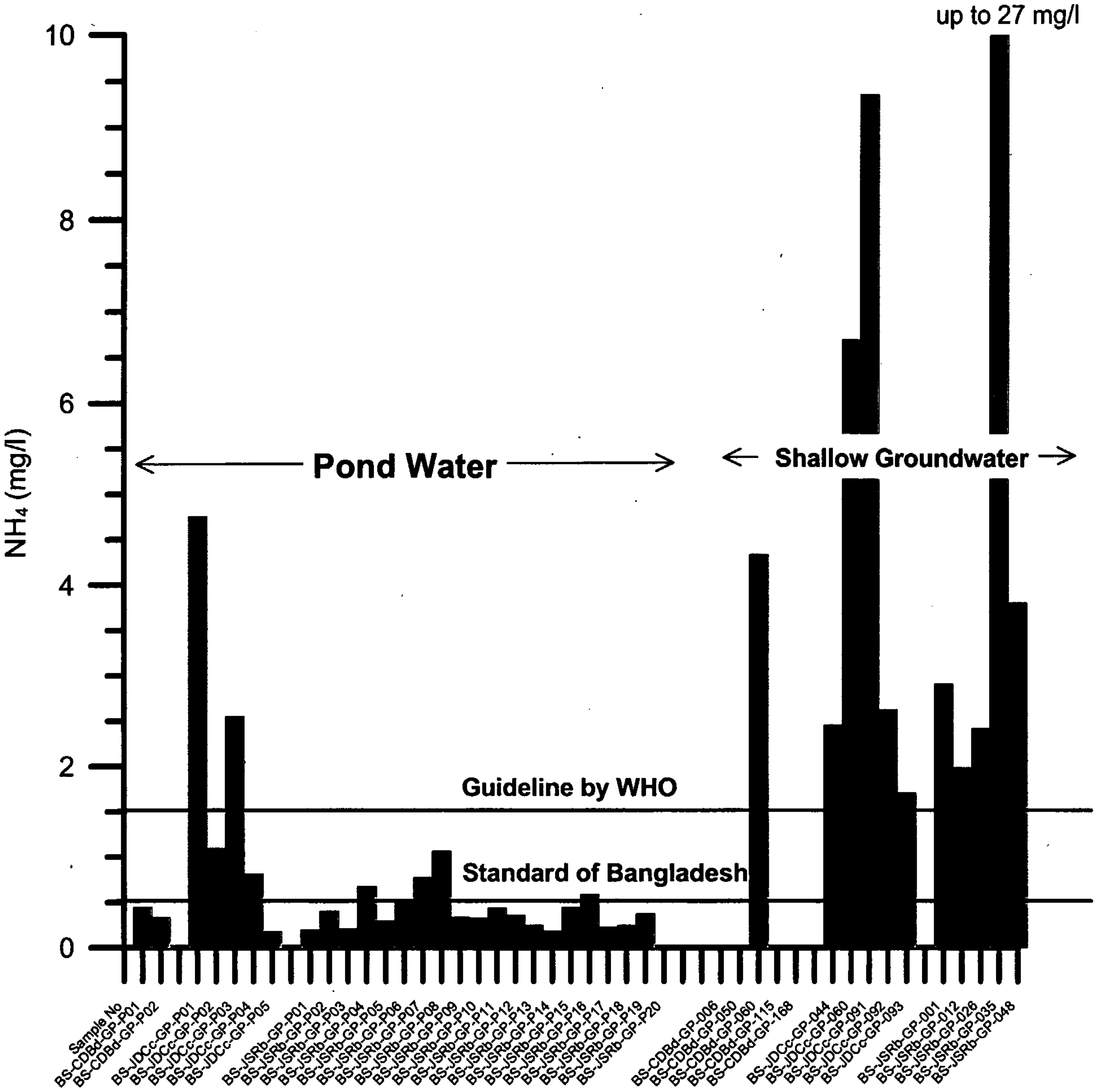


Figure 5.5.13	NH_4 Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

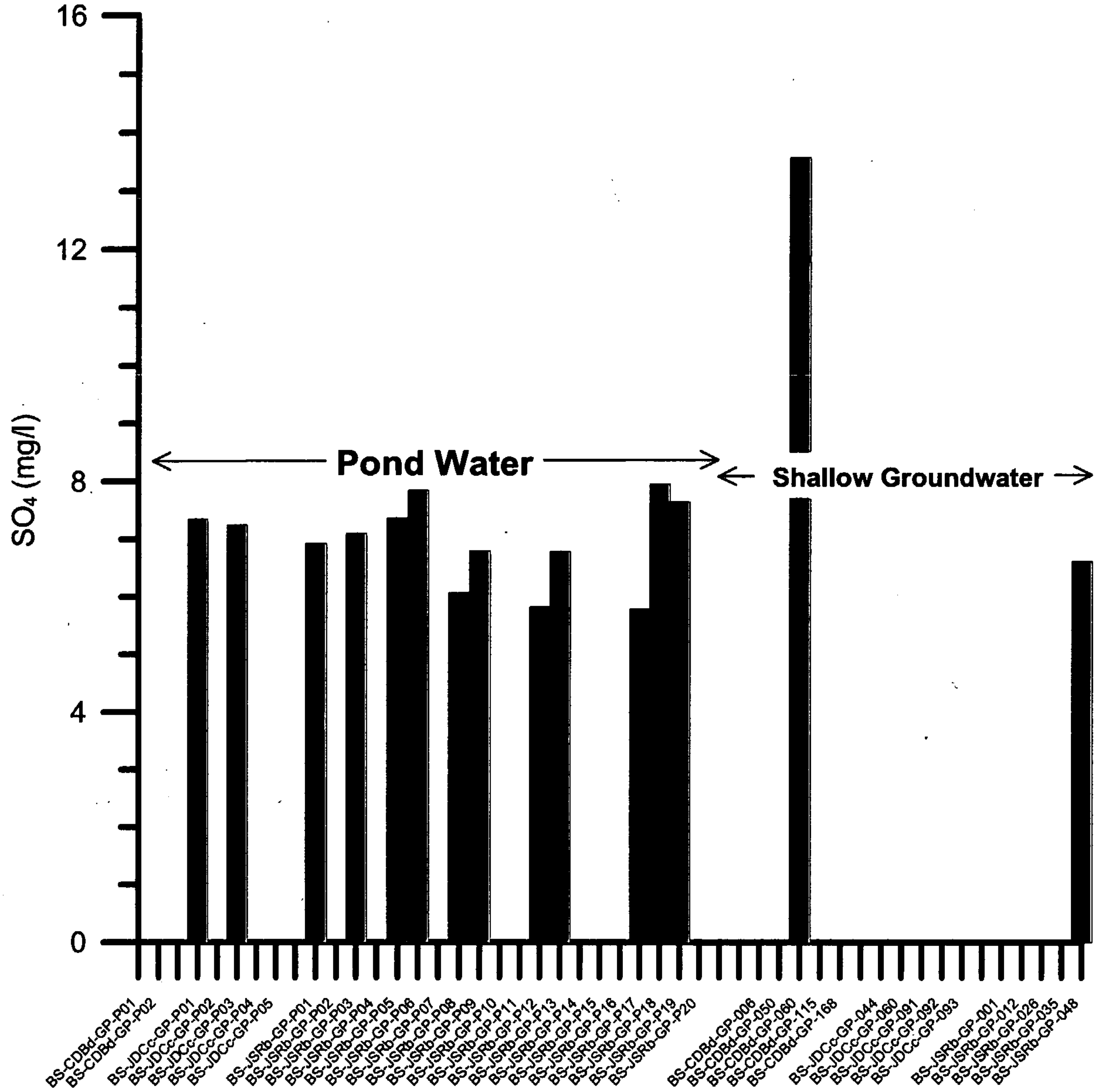


Figure 5.5.14	**SO_4 Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

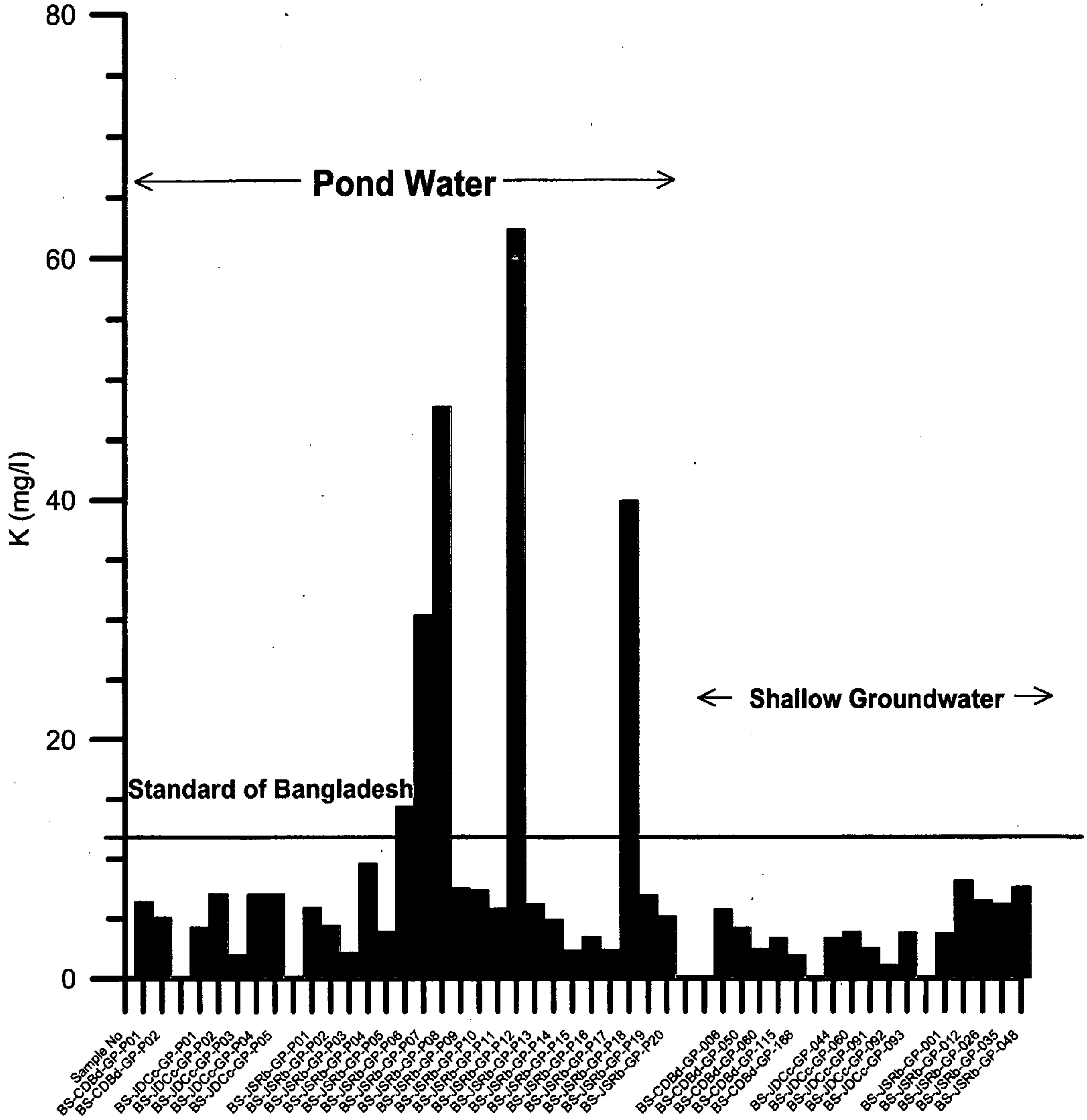


Figure 5.5.15	K Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

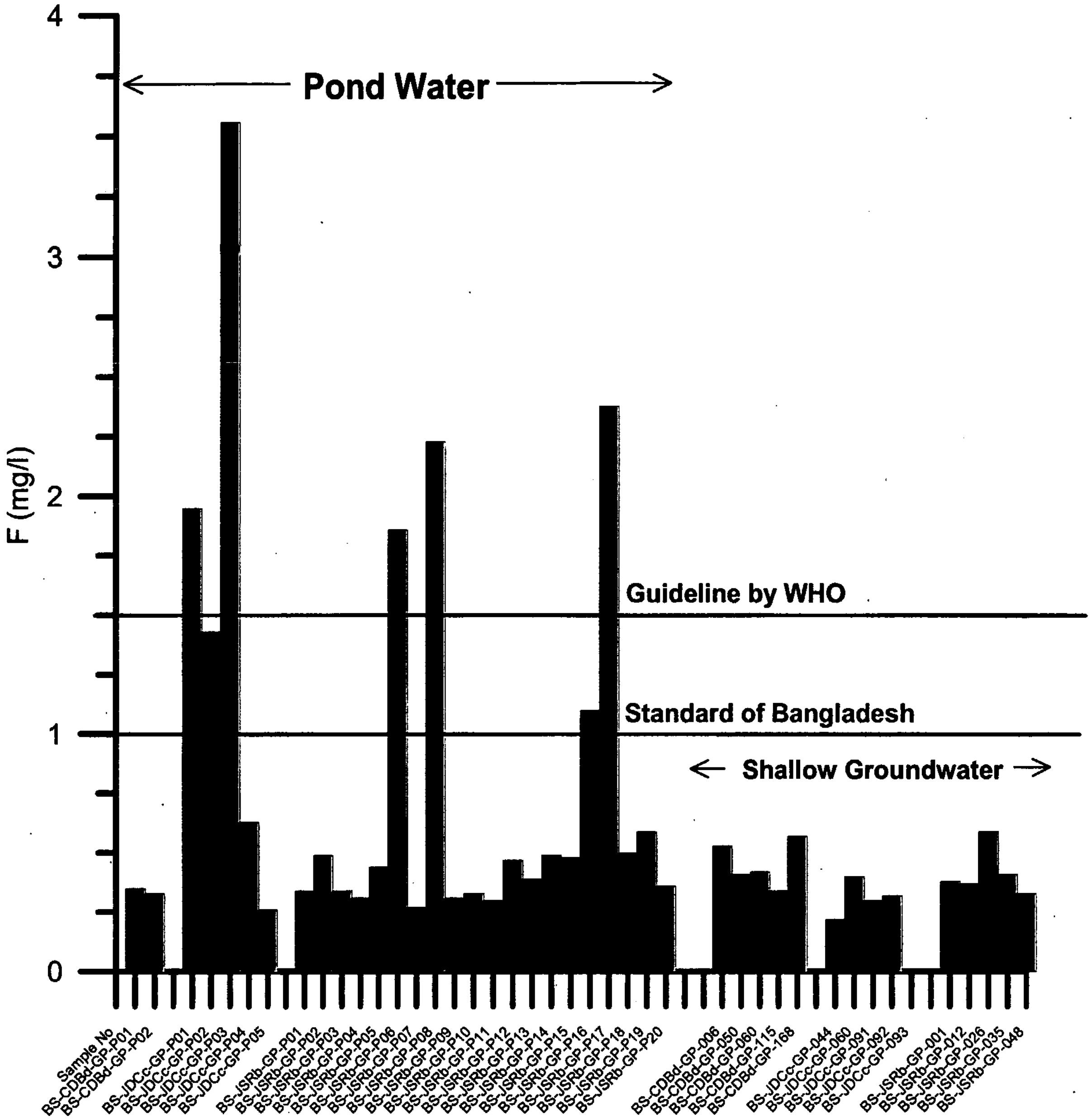


Figure 5.5.16	F Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

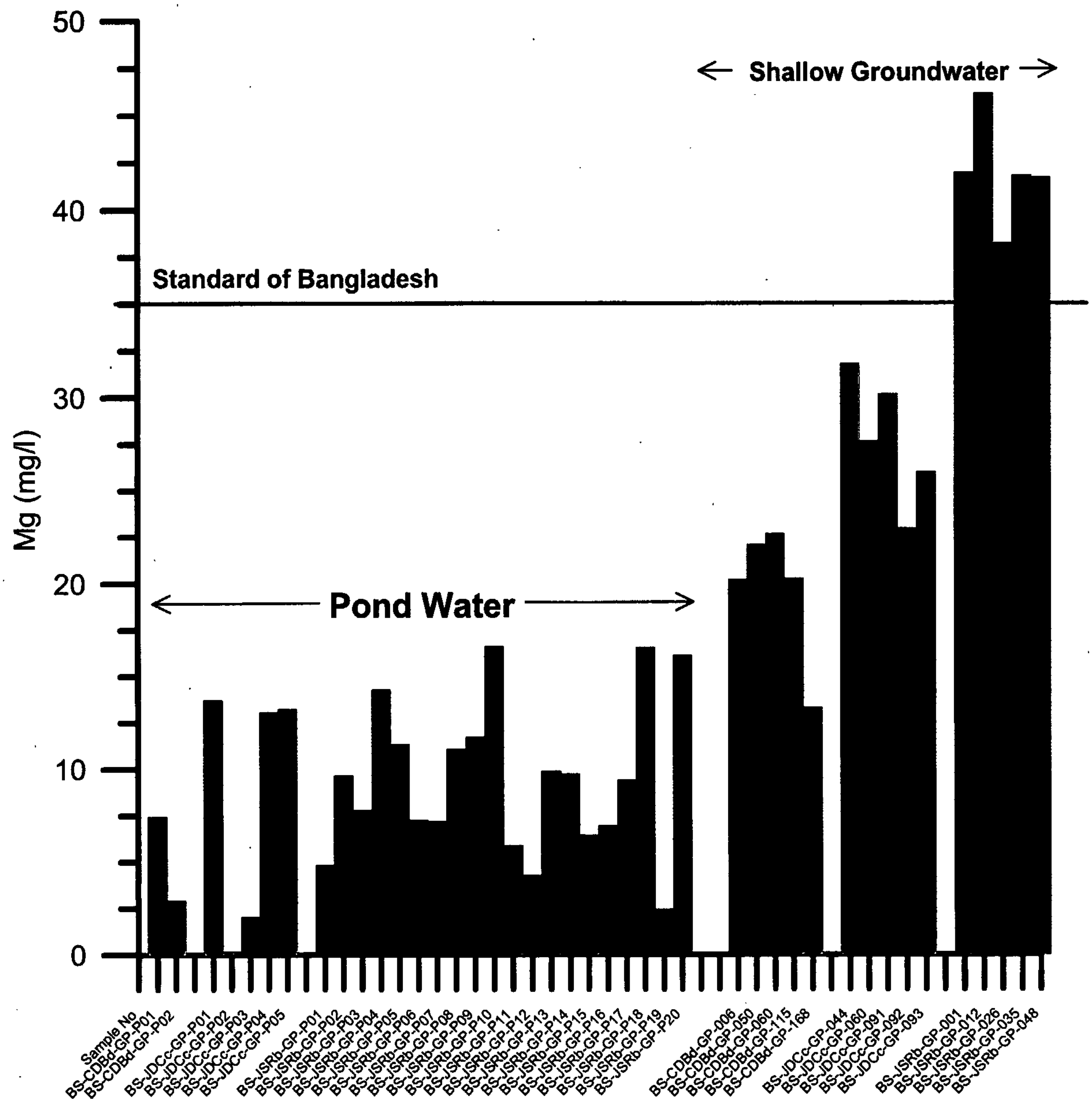


Figure 5.5.17	Mg Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

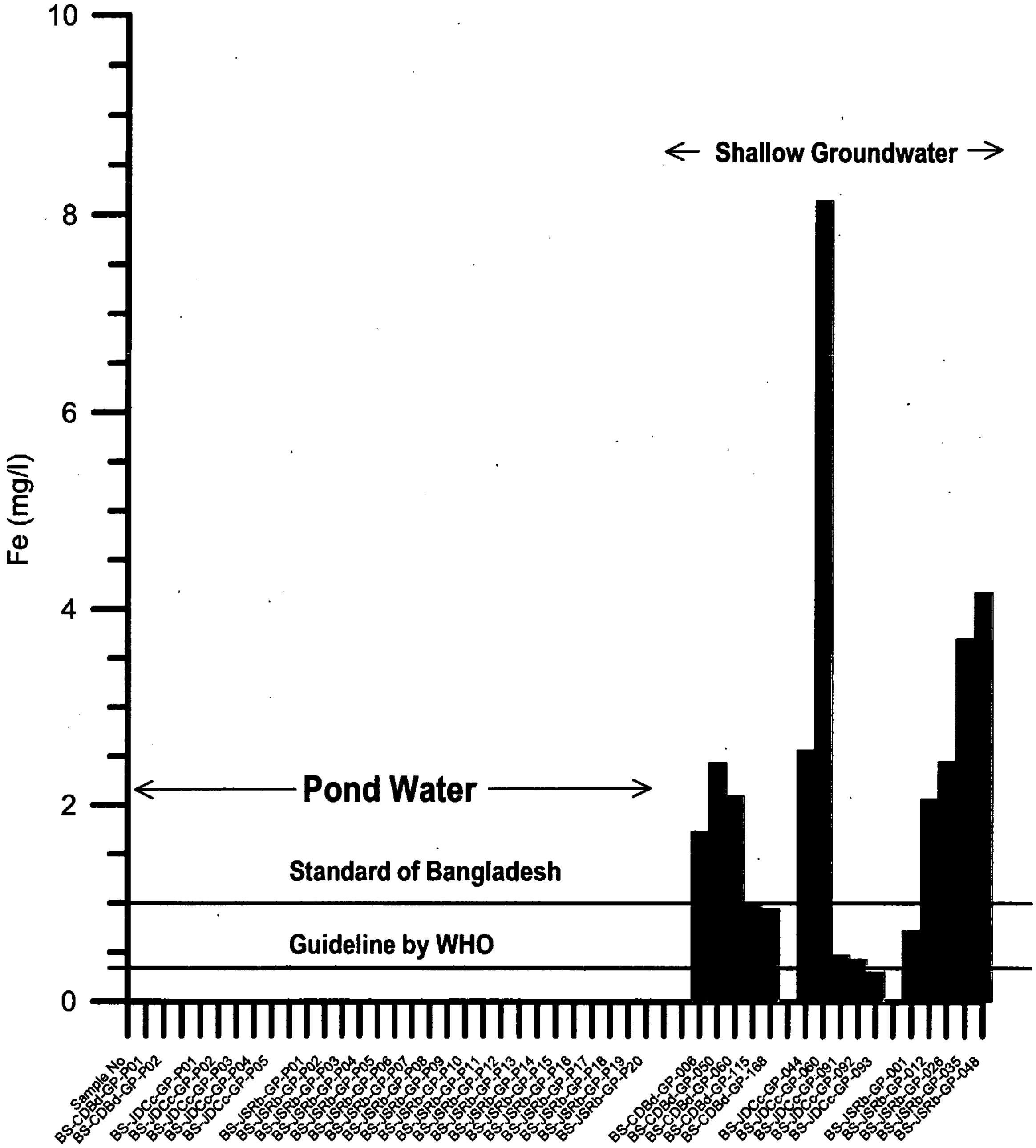


Figure 5.5.18	Fe Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

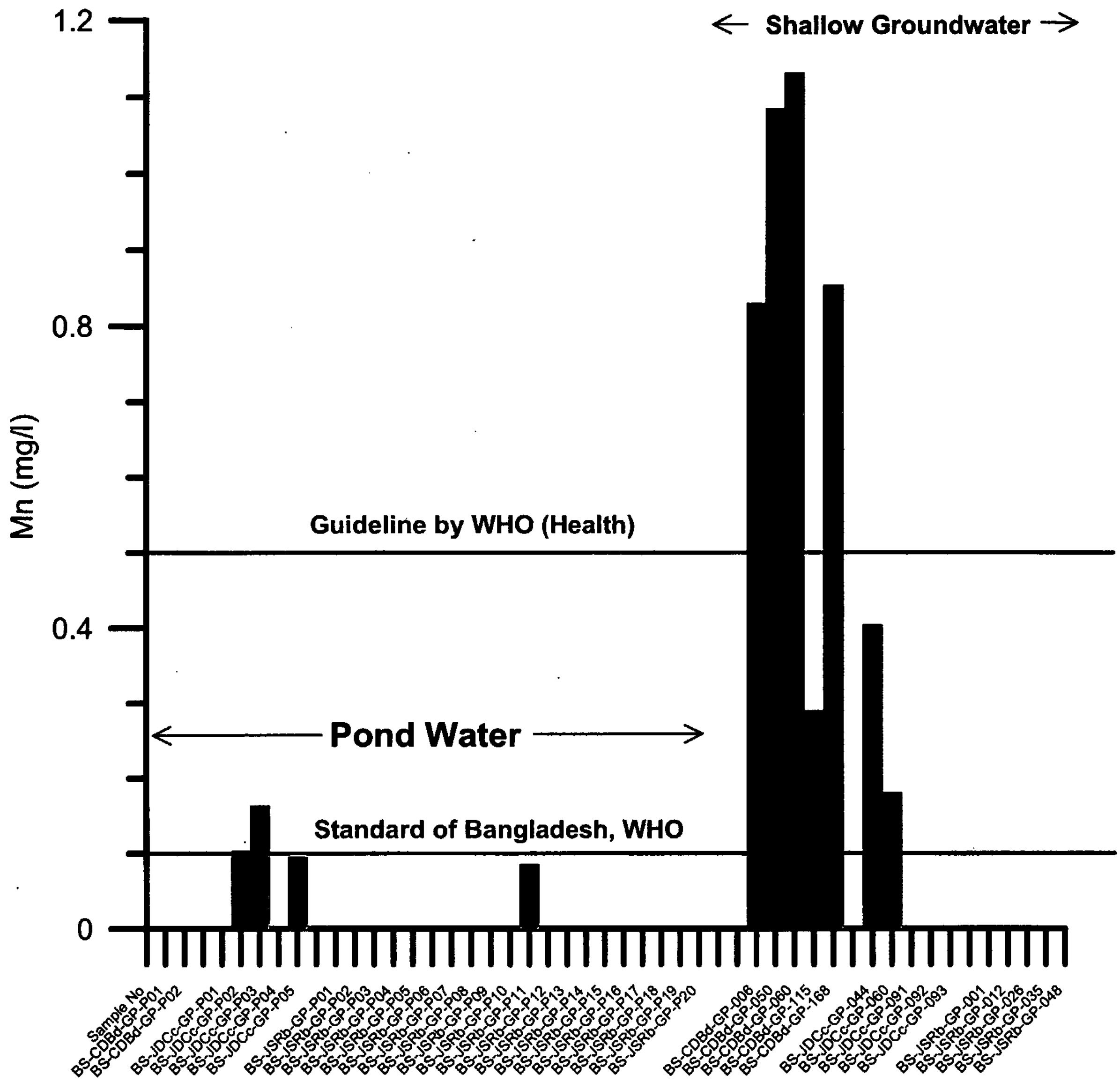


Figure 5.5.19	Mn Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

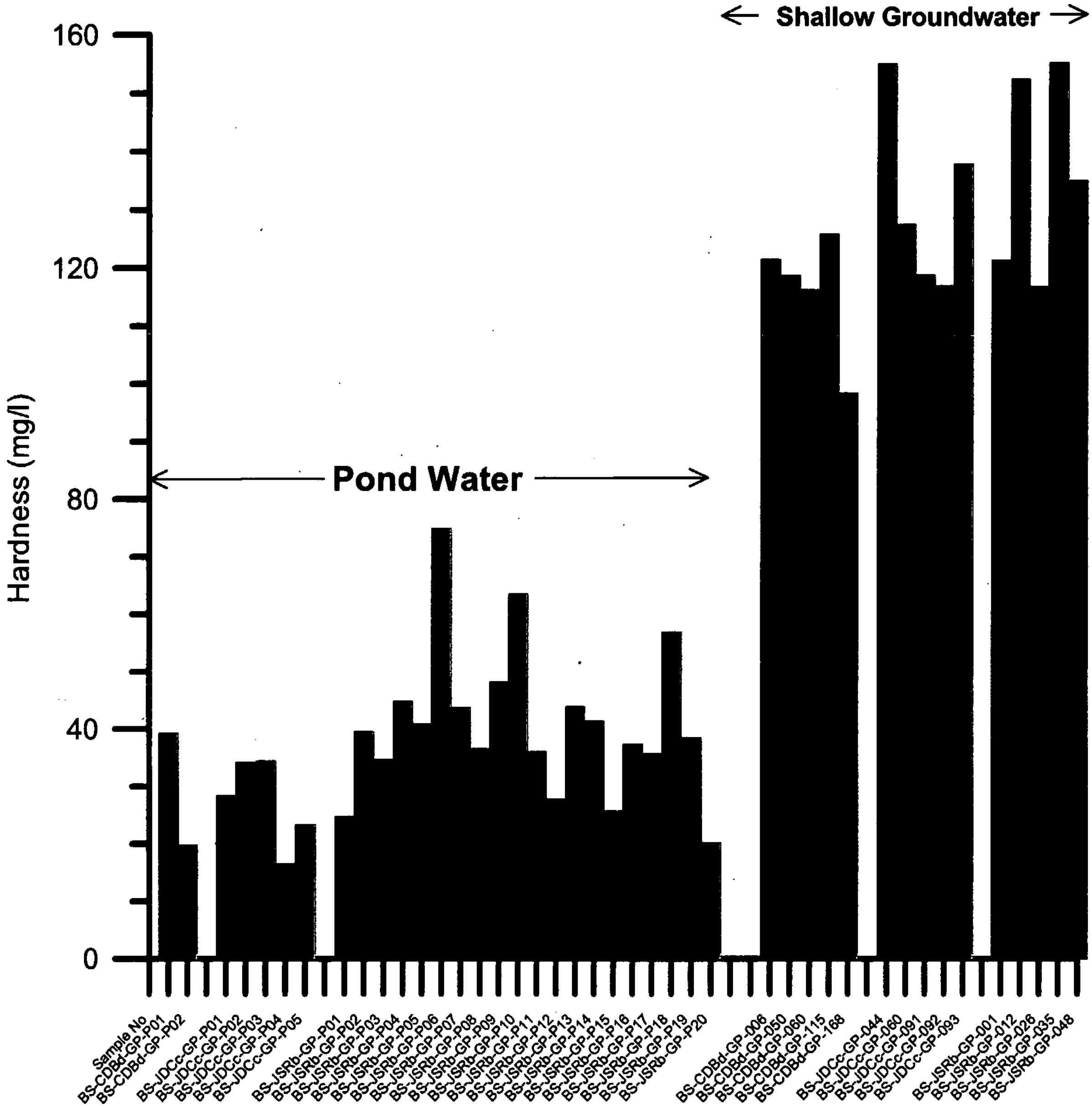


Figure 5.5.20	Hardness Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

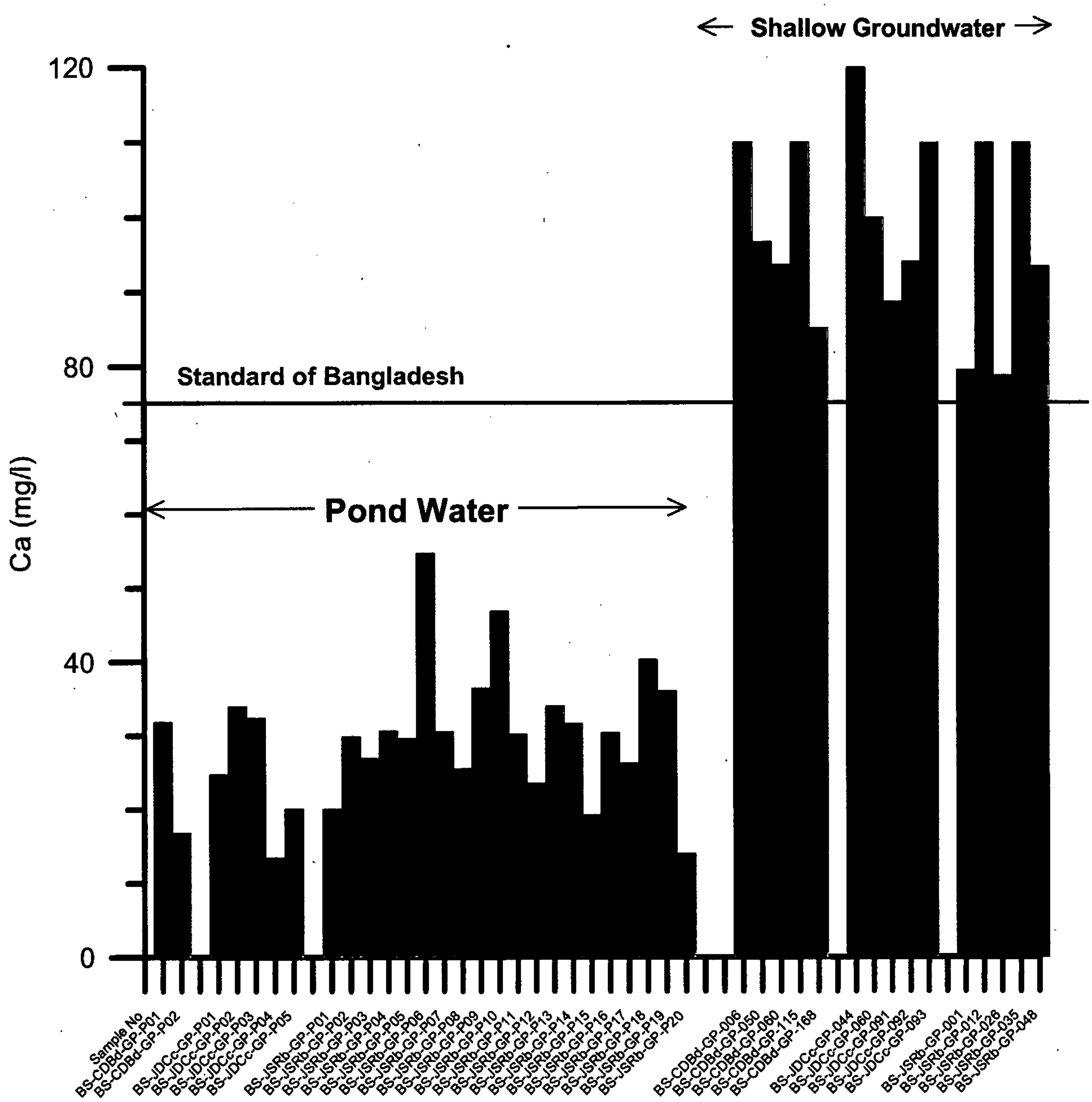


Figure 5.5.21	Ca Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

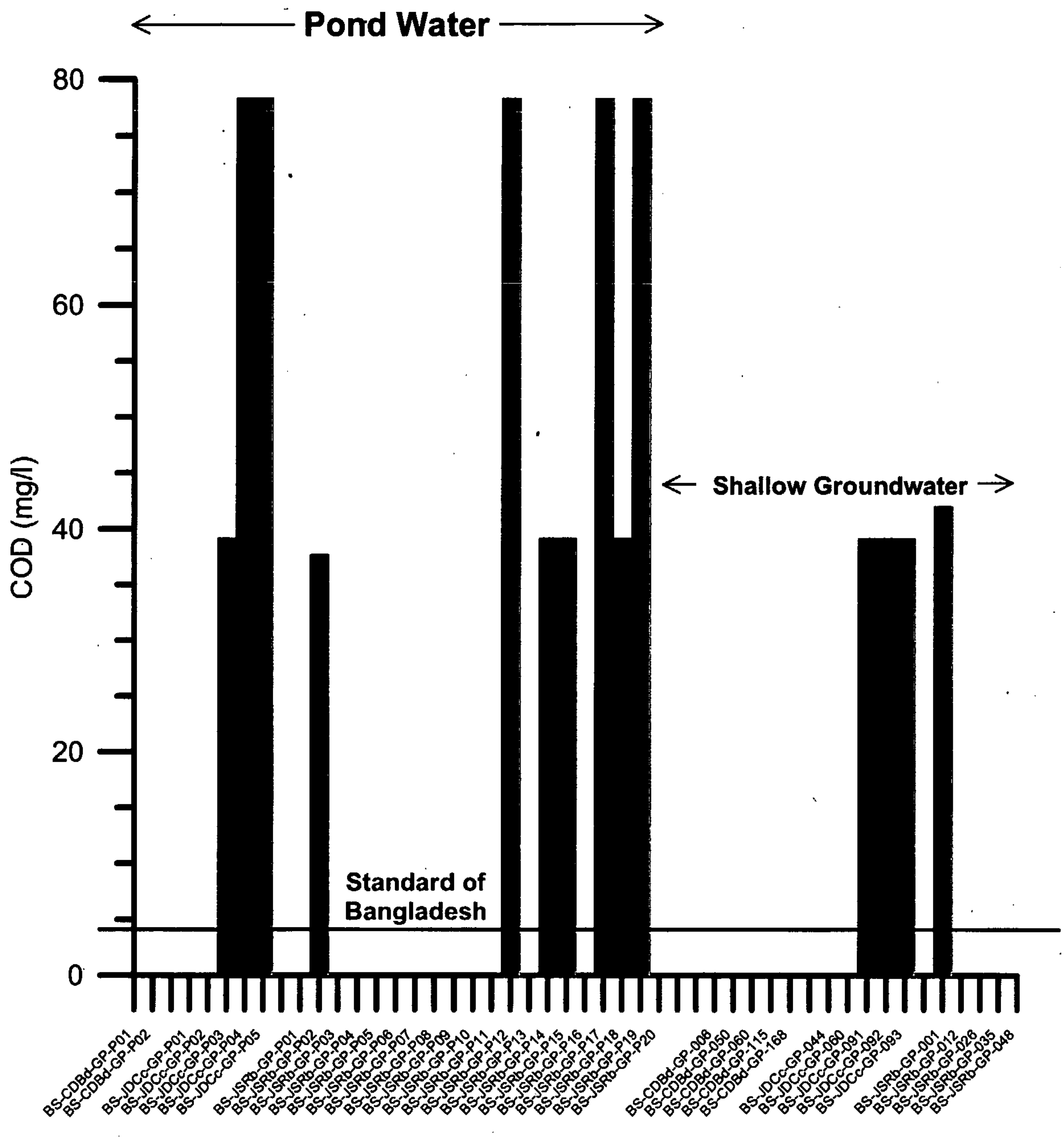
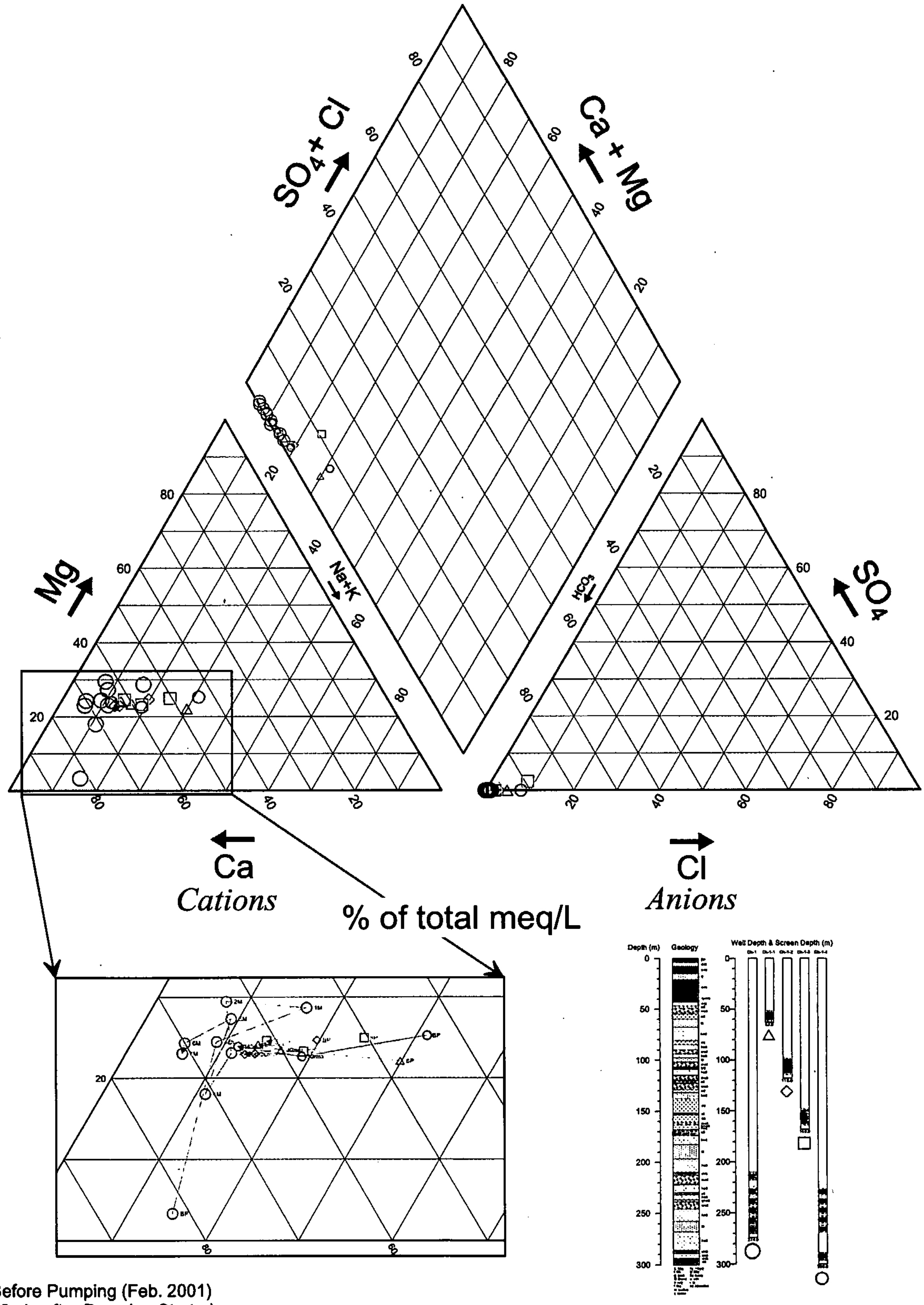


Figure 5.5.22	COD Data Comparison between Pond Water and Shallow Groundwater in the Model Rural Areas
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

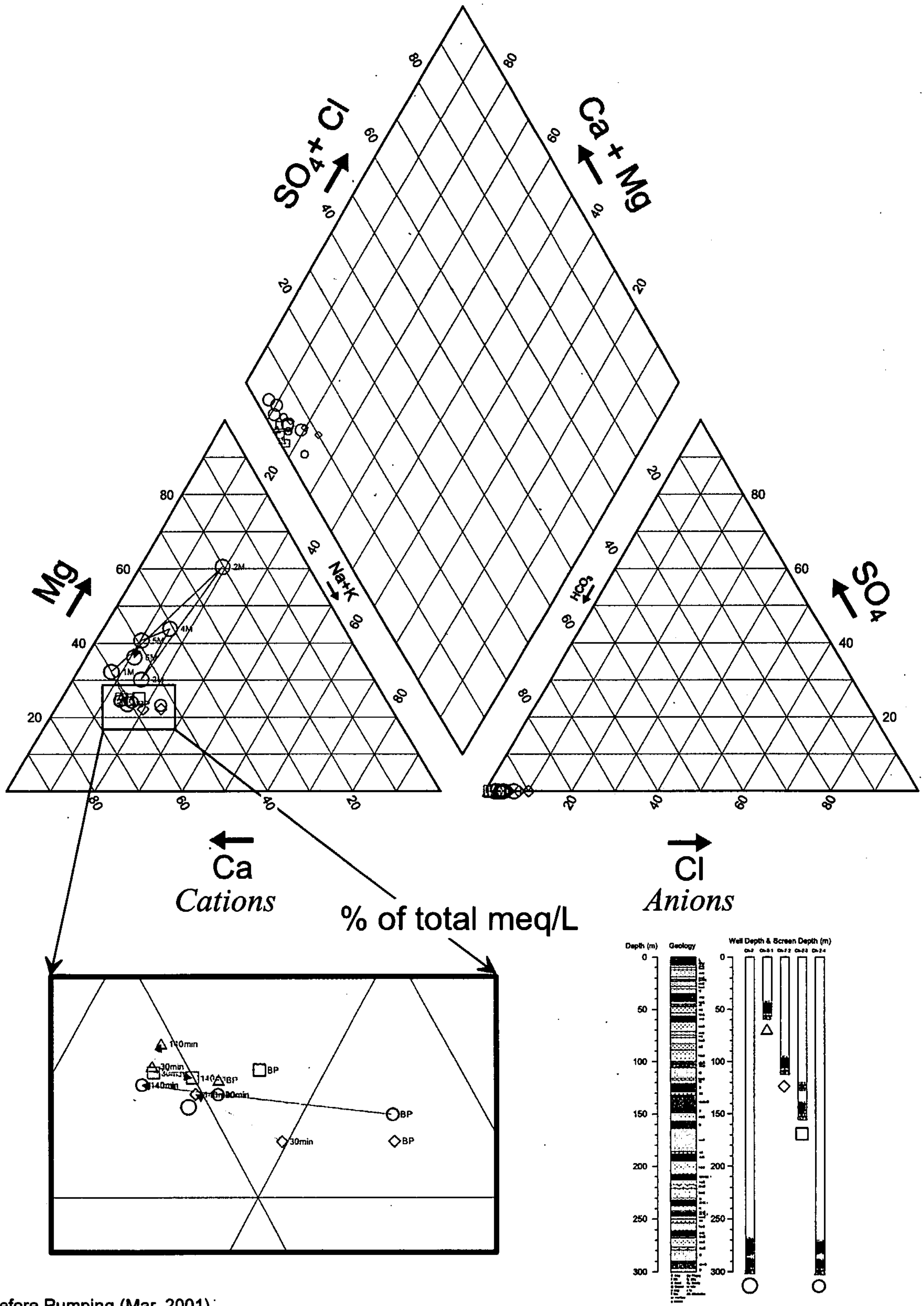


BP: Before Pumping (Feb. 2001)
30min: 30min after Pumping Started
140min: 140min after Pumping Started
48h: 48 hrs after Pumping Started
1M: Mar. 2001
2M: Apr. 2001
3M: Jun. 2001
4M: Jul. 2001
5M: Aug. 2001
6M: Sep. 2001
7M: Oct. 2001

Figure 5.5.23 **Trilinear Diagram of Groundwater at CH-1 Site, Chuadanga**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

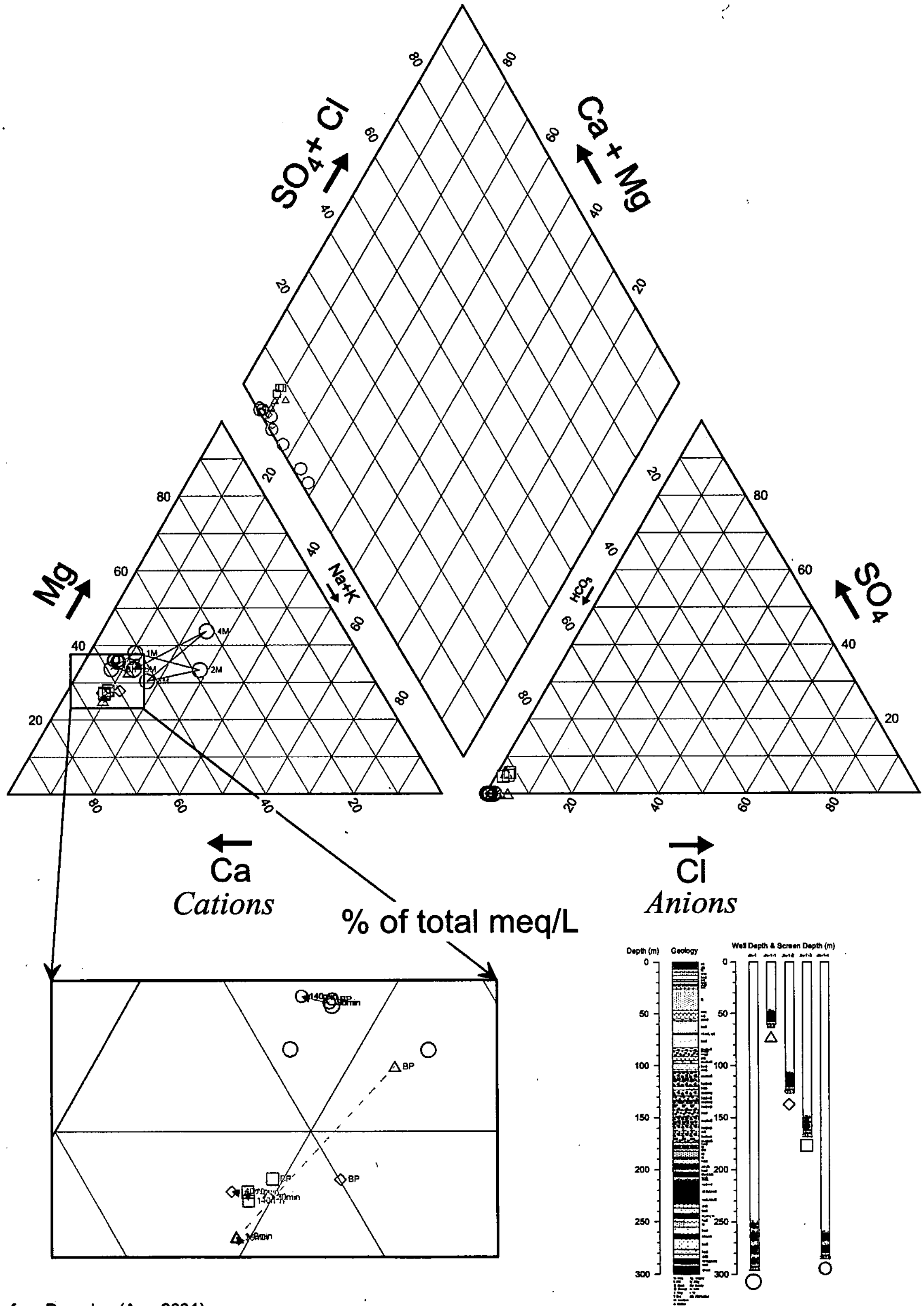


BP: Before Pumping (Mar. 2001)
30min: 30min after Pumping Started
140min: 140min after Pumping Started
48h: 48hrs after Pumping Started
1M: Apr. 2001
2M: Jun. 2001
3M: Jul. 2001
4M: Aug. 2001
5M: Sep. 2001
6M: Oct. 2001

Figure 5.5.24 **Trilinear Diagram of Groundwater at CH-2 Site, Chuadanga**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

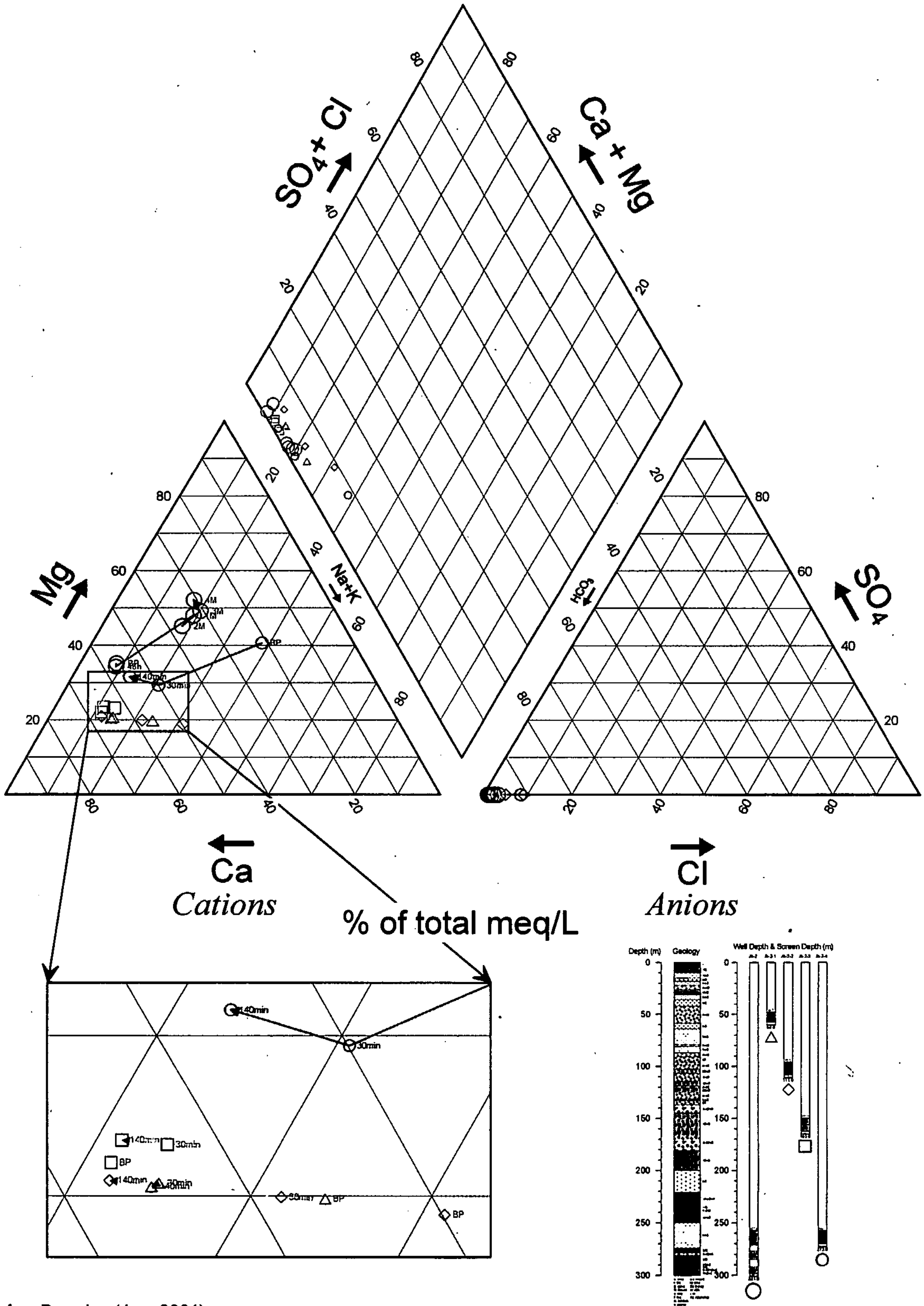


BP: Before Pumping (Apr. 2001)
30min: 30min after Pumping Started
140min: 140min after Pumping Started
48h: 48hrs after Pumping Started
1M: Jun. 2001
2M: Jul. 2001
3M: Aug. 2001
4M: Sep. 2001
5M: Oct. 2001

Figure 5.5.25	**Trilinear Diagram of Groundwater at JH-1 Site, Jhenaidah**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

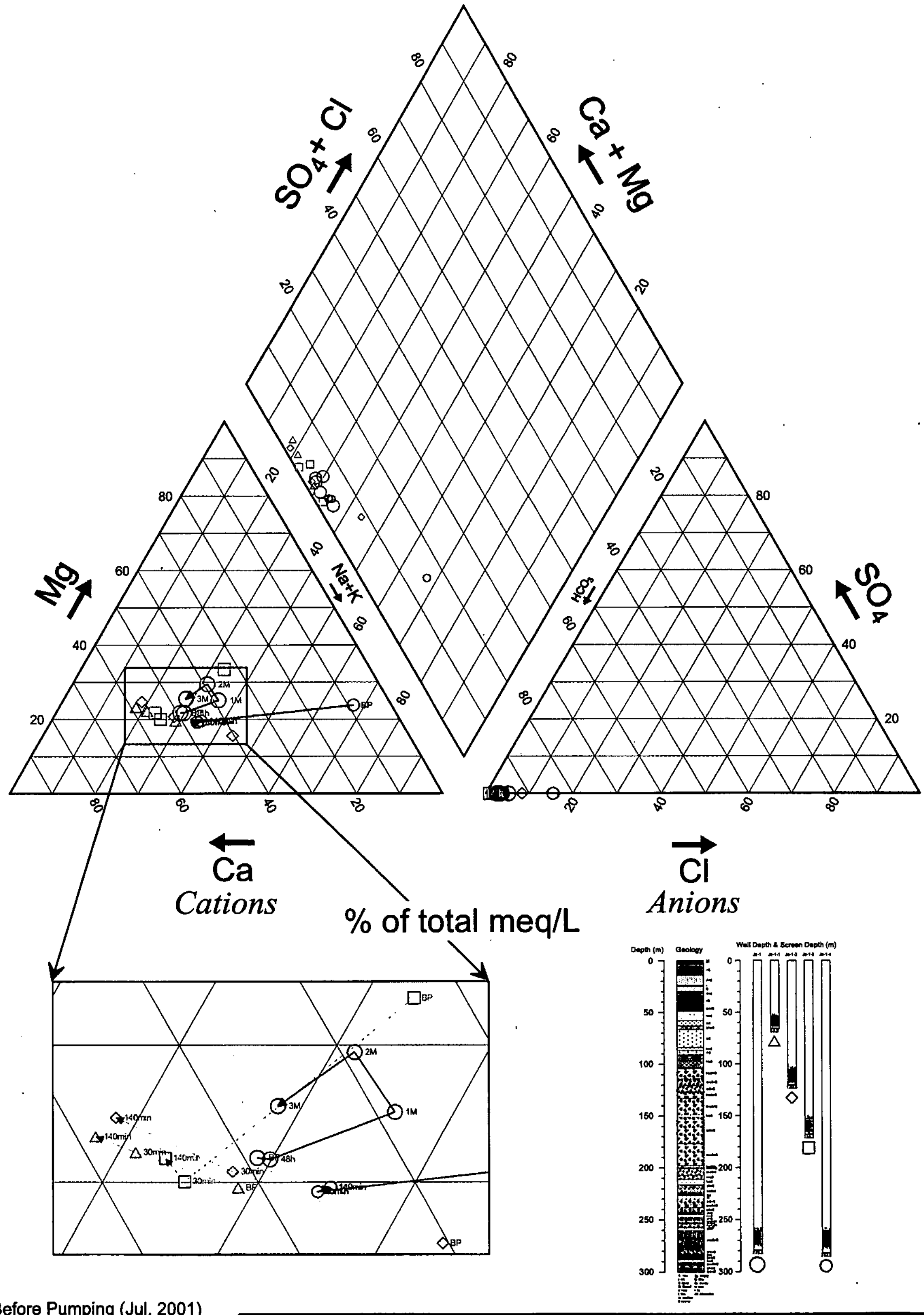


BP: Before Pumping (Jun. 2001)
30min: 30min after Pumping Started
140min: 140min after Pumping Started
48h 48hrs after Pumping Started
1M: Jul. 2001
2M: Aug. 2001
3M: Sep. 2001
4M: Oct. 2001

Figure 5.5.26	Trilinear Diagram of Groundwater at JH-2 Site, Jhenaidah

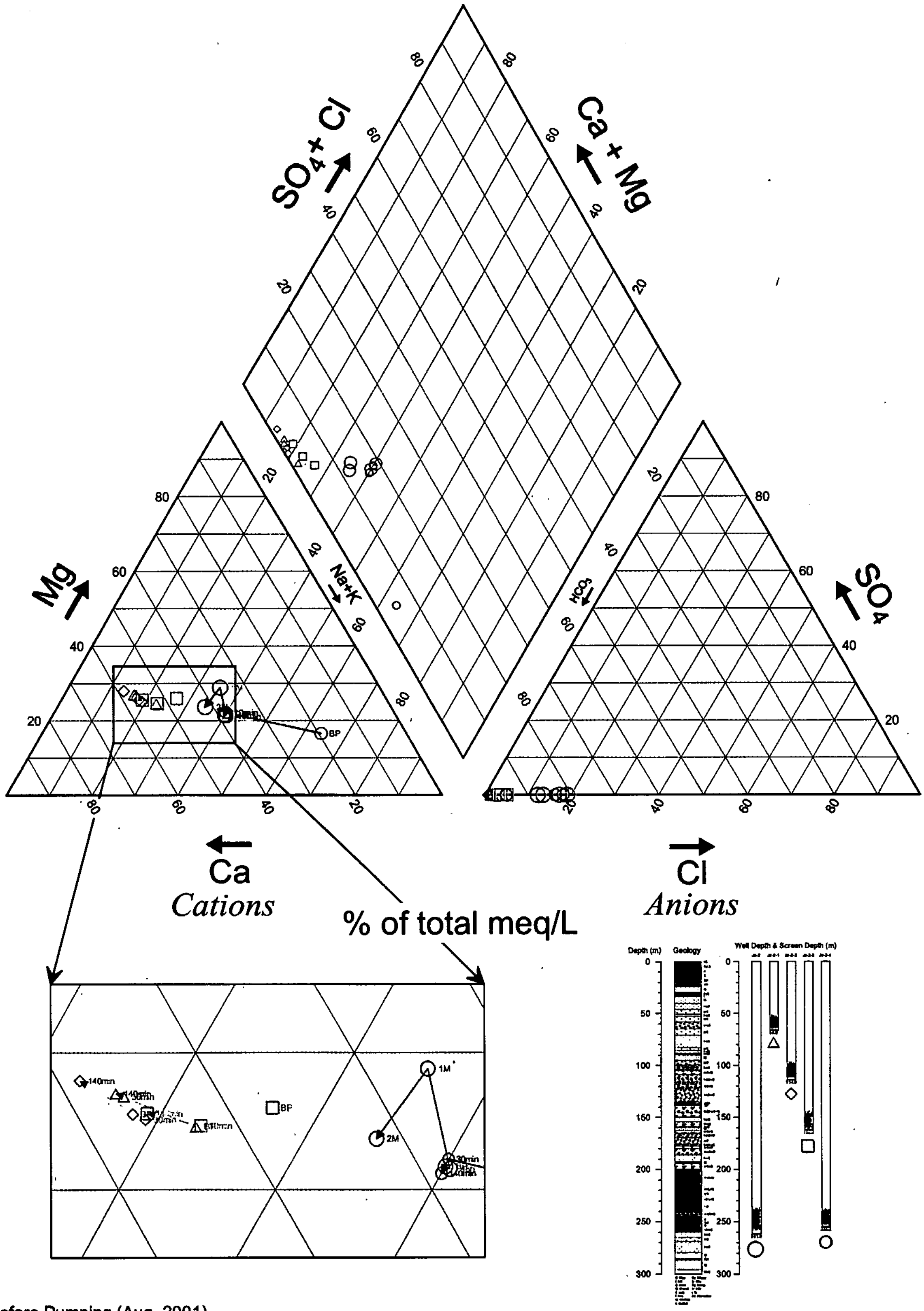
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



BP: Before Pumping (Jul. 2001)
30min: 30min after Pumping Started
140min: 140min after Pumping Started
48h 48hrs after Pumping Started
1M: Aug. 2001
2M: Sep. 2001
3M: Oct. 2001

Figure 5.5.27	**Trilinear Diagram of Groundwater at JS-1 Site, Jessore**
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



BP: Before Pumping (Aug. 2001)
30min: 30min after Pumping Started
140min: 140min after Pumping Started
48h 48hrs after Pumping Started
1M: Sep. 2001
2M: Oct. 2001

Figure 5.5.28	Trilinear Diagram of Groundwater at JS-2 Site, Jessore

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

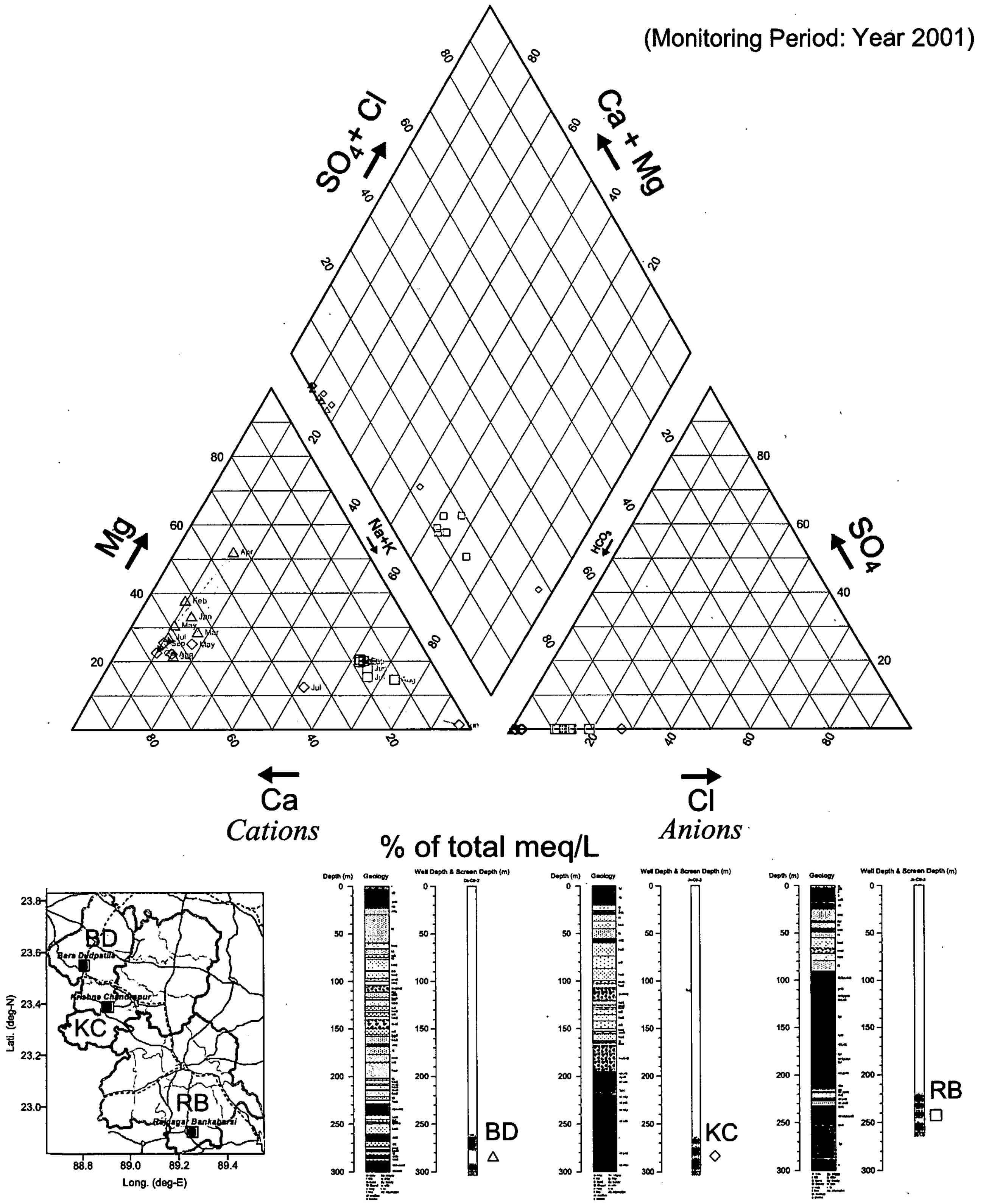
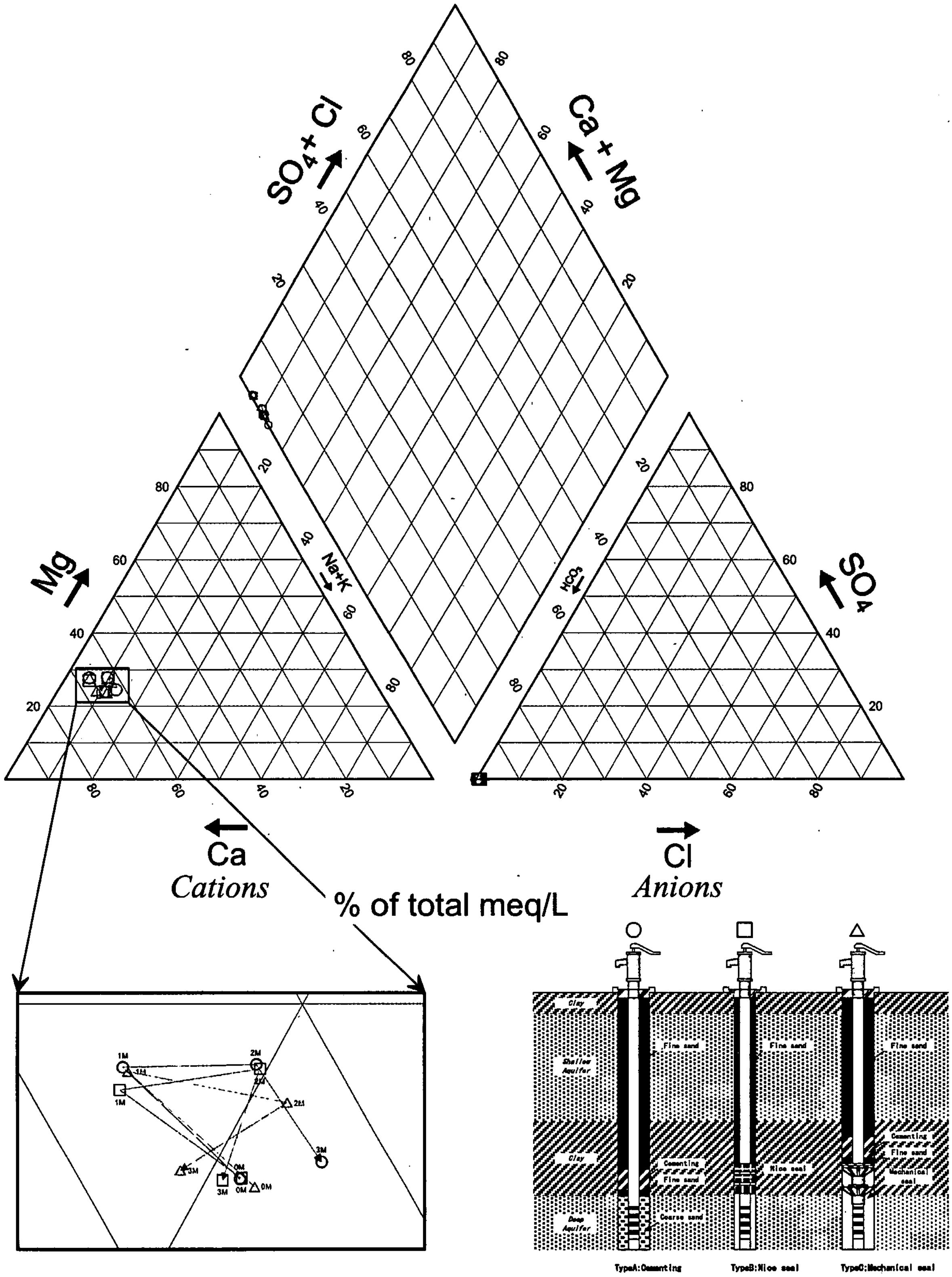


Figure 5.5.29	Trilinear Diagram of Groundwater at Obs. Holes in Model Rural Areas

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



LEGEND

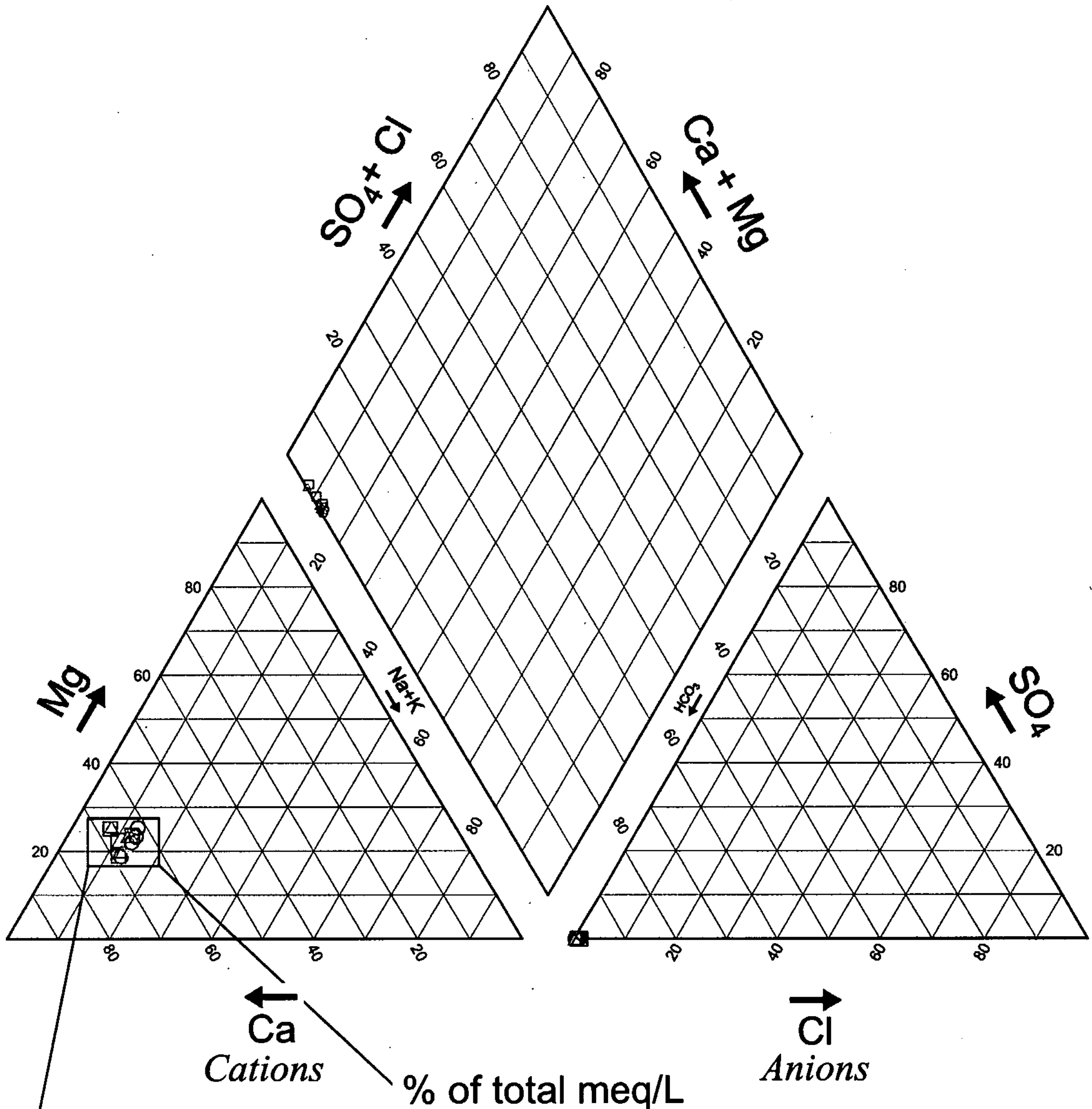
0M: Mar. 2001
1M: Apr. 2001
2M: May. 2001
3M: Jun. 2001

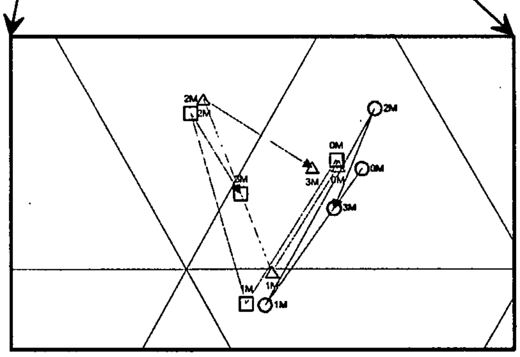
Figure 5.5.30

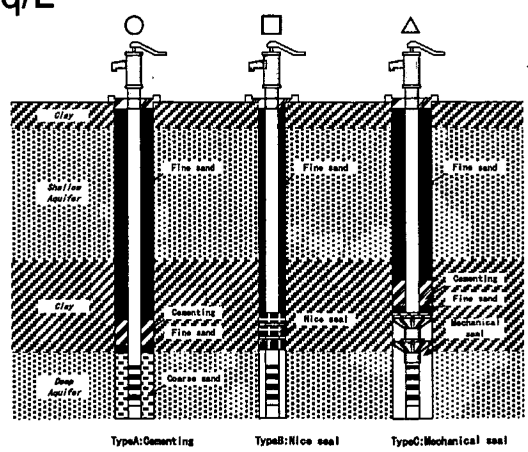
Trilinear Diagram of Groundwater at Improved Deep Wells in Bara Dudpatila Village, Chuadanga

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)







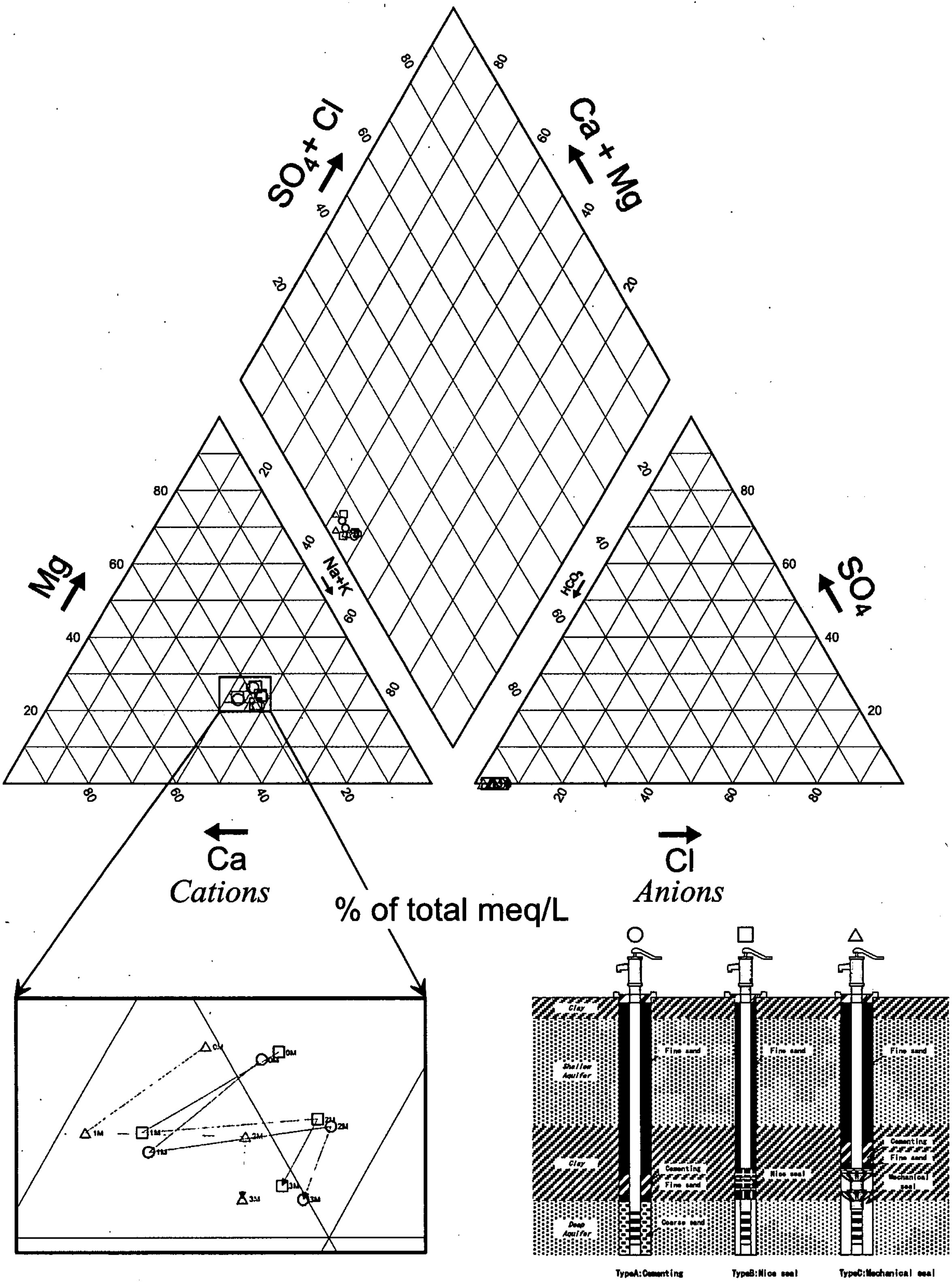
LEGEND

0M:	Feb. 2001
1M:	Mar. 2001
2M:	May. 2001
3M:	Jun. 2001

Figure 5.5.31 **Trilinear Diagram of Groundwater at Improved Deep Wells in Krishna Chandrapur Village, Jhenaidah**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

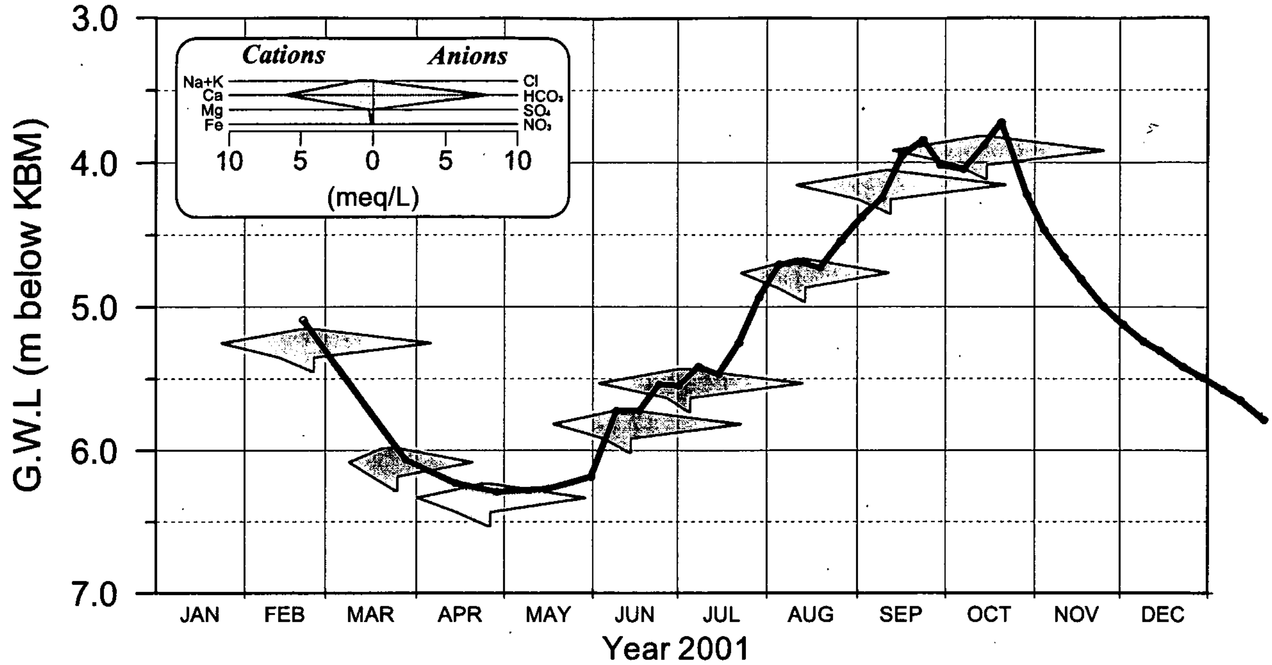
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



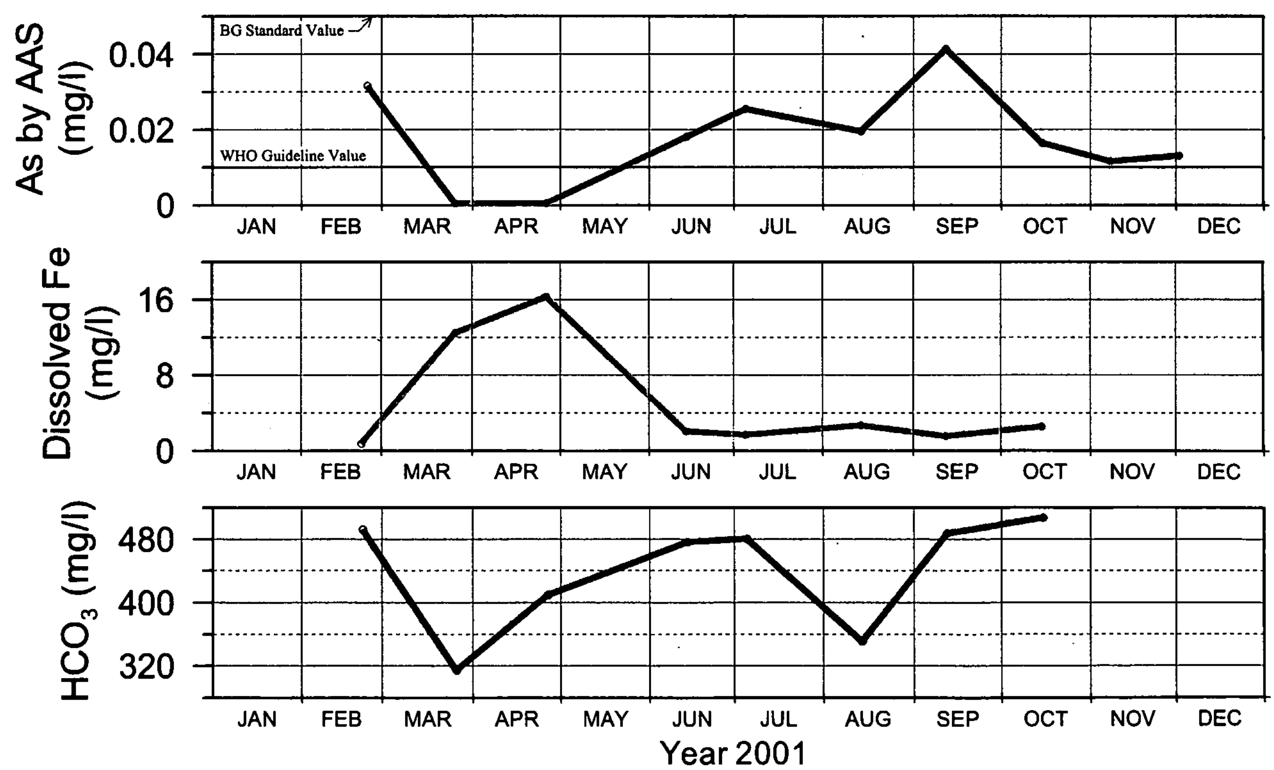
LEGEND

0M: Nov. 2000
1M: Jan. 2001
2M: Feb. 2001
3M: Mar. 2001

Figure 5.5.32	Trilinear Diagram of Groundwater at Improved Deep Wells in Rajnagar Bankabarsi Village, Jessore
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality (As, Fe, HCO_3)

Location: Poshu Hat, Chuadanga Pourashava

Site No.: CH-1

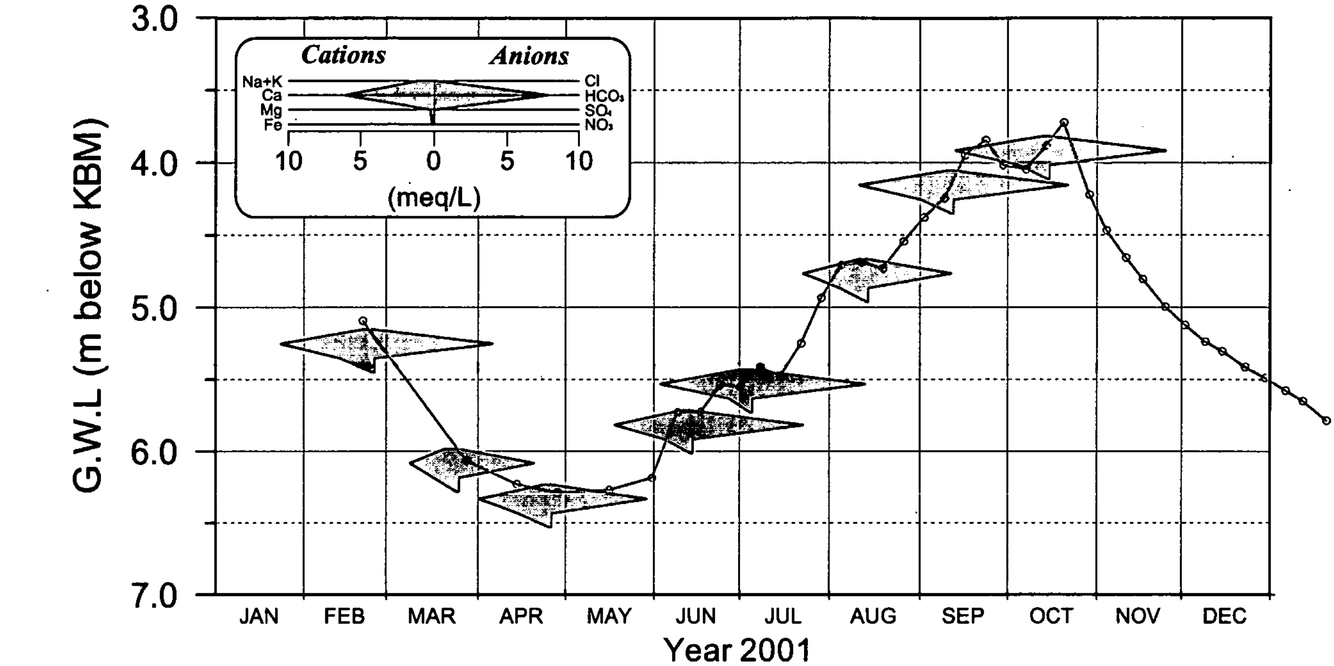
LEGEND

Ch-1 (Depth = 274.0 m)

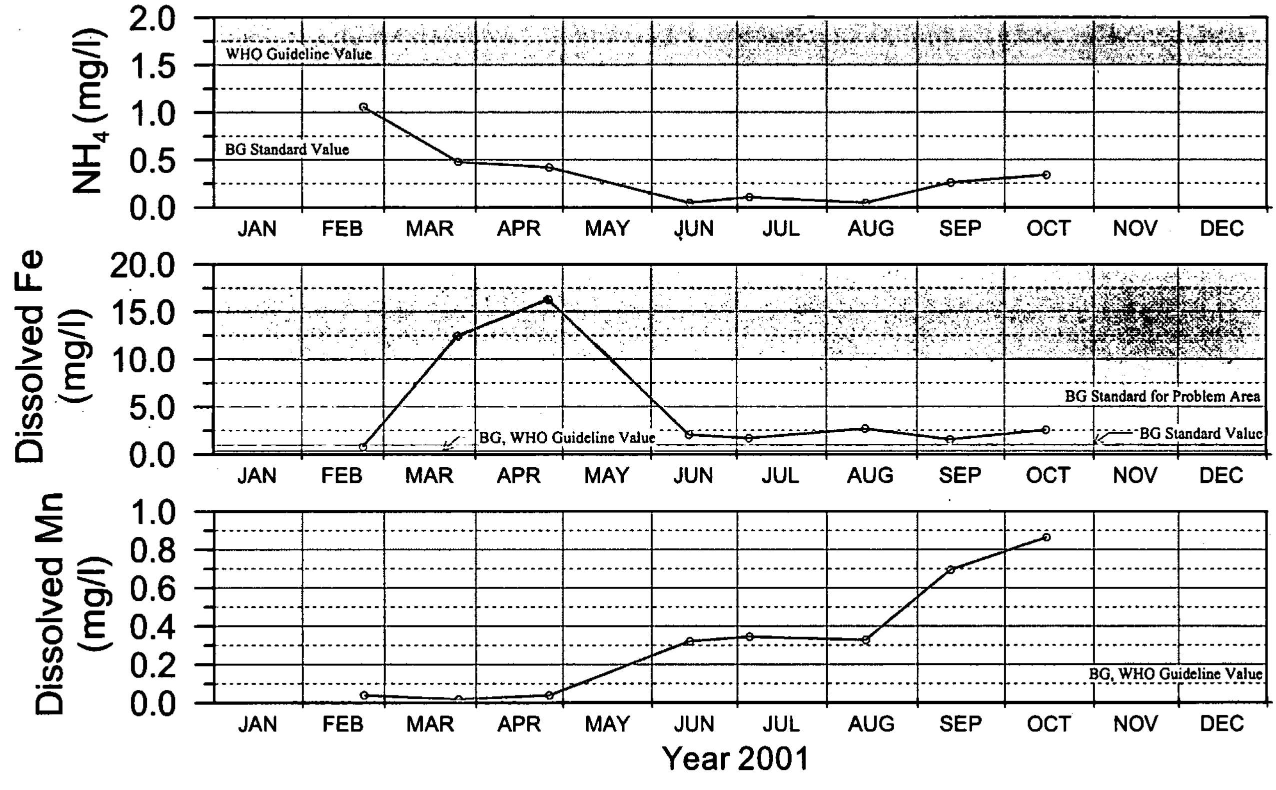
Figure 5.5.33	Changes in Groundwater Level and Groundwater Quality at Ch-1 Well, Chuadanga

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality (NH_4, Fe, Mn)

Location: Poshu Hat, Chuadanga Pourashava

Site No.: CH-1

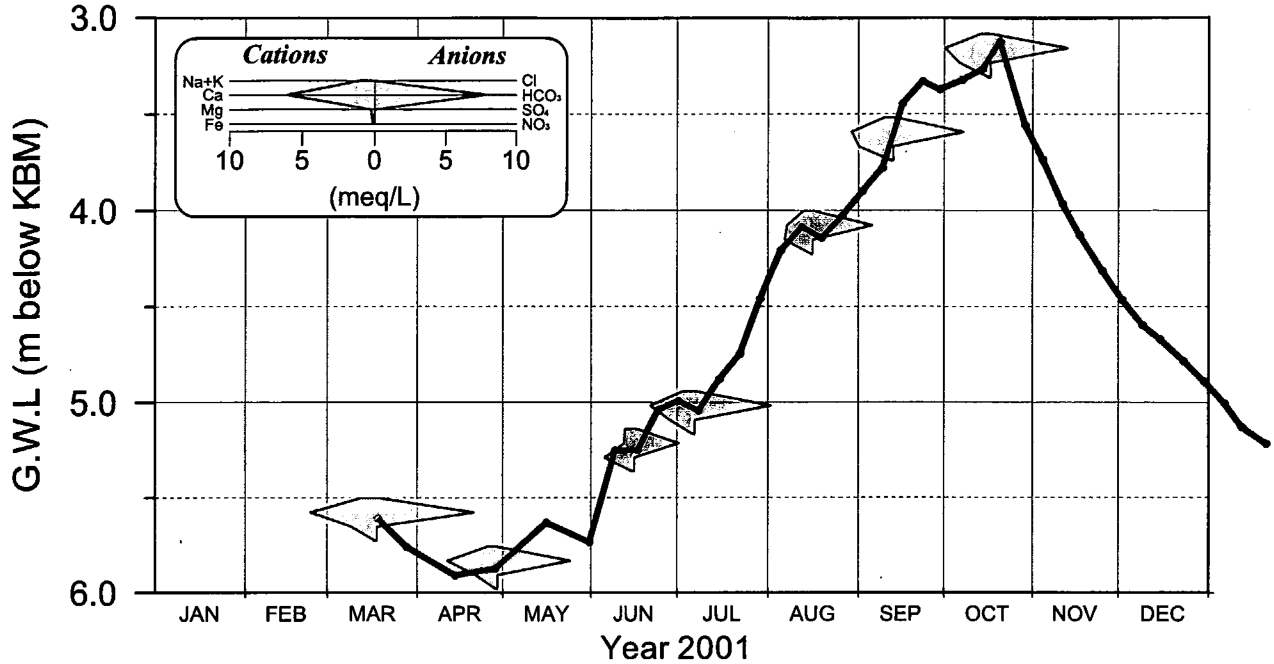
LEGEND

Ch-1 (Depth = 274.0 m)

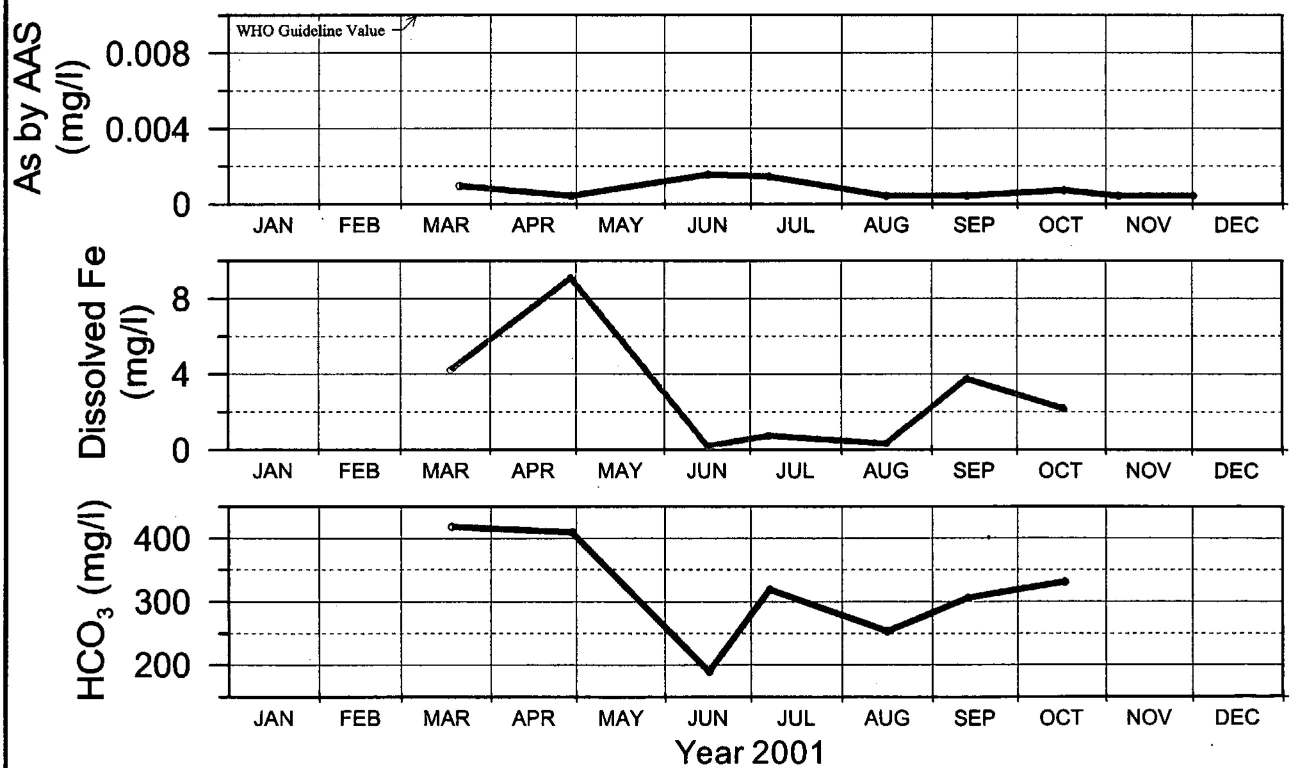
Figure 5.5.34	Changes in Groundwater Level and Groundwater Quality (NH_4, Fe, Mn) at Ch-1 Well, Chuadanga

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



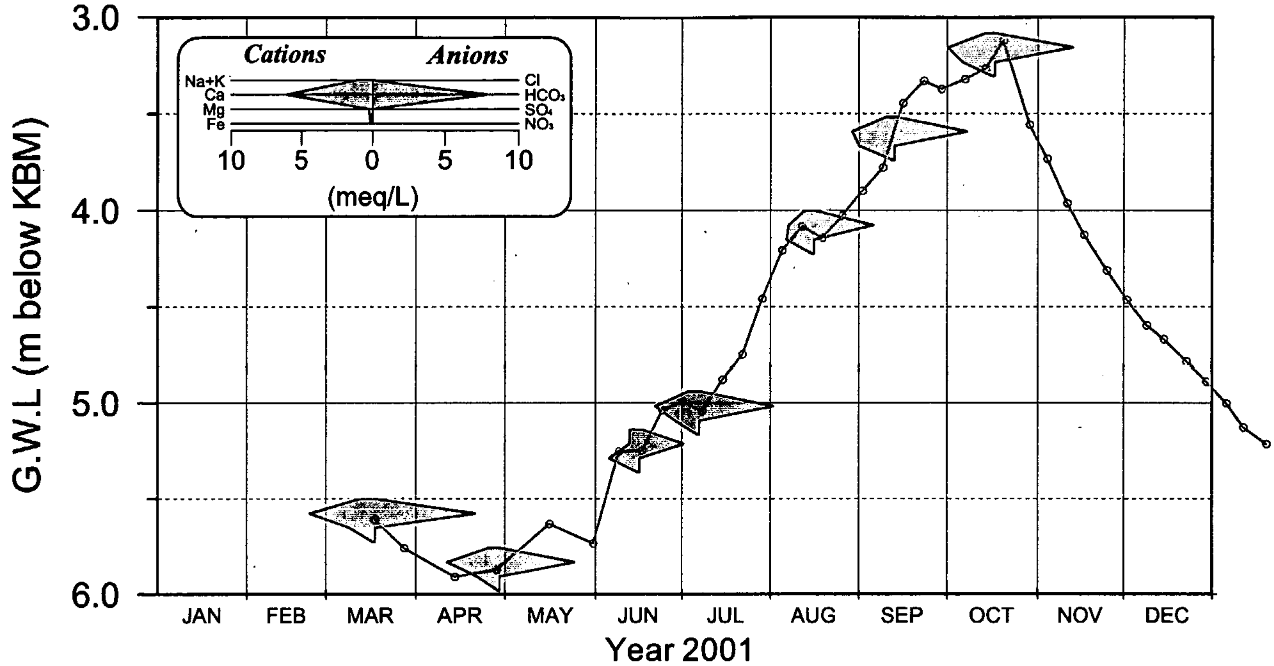
(b) Groundwater Quality (As, Fe, HCO_3)

Location: Girls College, Chuadanga Pourashava

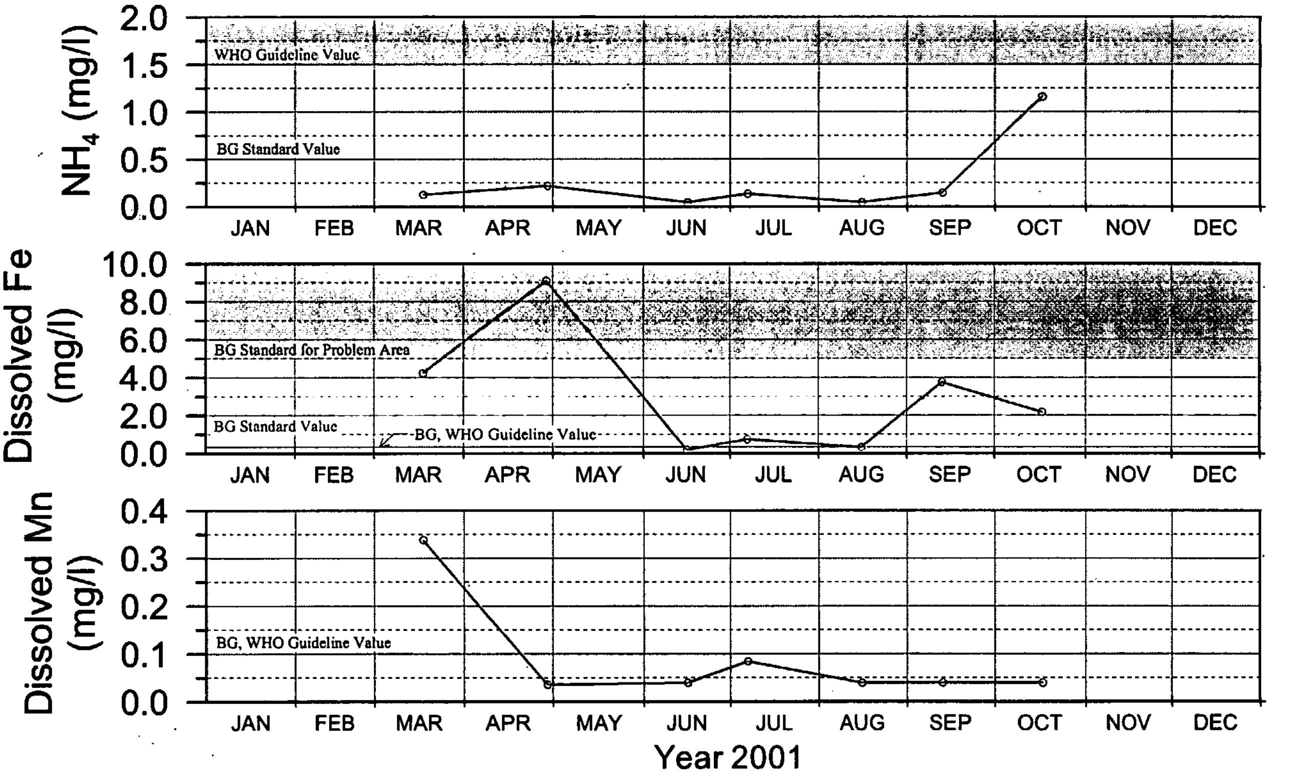
Site No.: CH-2

LEGEND
Ch-2 (Depth = 298.5 m)

Figure 5.5.35	**Changes in Groundwater Level and Groundwater Quality at Ch-2 Well, Chuadanga**
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality (NH_4, Fe, Mn)

Location: Girls College, Chuadanga Pourashava

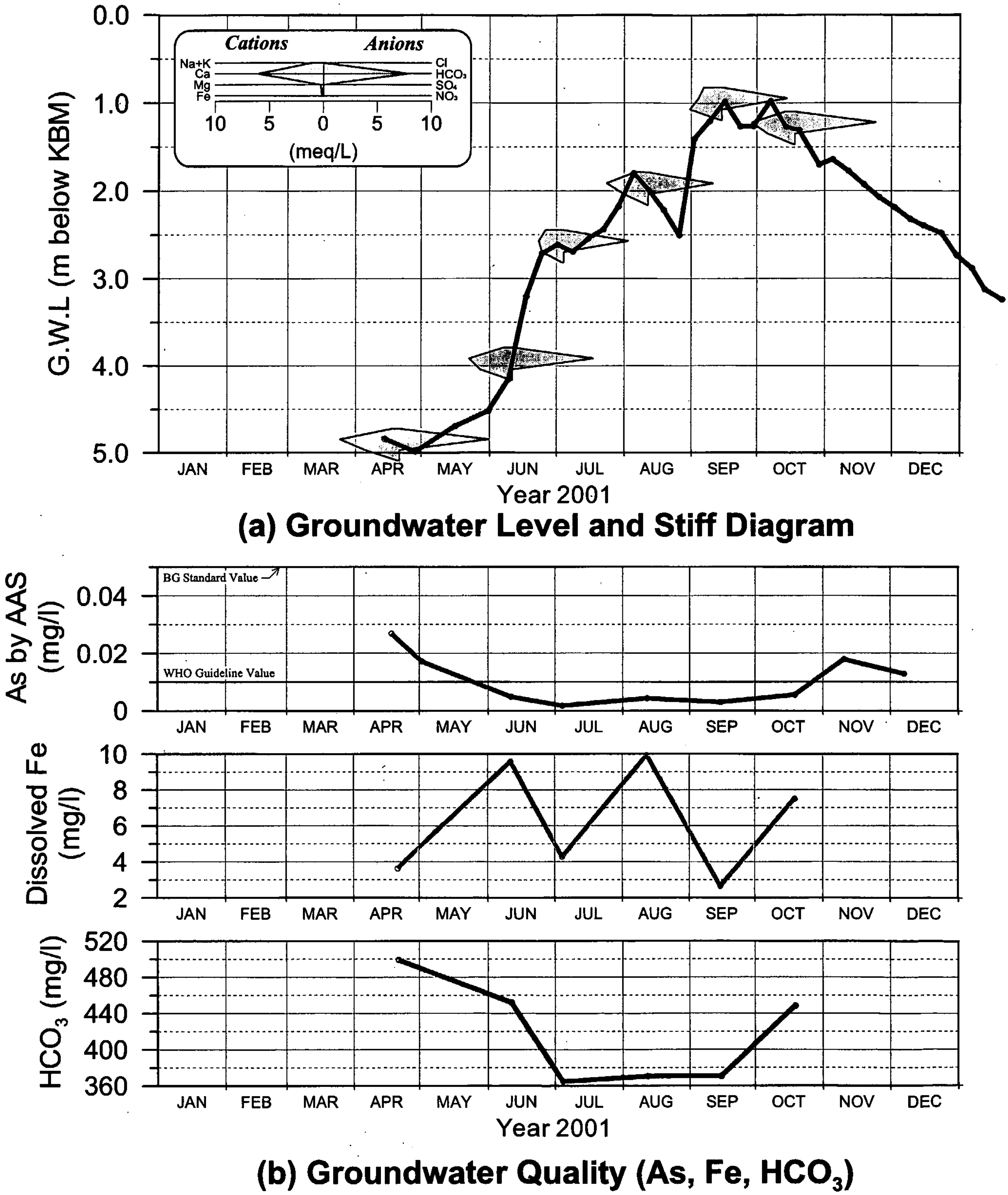
Site No.: CH-2

LEGEND
Ch-2 (Depth = 298.5 m)

Figure 5.5.36	Changes in Groundwater Level and Groundwater Quality (NH_4, Fe, Mn) at Ch-2 Well, Chuadanga

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



Location: Arabpur, Jhenaidah Pourashava

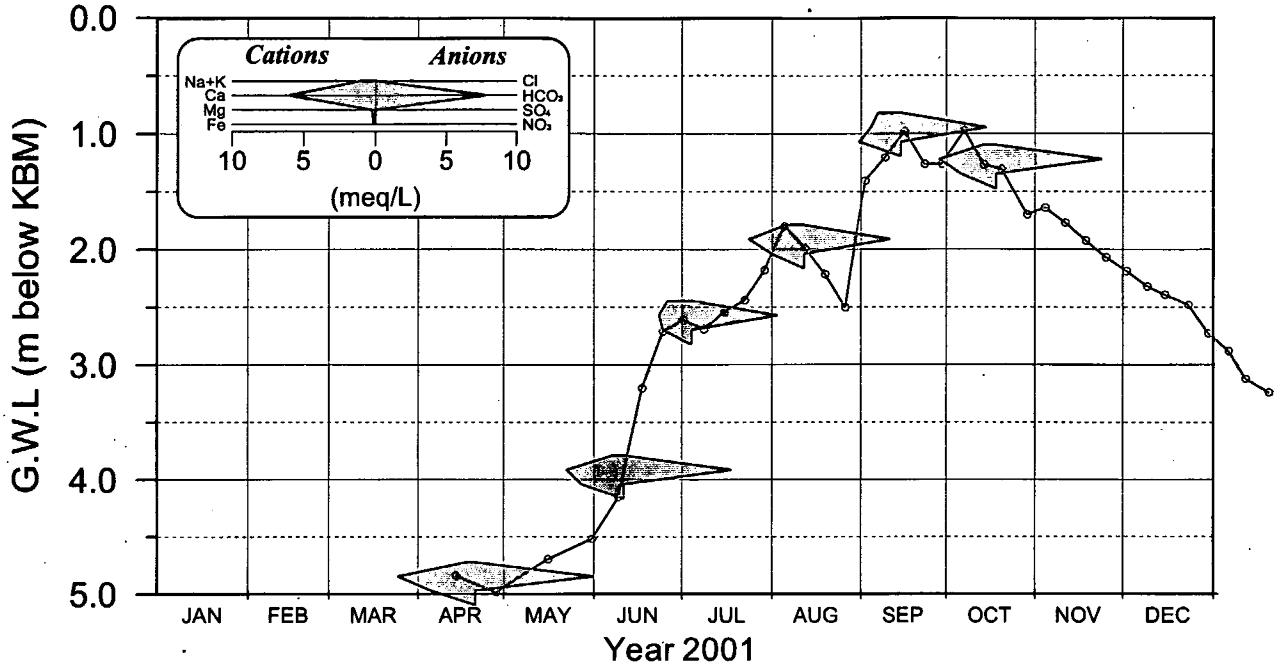
Site No.: JH-1

LEGEND
Jh-1 (Depth = 292.5 m)

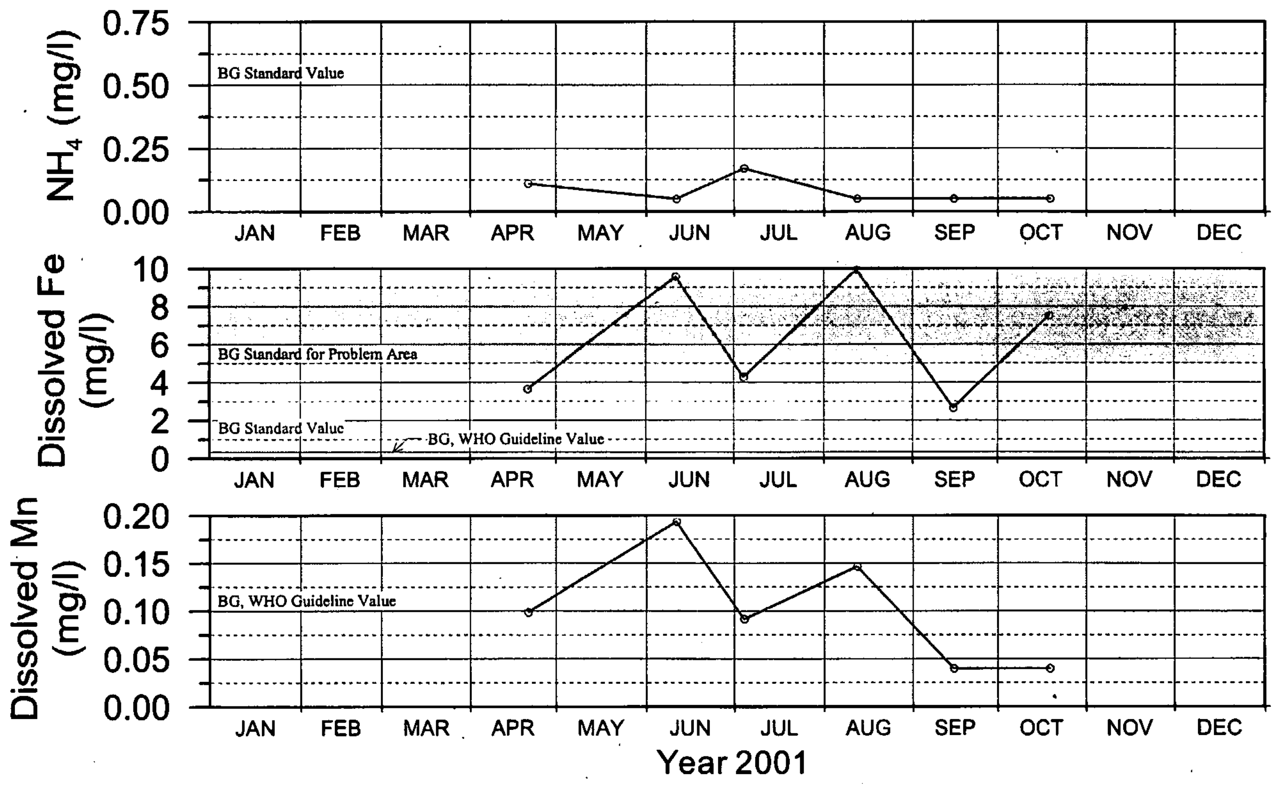
Figure 5.5.37 Changes in Groundwater Level and Groundwater Quality at Jh-1 Well, Jhenaidah

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality (NH_4, Fe, Mn)

Location: Arabpur, Jhenaidah Pourashava

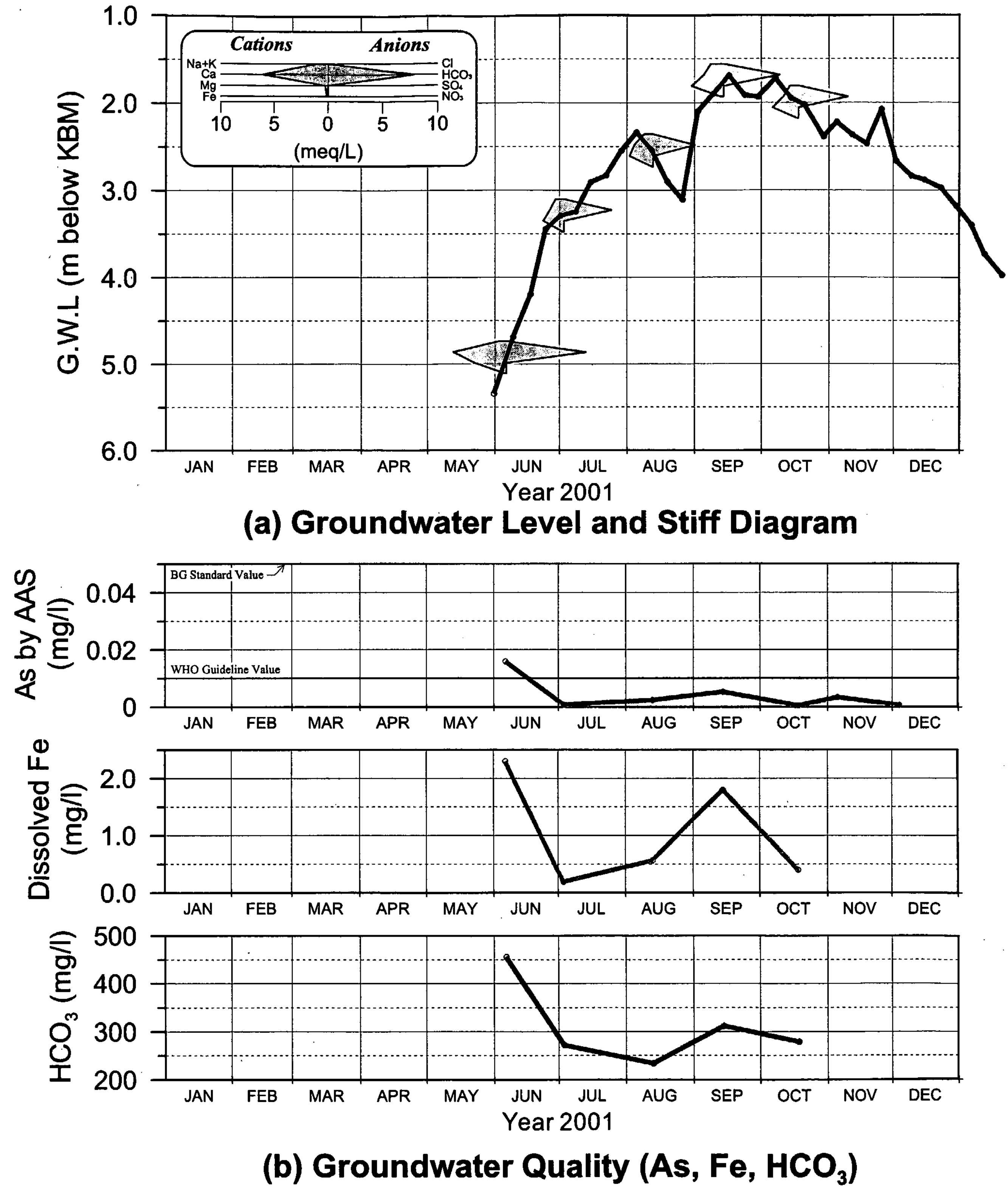
Site No.: JH-1

LEGEND
Jh-1 (Depth = 292.5 m)

Figure 5.5.38	Changes in Groundwater Level and Groundwater Quality (NH_4, Fe, Mn) at Jh-1 Well, Jhenaidah

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



Location: Hamdah, Jhenaidah Pourashava

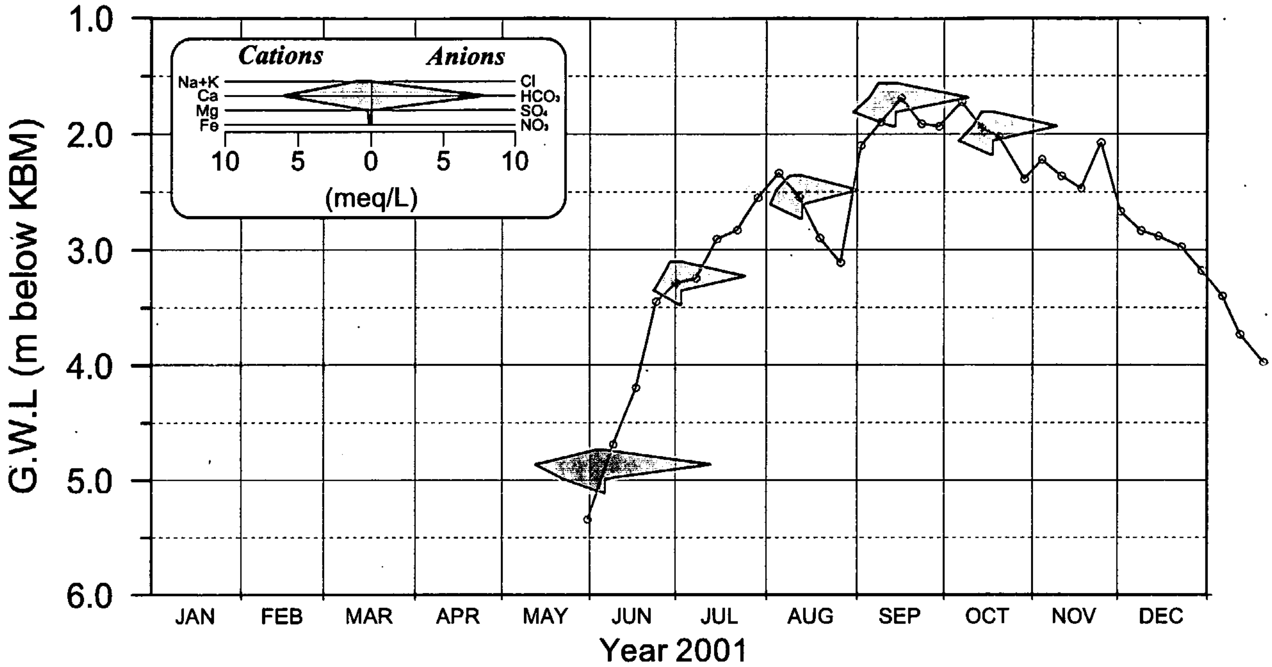
Site No.: JH-2

LEGEND
Jh-2 (Depth = 301.0 m)

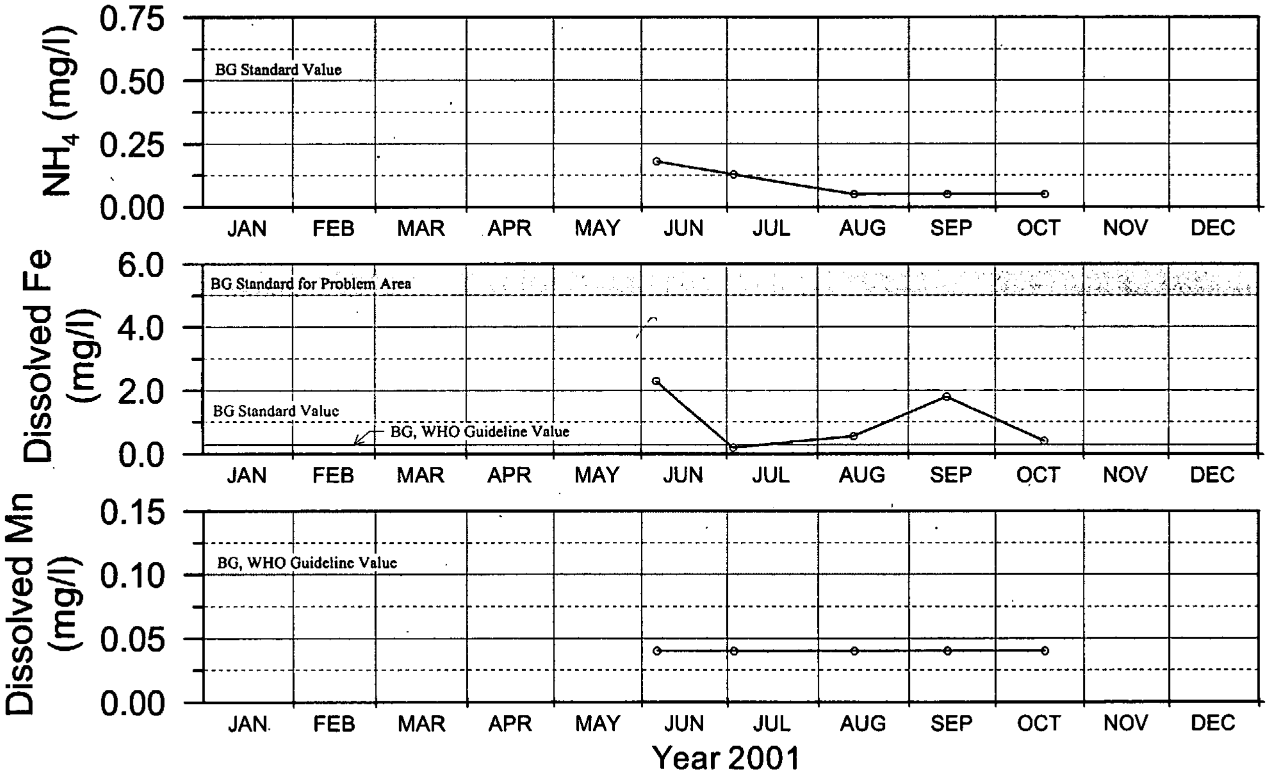
Figure 5.5.39	Changes in Groundwater Level and Groundwater Quality at Jh-2 Well, Jhenaidah

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



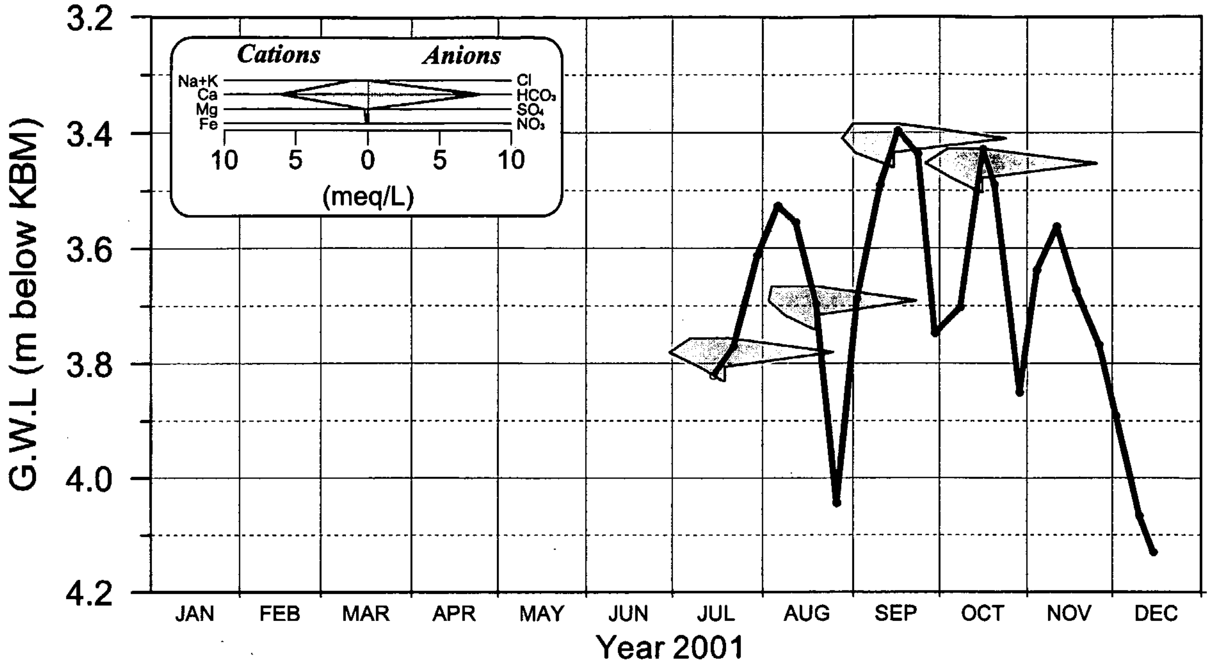
(b) Groundwater Quality (NH_4, Fe, Mn)

Location: Hamdah, Jhenaidah Pourashava

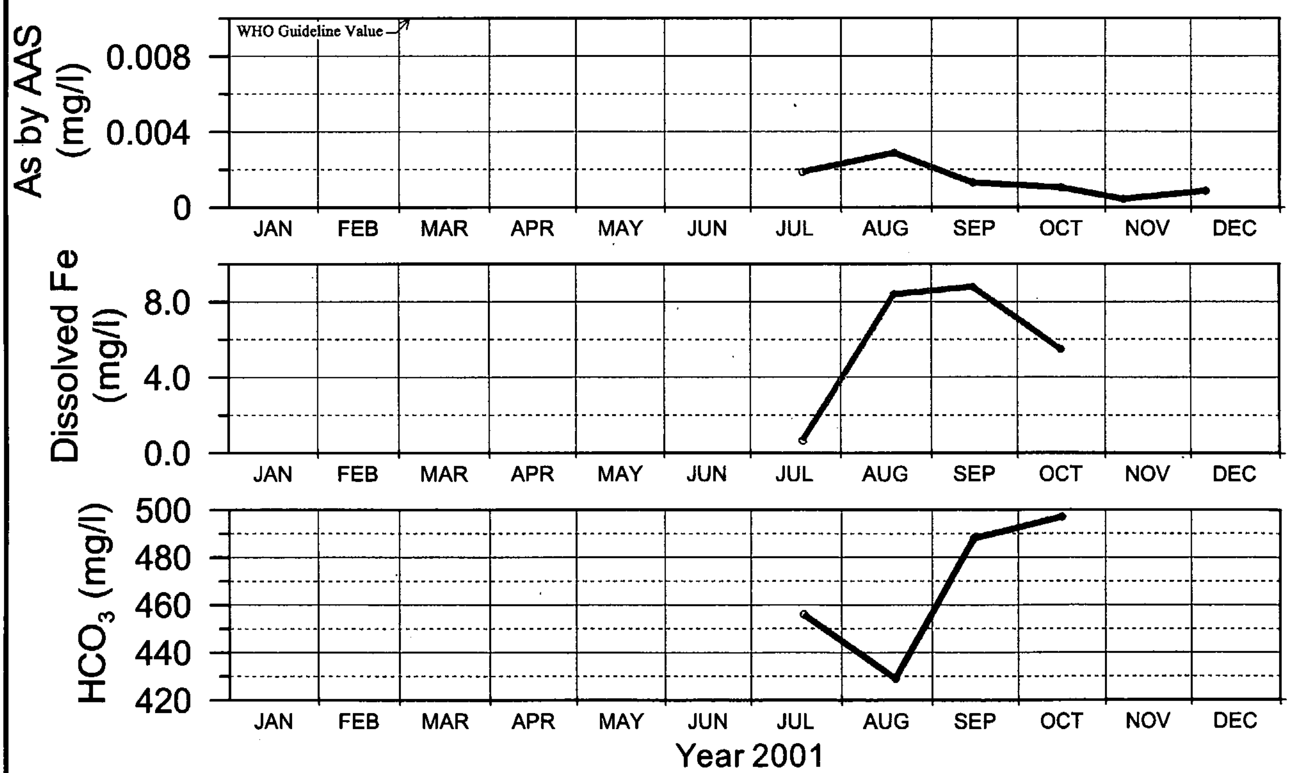
Site No.: JH-2

LEGEND
—o— Jh-2 (Depth = 301.0 m)

Figure 5.5.40	**Changes in Groundwater Level and Groundwater Quality (NH_4, Fe, Mn) at Jh-2 Well, Jhenaidah**
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality (As, Fe, HCO_3)

Location: Ghop, Jessore Pourashava

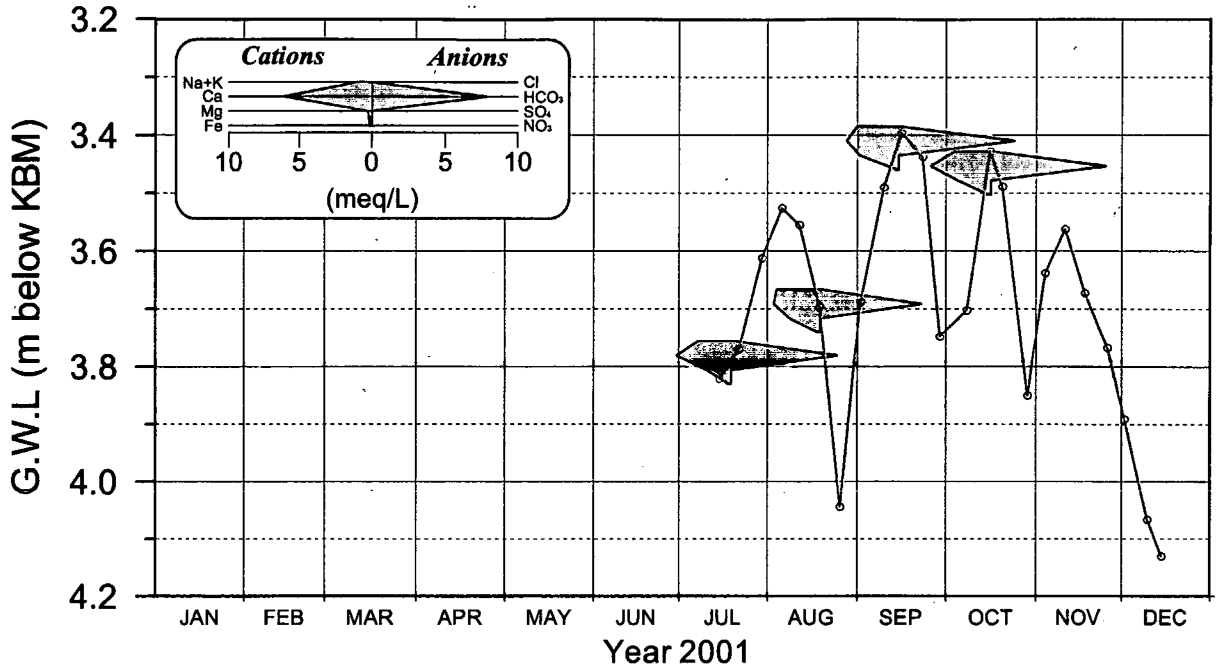
Site No.: JS-1

LEGEND
Js-1 (Depth = 279.5 m)

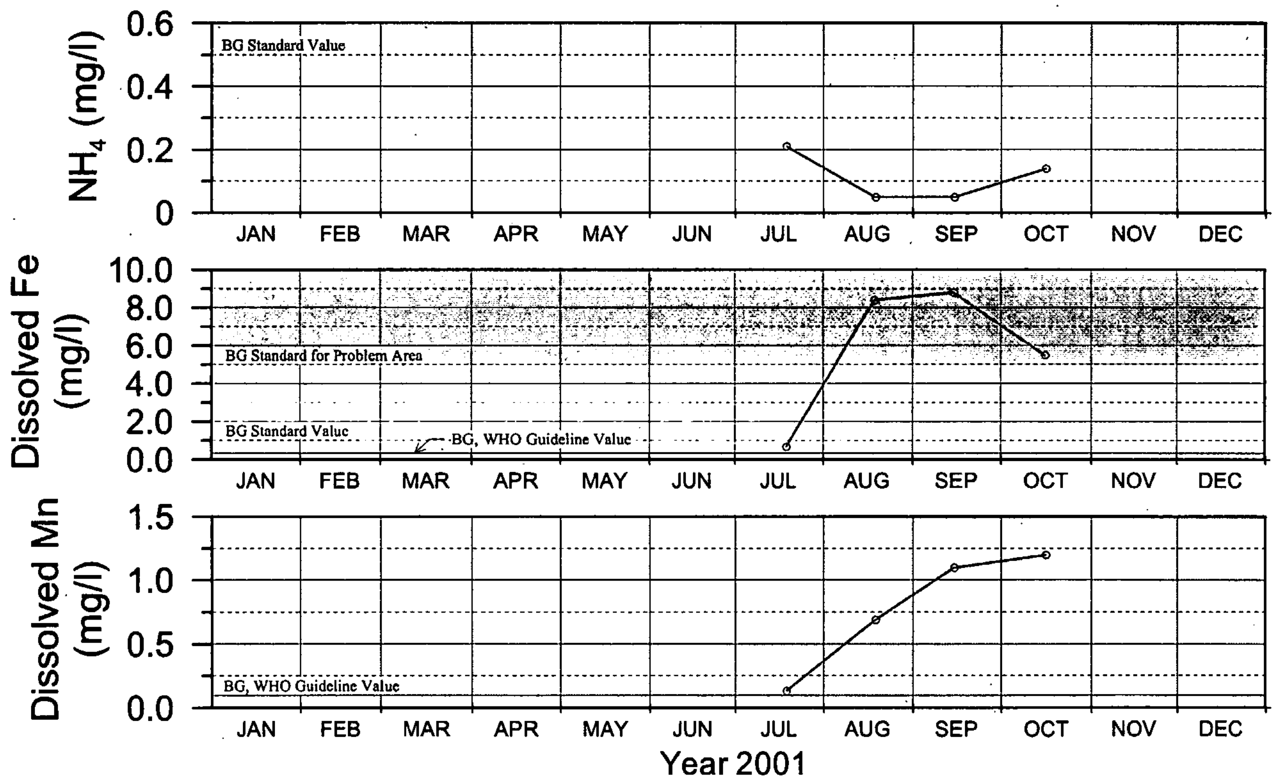
Figure 5.4.41 — **Changes in Groundwater Level and Groundwater Quality at Js-1 Well, Jessore**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality (NH_4, Fe, Mn)

Location: Ghop, Jessore Pourashava

Site No.: JS-1

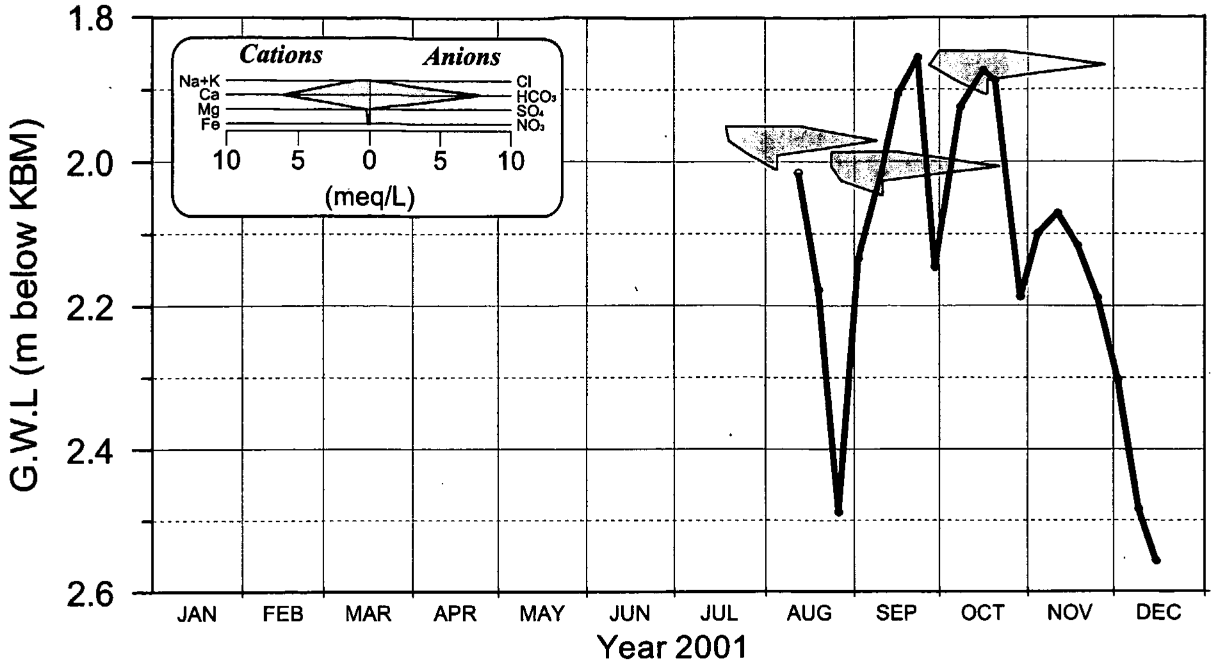
LEGEND

—o— Js-1 (Depth = 279.5 m)

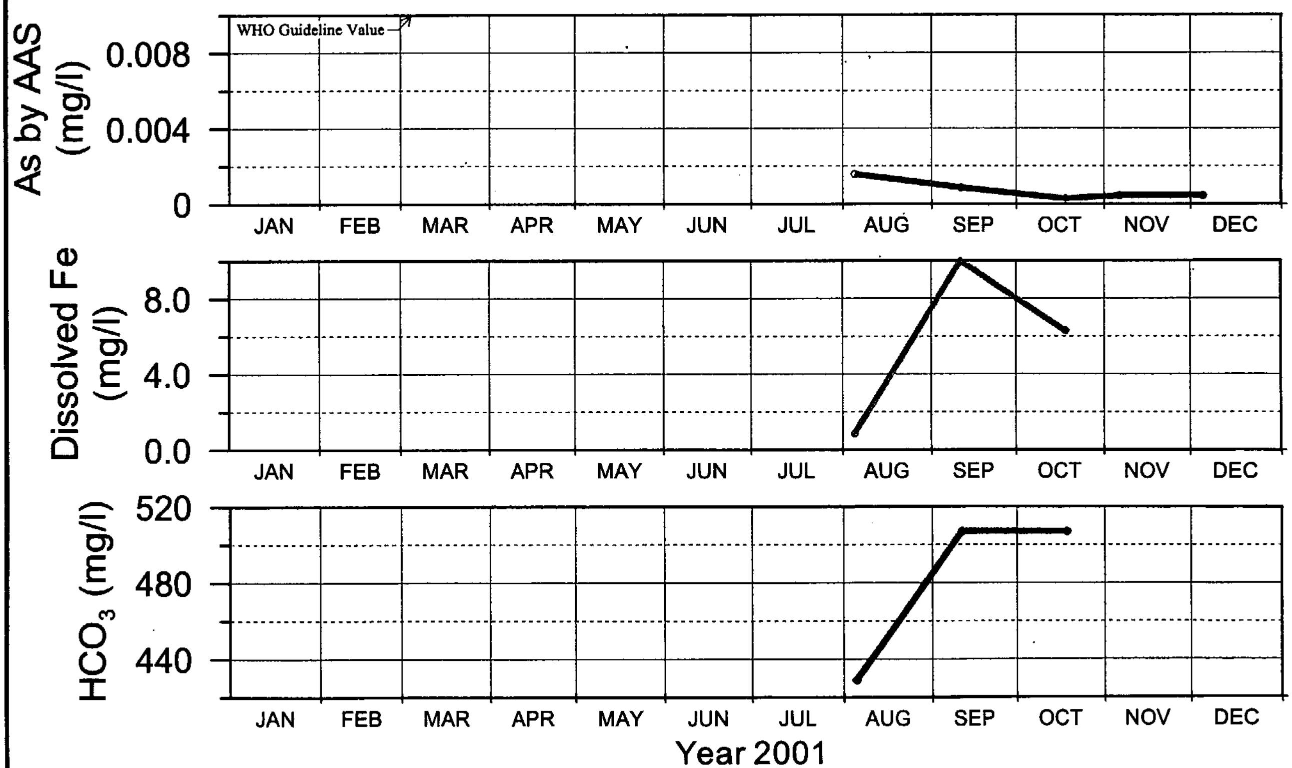
Figure 5.5.42	Changes in Groundwater Level and Groundwater Quality (NH_4, Fe, Mn) at Js-1 Well, Jessore

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality (As, Fe, HCO_3)

Location: Kharki, Jessore Pourashava

Site No.: JS-2

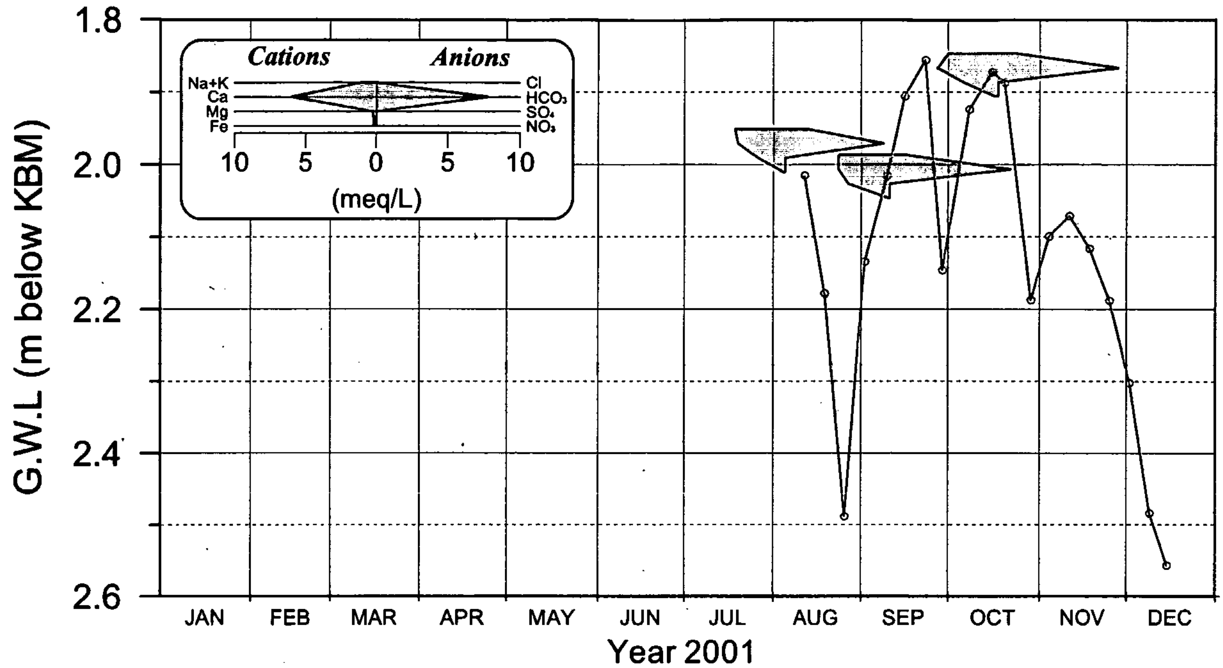
LEGEND

Js-2 (Depth = 261.8 m)

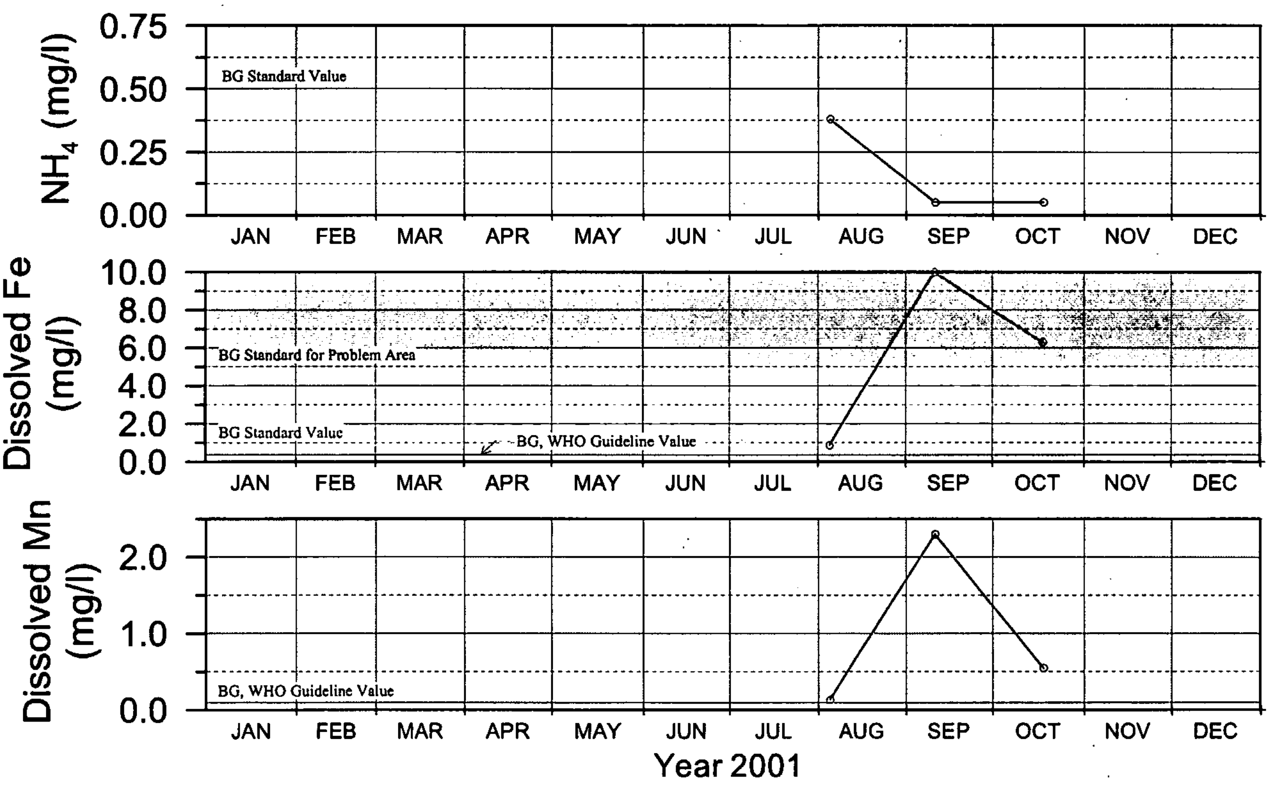
Figure 5.5.43	Changes in Groundwater Level and Groundwater Quality at Js-2 Well, Jessore

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



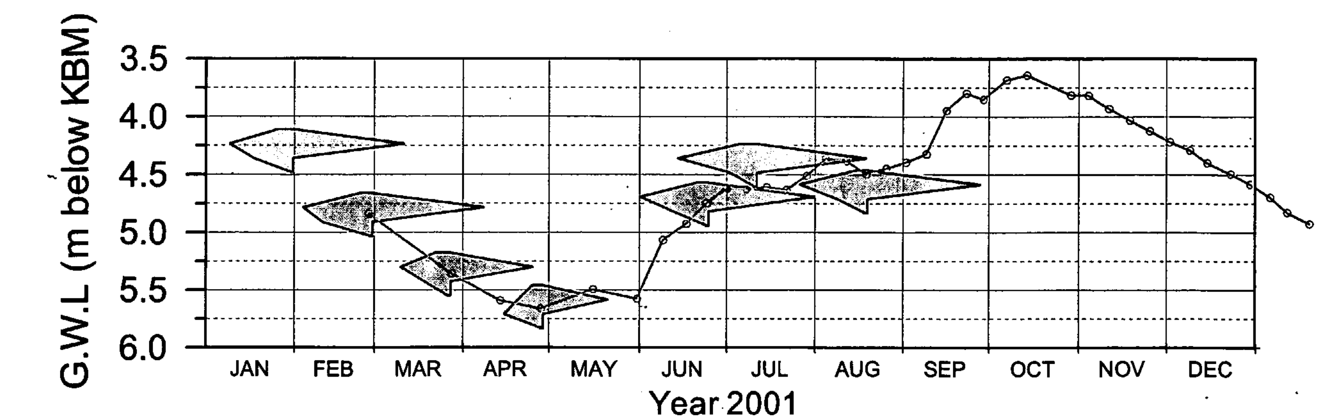
(b) Groundwater Quality (NH_4, Fe, Mn)

Location: Kharki, Jessore Pourashava

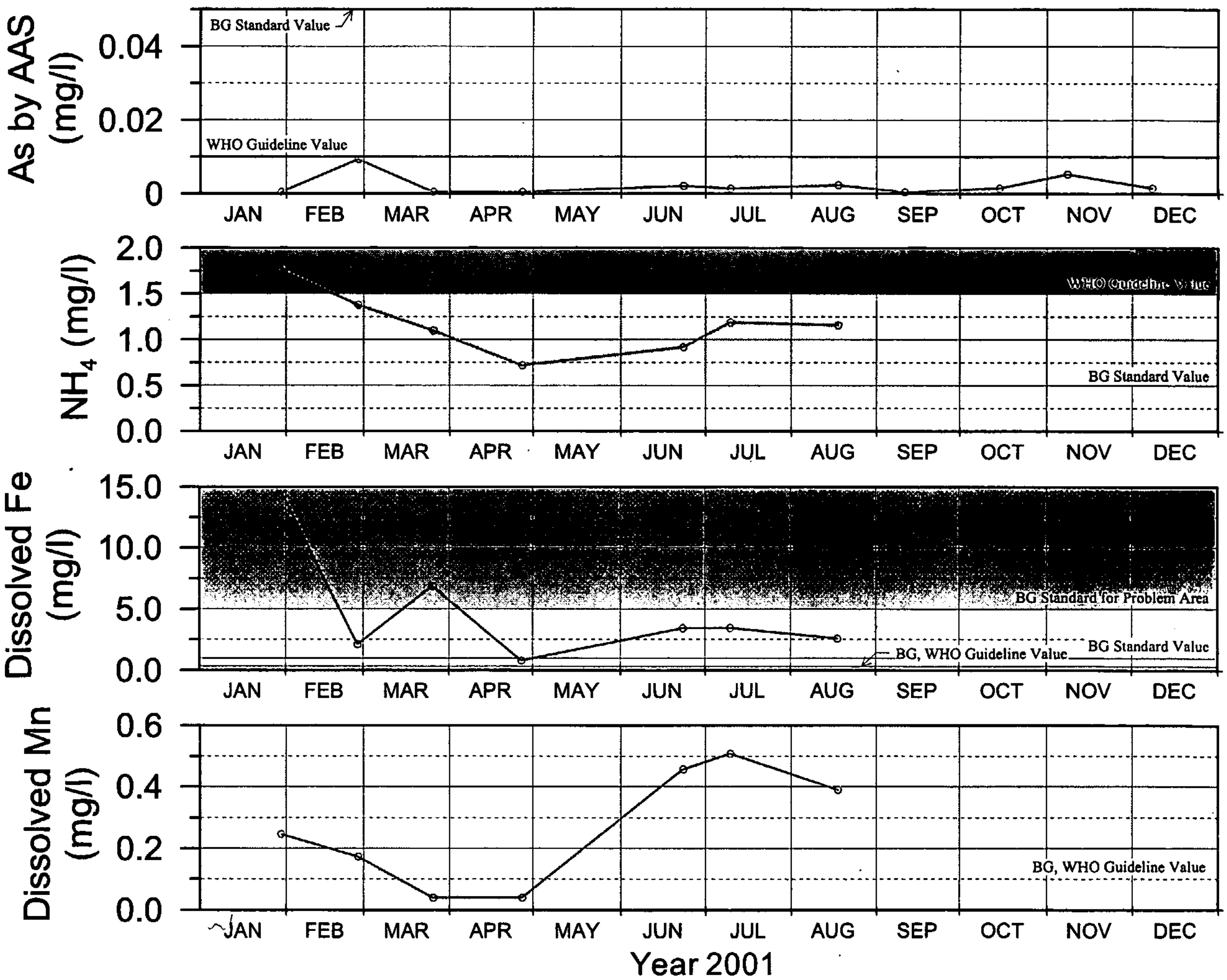
Site No.: JS-2

LEGEND
Js-2 (Depth = 261.8 m)

Figure 5.5.44	**Changes in Groundwater Level and Groundwater Quality (NH_4, Fe, Mn) at Js-2 Well, Jessore**
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality

Location: Bara Dudpatila, Damurhuda Thana
Site No.: CH-BD

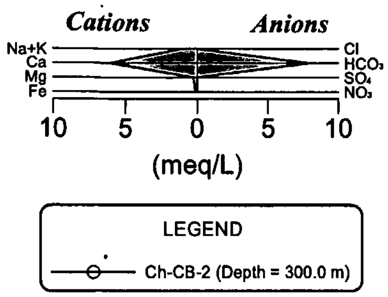
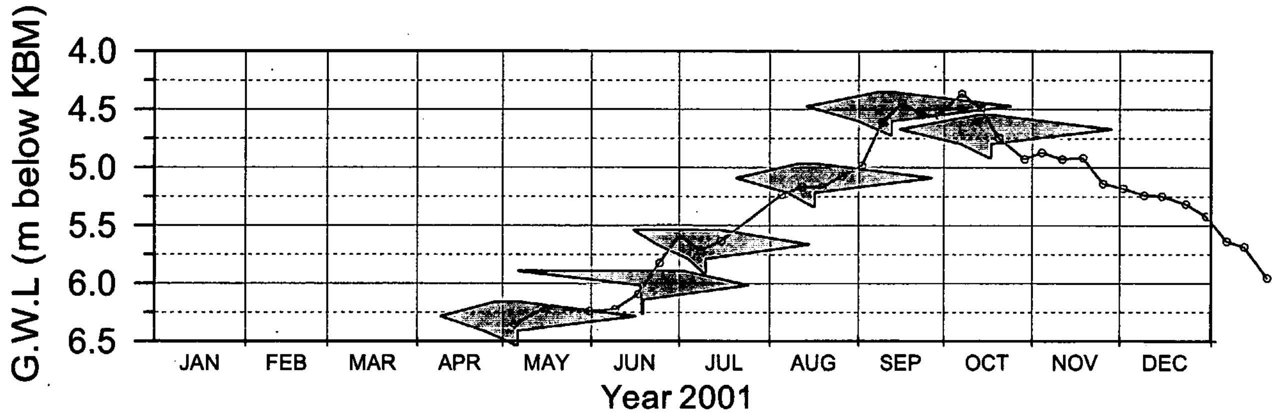


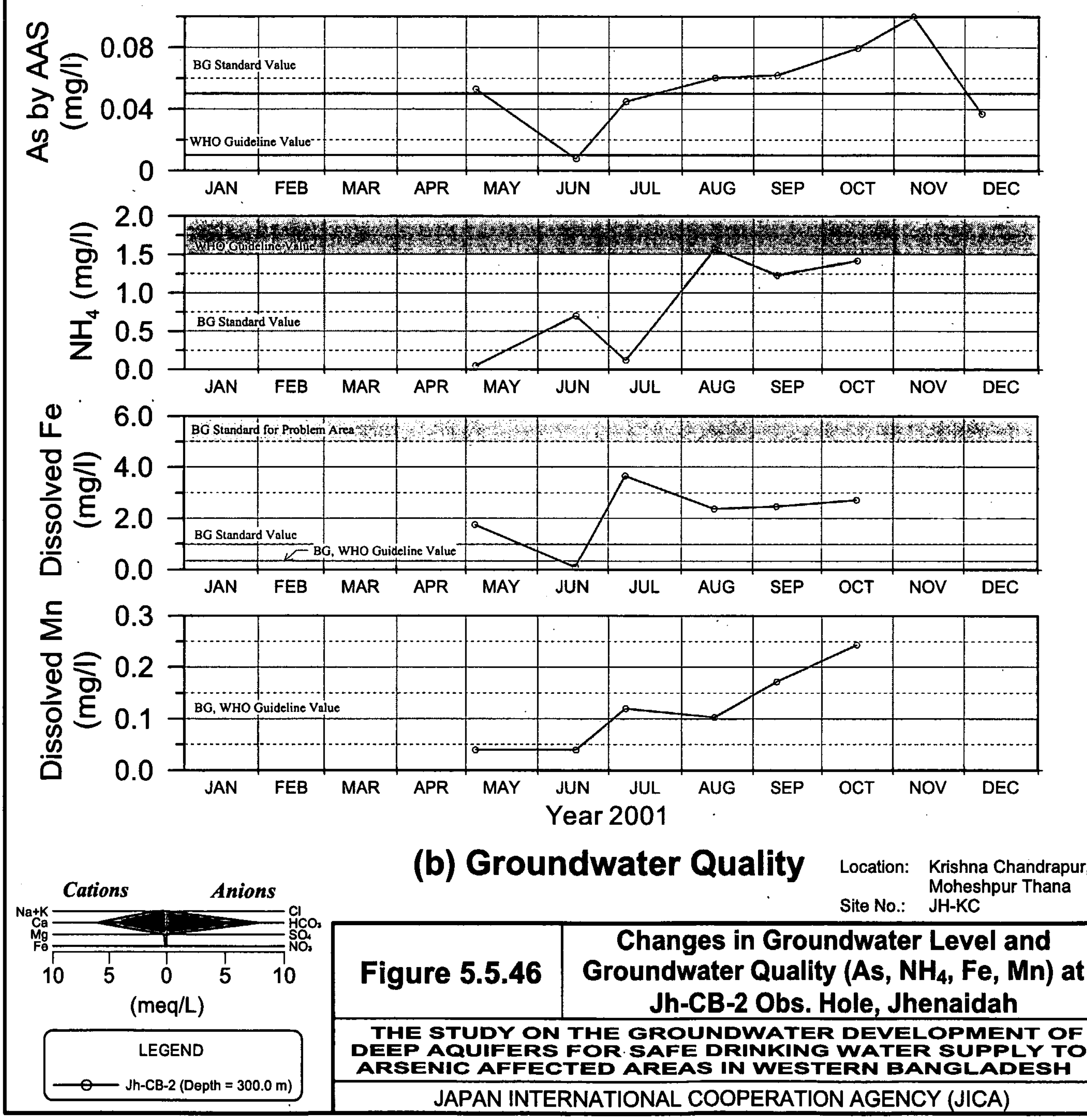
Figure 5.5.45	Changes in Groundwater Level and Groundwater Quality (As, NH_4, Fe, Mn) at Ch-CB-2 Obs. Hole, Chuadanga

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(a) Groundwater Level and Stiff Diagram



(b) Groundwater Quality

Location: Krishna Chandrapur, Moheshpur Thana
Site No.: JH-KC

Figure 5.5.46	Changes in Groundwater Level and Groundwater Quality (As, NH_4, Fe, Mn) at Jh-CB-2 Obs. Hole, Jhenaidah

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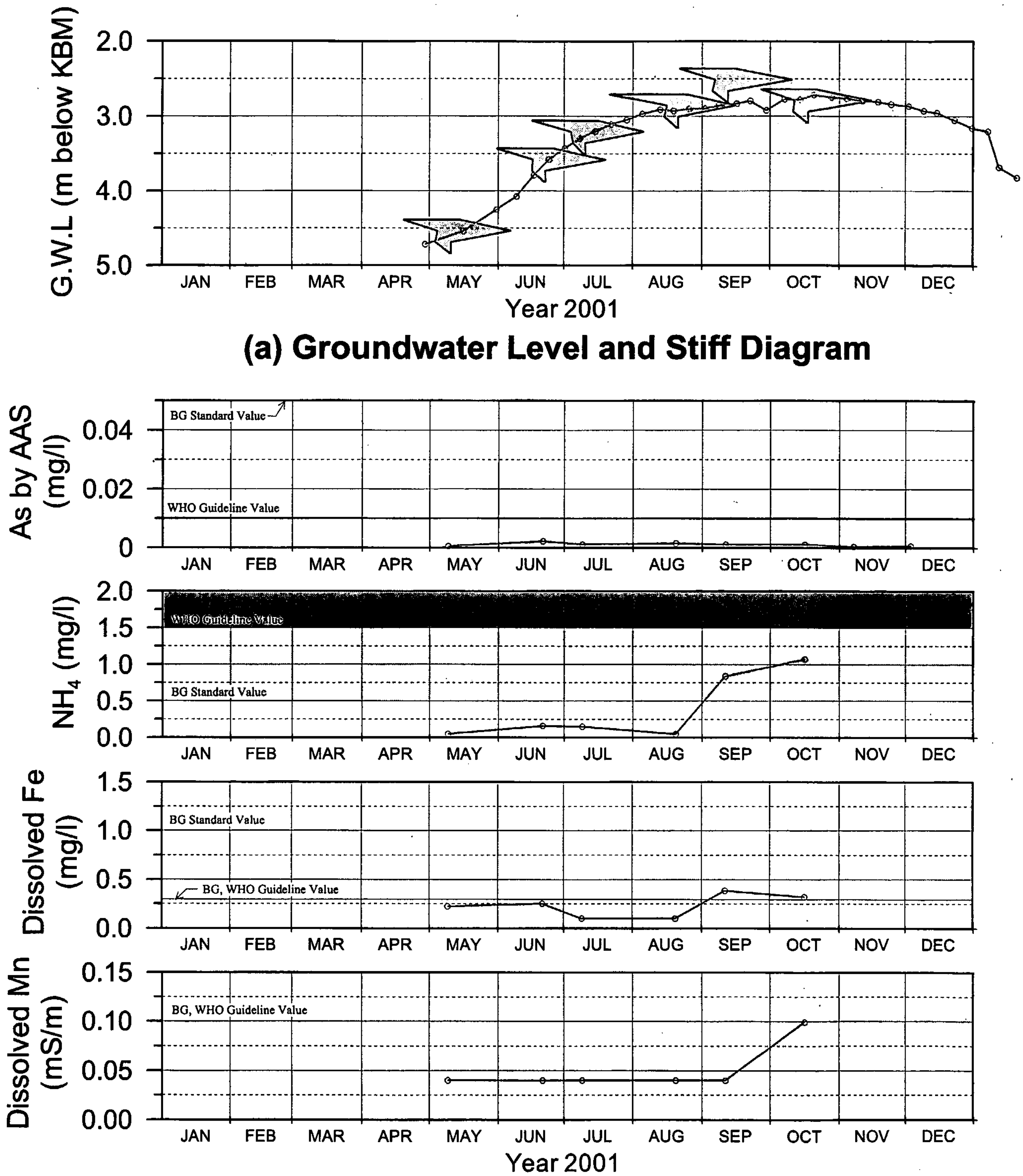
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



(b) Groundwater Quality

Location: Rajnagar Bankabarsi, Keshabpur Thana
Site No.: JS-RB

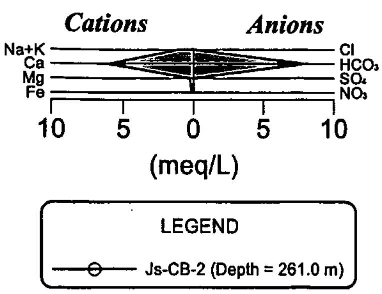


Figure 5.5.47	**Changes in Groundwater Level and Groundwater Quality (As, NH_4, Fe, Mn) at Js-CB-2 Obs. Hole, Jessore**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

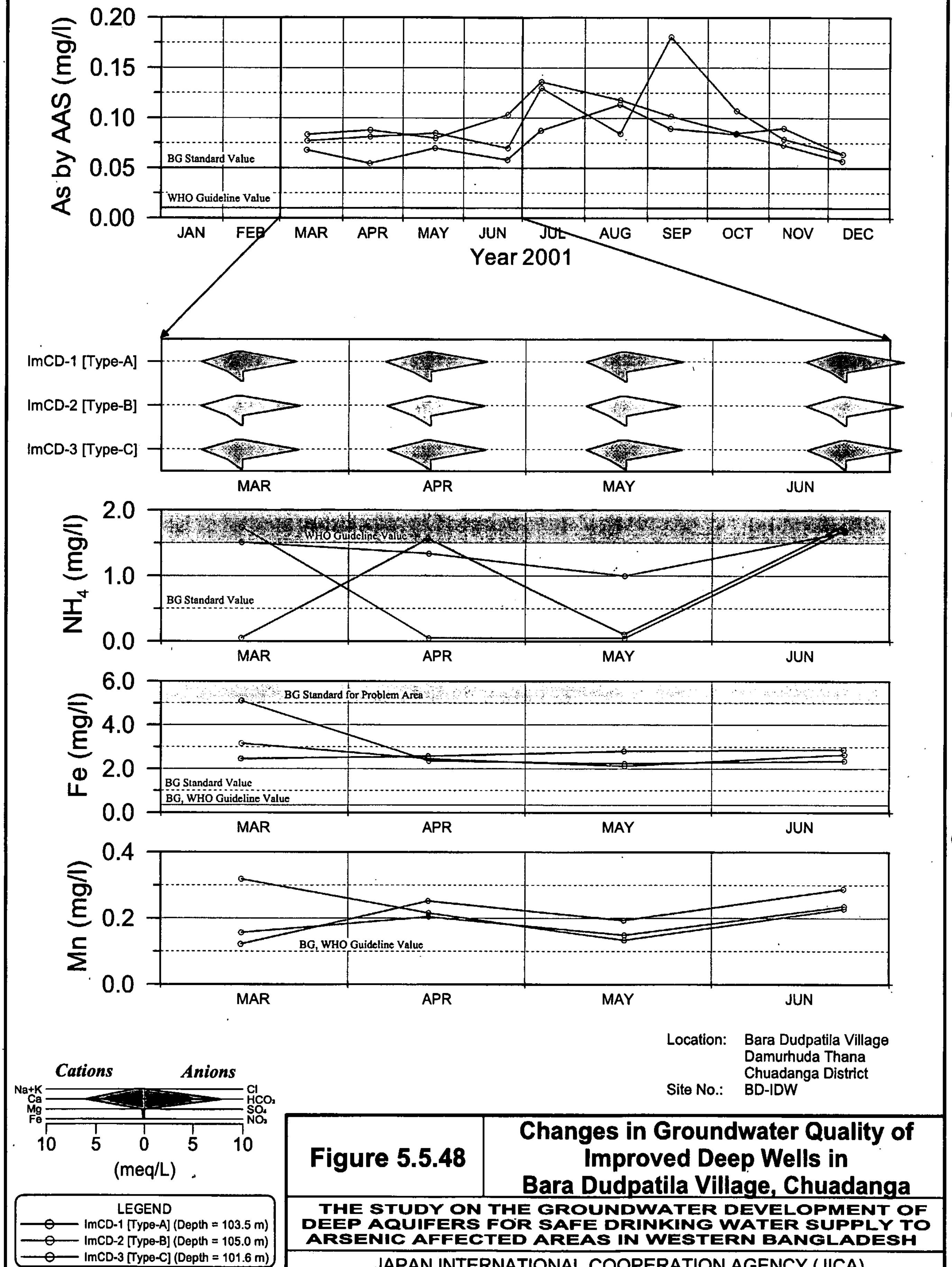
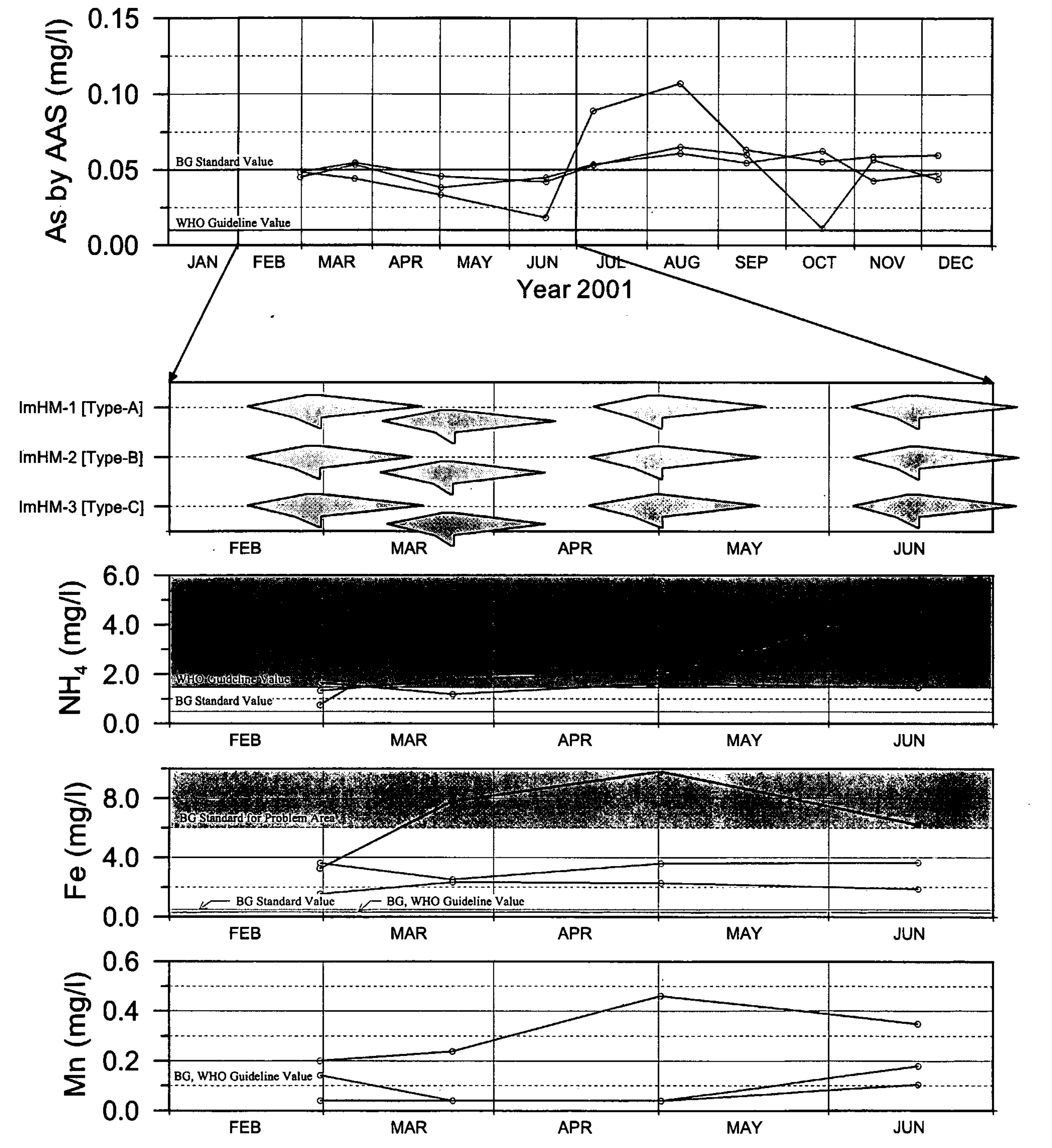


Figure 5.5.48	Changes in Groundwater Quality of Improved Deep Wells in Bara Dudpatila Village, Chuadanga

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



Location: Krishna Chandrapur Village
Moheshpur Thana
Jhenaidah District
Site No.: JH-KC

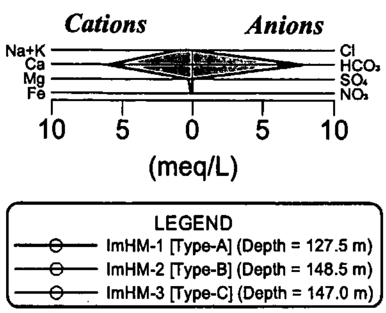
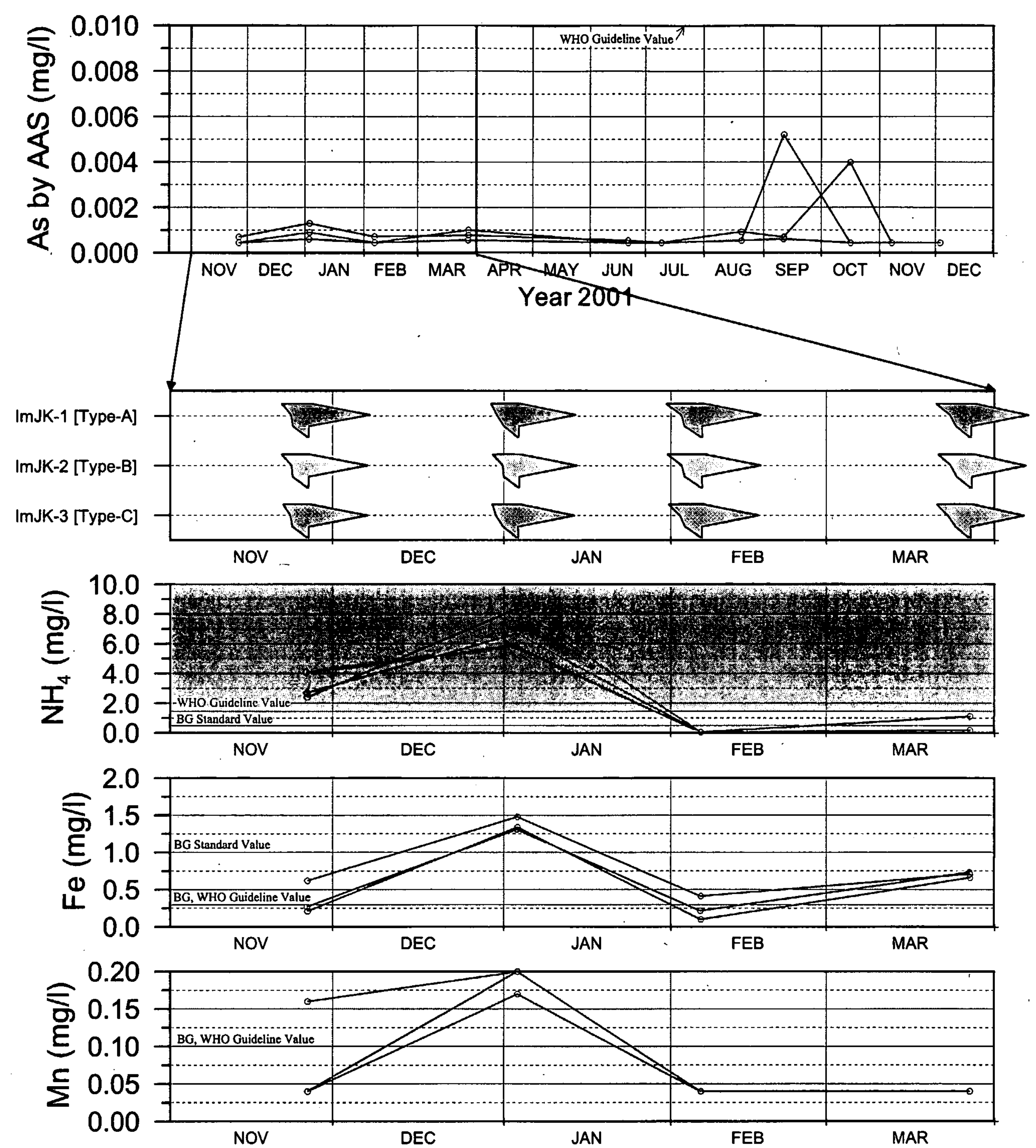


Figure 5.5.49 **Changes in Groundwater Quality of Improved Deep Wells in Krishna Chandrapur Village, Jhenaidah**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



Location: Rajnagar Bankabarsi Village
Keshabpur Thana
Jessore District
Site No.: RB-IDW

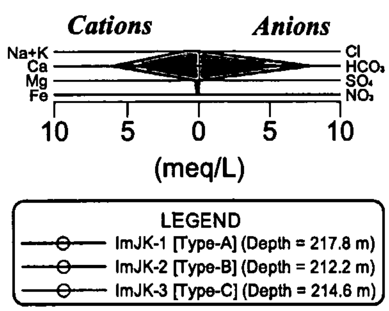
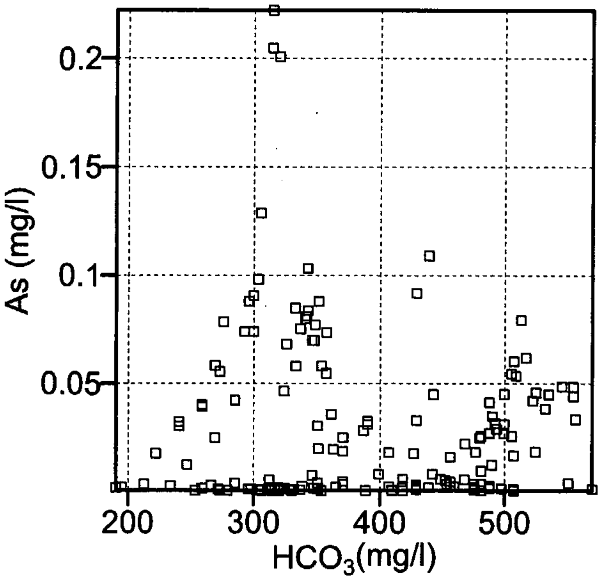


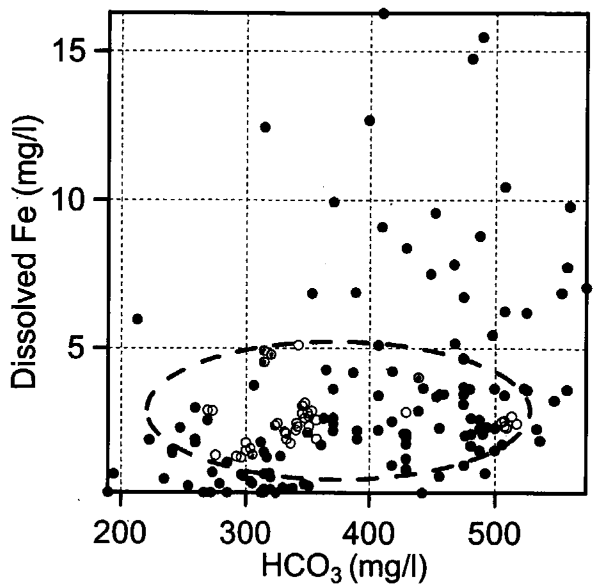
Figure 5.5.50 **Changes in Groundwater Quality of Improved Deep Wells in Rajnagar Bankabarsi Village, Jessore**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

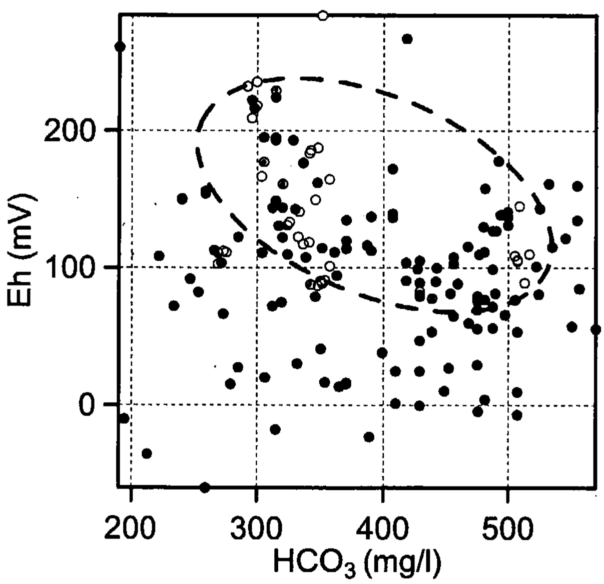
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



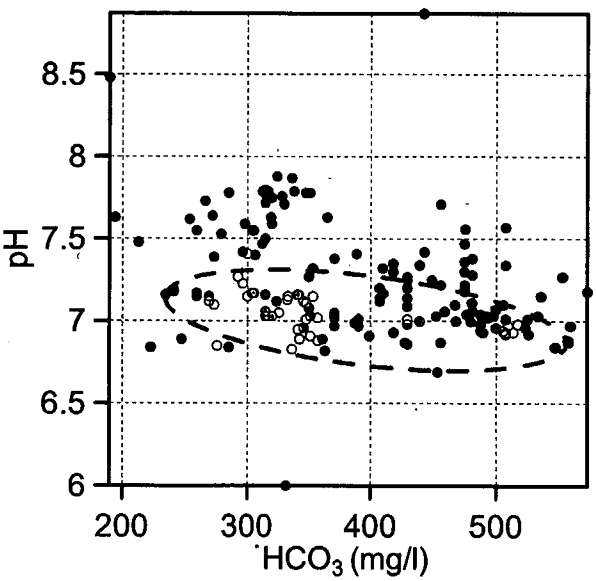
a) Relation between As and HCO_3



b) Relation among Fe, HCO_3 and As



c) Relation among Eh, HCO_3 and As



d) Relation among pH, HCO_3 and As

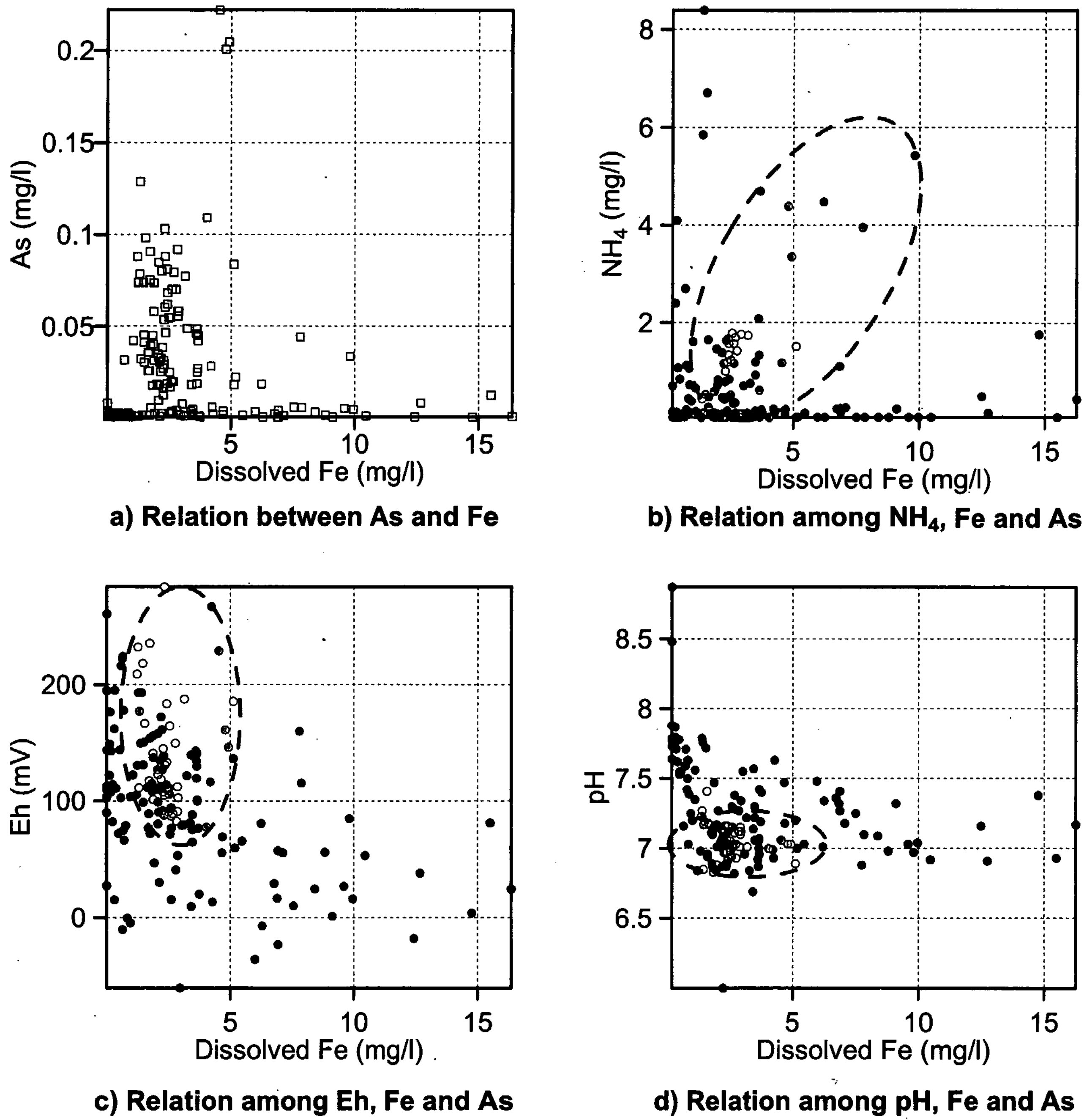
High Arsenic Concentration Zone

As Concentration (mg/l)
Analyzed by AAS

- 0 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.5
- 0.5 to 1
- 1 to 2

[The arsenic concentration and other water quality parameters were analyzed in the monthly groundwater monitoring program in 2001.
The arsenic concentrations were analyzed by the AAS in Jhenaidah Laboratory.
The other water quality parameters were analyzed in Plasma+ Laboratory, Dhaka.]

Figure 5.5.51	Relations of Bicarbonate to As, Fe, Eh, and pH in Groundwater of JICA Observation Wells/Holes
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



High Arsenic Concentration Zone

As Concentration (mg/l)
Analyzed by AAS

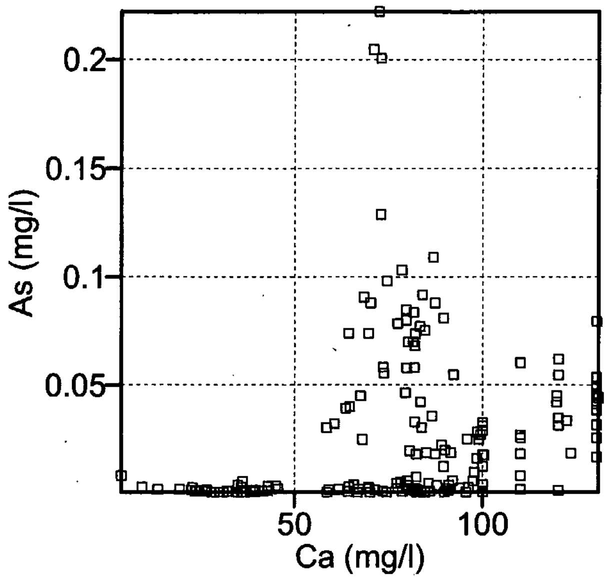
- 0 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.5
- 0.5 to 1
- 1 to 2

[The arsenic concentration and other water quality parameters were analyzed in the monthly groundwater monitoring program in 2001.
The arsenic concentrations were analyzed by the AAS in Jhenaidah Laboratory.
The other water quality parameters were analyzed in Plasma+ Laboratory, Dhaka.]

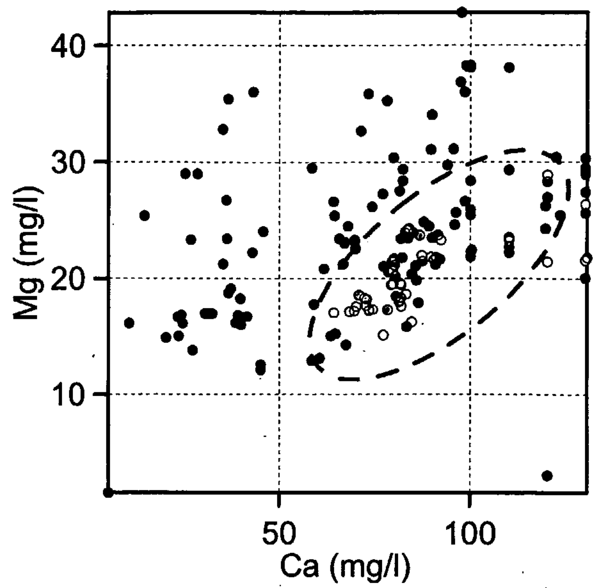
Figure 5.5.52	**Relations of Dissolved Iron to As, NH_4, Eh, and pH in Groundwater of JICA Observation Wells/Holes**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

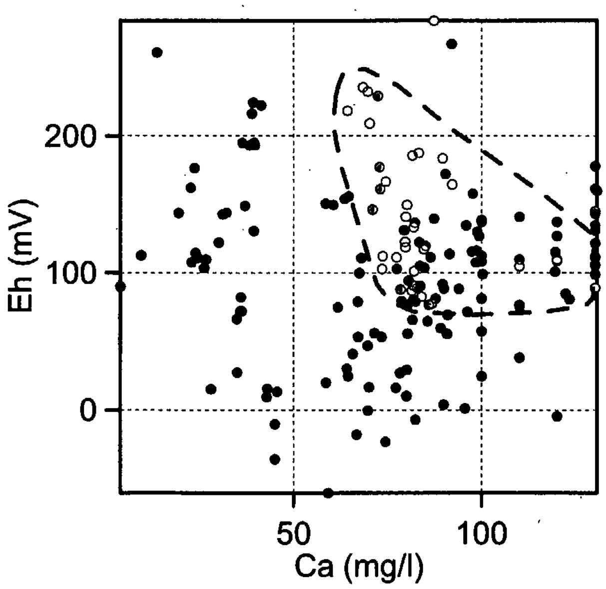
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



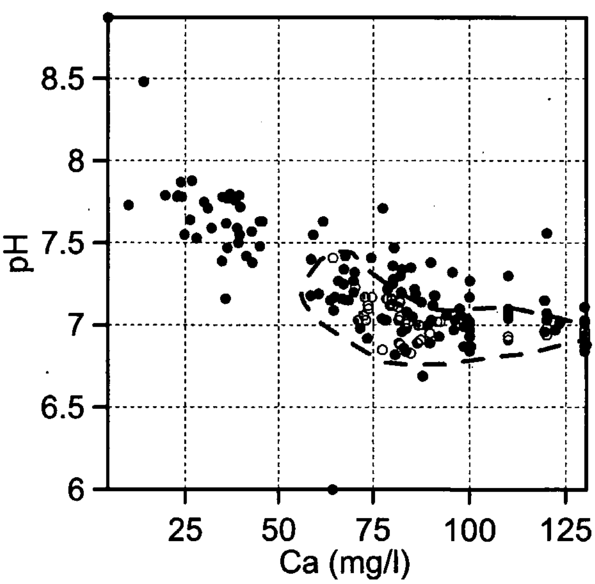
a) Relation between As and Ca



b) Relation among Mg, Ca and As



c) Relation among Eh, Ca and As



d) Relation among pH, Ca and As

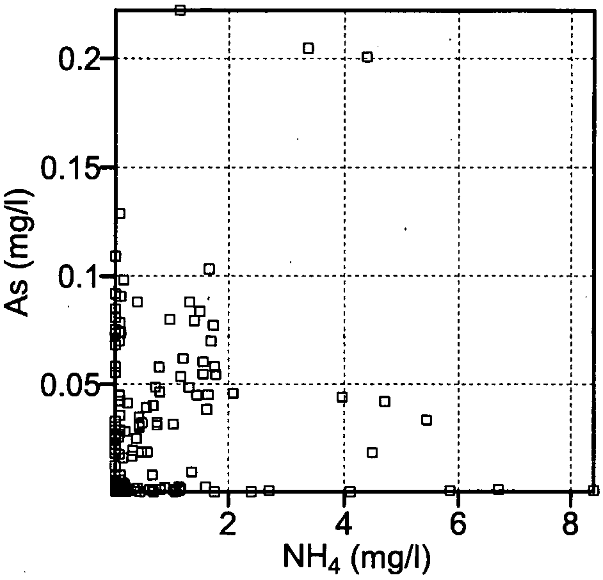
High Arsenic Concentration Zone

As Concentration (mg/l)
Analyzed by AAS

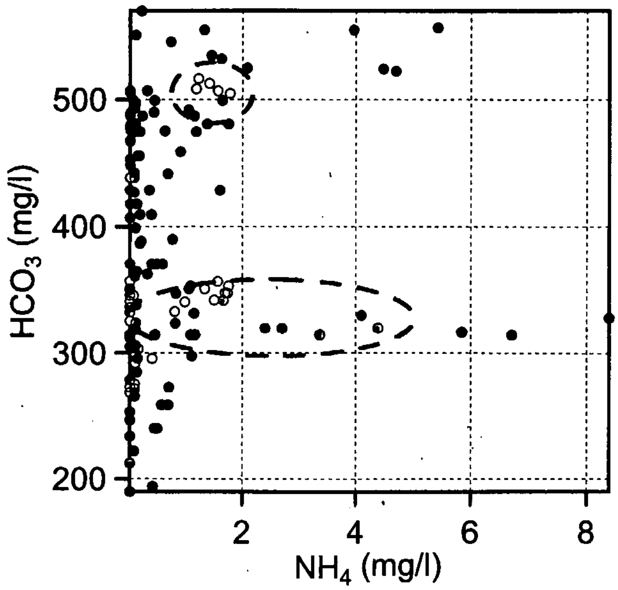
- 0 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.5
- 0.5 to 1
- 1 to 2

[The arsenic concentration and other water quality parameters were analyzed in the monthly groundwater monitoring program in 2001.
The arsenic concentrations were analyzed by the AAS in Jhenaidah Laboratory.
The other water quality parameters were analyzed in Plasma+ Laboratory, Dhaka.]

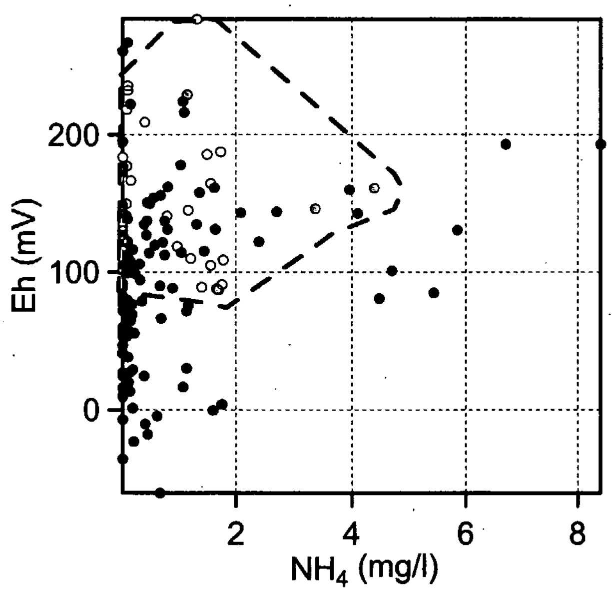
Figure 5.5.53	Relations of Calcium to As, Mg, Eh, and pH in Groundwater of JICA Observation Wells/Holes
THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	



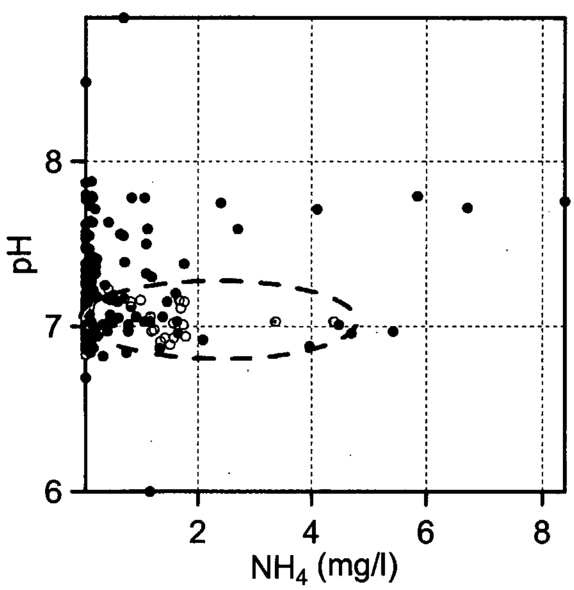
a) Relation between As and NH_4



b) Relation among HCO_3, NH_4 and As



c) Relation among Eh, NH_4 and As



d) Relation among pH, NH_4 and As

High Arsenic Concentration Zone

As Concentration (mg/l)
Analyzed by AAS

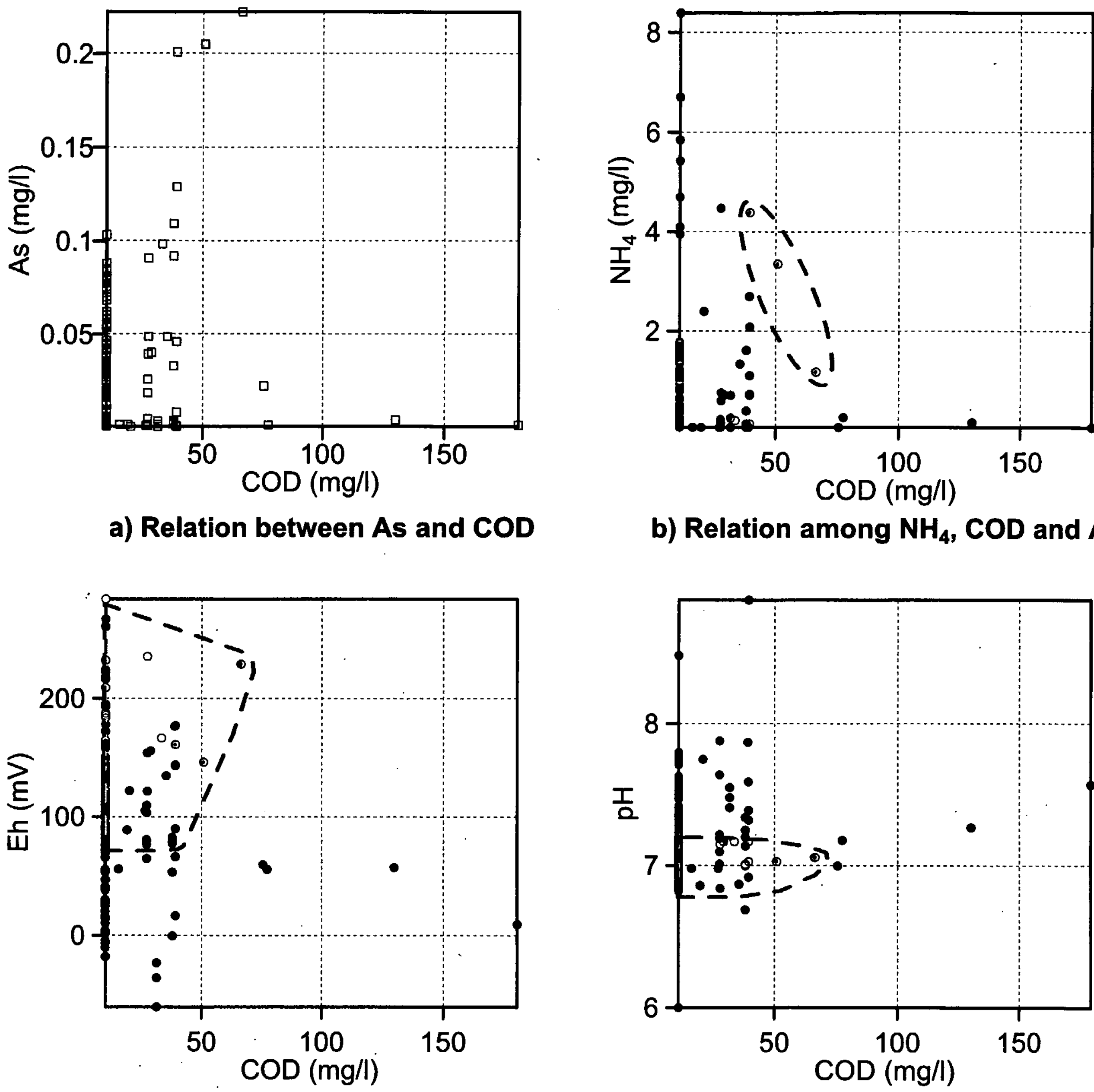
- 0 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.5
- 0.5 to 1
- 1 to 2

[The arsenic concentration and other water quality parameters were analyzed in the monthly groundwater monitoring program in 2001.
The arsenic concentrations were analyzed by the AAS in Jhenaidah Laboratory.
The other water quality parameters were analyzed in Plasma+ Laboratory, Dhaka.]

Figure 5.5.54	Relations of Ammonium to As, HCO_3, Eh, and pH in Groundwater of JICA Observation Wells/Holes

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



a) Relation between As and COD

b) Relation among NH_4, COD and As

c) Relation among Eh, COD and As

d) Relation among pH, COD and As

High Arsenic Concentration Zone

As Concentration (mg/l)
Analyzed by AAS

- 0 to 0.005
- 0.005 to 0.01
- 0.01 to 0.05
- 0.05 to 0.1
- 0.1 to 0.5
- 0.5 to 1
- 1 to 2

[The arsenic concentration and other water quality parameters were analyzed in the monthly groundwater monitoring program in 2001.
The arsenic concentrations were analyzed by the AAS in Jhenaidah Laboratory.
The other water quality parameters were analyzed in Plasma+ Laboratory, Dhaka.]

Figure 5.5.55	Relations of COD to As, NH_4, Eh, and pH in Groundwater of JICA Observation Wells/Holes

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

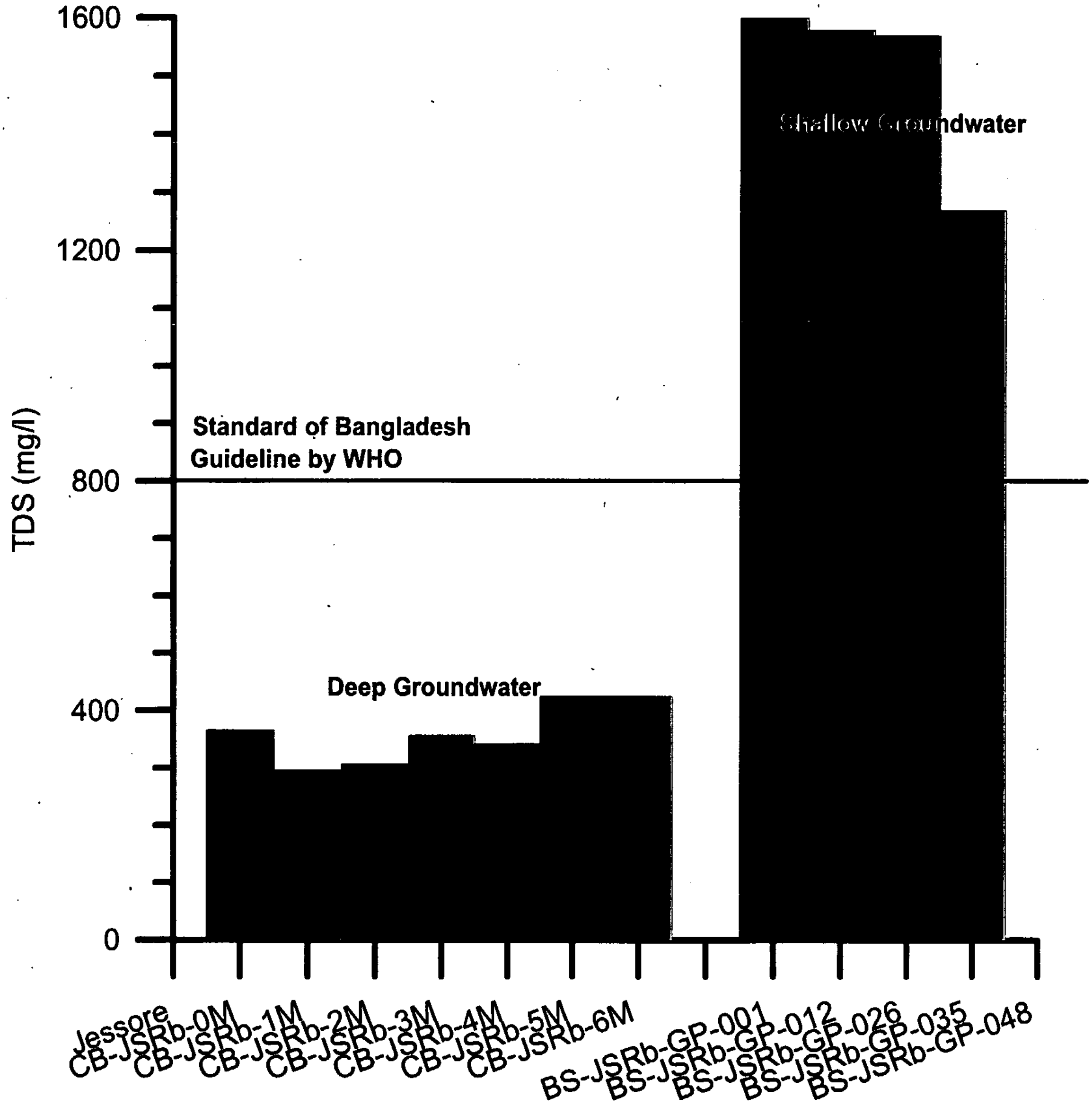


Figure 5.5.56	TDS Data Comparison between Shallow and Deep Groundwater in Rajnagar Bankabarsi

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

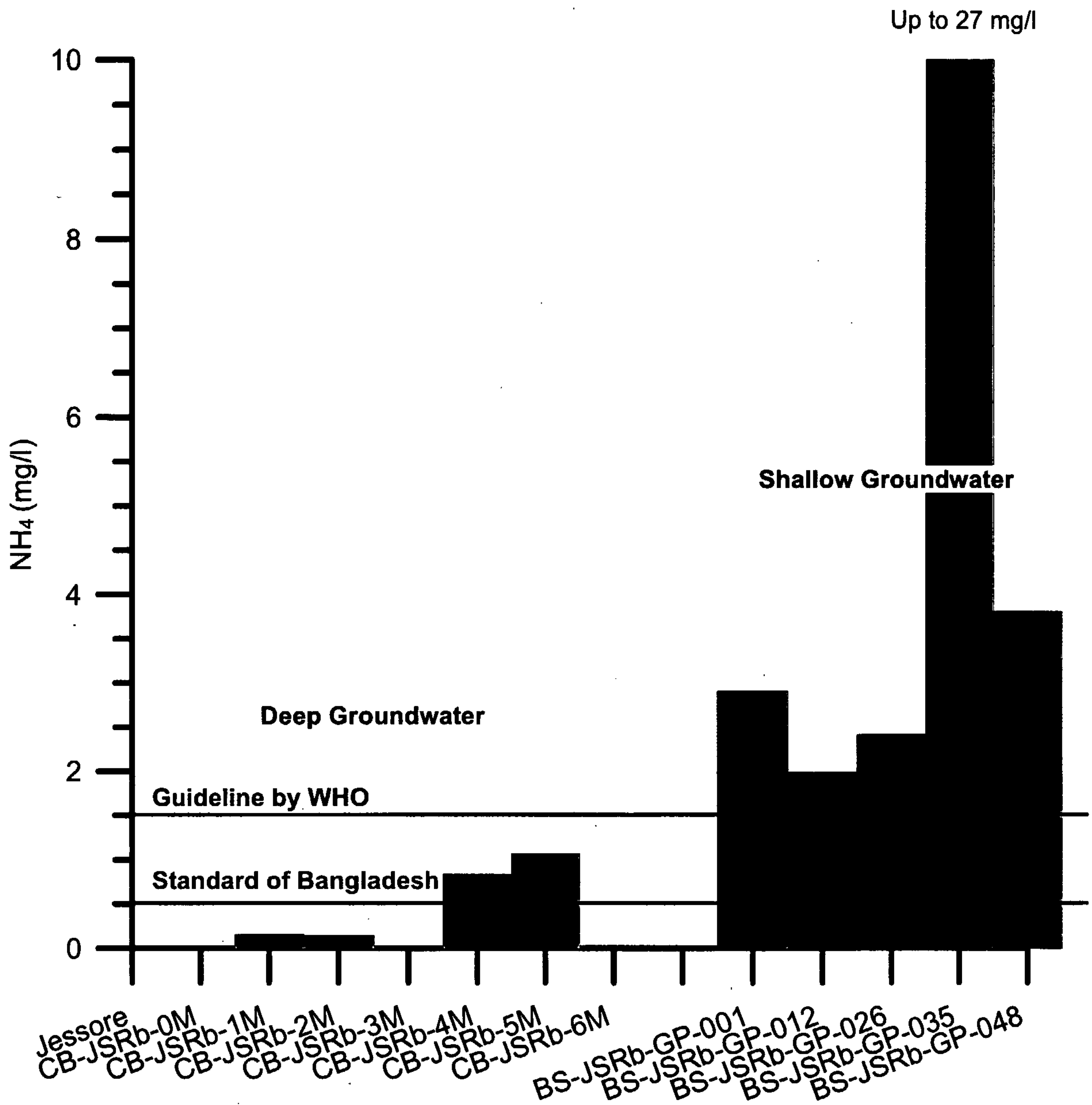


Figure 5.5.57	NH_4 Data Comparison between Shallow and Deep Groundwater in Rajnagar Bankabarsi

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

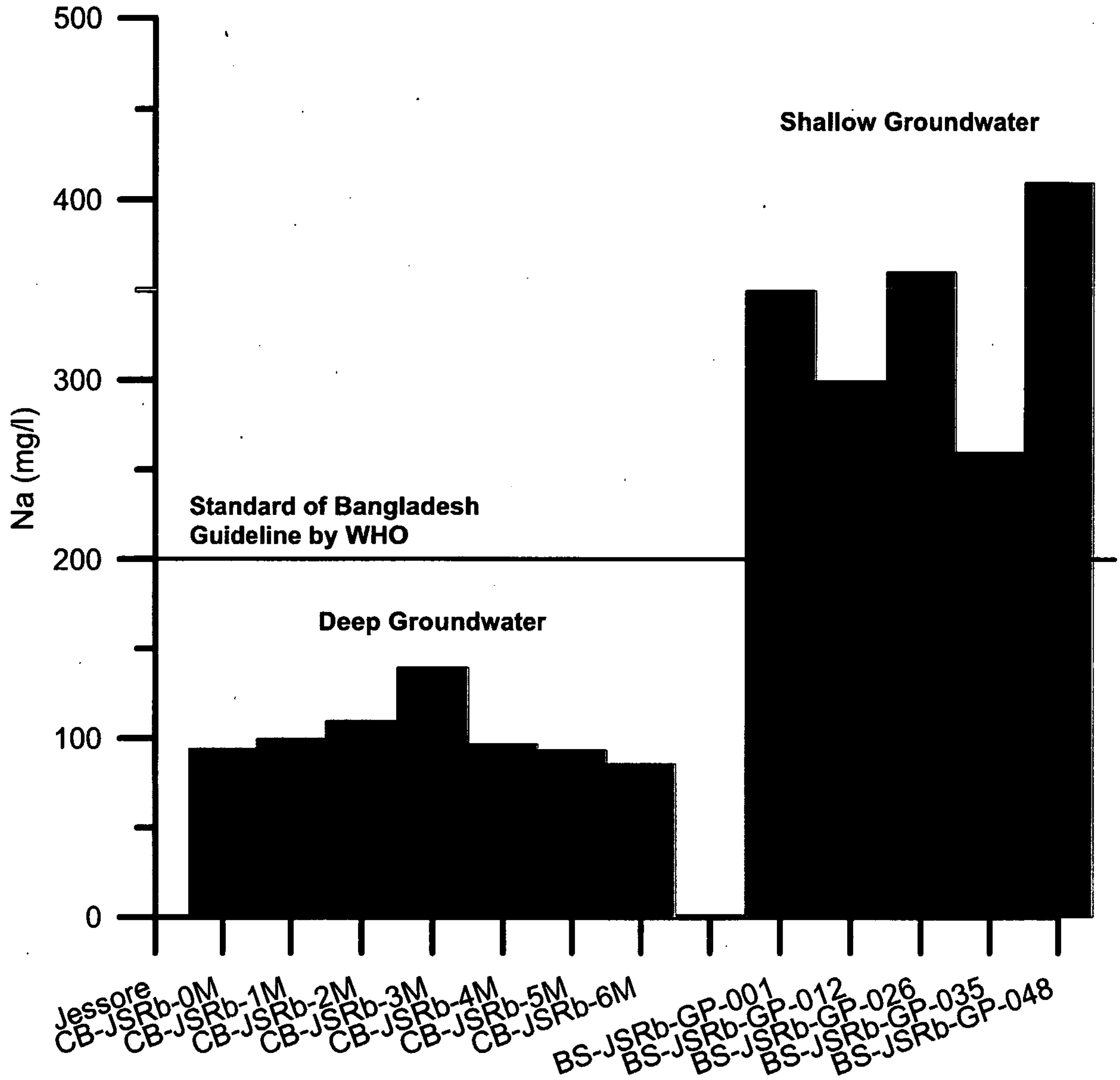


Figure 5.5.58	**Na Data Comparison between Shallow and Deep Groundwater in Rajnagar Bankabarsi**

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

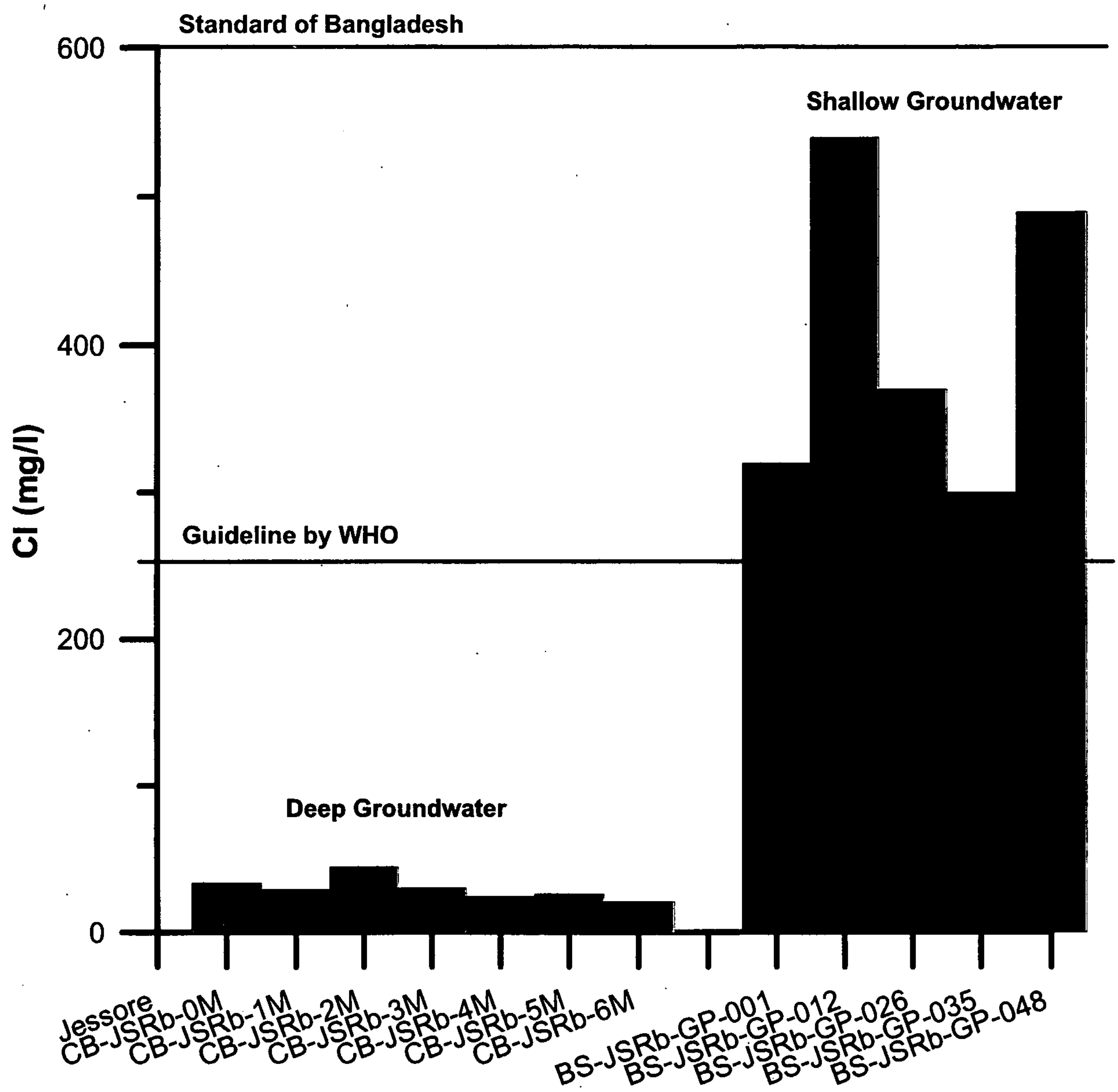


Figure 5.5.59	Cl Data Comparison between Shallow and Deep Groundwater in Rajnagar Bankabarsi

THE STUDY ON THE GROUNDWATER DEVELOPMENT OF DEEP AQUIFERS FOR SAFE DRINKING WATER SUPPLY TO ARSENIC AFFECTED AREAS IN WESTERN BANGLADESH

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)