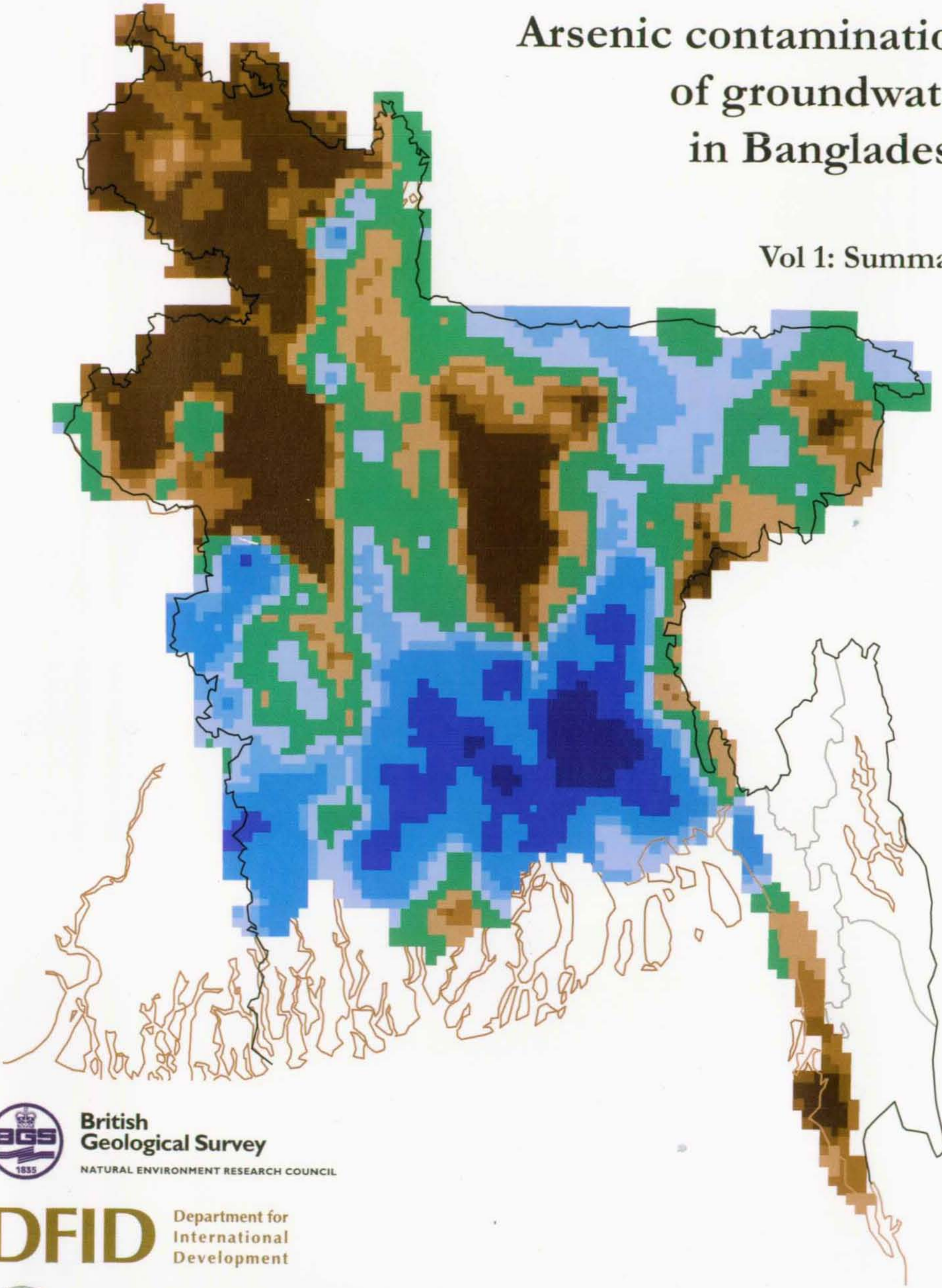
BGS Technical Report WC/00/19, Volume 1

Arsenic contamination of groundwater in Bangladesh

Vol 1: Summary



British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Government of the People's Republic of Bangladesh
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D G Kinniburgh and P L Smedley (Editors)

February 2001

The full report comprises four volumes:

- Volume 1. Summary
- Volume 2. Final report
- Volume 3. Hydrochemical atlas
- Volume 4. Data compilation

Further information can also be viewed and downloaded from our website at www.bgs.ac.uk/arsenic/Bangladesh

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Cover Illustration
Map of Bangladesh showing the regional distribution of arsenic in groundwater found during the National Hydrochemical Survey

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Executive summary

A survey of well waters (n=3534) from throughout Bangladesh, excluding the Chittagong Hill Tracts, has shown that water from 27% of the 'shallow' tubewells, that is wells less than 150 m deep, exceeded the Bangladesh standard for arsenic in drinking water (50 $\mu g\ L^{-1}$). 46% exceeded the WHO guideline value of 10 $\mu g\ L^{-1}$. Figures for 'deep' wells (greater than 150 m deep) were 1% and 5%, respectively. Since it is believed that there are a total of some 6–11 million tubewells in Bangladesh, mostly exploiting the depth range 10–50 m, some 1.5–2.5 million wells are estimated to be contaminated with arsenic according to the Bangladesh standard. 35 million people are believed to be exposed to an arsenic concentration in drinking water exceeding 50 $\mu g\ L^{-1}$ and 57 million people exposed to a concentration exceeding 10 $\mu g\ L^{-1}$.

There is a distinct regional pattern of arsenic contamination with the greatest contamination in the south and south-east of the country and the least contamination in the north-west and in the uplifted areas of north-central Bangladesh. However, there are occasional arsenic 'hot spots' in the generally low-arsenic regions of northern Bangladesh. In arsenic-contaminated areas, the large degree of well-to-well variation within a village means that it is difficult to predict whether a given well will be contaminated from tests carried out on neighbouring wells.

The young (Holocene) alluvial and deltaic deposits are most affected whereas the older alluvial sediments in the

It is unlikely that the regional pattern of arsenic con-

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hypothesis. Natural variations in the amount of iron oxide at the time of sediment burial may be a key factor in controlling the distribution of high arsenic groundwaters. Limited evidence suggests that the isolated arsenic hot spots found in northern Bangladesh occur in areas containing sediments particularly rich in iron oxides, and their accompanying adsorbed arsenic load.

While there is evidence for sulphide minerals in some of the sediments, and in some cases indirect evidence for their oxidation, there is no support for the 'pyrite oxidation' hypothesis in which pyrite oxidation in the zone of water table fluctuation is assumed to release arsenic and ultimately to be responsible for the groundwater arsenic problem. There is no evidence to support the proposition that the groundwater arsenic problem is caused by the recent seasonal drawdown of the water table due to a recent increase in irrigation abstraction.

Monitoring of groundwaters at two-weekly intervals at a number of sites, and at different depths, has shown some variation with time but there is as yet no convincing evidence for seasonal changes. Dramatic changes in contamination are not expected within such a short timescale. A monitoring programme should be undertaken at a range of sites to monitor possible long-term changes. In the three contaminated areas studied in most detail, the arsenic concentration increases most rapidly between 10–20 m below ground level.

While arsenic is the single greatest problem in Bangladesh groundwaters, other elements of concern from a health point of view, are manganese, boron and uranium. Some 35% of the groundwaters sampled exceeded the WHO guideline value for manganese (0.5 mg L^{-1}). The spatial pattern of the arsenic and manganese problem areas was significantly different and only 33% of shallow well waters complied with the WHO guideline values for both arsenic and manganese.

those from elsewhere in Bangladesh. Therefore the nationwide availability and sustainability of this resource needs to be established in terms of quality, quantity and sustainability. The possible impact of the large-scale abstraction of irrigation water on the deep aquifer also needs to be considered.

From a worldwide perspective, drinking water derived from aquifers showing similar characteristics to those of the Bengal Basin should be considered 'at risk' and need to be systematically tested for arsenic.

Main findings

1. Background to the study

At the time of the inception of this project (mid 1996), the scale of the groundwater arsenic problem in Bangladesh was largely unknown although the first indications of a problem were apparent from a small number of well water analyses from western Bangladesh. These had been undertaken in response to the well-publicised finding of an extensive groundwater arsenic problem in neighbouring West Bengal. In view of the seriousness of the potential problem and the rapidly-developing awareness of its likely scale, the project was split into two Phases: Phase I, a Rapid Investigation Phase (6 months) was designed to make a rapid assessment of the scale and nature of the problem by reviewing existing data and undertaking a survey of what were then believed to be the worst-affected parts of the country. During Phase I, Mott MacDonald Ltd (UK) led the Bangladesh input to the project. Phase II (21 months) followed with continued sampling and assessment including a groundwater monitoring programme.

The project began in January 1998 and has been funded throughout by the UK Department for International Development (DFID). The Department of Public Health Engineering (DPHE) of the Ministry of Local Government, Rural Development and Cooperatives has acted as the lead agency for the Government of Bangladesh (GoB) but other GoB Departments have been closely involved, principally the Bangladesh Water Development Board (BWDB).

A report on the findings of the Rapid Investigation Phase was published in January 1999 (DPHE/BGS/MML, 1999). During the course of this project, the seriousness and scale of the groundwater arsenic problem in Bangladesh has become apparent. Many GoB agencies, NGOs, international organisations and donors have now become involved and the GoB and the World Bank have begun a large-scale arsenic mitigation programme. A number of other surveys have also been undertaken, principally relating to the immediate needs of the mitigation programme. These have involved the identification of patients and the monitoring of health impacts, and the testing of various mitigation options.

The results of this project are being disseminated in various ways – through reports, presentations and the internet (www.bgs.ac.uk/arsenic). The hydrochemical database created during the project is publicly available.

2. Data acquisition

The acquisition of a substantial body of reliable water-quality and sedimentological data was a key objective of the project and was achieved through surveys at various scales. The locations of nearly all sample sites were established by hand-held Global Positioning System (GPS) devices which at the time of sampling (1998/99) were accurate to within about 50–100 m. The aim of the surveys was to establish the basic hydrochemistry of Bangladesh aquifers and of course to establish the extent of arsenic contamination. This was achieved by surveys at the national, *upazila* and mouza (village) scale. While it was not possible to achieve a similar national coverage of the sediments, a variety of sediments was also examined.

The *DPHE/BGS National Hydrochemical Survey* of tubewells attempted to apply a form of stratified random sampling over the whole of Bangladesh (excluding the Chittagong Hill Tracts) with the stratification designed to ensure a reasonably uniform spatial distribution of sampling sites. Such an ideal sampling scheme was difficult to realise for practical reasons, e.g. flooded areas, lack of roads for vehicular access, and the local lack of familiarity with randomised sampling schemes. Specifically, the selection of the sampled tubewells took no account of any prior information about their possible arsenic concentration – this was in any case largely unknown at the time.

The final data set for this survey consisted of samples from 3534 tubewells from 61 of the 64 districts of Bangladesh and from 433 of the 496 *upazilas*. The sampled area was approximately 129,000 km^2, compared with a total area for Bangladesh of about 152,000 km^2. The sample density was about 8 samples per *upazila*, or approximately one sample per 37 km^2. This is perhaps 0.03–0.05% of all Bangladesh tubewells. The majority of the sites sampled were Government (DPHE)-installed wells. These are believed to be representative of all wells. Sample collection was undertaken by project staff in close collaboration with local DPHE staff. Arsenic was measured in the BGS laboratories in most cases by atomic fluorescence spectrometry with hydride generation (HG-AFS).

All but four of the 3534 samples were also analysed for a wide variety of other elements by inductively-coupled plasma-atomic emission spectrometry (ICP-AES). A small subset of these samples was also analysed for a range of trace elements using inductively-coupled plasma-mass spectrometry (ICP-MS) to see if there were any other trace elements that were a cause for concern.

A survey of 113 *BWDB Water-Quality Monitoring Network sites* was carried out for arsenic and a wide range of other determinands including anions and trace elements. These sites were distributed across the whole of Bangladesh and were part of a regularly (bi-annually) sampled water-quality monitoring network. The wells included in this network are not a representative subset of all wells in Bangladesh and so any statistics derived from them have to be treated with caution – the network contained a greater proportion of 'deep' wells than found in Bangladesh as a whole, for example.

Three *Special Study Areas* were established in the three sadar (headquarter) *upazilas* of Nawabganj, Faridpur and

Lakshmipur districts in order to undertake sampling at a greater sample density and with a greater range of determinands than was possible in the national survey. Additional determinands included field parameters such as pH, redox potential and dissolved oxygen, a wide range of trace elements and the stable isotopes of oxygen, hydrogen, carbon and in a few cases, sulphur. These study areas were also where the *water-quality monitoring piezometers* were installed and where a regular water-level and water-quality monitoring programme was undertaken. Where possible, sampling piezometers were installed at 10 m intervals down to 50 m and sampled every two-weeks for up to 12 months. Deep boreholes were also drilled at Faridpur and Lakshmipur and included in the monitoring programme (there is no deep aquifer at Chapai Nawabganj, at least not within 150 m). Where possible, each of the piezometers was sampled on one occasion for tritium and ^{14}C as well as for parameters such as dissolved oxygen and redox potential. The drilling programme involved in installing these piezometers also provided core material for detailed logging and mineralogical and chemical analysis.

A Village survey was undertaken in the mouza of Mandari in Lakshmipur sadar *upazila*. This was known to be in a high-arsenic region of Bangladesh. The wells sampled were selected randomly. Mandari consists of a number of *para* or family settlements spread fairly uniformly over an area of approximately 6 km^2. The population of Mandari is thought to be about 2500. The aim of this survey was to examine the variation of arsenic at the village scale, the scale at which the actual compliance testing would have to take place. We aimed to make maps as accurately as possible within a short timescale and to measure the arsenic in the field as accurately as possible. For this, an 'Arsenator' was used. This was operated by Professor Walter Kosmus (Karl-Franzens University, Graz, Austria), the instrument's designer.

A map of the sample locations in Mandari was prepared using a combination of GPS, visual observation and a SPOT satellite photographic image. A total of 239 tubewells was sampled, analysed and mapped in six days by a team of 6 project staff and 4 local assistants. Additional analysis of the samples by ICP-AES was subsequently undertaken in the BGS laboratories in order to be able to relate the chemistry of arsenic to other water-quality parameters and to establish the nature of the spatial variation for a broad range of elements.

Other samples analysed for arsenic and a broad range of elements included seven river water samples from across Bangladesh and seven pumped public-supply water samples from the city of Dhaka. These were all from Dhaka WASA wells, and included one from each of the main supply divisions of the city

Sediment samples from 10 boreholes were analysed by a variety of techniques including total analysis by X-ray fluorescence spectrometry as well as selective dissolution with acid ammonium oxalate. A subset of 21 sediment samples from the three Special Study Areas were selected for detailed chemical and mineralogical analysis including particle size, magnetic and heavy-liquid separation, SEM observation and detailed magnetic characterisation.

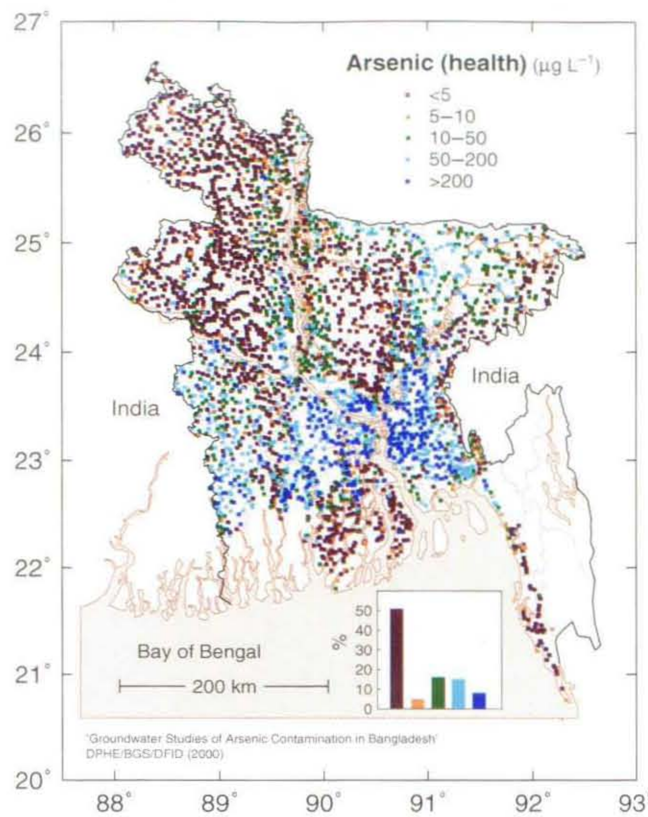

Figure 1. Map showing the concentration of arsenic in groundwaters based on the DPHE/BGS National Hydrochemical Survey. Class divisions are chosen on the basis of health criteria.

3. SCALE OF THE GROUNDWATER ARSENIC PROBLEM

The distribution of sample sites from the DPHE/BGS National Hydrochemical Survey and the arsenic concentrations are shown in Figure 1. Arsenic concentrations ranged from less than 0.25 µg L^{-1} to more than 1600 µg L^{-1}. The map shows clear differences in arsenic concentrations in different parts of Bangladesh with the greatest number of high-arsenic wells in the south and south-east of the country. However, superimposed on this regional pattern, there is considerable well-to-well variability over the scale of a few kilometres.

The regional differences can be seen more clearly when the point-source data shown in Figure 1 data are smoothed (Figure 2). This smoothing was carried out by a statistical technique (disjunctive kriging). The high-arsenic region in the south and east of Bangladesh is clear from this map. The DPHE/BGS survey showed that 25% of all the tubewells sampled contain in excess of 50 µg L^{-1} arsenic, the Bangladesh drinking-water standard. In addition, 9% of the tubewells exceeded 200 µg L^{-1}, 1.8% (64) exceeded 500 µg L^{-1} and 0.1% (3) exceeded 1000 µg L^{-1}. Few shallow groundwaters from the south of the country were 'arsenic-free' (i.e. contained less than 3 µg L^{-1}).

On the other hand, 24% of samples fell below the instrumental detection limit for arsenic, normally 0.25 or 0.5 µg L^{-1}. The minimum arsenic concentration is likely to be in the ng L^{-1} range. Concentrations of less than 1 µg L^{-1} are common in northern Bangladesh. They are

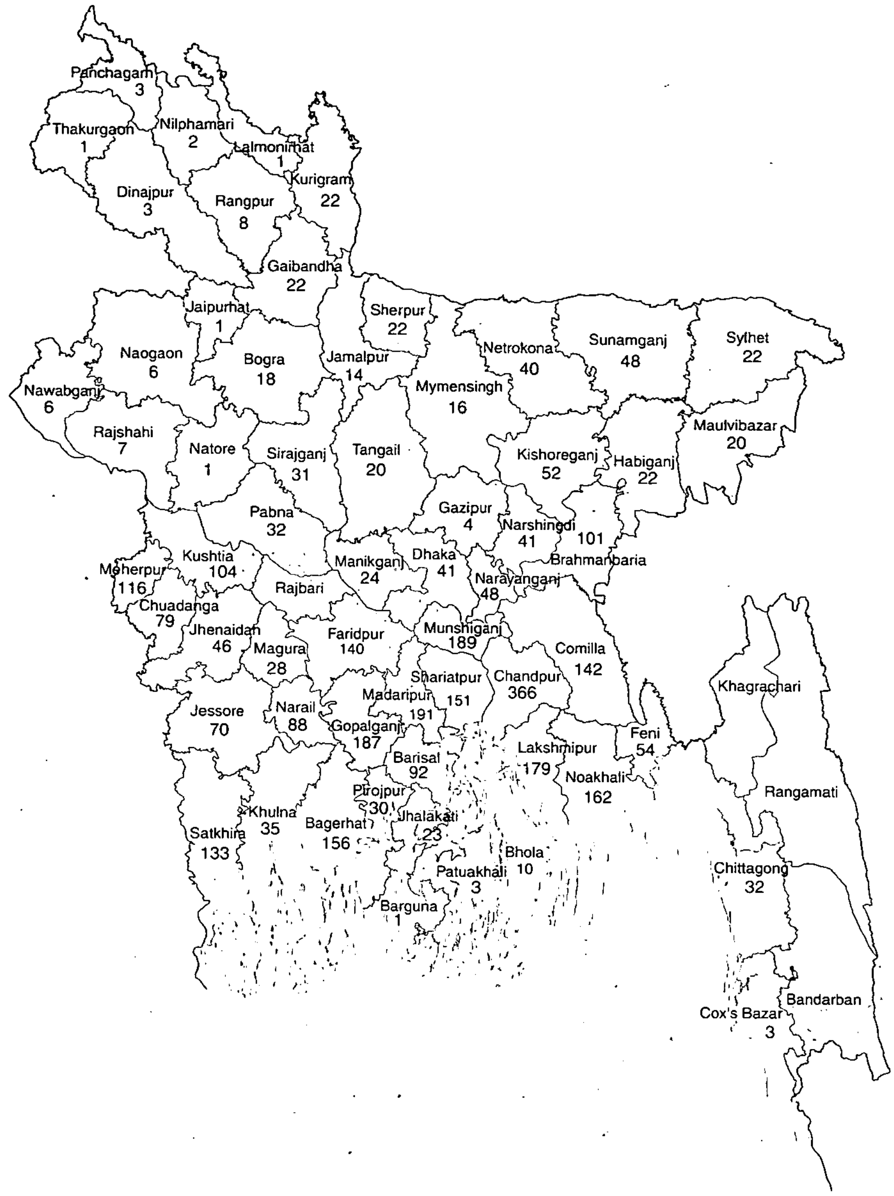

Figure 4. District-wise average arsenic concentration (in μg L^{-1}) found from the DPHE/BGS National Hydrochemical Survey

Dhaka showed that all contained less than 0.5 μg L^{-1} arsenic.

The population exposed to drinking water in which arsenic exceeds the Bangladesh standard was estimated in two different ways based on slightly different assumptions. These two methods gave estimates of 28 million people (*upazila*-averaged) and 35 million people (kriging to a 5 km grid). These estimates are based on an estimated 1999 population of 125.5 million for the whole of Bangladesh. If the WHO guideline value is used instead of the Bangladesh standard, these figures increase to 46 and 57 million people, respectively. In the absence of any data to the contrary, we assume that the kriged estimates (larger figures) are more reliable. The problem is clearly very large.

Other findings from the National Hydrochemical Survey

Many groundwaters also contained high concentrations of phosphorus (median 0.3 mg P L^{-1}, n=3530). This phosphorus was probably in part derived from the same source as the arsenic and while the phosphorus-arsenic correlation was not good enough to provide a reliable (or useful) prediction of the concentration of arsenic in a particular well, the two maps do show some correlation when viewed on a regional scale.

The majority of the groundwaters show characteristics that are typical of reducing groundwaters, notably high iron (median 1.1 mg L^{-1}, maximum 61 mg L^{-1}), high manganese (median 0.3 mg L^{-1}, maximum 10 mg L^{-1}) and low sulphate (median 1 mg L^{-1}, minimum less than 0.4 mg L^{-1}) concentrations.

High iron concentrations were widespread but were particularly common in the groundwaters from the Brahmaputra valley in northern Bangladesh (Figure 5). There was a poor overall correlation between arsenic concentrations, although locally significant positive correlations existed.

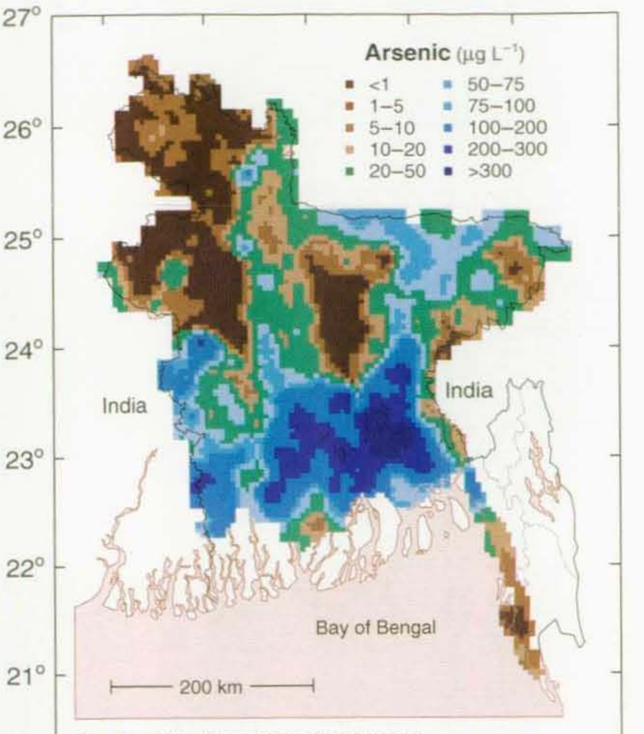

Figure 2. Smoothed map showing the regional trends in groundwater arsenic concentrations in shallow wells.

also typical of the deep aquifer (including water from the city of Dhaka) and the water derived from aquifers in the older sediments of the Madhupur and Barind tracts.

The median arsenic concentration found in all of the tubewells sampled was 4 $\mu g\ L^{-1}$ and the maximum concentration found was 1670 $\mu g\ L^{-1}$. The mean concentration was about 55 $\mu g\ L^{-1}$. This value depends to some extent on the concentration of arsenic assumed in the large number of wells containing less than the detection limit. The concentration of arsenic in these less-than-detection limit samples was assumed for statistical purposes to be half the detection limit.

There were important differences between 'shallow' wells and 'deep' wells (defined here as greater than or equal to 150 m depth), as well as between samples from recent (Holocene) alluvium and older (Plio-Pleistocene) alluvium. Arsenic contamination was essentially confined to groundwaters from the shallow aquifer (Figure 3).

Of the wells sampled in the DPHE/BGS National Hydrochemical Survey, 9% were 'deep'. Most of these deep wells were either from the southern coastal belt or from the Sylhet area. There are very few deep wells in the rest of the country. Of the shallow tubewells, 27% contained in excess of 50 $\mu g\ L^{-1}$ and 46% in excess of the WHO guideline value for arsenic (10 $\mu g\ L^{-1}$). Only 3 out of the 327 (1%) deep well samples exceeded 50 $\mu g\ L^{-1}$ and 16 (5%) exceeded 10 $\mu g\ L^{-1}$. Eight of the 61 sampled districts had no samples exceeding the Bangladesh standard for arsenic (50 $\mu g\ L^{-1}$) and all districts except Thakurgaon had at least one well exceeding the WHO guideline value for arsenic.

The worst-affected districts were (percentage of sampled wells with greater than 50 $\mu g\ L^{-1}$ in parentheses): Chandpur (90%), Munshiganj (83%), Gopalganj (79%), Madaripur (69%), Noakhali (69%), Satkhira (67%), Comilla (65%), Faridpur (65%), Shariatpur (65%), Meherpur (60%), Bagerhat (60%) and Lakshmipur (56%). Percentages are the percentage of all wells sampled.

The least-affected districts were: Thakurgaon, Barguna, Jaipurhat, Lalmonirhat, Natore, Nilphamari, Panchagarh, Patuakhali (all 0%), Rangpur (1%), Dinajpur (2%), Naogaon (2%), Gazipur (2%), Cox's Bazar (2%), Bhola (4%), Nawabganj (4%), Jhalakati (6%), Rajshahi (6%), Gaibandha (7%), Tangail (9%) and Kurigram (9%). Again, percentages are the percentage of all wells sampled.

The district-wise average arsenic concentration varies from 1 $\mu g\ L^{-1}$ in Thakurgaon to 366 $\mu g\ L^{-1}$ in Chandpur (Figure 4). This reflects a very large difference in the average arsenic dose likely to be taken in from drinking water by the people of these two districts.

There is a great deal of short-range variation in the arsenic concentration from well to well which makes predicting the concentration of arsenic in groundwater from unsampled wells in arsenic-contaminated areas difficult even when the concentrations in adjacent wells are known. This points to the necessity for an extensive testing programme. Even in areas of generally low arsenic concentrations, there are occasionally 'hot spots' where a cluster of wells with unusually high concentrations of arsenic are found. Such hot spots are most noticeable in northern Bangladesh. The Chapai Nawabganj hot spot in north western Bangladesh was estimated to be about 5 km by 3 km in extent. The sample density in the DPHE/BGS national survey was insufficient to identify all such hot spots.

Analysis of seven deep well waters from the city of

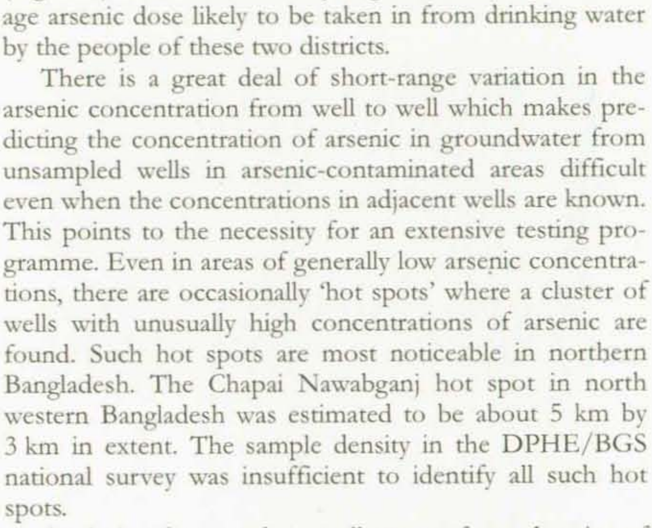

Figure 3. Arsenic concentration of groundwater in wells from the DPHE/BGS National Hydrochemical Survey plotted as a function of well depth.

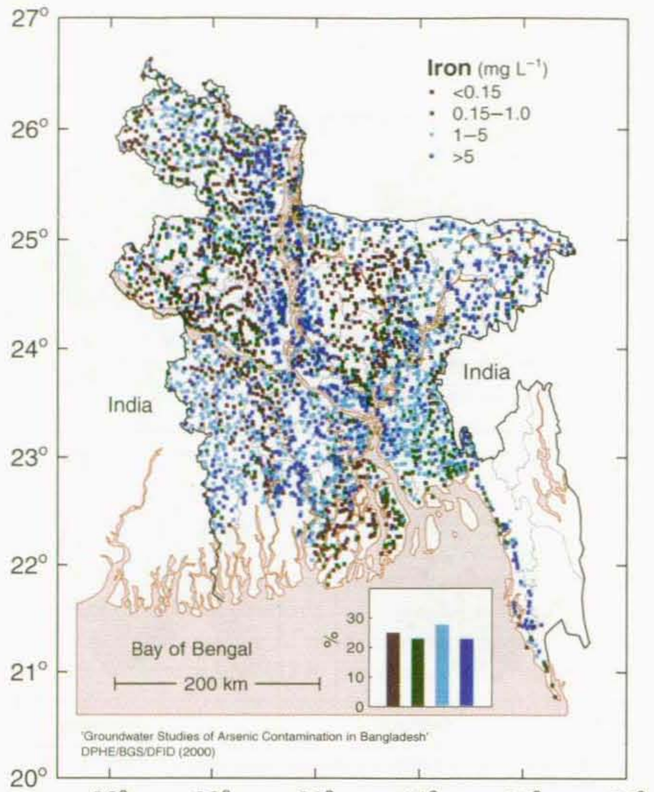

Figure 5. Map showing the concentration of iron found in Bangladesh groundwaters from the DPHE/BGS National Hydrochemical Survey

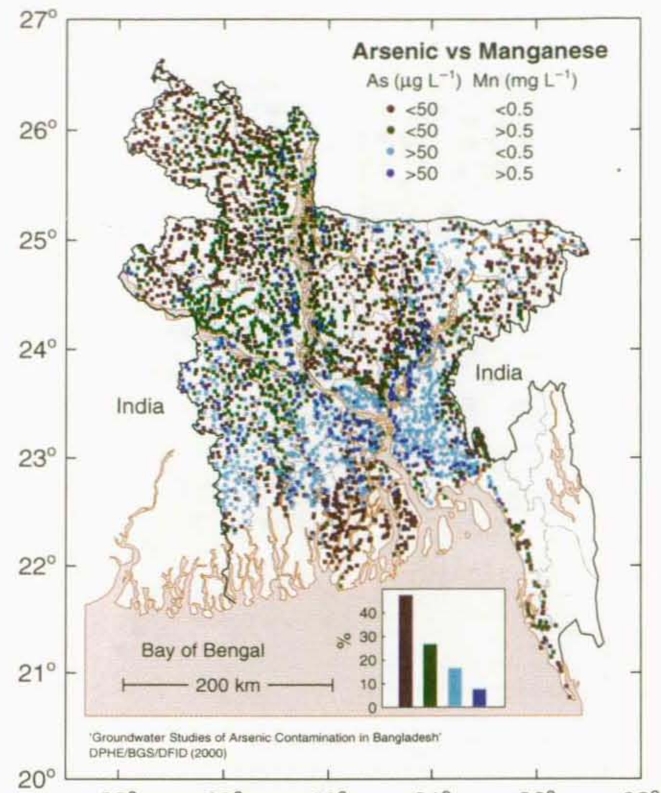

Figure 6. Map showing the joint distributions of arsenic and manganese in Bangladesh groundwaters based on data from the DPHE/BGS National Hydrochemical Survey. Class divisions include the Bangladesh standard for arsenic (50 $\mu g\ L^{-1}$) and the WHO guideline value for manganese (0.5 $mg\ L^{-1}$).

Excessive salinity in the coastal regions and particularly high iron concentrations (say more than 5–10 $mg\ L^{-1}$) in other areas including northern Bangladesh are important factors restricting the potability of groundwaters in Bangladesh. From our national survey, 23% of tubewell waters contained greater than 5 $mg\ L^{-1}$ iron and nearly 10% contained more than 10 $mg\ L^{-1}$.

Well waters exceeded the WHO guideline value of 0.5 $mg\ L^{-1}$ for manganese in 35% of the samples from the National Survey. Arsenic and manganese showed distinctly different regional patterns (Figure 6). Only 33% of shallow wells fell below both the WHO arsenic and manganese guideline values. 93% of deep wells did.

Boron exceeded the revised WHO guideline value of 0.5 $mg\ L^{-1}$ in 5.3% of samples and 9.1% exceeded the former guideline value of 0.3 $mg\ L^{-1}$. These high-boron samples are mostly found in the southern coastal region and in the low-lying region around Netrokona-Kishorganj. Boron is a residual component from seawater and high concentrations are usually associated with relatively high salinities.

4. BWDB Water-Quality Monitoring Network

The survey of 113 wells from the BWDB Water-Quality Monitoring Network complemented the DPHE/BGS National Hydrochemical Survey and the results generally showed the same regional trends. The number of samples in the BWDB survey was too small to provide reliable district-wise statistics. A comprehensive analysis of anions was undertaken which indicated that fluoride concentrations were normally low (median 0.2 $mg\ L^{-1}$). All were less than 1 $mg\ L^{-1}$. Indeed in north-western Bangladesh, they were lower than desirable in drinking water for dental health (Figure 7).

The iodide content of some of the waters from northern Bangladesh was also lower than desirable (less than 3 $\mu g\ L^{-1}$) and could lead to the development of iodine-deficiency disorders without supplementation with dietary iodine.

5. Special Study Areas

The chemistry of the groundwaters from the 1998 and 1999 surveys of the three Special Study Areas showed a high degree of spatial variability on a local scale, as well as with depth. Of the 243 samples collected, arsenic concentrations varied over four orders of magnitude, with the ranges in Lakshmipur, Faridpur and Chapai Nawabganj being respectively <3 to 986 $\mu g\ L^{-1}$, <3 to 1460 $\mu g\ L^{-1}$ and <3 to 2342 $\mu g\ L^{-1}$. In Lakshmipur, 55% of all groundwaters sampled exceeded the Bangladesh standard of 50 $\mu g\ L^{-1}$, 41% exceeded this value in Faridpur and 25% in Chapai Nawabganj. Exceedances of the WHO guideline value of 10 $\mu g\ L^{-1}$ were 70%, 69%, and 35% in Lakshmi-

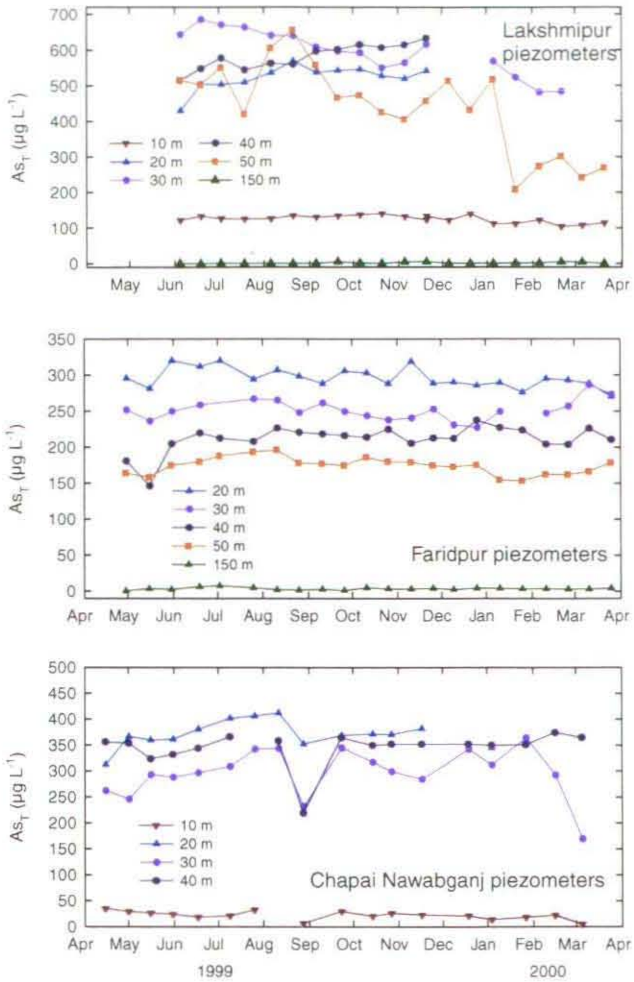

Figure 10. Temporal variations in arsenic concentration in piezometers at various depths from the three Special Study Areas.

pump tubewells sampled in the monitoring were used at other times. Arsenic in the piezometer waters (Figure 10) and other nearby wells had variable concentrations but over the short period of monitoring, did not appear to show significant increases or decreases with time. Variations were greatest at the shallowest depths (10–20 m) where the greatest water movement is expected, but dampened at greater depths. Fluctuating arsenic concentrations were apparent at the start of monitoring of some piezometers, which may have related to initial disturbances in the groundwater following drilling.

Monitored wells included three from the deep aquifer (piezometers at 150 m at both Lakshmipur and Faridpur; Figure 10, and one deep well at 286 m from Lakshmipur). During the monitored period, none of these sites showed increases in arsenic concentration with time and all remained well below 10 $\mu g\ L^{-1}$.

Three shallow dug wells from Chapai Nawabganj also had low arsenic concentrations. None of these showed increasing trends with time, although three individual analyses exceeded 10 $\mu g\ L^{-1}$ marginally during the monitored period. Concentrations of some other constituents (chloride, sodium, sulphate) in these samples were typically high and variable, suggesting that pollution has been a significant input to these sources.

No clear or consistent changes in arsenic were detected in the aquifers during the short monitoring interval. However, longer-term monitoring of the wells is required to establish whether there will be significant seasonal and long-term trends in water chemistry. The relatively small variation in arsenic concentrations observed in many of the wells emphasises the need for very careful sampling and high-precision analysis if seasonal or long-term trends are to be detected reliably.

8 SEDIMENT HISTORY

The Bengal Basin is a tectonically active subsiding depression formed at the junction of the Asian, Burmese and Indian plates, and is infilled with more than 15 km of marine and alluvial sediments of Cretaceous to Recent age. Throughout the Quaternary, the combined Ganges, Brahmaputra and Meghna (GBM) river system of Bangladesh has deposited a thick sequence of mixed alluvial and deltaic deposits in response to changes in sea-level rise and fall brought about by glacial cycles.

Within the Basin, there are areas of recent uplift (Madhupur and Barind Tracts) and subsidence (the Sylhet Basin) and major changes in the course of the Tista and Brahmaputra rivers can be seen in the sediments. Patterns of sediment deposition during the Upper Pleistocene were controlled by a fall in sea level to about 150 m below the present day sea level. This decline occurred between the last interglacial 120,000 years ago and the last glacial maximum some 21,000 years ago. Sea level recovered during the Holocene to the present-day level.

Various facies of deposition can be seen within the alluvial fan deltas, fluvial flood plains and deltaic environments. Lithostratigraphic correlation of these sediments has been attempted using palaeosol and peat horizons. Fine-grained deposits were laid down during periods with a relatively high sea level and correspondingly low-energy environment (so-called 'highstand' deposits) whereas coarse-grained deposits characteristic of a high-energy environment formed during periods of glacial maximum or 'lowstand' times.

Core sediments obtained from the two 'deep' boreholes drilled in the Special Study Areas provided the first detailed and relatively undisturbed samples of upper Pleistocene sediments recovered in Bangladesh. These boreholes were logged and correlated with DANIDA logs from the Lakshmipur area and with BGS logs from the Dhamrai-Manikganj area to produce conceptual models of past sediment deposition in the delta area and in the lower fluvial environment of the Brahmaputra valley.

Geological logs of deep boreholes drilled by BWDB were collated to provide an understanding of the possible patterns of sediment deposition during the last highstand and lowstand periods as well as during previous glacial-interglacial cycles. Using these data, tentative maps of the distribution of major incised channels at the last glacial maximum and before the last interglacial period were constructed. Seismic refraction survey data from the western part of the Ganges delta in Bangladesh showed the existence of a series of stacked channels containing coarse-grained sediments at depths greater than 500 m. These could form future sources of deep groundwater within that area.

9. SEDIMENT CHARACTERISTICS

Sediment samples, principally from the Special Study Areas, were analysed by a wide variety of techniques including total dissolution, selective dissolution with ammonium oxalate, magnetic separation, magnetic susceptibility, scanning electron microscopy (SEM) and X-ray diffraction.

In the 21 samples studied in detail, the average total arsenic concentration was 4 mg kg^{-1} and ranged from 0.4 mg kg^{-1} to 10 mg kg^{-1}. Arsenic concentrations were greatest in the fine-grained sediments and were highly correlated with iron content. The principal iron mineral observed was low-titanium magnetite but there was also some oxidised 'rust' material present. There was some evidence that this may have been derived from rust contamination from the drilling rig particularly in the Faridpur and Lakshmipur boreholes. The sediments also showed evidence of partial oxidation during storage.

Other rarer iron-containing minerals observed included titanomagnetite, ilmenite-magnetite composite grains, and ilmenite-hematite intergrowths. There was also abundant mica, particularly in the samples from Lakshmipur. Scanning electron microscopy (SEM) showed the sediments were in all respects typical alluvial and deltaic sediments.

Dissolution of the poorly-ordered metal oxides and desorption of elements by acid ammonium oxalate extractions of sediments from the cored piezometer holes in the Special Studies Areas showed that the sediments from Lakshmipur contained the greatest amounts of extractable arsenic, iron, manganese, aluminium and potassium. Average concentrations of oxalate-extractable As from the three sediment profiles drilled in the project were (in mg kg^{-1}, n=number of samples): Chapai Nawabganj (1.8, n=22); Faridpur (0.8, n=49) and Lakshmipur (2.1, n=48). All three of these are areas of high-arsenic groundwaters. There was also a high correlation between extracted iron and arsenic and in many cases also between iron and aluminium, and between iron and manganese. Average concentrations of extractable iron were (in mg kg^{-1}): Chapai Nawabganj (3000), Faridpur (2300) and Lakshmipur (4600). The fine-grained silts and clays normally contained a greater concentration of iron and many minor elements, including arsenic, compared with coarser-grained sediments which are characteristic of the exploitable parts of the aquifer.

The iron oxides may be derived in part from the weathering of the abundant biotite mica present in the sediments. Mica appears to be particularly abundant in sediments from the distal (lower) part of the delta where it may have been concentrated by natural re-suspension and sedimentation processes.

There was also more extractable sulphur (and sodium) in the Lakshmipur sediments than in the others, reflecting a greater marine contribution. Overall, the Lakshmipur sediments were much more variable than the sediments from Chapai Nawabganj and especially compared with those from Faridpur. This is consistent with the location of Lakshmipur being close to the boundary between the alluvial and deltaic sediments. This was also reflected in the large variability in salinity in the well waters from that area.

Ammonium-oxalate extracts were made on a limited number of sediments from low-arsenic areas including the Barind Tract region of northern-western Bangladesh, coarse-grained sediments from Thakurgaon, and older sediments from the Dupi Tila aquifer beneath Dhaka. These sediments all gave significantly lower average concentrations of extractable arsenic (normally less than 0.2 mg As kg^{-1}) and iron (normally less than 500 mg Fe kg^{-1}) compared with those from arsenic-contaminated areas.

The general conclusions from the sediment studies are that the sediments are typical of alluvial and deltaic sediments with normal amounts of arsenic, mainly in the 1–10 mg kg^{-1} range for total arsenic. However, even normal amounts of arsenic are sufficient to give excessive arsenic in the groundwater if dissolved or desorbed in sufficient quantity. Arsenic-rich groundwaters tended to be found in areas with sediments containing relatively high concentrations of oxalate-extractable iron and arsenic. This is consistent with the iron oxides being a principal source of arsenic in the arsenic-rich groundwaters.

While the role of iron oxides is undoubtedly important, other oxides such as manganese and aluminium oxides may also be important. It is difficult to separate the individual role of the various oxides from extraction data alone because of the non-selectivity of most extractants and the high correlations between the amounts extracted. Everything observed in the sediments is consistent with the desorption and dissolution of arsenic from oxide minerals being the key process controlling the release of arsenic to groundwater.

10. CAUSES OF THE ARSENIC PROBLEM

In order to understand the development of high-arsenic groundwaters in Bangladesh, we have to rely on our scientific knowledge of the likely processes involved, the inferred past history of the aquifers and the present-day evolution of groundwater quality in comparable environments. There is as yet no consensus amongst scientists about the precise cause of the arsenic problem in Bangladesh but below we indicate what we believe to be a plausible scenario that is consistent with most of the known facts. There is still a great deal of uncertainty about the timescale over which the events may have occurred.

Everything points to the arsenic being of natural origin although it is not yet possible to exclude the possibility that modern agricultural practices (groundwater abstraction from shallow wells, irrigation and fertilisation) will have no influence on the groundwater arsenic concentrations whatsoever. It is believed that the arsenic has been in the groundwater for many years, certainly since before the recent extensive abstraction of groundwater.

Both the arsenic content of Bangladesh sediments (0.4–10 mg kg^{-1}) and their mineralogy are typical of young alluvial and deltaic sediments that contain a wide variety of minerals reflecting their diverse source rocks. There is no need to speculate on a unique geological source of high arsenic rocks somewhere upstream of Bangladesh.

However, certain types of sedimentological processes

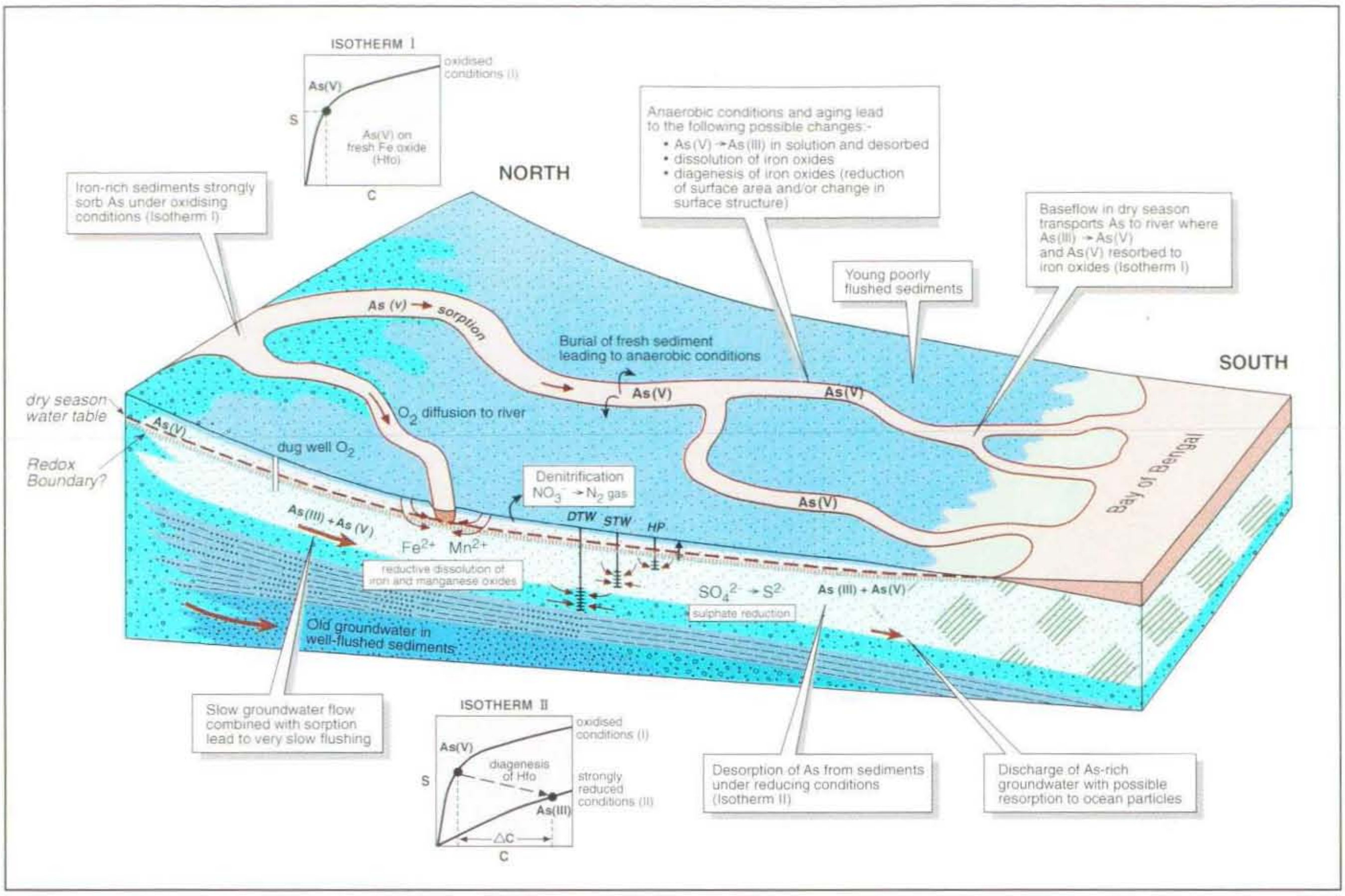

Figure 11. Schematic diagram showing the processes leading to the generation of high-arsenic groundwaters in the Bengal Basin.

have probably been more important in concentrating arsenic in some parts of the delta system than in others. In particular, colloidal-sized iron oxides with their strongly sorbed arsenic and platey, easily suspended, micaceous minerals appear to have been concentrated in the lower part of the delta.

Even 'ordinary' sediments such as these contain sufficient arsenic to give rise to the groundwater arsenic problem observed because of the very low drinking-water guideline value for arsenic and the high solid/solution ratios found in aquifers.

The development of strongly reducing conditions is believed to be the trigger that has been responsible for the release of naturally-occurring arsenic from the sediment into the groundwater. This arises from the rapid consumption of dissolved oxygen by the oxidation of fresh organic matter in the recently-buried sediments. Once strongly reducing conditions are achieved, arsenic is released from the sediments. The mechanism for this release is poorly understood quantitatively but is believed to involve the desorption from, and dissolution of, arsenic from various oxides, especially iron oxides.

This reaction is probably rapid (on geological timescales) and is essentially a diagenetic response of the sediments to a change from an oxidising environment to a reducing environment following burial. Possible changes of significance are a reduction in surface area of the iron oxides following their partial recrystallisation (ageing) and a change in their surface chemistry as a result of the formation of a mixed-oxidation state (Fe(II)–Fe(III)) surface. These changes, as well as the reduction of the strongly sorbed As(V) to the less strongly sorbed As(III), could lead to the release of arsenic from the sediments. Geochemical modelling has confirmed that such changes could account for the high arsenic concentrations observed in Bangladesh groundwaters. Phosphate is believed to be released by the same desorption and dissolution mechanisms (except that the oxidation state of phosphorus is not sensitive to redox conditions). These processes are shown schematically in Figure 11.

The release of arsenic (and phosphate) has also frequently been observed in recently-buried and reducing freshwater and marine sediments, and in flooded soils from many parts of the world. This release is magnified by a number of factors in Bangladesh, especially the large size of the delta and the unusually large depth of recently-deposited sediments, i.e. sediments deposited over the last few thousand years.

The flow of water in the aquifer is also important since this is the normal natural mechanism for flushing away the arsenic so released. The large flat delta region of Bangladesh leads to extremely low hydraulic gradients and correspondingly low rates of flushing of the aquifer. This means that the arsenic released will accumulate, as observed.

Where groundwater flushing is more active, as in parts of northern Bangladesh, or has existed for longer periods as in the deep aquifer, then arsenic concentrations are lower. It is likely that the high concentrations of arsenic found in Bangladesh groundwater will eventually disappear as fresh groundwater flushes through the aquifer, albeit very slowly. The rate of groundwater flow is poorly understood at present but this flushing will probably take thousands or tens of thousands of years. Significant falls in sea level have occurred in the recent past which will have greatly accelerated the flushing of the deeper aquifer. Such changes could occur again if the earth goes through another ice age.

The concept that the present groundwater arsenic problem results from a relatively rapid change in response to recent burial, and that the desorption of arsenic from oxides is an important part of this process, is encouraging in the sense that once the initial release of arsenic has been flushed away, it should not continue to be released unless conditions once again change for the worse, e.g. become even more reducing. This is generally unlikely in the deep aquifer but could occur in those parts of the shallow aquifer that are not yet very strongly reducing. For example, certain changes at the land surface could lead to a reduced rate of diffusion of oxygen to the underlying aquifer. The establishment of more extensive flooding and the puddling of soils associated with paddy fields are the most obvious mechanisms for achieving this. However, the redox buffering by the large volume of sediments involved is large and so any such changes are likely to be slow.

Therefore we believe that the deep aquifers which are currently predominantly arsenic-free in Bangladesh are likely to remain so, at least under natural flow conditions. However, we stress that this is only an initial observation based on limited evidence and that the precautionary principle suggests that this should not be relied on until more solid evidence is established in its favour. In particular, more detailed studies are required on the influence of pumping in both the shallow and deep aquifer to see how this might change the situation. There is conflicting anecdotal evidence on this at present. The connectivity of the shallow and deep aquifers is an important factor.

The careful monitoring of water quality in the aquifers at different depths and over various timescales is essential. A better understanding of the ages of the sediments and groundwaters and of the regional distribution of aquifers and aquicludes would also be very useful.

11. GROUNDWATER FLOW

The groundwater gradient and rate of groundwater flow are controlled by the distance between rivers and the balance between recharge and evaporation. This varies seasonally. In Bangladesh, hydraulic gradients are very low because of the limited relief. Hand-pump tubewells are unlikely to have a major effect on groundwater flow. Irrigation wells with their larger volumes of abstraction will tend to draw water from groundwater rather than from river recharge and may thereby change the local hydraulic gradients significantly. However, groundwater movement and hence aquifer flushing, is inherently very slow in Bangladesh. Under typical groundwater gradients, the timescale to replace the groundwater within an aquifer is of the order of tens of thousands of years. This is revealed by the old 'ages' of groundwater and the large degree of stratification of water quality in the aquifers. It is also reflected in the considerable degree of spatial variation observed in groundwater quality even within a given village.

The magnitude of vertical groundwater flow is important for determining the extent to which arsenic might be transmitted from the shallow contaminated zone to the deeper uncontaminated aquifer. The magnitude depends on the presence, or otherwise, of layers of low hydraulic conductivity (aquicludes) which will restrict vertical flow as well as the presence of thick layers of more permeable material at depth which will enhance vertical flow.

The distribution, nature and size of present-day rivers also has an important effect on groundwater velocities and as such, rivers may play a significant role in controlling the short-range variability of groundwater arsenic concentrations through their effect on local hydraulic gradients. Particularly low groundwater velocities are found in areas surrounded on two or three sides by a river, as for example in the inside of meanders. This may account, in part at least, for localised arsenic-rich 'hot spots' especially where the river system is stable for a long period of time.

Modelling estimates were made of groundwater travel times from the water table to both shallow and deep tubewells based on the aquifer conditions at Faridpur. For the shallow aquifer, assuming well screens at 65–75 m below the water table, it was estimated that 50% of the flow took less than 50 years to reach the well. However, this is highly dependent on the recharge rate; the higher the rate, the shorter the travel time. The approximate lateral distance of flow from the water table to the wells was estimated to be around 50–125 m.

For the deep aquifer, assuming a well screen at 110–135 m below water table, the travel time under pumped conditions was estimated to be in excess of 200 years from a lateral distance of approximately 500 m. Under natural (unpumped) conditions, flow to the same depths was estimated to be in excess of 300 years, with a lateral movement of 1000 m. These travel-time estimates are consistent with the observed presence of tritium in the upper part of the shallow aquifer and its absence from the deep aquifer.

Groundwater modelling has demonstrated that the distribution of vertical flows is highly dependent on the assumed lithological profile. Lithology therefore has to be known in detail and included in the models, before reliable predictions of vertical flows can be made. This is especially important for considering flow to the deep aquifer. Modelling of the Faridpur aquifer indicated that percentages of flow to the deep aquifer (taken to be greater than 130 m depth) can vary by as much as three times (4–12%) depending on the distribution of hydraulic properties of the sediment profile. Lithological information from the borehole log obtained for Faridpur suggests that, unlike elsewhere in Bangladesh, there is not an extensive, well-defined aquitard layer between the shallow and deep aquifer. Groundwater flow to the deep aquifer based on the Faridpur model is therefore likely to represent a worst-case estimate.

12. OTHER HEALTH-RELATED WATER QUALITY PROBLEMS

A wide range of inorganic constituents was measured in groundwaters derived from the various surveys undertaken within this project. There were limitations to what could be achieved particularly in the determination of unstable determinands such as ammonium, nitrate, nitrite, bicarbonate and pH. These parameters were not measured in the DPHE/BGS National Hydrochemical Survey because it was not possible to guarantee their preservation before analysis. However, they were measured on most of the samples from the three Special Study Areas. Ammonium, as well as bacteriological quality were also measured in a parallel set of samples collected during Phase I of the national survey by Dr Bilqis Amin Hoque, formerly of the International Center for Diarrhoeal Disease of Bangladesh (ICDDR,B).

Of the inorganic constituents considered in Bangladesh groundwaters, arsenic represents by far the most serious health risk. However, potential problems also arise from a number of other constituents. From the DPHE/BGS National Hydrochemical Survey, 35% of samples exceeded the WHO guideline value (0.5 mg L^{-1}) for manganese in drinking water, and some significantly so (maximum 10 mg L^{-1}). Of the DPHE/BGS National Hydrochemical Survey samples, 8% exceeded both 50 µg L^{-1} arsenic and 0.5 mg L^{-1} manganese, while 48% of samples were below both the Bangladesh arsenic standard and the WHO guideline value for manganese. Wells in parts of western Bangladesh (e.g. the Rajshahi area) are relatively high in manganese but low in arsenic (Figure 6). The reverse is true in much of southern Bangladesh. Altogether, 36% or about one third of samples that were below the Bangladesh standard for arsenic exceeded the WHO manganese guideline value. Groundwater from the older sediments (Barind and Madhupur Tracts), the deep aquifer in the southern coastal region (and in Dhaka), and from the coarse-grained sediments of north-western Bangladesh tended to comply with the WHO guideline values for both arsenic and manganese. Only 2% of the deep wells sampled in the National survey exceeded 0.5 mg Mn L^{-1}.

Five percent of samples from the DPHE/BGS National Hydrochemical Survey also exceeded the WHO guideline value of 0.5 mg L^{-1} for boron. These sites were concentrated in the southern coastal region and in a small region of north-eastern Bangladesh. Boron is a residual component from sea water and therefore tends to be greatest in areas affected by salinity. The sodium concentration in the affected groundwaters usually exceeded 200 mg L^{-1}.

The lack of a high spatial correlation between arsenic, manganese and boron means that there will be some groundwaters that conform to the arsenic drinking water standard but fail on one of the other standards, and *vice versa*.

A much smaller number of samples (0.3%) exceeded the WHO guideline value of 0.7 mg L^{-1} for barium. These were mostly located in the south-west coastal region.

Nitrate and nitrite were not measured in the DPHE/BGS National Hydrochemical Survey but results from the three Special Study Areas indicate that occasional exceedances of guideline values for these determinands will be found but that they are unlikely to be widespread. The strongly reducing conditions found in many Bangladesh aquifers provide a favourable geochemical environment for denitrification and therefore low nitrate concentrations are to be expected and are normally found. Isolated high nitrate concentrations were occasionally found in the shallow groundwaters and are indicative of pollution (e.g. from latrines) and are likely to be accompanied by high concentrations of sulphate, chloride, bromide and often nitrite as well as bacteriological contamination.

Like nitrate, concentrations of nitrite in the Special Study Areas were also mostly low, and usually less than the WHO guideline value of 0.91 mg L^{-1} as NO_2-N. 4% of sampled wells had concentrations in excess of the guideline value. These were mainly but not always in samples which were thought to be polluted.

A wide range of trace elements was measured in the 272 samples collected in total from the Special Study Areas. Results indicated no exceedances above WHO guideline values for antimony, cadmium, chromium, molybdenum or nickel, and most were well below the guidelines. Lead was found in excess of the WHO guideline value (10 µg L^{-1}) in just one sample (concentration 29 µg L^{-1}). Similar concentration ranges, with no exceedances, were found for these trace elements in samples from the BWDB water-quality monitoring network. In these samples, the maximum lead concentration found was 8 µg L^{-1}.

Considering these trace elements, a few exceedances were observed in the subset of 20 samples selected for analysis from the national survey. However, these were in most cases not significantly above the WHO guidelines and are therefore not considered a major problem. Molybdenum was the only exception, with two samples from the national survey having unusually high concentrations of 410 µg L^{-1} and 800 µg L^{-1}.

One element of potential health concern highlighted by the analytical data was uranium. This has been assigned a provisional guideline value of 2 µg L^{-1} by WHO. Concentrations in excess of this were found in a large number of samples – 50% of the subset of samples selected for trace-element analysis from the national survey, 12% of the BWDB survey samples, and 28% of the samples from the three Special Study Areas. Uranium concentrations show quite large differences both within and between the three Special Study Areas (Figure 12).

The maximum uranium concentration observed was 47 µg L^{-1} from the Chapai Nawabganj Special Study Area, although the median concentration was less than 2 µg L^{-1} (0.42 µg L^{-1}). Concentrations were particularly high in dug-well waters from Chapai Nawabganj. Uranium generally showed a negative correlation with arsenic, largely as a result of the variations in redox conditions. Highly reducing conditions favour arsenic mobilisation, whereas more oxidising conditions favour uranium mobilisation.

Constituents considered troublesome on aesthetic grounds include high salinity, iron and ammonium. Salinity is highest in groundwaters from the southern part of Bangladesh where seawater influences have been greatest, as evidenced by high sodium and chloride concentrations and by a high specific electrical conductance. Iron and more testing is undertaken, it is likely that the broad regional patterns so far identified will be confirmed. Certainly the present knowledge is sufficient to define broad areas for a priority mitigation effort.

There are no long-term monitoring data for arsenic in tubewells anywhere in Bangladesh and so the probable future changes in groundwater quality are largely unknown. The best assumption for planning purposes is probably to assume that the situation will not change appreciably in the short term, and probably not also in the medium term. In the mean time, the careful monitoring of a network of a wells over a broad range of timescales is important. There are very few data for this at present, even for short timescales. Such monitoring is difficult to do because of the relatively small changes expected. There appears to be some short-term variation (over weeks and less) in the arsenic concentration of tubewells. The reasons for this are uncertain but probably reflect changes in the flow paths of the pumped water as the water table or pumping regime changes, combined with a strong stratification of water quality within the aquifer itself.

It is difficult to judge how rapidly the shallow aquifer will change in response to natural groundwater flushing. The overall long-term trend should be downwards, although in the short term, some wells might increase as a pulse of high arsenic groundwater passes through. In practice, such natural flushing is unlikely to be significant on the timescale of the tubewells, e.g. a few decades.

Increased groundwater mixing as a result of pumping is likely to accelerate and to some extent alter these natural changes. This mixing will tend to increase the concentration of arsenic in wells which presently have low arsenic concentrations and reduce it in high-arsenic wells. Because of the extremely heterogeneous nature of the aquifer (spatially), the highly skewed distribution of arsenic concentrations found and the low acceptable concentration of arsenic in drinking water, it is likely that this short-term mixing will lead to an increase in the number of wells exceeding a given water quality standard. But again, the timescale of such changes is at present very uncertain.

Our limited monitoring in three areas over approximately nine months has not identified any significant and consistent changes in water quality during that time. Rather it has highlighted the difficulties of carrying out such exercises in terms of sampling and analytical procedures. In practice, it will probably be difficult to detect changes in chemical concentrations of less than 10%.

Groundwater from the deep aquifer was sampled predominantly from the Barisal, Lakshmipur, Faridpur and Sylhet areas and was found to be essentially arsenic-free (less than 3 $\mu g\ L^{-1}$). These samples may or may not be representative of the deep aquifer in other areas. There is no reason to believe that the deep aquifer will become seriously contaminated, certainly in the short-term, providing that care is taken during borehole construction to isolate the upper and lower aquifers and so prevent direct leakage of contaminated water to the deep aquifer. Therefore deep wells provide a possible option for the long term supply of safe drinking water. Ideally the development of deep wells should be combined with a basic water distribution network that makes it economically feasible as well as being attractive and convenient to use. Existing wells could still be used for non-potable uses.

Experience gained so far indicates that water from the great majority of carefully-constructed deep wells would not only pass the current Bangladesh standard for arsenic but would pass all other existing national and international standards and guidelines for arsenic. The likelihood of a manganese exceedance is also much lower in these deep groundwaters. Most of the deep groundwaters tested in our surveys were from the southern coastal region where the shallow groundwaters are affected by salinity and these deep groundwaters may not be typical of those from elsewhere in Bangladesh. Therefore the nationwide availability and sustainability of this resource needs to be established both in terms of quality and quantity. In some areas, a stony layer at depth makes deep drilling difficult given the drilling rigs currently available in Bangladesh. The possible impact of the large-scale abstraction of irrigation water on the deep aquifer also needs to be considered.

Aside from the mitigation technology *per se*, probably the single greatest contribution that science and technology can make to solving the arsenic problem would be the development of a reliable, sensitive and affordable field-test kit for arsenic analysis at the microgramme-per-litre level. Combining any unavoidable short-term variability from the aquifer itself with the inevitable sampling and analytical errors means that samples close to the adopted arsenic standard will have quite a high probability of changing from 'acceptable' to 'unacceptable', or *vice versa*, with time. A three-tier classification would therefore be preferable: 'definitely acceptable', 'maybe acceptable' and 'definitely unacceptable'. Several improved field-test kits are currently being developed which offer semi-quantitative visual measurements, e.g. 0, 10, 30, 50, 70, 300, and 500 $\mu g\ L^{-1}$. This will greatly improve their value.

A great premium should be placed on obtaining reliable analytical results for arsenic measurements since this will avoid the need for replication, save time wasted in tracking down errors and will give the survey the necessary credence amongst the population at large.

Attempts to reverse the geochemical processes that have given rise to the arsenic-rich groundwaters offer one approach to mitigation. In principle, this could be achieved by either (i) the in situ (re)oxidation of the groundwater and sediment to enhance arsenic sorption processes, or (ii) by inducing the in situ precipitation of pyrite and coprecipitation of arsenic with the addition of injected sulphate (as calcium sulphate). While such approaches have some attractions, there are many practical problems to be overcome before they could become viable – the large quantities of chemicals required, clogging of the aquifer and the need for a reliable electricity supply for the pumps, for example. Perhaps more importantly, Bangladesh has little track record of the successful long-term implementation of such technical solutions in rural areas, particularly where there is a need for substantial recurrent expenditure in terms of maintenance, chemicals and electricity. The absence of a distributed water supply in the rural parts of Bangladesh also significantly hinders all technological solutions to the problem.

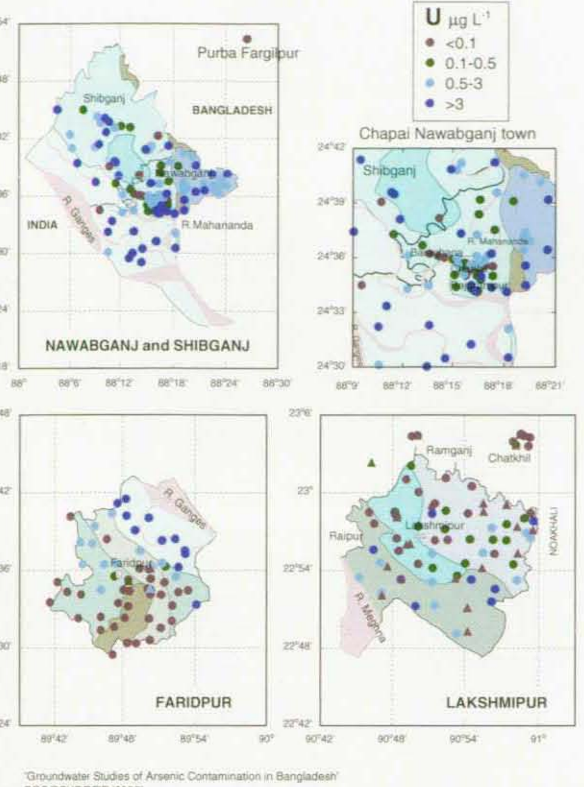

Figure 12. Uranium concentrations in groundwaters from the three Special Study Areas.

ammonium are often present in very high concentrations (up to 11 mg L^{-1} and 17.8 mg L^{-1} respectively) reflecting the reducing conditions of the aquifers. The parallel ICDDR,B survey in Phase I found a median ammonium-N concentration of 1.0 mg N L^{-1}.

High aluminium concentrations are found in a few groundwaters but these are believed to be derived from colloidal material and are not thought to be problematic.

Of the seven deep tubewells analysed from Dhaka, concentrations of the trace metals were usually very low. Concentrations of arsenic, antimony, boron, cadmium, chromium, lead, molybdenum, nickel and uranium were all well below WHO guideline values. Manganese exceeded 0.5 mg L^{-1} in only one sample (0.67 mg L^{-1}).

Only inorganic constituents have been considered in this study and hence no indication can be given of the bacteriological quality of the groundwaters or of potential contamination with pesticides. Occasional high concentrations of nitrate together with nitrite, chloride, sulphate and elevated SEC values, suggest that pollution of some tubewells and dug wells may be severe, especially for those at very shallow depths. Hence bacterial quality of some of these groundwaters is expected to be impaired.

In conclusion, the constituents of greatest concern in Bangladesh groundwaters are arsenic, manganese and possibly uranium, and to a lesser extent boron. With the exception of manganese, these constituents are present in groundwater as neutral species or as anions. Trace metals such as nickel, copper and lead which are mostly present in the groundwater as cations are rarely a cause for concern.

13. IMPLICATIONS FOR ARSENIC MITIGATION

While national surveys such as the one undertaken in this project can identify the worst- and least-affected areas and even provide estimates of the percentage of wells likely to be affected, they cannot identify the individual wells that are affected, e.g. those greater than 50 µg As L^{-1}.

The large amount of short-range spatial (well-to-well) variation in arsenic concentrations means that ultimately all shallow wells in recent alluvium in Bangladesh need to be tested for arsenic if they are to be used for drinking water. Since timeliness is a crucial factor in any arsenic mitigation programme, the aim should be to tackle the worst-affected areas first as part of a priority programme.

Priority in the surveying and mitigation should therefore be given to the badly-affected areas identified in the south and east of Bangladesh. The resources of such a priority programme should be allocated according to the severity of the problem, based for example on the percentage of wells in a district that are affected, or on the average arsenic concentration in an area, or on the probability that the water quality standard in an area will be exceeded. Our national survey of arsenic provides one set of estimates for setting such priorities and broadly agrees with other studies of the regional distribution of arsenic.

There are areas in north-western Bangladesh that should receive low priority in terms of resources allocated because the extent of contamination there is much lower than elsewhere and, in some places, is not significant.

Our survey has highlighted some quite extensive arsenic-rich areas in northern Bangladesh, particularly in the Netrokona-Sunamganj area. Apparent arsenic hot spots in northern Bangladesh are probably best located by a combination of nationwide public awareness campaigns, backed up by rapid deployment of medical technicians and doctors trained to recognise the early symptoms of arsenic poisoning. This could be accompanied by a rapid low-density survey of every mouza (some 65,000 in all of Bangladesh) in order to identify all sizable hot spots. This could be achieved by sampling just a few wells in each mouza.

Professional statistical expertise should be sought when making estimates of arsenic distribution as many difficult technical decisions need to be taken in arriving at the best estimates, and in understanding the errors involved in these estimates. Reliable statistics enable resources to be allocated most efficiently and the most appropriate action to be taken at an early stage. The large number of well waters with arsenic concentrations at, or close to, the detection limit of our survey (below 1 µg L^{-1}) and the extreme range in concentrations found gives problems in arriving at rigorous statistical estimates of many parameters.

Other arsenic survey data collected and analysed by other agencies under comparable conditions will add to the picture and enable our survey estimates to be updated. Although it is difficult to judge the accuracy of our district-based estimates for the percentage of wells affected, the basic north-south divide appears to be confirmed by all other surveys. While the detailed picture will be refined as

14. Reference

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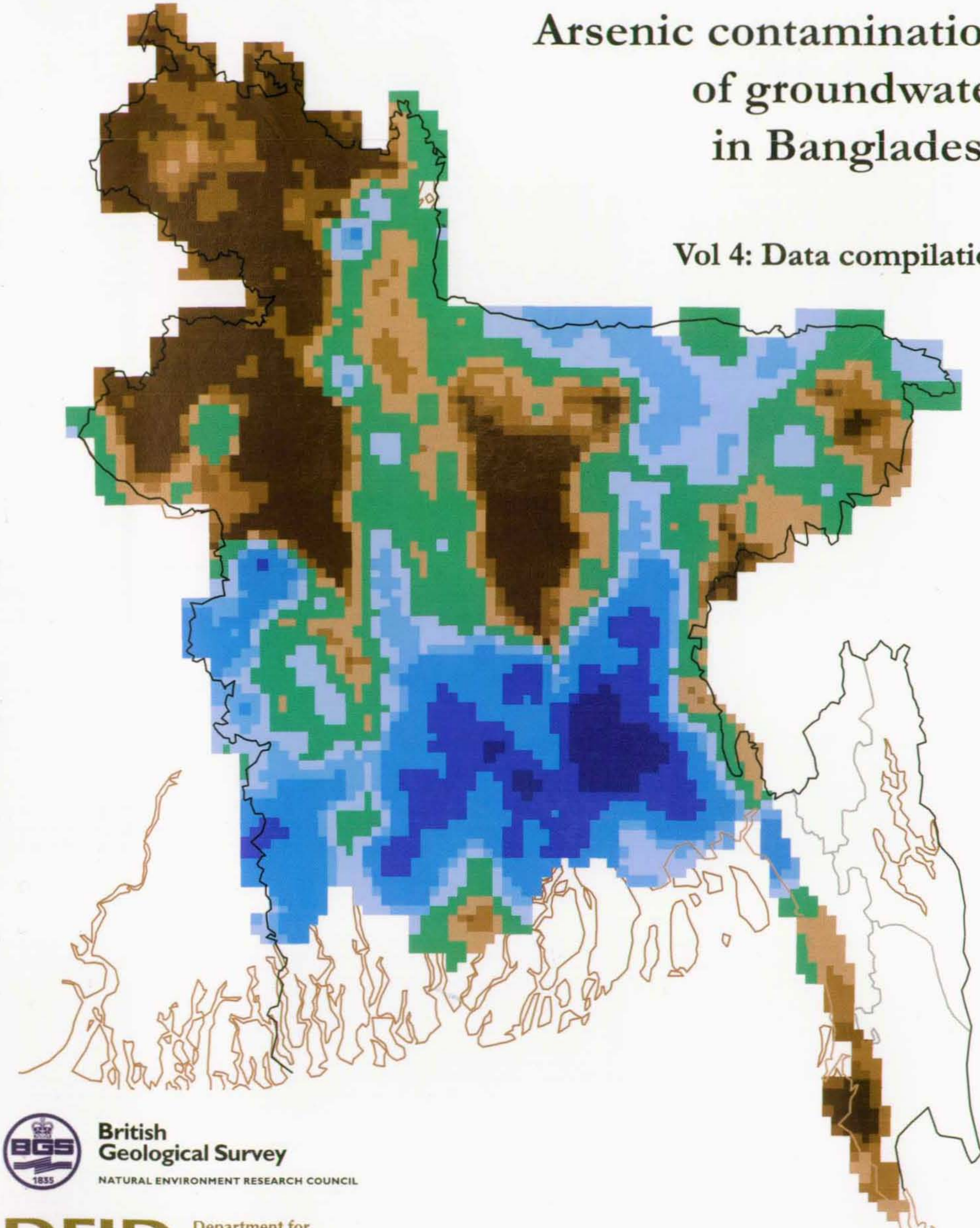

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February 2001

The full report comprises four volumes:

- Volume 1. Summary
- Volume 2. Final report
- Volume 3. Hydrochemical atlas
- Volume 4. Data compilation

Further information can also be viewed and downloaded from our website at www.bgs.ac.uk/arsenic/Bangladesh

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Cover Illustration

Map of Bangladesh showing the regional distribution of arsenic in groundwater found during the National Hydrochemical Survey

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A limited number of complimentary copies of this report are available to bonafide organizations working within Bangladesh in the field of arsenic mitigation. Requests should be sent on headed paper to DFID Manager (Water & Sanitation), House No. 42, Road No. 28, Gulshan, Dhaka. Copies may also be purchased from Graphosman, 3/3-C Purana Paltan, Karim Mansion (1st Floor), Dhaka-1000, Bangladesh. Tel : 9552394, 9557596, E-mail : graphos@shaplanet.com at a cost of ....+Postage.

A National Hydrochemical Survey

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-00701	RIP3491	06/03/1998	22.8731	90.7844	1992	STW	10.7	near sluicegate	Chittagong	Lakshmipur	Lakshmipur Sadar	Shakchar	Char Ramani Mohan
S98-00718	RIP3492	08/03/1998	23.0194	90.8786	1971	STW	12.2	Nandigram High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Baksipur	Nandigram
S98-00724	RIP3493	10/03/1998	22.965	90.9597	1995	STW	12.2	Mr Nurunnabi	Chittagong	Lakshmipur	Lakshmipur Sadar	Uttar Joypur	Chandra Prabhabag
S98-00727	RIP3498	10/03/1998	22.9253	90.9744	1997	DTW	262.1	Kamarchat Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Chandraganj	Ganipur
S98-00733	RIP3494	11/03/1998	22.8653	90.9372	1993	STW	7.9	Madha Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Kushakhali	Madna
S98-00734	RIP3499	11/03/1998	22.8525	90.9058	1990	DTW	182.9	Farashganj Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Kushakhali	Farasganj
S98-00736	RIP3495	11/03/1998	22.8567	90.8642	1991	STW	7.9	Miarbari Hydar Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Bhabaniganj	Char Monasa
S98-00749	RIP3496	14/03/1998	22.9322	90.7767	1994	STW	7.9	Mr Munir Ahmed Bhuiyan	Chittagong	Lakshmipur	Lakshmipur Sadar	Char Ruhita	Char Ruhita
S98-00752	RIP3500	14/03/1998	22.9347	90.8294	1992	DTW	318	DANIDA No. 1 Urban Supply	Chittagong	Lakshmipur	Lakshmipur Sadar	Lakshmipur Paurashava	
S98-00756	RIP3497	15/03/1998	22.9414	90.8644	1991	STW	14	Mr Rofique	Chittagong	Lakshmipur	Lakshmipur Sadar	Laharkandi	Athiatali
S98-00777	RIP1961	07/03/1998	23.5331	89.79	1994	STW	26.2	Mr Md Akkas Shek	Dhaka	Faridpur	Faridpur Sadar	Kanaipur	Solakunda
S98-00781	RIP1962	08/03/1998	23.5347	89.8675	1995	STW	32	Mr Abdur Rahman Bhuyan	Dhaka	Faridpur	Faridpur Sadar	Greda	Jayar
S98-00784	RIP1963	08/03/1998	23.5969	89.8769	1968	STW	20.1	Mr Kazi Mikter Hossain	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Bhajandanga
S98-00791	RIP1964	09/03/1998	23.6603	89.7639	1978	STW	28	Mr Md Jalal Uddin Shek	Dhaka	Faridpur	Faridpur Sadar	Ishan Gopalpur	Durgapur
S98-00796	RIP1969	10/03/1998	23.5825	89.8403	1990	DTW	137.2	River Research Institute	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Habeli Rajapur
S98-00798	RIP1970	10/03/1998	23.5872	89.8133	1988	DTW	213.4	Technical Training Centre	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	
S98-00818	RIP1965	13/03/1998	23.6669	89.8369	1987	STW	21.9	Mr Abdul Khaleque	Dhaka	Faridpur	Faridpur Sadar	Char Madhabdia	Dakshin (S) Decree Cha
S98-00821	RIP1966	14/03/1998	23.5753	89.7178	1997	STW	18.3	Mr Kazi Abdul Mazed	Dhaka	Faridpur	Faridpur Sadar	Krishnanagar	Bhabukdia
S98-00824	RIP1967	14/03/1998	23.6139	89.7936	1995	STW	15.8	Mr Sk Shorab	Dhaka	Faridpur	Faridpur Sadar	Majchar	Dayarampur
S98-00829	RIP1968	15/03/1998	23.5819	89.835	1994	STW	36.6	Mr Md Aminuddin Sardar	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Habeli Rajapur
S98-00854	RIP2261	21/03/1998	24.6017	88.2767	1990	Tara	34	DPHE Campus,Mr Nurul Islam Khan	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Paurashava
S98-00858	RIP2262	22/03/1998	24.6403	88.3783	1995	STW	42.7	Mr Gopal Hasda, Natunpara	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Jalahar
S98-00871	RIP2263	23/03/1998	24.6372	88.2381	1990	STW	29	Mr Bhulu Mondol	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Arazi Simultala
S98-00877	RIP2264	24/03/1998	24.6883	88.2633	1987	STW	29	Mr Famzlur Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Arunbari
S98-00881	RIP2265	24/03/1998	24.6525	88.3139	1993	Tara	38.1	Mr Doyal Roy	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Amarak
S98-00883	RIP2266	25/03/1998	24.5736	88.2067	1988	Tara	33.5	Kalinagar Primary School	Rajshahi	Nawabganj	Nawabganj Sadar	Sundorpur	Kalinagar
S98-00890	RIP2267	25/03/1998	24.5228	88.2683	1998	STW	19.8	Mr Dhideuli Hal	Rajshahi	Nawabganj	Nawabganj Sadar	Debinagar	Debinagar
S98-00891	RIP2268	26/03/1998	24.5022	88.1817	1994	STW	21.3	Mal Bagadanga Primary School	Rajshahi	Nawabganj	Nawabganj Sadar	Char Bagadanga	Mal Bagadanga
S98-00894	RIP2269	26/03/1998	24.4844	88.245	1988	STW	21.3	Mr Golam Hossain	Rajshahi	Nawabganj	Nawabganj Sadar	Alatuli	Roninagar
S98-00910	RIP2270	28/03/1998	24.6114	88.3478	1986	Tara	41.1	Mr Ruhul Amin	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Pustampur
S98-02451	RIP0001	04/03/1998	23.642	90.609	1986	STW	41	T.N.O Residence	Dhaka	Narayanganj	Sonargaon	Aminpur	Aminpur
S98-02452	RIP0009	10/03/1998	23.723	90.522	1992	STW	59	Malilur Rahaman	Dhaka	Narayanganj	Rupganj	Tarabo	Dighi baraba
S98-02453	RIP0014	11/03/1998	23.84	90.634	1992	STW	36	Juddin Molla	Dhaka	Narayanganj	Araihazar	Satgram	Bara nogaon
S98-02454	RIP0020	12/03/1998	23.688	90.522	1990	STW	66	Z Hossain	Dhaka	Narayanganj	Shiddirganj	Shiddirganj	Shiddirganj
S98-02455	RIP0023	12/03/1998	23.667	90.48	1997	STW	31	Msuf	Dhaka	Narayanganj	Fatulla	Kutubpur	Deolpara
S98-02456	RIP0025	15/03/1998	23.812	90.217	1973	STW	58		Dhaka	Manikganj	Singair	Dhalla	Ulail
S98-02457	RIP0030	12/03/1998	23.617	90.499	1995	STW	62	Sri Rani Dey	Dhaka	Narayanganj	Narayanganj Sadar	Ward no-05	D.n. road
S98-02458	RIP0033	12/03/1998	23.615	90.51	1997	STW	61	Tina Begum	Dhaka	Narayanganj	Bandar	Bandar	Bandar
S98-02459	RIP0035	15/03/1998	23.902	89.986	1998	STW	15	Nasirul Hoque Khan	Dhaka	Manikganj	Manikganj Sadar	Garpara	Panjankhara
S98-02460	RIP0042	16/03/1998	23.847	89.829	1997	STW	52	Mr. Shariful Islam	Dhaka	Manikganj	Shibalaya	Ulail	Sibrampur
S98-02461	RIP0048	18/03/1998	23.968	89.83	1985	DTW	82		Dhaka	Manikganj	Daulatpur (M)	Chakmirpur	Chakmirpur
S98-02462	RIP0050	16/03/1998	23.771	89.915	1980	STW	31	Jhitka High School	Dhaka	Manikganj	Harirampur	Chala	Kalikapur
S98-02463	RIP0057	18/03/1998	23.856	89.939	1980	STW	44	Baniajuri Pry. Sch	Dhaka	Manikganj	Ghior	Baniajuri	Baniajuri
S98-02464	RIP0074	21/04/1998	23.99	90.044	1978	HTW	24	DPHE Complex	Dhaka	Manikganj	Saturia	Baliati	Baliati
S98-02465	RIP0084	21/04/1998	23.919	90.214	1995	Tara	65	DPHE Office	Dhaka	Dhaka	Dhamrai	Dhamrai	Dhamrai
S98-02466	RIP0092	22/04/1998	23.835	90.261	1984	DTW	115	TNO Complex	Dhaka	Dhaka	Savar	Savar	Dakshin dariapur
S98-02467	RIP0102	22/04/1998	23.696	90.347	1992	STW	43	DPHEOffice	Dhaka	Dhaka	Keraniganj	Basta	Konakhola
S98-02468	RIP0110	23/04/1998	23.616	90.125	1997	STW	60	DPHE Office	Dhaka	Dhaka	Dohar	Joypara	Joypara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-00701	2514385190	13	< 0.04	0.27	0.096	49.6	< 0.008	< 0.02	< 0.008	1.17	11.1	< 0.003	32.7	0.624	211	0.7	12.2	1.2	0.304	< 0.006	0.049
S98-00718	2514310666	256	< 0.04	0.04	0.01	56.9	< 0.008	< 0.02	< 0.008	1.74	6.9	< 0.003	29.9	0.447	7.9	1.2	13.9	< 0.2	0.246	< 0.006	0.031
S98-00724	2514395147	38	< 0.04	0.26	0.013	16.6	< 0.008	< 0.02	< 0.008	0.317	7.1	0.003	15.7	0.231	205	0.6	13.8	1.5	0.108	< 0.006	0.021
S98-00727	2514320346	8	< 0.04	0.03	0.383	111	< 0.008	< 0.02	< 0.008	9.46	6.9	0.018	75.8	0.294	201	0.3	27.2	4.9	0.873	< 0.006	0.067
S98-00733	2514355579	< 6	0.07	0.82	0.073	81	< 0.008	< 0.02	< 0.008	0.59	30.2	0.012	124	1.17	1090	0.5	10.3	265	0.797	0.009	0.054
S98-00734	2514355315	< 6	< 0.04	0.05	0.069	27.9	< 0.008	< 0.02	< 0.008	0.716	6	0.006	16.9	0.051	43.8	0.2	21.4	< 0.2	0.216	< 0.006	< 0.008
S98-00736	2514315181	15	< 0.04	0.25	0.014	28.3	< 0.008	< 0.02	< 0.008	0.154	12.4	< 0.003	22.4	0.295	203	0.3	10.5	6.9	0.176	< 0.006	0.012
S98-00749	2514330194	65	< 0.04	0.16	0.052	81.1	< 0.008	< 0.02	< 0.008	3.12	11.9	< 0.003	67.2	1.79	60.7	0.5	11.6	17.9	0.444	< 0.006	< 0.008
S98-00752	2514357	< 6	< 0.04	0.04	0.068	24	< 0.008	< 0.02	< 0.008	1.19	3.7	0.004	16.9	0.076	32.3	0.3	27.2	< 0.2	0.209	< 0.006	< 0.008
S98-00756	251436056	142	< 0.04	0.08	0.011	22	< 0.008	< 0.02	< 0.008	3.92	4.6	0.004	18.6	1.29	48.6	0.4	15.5	0.8	0.13	< 0.006	0.352
S98-00777	3294763931	41	< 0.04	0.02	0.155	115	< 0.008	< 0.02	< 0.008	5.69	3.9	< 0.003	23.2	0.754	13.1	1.4	14.1	< 0.2	0.293	< 0.006	0.016
S98-00781	3294739532	162	< 0.04	0.05	0.081	49.2	< 0.008	< 0.02	< 0.008	3.37	6.1	< 0.003	37	0.041	14	2.1	17.1	< 0.2	0.26	< 0.006	< 0.008
S98-00784	329477120	57	< 0.04	0.02	0.136	129	< 0.008	< 0.02	< 0.008	2.21	3.9	< 0.003	25.9	1.26	9.6	0.3	14.1	0.4	0.428	< 0.006	< 0.008
S98-00791	3294747367	245	< 0.04	0.03	0.168	125	< 0.008	< 0.02	< 0.008	5.97	5.2	< 0.003	28.4	2.86	14.4	0.6	11.8	< 0.2	0.45	< 0.006	0.014
S98-00796	3294755475	< 6	< 0.04	0.1	0.123	67.2	< 0.008	< 0.02	< 0.008	1.73	3.4	0.007	28.4	0.371	148	0.3	19.6	< 0.2	0.353	< 0.006	0.015
S98-00798	3294719	< 6	< 0.04	0.05	0.229	125	< 0.008	< 0.02	< 0.008	5.74	5.1	0.009	49.1	0.133	67.3	< 0.2	10.2	0.2	0.58	< 0.006	6.27
S98-00818	3294723310	< 6	< 0.04	0.03	0.125	115	< 0.008	< 0.02	< 0.008	0.119	5.3	< 0.003	24.3	0.884	12.9	< 0.2	10.9	21.7	0.415	< 0.006	< 0.008
S98-00821	3294771114	132	< 0.04	0.03	0.151	122	< 0.008	< 0.02	0.009	5.57	3.3	< 0.003	27.5	0.651	17.6	1.1	14.4	< 0.2	0.357	< 0.006	0.009
S98-00824	3294779316	10	< 0.04	0.02	0.094	92.1	< 0.008	< 0.02	< 0.008	0.604	3.5	< 0.003	22.2	0.557	13.3	< 0.2	15.4	13.5	0.35	< 0.006	< 0.008
S98-00829	3294755475	< 6	< 0.04	0.03	0.078	67	< 0.008	< 0.02	< 0.008	11	4	0.003	46.9	0.088	17	3.2	38	0.3	0.363	< 0.006	< 0.008
S98-00854	5706696	35	< 0.04	0.01	0.152	110	< 0.008	< 0.02	< 0.008	0.627	5.6	< 0.003	26.6	0.764	28.6	0.2	14.5	18.7	0.254	< 0.006	0.008
S98-00858	5706644471	< 6	< 0.04	0.04	0.062	75.4	< 0.008	< 0.02	< 0.008	0.045	0.8	0.005	24.7	0.035	54.5	0.2	18	3.9	0.391	< 0.006	< 0.008
S98-00871	570661151	< 6	< 0.04	< 0.01	0.064	86.4	< 0.008	< 0.02	< 0.008	1.52	1.3	< 0.003	13.5	0.389	17.2	< 0.2	8.44	6.8	0.281	< 0.006	< 0.008
S98-00877	570663356	< 6	< 0.04	0.02	0.142	178	< 0.008	< 0.02	< 0.008	1.02	4.7	< 0.003	35.2	1.65	39.2	< 0.2	12.3	99.2	0.396	< 0.006	0.011
S98-00881	570663322	< 6	< 0.04	0.02	0.039	47.2	< 0.008	< 0.02	< 0.008	0.022	0.7	0.008	12.4	0.02	22.4	< 0.2	20.3	< 0.2	0.22	< 0.006	0.022
S98-00883	5706694494	8	< 0.04	0.02	0.093	81	< 0.008	< 0.02	< 0.008	0.461	4.5	< 0.003	17.8	0.57	8.7	< 0.2	13.1	< 0.2	0.305	< 0.006	0.047
S98-00890	5706627295	< 6	< 0.04	0.02	0.115	102	< 0.008	< 0.02	< 0.008	0.298	5.6	< 0.003	23.8	0.435	11.2	< 0.2	9.33	9.8	0.326	< 0.006	< 0.008
S98-00891	5706622614	14	< 0.04	< 0.01	0.075	72.7	< 0.008	< 0.02	< 0.008	0.171	4	< 0.003	15.1	0.607	5.2	< 0.2	10.5	2.2	0.255	< 0.006	< 0.008
S98-00894	570665830	< 6	< 0.04	0.01	0.089	79.5	< 0.008	< 0.02	< 0.008	0.047	4.8	< 0.003	14.3	0.419	12.9	< 0.2	8.49	13	0.264	< 0.006	0.035
S98-00910	5706644790	< 6	< 0.04	0.04	0.092	86.7	< 0.008	< 0.02	< 0.008	0.016	1.1	0.013	34.1	0.135	57.8	< 0.2	15.1	9.6	0.533	< 0.006	0.019
S98-02451	3670408017	324	< 0.04	0.03	0.066	48.6	< 0.008	< 0.02	< 0.008	8.87	3.4	< 0.003	12.9	1.91	14	1.1	13.2	< 0.2	0.222	< 0.006	0.155
S98-02452	3676887347	< 6	< 0.04	< 0.01	0.042	37.9	< 0.008	< 0.02	< 0.008	0.199	1.4	0.006	14.4	0.038	49.6	< 0.2	29.3	13.9	0.236	< 0.006	< 0.008
S98-02453	3670287118	< 6	< 0.04	0.1	0.043	6.84	< 0.008	< 0.02	< 0.008	0.128	2.2	0.006	5.71	0.182	169	0.3	17.3	1	0.0752	< 0.006	< 0.008
S98-02454	3678063773	< 6	< 0.04	0.03	0.309	83.4	0.009	< 0.02	< 0.008	2.5	1.6	< 0.003	35.3	8.39	52.2	0.4	22.7	< 0.2	0.52	0.007	0.008
S98-02455	3672079379	< 6	< 0.04	0.1	0.036	33.7	< 0.008	< 0.02	< 0.008	0.425	2.3	0.011	14.8	0.281	207	0.7	20.6	2.1	0.239	< 0.006	< 0.008
S98-02456	3568243944	< 6	< 0.04	0.02	0.041	44.8	< 0.008	< 0.02	< 0.008	0.396	1.6	0.019	17.9	0.299	23.4	< 0.2	21.1	< 0.2	0.275	< 0.006	< 0.008
S98-02457	3675805219	9	< 0.04	0.13	0.058	43.4	< 0.008	< 0.02	< 0.008	0.079	3	0.006	34.4	2.3	167	0.7	18.4	0.2	0.358	0.006	0.059
S98-02458	3670615082	< 6	< 0.04	0.07	0.133	63.1	< 0.008	< 0.02	< 0.008	0.191	5	0.007	69.7	2.28	80.2	0.3	17.9	7.6	0.566	< 0.006	< 0.008
S98-02459	3564631250	< 6	0.28	< 0.01	0.041	97.9	< 0.008	< 0.02	< 0.008	1.65	1.7	< 0.003	22.4	0.967	6.82	< 0.2	12.6	3.8	0.179	< 0.006	0.298
S98-02460	3567871890	41	< 0.04	0.08	0.196	79.9	< 0.008	< 0.02	< 0.008	8.58	4.4	< 0.003	32	0.133	50.4	1.9	25.2	< 0.2	0.351	< 0.006	0.04
S98-02461	3561028206	46	< 0.04	0.05	0.138	79.2	< 0.008	< 0.02	< 0.008	2.82	3.9	0.005	25.4	0.195	32.8	0.4	18.6	< 0.2	0.364	< 0.006	0.014
S98-02462	3562836	60	< 0.04	0.02	0.221	89.7	< 0.008	< 0.02	< 0.008	5.44	8.3	< 0.003	39.4	0.343	34.5	0.6	18.3	< 0.2	0.584	< 0.006	0.134
S98-02463	3562223111	89	< 0.04	0.02	0.14	74.3	< 0.008	< 0.02	< 0.008	14.3	4.5	< 0.003	22.1	0.454	15	1.1	20.8	< 0.2	0.329	< 0.006	0.017
S98-02464	3567019060	20	< 0.04	0.02	0.121	53	< 0.008	< 0.02	< 0.008	10.4	2.6	< 0.003	23.7	0.67	8.47	1	20	1.2	0.17	< 0.006	0.046
S98-02465	3261435354	< 6	< 0.04	< 0.01	0.066	96.9	< 0.008	< 0.02	< 0.008	0.145	3.5	0.011	24.3	0.392	38.7	< 0.2	31.9	27.3	0.722	< 0.006	0.035
S98-02466	3267278296	< 6	< 0.04	< 0.01	0.024	19.8	< 0.008	< 0.02	< 0.008	0.166	1.9	0.004	6.33	0.029	20.6	< 0.2	30.1	0.3	0.155	0.008	0.034
S98-02467	3263808641	< 6	< 0.04	< 0.01	0.043	57.2	< 0.008	< 0.02	< 0.008	0.09	2.9	0.005	18.4	0.086	23	< 0.2	24.2	33.9	0.408	< 0.006	0.015
S98-02468	3261810410	184	< 0.04	0.04	0.271	113	< 0.008	< 0.02	< 0.008	8.85	6	0.005	47.7	0.227	29.9	1.4	21.9	1.4	0.579	< 0.006	0.015

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02469	RIP0118	23/04/1998	23.651	90.132	1994	STW	20	Sheikh Nasir Uddin	Dhaka	Dhaka	Nawabganj (Dh)	Bandura	Magirkanda
S98-02470	RIP1001	23/03/1998	22.966	89.479	1985	DTW	262	Thana Parisad Office	Khulna	Khulna	Phultala	Damodarpur	Damodal
S98-02471	RIP1009	24/03/1998	22.737	89.519	1979	DTW	187	DPHE	Khulna	Khulna	Batiaghata	Batiaghata	Hetalburia
S98-02472	RIP1016	25/03/1998	22.576	89.325	1991	STW	49	Bazlur Rahman	Khulna	Khulna	Paikgachha	Soladana	Paikgachha
S98-02473	RIP1029	27/03/1998	22.811	89.038	1985	STW	34	Jhaodanga H Hchool	Khulna	Satkhira	Satkhira Sadar	Jhaodanga	Jhaodanga
S98-02474	RIP1031	23/03/1998	22.932	89.668	1994	STW	26	Thana Parisad Mosque	Khulna	Khulna	Terokhada	Terokhada	Terokhada
S98-02475	RIP1037	24/03/1998	22.576	89.499		STW	41	Ali Haidar	Khulna	Khulna	Dacope	Chalna	Baraikhal
S98-02476	RIP1040	25/03/1998	22.8	89.645	1987	DTW	131	THANA PARISHAD	Khulna	Khulna	Rupsa	T.S Bahirdia	Taltala
S98-02477	RIP1050	26/03/1998	22.837	89.55	1986	DTW	312	Chief Engr.Mech.Port	Khulna	Khulna	Khulna Metro	Ward-10	Khalispur
S98-02478	RIP1061	23/03/1998	22.887	89.535	1997	DTW	282	Sk Abdul Mazid	Khulna	Khulna	Dighalia	Dighalia	Dighalia
S98-02479	RIP1066	23/03/1998	22.871	89.508	1979	STW	60	Tamjit Fakir	Khulna	Khulna	Dighalia	Deana	Arunghat
S98-02480	RIP1068	23/03/1998	22.819	89.421	1997	STW	59	Babulal Chatarjee	Khulna	Khulna	Dumuria	Dumuria	Arzi Dumuria
S98-02481	RIP1076	25/03/1998	22.778	89.706	1994	STW	39	M.K.Zaman	Khulna	Bagerhat	Fakirhat	Bahirdia Mansa	Attaka
S98-02482	RIP1089	27/03/1998	22.52	89.021	1975	STW	20	Nirmal	Khulna	Satkhira	Kaliganj (S)	Nalta	Nalta
S98-02483	RIP1097	28/03/1998	22.639	89.041	1991	STW	39	Lakshan Chandra Roy	Khulna	Satkhira	Debhata	Kulia	Kulia
S98-02484	RIP1104	31/03/1998	22.824	89.748	1995	STW	34	Robindranath Bishwas	Khulna	Bagerhat	Mollahat	Gaola	Gaola
S98-02485	RIP1111	01/04/1998	22.546	89.652	1990	STW	26	Ramesh Chandra Shah	Khulna	Bagerhat	Rampal	Perikhali	Perikhali
S98-02486	RIP1119	04/04/1998	23.373	89.371	1986	DTW	115	Thana Parishad	Khulna	Magura	Shalikha	Arpara	Arpara
S98-02487	RIP1138	28/03/1998	22.86	89.04	1984	STW	39	DPHE Office	Khulna	Satkhira	Kalaroa	Helatola	Tulshidanga
S98-02488	RIP1146	29/03/1998	22.343	89.112	1997	STW	13	Habibulla Gazi	Khulna	Satkhira	Shyamnagar	Shyamnagar	Nakipur majat
S98-02489	RIP1155	28/03/1998	22.75	89.259	1980	STW	22	DPHE Office	Khulna	Satkhira	Tala	Tala	Baraihati
S98-02490	RIP1164	29/03/1998	22.538	89.24	1975	STW	56	Kazi Abdur Rouf	Khulna	Satkhira	Assasuni	Baradal	Baradal
S98-02491	RIP1177	31/03/1998	22.763	89.855	1994	STW	45	Kazi Mofizul Ahmad	Khulna	Bagerhat	Chitalmari	Santospur	Santoshpur
S98-02492	RIP1183	30/03/1998	22.565	89.845	1985	STW	20	Chapri Mosque	Khulna	Bagerhat	Morrelganj	Teligati	Chapri
S98-02493	RIP1189	30/03/1998	22.311	89.846	1992	STW	10	DPHE Complex	Khulna	Bagerhat	Sarankhola	Khontakata	Amragachia
S98-02494	RIP1193	31/03/1998	22.642	89.814	1996	STW	20	Rafiqul Islam Mia	Khulna	Bagerhat	Bagerhat Sadar	Bemarta	Chaitali
S98-02495	RIP1219	04/04/1998	23.402	89.602	1984	DTW	98	Thana Parishad	Khulna	Magura	Mohammadpur (M)	Mohammadpur	Mohammadpur
S98-02496	RIP1227	12/04/1998	23.17	89.042	1973	STW	45	Farid Uddin Bishwas	Khulna	Jessore	Jhikargachha	Magura	Mohammadpur
S98-02497	RIP1235	13/04/1998	23.042	89.391	1979	STW	50	Noapara P. School	Khulna	Jessore	Abhaynagar	Paurashava	Noapara
S98-02498	RIP1242	14/04/1998	23.27	89.246	1982	STW	51	Abdul Aziz	Khulna	Jessore	Jessore Sadar	Labutala	Khajura
S98-02499	RIP1246	16/04/1998	23.419	88.821	1984	DTW	94	Thana Parishad	Khulna	Chuadanga	Jiban Nagar	Jiban Nagar	Jiban Nagar
S98-02500	RIP1252	17/04/1998	23.399	88.977	1986	STW	44	Mofiz Uddin	Khulna	Jhenaidah	Kotchandpur	Baluhar	Baluhar
S98-02501	RIP1259	19/04/1998	23.734	89.208	1996	Tara	47	Md. Zoad Ali	Khulna	Jhenaidah	Shailkupa	Kancherkol	Kancherkol
S98-02502	RIP1268	22/04/1998	23.611	89.021	1996	STW	39	Yusuf Ali	Khulna	Jhenaidah	Harinakunda	Daulatpur	Parbatpur
S98-02503	RIP1275	22/04/1998	23.863	89.244	1991	Tara	40	DPHE Complex	Khulna	Kushtia	Kumarkhali	Paurashova, W04	Durgapur
S98-02504	RIP1285	31/03/1998	22.722	89.847	1997	STW	18	Osman Khan	Khulna	Bagerhat	Kachua (B)	Dhopakhali	Kamarghati
S98-02505	RIP1286	01/04/1998	22.55	89.59	1996	STW	18	Habibur Rahaman	Khulna	Bagerhat	Mongla	Buridanga	Bidyarbaondiraj
S98-02506	RIP1293	05/04/1998	23.121	89.649	1974	STW	50	Amirtalal Shah	Khulna	Narail	Lohagara (N)	Dighalia	Dighalia
S98-02507	RIP1294	04/04/1998	23.589	89.397	1978	STW	50	Abdul Jalil	Khulna	Magura	Sreepur (M)	Sreepur	Madanpur
S98-02508	RIP1313	22/04/1998	24.009	88.876	1998	Tara	100	DPHE Copmplex	Khulna	Kushtia	Daulatpur (Ku)	Daulatpur	Daulatpur
S98-02509	RIP1334	21/04/1998	23.769	89.256	1989	STW	39	Md. Abdul Jalil	Khulna	Kushtia	Khoksa	Khoksa	Bhabanipur
S98-02510	RIP1341	22/04/1998	24.018	89.007	1989	STW	39	Chad Ali Biswas	Khulna	Kushtia	Bheramara	Bahirchar	Bahirchar west
S98-02511	RIP1353	04/05/1998	23.07	89.559	1998	STW	63	Golam Sarwar	Khulna	Narail	Kalia	Chanchari	Banagram
S98-02512	RIP1354	12/04/1998	23.12	88.974	1963	STW	22	Shahadat Hossain	Khulna	Jessore	Sharsha	Nizampur	Amtala
S98-02513	RIP1362	13/04/1998	22.906	89.216	1985	STW	49	Thana Parishad	Khulna	Jessore	Keshabpur	Keshabpur	Altapol
S98-02514	RIP1378	16/04/1998	23.603	88.774	1996	STW	40	DPHE Office	Khulna	Chuadanga	Damurhuda	Damurhuda	Dasami
S98-02515	RIP1386	17/04/1998	23.678	88.869	1983	STW	39	Mrs Amdad	Khulna	Chuadanga	Chuadanga Sadar	Mominpur	Boalmari
S98-02516	RIP1392	18/04/1998	23.781	88.734	1994	STW	39	Omar Ali	Khulna	Meherpur	Gangni	Dhankhola	Chitla

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02469	3266220637	133	< 0.04	0.03	0.107	74.1	< 0.008	< 0.02	< 0.008	1.56	1.9	0.004	21.1	1.41	76.2	0.6	17.1	1	0.61	< 0.006	0.013
S98-02470	4476938331	< 6	< 0.04	0.13	0.041	31.7	< 0.008	< 0.02	< 0.008	0.042	2.7	0.003	15.2	0.021	110	< 0.2	12.1	< 0.2	0.235	< 0.006	0.133
S98-02471	4471235059	< 6	< 0.04	0.3	0.047	35.5	< 0.008	< 0.02	< 0.008	0.124	4.2	0.007	19.1	0.077	196	0.5	9.38	< 0.2	0.326	< 0.006	0.008
S98-02472	4476489772	130	< 0.04	0.19	0.706	193	< 0.008	< 0.02	< 0.008	6.75	14.6	0.008	114	0.127	513	2.1	20.6	0.9	1.15	< 0.006	0.01
S98-02473	4878267401	109	< 0.04	0.03	0.238	114	< 0.008	< 0.02	< 0.008	7.03	3.5	0.003	26.3	0.064	16.6	0.8	20.4	0.2	0.343	< 0.006	< 0.008
S98-02474	4479481994	114	< 0.04	0.11	0.107	72	< 0.008	< 0.02	< 0.008	2.31	4.1	0.003	17.3	0.039	201	2.4	19.4	1	0.27	< 0.006	< 0.008
S98-02475	4471731119	12	0.07	0.83	0.211	75.8	< 0.008	< 0.02	< 0.008	1.58	17.7	0.008	103	0.066	2460	4.5	20.4	2	0.678	0.008	0.016
S98-02476	4477581949	89	< 0.04	0.07	0.082	72.8	< 0.008	< 0.02	< 0.008	0.432	5.6	0.007	41.5	0.052	34.6	0.9	17.7	< 0.2	0.391	< 0.006	< 0.008
S98-02477	4476310250	< 6	< 0.04	0.19	0.113	40.1	< 0.008	< 0.02	< 0.008	0.525	5.3	0.008	20.8	0.033	186	0.2	12.4	< 0.2	0.318	< 0.006	< 0.008
S98-02478	4474057379	< 6	< 0.04	0.15	0.579	155	< 0.008	< 0.02	< 0.008	0.614	7.5	0.015	82.3	0.091	315	0.8	13.8	1.1	1.17	< 0.006	0.011
S98-02479	4474047047	73	< 0.04	0.26	0.303	55.7	< 0.008	< 0.02	< 0.008	4.28	3.6	0.013	47.2	0.126	804	2.4	12.9	0.6	0.465	< 0.006	0.012
S98-02480	4473039834	< 6	< 0.04	0.16	0.04	31.8	< 0.008	< 0.02	< 0.008	0.07	0.7	0.013	18.4	0.442	381	0.4	16.4	0.9	0.174	0.006	0.028
S98-02481	4013410014	121	< 0.04	0.03	0.128	116	< 0.008	< 0.02	< 0.008	0.352	3.2	0.004	23.7	0.719	16.5	0.3	15.9	2.4	0.296	< 0.006	0.016
S98-02482	4874779679	100	< 0.04	0.05	0.223	121	< 0.008	< 0.02	< 0.008	6.1	4.8	< 0.003	38.7	0.129	28.1	2.1	16.8	1.3	0.476	< 0.006	< 0.008
S98-02483	4872531634	176	< 0.04	0.12	0.289	100	< 0.008	< 0.02	< 0.008	3.29	4.3	0.005	32.6	0.056	278	1.3	16.7	1	0.398	< 0.006	0.01
S98-02484	4015647365	124	< 0.04	0.04	0.226	131	< 0.008	< 0.02	< 0.008	13.4	3.7	0.004	34.7	0.128	33.5	1.2	23.4	1.1	0.413	< 0.006	0.008
S98-02485	4017371766	505	0.04	0.05	0.328	291	< 0.008	< 0.02	< 0.008	7.16	6.5	0.003	63.4	0.297	127	1.7	13.4	1	1.06	< 0.006	0.008
S98-02486	4558511049	78	< 0.04	0.02	0.201	101	< 0.008	< 0.02	< 0.008	3.6	3.3	0.008	23.1	0.433	21.4	0.3	19.4	< 0.2	0.326	< 0.006	0.064
S98-02487	4874323986	147	< 0.04	0.02	0.21	116	< 0.008	< 0.02	< 0.008	9.21	1.9	0.003	24.8	0.128	36	1.4	19.4	0.2	0.292	< 0.006	0.03
S98-02488	4878694734	< 6	< 0.04	0.44	0.067	93.9	< 0.008	< 0.02	< 0.008	2.38	22.5	0.013	61	0.194	336	1.1	24.8	0.6	0.552	< 0.006	0.028
S98-02489	4879087112	106	< 0.04	0.04	0.227	80.3	< 0.008	< 0.02	< 0.008	3.57	3.5	0.004	22.7	0.087	24.8	1.4	18.5	< 0.2	0.322	< 0.006	< 0.008
S98-02490	4870425107	155	< 0.04	0.26	0.5	105	< 0.008	< 0.02	< 0.008	3.99	12.8	0.008	69.1	0.052	573	2	17.5	1.1	0.665	< 0.006	< 0.008
S98-02491	4011463884	217	0.07	0.13	0.282	109	< 0.008	< 0.02	< 0.008	7.52	11.1	0.006	53.5	0.067	362	2.6	20.7	1.2	0.569	< 0.006	0.012
S98-02492	4016095273	92	< 0.04	0.13	0.279	176	< 0.008	< 0.02	< 0.008	7.46	7	0.003	46	0.478	330	1.6	12.6	41.9	0.642	< 0.006	< 0.008
S98-02493	4017738090	< 6	< 0.04	0.3	0.021	38.7	< 0.008	< 0.02	< 0.008	0.175	8.6	0.004	30.2	0.111	230	3.2	19	0.4	0.225	< 0.006	0.012
S98-02494	4010825252	301	< 0.04	0.1	0.502	264	< 0.008	< 0.02	< 0.008	16	9.7	0.004	80.5	0.298	299	0.6	16.6	1.5	1.04	< 0.006	0.037
S98-02495	4556652615	61	< 0.04	0.02	0.076	100	< 0.008	< 0.02	< 0.008	0.747	2.6	0.012	33.3	1.48	16.8	0.3	20.9	< 0.2	0.453	< 0.006	0.008
S98-02496	4412353608	111	< 0.04	0.02	0.391	145	< 0.008	< 0.02	< 0.008	4.11	3.8	< 0.003	33.1	0.638	21.6	0.3	14.5	14.6	0.445	< 0.006	0.009
S98-02497	4410431718	136	< 0.04	0.06	0.064	115	< 0.008	< 0.02	< 0.008	3.93	2.1	0.008	35.7	0.233	33.6	0.3	14.7	< 0.2	0.558	< 0.006	0.009
S98-02498	4414777568	9	< 0.04	0.02	0.136	91.5	< 0.008	< 0.02	< 0.008	2.29	2.8	0.003	16.7	0.084	10.2	< 0.2	15.1	< 0.2	0.224	< 0.006	< 0.008
S98-02499	4185557341	30	< 0.04	0.03	0.248	114	< 0.008	< 0.02	< 0.008	3.43	2.9	0.004	24.5	0.124	17.2	0.4	17	0.2	0.259	< 0.006	0.01
S98-02500	4444213159	45	< 0.04	0.03	0.125	105	< 0.008	< 0.02	< 0.008	1.4	5.6	< 0.003	23.5	0.225	16.4	0.5	12.3	17.5	0.361	< 0.006	0.008
S98-02501	4448056505	< 6	< 0.04	0.03	0.041	94.7	< 0.008	< 0.02	< 0.008	0.023	1.2	0.006	23.6	1.5	24.6	< 0.2	20.5	< 0.2	0.377	< 0.006	0.014
S98-02502	4441431723	71	< 0.04	0.02	0.122	131	< 0.008	< 0.02	< 0.008	4.71	2.8	0.005	31.6	0.462	21.4	0.5	16.9	< 0.2	0.307	< 0.006	< 0.008
S98-02503	4507170273	< 6	< 0.04	0.02	0.084	119	< 0.008	< 0.02	< 0.008	0.025	1.1	0.004	32.6	0.474	36.7	0.2	17.7	< 0.2	0.43	< 0.006	0.014
S98-02504	4013828543	59	< 0.04	0.07	0.568	275	< 0.008	< 0.02	< 0.008	11.2	7.6	0.005	76.6	0.145	236	1.1	18	49.5	1.03	< 0.006	0.026
S98-02505	4015827216	< 6	0.05	0.91	0.45	79.6	< 0.008	< 0.02	< 0.008	2.88	31.6	0.009	76.8	0.306	988	0.6	16.1	1.4	0.61	0.007	0.023
S98-02506	4655207287	152	< 0.04	0.04	0.28	86.6	< 0.008	< 0.02	< 0.008	3.04	10.6	< 0.003	32.9	0.105	24.2	1.8	15.5	< 0.2	0.435	< 0.006	0.021
S98-02507	4559584563	< 6	< 0.04	0.05	0.123	88.3	< 0.008	< 0.02	< 0.008	0.096	3	0.015	28.2	0.76	67.5	0.7	17.6	0.7	0.406	< 0.006	0.013
S98-02508	4503933337	< 6	< 0.04	0.02	0.126	115	< 0.008	< 0.02	< 0.008	0.691	3.9	0.005	27.8	1.1	16.5	< 0.2	18.1	0.6	0.356	< 0.006	0.011
S98-02509	4506347138	< 6	< 0.04	0.03	0.054	97	0.036	0.72	< 0.008	8.43	1.3	0.005	33.3	1.01	41.7	0.4	18	1.4	0.458	0.008	0.011
S98-02510	4501527094	< 6	< 0.04	0.03	0.121	68.7	< 0.008	< 0.02	< 0.008	0.082	2.6	< 0.003	16.4	0.898	14.2	< 0.2	13.2	4.6	0.179	< 0.006	0.011
S98-02511	4652831146	< 6	< 0.04	0.08	0.071	99.1	0.036	< 0.02	< 0.008	0.059	1.8	0.029	43.2	1.43	598	0.5	16.1	2	0.541	0.006	0.02
S98-02512	4419069014	54	< 0.04	0.02	0.117	78.1	< 0.008	< 0.02	< 0.008	2.9	2.5	< 0.003	18.7	0.379	9.2	1	13.8	< 0.2	0.22	< 0.006	< 0.008
S98-02513	4413828014	166	< 0.04	0.07	0.236	82.5	< 0.008	< 0.02	< 0.008	3.9	4.6	0.004	29.8	0.039	52.7	1.3	18.9	< 0.2	0.378	< 0.006	0.008
S98-02514	4183111318	50	< 0.04	0.02	0.244	111	< 0.008	< 0.02	< 0.008	4.56	3.3	0.004	24.1	0.472	24.4	0.5	13.9	1.2	0.323	< 0.006	< 0.008
S98-02515	4182359211	41	< 0.04	0.01	0.157	86.9	< 0.008	< 0.02	< 0.008	2.08	3.6	< 0.003	15.8	0.5	9.1	0.2	11.7	< 0.2	0.193	< 0.006	0.01
S98-02516	4574721328	33	< 0.04	0.02	0.234	114	< 0.008	< 0.02	< 0.008	3.23	9.3	< 0.003	22	0.62	11.3	0.5	12.3	14.6	0.278	< 0.006	0.009

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02517	RIP1399	19/04/1998	23.404	89.221	1997	STW	49	Md. Mutaleb	Khulna	Jhenaidah	Kaliganj (J)	Kola	Khalkula
S98-02518	RIP1416	05/04/1998	23.181	89.543	1969	STW	54	Arab Ali	Khulna	Narail	Narail Sadar	Auria	Taltala
S98-02519	RIP1417	12/04/1998	23.26	89.024	1993	DTW	118	Thana Health Complex	Khulna	Jessore	Chaugachha	Chaugachha	Chaugachha
S98-02520	RIP1426	13/04/1998	22.963	89.23	1993	STW	67	Md Omar Ali	Khulna	Jessore	Manirampur	Shyamkur	Aminpur
S98-02521	RIP1435	14/04/1998	23.222	89.408	1984	STW	50	Dhahala Mandal	Khulna	Jessore	Bagher Para	Dohakula	Mamudanipur
S98-02522	RIP1443	16/04/1998	23.76	88.942	1982	DTW	82	Thana Parishad	Khulna	Chuadanga	Alamdanga	Paurashava W01	Gobindapur
S98-02523	RIP1457	19/04/1998	23.352	88.918	1995	DTW	123	TWS	Khulna	Jhenaidah	Moheshpur	Pourasava w02	Moheshpur
S98-02524	RIP1458	18/04/1998	23.659	88.62	1979	STW	39	Water Superentendent	Khulna	Meherpur	Meherpur Sadar	Paurashava W07	Meherpur
S98-02525	RIP1475	20/04/1998	23.476	89.146	1996	Tara	47	Md. Moshiur Rahman	Khulna	Jhenaidah	Jhenaidah Sadar	Maharajpur	Bishykhali
S98-02526	RIP1481	21/04/1998	23.93	89.083	1994	Tara	37	Shamiul hoque	Khulna	Kushtia	Kushtia Sadar	Barakhada	Barakhada
S98-02527	RIP1525	30/04/1998	22.35	90.579	1992	DTW	283	Chandu Mollah	Barisal	Patuakhali	Dashmina	Baharampur	Baharampur
S98-02528	RIP1531	27/04/1998	22.97	90.159	1995	DTW	237	DPHE Office	Barisal	Barisal	Agailjhara	Bakal	Manasi phulasri
S98-02529	RIP1549	30/04/1998	22.414	90.566	1994	DTW	322	Salim Gazi	Barisal	Patuakhali	Bauphal	Daspara	Daspara
S98-02530	RIP1556	01/05/1998	22.358	90.342	1998	HTW	17	Himi Poly Clinic	Barisal	Patuakhali	Patuakhali Sadar	Paurashava w03	Thanapara
S98-02531	RIP1565	03/05/1998	22.041	89.972	1997	STW	12	DPHE Office	Barisal	Barguna	Patharghata	Patharghata	Patharghata
S98-02532	RIP1573	05/05/1998	22.626	90.061	1990	DTW	256	DPHE Office	Barisal	Pirojpur	Kawkhali	Kawkhali	Uzialkhan
S98-02533	RIP1593	30/04/1998	22.359	90.216	1995	DTW	299	Thana Parishad	Barisal	Patuakhali	Mirzaganj	Deuli Subidkhali	Pas. Subidkhali
S98-02534	RIP1601	02/05/1998	21.951	90.183	1990	DTW	299	Pakhimara P. School	Barisal	Patuakhali	Kalapara	Nilganj	Pakhimara
S98-02535	RIP1608	03/05/1998	21.982	90.088	1980	DTW	306	Sikder Ali	Barisal	Barguna	Amtali	Barabagi	Barabagi
S98-02536	RIP1617	04/05/1998	22.416	90.166	1995	DTW	289	DPHE Office	Barisal	Barguna	Betagi	Betagi	Betagi
S98-02537	RIP1653	12/05/1998	23.076	90.436	1978	STW	35	DPHE Office	Dhaka	Shariatpur	Gosairhat	Idilpur	Dhipur
S98-02538	RIP1661	02/05/1998	22.257	90.416	1996	DTW	300	Maulana Waliullah	Barisal	Patuakhali	Galachipa	Chiknikandi	Khadijoar
S98-02539	RIP1665	03/05/1998	22.172	90.092	1995	DTW	302	Abdul Khak Mallik	Barisal	Barguna	Barguna Sadar	Badarkhali	Kumrakhali
S98-02540	RIP1671	04/05/1998	22.308	90.096	1984	DTW	285	Bamna Bazar	Barisal	Barguna	Bamna	Bamna	Shafipur
S98-02541	RIP1677	05/05/1998	22.488	90.067	1996	STW	22	DPHE Office	Barisal	Pirojpur	Bhandaria	Bhandaria	Lakshmipura
S98-02542	RIP1682	06/05/1998	22.516	89.996	1994	STW	15	Alpu Sikder	Barisal	Pirojpur	Indurkani	Parerhat	Hognabunia
S98-02543	RIP1692	07/05/1998	22.568	90.148	1979	STW	12	DPHE Office	Barisal	Jhalakati	Rajapur	Rajapur	Rajapur
S98-02544	RIP1699	09/05/1998	22.647	90.231	1996	STW	15	Mashiur Rahaman	Barisal	Jhalakati	Nalchity	Nathullabad	Lakshankati
S98-02545	RIP1708	07/05/1998	22.639	90.18	1992	DTW	306	Gabkhan Ferry Ghat	Barisal	Jhalakati	Jhalakati Sadar	Gabkhan Dhansiri	Gabkhan
S98-02546	RIP1719	09/05/1998	22.402	90.127	1995	STW	13	Alamgir Hossain	Barisal	Jhalakati	Kathalia	Kathalia	Kathalia
S98-02547	RIP1738	12/05/1998	23.138	90.444	1984	STW	63	DPHE Office	Dhaka	Shariatpur	Damudya	Damudya	Dahshin Damudya
S98-02548	RIP1759	12/05/1998	23.229	90.533	1995	STW	27	Union Parishad	Dhaka	Shariatpur	Bhedarganj	Sakhipura	Char Sakipura
S98-02549	RIP1762	12/05/1998	23.2	90.469	1993	STW	33	Abdul Kalam Dewan	Dhaka	Shariatpur	Bhedarganj	Rambhadrapur	Koraltali
S98-02550	RIP1767	12/05/1998	23.301	90.409	1989	STW	39	DPHE Office	Dhaka	Shariatpur	Naria	Naria	Naria
S98-02551	RIP1775	14/05/1998	22.906	89.899	1995	STW	14	Baggabandhu Bhaban	Dhaka	Gopalganj	Tungipara	Patgati	Tungipara
S98-02552	RIP1783	16/05/1998	23.144	89.763	1990	STW	39	Union Parishad	Dhaka	Gopalganj	Kashiani	Fukura	Fukura
S98-02553	RIP1791	13/05/1998	23.186	90.339	1988	DTW	246	DPHE Office	Dhaka	Shariatpur	Palong	Paurashava W03	Dharuka
S98-02554	RIP1800	14/05/1998	22.987	90.006	1990	STW	29	DPHE Office	Dhaka	Gopalganj	Kotalipara	Ghagor	Mokshakotali
S98-02555	RIP1808	16/05/1998	23.317	89.871	1998	DTW	281	Thana Parishad	Dhaka	Gopalganj	Muksudpur	Tengrakhola	Gopinathpur
S98-02556	RIP1811	17/05/1998	23.298	89.701	1993	STW	58	Zahir uddin	Dhaka	Faridpur	Alfadanga	Buraich	Buraich
S98-02557	RIP1817	17/05/1998	23.327	89.71	1997	STW	20	Akmal Chaudury	Dhaka	Faridpur	Boalmari	Shekhar	Maitkumra
S98-02558	RIP1819	18/05/1998	23.387	89.984	1997	STW	82	Mohammad Ismail	Dhaka	Faridpur	Bhanga	Bhanga	Hasamdia
S98-02559	RIP1827	19/05/1998	23.698	89.719	1978	STW	29	Gazi Abdul Malek	Dhaka	Rajbari	Rajbari Sadar	Kharkharapur	C.Kharkharapur
S98-02560	RIP1836	13/05/1998	23.331	90.324	1984	STW	21	DPHE Office	Dhaka	Shariatpur	Zanjira	Zanjira	Hariasa
S98-02561	RIP1844	14/05/1998	22.994	89.816	1980	STW	22	DPHE Office	Dhaka	Gopalganj	Gopalganj Sadar	Paurashava W03	Court bankpara
S98-02562	RIP1868	18/05/1998	23.472	90.029	1978	STW	38	DPHE Office	Dhaka	Faridpur	Sadarpur	Sadarpur	Satararashi
S98-02563	RIP1882	20/05/1998	23.795	89.421	1994	STW	56	Nurul Islam	Dhaka	Rajbari	Pangsha	Pangsha	Narayanpur
S98-02564	RIP1890	17/05/1998	23.481	89.498	1974	STW	58	Mukul Mia	Dhaka	Faridpur	Madhukhali	Kamarkhali	Char Pukhuria

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02517	4443347528	55	< 0.04	0.05	0.095	97.9	< 0.008	< 0.02	< 0.008	6.16	3.3	< 0.003	37.7	0.292	37.7	0.9	18.5	< 0.2	0.5	< 0.006	0.01
S98-02518	4657606928	198	< 0.04	0.13	0.141	72.9	< 0.008	< 0.02	< 0.008	5.92	2.7	0.004	33.8	0.168	344	0.7	13.8	< 0.2	0.441	< 0.006	0.111
S98-02519	4411108246	49	< 0.04	0.02	0.122	75.4	< 0.008	< 0.02	< 0.008	1.68	2.6	0.005	17.9	0.171	8.4	0.6	14.6	< 0.2	0.242	< 0.006	0.019
S98-02520	4416194012	168	< 0.04	0.06	0.406	127	< 0.008	< 0.02	< 0.008	3.7	8.2	0.005	60.7	0.099	41.5	1.1	18.3	< 0.2	0.762	< 0.006	< 0.008
S98-02521	4410947669	152	< 0.04	0.03	0.226	106	< 0.008	< 0.02	< 0.008	3.93	7	0.003	25.2	0.262	20.9	1	15.4	< 0.2	0.407	< 0.006	< 0.008
S98-02522	4180767510	35	< 0.04	0.02	0.129	91.7	< 0.008	< 0.02	< 0.008	0.559	3.5	0.004	18.8	0.723	9.9	0.4	15.2	0.7	0.25	< 0.006	0.223
S98-02523	4447159663	74	< 0.04	0.01	0.124	78.6	< 0.008	< 0.02	< 0.008	1.12	3.2	< 0.003	15.3	0.184	8.9	0.8	14.7	6.7	0.224	< 0.006	0.12
S98-02524	4578772	72	< 0.04	0.05	0.196	122	< 0.008	< 0.02	< 0.008	3.92	3.6	< 0.003	48.5	0.639	22.5	0.8	12.7	0.6	0.49	< 0.006	0.021
S98-02525	4441958181	< 6	< 0.04	0.03	0.038	87	< 0.008	< 0.02	< 0.008	0.056	1.2	< 0.003	33.8	1.15	20.3	0.4	20.3	< 0.2	0.409	< 0.006	0.029
S98-02526	4507925119	< 6	< 0.04	0.05	0.11	112	< 0.008	< 0.02	< 0.008	0.059	2.1	0.006	24.7	0.887	27.6	0.2	17.9	< 0.2	0.385	< 0.006	0.014
S98-02527	1785221076	< 6	< 0.04	0.19	0.049	19.1	< 0.008	< 0.02	< 0.008	0.134	3.8	< 0.003	11.9	0.036	128	0.7	10.5	0.3	0.21	< 0.006	< 0.008
S98-02528	1060215588	< 6	< 0.04	0.6	0.069	16.8	< 0.008	< 0.02	< 0.008	0.297	3	0.008	7.46	0.049	303	0.6	13.5	< 0.2	0.127	< 0.006	0.011
S98-02529	1783835445	< 6	< 0.04	0.26	0.007	6.3	< 0.008	< 0.02	< 0.008	0.105	2.6	0.004	3.94	0.027	153	0.6	8.85	0.2	0.0738	< 0.006	< 0.008
S98-02530	1789575710	< 6	0.09	0.92	0.202	168	0.008	< 0.02	0.029	4.67	42.5	0.011	260	0.255	2640	4	16.8	339	1.49	0.011	0.044
S98-02531	1048571841	11	< 0.04	1.06	0.029	21.2	< 0.008	< 0.02	< 0.008	1.66	20.9	0.007	20.3	0.123	561	3.9	14.8	225	0.157	< 0.006	0.039
S98-02532	1794747994	< 6	< 0.04	0.97	0.069	15.3	< 0.008	< 0.02	< 0.008	0.194	3.1	0.006	6.94	0.021	370	0.3	9.28	2.6	0.166	< 0.006	< 0.008
S98-02533	1787627760	< 6	< 0.04	0.54	0.018	5.94	< 0.008	< 0.02	< 0.008	0.08	3.3	0.004	4.62	0.016	258	0.9	8.73	0.5	0.0712	< 0.006	< 0.008
S98-02534	1786671952	< 6	< 0.04	1.04	0.015	4.36	< 0.008	< 0.02	< 0.008	0.122	3.3	0.005	3.66	0.01	341	1.4	8.88	1.5	0.0512	0.006	0.008
S98-02535	1040939085	< 6	< 0.04	1.24	0.019	5.32	< 0.008	< 0.02	< 0.008	0.176	3.8	0.003	4.87	0.011	427	2.1	8.62	0.9	0.073	< 0.006	< 0.008
S98-02536	1044711151	< 6	< 0.04	0.55	0.076	17.1	< 0.008	< 0.02	< 0.008	0.189	6.5	0.006	15	0.067	479	0.6	9	< 0.2	0.217	< 0.006	< 0.008
S98-02537	3863635460	248	0.04	0.28	0.042	36.4	< 0.008	< 0.02	< 0.008	1.2	8.5	0.004	30.2	0.133	100	1.6	15.1	0.5	0.235	< 0.006	0.011
S98-02538	1785750573	< 6	< 0.04	0.31	0.022	6.01	< 0.008	< 0.02	< 0.008	0.078	2.2	0.004	2.94	0.01	167	0.5	9.39	1.9	0.0807	< 0.006	0.011
S98-02539	1042819638	< 6	< 0.04	0.64	0.015	5.09	< 0.008	< 0.02	< 0.008	0.318	3.2	0.004	3.83	0.012	263	1.7	8.85	1	0.0623	< 0.006	< 0.008
S98-02540	1041923943	< 6	< 0.04	0.71	0.027	4.96	< 0.008	< 0.02	< 0.008	0.142	3.6	0.003	4.5	0.012	279	1.5	8.57	1.2	0.0626	< 0.006	< 0.008
S98-02541	1791411537	< 6	< 0.04	0.13	0.064	43.4	< 0.008	< 0.02	< 0.008	0.971	12.5	0.003	30	0.149	120	0.4	19	0.8	0.256	< 0.006	0.014
S98-02542	1793843582	< 6	0.06	0.55	0.128	72.2	< 0.008	< 0.02	< 0.008	5.4	21	0.013	93.4	0.086	880	5.2	28.9	2.2	0.583	0.008	0.02
S98-02543	1428454842	17	< 0.04	0.24	0.025	35	< 0.008	< 0.02	< 0.008	0.985	10.2	0.005	35.7	0.068	295	3.7	23.6	0.6	0.257	< 0.006	0.015
S98-02544	1427363537	16	0.19	0.14	0.07	47.3	< 0.008	< 0.02	< 0.008	4.59	7.5	< 0.003	30.6	0.366	89.6	3	25.9	0.5	0.252	< 0.006	0.011
S98-02545	1424028357	7	< 0.04	0.7	0.046	11.9	< 0.008	< 0.02	< 0.008	0.195	3.1	0.007	6.04	0.019	314	0.7	9.8	1.6	0.131	< 0.006	< 0.008
S98-02546	1424363529	< 6	0.06	0.58	0.032	6.89	< 0.008	< 0.02	< 0.008	0.43	5.8	< 0.003	5.23	0.039	339	7.1	14.6	3.6	0.046	0.009	< 0.008
S98-02547	3862511331	77	< 0.04	0.21	0.188	44.9	< 0.008	< 0.02	< 0.008	2.31	13.8	0.007	53.6	0.122	321	4.3	29.9	0.9	0.389	< 0.006	0.022
S98-02548	3861486273	30	< 0.04	0.04	0.113	119	< 0.008	< 0.02	< 0.008	0.516	4.5	< 0.003	26.6	0.658	12.4	0.3	15.9	8	0.395	< 0.006	0.01
S98-02549	3861477601	49	< 0.04	0.01	0.09	86.4	< 0.008	< 0.02	< 0.008	0.992	5.1	< 0.003	15.9	0.895	5.1	0.4	12.7	7.8	0.28	< 0.006	0.018
S98-02550	3866575759	275	< 0.04	0.04	0.13	86.8	< 0.008	< 0.02	< 0.008	4.66	5.8	< 0.003	27.4	1.69	36.8	1.5	19.8	0.6	0.351	< 0.006	0.017
S98-02551	3359176972	22	< 0.04	0.04	0.332	210	< 0.008	< 0.02	< 0.008	9.04	6.6	0.004	59.1	0.306	61.3	1.8	22.6	17.2	0.711	< 0.006	0.015
S98-02552	3354313744	76	< 0.04	0.02	0.199	101	< 0.008	< 0.02	< 0.008	17	3.3	0.004	15.4	0.177	12.5	1	20.6	1.5	0.252	< 0.006	0.012
S98-02553	3866995487	< 6	0.04	0.23	0.467	218	< 0.008	< 0.02	< 0.008	2.04	8.2	0.026	130	0.196	580	0.4	17.2	9.9	1.46	0.007	0.011
S98-02554	3355123636	193	< 0.04	0.07	0.144	97.9	< 0.008	< 0.02	< 0.008	4.29	3.6	< 0.003	26.6	0.058	66.3	1.2	16.6	0.4	0.329	< 0.006	0.009
S98-02555	3355889392	< 6	< 0.04	0.1	0.941	264	< 0.008	< 0.02	< 0.008	1.52	10.1	0.03	134	0.126	609	0.3	16.8	11.1	2.03	< 0.006	0.009
S98-02556	3290331193	203	< 0.04	0.05	0.104	89	< 0.008	< 0.02	< 0.008	3.18	5.6	< 0.003	45.4	0.139	22.3	2	19.2	< 0.2	0.496	< 0.006	0.01
S98-02557	3291873640	74	< 0.04	0.02	0.239	118	< 0.008	< 0.02	< 0.008	10.9	1.9	< 0.003	22.3	0.475	12.6	1.1	14.8	< 0.2	0.301	< 0.006	0.011
S98-02558	3291023417	238	< 0.04	0.1	0.245	80.1	< 0.008	< 0.02	< 0.008	3.97	11.5	0.005	64.6	0.079	133	2.3	15.6	< 0.2	0.536	< 0.006	< 0.008
S98-02559	3827643277	161	< 0.04	0.03	0.164	117	< 0.008	< 0.02	< 0.008	6.73	4.9	< 0.003	34	1.32	18.1	0.6	16.4	< 0.2	0.404	< 0.006	0.01
S98-02560	3869494467	72	< 0.04	0.02	0.088	94.4	< 0.008	< 0.02	< 0.008	0.958	3.9	< 0.003	17.2	0.852	14.6	0.8	13.1	17.4	0.302	< 0.006	0.016
S98-02561	3353238199	188	< 0.04	0.03	0.108	121	< 0.008	< 0.02	< 0.008	3.93	4.1	< 0.003	26	1.21	21.6	0.5	14	3.5	0.421	< 0.006	0.009
S98-02562	3298485833	272	< 0.04	0.04	0.314	120	< 0.008	< 0.02	< 0.008	3.86	6.8	0.005	47	0.161	32.5	1.1	17.2	1.1	0.584	< 0.006	< 0.008
S98-02563	3827375729	8	< 0.04	0.02	0.084	157	< 0.008	< 0.02	< 0.008	0.158	2.3	0.01	38.8	1.53	34.4	< 0.2	18	20.4	0.68	< 0.006	< 0.008
S98-02564	3295642245	61	< 0.04	0.03	0.243	153	< 0.008	< 0.02	< 0.008	2.07	4.1	0.004	26.8	0.635	14	0.9	16	5.1	0.393	0.006	0.023

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02565	RIP1898	18/05/1998	23.419	89.897	1978	STW	34	DPHEOffice	Dhaka	Faridpur	Nagarkanda	Nagarkanda	Goagjagdia
S98-02566	RIP1906	19/05/1998	23.554	89.934	1996	STW	26	High School	Dhaka	Faridpur	Char Bhadrasan	Gazirtek	Char Ajdoya
S98-02567	RIP1949	29/04/1998	22.808	90.306	1965	DTW	253	DPHE Office	Barisal	Barisal	Babuganj	Rahmatpur	Khapura
S98-02568	RIP2009	31/03/1998	24.82	88.225	1988	Tara	39	Kaisar Ali Mandal	Rajshahi	Nawabganj	Bholahat	Jambaria	Chata jambaria
S98-02569	RIP2015	31/03/1998	24.821	88.144	1994	STW	33	Sona Mosque	Rajshahi	Nawabganj	Shibganj (N)	Shahbazpur	Pirozpur
S98-02570	RIP2016	01/04/1998	24.688	88.45	1994	Tara	45	Union Parishad	Rajshahi	Nawabganj	Nachole	Nizampur	Bakail
S98-02571	RIP2026	01/04/1998	24.755	88.304	1990	STW	31	Tami Mandal	Rajshahi	Nawabganj	Gomastapur	Gomastapur	Chak pustum
S98-02572	RIP2036	02/04/1998	24.468	88.322	1996	Tara	32	DPHE Office	Rajshahi	Rajshahi	Godagari	Paurashava	Bhagabantapur
S98-02573	RIP2046	02/04/1998	24.553	88.583	1982	STW	30	Kasem	Rajshahi	Rajshahi	Tanore	Saranjai	Burag
S98-02574	RIP2056	02/04/1998	24.361	88.706	1993	STW	32	Mrs Fatema	Rajshahi	Rajshahi	Puthia	Belpukuna	Bhangra
S98-02575	RIP2066	03/04/1998	24.511	88.625	1992	Tara	38	Maugachhi High Schoo	Rajshahi	Rajshahi	Mohanpur	Maugachhi	Maugachhi
S98-02576	RIP2098	05/04/1998	24.367	88.687	1996	STW	33	Mr Asimuddin	Rajshahi	Rajshahi	Paba	Harian	Emadpur
S98-02577	RIP2116	12/04/1998	24.299	88.966	1985	STW	36	DPHE Office	Rajshahi	Natore	Bagatipara	Bagatipara	Parabaria
S98-02578	RIP2124	12/04/1998	24.202	88.999	1985	STW	41	DPHE Office	Rajshahi	Natore	Lalpur	Gopalpur	Baidynathpur
S98-02579	RIP2131	13/04/1998	24.319	89.192	1992	STW	39	Mr Rahimuddin Praman	Rajshahi	Natore	Baraigram	Baraigram	Manikpur
S98-02580	RIP2140	13/04/1998	24.368	89.237	1995	Tara	36	DPHE Complex	Rajshahi	Natore	Gurudaspur	Paurashava	Khamarnaskoir
S98-02581	RIP2148	14/04/1998	24.37	89.054	1975	STW	34	Laxmipur UP	Rajshahi	Natore	Natore Sadar	Lakshmipur khol.	Hybatpur
S98-02582	RIP2160	15/04/1998	24.225	89.296	1991	Tara	42	DPHE Office	Rajshahi	Pabna	Chatmohar	Chatmohar	Chatmohar
S98-02583	RIP2167	15/04/1998	24.087	89.227	1989	Tara	14	DPHE Office	Rajshahi	Pabna	Atgharia	Debottar	Debottar
S98-02584	RIP2176	15/04/1998	24.072	89.626	1995	Tara	26	Thana Parishad	Rajshahi	Pabna	Bera	Paurashava	Hatigara
S98-02585	RIP2193	16/04/1998	24.159	89.448	1989	Tara	39	DPHE Office	Rajshahi	Pabna	Faridpur	Banwarinagar	Khalisadaha
S98-02586	RIP2200	17/04/1998	24.218	89.396	1996	Tara	39	DPHE Office	Rajshahi	Pabna	Bhangura	Bhangura	Chaubaria
S98-02587	RIP2208	19/04/1998	24.028	89.251	1975	STW	31	Dr A. Rashed	Rajshahi	Pabna	Pabna Sadar	Malanchi	Singa
S98-02588	RIP2218	18/04/1998	24.16	89.026	1995	STW	24	Arambaria Bazar	Rajshahi	Pabna	Ishwardi	Sara	Alambaria
S98-02589	RIP3001	25/04/1998	23.614	91.102	1984	DTW	125	Thana Parishad	Chittagong	Comilla	Brahmanpara	Brahmanpara	Prahmanpara
S98-02590	RIP3008	26/04/1998	23.536	90.716	1989	STW	25	Gazefed Qtr.	Chittagong	Comilla	Daudkandi	D. Daudkandi	D. Daudkandi
S98-02591	RIP3017	27/04/1998	23.489	91.007	1984	DTW	125	Thana Parishad	Chittagong	Comilla	Chandina	Pasc. Chandina	Casc. Chandina
S98-02592	RIP3026	27/04/1998	23.713	90.878	1987	STW	24	Khanepara J, Mosque	Chittagong	Comilla	Muradnagar	U. Ramchandrapur	B. Ramchandrapur
S98-02593	RIP3041	30/04/1998	23.18	91.244	1993	STW	23	Montuli Mosque	Chittagong	Comilla	Nangalkot	Roykot	Joykot
S98-02594	RIP3049	01/05/1998	23.207	90.688	1990	STW	20	Baghadi Mosque	Chittagong	Chandpur	Chandpur Sadar	Baghadi	Baghadi
S98-02595	RIP3051	25/04/1998	23.553	91.128	1982	STW	35	DPHE Office	Chittagong	Comilla	Burichang	Purba Burichang	Burba Burichang
S98-02596	RIP3059	26/04/1998	23.702	91.047	1998	STW	30	Ishtagram P. School	Chittagong	Comilla	Debidwar	U. Barashalghar	I. Barashalghar
S98-02597	RIP3070	27/04/1998	23.225	91.317	1995	STW	30	Mafizur Rahaman	Chittagong	Comilla	Chauddagram	Chauddagram	Bhauddagram
S98-02598	RIP3087	29/04/1998	23.682	90.784	1985	STW	25	Thana Parishad	Chittagong	Comilla	Homna	Uttar Homna	Httar homna
S98-02599	RIP3094	30/04/1998	23.235	91.117	1994	DTW	98	Thana Health Comp.	Chittagong	Comilla	Laksam	Paurashava W02	Paurashava W02
S98-02600	RIP3106	02/05/1998	23.425	91.134	1996	Tara	49	Sheikh Makbul	Chittagong	Comilla	Comilla Sadar	Bijoypur	Sijoypur
S98-02601	RIP3117	03/05/1998	23.34	90.89	1979	DTW	98	Thana Health Complex	Chittagong	Chandpur	Kachua (C)	Kadla	Koa
S98-02602	RIP3127	04/05/1998	23.432	90.604	1981	STW	25	Nazrul Ali	Chittagong	Chandpur	Matlab	Sangarchar	Sikirchar
S98-02603	RIP3132	05/05/1998	23.136	90.746	1998	DTW	251	Abul Kalam	Chittagong	Chandpur	Faridganj	Uttar Faridganj	Faridganj
S98-02604	RIP3146	07/05/1998	23.097	90.86	1997	DTW	282	Sonapur GH School	Chittagong	Lakshmipur	Ramganj	Sonapur	Angarpara
S98-02605	RIP3159	02/05/1998	23.391	91.101	1990	STW	34	Md Abdur Jabbar	Chittagong	Comilla	Barura	Daks. Bhabanipur	Paks. Bhabanipur
S98-02606	RIP3169	03/05/1998	23.25	90.878	1984	DTW	98	Thana Parishad	Chittagong	Chandpur	Hajiganj	Paurashava W03	Kangais
S98-02607	RIP3177	05/05/1998	23.086	90.644	1998	DTW	221	NilKAMAL H. School	Chittagong	Chandpur	Haimchar	Nilkamal	Char Saladi
S98-02608	RIP3182	07/05/1998	22.651	90.92	1997	DTW	308	Thana Parshad Mosque	Chittagong	Lakshmipur	Ramgati	Char Alexander	Char Alexander
S98-02609	RIP3191	08/05/1998	23.031	90.694	1997	STW	14	Mohamaullah Choudhar	Chittagong	Lakshmipur	Raipur (L)	Char Ababil	Pangashia
S98-02610	RIP3194	09/05/1998	22.381	90.686	1993	DTW	330	Mothahar Hossain	Barisal	Bhola	Lalmohan	Badarpur	Badarpur
S98-02611	RIP3218	13/05/1998	22.829	91.094	1995	STW	14	Parshi Mandis	Chittagong	Noakhali	Noakhali Sadar	Binodpur	Pas.badaripur
S98-02612	RIP3229	14/05/1998	23.191	90.958	1985	STW	23	suchipara H.School	Chittagong	Chandpur	Shahrasti	Uttar Suchipara	Suchipara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02565	3296267303	188	< 0.04	0.03	0.158	170	< 0.008	< 0.02	< 0.008	3.98	5.2	< 0.003	32.7	0.918	37.3	1.7	16.6	90.7	0.537	< 0.006	0.048
S98-02566	3292176035	220	< 0.04	0.04	0.17	165	< 0.008	< 0.02	< 0.008	3.02	5.3	< 0.003	37.9	1.58	15.2	0.2	13.7	0.5	0.603	< 0.006	< 0.008
S98-02567	1060381548	< 6	< 0.04	0.69	0.044	11.3	< 0.008	< 0.02	< 0.008	0.126	2.4	0.007	5.13	0.04	390	0.5	10.5	< 0.2	0.128	< 0.006	0.071
S98-02568	5701875287	< 6	< 0.04	0.03	0.115	114	< 0.008	< 0.02	< 0.008	0.044	2.7	0.012	31.3	0.581	38.8	0.3	17.1	0.6	0.408	< 0.006	0.01
S98-02569	5708877693	< 6	< 0.04	0.02	0.043	105	< 0.008	< 0.02	< 0.008	0.083	1.2	0.007	31.4	0.973	35.1	< 0.2	15.4	6.5	0.342	< 0.006	0.01
S98-02570	5705676108	< 6	< 0.04	0.06	0.06	74.8	< 0.008	< 0.02	< 0.008	0.822	1	0.004	20.6	0.016	53.7	< 0.2	19.7	0.6	0.313	< 0.006	0.489
S98-02571	5703752257	< 6	< 0.04	0.02	0.05	49.1	< 0.008	< 0.02	< 0.008	0.166	0.8	0.007	10.5	0.179	43.4	< 0.2	23.9	11	0.242	< 0.006	0.009
S98-02572	5813438150	< 6	< 0.04	< 0.01	0.039	64	< 0.008	< 0.02	< 0.008	0.04	0.9	0.009	12.5	0.057	41.2	< 0.2	22.4	15.9	0.288	< 0.006	0.022
S98-02573	5819467211	< 6	< 0.04	< 0.01	0.009	11.4	< 0.008	< 0.02	< 0.008	0.087	0.6	< 0.003	5.65	0.231	22	0.3	23.8	1.4	0.067	< 0.006	0.008
S98-02574	5818227155	21	< 0.04	0.02	0.207	132	< 0.008	< 0.02	< 0.008	2.22	6.6	0.004	26.6	0.805	16.7	0.7	14.9	0.9	0.251	< 0.006	< 0.008
S98-02575	5815367679	< 6	< 0.04	0.01	0.028	76.7	< 0.008	< 0.02	< 0.008	0.016	1.1	< 0.003	21.7	1.42	26.7	0.3	14.6	< 0.2	0.329	< 0.006	< 0.008
S98-02576	5817239309	< 6	< 0.04	< 0.01	0.041	93.4	< 0.008	< 0.02	< 0.008	0.023	1.6	< 0.003	21	0.51	21.3	0.2	17.4	1.5	0.221	< 0.006	< 0.008
S98-02577	5690919845	< 6	< 0.04	0.02	0.057	119	< 0.008	< 0.02	< 0.008	0.039	1	0.004	29.3	1.9	26.8	< 0.2	16.9	5.7	0.339	0.007	0.051
S98-02578	5694457078	< 6	< 0.04	< 0.01	0.032	85	< 0.008	< 0.02	< 0.008	0.079	1.1	0.004	21.7	0.996	28.7	< 0.2	19.2	3.3	0.373	< 0.006	0.016
S98-02579	5691515	< 6	< 0.04	0.01	0.057	101	< 0.008	< 0.02	< 0.008	0.126	1	0.005	24.6	0.482	26.8	< 0.2	16.5	51.8	0.238	< 0.006	0.01
S98-02580	5694154612	< 6	< 0.04	< 0.01	0.062	80.8	< 0.008	< 0.02	< 0.008	0.129	1.6	0.022	24.6	0.539	35.9	< 0.2	23.6	21.2	0.306	< 0.006	0.056
S98-02581	5696365480	< 6	< 0.04	0.01	0.052	129	< 0.008	< 0.02	< 0.008	0.029	1.2	0.004	32	0.642	35.8	0.3	19.4	46.7	0.48	0.006	0.009
S98-02582	5762217254	< 6	< 0.04	0.02	0.062	99.4	< 0.008	< 0.02	< 0.008	0.098	2.7	0.008	30.7	0.779	24	< 0.2	17.6	11.4	0.426	< 0.006	0.026
S98-02583	5760531259	< 6	< 0.04	0.02	0.049	84.6	< 0.008	< 0.02	< 0.008	0.207	1.7	0.01	26.8	0.273	29.8	< 0.2	18.7	3.6	0.353	< 0.006	0.026
S98-02584	5761610469	10	< 0.04	0.02	0.089	70.4	< 0.008	< 0.02	< 0.008	5.19	1.9	< 0.003	25.8	0.352	14.1	1.2	17.1	3.5	0.155	< 0.006	0.018
S98-02585	5763310585	< 6	0.07	0.03	0.044	62.4	< 0.008	< 0.02	< 0.008	0.244	1.8	< 0.003	25.4	0.277	36.8	< 0.2	20.4	5.6	0.269	< 0.006	0.022
S98-02586	5761931203	< 6	< 0.04	0.02	0.046	75.2	< 0.008	< 0.02	< 0.008	0.045	1.4	0.013	26.2	0.529	32.5	0.2	20.2	8.4	0.326	0.008	0.019
S98-02587	5765569939	< 6	0.06	0.03	0.063	116	< 0.008	< 0.02	< 0.008	0.218	0.9	0.005	30.4	0.359	50.9	< 0.2	17.2	1.9	0.411	< 0.006	0.019
S98-02588	5763984029	9	< 0.04	0.02	0.097	130	< 0.008	< 0.02	< 0.008	0.61	1.2	< 0.003	34.8	1.1	31.1	< 0.2	12.1	9.2	0.43	< 0.006	< 0.008
S98-02589	2191518159	< 6	< 0.04	0.08	0.049	17	< 0.008	< 0.02	< 0.008	1.98	2	0.009	9.09	0.132	186	0.3	25.8	< 0.2	0.131	< 0.006	0.041
S98-02590	2193625338	411	< 0.04	0.08	0.066	60.3	< 0.008	< 0.02	< 0.008	5.37	7	< 0.003	27.7	0.182	57.1	1.8	17	0.3	0.331	< 0.006	< 0.008
S98-02591	2192747213	118	< 0.04	0.14	0.013	21.4	< 0.008	< 0.02	< 0.008	0.471	4	0.006	13.3	0.333	159	1.5	20.8	2.7	0.169	< 0.006	0.009
S98-02592	2198185058	278	< 0.04	0.06	0.044	39.9	< 0.008	< 0.02	< 0.008	5.29	6.6	< 0.003	20.2	0.292	30.9	1.2	21.1	0.3	0.246	< 0.006	0.01
S98-02593	2198786461	64	< 0.04	0.01	0.007	17.2	< 0.008	< 0.02	< 0.008	5.2	2.7	0.006	11.2	1.46	10.2	0.3	25.5	1.9	0.0615	< 0.006	0.011
S98-02594	2132222037	641	< 0.04	0.11	0.158	108	< 0.008	< 0.02	< 0.008	11.1	9.1	< 0.003	43.6	0.373	75.1	0.8	13.3	0.5	0.54	< 0.006	0.01
S98-02595	2191831072	9	< 0.04	0.13	0.005	1.23	< 0.008	< 0.02	< 0.008	0.036	0.3	< 0.003	0.64	0.041	95.3	1	14.9	0.7	0.0081	0.013	0.016
S98-02596	2194005486	127	< 0.04	0.04	0.011	25.6	< 0.008	< 0.02	< 0.008	4.46	6	< 0.003	29.4	0.256	17.5	0.7	20.1	0.3	0.195	< 0.006	0.012
S98-02597	2193123066	< 6	< 0.04	< 0.01	0.031	7.15	< 0.008	< 0.02	< 0.008	0.357	2.7	0.01	2.12	0.009	7.47	< 0.2	26.1	< 0.2	0.0657	< 0.006	0.011
S98-02598	2195466412	73	< 0.04	0.02	0.056	40.4	< 0.008	< 0.02	< 0.008	3.1	3.4	< 0.003	19.4	1.79	21.6	0.7	16.1	18.3	0.163	< 0.006	0.032
S98-02599	2197210725	98	< 0.04	0.07	0.013	30.9	< 0.008	< 0.02	< 0.008	0.487	9.6	0.003	48	0.255	63.2	0.8	15.9	3.9	0.24	< 0.006	0.008
S98-02600	2196721819	< 6	< 0.04	< 0.01	0.003	5.35	< 0.008	< 0.02	< 0.008	0.053	1.2	< 0.003	1.97	0.012	8.54	< 0.2	24.8	0.8	0.0525	< 0.006	0.038
S98-02601	2135855533	30	< 0.04	0.11	0.143	56.5	< 0.008	< 0.02	< 0.008	5.82	5.5	0.007	31	0.16	282	0.9	20.8	0.5	0.433	< 0.006	0.072
S98-02602	2137669912	391	< 0.04	0.05	0.189	159	< 0.008	< 0.02	< 0.008	14.4	8	< 0.003	47.9	1.37	46.8	11.2	12.5	0.5	0.603	< 0.006	0.014
S98-02603	2134529387	< 6	< 0.04	0.04	0.04	28.1	< 0.008	< 0.02	< 0.008	0.586	3.9	0.003	17.7	0.051	30.8	< 0.2	25.7	0.6	0.223	< 0.006	0.038
S98-02604	2516595052	< 6	< 0.04	0.03	0.124	38.6	< 0.008	< 0.02	< 0.008	3.18	5.6	0.005	22.7	0.14	32.8	0.3	33.5	0.2	0.293	< 0.006	0.036
S98-02605	2190925814	< 6	< 0.04	0.05	0.018	16.4	< 0.008	< 0.02	< 0.008	0.164	2.2	< 0.003	11.6	1.57	35	0.3	18.4	0.4	0.183	< 0.006	0.009
S98-02606	2134908268	194	0.04	0.36	0.049	43.2	< 0.008	< 0.02	< 0.008	1.49	15.4	0.006	67.9	0.118	574	4	15.9	0.6	0.473	< 0.006	0.009
S98-02607	2134771037	6	< 0.04	0.08	0.247	82.2	< 0.008	< 0.02	< 0.008	13.3	13.5	0.007	52.4	1.04	178	0.5	22	4.1	0.627	< 0.006	0.061
S98-02608	2517323138	< 6	0.04	0.05	0.202	63.6	< 0.008	< 0.02	< 0.008	4.27	5.2	0.009	37.4	0.128	52.8	0.3	27.3	< 0.2	0.435	< 0.006	0.014
S98-02609	2515823832	375	0.05	0.21	0.251	189	< 0.008	< 0.02	< 0.008	8.07	11.8	0.004	102	1.33	124	1.3	14.8	0.4	0.85	0.008	< 0.008
S98-02610	1095409107	< 6	0.05	0.2	0.026	18.9	< 0.008	< 0.02	< 0.008	0.068	3.6	0.005	8.14	0.021	124	0.2	10.3	< 0.2	0.21	< 0.006	< 0.008
S98-02611	2758715922	143	0.04	0.81	0.017	18.4	< 0.008	< 0.02	< 0.008	1.13	8.8	0.004	20.5	0.162	412	4	14.3	0.6	0.164	< 0.006	0.009
S98-02612	2139585935	233	< 0.04	0.21	0.02	20.3	< 0.008	< 0.02	< 0.008	1.14	11.4	< 0.003	31.6	0.085	165	3.4	17.6	0.5	0.195	< 0.006	0.009

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02613	RIP3237	16/05/1998	22.87	91.276	1995	STW	9	DPHE Office	Chittagong	Noakhali	Companiganj (N)	Char kakra	Charkakra
S98-02614	RIP3246	17/05/1998	23.039	91.52	1988	DTW	244	DPHE Office	Chittagong	Feni	Chhagalnaiya	Chhagalnaiya	Pa.chhagalnaiya
S98-02615	RIP3266	10/05/1998	22.413	90.851	1979	DTW	285	Thana Parishad	Barisal	Bhola	Tazumuddin	Chandpur	Shashiganj
S98-02616	RIP3282	13/05/1998	22.945	91.06	1992	STW	14	Mr Siddiqullah	Chittagong	Noakhali	Begumganj	Jirtali	Jirtali
S98-02617	RIP3294	14/05/1998	23.061	90.969	1984	STW	14	DPHEOffice	Chittagong	Noakhali	Chatkhil	Chatkhil	Chatkhil
S98-02618	RIP3302	16/05/1998	22.879	91.235	1986	DTW	292	Thana Health Comple.	Chittagong	Noakhali	Senbagh	Kadra	Kadra
S98-02619	RIP3311	17/05/1998	23.029	91.404	1992	STW	18	DPHE Office	Chittagong	Feni	Feni Sadar	Dharmapur	Sultanpur
S98-02620	RIP3323	17/05/1998	23.188	91.435	1985	STW	22	Chithalia Bazar	Chittagong	Feni	Parshuram	Chithalia	Chithalia
S98-02621	RIP3329	19/05/1998	22.958	91.289	1980	STW	15	Jatindranarayan	Chittagong	Feni	Daganbhuiyan	Purba chandrapur	Purba chandrapur
S98-02622	RIP3338	21/05/1998	21.971	91.955	1996	DTW	203	Bakkar Ahamad	Chittagong	Chittagong	Banshkhali	Chambal	Pas.chambal
S98-02623	RIP3347	22/05/1998	22.343	91.804	1970	DTW	184	Wabda Colony	Chittagong	Chittagong	Double Mooring	SMA W24	Mansurabad
S98-02624	RIP3349	22/05/1998	22.349	91.837	1997	STW	52	DPHE Office	Chittagong	Chittagong	Kotwali (C)	SMA W25	Dewan bazar
S98-02625	RIP3356	18/05/1998	23.067	91.4353	1995	STW	33	Union Parishad	Chittagong	Feni	Fulgazi	Anandapur	Hasanpur
S98-02626	RIP3364	19/05/1998	22.936	91.376	1994	STW	20	Union Parishad	Chittagong	Feni	Sonagazi	Char majlishpur	Bishnupur
S98-02627	RIP3374	21/05/1998	22.228	91.902	1988	STW	44	DPHE Office	Chittagong	Chittagong	Anowara	Anowara	Anowara
S98-02628	RIP3384	22/05/1998	22.361	91.804	1980	STW	52	Wireless Compound	Chittagong	Chittagong	Pahartali	SMA W23	Wireless colony
S98-02629	RIP3386	22/05/1998	22.29	91.783	1992	STW	21	md Siraj	Chittagong	Chittagong	Chittagong Port	SMA W39	Dahshin halishar
S98-02630	RIP3388	22/05/1998	21.619	92.069	1993	DTW	197	Khantakhali H. Schoo	Chittagong	Cox's Bazar	Chakaria	Khuntakhali	Khuntakhali
S98-02631	RIP3396	24/05/1998	21.247	92.138	1981	DTW	164	DPHE Office	Chittagong	Cox's Bazar	Ukhia	Rajapalong	Uhalapalong
S98-02632	RIP3404	25/05/1998	21.521	91.97	1990	STW	20	Ukka Singh	Chittagong	Cox's Bazar	Maheshkhali	Gorakghata	Gorakghata
S98-02633	RIP3451	22/05/1998	22.368	91.843	1998	STW	64	Mahabubur Rahaman	Chittagong	Chittagong	Panchlaish	SMA W11	Sulok bazar
S98-02634	RIP3452	22/05/1998	22.347	91.852	1990	STW	30	Md Yunus	Chittagong	Chittagong	Chandgaon	SMA W30	Purba bakulia
S98-02635	RIP3461	24/05/1998	20.875	92.295	1983	STW	8	DPHE Office	Chittagong	Cox's Bazar	Teknaf	Teknaf	Teknaf
S98-02636	RIP3468	25/05/1998	21.426	92.009	1984	STW	40	Thana Parishad Mosqu	Chittagong	Cox's Bazar	Cox's Bazar Sadar	Jhilwanja	Jhilwanja
S98-02637	RIP0301	24/05/1998	24.43	91.904	1985	STW	49	Patanushar UP	Sylhet	Maulvibazar	Kamalganj	Patanushar	Patanushar
S98-02638	RIP0310	25/05/1998	24.431	91.934	1994	STW	54	Katarkona H Madrasa	Sylhet	Maulvibazar	Kulaura	Hajipur	Katarkona
S98-02639	RIP0320	26/05/1998	24.814	91.759	1963	STW	56	DPHE Compound	Sylhet	Sylhet	Bishwanath	Bishwanath	Musalia
S98-02640	RIP0327	27/05/1998	24.88	92.369	1984	STW	27	Thana DPHE Office	Sylhet	Sylhet	Zakiganj	Zakiganj	Alamnagar
S98-02641	RIP0331	24/05/1998	24.593	91.691	1997	DTW	113	Abdul Razzak (Sujan)	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Khalilpur	Nachirpur
S98-02642	RIP0341	25/05/1998	24.522	91.859	1989	STW	58	Thana DPHE Office	Sylhet	Maulvibazar	Rajnagar	Rajnagar	Padinapur
S98-02643	RIP0349	26/05/1998	24.652	91.823	1994	STW	91	TNO	Sylhet	Sylhet	Balaganj	Balaganj	Digarberkuri
S98-02644	RIP0358	27/05/1998	24.822	92.122	1991	STW	51	Girls High School	Sylhet	Sylhet	Beanibazar	Mathura	Mathura
S98-02645	RIP0361	24/05/1998	24.308	91.738	1996	DTW	105	Pourashava	Sylhet	Maulvibazar	Srimangal	Pourashava	Pukkurpar
S98-02646	RIP0369	25/05/1998	24.691	92.188	1985	STW	49	Thana DPHE Office	Sylhet	Maulvibazar	Barlekha	Barlekha	Panidhar
S98-02647	RIP0377	26/05/1998	24.697	91.937	1989	STW	34	DPHE Office	Sylhet	Sylhet	Fenchuganj	Fenchuganj	Bonshal colony
S98-02648	RIP0383	27/05/1998	24.831	92.044	1995	STW	38	Rafiqeuddin Ahmed	Sylhet	Sylhet	Golapganj	Paschim amura	Shilghat
S98-02649	RIP0391	28/05/1998	25.01	92.258	1984	STW	47	Thana DPHE Office	Sylhet	Sylhet	Kanaighat	Kanaighat	Bishnapur
S98-02650	RIP0397	30/05/1998	25.089	91.76	1994	STW	79	LLivestock Office	Sylhet	Sylhet	Companiganj (S)	Islampur	Shamshernagar
S98-02651	RIP0409	30/05/1998	25.057	91.39	1997	DTW	134	Thana DPHE Office	Sylhet	Sunamganj	Sunamganj Sadar	Paurashava w3	Uttar mallikpur
S98-02652	RIP0417	31/05/1998	25.031	91.663	1996	DTW	110	Thana Parishad	Sylhet	Sunamganj	Chhatak	Chhatak	Bagbari
S98-02653	RIP0425	28/05/1998	25.135	92.132	1986	STW	10	DPHE Office	Sylhet	Sylhet	Jaintiapur	Nizpat	Jaintiapur nizpa
S98-02654	RIP0431	28/05/1998	24.99	92.046	1980	STW	38	Union Parisad	Sylhet	Sylhet	Gowainghat	Fatepur	Paschim balipara
S98-02655	RIP0432	30/05/1998	24.89	91.873	1997	Tara	64	Police Furry	Sylhet	Sylhet	Sylhet Sadar	Pourashava w3	Municipal Market
S98-02656	RIP0440	31/05/1998	24.794	91.578	1996	STW	126	Primary School	Sylhet	Sunamganj	Jagannathpur	Patali	Chandpur
S98-02657	RIP0454	31/05/1998	24.195	91.522	1994	STW	72	Thana DPHE Office	Sylhet	Habiganj	Chunarughat	Deorgach	Chandona
S98-02658	RIP0462	01/06/1998	24.317	91.328	1965	STW	49	Rarishal High School	Sylhet	Habiganj	Lakhai	Karab	Rarishal
S98-02659	RIP0467	02/06/1998	24.289	91.566	1997	Tara	41	Police Furry	Sylhet	Habiganj	Bahubal	Badeshwar	Kamaichara
S98-02660	RIP0471	31/05/1998	24.098	91.322	1984	STW	36	Thana Parishad	Sylhet	Habiganj	Madhabpur	Madhabpur	Kutania

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02613	2752135710	33	< 0.04	0.26	0.015	44.5	< 0.008	< 0.02	< 0.008	0.38	20.3	0.007	79.9	0.978	95	0.5	14.2	44.3	0.441	< 0.006	0.013
S98-02614	2301428699	13	< 0.04	0.06	0.148	17.6	< 0.008	0.16	< 0.008	0.702	2.2	0.003	13.6	0.344	77.9	0.4	11	< 0.2	0.207	< 0.006	0.062
S98-02615	1099157847	< 6	< 0.04	0.14	0.122	45.4	< 0.008	< 0.02	< 0.008	0.582	9.5	0.004	36.1	0.082	98.8	0.4	15.4	< 0.2	0.475	< 0.006	0.009
S98-02616	2750756933	66	0.04	0.42	0.006	6.33	< 0.008	< 0.02	< 0.008	0.151	7.6	0.004	6.65	0.106	192	0.9	13.4	1.4	0.0572	< 0.006	0.01
S98-02617	2751019171	71	< 0.04	0.09	0.011	31.9	< 0.008	< 0.02	< 0.008	0.229	13.2	0.004	45.4	0.804	22	0.5	15.1	3.2	0.236	< 0.006	< 0.008
S98-02618	2758057462	6	< 0.04	0.03	0.098	34.5	< 0.008	< 0.02	< 0.008	2.5	4.2	0.007	24.4	0.152	56.7	< 0.2	27.9	0.6	0.249	< 0.006	0.106
S98-02619	2302921897	16	< 0.04	0.11	0.12	19.7	< 0.008	< 0.02	< 0.008	0.405	6.4	0.004	24.9	1.16	108	0.5	11.8	0.2	0.226	< 0.006	0.008
S98-02620	2305123144	22	< 0.04	0.02	0.07	7.84	< 0.008	< 0.02	< 0.008	21	1.7	< 0.003	5.94	1.18	15.5	1.1	15.7	0.2	0.0789	< 0.006	0.031
S98-02621	2302569748	98	< 0.04	0.1	0.013	28.3	< 0.008	< 0.02	< 0.008	1.08	15.2	< 0.003	42.7	0.48	16.9	0.7	15.2	1.1	0.249	< 0.006	0.033
S98-02622	2150818815	< 6	< 0.04	0.02	0.034	6.78	< 0.008	< 0.02	< 0.008	6.6	3.1	0.011	5.08	0.362	25.2	0.4	25.5	< 0.2	0.0831	< 0.006	0.013
S98-02623	2152815080	< 6	24.2	0.05	0.014	24.7	< 0.008	< 0.02	< 0.008	0.213	2.4	0.003	6.84	0.044	50.2	0.3	14	9	0.122	< 0.006	0.026
S98-02624	2154115497	< 6	< 0.04	0.02	0.015	11.7	< 0.008	< 0.02	< 0.008	20	2.2	0.008	5.44	0.849	15.1	< 0.2	22	13.2	0.114	< 0.006	1.42
S98-02625	2303327346	6	< 0.04	0.26	0.013	7.21	< 0.008	< 0.02	< 0.008	2.4	12.3	< 0.003	16.6	0.04	158	1.5	13.7	0.3	0.119	< 0.006	0.011
S98-02626	2309447155	166	< 0.04	0.26	0.009	17.8	< 0.008	< 0.02	< 0.008	0.361	13.3	0.004	36.3	0.124	184	2.7	14.6	0.3	0.216	< 0.006	0.011
S98-02627	2150409026	8	1.07	1.51	0.019	44.5	< 0.008	0.41	0.023	0.58	86.4	0.01	93.6	0.201	322	9.9	30.8	1.5	0.586	< 0.006	0.207
S98-02628	2155515976	< 6	< 0.04	0.03	0.01	34.8	< 0.008	< 0.02	< 0.008	0.168	2.4	< 0.003	9.33	0.256	30.9	0.7	15.6	0.9	0.223	< 0.006	0.02
S98-02629	2152015161	16	< 0.04	0.55	0.013	14.7	< 0.008	< 0.02	< 0.008	0.929	24	< 0.003	46	0.116	412	9.1	18.4	13.4	0.273	< 0.006	< 0.008
S98-02630	2221667535	< 6	< 0.04	0.02	0.023	8.59	< 0.008	< 0.02	< 0.008	5.01	3.5	0.016	4.79	0.343	18.3	0.4	29.6	1.4	0.126	< 0.006	0.01
S98-02631	2229447841	< 6	< 0.04	0.05	0.006	2.21	< 0.008	< 0.02	< 0.008	1.12	4	0.005	2.61	0.125	46.6	0.7	14.4	< 0.2	0.0279	< 0.006	0.072
S98-02632	2224935288	< 6	< 0.04	0.05	0.003	12.4	< 0.008	< 0.02	< 0.008	0.11	7.4	< 0.003	12	0.148	43	0.3	9.13	6.8	0.0933	< 0.006	< 0.008
S98-02633	2155715995	< 6	< 0.04	0.02	0.013	6.89	< 0.008	< 0.02	< 0.008	8.22	2.8	0.003	7.09	0.898	21.5	0.2	20.5	4.2	0.0842	< 0.006	0.039
S98-02634	2151915110	80	< 0.04	0.13	0.055	31.2	< 0.008	< 0.02	< 0.008	9.15	15.5	< 0.003	51.8	0.547	101	1.3	16.9	0.4	0.393	< 0.006	0.012
S98-02635	2229063829	< 6	0.35	0.92	0.002	1.99	< 0.008	< 0.02	< 0.008	0.504	5	< 0.003	2.26	0.024	127	1.9	16.7	0.6	0.042	0.025	0.014
S98-02636	2222447523	< 6	< 0.04	0.02	0.009	19	< 0.008	< 0.02	< 0.008	8.05	1.6	0.005	10.2	0.695	10.9	0.8	21	12.5	0.183	< 0.006	0.013
S98-02637	6585666704	254	< 0.04	< 0.01	0.109	25.4	< 0.008	< 0.02	< 0.008	5.33	3.1	< 0.003	10.8	0.943	13.3	< 0.2	12.4	0.3	0.221	< 0.006	0.008
S98-02638	6586535494	8	< 0.04	< 0.01	0.13	8.23	< 0.008	< 0.02	< 0.008	5.97	3.4	< 0.003	3.99	0.25	16.7	< 0.2	14.6	0.3	0.0855	< 0.006	< 0.008
S98-02639	6912021700	53	< 0.04	< 0.01	0.029	7.28	< 0.008	< 0.02	< 0.008	3.42	2.3	< 0.003	4.15	0.198	36.5	0.6	4.32	0.3	0.04	< 0.006	0.012
S98-02640	6919485024	80	< 0.04	0.04	0.09	10	< 0.008	< 0.02	< 0.008	15.6	2.5	< 0.003	7.8	0.303	47.3	1.2	19.9	0.9	0.108	< 0.006	0.019
S98-02641	6587458730	133	< 0.04	0.02	0.062	10.3	< 0.008	< 0.02	< 0.008	1.23	1	< 0.003	8.4	0.069	110	2.8	11.3	0.6	0.0948	< 0.006	0.009
S98-02642	6588063	91	< 0.04	0.02	0.082	15.9	< 0.008	< 0.02	< 0.008	20.5	1.6	< 0.003	11.6	0.417	20.8	1.2	22.8	0.7	0.156	< 0.006	0.014
S98-02643	6910806209	139	< 0.04	0.02	0.074	7.87	< 0.008	< 0.02	< 0.008	1.96	1.3	< 0.003	6.88	0.063	99.7	3.1	11.5	0.5	0.0816	< 0.006	0.008
S98-02644	6911760631	< 6	< 0.04	< 0.01	0.121	8.87	< 0.008	< 0.02	< 0.008	7.46	2.8	< 0.003	5.64	0.467	23.9	2.4	24.4	1	0.15	< 0.006	0.051
S98-02645	6588302923	15	< 0.04	< 0.01	0.223	9.36	< 0.008	< 0.02	< 0.008	7	5.8	< 0.003	3.21	0.227	18.3	0.2	13.6	< 0.2	0.0874	< 0.006	0.738
S98-02646	6581407	< 6	< 0.04	< 0.01	0.148	10.7	< 0.008	< 0.02	< 0.008	9.16	1.8	< 0.003	3.83	0.181	10.8	< 0.2	22.2	< 0.2	0.146	< 0.006	< 0.008
S98-02647	6913523132	< 6	< 0.04	< 0.01	0.057	4.23	< 0.008	< 0.02	< 0.008	0.486	2.2	< 0.003	2.68	0.708	12.7	< 0.2	6.21	0.8	0.0434	< 0.006	0.009
S98-02648	6913895945	< 6	< 0.04	< 0.01	0.024	0.8	< 0.008	< 0.02	< 0.008	0.567	1.2	< 0.003	0.27	0.044	0.8	< 0.2	5.48	0.4	0.0073	< 0.006	0.011
S98-02649	6915947155	151	< 0.04	0.05	0.077	17.6	< 0.008	< 0.02	< 0.008	10.2	3.7	< 0.003	13.1	0.227	28.4	1.7	22.6	0.6	0.201	< 0.006	0.01
S98-02650	6912711852	73	< 0.04	0.01	0.045	28.4	< 0.008	< 0.02	< 0.008	3.54	1.7	< 0.003	17.5	0.039	43.5	1	11.1	< 0.2	0.138	< 0.006	0.01
S98-02651	6908903	50	< 0.04	0.02	0.091	24.6	< 0.008	< 0.02	< 0.008	1.06	1.6	< 0.003	12.5	0.257	61.1	1.7	15.2	0.3	0.146	< 0.006	0.009
S98-02652	6902309037	246	0.05	0.07	0.013	0.97	< 0.008	< 0.02	0.009	0.282	1	< 0.003	0.56	0.019	85.4	7.6	5.79	0.3	0.0066	0.006	< 0.008
S98-02653	6915363474	< 6	< 0.04	< 0.01	0.05	3.43	< 0.008	< 0.02	< 0.008	3.6	5.5	< 0.003	0.96	0.276	3	< 0.2	6.07	13.6	0.0136	< 0.006	0.052
S98-02654	6914121760	< 6	< 0.04	< 0.01	0.015	13.7	< 0.008	< 0.02	< 0.008	0.208	0.7	< 0.003	5.7	0.428	17.9	0.2	19.2	3	0.141	< 0.006	0.013
S98-02655	6916203689	< 6	< 0.04	0.02	0.405	24.2	< 0.008	< 0.02	< 0.008	0.029	17.7	< 0.003	27.1	2.06	26.4	< 0.2	5.21	12.2	0.125	< 0.006	0.076
S98-02656	6904766174	23	< 0.04	0.04	0.065	4.95	< 0.008	< 0.02	< 0.008	6.93	1.2	< 0.003	2.62	0.35	52.4	3.5	18.8	< 0.2	0.0547	< 0.006	0.008
S98-02657	6362628434	< 6	< 0.04	< 0.01	0.058	8.53	< 0.008	< 0.02	< 0.008	5.76	2.3	0.007	3.48	0.24	10.7	< 0.2	25.6	1.7	0.081	< 0.006	0.008
S98-02658	6366840810	< 6	< 0.04	0.03	0.018	5.99	< 0.008	< 0.02	< 0.008	0.048	0.6	< 0.003	2.47	0.563	55.5	< 0.2	18	< 0.2	0.0465	< 0.006	< 0.008
S98-02659	6360523517	< 6	< 0.04	< 0.01	0.055	2	< 0.008	< 0.02	< 0.008	0.045	2.6	0.004	0.73	0.014	1.5	0.2	8.12	< 0.2	0.0191	< 0.006	0.083
S98-02660	6367177588	< 6	< 0.04	< 0.01	0.031	16.4	< 0.008	< 0.02	< 0.008	0.171	1.1	0.003	6.54	0.221	14.9	0.5	29	1	0.121	< 0.006	0.01

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02661	RIP0478	01/06/1998	24.397	91.427	1998	STW	50	Md. Nuru Mia	Sylhet	Habiganj	Habiganj Sadar	Tegharia	Rampur
S98-02662	RIP0486	02/06/1998	24.575	91.513	1983	DTW	144	Thana Parishad	Sylhet	Habiganj	Nabiganj	Nabiganj	Gandha
S98-02663	RIP0494	03/06/1998	24.122	91.083	1997	STW	43	Chunta Mosque	Chittagong	Brahamanbaria	Sarail	Chunta	Chunta
S98-02664	RIP0500	03/06/1998	23.984	91.109	1984	STW	53	Shshidul Huq Bhuya	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Paurashava w1	Paschim Paikpara
S98-02665	RIP0501	04/06/1998	23.672	91.159	1997	STW	29	Abul Bashar	Chittagong	Brahamanbaria	Kasba	Bayek	Kaikhola
S98-02666	RIP0514	03/06/1998	24.196	91.198	1995	STW	49	Thana DPHE Office	Chittagong	Brahamanbaria	Nasirnagar	Nasirnagar	Nasirnagar
S98-02667	RIP0520	04/06/1998	23.866	91.214	1984	STW	22	Thana Parishad	Chittagong	Brahamanbaria	Akhaura	Dakshin akhaura	Radanagar
S98-02668	RIP0601	09/06/1998	23.467	90.334	1984	DTW	92	Thana Parishad	Dhaka	Munshiganj	Lohajang	Lohajang	Bara noapara
S98-02669	RIP0608	10/06/1998	23.542	90.607	1983	STW	13	Thana DPHE Office	Dhaka	Munshiganj	Gazaria	Gazaria	Goshairchar
S98-02670	RIP0614	11/06/1998	23.572	90.374	1982	STW	55	Thana DPHE Office	Dhaka	Munshiganj	Serajdikhan	Rasunia	Rasunia
S98-02671	RIP0626	09/06/1998	23.488	90.551	1995	STW	76	Takichar Mosque	Dhaka	Munshiganj	Munshiganj Sadar	Char kewar	Takichar
S98-02672	RIP0632	10/06/1998	23.552	90.209	1975	STW	60	Md Ayub Ali	Dhaka	Munshiganj	Srinagar	Bagra	Purbo baghra
S98-02673	RIP0640	11/06/1998	23.543	90.463	1995	STW	47	Uttar Betka Pry, Sch	Dhaka	Munshiganj	Tongibari	Betka	Uttar betka
S98-02674	RIP3035	29/04/1998	23.769	90.76	1994	STW	28	Md Khalil	Chittagong	Brahamanbaria	Banchharampur	D. Banchharampur	Char chhayani
S98-02675	RIP3080	28/04/1998	23.808	90.888	1986	STW	29	Bachu Mia	Chittagong	Brahamanbaria	Nabinagar	Ratanpur	Majhiara
S98-02676	RIP3475	14/06/1998	22.613	91.645	1990	STW	19	Thana Parishad Mosqu	Chittagong	Chittagong	Sitakunda	Sitakund	Mahadebpur
S98-02677	RIP3483	15/06/1998	22.777	91.57	1984	STW	15	Thana DPHE Office	Chittagong	Chittagong	Mirsharai	Mirsarai	Purba maghadia
S98-02678	RIP3453	23/05/1998	21.427	92.083	1997	DTW	225	Khala Mia	Chittagong	Cox's Bazar	Ramu	Jorihhala	Chakmarkul
S98-02679	RIP0008	09/03/1998	23.746	90.545	1989	STW	34	Min Mollah	Dhaka	Narayanganj	Rupganj	Tarabo	Barpa
S98-02680	RIP0405	28/05/1998	25.091	91.984	1985	STW	63	DPHE Compound	Sylhet	Sylhet	Gowainghat	West jaflong	Gowain
S98-02681	RIP1022	26/03/1998	22.803	89.579	1996	DTW	213	DPHE Compound	Khulna	Khulna	Khulna Metro	Ward 01	Rupsa
S98-02682	RIP1126	05/04/1998	23.041	89.635	1989	STW	57	DPHE Bhaban	Khulna	Narail	Kalia	Paurashava w01	Ramnagar
S98-02683	RIP1170	30/03/1998	22.651	89.882	1989	STW	24	DPHE Office	Khulna	Bagerhat	Kachua (B)	Kachua	Kachua
S98-02684	RIP1176	31/03/1998	22.747	89.84	1979	STW	29	Md. Syed Ali	Khulna	Bagerhat	Chitalmari	Santoshpur	Nasirpur
S98-02685	RIP1203	05/04/1998	23.113	89.5	1994	STW	53	Parbotti Bidda Ril	Khulna	Narail	Narail Sadar	Kalora	Kclora
S98-02686	RIP1209	04/03/1998	23.486	89.421	1976	STW	54	DPHE Office	Khulna	Magura	Magura Sadar	Paurashava w02	Bhaira
S98-02687	RIP1321	26/04/1998	22.715	90.352		STW	22	DPHE Office	Barisal	Barisal	Barisal Sadar	Kashipur	Ichhakati
S98-02688	RIP1328	27/04/1998	22.893	90.506	1996	DTW	30	DPHE Office	Barisal	Barisal	Hizla	Barajalia	Khunna
S98-02689	RIP1331	20/04/1998	23.546	89.163	1985	DTW	125	DPHE Thana Complex	Khulna	Jhenaidah	Jhenaidah Sadar	Pourasava	Beparipara
S98-02690	RIP1340	22/04/1998	23.967	89.043	1994	STW	62	Md. Emdadul Hoque	Khulna	Kushtia	Mirpur (K)	Bahalbaria	Bahalbaria
S98-02691	RIP1499	27/04/1998	23.051	90.201	1990	STW	46	Kazi Moslem	Barisal	Barisal	Gournadi	Khanjapur	Purba dumuria
S98-02692	RIP1509	28/04/1998	22.536	90.35	1998	DTW	345	Bakerganj Bazar	Barisal	Barisal	Bakerganj	Bharpasha	Bharpasha
S98-02693	RIP1518	29/04/1998	22.773	90.142	1994	STW	21	Md Nurul Islam	Barisal	Barisal	Banaripara	Banaripara	Brahmankati
S98-02694	RIP1541	28/04/1998	22.821	90.252	1998	DTW	292	DPHE Office	Barisal	Barisal	Wazirpur	Shikarpur	Wazirpur
S98-02695	RIP1570	04/05/1998	22.143	90.21	1997	DTW	285	Md Altaf Hossain	Barisal	Barguna	Barguna Sadar	Burirchar	Burirchar
S98-02696	RIP1580	06/05/1998	22.707	89.977	1996	STW	11	DPHE Office	Barisal	Pirojpur	Nazirpur	Nazirpur	Bara Baichikati
S98-02697	RIP1581	28/04/1998	22.819	90.473	1992	DTW	302	Nur Mohammad	Barisal	Barisal	Mehendiganj	Darichar Khajuri	Darichar khajura
S98-02698	RIP1583	29/04/1998	22.814	90.363	1994	STW	16	Mirganj Mosque	Barisal	Barisal	Muladi	Kazirchar	Char commissiona
S98-02699	RIP1622	05/05/1998	22.391	89.991	1997	STW	14	Jantala Bazar	Barisal	Pirojpur	Mathbaria	Mirukhali	Bashbunia
S98-02700	RIP1630	06/05/1998	22.743	90.099	1993	DTW	268	DPHE Office	Barisal	Pirojpur	Nesarabad	Nesarabad	Nesarabad
S98-02701	RIP1640	09/05/1998	22.372	90.093	1993	DTW	322	Faizul Haq Master	Barisal	Jhalakati	Kathalia	Amua	Banshbaria
S98-02702	RIP1643	05/09/1998	22.456	90.102	1993	STW	25	Abdus Sattar Hawalde	Barisal	Pirojpur	Bhandaria	Gouripur	Radanagar
S98-02703	RIP1645	11/05/1998	23.341	90.173	1998	DTW	245	DPHE Office	Dhaka	Madaripur	Shibchar	Bayratala	Baranilakhi
S98-02704	RIP1723	10/05/1998	23.453	90.203	1992	STW	46	Sirazul Haq	Dhaka	Madaripur	Madaripur Sadar	Paurashava W01	Tharmuguria
S98-02705	RIP1729	11/05/1998	23.205	90.05	1998	DTW	301	DPHE Office	Dhaka	Madaripur	Rajoir	Rajoir	Rajoir
S98-02706	RIP1750	11/05/1998	23.081	90.302	1996	DTW	240	Akfat Ali	Dhaka	Madaripur	Kalkini	Enayetnagar	Kalai Sadar Char
S98-02707	RIP1875	19/05/1998	23.633	89.551	1984	STW	43	Thana Oarishad Mosq.	Dhaka	Rajbari	Baliakandi	Baliakandi	Baliakandi
S98-02708	RIP1887	20/05/1998	23.482	89.881	1986	STW	23	Halim Mia	Dhaka	Faridpur	Nagarkanda	Talma	Talma

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02661	6364495783	17	0.06	0.02	0.092	17.2	< 0.008	< 0.02	< 0.008	6.65	1.8	< 0.003	6.38	0.472	43.7	1.9	19.6	< 0.2	0.128	< 0.006	0.011
S98-02662	6367780273	50	< 0.04	0.02	0.075	13.6	< 0.008	< 0.02	< 0.008	6.64	1.2	< 0.003	7.79	0.255	44.6	2	21.4	< 0.2	0.105	< 0.006	0.065
S98-02663	2129419288	8	< 0.04	0.02	0.038	12.2	< 0.008	< 0.02	< 0.008	9.74	1.5	0.003	5.87	0.479	30.3	0.6	26.2	< 0.2	0.12	< 0.006	0.009
S98-02664	2121301995	105	< 0.04	0.09	0.03	30.8	< 0.008	< 0.02	< 0.008	2.34	5.1	0.006	18.1	0.046	69.6	0.8	22.8	0.4	0.275	< 0.006	0.009
S98-02665	2126331587	8	< 0.04	0.04	0.042	20.1	< 0.008	< 0.02	< 0.008	1.5	2.4	< 0.003	10.1	0.25	37.7	0.6	15.2	3.7	0.169	< 0.006	0.012
S98-02666	2129087766	< 6	< 0.04	0.02	0.022	21.1	< 0.008	< 0.02	< 0.008	0.603	1	0.006	8.6	0.54	21.4	< 0.2	21.1	< 0.2	0.137	< 0.006	0.009
S98-02667	2120219817	< 6	< 0.04	< 0.01	0.019	12.6	< 0.008	< 0.02	< 0.008	0.15	1.1	< 0.003	4.81	0.775	14.1	0.4	30.2	.4.7	0.0892	< 0.006	< 0.008
S98-02668	3594479097	133	0.05	0.14	0.131	45.6	< 0.008	< 0.02	< 0.008	1.88	7	0.006	34.3	0.116	183	1.1	14.5	0.4	0.322	< 0.006	0.013
S98-02669	3592442408	120	< 0.04	0.02	0.043	52	< 0.008	< 0.02	< 0.008	3.86	3.4	< 0.003	12.5	0.912	8.1	2.2	17.7	< 0.2	0.18	< 0.006	0.011
S98-02670	3597474865	529	< 0.04	0.03	0.046	60.6	< 0.008	< 0.02	< 0.008	1.27	4	< 0.003	15.3	0.11	14.2	1.1	14.9	0.2	0.235	< 0.006	0.012
S98-02671	3595628957	< 6	< 0.04	0.05	0.057	61	< 0.008	< 0.02	< 0.008	0.129	2.9	0.007	23.6	1.96	76.9	0.3	23.2	0.5	0.399	< 0.006	0.027
S98-02672	3598413770	104	< 0.04	0.05	0.102	54.8	< 0.008	< 0.02	< 0.008	7.69	5.9	0.004	33.7	0.19	21.8	1.4	25.5	1	0.331	< 0.006	0.027
S98-02673	3599431987	263	0.05	0.04	0.132	68.3	< 0.008	< 0.02	< 0.008	11.4	6	0.003	19.3	0.287	11.2	0.5	16	0.4	0.356	< 0.006	0.016
S98-02674	2120414204	115	< 0.04	0.05	0.306	87.6	< 0.008	< 0.02	< 0.008	2.5	71.3	< 0.003	36.5	1.5	45.5	0.8	15.8	42.1	0.429	< 0.006	0.015
S98-02675	2128572645	326	< 0.04	0.27	0.017	26.1	< 0.008	< 0.02	< 0.008	1.15	10.4	< 0.003	31.3	0.066	280	5.1	21.1	1.2	0.27	< 0.006	0.01
S98-02676	2158676727	151	< 0.04	0.52	0.02	36.3	< 0.008	< 0.02	< 0.008	0.713	6.3	0.013	29.5	1.48	88.8	1.1	15.1	1.4	0.25	< 0.006	0.013
S98-02677	2155359790	229	< 0.04	0.3	0.006	21.5	< 0.008	< 0.02	< 0.008	1.15	19.5	< 0.003	41.7	0.328	96.6	1.5	10.7	< 0.2	0.304	< 0.006	< 0.008
S98-02678	2226638051	< 6	< 0.04	0.02	0.005	10	< 0.008	< 0.02	< 0.008	0.075	3.4	0.009	11.1	0.006	25.1	0.3	20.6	1.1	0.124	< 0.006	0.011
S98-02679	3676887117	< 0.5	< 0.04	0.04	0.035	5.08	< 0.008	< 0.02	< 0.008	0.049	2.7	< 0.003	6.84	0.894	49.5	0.4	16	4.1	0.0628	0.008	0.043
S98-02680	6914142356	21.3	0.04	0.04	0.123	16.5	< 0.008	< 0.02	< 0.008	14.9	2.7	< 0.003	7.35	0.17	42.2	1.4	16.7	0.8	0.137	0.006	0.013
S98-02681	4476301707	< 0.5	< 0.04	0.12	0.063	29.8	< 0.008	< 0.02	< 0.008	0.058	4.3	0.006	17.5	0.023	115	< 0.2	13.4	< 0.2	0.259	< 0.006	< 0.008
S98-02682	4652856846	20.9	< 0.04	0.13	0.236	69	< 0.008	< 0.02	< 0.008	3.8	6.9	0.006	31.4	0.058	202	2.7	18.4	0.4	0.377	< 0.006	0.009
S98-02683	4013857523	18.8	< 0.04	0.44	0.156	101	< 0.008	< 0.02	< 0.008	2.58	30	0.006	116	0.043	623	0.9	20	0.4	0.929	< 0.006	< 0.008
S98-02684	4011463729	176	< 0.04	0.14	0.237	137	< 0.008	< 0.02	< 0.008	10.1	8.7	0.004	46.4	0.128	367	1.5	24.5	0.8	0.546	< 0.006	< 0.008
S98-02685	4657647544	1.5	< 0.04	0.06	0.083	97.6	< 0.008	< 0.02	< 0.008	0.029	1.1	0.01	37.9	1.45	97.2	< 0.2	16.5	4.5	0.39	0.008	0.012
S98-02686	4555760973	37.5	< 0.04	0.02	0.146	95.8	< 0.008	< 0.02	< 0.008	2.14	3.4	< 0.003	20.2	0.378	9.3	0.2	15.5	< 0.2	0.205	< 0.006	< 0.008
S98-02687	1065169470	279	0.04	0.54	0.094	106	< 0.008	< 0.02	< 0.008	2.24	21.8	0.004	100	0.234	819	0.9	12.6	0.3	0.764	< 0.006	0.023
S98-02688	1063613	1.5	< 0.04	0.5	0.021	6.74	< 0.008	< 0.02	< 0.008	0.09	2	< 0.003	3.46	0.023	248	0.6	10.6	< 0.2	0.0867	< 0.006	< 0.008
S98-02689	4441955079	26.3	< 0.04	0.02	0.083	85.1	< 0.008	< 0.02	< 0.008	0.788	3.1	0.007	20.4	0.561	11.1	< 0.2	19.9	< 0.2	0.244	< 0.006	< 0.008
S98-02690	4509421089	26.5	< 0.04	0.03	0.428	141	< 0.008	< 0.02	< 0.008	8.1	7.5	0.005	30.3	0.248	25.3	1.3	16.5	2.8	0.343	< 0.006	0.016
S98-02691	1063255769	26.4	< 0.04	0.94	0.132	25.4	< 0.008	< 0.02	< 0.008	1.86	21.3	0.008	37.4	0.079	743	11.7	28.2	1.5	0.274	< 0.006	< 0.008
S98-02692	1060706147	< 0.5	< 0.04	0.33	0.012	5.17	< 0.008	< 0.02	< 0.008	0.293	2.3	0.003	2.75	0.018	176	0.4	10.2	0.5	0.0656	< 0.006	0.014
S98-02693	1061010245	11.5	< 0.04	0.11	0.089	52.8	< 0.008	< 0.02	< 0.008	4.06	4.7	< 0.003	34.3	0.147	48.7	1.5	15.1	1.3	0.308	< 0.006	0.083
S98-02694	1069484994	2	< 0.04	0.4	0.017	5.94	< 0.008	< 0.02	< 0.008	0.119	1.6	0.005	2.62	0.014	207	0.4	11.3	< 0.2	0.0546	< 0.006	< 0.008
S98-02695	1042838206	1.1	< 0.04	0.63	0.012	4.86	< 0.008	< 0.02	< 0.008	0.269	2.8	< 0.003	2.79	0.015	243	1.3	9.33	1.5	0.0555	< 0.006	0.018
S98-02696	1797652089	270	< 0.04	0.04	0.228	220	< 0.008	< 0.02	< 0.008	4.76	5.9	< 0.003	52.4	1.77	28.5	0.5	14.8	3	0.765	< 0.006	0.015
S98-02697	1066263331	2.6	< 0.04	0.19	0.026	8.82	< 0.008	< 0.02	< 0.008	0.103	3.2	< 0.003	4.98	0.035	159	0.4	11.1	< 0.2	0.137	< 0.006	< 0.008
S98-02698	1066947328	35.4	< 0.04	0.03	0.153	122	< 0.008	< 0.02	< 0.008	2.76	5.7	< 0.003	25.4	2.07	14.1	< 0.2	12.8	1.1	0.436	< 0.006	0.031
S98-02699	1795869120	1.4	< 0.04	0.82	0.07	113	< 0.008	< 0.02	< 0.008	4.25	25.1	0.011	124	0.569	1490	1.4	21	753	0.745	< 0.006	0.031
S98-02700	1798795482	1.1	< 0.04	0.5	0.024	5.81	< 0.008	< 0.02	< 0.008	0.079	1.7	0.004	2.69	0.009	255	0.5	10.8	0.7	0.0528	< 0.006	< 0.008
S98-02701	1424315169	0.5	< 0.04	1.2	0.25	92.9	< 0.008	< 0.02	< 0.008	0.103	9.1	0.015	52.8	0.182	1690	2.6	7.85	< 0.2	1.52	< 0.006	0.028
S98-02702	1791447833	5.4	< 0.04	0.68	0.477	151	< 0.008	< 0.02	< 0.008	2.14	15.4	0.008	194	0.185	2050	5.9	19.6	138	1.07	< 0.006	0.032
S98-02703	3548715161	4.7	< 0.04	0.06	0.598	167	< 0.008	< 0.02	< 0.008	1.38	7.8	0.017	90	1.59	125	0.5	19.6	6.4	1.17	< 0.006	0.009
S98-02704	3545457956	375	< 0.04	0.11	0.106	79.4	< 0.008	< 0.02	< 0.008	4.46	6.8	< 0.003	31.5	0.108	45.1	1.4	21.5	0.8	0.377	< 0.006	0.011
S98-02705	3548095748	3.5	< 0.04	0.15	0.746	191	< 0.008	< 0.02	< 0.008	6.28	12.1	0.032	130	0.124	676	1.1	19.3	0.5	1.51	< 0.006	0.362
S98-02706	3544037521	2	0.17	0.35	0.11	32.4	< 0.008	< 0.02	< 0.008	0.781	3.5	0.005	14	0.043	186	0.3	16	< 0.2	0.239	< 0.006	< 0.008
S98-02707	3820719080	4.7	< 0.04	0.04	0.103	65	< 0.008	< 0.02	< 0.008	0.187	1.1	< 0.003	21.9	1.29	87.2	< 0.2	17	0.9	0.274	< 0.006	< 0.008
S98-02708	3296294965	99.6	< 0.04	0.14	0.105	75.7	< 0.008	< 0.02	< 0.008	6.31	6.3	< 0.003	18.6	0.094	70.7	2.8	20.3	1.5	0.337	< 0.006	0.019

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02709	RIP1914	20/05/1998	23.725	89.753	1985	STW	16	Thana Parishad Mosq.	Dhaka	Rajbari	Goalandaghat	Ujanchar	Uttar Ujanchar
S98-02710	RIP2001	31/03/1998	24.681	88.169	1983	STW	39	TNO Office	Rajshahi	Nawabganj	Shibganj (N)	Shibganj	Selimabad
S98-02711	RIP2074	03/04/1998	24.532	88.759		STW	32	Zahurul Islam	Rajshahi	Rajshahi	Bagmara	Gamipur	Hashnipur
S98-02712	RIP2080	03/04/1998	24.294	88.74	1997	STW	53	???	Rajshahi	Rajshahi	Charghat	Sardha	Sardha
S98-02713	RIP2090	04/04/1998	24.227	88.758	1982	STW	39	Mohasin Ali Majundar	Rajshahi	Rajshahi	Bagha	Manigram	Helalpur
S98-02714	RIP2108	05/04/1998	24.427	88.771	1994	STW	32	Abu Obaida Masum	Rajshahi	Rajshahi	Durgapur (R)	Maria	Raipara
S98-02715	RIP2184	16/04/1998	23.942	89.41	1977	STW	42	K. Moniruzzama	Rajshahi	Pabna	Sujanagar	Sujanagar	Sujanagar
S98-02716	RIP2228	18/04/1998	24.042	89.542	1997	STW	41	Dabir Pramanik	Rajshahi	Pabna	Santhia	Gourigram	Bandiramchar
S98-02717	RIP3079	28/04/1998	23.831	90.9	1996	STW	30	Nazim Uddin	Chittagong	Brahamanbaria	Nabinagar	Shyamgram	Shyamgaon
S98-02718	RIP3096	30/04/1998	23.169	91.129	1990	STW	20	Khila Bazar	Chittagong	Comilla	Laksam	Uttar Hawla	Kttar Hawla
S98-02719	RIP3200	10/05/1998	22.491	90.711	1997	DTW	284	Gani Master	Barisal	Bhola	Burhanuddin	Kutba	Kutba
S98-02720	RIP3209	11/05/1998	22.683	90.648	1996	STW	14	DPHE Office	Barisal	Bhola	Bhola Sadar	Paurashava	Sadar road
S98-02721	RIP3258	09/05/1998	22.164	90.758	1993	DTW	294	Abu Tahar	Barisal	Bhola	Char Fasson	Jinnahgar	Char utt. madras
S98-02722	RIP3274	11/05/1998	22.628	90.662	1998	DTW	294	Mr Nur Alam	Barisal	Bhola	Daulatkhan	Uttar joynagar	Uttar Joynagar
S98-02724	RIP0003	09/03/1998	23.624	90.611	1970	STW	30	H Ali Pradhan	Dhaka	Narayanganj	Sonargaon	Pirojpur	Asharichar
S98-02725	RIP0004	09/03/1998	23.673	90.631	1989	STW	30	Khardi P. School	Dhaka	Narayanganj	Sonargaon	Badyer bazar	Khanshardi
S98-02726	RIP0005	09/03/1998	23.727	90.634	1997	STW	25	Tul Islam Molla	Dhaka	Narayanganj	Sonargaon	Noagaon	Char kamaldi
S98-02727	RIP0006	09/03/1998	23.754	90.582	1995	STW	25	A Awal	Dhaka	Narayanganj	Sonargaon	Jampur	Singlaba
S98-02728	RIP0007	09/03/1998	23.755	90.581	1984	STW	54	Dslam	Dhaka	Narayanganj	Sonargaon	Jampur	Singlaba
S98-02729	RIP0010	10/03/1998	23.778	90.526	1994	STW	48	Dbavgla	Dhaka	Narayanganj	Rupganj	Murapara	Mahamudabad
S98-02730	RIP0011	10/03/1998	23.831	90.554	1958	STW	15	Hmd. Yusuf	Dhaka	Narayanganj	Rupganj	Kanchon	Kanchon
S98-02731	RIP0012	10/03/1998	23.875	90.581	1997	STW	39	Gbangla H. School	Dhaka	Narayanganj	Rupganj	Bholabo	Atlapur
S98-02732	RIP0013	10/03/1998	23.865	90.551	1988	STW	56	M Miah	Dhaka	Narayanganj	Rupganj	Daulatpur	Debagram
S98-02733	RIP0015	11/03/1998	23.787	90.605	1992	STW	16	M Hossain	Dhaka	Narayanganj	Araihazar	Duptara	Satyabandi
S98-02734	RIP0016	11/03/1998	23.787	90.659	1993	STW	39	Aazar Govt College	Dhaka	Narayanganj	Araihazar	Araihazar	Araihazar
S98-02735	RIP0017	11/03/1998	23.788	90.705	1996	STW	16	Mgal Ali	Dhaka	Narayanganj	Araihazar	Sadasasrdi	Ramchandradi
S98-02736	RIP0018	11/03/1998	23.779	90.678	1997	STW	15	J Ali	Dhaka	Narayanganj	Araihazar	Mohammadpur	Kallandi
S98-02737	RIP0019	11/03/1998	23.751	90.667	1993	STW	39	Habdul Khaleque	Dhaka	Narayanganj	Araihazar	Haizad	Ilamdi
S98-02738	RIP0021	12/03/1998	23.7	90.516	1993	DTW	135	Sil wapda Colony	Dhaka	Narayanganj	Shiddirganj	Shiddirganj	Simrail
S98-02739	RIP0022	12/03/1998	23.717	90.512	1990	STW	36	Marafuddin	Dhaka	Narayanganj	Shiddirganj	Godnail	Godnail
S98-02740	RIP0024	12/03/1998	23.649	90.476	1995	STW	52	Mad	Dhaka	Narayanganj	Fatulla	Fatulla	Haziganj
S98-02741	RIP0026	15/03/1998	23.764	90.165	1991	STW	38	Shahrial High School	Dhaka	Manikganj	Singair	Sayesta	Sayesta
S98-02742	RIP0027	15/03/1998	23.772	90.205	1991	STW	51	Amal Kumar Sarkar	Dhaka	Manikganj	Singair	Jamirta	Hutair
S98-02743	RIP0028	15/03/1998	23.817	90.122	1997	STW	41	Hafez Joynal Abedin	Dhaka	Manikganj	Singair	Singair	Singair
S98-02744	RIP0029	15/03/1998	23.833	90.085	1997	STW	22		Dhaka	Manikganj	Singair	Baira	Baira
S98-02745	RIP0031	12/03/1998	23.607	90.496	1985	DTW	164	Addin	Dhaka	Narayanganj	Narayanganj Sadar	Ward no-07	Paikpara
S98-02746	RIP0032	12/03/1998	23.591	90.501	1975	STW	46		Dhaka	Narayanganj	Narayanganj Sadar	Gognagar	Saidpur
S98-02747	RIP0034	12/03/1998	23.652	90.524	1997	STW	66	Siddik Bapari	Dhaka	Narayanganj	Bandar	Mosapur	Laksman khola
S98-02748	RIP0036	15/03/1998	23.869	90.023	1993	STW	17	Rupchand	Dhaka	Manikganj	Manikganj Sadar	Paurashava	Navagram
S98-02749	RIP0037	15/03/1998	23.851	90.001	1979	DTW	115	Sohrab Uddin	Dhaka	Manikganj	Manikganj Sadar	Paurashava	Betila
S98-02750	RIP0038	15/03/1998	23.88	90.071	1996	STW	34	Md. Afaz Uddin	Dhaka	Manikganj	Manikganj Sadar	Krishnapur	Bora kafigram hi
S98-02751	RIP0039	15/03/1998	23.816	90.062	1983	STW	23	Md. Arzan Ali Master	Dhaka	Manikganj	Manikganj Sadar	Betila mitara	Chhota baril
S98-02752	RIP0040	15/03/1998	23.802	90.02	1983	STW	18	Kalu Sarkar	Dhaka	Manikganj	Manikganj Sadar	Putail	Mid putail
S98-02753	RIP0041	15/03/1998	23.757	90.019	1990	STW	24	Rafiqul Hoque	Dhaka	Manikganj	Manikganj Sadar	Bhararia	Bhararia
S98-02754	RIP0043	16/03/1998	23.847	89.829	1984	DTW	118	Lutfor Rahman	Dhaka	Manikganj	Shibalaya	Ulail	Sibrampur
S98-02755	RIP0044	16/03/1998	23.897	89.8	1990	STW	47	Mr. Hashem Ali	Dhaka	Manikganj	Shibalaya	Uthali	Raninagar
S98-02756	RIP0045	16/03/1998	23.867	89.775	1993	STW	39	Shafiz Uddin Seikh	Dhaka	Manikganj	Shibalaya	Teota	Dakshin teota
S98-02757	RIP0046	16/03/1998	23.823	89.792	1980	STW	59	Hanif Master	Dhaka	Manikganj	Shibalaya	Shibalaya	Bara anulia

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02709	3822976994	10.1	0.21	0.02	0.114	111	< 0.008	< 0.02	< 0.008	0.694	4.1	< 0.003	22.8	1.04	10.5	< 0.2	14.4	4.2	0.393	< 0.006	0.034
S98-02710	5708883844	3.6	< 0.04	0.03	0.107	128	< 0.008	< 0.02	< 0.008	0.476	2.6	0.01	41.7	0.563	59.2	0.3	14.8	45.4	0.466	0.006	0.014
S98-02711	5811250386	1.3	< 0.04	0.02	0.035	104	< 0.008	< 0.02	< 0.008	0.089	0.9	0.008	25	1.03	28	< 0.2	17.9	10.5	0.347	0.006	0.215
S98-02712	5812594921	15.7	< 0.04	0.02	0.156	132	< 0.008	< 0.02	< 0.008	0.117	2.6	0.006	32.9	1.19	26.3	< 0.2	15.3	10.1	0.455	< 0.006	0.172
S98-02713	5811063502	< 0.5	< 0.04	0.02	0.046	117	< 0.008	< 0.02	< 0.008	0.057	1.7	0.008	31.4	1.55	28.1	< 0.2	16.8	< 0.2	0.4	< 0.006	0.012
S98-02714	5813171837	< 0.5	< 0.04	0.01	0.022	83.9	< 0.008	< 0.02	< 0.008	0.094	1	0.004	23	0.708	26.8	0.3	17.1	< 0.2	0.308	< 0.006	0.012
S98-02715	5768385915	0.5	< 0.04	0.03	0.06	91.2	< 0.008	< 0.02	< 0.008	0.087	1.4	0.003	36.6	1.79	52.4	0.4	19.9	< 0.2	0.424	0.007	0.017
S98-02716	5767243028	21	< 0.04	0.03	0.143	51.7	< 0.008	< 0.02	< 0.008	16.1	2.1	0.004	17.7	0.191	27.8	1.1	24.4	1.7	0.228	< 0.006	0.013
S98-02717	2128585940	406	< 0.04	0.17	0.04	34.3	< 0.008	< 0.02	< 0.008	2.13	9.7	< 0.003	34.8	0.122	154	2.7	17.7	1.4	0.298	< 0.006	0.015
S98-02718	2197291510	350	< 0.04	0.1	0.007	27.3	< 0.008	< 0.02	< 0.008	1.47	11.4	< 0.003	49	0.315	74.7	1.4	11.2	2.4	0.289	< 0.006	< 0.008
S98-02719	1092157668	1	< 0.04	0.08	0.117	39.7	< 0.008	< 0.02	< 0.008	0.01	5.4	0.003	26.5	0.059	78.9	0.3	13.6	< 0.2	0.44	< 0.006	0.008
S98-02720	1091850	163	< 0.04	0.29	0.051	74.2	< 0.008	< 0.02	< 0.008	1.22	12	< 0.003	48.6	0.82	169	0.9	14	0.3	0.389	< 0.006	0.079
S98-02721	1092566907	2.7	< 0.04	0.12	0.05	26.8	< 0.008	< 0.02	< 0.008	0.064	3.5	< 0.003	12	0.03	99.1	0.2	12.1	0.7	0.283	< 0.006	< 0.008
S98-02722	1092976952	1.2	< 0.04	0.16	0.042	27	< 0.008	< 0.02	< 0.008	0.249	4.5	0.005	19.5	0.066	128	0.3	14.4	< 0.2	0.306	< 0.006	0.01
S98-02724	3670469025	224	< 0.04	0.07	0.168	133	< 0.008	< 0.02	< 0.008	14.1	7.5	0.003	42.8	0.593	66.9	0.9	18.7	< 0.2	0.453	< 0.006	< 0.008
S98-02725	3670417349	311	< 0.04	0.05	0.061	78.8	< 0.008	< 0.02	< 0.008	3.11	3.9	< 0.003	20.2	0.67	25.8	0.9	18.8	0.5	0.261	< 0.006	< 0.008
S98-02726	3670460255	175	0.08	0.04	0.23	219	< 0.008	< 0.02	< 0.008	3.14	5.3	< 0.003	67.6	1.9	33.8	0.4	24.2	75.8	0.668	< 0.006	0.009
S98-02727	3670434921	< 0.5	< 0.04	< 0.01	0.117	239	< 0.008	< 0.02	< 0.008	0.165	3.9	0.004	102	4.24	80.4	< 0.2	31.2	226	1.34	0.006	0.009
S98-02728	3670434921	< 0.5	< 0.04	0.02	0.087	57.2	< 0.008	< 0.02	< 0.008	0.673	2	0.01	23.1	0.253	94.2	0.2	30.7	5	0.388	< 0.006	< 0.008
S98-02729	3676863666	< 0.5	< 0.04	0.03	0.017	27.6	< 0.008	< 0.02	< 0.008	0.216	1.9	0.004	11.9	0.567	36	0.2	28.9	20.1	0.186	< 0.006	< 0.008
S98-02730	3676847488	< 0.5	< 0.04	0.02	0.043	30.3	< 0.008	< 0.02	< 0.008	0.248	1.5	0.008	10.2	0.305	37.4	< 0.2	25.8	7.8	0.198	< 0.006	< 0.008
S98-02731	3676807042	31.9	< 0.04	0.05	0.102	51.5	< 0.008	< 0.02	< 0.008	26.1	4.9	< 0.003	23.5	0.23	34.2	1.2	32	0.3	0.28	< 0.006	< 0.008
S98-02732	3676831328	0.7	< 0.04	< 0.01	0.01	22.4	< 0.008	< 0.02	< 0.008	0.104	1.9	< 0.003	6.52	0.003	23.9	< 0.2	34.5	0.9	0.162	< 0.006	< 0.008
S98-02733	3670231860	180	< 0.04	0.06	0.096	38.9	< 0.008	< 0.02	< 0.008	7.11	5.3	< 0.003	29.6	1.23	32.8	< 0.2	16.9	0.3	0.203	< 0.006	< 0.008
S98-02734	3670207021	70.8	< 0.04	0.01	0.038	28.5	< 0.008	< 0.02	< 0.008	2.22	4.1	< 0.003	9.89	0.822	11.4	1.3	18.2	1.7	0.0965	< 0.006	< 0.008
S98-02735	3670279795	1.1	< 0.04	0.05	0.48	83.1	< 0.008	< 0.02	< 0.008	0.314	51.3	0.007	49.5	2.09	98.4	< 0.2	13.6	80	0.24	< 0.006	< 0.008
S98-02736	3670271537	< 0.5	< 0.04	0.02	0.081	29.8	< 0.008	< 0.02	< 0.008	0.154	5.7	0.006	11.4	0.594	20.2	< 0.2	16.3	27.8	0.11	< 0.006	< 0.008
S98-02737	3670247435	76.6	< 0.04	0.03	0.116	76.1	< 0.008	< 0.02	< 0.008	2.07	4.1	< 0.003	19.2	1.14	22.1	0.8	18	0.3	0.247	< 0.006	0.029
S98-02738	3678063884	1.1	< 0.04	0.03	0.104	30.8	< 0.008	< 0.02	< 0.008	2.12	1.4	0.004	12.8	0.209	40.6	< 0.2	27.1	0.8	0.187	< 0.006	0.022
S98-02739	3678063442	< 0.5	< 0.04	0.05	0.201	75.5	< 0.008	< 0.02	< 0.008	0.231	2.7	0.031	36.4	0.977	314	0.4	22.1	16.6	0.496	< 0.006	< 0.008
S98-02740	3672047544	< 0.5	< 0.04	0.03	0.045	59.1	< 0.008	< 0.02	< 0.008	0.275	1.7	0.005	20.9	0.251	49	0.2	24.4	5.4	0.386	< 0.006	< 0.008
S98-02741	3568288880	9.6	< 0.04	0.01	0.051	41.9	< 0.008	< 0.02	< 0.008	4.85	1.9	< 0.003	11.8	0.187	8.7	1.1	20.5	< 0.2	0.16	< 0.006	< 0.008
S98-02742	3568260486	0.8	< 0.04	0.03	0.42	94.1	< 0.008	< 0.02	< 0.008	10.2	24.6	< 0.003	45.8	0.462	35.4	1.2	19	118	0.4	< 0.006	< 0.008
S98-02743	3568286880	1.9	< 0.04	0.01	0.029	35.2	< 0.008	< 0.02	< 0.008	0.077	3.2	< 0.003	21.7	0.002	14.1	< 0.2	23.5	< 0.2	0.196	< 0.006	< 0.008
S98-02744	3568208114	45.6	< 0.01	0.03	0.15	139	< 0.003	< 0.002	< 0.008	10	1.8	< 0.003	42.4	0.098	14.2	1.3	28	1.1	0.256	< 0.002	0.006
S98-02745	3675807860	< 0.5	< 0.01	0.04	0.041	24.3	< 0.003	< 0.002	< 0.008	0.438	1.5	0.011	10.8	0.133	42.5	0.1	33.8	2	0.155	0.003	0.01
S98-02746	3675847848	25.7	< 0.01	0.06	0.14	103	< 0.003	< 0.002	< 0.008	3.49	5.8	< 0.003	41.6	2.26	64.4	1.2	20.3	50.4	0.344	< 0.002	0.018
S98-02747	3670679564	3.1	< 0.04	0.04	0.174	45.1	< 0.008	< 0.02	< 0.008	3.46	2	0.005	26.4	0.533	46.4	0.3	27.9	1.1	0.313	< 0.006	0.122
S98-02748	3564646806	12.9	< 0.04	0.02	0.208	68	< 0.008	< 0.02	< 0.008	12	8.6	< 0.003	17.5	0.815	7.2	1.3	18.7	11.8	0.249	< 0.006	< 0.008
S98-02749	3564646242	43.6	< 0.04	0.03	0.104	64.1	< 0.008	< 0.02	< 0.008	7.43	4.1	0.004	22.2	0.245	27.1	1	23.1	< 0.2	0.269	< 0.006	< 0.008
S98-02750	3564671113	12.8	< 0.04	0.02	0.166	86.6	< 0.008	< 0.02	< 0.008	2.69	1.8	< 0.003	35	3.77	12.9	0.5	17.5	6.2	0.243	< 0.006	< 0.008
S98-02751	3564607290	4.6	< 0.04	0.03	0.262	48.2	< 0.008	< 0.02	< 0.008	7.46	60.7	< 0.003	33.3	0.286	12.1	0.8	21.8	13.7	0.122	< 0.006	0.008
S98-02752	3564694646	9.1	< 0.04	0.11	0.11	99.4	< 0.008	< 0.02	< 0.008	0.422	4.2	< 0.003	20.6	6.03	8.4	0.6	19.4	11.8	0.316	< 0.006	< 0.008
S98-02753	3564615188	51.9	< 0.04	0.02	0.134	105	< 0.008	< 0.02	< 0.008	4.59	3.6	< 0.003	28.4	0.496	14.5	2.3	18.9	14.8	0.356	< 0.006	< 0.008
S98-02754	3567871890	14.8	< 0.04	0.13	0.215	86.2	< 0.008	< 0.02	< 0.008	4.95	4.1	0.004	33	0.112	67.4	0.8	20.8	< 0.2	0.393	< 0.006	< 0.008
S98-02755	3567883816	43.2	< 0.04	0.05	0.255	79.1	< 0.008	< 0.02	< 0.008	13.8	5.3	0.004	31.8	0.225	46.9	1.6	23.4	< 0.2	0.401	< 0.006	< 0.008
S98-02756	3567859365	5.9	< 0.01	0.03	0.025	50	< 0.003	< 0.002	< 0.008	0.404	5.6	0.007	36.7	0.001	32.6	0.1	33.9	0.2	0.281	< 0.002	< 0.004
S98-02757	3567847059	30.4	< 0.04	0.06	0.294	92.2	< 0.008	< 0.02	< 0.008	13.5	6.8	0.005	38.3	0.237	40.6	1.9	26.9	< 0.2	0.382	< 0.006	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02758	RIP0047	16/03/1998	23.836	89.872	1991	STW	38	Ismail	Dhaka	Manikganj	Shibalaya	Mohadebpur	Uttar banagram
S98-02759	RIP0049	18/03/1998	23.968	89.83	1983	STW	20		Dhaka	Manikganj	Daulatpur (M)	Chakmirpur	Chakmirpur
S98-02760	RIP0051	16/03/1998	23.744	89.978	1984	DTW	105		Dhaka	Manikganj	Harirampur	Boyra	Boyra
S98-02761	RIP0052	16/03/1998	23.748	90.016	1993	STW	34	Md. Khorshed Alam	Dhaka	Manikganj	Harirampur	Balara	Balara
S98-02762	RIP0053	16/03/1998	23.764	89.962	1989	STW	39	Abdul Aiz Molla	Dhaka	Manikganj	Harirampur	Chala	Louta
S98-02763	RIP0054	16/03/1998	23.771	89.91	1997	STW	36	Abdul Hoque	Dhaka	Manikganj	Harirampur	Gopinathpur	Gopinathpur
S98-02764	RIP0055	16/03/1998	23.774	89.9	1995	STW	39	Jhitka P-Para P. Sch	Dhaka	Manikganj	Harirampur	Balla	Jhitka
S98-02765	RIP0058	18/03/1998	23.877	89.91	1960	STW	50	Mr. Mosharraf Hoss.	Dhaka	Manikganj	Ghior	Baliakhora	Baliakhora
S98-02766	RIP0059	18/03/1998	23.893	89.878	1984	DTW	112	Thana Parishad	Dhaka	Manikganj	Ghior	Ghior	Ghior
S98-02767	RIP0060	18/03/1998	23.926	89.859	1990	STW	39	Altaf Hossain	Dhaka	Manikganj	Ghior	Poila	Char bailjuri
S98-02768	RIP0061	08/03/1998	23.893	89.89	1997	STW	42	Haroon Chandra	Dhaka	Manikganj	Ghior	Ghior	Maslaghi
S98-02769	RIP0062	18/03/1998	23.871	89.839	1996	STW	52	Baratia Bazar	Dhaka	Manikganj	Ghior	Baratia	Baratia
S98-02770	RIP0063	18/03/1998	23.801	89.96	1991	STW	35	Shamsuzzaman	Dhaka	Manikganj	Ghior	Nali	Ovajani
S98-02771	RIP0070	18/03/1998	23.975	89.906	1997	STW	34	Eklas Uddin	Dhaka	Manikganj	Daulatpur (M)	Kalia	Bilkalidaha
S98-02772	RIP0071	18/03/1998	23.947	89.931	1993	STW	20	Sharif Uddin	Dhaka	Manikganj	Daulatpur (M)	Dhamsar	Uttar bairagi
S98-02773	RIP0072	18/03/1998	23.919	89.835	1982	STW	49	Nironjan	Dhaka	Manikganj	Daulatpur (M)	Khalsi	Binodpur
S98-02774	RIP0073	18/03/1998	23.937	89.783	1988	STW	18	K. Nuruzzaman	Dhaka	Manikganj	Daulatpur (M)	Jiyanpur	Jiyanpur
S98-02775	RIP0075	21/04/1998	23.991	90.044	1984	DTW	92	TNO Office	Dhaka	Manikganj	Saturia	Baliati	Baliati
S98-02776	RIP0076	21/04/1998	23.972	90.041	1995	STW	28	Saturia H. School	Dhaka	Manikganj	Saturia	Saturia	Kaumara
S98-02777	RIP0077	21/04/1998	23.972	89.992	1965	STW	25	Mr Elahi Box	Dhaka	Manikganj	Saturia	Daragram	Daragram
S98-02778	RIP0078	21/04/1998	23.994	89.96	1991	STW	23	???	Dhaka	Manikganj	Saturia	Baraid	Patilapara
S98-02779	RIP0079	21/04/1998	23.969	89.967	1996	STW	15	Gopalpur P. School	Dhaka	Manikganj	Saturia	Baraid	Gopalpur
S98-02780	RIP0080	21/04/1998	23.95	90.023	1979	STW	26	Mr hamayet Ali	Dhaka	Manikganj	Saturia	Horgoz	Horgoz
S98-02781	RIP0081	21/04/1998	23.917	90.034	1976	STW	23	Janna Mosque Committ	Dhaka	Manikganj	Saturia	Fukurhati	Janna
S98-02782	RIP0082	21/04/1998	23.918	89.979	1975	STW	26	Mr Tazimuddin	Dhaka	Manikganj	Saturia	Tilli	Tilli
S98-02783	RIP0083	21/04/1998	23.899	90.041	1991	STW	20	Golar Bazar	Dhaka	Manikganj	Saturia	Dhankora	Saturia
S98-02784	RIP0085	21/04/1998	23.906	90.194	1995	STW	26	Md Mzaffar Hossain	Dhaka	Dhaka	Dhamrai	Kulla	Kulla
S98-02785	RIP0086	21/04/1998	23.926	90.179	1996	STW	71	Md Abdul Kader	Dhaka	Dhaka	Dhamrai	Sombhag	Dautia
S98-02786	RIP0087	21/04/1998	23.995	90.081	1995	STW	62	Azufa Khatun	Dhaka	Dhaka	Dhamrai	Balia	Mandarpur
S98-02787	RIP0088	21/04/1998	23.961	90.082	1997	STW	53	Md Madan Ali	Dhaka	Dhaka	Dhamrai	Gangutia	Kadlipara
S98-02788	RIP0089	21/04/1998	23.946	90.115	1990	STW	55	Maijuddin	Dhaka	Dhaka	Dhamrai	Sanora	Uttar nadhatta
S98-02789	RIP0090	21/04/1998	23.92	90.139	1996	Tara	57	Riazuddin Master	Dhaka	Dhaka	Dhamrai	Sutipara	Sutipara
S98-02790	RIP0091	21/10/1998	23.893	90.13	1995	STW	38	Noor Mohammad	Dhaka	Dhaka	Dhamrai	Nannar	Chaona
S98-02791	RIP0093	22/04/1998	23.834	90.26	1984	STW	41	DPHE Complex	Dhaka	Dhaka	Savar	Savar	Dakshin dariapur
S98-02792	RIP0094	22/04/1998	23.88	90.268	1984	DTW	115	Kamal Uddin Hall,JU	Dhaka	Dhaka	Savar	Pathalia	Boraoalia
S98-02793	RIP0095	22/04/1998	23.91	90.301	1997	STW	59	Mr Ruhul Amin	Dhaka	Dhaka	Savar	Ashulia	Dhananjoypur
S98-02794	RIP0096	22/04/1998	23.933	90.308	1996	STW	34	Dewan Super Market	Dhaka	Dhaka	Savar	Yearpur	Diakhbli
S98-02795	RIP0097	22/04/1998	23.991	90.248	1995	STW	56	Tengari P. School	Dhaka	Dhaka	Savar	Shimulia	Tenguria
S98-02796	RIP0098	22/04/1998	23.911	90.234	1996	STW	43	Bazar Committee	Dhaka	Dhaka	Savar	Pathalia	Dhania
S98-02797	RIP0099	22/04/1998	23.79	90.269	1989	STW	43	Zulmat Ali Haweldar	Dhaka	Dhaka	Savar	Tetulghora	Dahshin shympur
S98-02798	RIP0100	22/04/1998	23.794	90.293	1997	STW	43	Md abdul Latif	Dhaka	Dhaka	Savar	Banagram	Kandi baliarpur
S98-02799	RIP0103	22/04/1998	23.73	90.339	1996	STW	44	Md Babul	Dhaka	Dhaka	Keraniganj	Sakta	Ati
S98-02800	RIP0104	22/04/1998	23.73	90.317	1997	STW	76	Mr Yakub Ali	Dhaka	Dhaka	Keraniganj	Taranagar	Baramandharia
S98-02801	RIP0105	22/04/1998	23.732	90.276	1996	STW	25	Emdad Hossain	Dhaka	Dhaka	Keraniganj	Hazrapur	Maniknagar
S98-02802	RIP0106	22/04/1998	23.687	90.287	1996	STW	85	Mr Nurul Islam	Dhaka	Dhaka	Keraniganj	Kalatia	Kharakandi
S98-02803	RIP0107	22/04/1998	23.686	90.308	1995	STW	85	Gobinda Shah	Dhaka	Dhaka	Keraniganj	Ruhitpur	Ruhilpur
S98-02804	RIP0108	22/04/1998	23.701	90.384	1998	Tara	73	Saima Khatun	Dhaka	Dhaka	Keraniganj	Zinjira	Mandail
S98-02805	RIP0109	22/04/1998	23.667	90.434	1995	STW	74	Omar Ali	Dhaka	Dhaka	Keraniganj	Teguria	Teguria

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02758	3567823958	4.7	< 0.04	0.01	0.122	74.3	< 0.008	< 0.02	< 0.008	5.31	3.7	< 0.003	30.5	0.332	12.6	0.5	19.9	5.4	0.222	< 0.006	< 0.008
S98-02759	3561028206	< 0.5	< 0.01	0.02	0.076	79.5	< 0.003	< 0.002	< 0.008	0.229	4.2	< 0.003	33.5	1.81	11.2	< 0.1	18.4	7.7	0.219	< 0.002	0.014
S98-02760	3562822090	65	< 0.04	0.02	0.144	116	< 0.008	< 0.02	< 0.008	4.79	4.5	0.003	34.1	0.508	12.5	1.1	21.7	0.4	0.412	< 0.006	0.01
S98-02761	3562821128	12.9	< 0.04	0.02	0.114	116	< 0.008	< 0.02	< 0.008	3.6	3.4	< 0.003	35.9	1.55	16.8	0.6	22.1	35.5	0.303	< 0.006	< 0.008
S98-02762	3562836614	82.7	< 0.04	0.02	0.137	97.5	< 0.008	< 0.02	< 0.008	9.37	4.7	< 0.003	32	1.9	18.9	0.5	21.1	1.2	0.44	< 0.006	< 0.008
S98-02763	3562858	88.8	0.4	0.03	0.132	81.4	< 0.008	< 0.02	< 0.008	5.55	4.5	< 0.003	36	0.336	61.2	0.9	20.2	< 0.2	0.409	< 0.006	0.009
S98-02764	3562814	1	< 0.04	0.02	0.089	72.3	< 0.008	< 0.02	< 0.008	3.79	1.5	< 0.003	15.7	0.469	8	0.7	16.3	14.3	0.18	< 0.006	< 0.008
S98-02765	3562211088	20.2	< 0.04	0.02	0.131	116	< 0.008	< 0.02	< 0.008	4.2	4.1	< 0.003	26.8	0.422	10	1.5	20	< 0.2	0.372	< 0.006	0.017
S98-02766	3562247459	15.4	< 0.01	< 0.1	0.069	42.6	< 0.003	< 0.002	< 0.008	0.06	4.4	0.005	26	0.044	19.9	< 0.1	25.5	4.5	0.21	< 0.002	0.007
S98-02767	3562271300	35	< 0.01	< 0.1	0.072	41.5	< 0.003	< 0.002	< 0.008	0.027	3.2	< 0.004	30	0.003	30.6	< 0.1	22.2	0.3	0.347	< 0.002	0.047
S98-02768	3562247659	18.6	< 0.01	< 0.1	0.102	40.2	< 0.003	< 0.002	< 0.008	0.022	12.4	< 0.004	30.5	0.039	19.5	< 0.1	27.7	3.2	0.218	< 0.002	0.06
S98-02769	3562235176	30.6	< 0.01	< 0.1	0.016	45.5	< 0.003	< 0.002	< 0.008	0.058	3.8	0.007	20.2	< 0.002	18.4	0.2	32.7	0.4	0.181	< 0.002	0.012
S98-02770	3562259759	20.1	< 0.01	< 0.1	0.064	41	< 0.003	< 0.002	< 0.008	0.022	5	< 0.004	35.7	0.002	11.9	< 0.1	22.3	9.7	0.21	< 0.002	0.031
S98-02771	3561076152	14.7	< 0.01	< 0.1	0.043	66.2	< 0.003	< 0.002	< 0.008	0.678	4.5	0.007	15.7	0.924	9.8	< 0.1	26.7	0.3	0.14	< 0.002	0.02
S98-02772	3561057967	0.8	< 0.01	< 0.1	0.023	42.1	< 0.003	< 0.002	< 0.008	0.336	3.3	< 0.004	24.8	0.006	13.5	< 0.1	24.9	92.9	0.122	< 0.002	0.017
S98-02773	3561085163	13.2	< 0.01	< 0.1	0.011	68.5	< 0.003	< 0.002	< 0.008	0.061	2.9	< 0.004	18.5	0.004	8.4	0.4	20.8	7.7	0.182	< 0.002	0.017
S98-02774	3561066462	12.2	0.04	0.02	0.105	102	< 0.008	< 0.02	< 0.008	1.78	3.4	0.004	35.3	1.32	10.1	0.5	16.7	14.3	0.257	< 0.006	< 0.008
S98-02775	3567019060	2.9	0.04	0.02	0.091	70.8	< 0.008	< 0.02	< 0.008	0.094	4.9	0.007	36.4	0.463	18.9	< 0.2	24.8	2.6	0.3	< 0.006	0.211
S98-02776	3567095553	18.2	0.05	0.04	0.201	90.6	< 0.008	< 0.02	< 0.008	13	4.1	0.005	38.6	2.82	21.9	1	20.2	38.2	0.29	0.01	0.023
S98-02777	3567038319	3.6	0.04	0.03	0.118	59.2	< 0.008	< 0.02	< 0.008	7.46	3	0.005	27.7	0.558	12.2	1.2	22.5	3.9	0.172	< 0.006	0.009
S98-02778	3567028791	8.2	< 0.04	0.02	0.062	52.4	< 0.008	< 0.02	< 0.008	2.07	3.4	0.003	13.5	0.56	7	0.2	20.1	0.8	0.152	< 0.006	0.011
S98-02779	3567028406	< 0.5	0.06	0.03	0.085	72.5	< 0.008	< 0.02	< 0.008	1.69	3.8	0.004	18.2	2.24	8.4	< 0.2	15.3	12.9	0.237	< 0.006	0.014
S98-02780	3567076431	31.2	0.05	0.03	0.066	78.7	< 0.008	< 0.02	< 0.008	0.639	3.9	0.003	20.2	1.03	7.4	0.8	19.5	6	0.236	< 0.006	0.07
S98-02781	3567066482	< 0.5	0.04	0.03	0.1	98.4	< 0.008	< 0.02	< 0.008	0.38	4.4	0.004	28.2	1.96	11.5	< 0.2	17.1	5.5	0.31	0.006	< 0.008
S98-02782	3567095934	62.8	0.05	0.03	0.144	80.2	< 0.008	< 0.02	< 0.008	8.19	3.4	< 0.003	16.7	2.31	7	1	19.9	2.2	0.261	< 0.006	0.018
S98-02783	3567067638	14.9	0.06	0.03	0.114	99.6	< 0.008	< 0.02	< 0.008	5.67	3.8	0.003	23	3.16	12.3	0.7	22.5	8.5	0.294	0.006	0.011
S98-02784	3261453598	< 0.5	< 0.04	0.03	0.1	43.8	< 0.008	< 0.02	< 0.008	2.01	8.9	0.005	21.3	0.78	10.3	< 0.2	21.1	13.5	0.205	< 0.006	0.013
S98-02785	3261483325	3.6	0.04	0.02	0.174	68.5	< 0.008	< 0.02	< 0.008	22.7	3.5	0.009	25.8	0.364	13.6	1.1	24.8	1.6	0.246	< 0.006	0.044
S98-02786	3261417656	21.2	0.04	0.03	0.134	74.5	< 0.008	< 0.02	< 0.008	7.2	3.4	0.005	27.9	0.272	19.9	1.5	26.3	< 0.2	0.39	0.007	0.018
S98-02787	3261441533	5.9	0.04	0.03	0.083	41.5	< 0.008	< 0.02	< 0.008	8.15	3.7	0.004	22.5	1.03	12.6	1.2	23.7	11.6	0.143	< 0.006	0.012
S98-02788	3261477978	29.9	< 0.04	0.03	0.184	58.8	< 0.008	< 0.02	0.012	12.3	3.6	0.006	21.3	0.328	18.8	1.5	28.2	< 0.2	0.307	< 0.006	0.061
S98-02789	3261494939	3.6	< 0.04	0.02	0.085	80.9	< 0.008	< 0.02	< 0.008	0.104	2.2	0.025	23.6	2.8	22	< 0.2	27.7	< 0.2	0.399	< 0.006	0.01
S98-02790	3261465	107	0.06	0.04	0.176	119	< 0.008	< 0.02	< 0.008	10.2	5.3	0.005	42.5	1.25	23	1.1	22.3	0.3	0.561	0.007	< 0.008
S98-02791	3267278296	1	< 0.01	< 0.1	0.016	11.8	< 0.003	< 0.002	< 0.008	0.04	1.7	< 0.004	4.05	< 0.002	15.6	0.2	40.2	9.6	0.106	0.007	0.01
S98-02792	3267272103	< 0.5	< 0.04	< 0.01	0.026	18.5	< 0.008	< 0.02	0.014	0.028	1.5	0.005	6.49	0.012	16.1	< 0.2	37.1	1.8	0.113	0.009	0.03
S98-02793	3267211386	< 0.5	< 0.04	< 0.01	0.019	4.56	< 0.008	< 0.02	< 0.008	0.16	1.5	< 0.003	1.27	0.013	6.2	< 0.2	22.3	3.2	0.048	< 0.006	0.01
S98-02794	3267294402	< 0.5	< 0.04	< 0.01	0.017	7.07	< 0.008	< 0.02	< 0.008	1.17	1.5	0.004	1.92	0.024	8.3	< 0.2	25.1	0.9	0.0795	0.007	0.012
S98-02795	3267283946	< 0.5	< 0.04	0.02	0.053	23.7	< 0.008	< 0.02	< 0.008	0.381	1	< 0.003	6.79	0.071	23.5	< 0.2	29.3	1.8	0.169	0.01	0.054
S98-02796	3267272389	< 0.5	< 0.04	0.01	0.034	21.6	< 0.008	< 0.02	< 0.008	0.056	1.3	< 0.003	6.48	0.018	17.5	0.4	25.6	1.2	0.144	0.016	0.009
S98-02797	3267289341	< 0.5	< 0.04	0.02	0.015	30.5	< 0.008	< 0.02	< 0.008	0.088	1	< 0.003	10.5	0.431	32.6	0.5	20.3	3.9	0.194	< 0.006	0.009
S98-02798	3267222560	< 0.5	< 0.04	< 0.01	0.067	24.1	< 0.008	< 0.02	< 0.008	0.172	1.9	< 0.003	5.64	0.026	23.3	< 0.2	33.1	3	0.172	0.006	0.012
S98-02799	3263860057	13.3	< 0.04	0.02	0.053	78.8	< 0.008	< 0.02	< 0.008	2.4	2.1	< 0.003	22.1	4.63	16.7	0.3	28.4	< 0.2	0.443	< 0.006	0.011
S98-02800	3263877131	< 0.5	< 0.04	0.02	0.038	112	< 0.008	< 0.02	< 0.008	0.294	4	< 0.003	25.5	5.56	21.4	0.3	23.5	1.5	0.418	0.009	0.014
S98-02801	3263817698	43.3	< 0.04	0.03	0.128	63.8	< 0.008	< 0.02	< 0.008	18.6	3.7	< 0.003	16.7	1.07	15	1	33.5	0.3	0.226	< 0.006	< 0.008
S98-02802	3263825633	98.4	< 0.04	0.02	0.137	85.6	< 0.008	< 0.02	< 0.008	11.1	4.2	0.004	22.5	0.438	17.6	1.5	27.1	0.8	0.362	< 0.006	0.019
S98-02803	3263851863	< 0.5	< 0.04	0.02	0.08	132	< 0.008	< 0.02	< 0.008	0.102	3.8	< 0.003	34.6	1.27	24	< 0.2	21.8	6.9	0.516	0.006	< 0.008
S98-02804	3263894690	< 0.5	< 0.04	< 0.01	0.026	47.7	< 0.008	< 0.02	< 0.008	0.354	2.7	< 0.003	16.2	0.188	41.8	< 0.2	30.7	1.8	0.398	< 0.006	0.166
S98-02805	3263886945	< 0.5	< 0.04	< 0.01	0.037	58.8	< 0.008	< 0.02	< 0.008	0.32	2.3	< 0.003	18.9	0.374	20.8	< 0.2	26.8	3.1	0.306	< 0.006	0.031

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02806	RIP0111	23/04/1998	23.632	90.081	1982	STW	51	Abdul Hakim Master	Dhaka	Dhaka	Dohar	Kushumhati	Kartikpur
S98-02807	RIP0112	23/04/1998	23.642	90.047	1997	STW	65	Kurban Ali	Dhaka	Dhaka	Dohar	Nayabari	Dakshin bahra
S98-02808	RIP0113	23/04/1998	23.595	90.139	1992	STW	63	Union Parishad	Dhaka	Dhaka	Dohar	Sutarpara	Ghata
S98-02809	RIP0114	23/04/1998	23.577	90.148	1981	STW	57	Abdul Sattar Charman	Dhaka	Dhaka	Dohar	Narisha	Meghula
S98-02810	RIP0115	23/04/1998	23.538	90.176	1995	STW	61	Basir Uddin Munsee	Dhaka	Dhaka	Dohar	Muksudpur	Bethua
S98-02811	RIP0119	23/04/1998	23.659	90.166	1983	STW	56	DPHE Compound	Dhaka	Dhaka	Nawabganj (Dh)	Kalakupa	Kasimpur
S98-02812	RIP0120	23/04/1998	23.644	90.179	1997	STW	59	Bakshnagar H. School	Dhaka	Dhaka	Nawabganj (Dh)	Bakshnagar	Chhota baksh n.
S98-02813	RIP0121	23/04/1998	23.631	90.21	1995	STW	49	Tara Alexh	Dhaka	Dhaka	Nawabganj (Dh)	Galimpur	Galimpur
S98-02814	RIP0122	23/04/1998	23.622	90.226	1979	STW	54	Mir Amanullah	Dhaka	Dhaka	Nawabganj (Dh)	Charain	Charain
S98-02815	RIP0123	23/04/1998	23.649	90.204	1978	STW	56	Mosque Committee	Dhaka	Dhaka	Nawabganj (Dh)	Barrah	Dakshin chaukihh
S98-02816	RIP0124	23/04/1998	23.641	90.215	1998	STW	61	Milu Hossain	Dhaka	Dhaka	Nawabganj (Dh)	Agla	Tikorpur
S98-02817	RIP0302	24/05/1998	24.382	91.903	1996	STW	44	S.Nagar Railway Stat	Sylhet	Maulvibazar	Kamalganj	Shamshernagar	Shamshernagar
S98-02818	RIP0303	24/05/1998	24.405	91.858	1994	STW	44	Shibbir Ahmed	Sylhet	Maulvibazar	Kamalganj	Munshibazar	Dhifeswar
S98-02819	RIP0304	24/05/1998	24.404	91.846	1995	STW	67	Hazi Abdul Bari	Sylhet	Maulvibazar	Kamalganj	Rahimpur	Sideshwarpur
S98-02820	RIP0305	24/05/1998	24.315	91.843	1995	STW	23	Aftab Uddin	Sylhet	Maulvibazar	Kamalganj	Modhabpur	Dhalairpar
S98-02821	RIP0306	24/05/1998	24.354	91.846	1992	STW	44	Safat Ali,Alia Madra	Sylhet	Maulvibazar	Kamalganj	Kamalganj	Kumrakapan
S98-02822	RIP0307	24/05/1998	24.321	91.855	1998	Tara	69	Kala Chand Sing	Sylhet	Maulvibazar	Kamalganj	Alinagar	Tilakpurchak
S98-02823	RIP0308	24/05/1998	24.278	91.864	1993	STW	46	Tanu Babu Sing	Sylhet	Maulvibazar	Kamalganj	Adampur	Jalalpur
S98-02824	RIP0309	24/05/1998	24.356	91.858	1992	STW	41	TNO Campus	Sylhet	Maulvibazar	Kamalganj	Alinagar	Nachharatpur
S98-02825	RIP0311	25/05/1998	24.518	91.976	1997	STW	59	Jalalabad High Schoo	Sylhet	Maulvibazar	Kulaura	Brahmanbazar	Jalalabad
S98-02826	RIP0312	25/05/1998	24.566	91.978	1996	STW	49	Ibrahim Ali Shah	Sylhet	Maulvibazar	Kulaura	Baramchai	Singur
S98-02827	RIP0313	25/05/1998	24.502	92.03	1983	STW	26	Abdul Hasib	Sylhet	Maulvibazar	Kulaura	Kulaura	Mukundapur
S98-02828	RIP0314	25/05/1998	24.502	92.03	1994	STW	64	Syed Ali Abbas	Sylhet	Maulvibazar	Kulaura	Kulaura	Mukundapur
S98-02829	RIP0315	25/05/1998	24.528	92.038	1985	STW	59	TTDC Area	Sylhet	Maulvibazar	Kulaura	Paurashava	Ttdc area
S98-02830	RIP0316	25/05/1998	24.459	92.152	1993	STW	39	Fultala High School	Sylhet	Maulvibazar	Kulaura	Fultala	Konagaon
S98-02831	RIP0317	25/05/1998	24.487	92.144	1996	STW	34	Sagarnal Pry School	Sylhet	Maulvibazar	Kulaura	Sagarnal	Uttar sagarnal
S98-02832	RIP0318	25/05/1998	24.59	92.118	1996	STW	33	Kaminiganj Cow's Hat	Sylhet	Maulvibazar	Kulaura	Jaifarnagar	Kaminiganj
S98-02833	RIP0319	25/05/1998	24.562	92.162	1995	STW	23	G.Bari Jame Marjed	Sylhet	Maulvibazar	Kulaura	Goalbari	Goalbari
S98-02834	RIP0321	25/05/1998	24.84	91.768	1993	STW	30	Ramdhana Govt.PS	Sylhet	Sylhet	Bishwanath	Alankari	Kamalpur
S98-02835	RIP0322	26/05/1998	24.814	91.759	1983	STW	90	Upazila Parisad	Sylhet	Sylhet	Bishwanath	Bishwanath	Junai musalia
S98-02836	RIP0323	26/05/1998	24.859	91.731	1997	STW	92	Badan Noor	Sylhet	Sylhet	Bishwanath	Rampasha	Rampasha
S98-02837	RIP0324	26/05/1998	24.79	91.661	1997	STW	99	Sanur Ali	Sylhet	Sylhet	Bishwanath	Dasghar	Baisghar
S98-02838	RIP0325	26/05/1998	24.784	91.713	1997	DTW	108	Kalijuri Govt. PS	Sylhet	Sylhet	Bishwanath	Deokalash	Kalijuri
S98-02839	RIP0326	26/05/1998	24.916	91.722	1997	DTW	105	Naisat Ali Mia	Sylhet	Sylhet	Bishwanath	Lamakazi	Nurpur
S98-02840	RIP0328	27/05/1998	24.878	92.37	1984	STW	47	Abdul Karim	Sylhet	Sylhet	Zakiganj	Zakiganj	Alamnagar
S98-02841	RIP0329	27/05/1998	24.891	92.373	1985	STW	39	IZAAT ALI	Sylhet	Sylhet	Zakiganj	Kholachara	Gangadatta
S98-02842	RIP0330	27/05/1998	24.944	92.385	1996	STW	46	Ratanganj Bazar	Sylhet	Sylhet	Zakiganj	Kazalshar	Kazalshar
S98-02843	RIP0332	24/05/1998	24.577	91.689	1992	STW	100	Abdul Khaleque	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Manumukh	Ghorakhal
S98-02844	RIP0333	24/05/1998	24.484	91.682	1991	STW	100	Alimullah	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Amtail	Khusalpur
S98-02845	RIP0334	24/05/1998	24.486	91.633	1974	STW	34	Union Parishad	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Upper Kagabala	Kagabala
S98-02846	RIP0335	24/05/1998	24.461	91.65	1997	STW	67	Hazi Mamtazuddin	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Nazirabad	Rautgaon
S98-02847	RIP0336	24/05/1998	24.49	91.75	1996	STW	84	Abdur Rashid Master	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Mostafapur	Gharua
S98-02848	RIP0337	24/05/1998	24.412	91.758	1988	STW	48	Mosque Comittee	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Giasnagar	Gayesnagar
S98-02849	RIP0338	24/05/1998	24.485	91.767	1987	STW	72	Syed Mohsin Ali	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Ward-03	Darjee mahal
S98-02850	RIP0339	24/05/1998	24.519	91.779	1996	STW	72	Primary School	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Ekatona	Ekatona
S98-02851	RIP0340	24/05/1998	24.484	91.781	1994	STW	46	Wahidur Rahman	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Ward-01	Court area
S98-02852	RIP0342	25/05/1998	24.605	91.85	1995	STW	39	Emani Mia	Sylhet	Maulvibazar	Rajnagar	Munshibazar	Medinimahal
S98-02853	RIP0343	25/05/1998	24.556	91.853	1997	STW	57	High School	Sylhet	Maulvibazar	Rajnagar	Panchgaon	Panchgaon

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02806	3261821461	262	< 0.04	0.04	0.223	152	< 0.008	< 0.02	< 0.008	7.02	6.8	< 0.003	33	0.98	85.4	1.6	16.7	0.5	0.488	< 0.006	0.021
S98-02807	3261863256	11.7	< 0.04	0.02	0.247	82.3	< 0.008	< 0.02	< 0.008	8.68	14.8	0.005	41.8	0.604	11.3	1.4	23.3	< 0.2	0.309	< 0.006	< 0.008
S98-02808	3261884317	107	< 0.04	0.05	0.25	103	< 0.008	< 0.02	< 0.008	7.11	6.7	0.004	49.1	0.127	45	1.6	20.5	0.3	0.5	< 0.006	0.01
S98-02809	3261852687	65	< 0.04	0.07	0.186	68.5	< 0.008	< 0.02	< 0.008	7.64	6	0.003	43.7	0.147	36.6	3	26.8	9.3	0.348	< 0.006	0.051
S98-02810	3261842082	81.1	< 0.04	0.12	0.168	42.4	< 0.008	< 0.02	< 0.008	3.38	8.5	< 0.003	36.9	0.098	60.9	2.6	24	0.6	0.288	< 0.006	< 0.008
S98-02811	3266274528	94.2	< 0.04	0.03	0.258	122	< 0.008	< 0.02	< 0.008	7.78	7.7	0.004	74.9	0.29	48.6	1.1	23.1	10.8	0.675	< 0.006	0.074
S98-02812	3266213264	95.6	< 0.04	0.03	0.286	87.8	< 0.008	< 0.02	< 0.008	8.1	6.9	0.006	47	0.414	50	1.1	23.1	0.4	0.496	< 0.006	< 0.008
S98-02813	3266247373	58.7	< 0.04	0.04	0.207	84.8	< 0.008	< 0.02	< 0.008	16.1	5	0.006	43.8	0.344	40.7	0.9	28	< 0.2	0.452	< 0.006	0.013
S98-02814	3266240321	70.4	< 0.04	0.04	0.09	44.5	< 0.008	< 0.02	< 0.008	4.31	4	< 0.003	25	0.192	27.3	1.4	25	5.7	0.228	< 0.006	0.015
S98-02815	3266227331	262	< 0.04	0.04	0.29	96.2	< 0.008	< 0.02	< 0.008	8.77	6.7	0.006	39	0.412	77.3	0.9	18.7	0.8	0.527	< 0.006	0.011
S98-02816	3266206943	81.2	< 0.04	0.06	0.127	54.6	< 0.008	< 0.02	< 0.008	10.8	4	0.004	20.9	0.138	93.9	1.6	21.5	1.1	0.233	< 0.006	0.018
S98-02817	6585685845	< 0.5	0.04	< 0.01	0.481	8.46	< 0.008	< 0.02	< 0.008	0.181	7.9	0.005	3.89	0.096	20.1	< 0.2	9.46	0.6	0.101	< 0.006	0.029
S98-02818	6585657255	47.1	< 0.04	< 0.01	0.127	12.2	0.083	< 0.02	< 0.008	20	1.8	< 0.003	6.44	0.77	17.6	1	20.8	0.6	0.108	< 0.006	0.008
S98-02819	6585676871	7.3	< 0.04	< 0.01	0.118	8.62	< 0.008	< 0.02	< 0.008	14.3	3.2	< 0.003	4.14	0.346	23.4	0.6	21.8	0.5	0.0923	< 0.006	0.271
S98-02820	6585647537	< 0.5	< 0.04	< 0.01	0.029	2.5	< 0.008	< 0.02	< 0.008	0.324	2.8	< 0.003	0.71	0.038	4.2	< 0.2	13.5	0.6	0.0225	< 0.006	0.011
S98-02821	6585638501	13.8	< 0.04	< 0.01	0.105	9.24	< 0.008	< 0.02	< 0.008	26.3	1.9	< 0.003	3.49	0.767	12.2	0.6	19.6	0.6	0.081	< 0.006	0.014
S98-02822	6585619959	< 0.5	0.04	< 0.01	0.04	11.2	< 0.008	< 0.02	< 0.008	0.881	6.1	0.006	3.35	0.659	4.1	0.3	18	3.7	0.052	< 0.006	0.199
S98-02823	6585609413	18.4	< 0.04	< 0.01	0.065	14.1	0.011	< 0.02	< 0.008	16.3	2.7	< 0.003	5.69	0.544	7.5	0.2	15.6	< 0.2	0.109	< 0.006	0.02
S98-02824	6585619633	8.7	< 0.04	< 0.01	0.104	8.87	< 0.008	< 0.02	< 0.008	8.95	2.1	< 0.003	4.13	0.412	21.9	0.4	23.5	21.7	0.083	< 0.006	0.078
S98-02825	6586517408	17.6	< 0.04	< 0.01	0.039	4	< 0.008	< 0.02	< 0.008	0.698	1.3	< 0.003	2.81	0.036	73	1.2	9.06	10.3	0.0358	< 0.006	0.059
S98-02826	6586505954	3.4	< 0.04	< 0.01	0.067	5.49	< 0.008	< 0.02	< 0.008	17.1	2.5	< 0.003	2.45	0.209	5.4	0.3	7.07	0.4	0.0416	< 0.006	0.117
S98-02827	6586565665	7.4	< 0.04	< 0.01	0.078	6.61	< 0.008	< 0.02	< 0.008	1.37	1.7	< 0.003	5.14	0.384	59.4	0.4	13.4	0.3	0.0586	< 0.006	< 0.008
S98-02828	6586565665	32.2	< 0.04	< 0.01	0.057	4.94	< 0.008	< 0.02	< 0.008	1.42	1.1	< 0.003	4.02	0.216	79.8	2.3	11	0.6	0.0466	< 0.006	< 0.008
S98-02829	6586565	39	< 0.04	0.01	0.058	6.39	< 0.008	< 0.02	< 0.008	1.41	1	< 0.003	5.63	0.13	79.7	2.2	11.7	0.5	0.0607	< 0.006	0.059
S98-02830	6586523517	< 0.5	< 0.04	< 0.01	0.03	13.8	< 0.008	< 0.02	< 0.008	4.59	2.5	0.01	5.81	0.25	17.6	< 0.2	39	1.6	0.152	< 0.006	0.012
S98-02831	6586583994	< 0.5	< 0.04	< 0.01	0.02	11.6	< 0.008	< 0.02	< 0.008	6.71	2	0.008	4.28	0.405	21.3	0.3	40.8	2	0.121	< 0.006	0.009
S98-02832	6586547425	2.2	< 0.04	< 0.01	0.05	2.51	< 0.008	< 0.02	< 0.008	3.73	6.8	< 0.003	2.07	0.09	53.4	0.5	13.6	0.5	0.0266	< 0.006	0.008
S98-02833	6586529287	< 0.5	< 0.04	< 0.01	0.052	4.21	0.009	< 0.02	< 0.008	2.02	3.3	0.006	2.64	0.114	1	< 0.2	9.62	0.8	0.0311	< 0.006	0.037
S98-02834	6912010510	< 0.5	< 0.04	< 0.01	0.027	6.27	< 0.008	< 0.02	< 0.008	0.273	3.3	< 0.003	2.61	0.158	22	< 0.2	8.12	0.8	0.0467	< 0.006	< 0.008
S98-02835	6912021700	2.7	< 0.04	< 0.01	0.067	6.04	< 0.008	< 0.02	< 0.008	15.1	1.2	< 0.003	3.19	0.495	29.3	3.2	24	0.3	0.0615	< 0.006	0.013
S98-02836	6912084847	2.1	< 0.04	< 0.01	0.056	4.96	< 0.008	< 0.02	< 0.008	15	1.5	0.003	2.9	0.647	25.4	1.5	23.2	< 0.2	0.0501	< 0.006	0.029
S98-02837	6912052181	29.9	< 0.04	0.03	0.052	4.12	< 0.008	< 0.02	< 0.008	1.21	1.4	< 0.003	2.99	0.104	100	5.5	12.9	0.4	0.0417	< 0.006	< 0.008
S98-02838	6912042501	23	< 0.04	0.02	0.057	4.57	< 0.008	< 0.02	< 0.008	2	1.4	< 0.003	3.5	0.146	86.8	4.6	15.2	0.4	0.0475	< 0.006	< 0.008
S98-02839	6912073709	10	< 0.04	0.02	0.074	6.98	< 0.008	< 0.02	< 0.008	8.28	1.4	< 0.003	4.29	0.246	42.1	2.3	17	0.5	0.0696	< 0.006	0.056
S98-02840	6919485024	< 0.5	< 0.04	0.11	0.017	1.63	< 0.008	< 0.02	< 0.008	5.11	1	< 0.003	0.61	0.25	53.8	0.7	22	0.3	0.0144	< 0.006	0.014
S98-02841	6919457305	29.3	< 0.04	0.17	0.03	0.91	< 0.008	< 0.02	< 0.008	0.85	1.8	< 0.003	0.52	0.048	106	2.8	6.23	0.5	0.0091	< 0.006	< 0.008
S98-02842	6919447453	50.8	< 0.04	0.07	0.121	17	< 0.008	< 0.02	< 0.008	16.1	3.5	0.003	11.2	0.179	74.7	2.9	21.7	0.5	0.19	< 0.006	0.009
S98-02843	6587465440	74.5	< 0.04	0.02	0.079	10.7	< 0.008	< 0.02	< 0.008	1.4	1.4	< 0.003	9.43	0.068	102	2.4	11.9	0.4	0.101	< 0.006	0.009
S98-02844	6587414310	58.5	< 0.04	0.04	0.115	11.8	< 0.008	< 0.02	< 0.008	2.56	1.3	< 0.003	9.96	0.064	138	3.8	11.2	0.5	0.102	< 0.006	< 0.008
S98-02845	6587494554	23.7	< 0.04	0.02	0.122	11.3	< 0.008	< 0.02	< 0.008	16.2	2.1	< 0.003	7.46	0.267	57.3	1.5	13.7	< 0.2	0.104	< 0.006	0.017
S98-02846	6587487860	27.6	< 0.04	0.04	0.157	15.8	< 0.008	< 0.02	< 0.008	6.25	2.1	< 0.003	14	0.121	71.2	2	14.5	0.2	0.142	< 0.006	0.012
S98-02847	6587480432	11.5	< 0.04	< 0.01	0.073	8.56	< 0.008	< 0.02	< 0.008	6.39	1.2	< 0.003	4.69	0.23	48.5	1.2	19.8	< 0.2	0.0715	< 0.006	0.046
S98-02848	6587436409	3.8	< 0.04	< 0.01	0.116	8.78	< 0.008	< 0.02	< 0.008	16.8	2.9	< 0.003	3.28	0.23	10.8	0.5	15.5	< 0.2	0.0786	< 0.006	0.008
S98-02849	6587421308	4.5	< 0.04	< 0.01	0.061	6.7	< 0.008	< 0.02	< 0.008	5.63	1.6	< 0.003	4.02	0.181	25.2	0.7	16.1	0.4	0.067	< 0.006	0.036
S98-02850	6587429	56.9	< 0.04	0.01	0.044	8.73	< 0.008	< 0.02	< 0.008	4	2.2	< 0.003	4.58	0.441	29.5	0.6	13	0.2	0.0771	< 0.006	0.086
S98-02851	6587421209	1.1	< 0.04	< 0.01	0.063	4.41	< 0.008	< 0.02	< 0.008	0.38	4.3	0.004	1.46	0.035	7.3	< 0.2	9.21	0.3	0.0346	< 0.006	0.03
S98-02852	6588042675	7.3	< 0.04	0.02	0.172	22	< 0.008	< 0.02	< 0.008	22.9	2.5	0.005	10.2	1.48	67.9	1.7	23.2	0.6	0.184	< 0.006	< 0.008
S98-02853	6588052746	25	< 0.04	< 0.01	0.076	8.12	< 0.008	< 0.02	< 0.008	6.96	1.2	< 0.003	5.73	0.361	36.4	1.3	14.1	< 0.2	0.0743	< 0.006	0.011

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02854	RIP0344	25/05/1998	24.622	91.929	1997	STW	46	Aswiri Prasad Kayeri	Sylhet	Maulvibazar	Rajnagar	Uttarbhagh	Uttarbhag t.g.
S98-02855	RIP0345	25/05/1998	24.597	91.903	1991	Tara	52	Golam Sanowar Hossen	Sylhet	Maulvibazar	Rajnagar	Munshibazar	Gayaspur
S98-02856	RIP0346	25/05/1998	24.517	91.897	1996	Tara	59	Md. Helal Mia	Sylhet	Maulvibazar	Rajnagar	Tengra	Ilaspur
S98-02857	RIP0347	25/05/1998	24.482	91.894	1982	STW	57	Tarapasa High School	Sylhet	Maulvibazar	Rajnagar	Kamarchak	Tarapasa
S98-02858	RIP0348	25/05/1998	24.5	91.815	1980	STW	37	High School	Sylhet	Maulvibazar	Rajnagar	Mansurnagar	Kadamlata
S98-02859	RIP0350	26/05/1998	24.705	91.802	1986	STW	62	Bazar Comittee	Sylhet	Sylhet	Balaganj	Osmanpur	Kabulpur
S98-02860	RIP0351	26/05/1998	24.712	91.799	1996	DTW	148	Pirer Bazar Comittee	Sylhet	Sylhet	Balaganj	Osmanpur	Alipur
S98-02861	RIP0352	26/05/1998	24.632	91.688	1996	DTW	137	Md. Afazuddin	Sylhet	Sylhet	Balaganj	Sadipur	Khasrupur
S98-02862	RIP0353	26/05/1998	24.67	91.749	1973	STW	59	Burunza High School	Sylhet	Sylhet	Balaganj	Burunza	Nijburunza
S98-02863	RIP0354	26/05/1998	24.719	91.695	1997	DTW	251	Nesarul Islam	Sylhet	Sylhet	Balaganj	Umarpur	Umarpur
S98-02864	RIP0355	26/05/1998	24.718	91.695	1978	STW	60	Nesarul Islam	Sylhet	Sylhet	Balaganj	Umarpur	Umarpur
S98-02865	RIP0356	26/05/1998	24.75	91.829	1993	STW	65	Bazar Comittee	Sylhet	Sylhet	Balaganj	Dewanbazar	Sirajpur
S98-02866	RIP0357	26/05/1998	24.754	91.786	1994	STW	72	Principal of Madrasa	Sylhet	Sylhet	Balaganj	Dayamir	Dayamir
S98-02867	RIP0359	27/05/1998	24.797	92.12	1997	STW	54	Md. Aziruddin	Sylhet	Sylhet	Beanibazar	Tilpara	Dasura
S98-02868	RIP0360	27/05/1998	24.812	92.181	1997	STW	30	Md. Amiluddin	Sylhet	Sylhet	Beanibazar	Muria	Chotodesh
S98-02869	RIP0362	24/05/1998	24.31	91.741	1986	STW	42	DPHE Office	Sylhet	Maulvibazar	Srimangal	Pourashava	Court road
S98-02870	RIP0363	24/05/1998	24.259	91.737	1987	STW	36	Rada Kantho Tati	Sylhet	Maulvibazar	Srimangal	Kalighat	Kalighat
S98-02871	RIP0364	24/05/1998	24.211	91.696	1993	STW	31	Anil Banarjee	Sylhet	Maulvibazar	Srimangal	Rajghat	Rajghat
S98-02872	RIP0365	24/05/1998	24.271	91.646	1990	STW	48	Rabi Das	Sylhet	Maulvibazar	Srimangal	Satgaon	Gandirchara
S98-02873	RIP0366	24/05/1998	24.4	91.637	1992	STW	29	Madoris Mia	Sylhet	Maulvibazar	Srimangal	Mirjapur	Jatrapasha
S98-02874	RIP0367	24/05/1998	24.3	91.666	1997	STW	59	Satgaon Samity	Sylhet	Maulvibazar	Srimangal	Banabhir	Satgaon station
S98-02875	RIP0368	24/05/1998	24.373	91.751	1982	STW	41	Abdus Sattar	Sylhet	Maulvibazar	Srimangal	Kalapur	Kalapur
S98-02876	RIP0370	25/05/1998	24.69	92.188	1985	PTW	157	Thana Parishad	Sylhet	Maulvibazar	Barlekha	Barlekha	Pakhiala
S98-02877	RIP0371	25/05/1998	24.793	92.241	1986	STW	23	Md. Eleas Ali	Sylhet	Maulvibazar	Barlekha	Uttar Shahabajpu	Nandua
S98-02878	RIP0372	25/05/1998	24.739	92.208	1986	STW	42	Rajat Babu	Sylhet	Maulvibazar	Barlekha	Daskin Shahabajp	Gulsar
S98-02879	RIP0373	25/05/1998	24.749	92.143	1995	STW	59	Brajonath Das	Sylhet	Maulvibazar	Barlekha	Daserbazar	Galua
S98-02880	RIP0374	25/05/1998	24.667	92.192	1994	Tara	83	Mussandar Ali	Sylhet	Maulvibazar	Barlekha	Dakshin bag utta	Rokanpur
S98-02881	RIP0375	25/05/1998	24.655	92.148	1970	STW	61	UP Office	Sylhet	Maulvibazar	Barlekha	Sujanagar	Sujanagar
S98-02882	RIP0376	25/05/1998	24.573	92.167	1994	Tara	47	Serajuddin	Sylhet	Maulvibazar	Barlekha	Purbojuri	Baradamai
S98-02883	RIP0378	26/05/1998	24.697	91.943	1996	STW	72	Thana Hospital	Sylhet	Sylhet	Fenchuganj	Fenchuganj	Fenchuganj
S98-02884	RIP0379	26/05/1998	24.684	91.983	1997	STW	31	Md Zamiruddin Shah	Sylhet	Sylhet	Fenchuganj	Gilachara	Gazipur
S98-02885	RIP0380	26/05/1998	24.656	91.987	1988	STW	64	Mominchara Tea Est	Sylhet	Sylhet	Fenchuganj	Gillachara	Mominchara
S98-02886	RIP0381	26/05/1998	24.665	91.944	1997	Tara	40	Kais Mia	Sylhet	Sylhet	Fenchuganj	Maizgaon	Mollahpara
S98-02887	RIP0382	26/05/1998	24.741	91.926	1978	STW	49	Senor Bazar Jand	Sylhet	Sylhet	Fenchuganj	Fenchuganj	Kotapur
S98-02888	RIP0384	27/05/1998	24.792	92.034	1991	STW	46	Abdul Matin	Sylhet	Sylhet	Golapganj	Dhaka daskhin	Kanishail
S98-02889	RIP0385	27/05/1998	24.754	92.022	1994	STW	33	Khumic Kheaghat	Sylhet	Sylhet	Golapganj	Badeshwar	Khumia
S98-02890	RIP0386	27/05/1998	24.8	91.985	1988	STW	49	Dr. Ismat Ali	Sylhet	Sylhet	Golapganj	Lakhanabond	Lakhanabonad
S98-02891	RIP0387	27/05/1998	24.815	91.971	1994	STW	82	FAZLUR RAHMAN	Sylhet	Sylhet	Golapganj	Lakshmipasha	Lakshmipasha
S98-02892	RIP0388	27/05/1998	24.848	91.936	1992	STW	87	Gopal Chandra Dev	Sylhet	Sylhet	Golapganj	Fulbari	Hilalpur
S98-02893	RIP0389	27/05/1998	24.848	92.023	1985	PTW	180	THANA PARISHAD	Sylhet	Sylhet	Golapganj	Golapganj	Rankheli
S98-02894	RIP0390	27/05/1998	24.848	92.023	1995	STW	29	THANA PARISHAD	Sylhet	Sylhet	Golapganj	Golapganj	Rankheli
S98-02895	RIP0392	28/05/1998	25.044	92.2	1997	STW	71	Saifullah Mia	Sylhet	Sylhet	Kanaighat	Bara chatul	Dungra
S98-02896	RIP0393	28/05/1998	24.908	92.129	1993	STW	45	Shamsul Huq	Sylhet	Sylhet	Kanaighat	Rajaganj	Faljur
S98-02897	RIP0394	28/05/1998	24.912	92.139	1997	STW	45	Kabir Ahmed	Sylhet	Sylhet	Kanaighat	Jhingabari	Harishing mati
S98-02898	RIP0395	28/05/1998	24.99	92.348	1988	STW	62	Dighirpar Purb U/C	Sylhet	Sylhet	Kanaighat	Dighirpar purba	Saraker bazar
S98-02899	RIP0396	28/05/1998	24.995	92.271	1979	STW	52	Baium Pry. School	Sylhet	Sylhet	Kanaighat	Dhigirpar paschi	Bayanpur
S98-02900	RIP0398	30/05/1998	25.108	91.762	1982	STW	11	Tuker Bazer Mosque	Sylhet	Sylhet	Companiganj (S)	Islampur	Taimur nagar
S98-02901	RIP0399	30/05/1998	25.108	91.761	1998	STW	71	Mohammad Dhan Mia	Sylhet	Sylhet	Companiganj (S)	Islampur	Taimur nagar

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02854	6588084987	1.5	< 0.04	< 0.01	0.035	2.5	< 0.008	< 0.02	< 0.008	0.087	3.1	0.009	0.83	0.018	0.9	< 0.2	10.3	0.3	0.0174	< 0.006	0.024
S98-02855	6588042362	0.6	< 0.04	< 0.01	0.025	3.22	< 0.008	< 0.02	< 0.008	0.432	2.1	0.007	1.59	0.037	1.5	< 0.2	12.6	0.5	0.026	< 0.006	0.021
S98-02856	6588073433	< 0.5	< 0.04	< 0.01	0.032	2.29	< 0.008	< 0.02	< 0.008	0.118	2.3	< 0.003	0.8	0.018	1.9	< 0.2	10.3	0.3	0.0211	< 0.006	0.033
S98-02857	6588021945	< 0.5	< 0.04	< 0.01	0.089	8.23	< 0.008	< 0.02	< 0.008	0.512	3.5	< 0.003	3.12	0.596	12.5	< 0.2	12.6	0.9	0.0649	< 0.006	0.011
S98-02858	6588031490	< 0.5	< 0.04	< 0.01	0.056	6.71	< 0.008	< 0.02	< 0.008	0.15	3.6	< 0.003	3.13	0.074	14.6	< 0.2	16.4	< 0.2	0.0641	< 0.006	< 0.008
S98-02859	6910894392	10.1	< 0.04	0.01	0.124	18.8	< 0.008	< 0.02	< 0.008	7.13	1.7	0.004	12.4	0.414	67	2.6	19.7	0.4	0.144	< 0.006	0.012
S98-02860	6910894037	17.1	< 0.04	0.03	0.064	7.39	< 0.008	< 0.02	< 0.008	1.75	1.6	< 0.003	5.78	0.122	71.5	3.5	15.8	< 0.2	0.0751	< 0.006	< 0.008
S98-02861	6910881501	157	< 0.04	0.03	0.097	8.62	< 0.008	< 0.02	< 0.008	2.3	1.2	< 0.003	8.06	0.035	126	4	11.1	0.4	0.0806	< 0.006	< 0.008
S98-02862	6910820685	71.9	< 0.04	0.02	0.158	19.5	< 0.008	< 0.02	< 0.008	33.3	2.5	< 0.003	9.85	1.25	70.5	1.8	24.1	0.6	0.173	< 0.006	0.016
S98-02863	6910861994	29.8	< 0.04	0.03	0.038	2.64	< 0.008	< 0.02	0.017	0.999	1.1	< 0.003	2.36	0.043	98.5	6.1	12.5	0.3	0.0295	< 0.006	0.014
S98-02864	6910861994	19.4	< 0.04	0.01	0.126	15	< 0.008	< 0.02	< 0.008	21.2	1.9	< 0.003	8.1	0.833	58.9	1.7	20.9	< 0.2	0.128	< 0.006	0.037
S98-02865	6910833903	26.8	< 0.04	0.02	0.117	14.7	< 0.008	< 0.02	< 0.008	5.37	1.9	< 0.003	9.79	0.213	69.7	2	19	4.9	0.124	< 0.006	0.009
S98-02866	6910827196	24.1	< 0.04	0.02	0.1	9.38	< 0.008	< 0.02	< 0.008	13.1	1.6	< 0.003	5.12	0.436	63.2	2.4	18	0.3	0.0861	< 0.006	< 0.008
S98-02867	6911794260	1.6	< 0.04	< 0.01	0.035	6.41	< 0.008	< 0.02	< 0.008	9.12	1.5	0.005	3.32	0.419	24.5	0.9	29.2	0.3	0.0545	< 0.006	0.009
S98-02868	6911777240	< 0.5	< 0.04	< 0.01	0.026	1.49	< 0.008	< 0.02	0.009	0.43	2.7	0.004	1.27	0.022	3.5	< 0.2	9.64	0.5	0.0146	< 0.006	0.024
S98-02869	6588302	3.1	< 0.01	< 0.01	0.168	7.24	< 0.003	< 0.002	< 0.008	13	5.1	< 0.003	2.39	0.314	2.76	< 0.1	10.7	< 0.2	0.0512	< 0.002	0.022
S98-02870	6588338470	< 0.5	< 0.01	0.02	0.083	4.75	< 0.003	< 0.002	< 0.008	0.624	3.6	< 0.003	1.45	0.226	3.15	< 0.1	12.8	0.3	0.0335	< 0.002	0.011
S98-02871	6588357750	3.7	< 0.01	0.03	0.17	10.4	< 0.003	< 0.002	< 0.008	10.2	3.3	< 0.003	3.45	0.289	11.1	0.2	24.2	1.2	0.0971	< 0.002	0.01
S98-02872	6588366325	4.2	< 0.01	0.02	0.184	10.9	< 0.003	< 0.002	< 0.008	9.64	3.2	< 0.003	4.36	0.272	11.6	0.1	15.3	< 0.2	0.0891	< 0.002	0.01
S98-02873	6588347443	9.5	< 0.01	0.02	0.163	13.3	< 0.003	< 0.002	0.011	13.5	2.1	< 0.003	5.13	0.359	17.6	0.5	21.3	< 0.2	0.102	< 0.002	0.017
S98-02874	6588319533	21.4	< 0.04	< 0.01	0.136	11	< 0.008	< 0.02	< 0.008	5.79	1.8	< 0.003	5.83	0.232	34.1	1.3	20.7	< 0.2	0.0893	< 0.006	0.013
S98-02875	6588328461	14.6	< 0.01	< 0.1	0.075	7.6	< 0.003	< 0.002	< 0.008	0.161	3.5	< 0.004	2.49	0.017	4.8	< 0.1	12.6	< 0.2	0.0537	< 0.002	0.021
S98-02876	6581407	1.8	< 0.04	< 0.01	0.167	11.2	< 0.008	< 0.02	< 0.008	9.28	2.4	< 0.003	3.79	0.242	13.8	0.2	23.4	0.3	0.146	< 0.006	0.061
S98-02877	6581471659	< 0.5	< 0.04	< 0.01	0.037	1.06	< 0.008	< 0.02	< 0.008	0.386	2	0.003	0.42	0.027	0.7	< 0.2	7.4	0.4	0.0118	< 0.006	0.009
S98-02878	6581479405	1.5	< 0.04	< 0.01	0.18	9.75	< 0.008	< 0.02	< 0.008	14.8	1.8	0.004	3.95	0.544	10.6	0.4	24.9	< 0.2	0.128	< 0.006	0.012
S98-02879	6581439411	< 0.5	< 0.04	< 0.01	0.018	1.83	< 0.008	< 0.02	< 0.008	5.59	1.1	< 0.003	0.83	0.242	33.4	0.5	19.7	< 0.2	0.016	< 0.006	0.01
S98-02880	6581423798	2.5	< 0.04	< 0.01	0.183	10.2	< 0.008	< 0.02	< 0.008	11.6	2.6	0.004	4.11	0.447	8.1	0.4	21.9	< 0.2	0.122	< 0.006	0.025
S98-02881	6581487874	18.4	< 0.04	< 0.01	0.172	12.9	< 0.008	< 0.02	< 0.008	2.53	1.9	< 0.003	9.26	0.1	45.1	0.9	10.3	< 0.2	0.148	< 0.006	0.117
S98-02882	6581447095	1.7	< 0.04	< 0.01	0.167	6.27	< 0.008	< 0.02	< 0.008	11.4	4.3	< 0.003	4.76	0.575	5.5	0.2	8.78	< 0.2	0.0716	< 0.006	0.019
S98-02883	6913523132	< 0.5	< 0.04	< 0.01	0.047	4.83	< 0.008	< 0.02	< 0.008	1.44	2.2	0.003	3.41	1.13	13.2	< 0.2	11.9	< 0.2	0.0417	< 0.006	0.205
S98-02884	6913547364	< 0.5	< 0.04	< 0.01	0.042	0.76	< 0.008	< 0.02	< 0.008	0.225	5.3	< 0.003	1.54	0.032	2	< 0.2	7.49	2.4	0.0146	< 0.006	< 0.008
S98-02885	6913547729	< 0.5	< 0.04	< 0.01	0.052	5.18	< 0.008	< 0.02	< 0.008	12.9	1.6	0.003	2.82	0.403	8.3	0.3	20.2	1	0.0531	< 0.006	0.013
S98-02886	6913571298	< 0.5	< 0.04	< 0.01	0.056	1.11	< 0.008	< 0.02	< 0.008	0.319	2.2	0.003	1.23	0.068	1.4	< 0.2	8.53	0.4	0.0144	< 0.006	0.137
S98-02887	6913523066	12.4	< 0.04	< 0.01	0.08	6.62	< 0.008	< 0.02	< 0.008	10.5	1.7	< 0.003	3.31	0.319	37.1	2.3	18.3	0.5	0.0609	< 0.006	0.009
S98-02888	6913825577	< 0.5	< 0.04	< 0.01	0.029	1.58	< 0.008	< 0.02	0.015	0.441	2.1	0.004	0.84	0.026	0.8	0.2	8.84	0.4	0.0131	< 0.006	0.142
S98-02889	6913817666	< 0.5	< 0.04	< 0.01	0.043	3.21	< 0.008	< 0.02	< 0.008	9.32	1.3	< 0.003	2.1	0.372	22.2	0.7	23.9	< 0.2	0.0413	< 0.006	0.008
S98-02890	6913869706	< 0.5	< 0.04	< 0.01	0.036	2.83	< 0.008	< 0.02	< 0.008	0.561	3.2	< 0.003	1.73	0.034	1.4	< 0.2	8.38	0.2	0.0236	< 0.006	0.012
S98-02891	6913860716	2.7	< 0.04	< 0.01	0.073	4.62	< 0.008	< 0.02	< 0.008	12.6	1.8	< 0.003	2.78	0.391	23.4	2	24.9	< 0.2	0.0599	< 0.006	0.014
S98-02892	6913843497	5.9	< 0.04	< 0.01	0.062	4.48	< 0.008	< 0.02	< 0.008	10.8	1.6	< 0.003	3.29	0.272	25	1.7	22.1	< 0.2	0.0594	< 0.006	< 0.008
S98-02893	6913851875	4.6	< 0.04	0.03	0.011	0.4	< 0.008	< 0.02	< 0.008	0.255	0.7	< 0.003	0.71	0.03	116	4.5	7.47	< 0.2	0.007	< 0.006	0.009
S98-02894	6913851875	4.8	< 0.04	0.04	0.015	0.46	< 0.008	< 0.02	< 0.008	0.2	0.8	< 0.003	1.43	0.015	144	9.2	6.27	< 0.2	0.0071	< 0.006	< 0.008
S98-02895	6915909140	50.1	< 0.04	0.04	0.19	15	< 0.008	< 0.02	< 0.008	39.9	1.3	< 0.003	8.53	0.327	51.2	2.3	22.5	0.5	0.138	< 0.006	0.036
S98-02896	6915985334	5.5	< 0.04	< 0.01	0.074	4.69	< 0.008	< 0.02	< 0.008	15.9	1.6	< 0.003	2.34	0.362	21.3	2.4	22.8	28.1	0.0526	< 0.006	0.045
S98-02897	6915928975	5	< 0.04	0.02	0.088	4.57	< 0.008	< 0.02	< 0.008	25.1	1.8	< 0.003	2.22	0.488	23.9	2.8	19.8	0.6	0.0508	< 0.006	0.012
S98-02898	6915976242	11	< 0.04	0.03	0.009	11.8	< 0.008	< 0.02	< 0.008	0.58	1.4	< 0.003	8.5	< 0.001	49.3	0.7	21.9	0.5	0.0865	< 0.006	< 0.008
S98-02899	6915928099	35.8	< 0.04	0.06	0.21	27	< 0.008	< 0.02	< 0.008	22.7	3.8	0.003	14.2	0.178	46.3	3.6	23.8	0.8	0.261	< 0.006	0.061
S98-02900	6912711923	8.6	0.11	0.02	0.095	22.8	< 0.008	< 0.02	< 0.008	41.7	1	< 0.003	9.9	0.689	7.7	0.5	17.7	< 0.2	0.0723	< 0.006	0.009
S98-02901	6912711923	24.7	0.09	< 0.01	0.12	61.7	< 0.008	< 0.02	< 0.008	6.47	3.6	< 0.003	41	0.14	34.2	4.7	25.8	0.3	0.185	< 0.006	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02902	RIP0400	30/05/1998	25.044	91.804	1993	STW	50	Borni Bus Stand	Sylhet	Sylhet	Companiganj (S)	Ranikheli	Borni
S98-02903	RIP0401	27/05/1998	24.944	92.442	1986	STW	46	MRS ASHRAFNESA	Sylhet	Sylhet	Zakiganj	Manikpur	Sharangadeb
S98-02904	RIP0402	27/05/1998	24.892	92.485	1990	STW	46	Barathakhola UP Offl	Sylhet	Sylhet	Zakiganj	Barathakuri	Uttarbhag
S98-02905	RIP0403	27/05/1998	24.874	92.436	1975	STW	53	GANGAJAL BAZAR	Sylhet	Sylhet	Zakiganj	Sultanpur	Gangajal
S98-02906	RIP0404	27/05/1998	24.94	92.23	1975	STW	48	Mosque Shahgali Bus	Sylhet	Sylhet	Zakiganj	Barahal	Khilgram
S98-02907	RIP0406	28/05/1998	25.134	91.95	1996	STW	65	Abdur Raof	Sylhet	Sylhet	Gowainghat	West jaflong	Thakurbari
S98-02908	RIP0407	28/05/1998	25.043	91.988	1990	STW	66	Munsur Mohshin	Sylhet	Sylhet	Gowainghat	Lengura	Daubari
S98-02909	RIP0408	28/05/1998	24.996	91.992	1995	STW	20	Fatehpur Madrasa Baz	Sylhet	Sylhet	Gowainghat	Fatepur	Fatehpur pancham
S98-02910	RIP0410	30/05/1998	24.926	91.494	1996	DTW	127	Md. Nayan Mia	Sylhet	Sunamganj	Sunamganj Sadar	Purba Pagla	Damudar
S98-02911	RIP0411	30/05/1998	24.887	91.479	1992	DTW	150	Heath Welfare Center	Sylhet	Sunamganj	Sunamganj Sadar	Durgapasha	Durgapasha
S98-02912	RIP0412	30/05/1998	24.916	91.428	1994	DTW	97	Md Ajman Ullah	Sylhet	Sunamganj	Sunamganj Sadar	Paschim Pagla	Paschim pagala
S98-02913	RIP0413	30/05/1998	24.922	91.411	1994	DTW	136	Md Aftab Mia	Sylhet	Sunamganj	Sunamganj Sadar	Jaykalas	Dakin srinathpur
S98-02914	RIP0414	30/05/1998	24.876	91.351	1996	DTW	136	Patheria Bazar Mosqu	Sylhet	Sunamganj	Sunamganj Sadar	Patharia	Patharia
S98-02915	RIP0415	30/05/1998	24.978	91.368	1988	DTW	115	Md Mohram Ali	Sylhet	Sunamganj	Sunamganj Sadar	Mohanpur	Kalayia
S98-02916	RIP0416	30/05/1998	25.093	91.428	1974	DTW	114	Haluargaon Masjid	Sylhet	Sunamganj	Sunamganj Sadar	Rangarchar	U.monmother char
S98-02917	RIP0418	31/05/1998	24.939	91.685	1996	DTW	153	Abdul Bahar	Sylhet	Sunamganj	Chhatak	Saidergaon	Purbachandpur
S98-02918	RIP0419	31/05/1998	24.999	91.664	1993	DTW	177	Md. Altab Ali	Sylhet	Sunamganj	Chhatak	Kalaruka	Madhya madhabpur
S98-02919	RIP0420	31/05/1998	24.927	91.692	1988	DTW	119	Baitul Mamur Jame Ma	Sylhet	Sunamganj	Chhatak	Saila Afzalabad	Kalidaspara
S98-02920	RIP0421	27/05/1998	24.796	92.166	1986	STW	14	Hazi Md. Moktar Ali	Sylhet	Sylhet	Beanibazar	Mollapur	Mollapur
S98-02921	RIP0422	27/05/1998	24.855	92.185	1991	STW	19	High School	Sylhet	Sylhet	Beanibazar	Sheola	Kakardia
S98-02922	RIP0423	27/05/1998	24.88	92.214	1982	STW	51	Union Parisad Office	Sylhet	Sylhet	Beanibazar	Dobhag	Uttarbhag
S98-02923	RIP0424	27/05/1998	24.898	92.14	1980	STW	63	Saiful Islam	Sylhet	Sylhet	Beanibazar	Charkhai	Adinabad
S98-02924	RIP0426	28/05/1998	25.155	92.021	1991	STW	15	Amir Miah H, School	Sylhet	Sylhet	Gowainghat	Purba Jaflong	Challakhal Tritl
S98-02925	RIP0427	28/05/1998	25.156	92.108	1997	STW	13	Md. Kanu Mia	Sylhet	Sylhet	Jaintiapur	Jaintiapur	Lakshmipur prath
S98-02926	RIP0428	28/05/1998	25.092	92.107	1997	STW	18	Master Bazlur Rahman	Sylhet	Sylhet	Gowainghat	Alirgaon	Nayakhal
S98-02927	RIP0429	28/05/1998	25.064	92.116	1988	STW	39	Union Parisad Office	Sylhet	Sylhet	Jaintiapur	Darbosta	Pakri
S98-02928	RIP0430	28/05/1998	25.065	92.151	1994	STW	44	Mostafa Kamal Chowdh	Sylhet	Sylhet	Jaintiapur	Charikhata	Ramprasad paschi
S98-02929	RIP0433	30/05/1998	24.91	91.77	1993	STW	54	Mosque Comittee	Sylhet	Sylhet	Sylhet Sadar	Mogalgaon	Ausa
S98-02930	RIP0434	30/05/1998	24.923	91.876	1996	Tara	60	Mosque Comittee	Sylhet	Sylhet	Sylhet Sadar	Tuker bazar	Laktura tea gard
S98-02931	RIP0435	30/05/1998	24.919	91.961	1994	STW	79	Altafur Rahman	Sylhet	Sylhet	Sylhet Sadar	Khadimpara	Atgaon
S98-02932	RIP0436	30/05/1998	24.89	91.892	1984	Tara	64	Upashahar Colony	Sylhet	Sylhet	Sylhet Sadar	Pourasava	Sonarpara (upsah
S98-02933	RIP0437	30/05/1998	24.87	91.914	1989	STW	62	Kuchai High School	Sylhet	Sylhet	Sylhet Sadar	Kuchai	Kuchai
S98-02934	RIP0438	30/05/1998	24.802	91.915	1996	STW	94	Md Manzurul Hasan	Sylhet	Sylhet	Sylhet Sadar	Moglabazar	Haragouri
S98-02935	RIP0439	30/05/1998	24.814	91.864	1994	STW	52	Golam Rabbani	Sylhet	Sylhet	Sylhet Sadar	Silam	Char mohammadpur
S98-02936	RIP0441	31/05/1998	24.804	91.547	1997	STW	151	Mosque Committe	Sylhet	Sunamganj	Jagannathpur	Kalkalia	Majidpur
S98-02937	RIP0442	31/05/1998	24.767	91.532	1996	STW	143	Sudir Chandra Gosh	Sylhet	Sunamganj	Jagannathpur	Jagannathpur	Jatrapasha
S98-02938	RIP0443	31/05/1998	24.753	91.571	1992	DTW	115	Abdur Razzak	Sylhet	Sunamganj	Jagannathpur	Raniganj	Teargaon
S98-02939	RIP0444	31/05/1998	24.723	91.574	1996	DTW	110	Md. Askir Mia	Sylhet	Sunamganj	Jagannathpur	Pailgaon	Ramapatipur
S98-02940	RIP0445	31/05/1998	24.77	91.555	1986	DTW	139	Nongegeted Quarter	Sylhet	Sunamganj	Jagannathpur	Jagannthpur	Jagannathpur bar
S98-02941	RIP0446	31/05/1998	24.787	91.638	1987	STW	77	Primary School	Sylhet	Sunamganj	Jagannathpur	Mirpur	Mirpur
S98-02942	RIP0447	31/05/1998	24.791	91.664	1991	DTW	98	Primary School	Sylhet	Sunamganj	Jagannathpur	Mirpur	Lahari
S98-02943	RIP0448	31/05/1998	24.926	91.511	1997	DTW	163	Primary School	Sylhet	Sunamganj	Chhatak	Jawarbazar	Dakhin bara kapa
S98-02944	RIP0449	31/05/1998	24.942	91.589	1995	DTW	123	Chechan Primary Scho	Sylhet	Sunamganj	Chhatak	Dakshin Khurma	Chechan
S98-02945	RIP0450	31/05/1998	24.939	91.651	1997	DTW	128	Noagaon Primary Scho	Sylhet	Sunamganj	Chhatak	Uttar Khurma	Ghilachhara
S98-02946	RIP0451	30/05/1998	25.077	91.779	1997	STW	72	KUTUBUDDIN	Sylhet	Sylhet	Companiganj (S)	Telikheli	Telikheli
S98-02947	RIP0452	30/05/1998	24.992	91.853	1970	STW	29	Salutikar Bazar Comm	Sylhet	Sylhet	Gowainghat	Nandirgaon	Salutikar
S98-02948	RIP0453	30/05/1998	25.064	91.87	1994	STW	69	Sirajuddin	Sylhet	Sylhet	Gowainghat	Towakul	Paikraj
S98-02949	RIP0455	31/05/1998	24.092	91.581	1994	STW	51	Assampara Bazar Mosq	Sylhet	Habiganj	Chunarughat	Gazipur	Gazipur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02902	6912747071	24.8	< 0.04	0.04	0.097	18.3	< 0.008	< 0.02	< 0.008	7.44	3	< 0.003	10	0.182	52.4	1.9	20.9	0.2	0.161	< 0.006	< 0.008
S98-02903	6919466907	83.3	< 0.04	0.05	0.113	11.6	< 0.008	< 0.02	< 0.008	15.2	3.3	< 0.003	9.57	0.053	32.9	1.3	18.8	0.8	0.143	< 0.006	0.037
S98-02904	6919419986	< 0.5	< 0.04	< 0.01	0.088	0.86	< 0.008	< 0.02	< 0.008	0.468	2.5	< 0.003	0.45	0.092	20.6	0.3	3.38	0.7	0.0112	< 0.006	0.035
S98-02905	6919476314	35.7	< 0.04	0.03	0.11	7.52	< 0.008	< 0.02	< 0.008	26.3	3.9	0.004	3.85	0.248	19.3	1.4	21.2	0.4	0.0817	< 0.006	0.013
S98-02906	6919409558	3.3	< 0.04	0.01	0.068	10.8	< 0.008	< 0.02	< 0.008	18.7	1.1	< 0.003	5.09	0.544	38.3	1.3	19.6	0.6	0.0811	< 0.006	0.013
S98-02907	6914142925	58	< 0.04	0.05	0.106	21.2	< 0.008	< 0.02	< 0.008	13.1	3.4	< 0.003	12.7	0.209	24.4	2.9	22.8	0.4	0.179	< 0.006	0.016
S98-02908	6914152243	20.2	< 0.04	0.03	0.075	12	< 0.008	< 0.02	< 0.008	26.9	1.8	< 0.003	3.1	0.194	41.3	2	18.1	0.6	0.0634	< 0.006	0.096
S98-02909	6914121295	6.2	< 0.04	< 0.01	0.035	4.02	< 0.008	< 0.02	< 0.008	18.5	2	< 0.003	2.87	0.193	11.6	0.7	17.8	0.2	0.0494	< 0.006	< 0.008
S98-02910	6908922269	60.7	< 0.01	< 0.1	0.032	12.1	< 0.003	< 0.002	< 0.008	3.76	1	< 0.004	5.65	0.417	95.1	2.9	21.8	< 0.2	0.0871	< 0.002	0.008
S98-02911	6908911308	36	< 0.04	0.16	0.039	5.22	< 0.008	< 0.02	< 0.008	0.535	1	< 0.003	2.58	0.045	144	12	10.4	0.2	0.042	< 0.006	< 0.008
S98-02912	6908994140	55.9	< 0.04	0.04	0.05	7.22	< 0.008	< 0.02	< 0.008	1.11	1.2	< 0.003	2.93	0.06	161	6.6	12.2	0.3	0.0556	< 0.006	< 0.008
S98-02913	6908933266	51.7	< 0.04	0.04	0.064	8.14	< 0.008	< 0.02	< 0.008	0.885	1.3	< 0.003	3.68	0.065	147	7.1	11.6	0.4	0.0644	< 0.006	< 0.008
S98-02914	6908961711	44.4	0.05	0.05	0.068	11	< 0.008	< 0.02	< 0.008	2.08	1.4	0.003	5.2	0.169	121	5.4	15.1	0.2	0.0769	< 0.006	< 0.008
S98-02915	6908950493	27.2	< 0.04	0.03	0.067	27.1	< 0.008	< 0.02	< 0.008	1.54	1.8	< 0.003	15.2	0.248	34.6	1.3	20.5	< 0.2	0.139	< 0.006	< 0.008
S98-02916	6908972966	32.8	< 0.04	0.02	0.044	13	< 0.008	< 0.02	< 0.008	9.2	1.3	< 0.003	7.65	0.105	23.5	0.6	18.4	< 0.2	0.108	< 0.006	0.017
S98-02917	6902385756	15.9	< 0.04	0.03	0.054	5.29	< 0.008	< 0.02	< 0.008	2.62	1.4	0.004	3.09	0.142	74.2	5.8	19.4	0.3	0.0566	< 0.006	< 0.008
S98-02918	6902357564	8.2	< 0.04	< 0.01	0.069	7.2	< 0.008	< 0.02	< 0.008	3.77	0.9	< 0.003	6.22	0.423	31.9	1.7	18.4	< 0.2	0.0904	< 0.006	< 0.008
S98-02919	6902390	24.3	< 0.04	0.04	0.063	5.48	< 0.008	< 0.02	< 0.008	2.23	1.3	< 0.003	3.94	0.081	95.5	5.6	15	0.4	0.0532	< 0.006	< 0.008
S98-02920	6911769658	< 0.5	0.04	< 0.01	0.026	0.86	< 0.008	< 0.02	< 0.008	0.084	1	< 0.003	0.45	0.046	3.4	< 0.2	5.02	0.4	0.0103	< 0.006	0.013
S98-02921	6911786473	5.2	< 0.04	< 0.01	0.083	5.37	< 0.008	< 0.02	< 0.008	14.5	2.4	< 0.003	3.38	0.382	11.3	0.3	11.6	0.4	0.0494	< 0.006	< 0.008
S98-02922	6911734994	51.9	< 0.04	0.01	0.084	11.5	< 0.008	< 0.02	< 0.008	8.14	3.1	< 0.003	5.52	0.055	31.9	2.6	7.63	0.4	0.0539	< 0.006	0.009
S98-02923	6911725020	< 0.5	< 0.04	< 0.01	0.025	5.6	< 0.008	< 0.02	< 0.008	12.8	1.3	0.003	2.1	0.494	23.1	2	22.3	4.9	0.0382	< 0.006	0.027
S98-02924	6914131168	< 0.5	< 0.04	< 0.01	0.044	26.6	< 0.008	< 0.02	< 0.008	2.19	1.3	< 0.003	15.7	0.483	15	< 0.2	18.5	13.3	0.104	0.008	0.01
S98-02925	6915300567	14.3	< 0.04	< 0.01	0.022	5.79	< 0.008	< 0.02	< 0.008	3.97	2.5	< 0.003	3.75	0.078	29.7	0.8	3.53	8.9	0.0219	< 0.006	0.181
S98-02926	6914110687	19	< 0.04	0.04	0.096	11.9	< 0.008	< 0.02	< 0.008	61	2	< 0.003	5.4	0.789	11.4	0.8	25.5	17.5	0.102	< 0.006	0.285
S98-02927	6915331769	6.7	< 0.04	< 0.01	0.06	6.66	< 0.008	< 0.02	< 0.008	0.519	2.1	< 0.003	3.29	0.165	45.7	0.7	7.54	0.6	0.082	< 0.006	< 0.008
S98-02928	6915300831	1.5	< 0.04	< 0.01	0.097	3.57	< 0.008	< 0.02	< 0.008	7.91	8	< 0.003	7.06	0.09	4.6	0.6	7.8	0.3	0.0419	< 0.006	0.028
S98-02929	6916255037	9.2	< 0.04	< 0.01	0.056	13.9	< 0.008	< 0.02	< 0.008	6.46	2	< 0.003	7.27	0.326	37.1	1.4	16.9	< 0.2	0.108	< 0.006	0.017
S98-02930	6916290559	< 0.5	< 0.04	< 0.01	0.008	6.93	< 0.008	< 0.02	< 0.008	2.46	1.1	0.003	3.11	0.413	9.1	< 0.2	25.1	3.7	0.0625	< 0.006	0.038
S98-02931	6916240034	7.1	< 0.04	0.01	0.057	4.45	< 0.008	< 0.02	< 0.008	2.46	1.6	< 0.003	8.16	0.26	23.4	1.2	14.1	< 0.2	0.0739	< 0.006	0.045
S98-02932	6916205988	< 0.5	0.08	< 0.01	0.122	4.78	0.019	< 0.02	< 0.008	0.122	9	0.004	2.22	0.5	9.6	< 0.2	6.48	4	0.0289	< 0.006	0.03
S98-02933	6916245549	< 0.5	< 0.04	< 0.01	0.043	3.56	< 0.008	< 0.02	< 0.008	15.7	2	0.004	2.39	0.48	13.4	0.3	20.2	< 0.2	0.0323	< 0.006	< 0.008
S98-02934	6916260366	29.7	< 0.04	0.04	0.106	10.4	< 0.008	< 0.02	< 0.008	6.92	2.2	< 0.003	10.5	0.108	59.3	1.6	15.6	0.2	0.105	< 0.006	< 0.008
S98-02935	6916275217	< 0.5	< 0.04	0.01	0.051	4.21	< 0.008	< 0.02	< 0.008	17.2	1.5	0.004	2.14	0.725	24.3	2.6	25.3	0.3	0.0482	< 0.006	0.009
S98-02936	6904738584	19.4	< 0.04	0.06	0.076	9.1	< 0.008	< 0.02	< 0.008	2.43	1.2	< 0.003	5.73	0.208	64	4.2	16.7	< 0.2	0.0883	< 0.006	< 0.008
S98-02937	6904728451	15.8	< 0.04	0.04	0.082	9.1	< 0.008	< 0.02	< 0.008	5.29	1.4	< 0.003	5.7	0.261	50.3	3	20.6	0.2	0.0986	< 0.006	0.023
S98-02938	6904776968	10.8	< 0.04	0.06	0.082	9.92	< 0.008	< 0.02	< 0.008	6.73	1.5	< 0.003	5.02	0.358	49.9	3.3	21.4	< 0.2	0.0964	< 0.006	0.017
S98-02939	6904757797	1.9	< 0.04	0.02	0.078	9.87	< 0.008	< 0.02	< 0.008	8.77	1.3	0.003	3.98	0.554	29.9	1.1	29.6	< 0.2	0.092	< 0.006	0.012
S98-02940	6904728421	12.5	< 0.04	0.04	0.096	8.89	< 0.008	< 0.02	< 0.008	7.62	1.5	< 0.003	4.45	0.326	49.4	3	20.2	< 0.2	0.0919	< 0.006	< 0.008
S98-02941	6904747634	33.8	< 0.04	0.03	0.08	8.59	< 0.008	< 0.02	< 0.008	1.39	1.2	< 0.003	5.21	0.121	111	6.2	12.4	< 0.2	0.0844	< 0.006	0.056
S98-02942	6904747565	34.7	< 0.04	0.03	0.055	4.16	0.071	< 0.02	< 0.008	1.21	1.3	< 0.003	3.03	0.099	105	6.7	12.9	0.3	0.0423	< 0.006	< 0.008
S98-02943	6902352236	58.7	< 0.04	0.07	0.058	6.51	< 0.008	< 0.02	< 0.008	1.12	1.3	< 0.003	4.73	0.028	116	3.1	9.77	0.3	0.0598	< 0.006	< 0.008
S98-02944	6902366179	37.2	< 0.04	0.05	0.061	9.99	< 0.008	< 0.02	< 0.008	1.89	1	< 0.003	4.93	0.066	99.1	4.1	15.4	0.4	0.0715	< 0.006	< 0.008
S98-02945	6902361301	28.1	< 0.04	0.04	0.046	3.97	< 0.008	< 0.02	< 0.008	1.07	1.1	< 0.003	2.25	0.086	110	9.6	14.5	0.3	0.0404	< 0.006	< 0.008
S98-02946	6912771925	70.3	< 0.01	0.04	0.127	36.9	< 0.003	< 0.002	< 0.008	11.1	3.5	< 0.003	21.4	0.123	34.1	2.3	25.4	0.6	0.233	< 0.002	0.005
S98-02947	6914163876	< 0.5	0.3	0.03	0.078	21.4	0.006	< 0.002	0.02	0.57	36.4	< 0.003	9.98	0.228	58.2	< 0.1	3.77	82.6	0.0618	< 0.002	0.023
S98-02948	6914184719	61.4	< 0.01	0.04	0.114	33.8	< 0.003	< 0.002	< 0.008	12.5	3.9	< 0.003	20.5	0.131	38	1.9	27.4	0.4	0.234	< 0.002	0.009
S98-02949	6362638337	1.3	< 0.01	< 0.01	0.157	10.4	< 0.003	0.002	< 0.008	4.18	2.9	< 0.003	4.25	0.257	8.08	< 0.1	22.3	0.5	0.104	< 0.002	0.014

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02950	RIP0456	31/05/1998	24.15	91.55	1996	STW	45	Molai Mia	Sylhet	Habiganj	Chunarughat	Ahamadabad	Rajarbazar
S98-02951	RIP0457	31/05/1998	24.258	91.536	1977	STW	36	Shatiapur UP	Sylhet	Habiganj	Chunarughat	Shatiajuri	Sundarpur
S98-02952	RIP0458	31/05/1998	24.271	91.476	1995	STW	76	Jasim Uddin	Sylhet	Habiganj	Chunarughat	Ubahata	Kutirgaon
S98-02953	RIP0459	31/05/1998	24.269	91.479	1996	STW	51	Manzurul Huq Masud	Sylhet	Habiganj	Chunarughat	Ubahata	Kutirgaon
S98-02954	RIP0460	31/05/1998	24.193	91.431	1992	STW	41	Forest BEAT Office	Sylhet	Habiganj	Chunarughat	Shankhola	Shaltila
S98-02955	RIP0461	31/05/1998	24.142	91.487	1984	STW	45	Chandri Mazar (T.G.)	Sylhet	Habiganj	Chunarughat	Deorgach	Chandripur t.g.
S98-02956	RIP0463	01/06/1998	24.306	91.3	1992	STW	72	Saju Mia	Sylhet	Habiganj	Lakhai	Bulla	Paschim bulla
S98-02957	RIP0464	01/06/1998	24.286	91.26	1987	STW	59	Haridhan Sutra Dhar	Sylhet	Habiganj	Lakhai	Bamai	Bamai
S98-02958	RIP0465	01/06/1998	24.261	91.254	1985	STW	60	Hafiz Abdur Rahman	Sylhet	Habiganj	Lakhai	Murakuri	Phulbaria
S98-02959	RIP0466	01/06/1998	24.274	91.283	1984	STW	47	Shanu Mia	Sylhet	Habiganj	Lakhai	Muriauk	Dharmapur
S98-02960	RIP0468	02/06/1998	24.298	91.518	1979	STW	50	Mirpur UP	Sylhet	Habiganj	Bahubal	Mirpur	Rupshankar
S98-02961	RIP0469	02/06/1998	24.369	91.572	1996	Tara	55	Manager TG Modhupur	Sylhet	Habiganj	Bahubal	Satkapan	Modhupur tea est
S98-02962	RIP0470	02/06/1998	24.363	91.523	1968	STW	51	Ulia Mosque	Sylhet	Habiganj	Bahubal	Satkapan	Ulua
S98-02963	RIP0472	31/05/1998	24.098	91.289	1983	DTW	98	Thana Parishad	Sylhet	Habiganj	Madhabpur	Madhabpur	Kutania
S98-02964	RIP0473	31/05/1998	24.105	91.273	1983	STW	46	Late Sayed Ali	Sylhet	Habiganj	Madhabpur	Adair	Adair
S98-02965	RIP0474	31/05/1998	24.048	91.359	1993	STW	27	Chawmohani Bazar	Sylhet	Habiganj	Madhabpur	Chawmohani	Alaboxpur
S98-02966	RIP0475	31/05/1998	24.157	91.352	1995	STW	62	Jagadishpur H/Comple	Sylhet	Habiganj	Madhabpur	Jagadishpur	Jagadishpur
S98-02967	RIP0476	31/05/1998	24.2	91.317	1988	STW	44	Chhatain Bazar	Sylhet	Habiganj	Madhabpur	Chhatain	Chhatain
S98-02968	RIP0477	31/05/1998	24.213	91.363	1994	STW	41	Abdul Khaleque	Sylhet	Habiganj	Madhabpur	Bagusura	Sahapur
S98-02969	RIP0479	01/06/1998	24.355	91.447	1993	STW	44	Syed Ahmedul Haque	Sylhet	Habiganj	Habiganj Sadar	Poil	Poil
S98-02970	RIP0480	01/06/1998	24.307	91.432	1994	STW	56	Md. Tazul Islam	Sylhet	Habiganj	Habiganj Sadar	Nizapur	Nizampur
S98-02971	RIP0481	01/06/1998	24.275	91.364	1996	STW	51	Nurpur UP	Sylhet	Habiganj	Habiganj Sadar	Nurpur	Ulahar
S98-02972	RIP0482	01/06/1998	24.303	91.45	1997	STW	35	Md Habibur Rahman	Sylhet	Habiganj	Habiganj Sadar	Shaistagonj	Jagatpur
S98-02973	RIP0483	01/06/1998	24.351	91.369	1997	STW	45	Md.Syakat Ali	Sylhet	Habiganj	Habiganj Sadar	Lukhra	Lukhra
S98-02974	RIP0484	01/06/1998	24.383	91.413	1988	DTW	139	DPHE Div. Office	Sylhet	Habiganj	Habiganj Sadar	Ward-02	Kalibari road
S98-02975	RIP0485	01/06/1998	24.378	91.414	1980	STW	46	DPHE Thana Office	Sylhet	Habiganj	Habiganj Sadar	Ward-03	Master quarter
S98-02976	RIP0487	02/06/1998	24.575	91.513	1983	STW	66	DPHE Thana Office	Sylhet	Habiganj	Nabiganj	Nabiganj	Gandha
S98-02977	RIP0488	02/06/1998	24.628	91.541	1988	STW	54	Motilal DaS	Sylhet	Habiganj	Nabiganj	Kargaon	Madhabpur
S98-02978	RIP0489	02/06/1998	24.612	91.629	1996	STW	49	Jalalpur. Pry, Schoo	Sylhet	Habiganj	Nabiganj	Aushkandi	Jalalpur
S98-02979	RIP0490	02/06/1998	24.572	91.603	1995	STW	38	Rustumpur Mosque	Sylhet	Habiganj	Nabiganj	Debpara	Fatarchar
S98-02980	RIP0491	02/06/1998	24.469	91.574	1996	STW	39	Paniunda Bazar	Sylhet	Habiganj	Nabiganj	Paniunda	Paniunda
S98-02981	RIP0492	02/06/1998	24.542	91.56	1997	STW	50	CHAWDHURY BAZAR	Sylhet	Habiganj	Nabiganj	Bausha	Dhulchatal
S98-02982	RIP0493	18/05/1998	24.489	91.474	1997	STW	64	Imam Bazar Madrasa	Sylhet	Habiganj	Nabiganj	Kaliar banga	Kaliar banga
S98-02983	RIP0495	03/06/1998	24.088	91.098	1996	STW	59	Md. Nur Mia	Chittagong	Brahamanbaria	Sarail	Kalikachha	Kalikachha
S98-02984	RIP0496	03/06/1998	24.072	91.11	1984	STW	43	Twin Quater	Chittagong	Brahamanbaria	Sarail	Sarail	Sarail
S98-02985	RIP0497	03/06/1998	24.064	91.18	1996	STW	61	Baitul Amaz Deeora	Chittagong	Brahamanbaria	Sarail	Sahajadapur	Deora
S98-02986	RIP0498	03/06/1998	24.05	91.176	1997	STW	31	Md. Khorshed Alam	Chittagong	Brahamanbaria	Sarail	Shabazpur	Shabazpur
S98-02987	RIP0499	03/06/1998	24.045	91.067	1986	STW	46	Bogair Bus Stand	Chittagong	Brahamanbaria	Sarail	Dakshin panism	Bogair
S98-02988	RIP0502	04/06/1998	23.708	91.139	1980	STW	26	BDR Camp	Chittagong	Brahamanbaria	Kasba	Kaimpur	Mainpur
S98-02989	RIP0503	04/06/1998	23.748	91.138	1992	STW	35	Thana Health Complex	Chittagong	Brahamanbaria	Kasba	Kasba	Kasba
S98-02990	RIP0504	04/06/1998	23.77	91.071	1992	STW	34	Chhabpur Dakhil Madr	Chittagong	Brahamanbaria	Kasba	Mehari	Chhabpur
S98-02991	RIP0505	04/06/1998	23.746	91.078	1984	STW	35	Mazidul Islam	Chittagong	Brahamanbaria	Kasba	Kuti	Kutijajiara
S98-02992	RIP0506	04/06/1998	23.791	91.175	1989	STW	20	Gopinathpur Pry. Sch	Chittagong	Brahamanbaria	Kasba	Gopinathpur	Gopinathpur
S98-02993	RIP0507	04/06/1998	23.77	91.112	1998	STW	52	Khakon Miah	Chittagong	Brahamanbaria	Kasba	Dakshin badair	Kharara
S98-02994	RIP0508	04/06/1998	23.811	91.125	1985	STW	35	Abdul Karim	Chittagong	Brahamanbaria	Kasba	Utter badair	Badair
S98-02995	RIP0509	05/06/1998	24.039	91.005	1986	STW	33	Failgat ? Mosque	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Uttar Araisidha	Sonarampur
S98-02996	RIP0510	05/06/1998	23.985	90.979	1978	STW	33	Ful Mia	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Pachim Sharifpur	Lalpur
S98-02997	RIP0511	02/06/1998	24.419	91.539	1986	STW	57	Arjat Ali	Sylhet	Habiganj	Bahubal	Shanghat	Shanghat

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02950	6362609066	< 0.5	< 0.04	< 0.01	0.069	8.62	< 0.008	< 0.02	< 0.008	6.05	2	0.005	3.28	0.293	8	< 0.2	22.1	0.2	0.0706	< 0.006	< 0.008
S98-02951	6362685952	34.2	< 0.04	0.02	0.079	6.79	< 0.008	< 0.02	< 0.008	25.4	1.1	< 0.003	3.98	0.88	18.2	1.3	20.8	0.2	0.062	< 0.006	0.01
S98-02952	6362695976	33.3	< 0.04	0.02	0.122	12.1	< 0.008	< 0.02	< 0.008	3.34	1.2	< 0.003	8.06	0.178	46.5	2	16.7	< 0.2	0.119	< 0.006	< 0.008
S98-02953	6362695976	20.3	< 0.04	0.02	0.105	11.1	< 0.008	< 0.02	< 0.008	4.41	1.3	< 0.003	5.72	0.5	41.5	1	15.2	< 0.2	0.0938	< 0.006	0.014
S98-02954	6362676789	< 0.5	< 0.04	< 0.01	0.049	13.7	< 0.008	< 0.02	< 0.008	0.09	1.9	0.004	5.07	0.219	12.8	< 0.2	31.7	3.5	0.11	< 0.006	< 0.008
S98-02955	6362628192	< 0.5	< 0.04	< 0.01	0.026	11.1	< 0.008	< 0.02	< 0.008	7.74	1.6	0.008	4.36	0.406	11.9	< 0.2	33	0.7	0.0953	< 0.006	< 0.008
S98-02956	6366827156	1.6	< 0.04	0.01	0.061	22.2	< 0.008	< 0.02	< 0.008	4.32	1.4	< 0.003	7.86	0.514	21.4	0.6	30.5	< 0.2	0.138	< 0.006	< 0.008
S98-02957	6366813099	39.6	< 0.01	0.03	0.163	21.7	< 0.003	0.003	< 0.008	7.95	1	< 0.003	9.27	0.14	43.6	1.4	24.5	< 0.2	0.152	< 0.002	0.008
S98-02958	6366867718	10.6	< 0.04	0.03	0.166	25	< 0.008	< 0.02	< 0.008	9.53	1.1	< 0.003	9.09	0.206	42.1	1.7	24.5	< 0.2	0.163	< 0.006	< 0.008
S98-02959	6366881227	< 0.5	< 0.04	0.01	0.042	26.5	< 0.008	< 0.02	< 0.008	1.92	1.1	< 0.003	8.91	0.308	32.8	0.2	23.7	< 0.2	0.152	< 0.006	< 0.008
S98-02960	6360547845	19.1	< 0.04	0.01	0.107	12.4	< 0.008	< 0.02	< 0.008	12.5	1.8	< 0.003	4.63	0.397	25.2	0.9	21.5	< 0.2	0.104	< 0.006	< 0.008
S98-02961	6360571849	< 0.5	0.05	< 0.01	0.053	0.86	< 0.008	< 0.02	< 0.008	0.507	1.2	< 0.003	0.38	0.056	0.8	< 0.2	5.88	2.8	0.0117	< 0.006	0.536
S98-02962	6360571727	16	< 0.04	0.02	0.091	13.2	< 0.008	< 0.02	< 0.008	8.64	1.4	< 0.003	4.72	0.481	51.6	1.3	16.1	< 0.2	0.103	< 0.006	0.014
S98-02963	6367177588	< 0.5	< 0.04	< 0.01	0.03	14.2	< 0.008	< 0.02	< 0.008	1.51	3.7	0.009	5.52	0.201	14.4	< 0.2	38.5	2	0.12	< 0.006	0.123
S98-02964	6367108010	11	< 0.04	0.02	0.065	8.3	< 0.008	< 0.02	< 0.008	21.5	1.4	< 0.003	3.28	0.503	9.9	0.6	17.3	< 0.2	0.0743	< 0.006	0.025
S98-02965	6367151027	< 0.5	< 0.04	< 0.01	0.017	20.7	< 0.008	< 0.02	< 0.008	1.05	1.3	0.004	8.69	0.58	17	< 0.2	31.4	0.5	0.131	< 0.006	< 0.008
S98-02966	6367169462	< 0.5	< 0.04	< 0.01	0.017	11.6	< 0.008	< 0.02	< 0.008	5.94	1.5	0.004	3.7	0.566	13	< 0.2	34.7	2.5	0.0976	< 0.006	0.019
S98-02967	6367143236	< 0.5	< 0.04	< 0.01	0.025	15.2	< 0.008	< 0.02	< 0.008	4.02	1.7	0.004	6.43	0.441	16.2	< 0.2	34.4	1.7	0.107	< 0.006	0.01
S98-02968	6367117835	< 0.5	0.04	< 0.01	0.045	7.51	< 0.008	< 0.02	< 0.008	0.29	2.4	< 0.003	1.8	0.023	11.2	< 0.2	26	1.1	0.0601	< 0.006	< 0.008
S98-02969	6364457721	17.3	0.12	0.02	0.076	12.3	< 0.008	< 0.02	< 0.008	3.66	1.4	< 0.003	5.42	0.257	46.1	2	19.5	< 0.2	0.092	< 0.006	0.01
S98-02970	6364438690	8.1	< 0.04	0.02	0.061	10.6	< 0.008	< 0.02	< 0.008	9.15	1.2	< 0.003	4.32	0.52	21.2	0.9	23.4	< 0.2	0.0883	< 0.006	0.01
S98-02971	6364447976	< 0.5	0.08	< 0.01	0.01	13.4	< 0.008	< 0.02	< 0.008	0.174	2	0.007	4.55	0.605	15.2	< 0.2	34.2	4.8	0.125	< 0.006	0.008
S98-02972	6364485479	18.7	0.15	0.02	0.085	9.73	< 0.008	< 0.02	< 0.008	18.1	1.3	< 0.003	3.22	0.468	33.8	1.3	20.9	< 0.2	0.0638	< 0.006	0.026
S98-02973	6364428578	< 0.5	< 0.04	0.02	0.048	19.4	< 0.008	< 0.02	< 0.008	0.914	3.8	0.011	7.98	0.084	40.3	< 0.2	29.3	0.8	0.153	< 0.006	0.037
S98-02974	6364402507	2	< 0.04	0.01	0.104	16.6	< 0.008	< 0.02	< 0.008	2.73	3.2	0.005	7.36	0.156	32.7	0.3	25.2	< 0.2	0.128	< 0.006	0.014
S98-02975	6364403568	1.8	< 0.04	0.01	0.089	16.2	< 0.008	< 0.02	< 0.008	4.26	2.8	0.007	7.22	0.221	23.6	0.6	28.1	< 0.2	0.124	< 0.006	0.01
S98-02976	6367780373	10.7	0.34	0.03	0.149	22.8	< 0.008	< 0.02	< 0.008	23.3	1.5	< 0.003	10.1	0.927	48.8	1.8	28.3	< 0.2	0.174	< 0.006	0.017
S98-02977	6367765619	25.6	0.17	0.01	0.098	10.8	< 0.008	< 0.02	< 0.008	14.2	2.1	0.003	5.28	0.288	58.7	1.5	15.9	< 0.2	0.0909	< 0.006	0.018
S98-02978	6367707486	4.4	0.04	0.02	0.071	10.4	< 0.008	< 0.02	< 0.008	15.9	1.7	0.004	3.86	0.501	56.6	1.1	22.1	< 0.2	0.0859	< 0.006	0.019
S98-02979	6367721334	0.5	< 0.04	0.02	0.075	14.7	< 0.008	< 0.02	< 0.008	1.37	2.6	< 0.003	6.59	0.146	60.4	0.3	20.8	< 0.2	0.159	< 0.006	< 0.008
S98-02980	6367787729	< 0.5	0.04	< 0.01	0.055	6.37	< 0.008	< 0.02	< 0.008	9.26	1.7	0.007	2.81	0.399	17.8	0.3	24.7	< 0.2	0.0598	< 0.006	0.029
S98-02981	6367714307	6.7	< 0.04	0.02	0.083	12.5	< 0.008	< 0.02	< 0.008	13.8	1.7	0.004	6.35	0.58	34.4	1.9	28.2	< 0.2	0.101	< 0.006	0.017
S98-02982	6367758529	12.1	0.18	0.02	0.119	15.4	< 0.008	< 0.02	< 0.008	10.8	1.7	< 0.003	7.9	0.334	38.3	1.7	26.3	< 0.2	0.124	< 0.006	0.018
S98-02983	2129428510	< 0.5	< 0.04	0.01	0.031	13.1	< 0.008	< 0.02	< 0.008	4.1	1.6	0.013	5.35	0.248	35.1	< 0.2	33.6	3.7	0.102	< 0.006	0.016
S98-02984	2129476837	< 0.5	< 0.04	0.02	0.016	9.75	< 0.008	< 0.02	< 0.008	2.82	2.4	0.006	3.66	0.15	47.4	< 0.2	29.9	< 0.2	0.0767	< 0.006	0.01
S98-02985	2129495327	2	< 0.04	0.02	0.017	20.2	< 0.008	< 0.02	< 0.008	0.086	1.8	< 0.003	10.2	2.47	14.2	0.4	23.1	< 0.2	0.139	< 0.006	< 0.008
S98-02986	2129485785	11.9	< 0.04	0.02	0.024	26.5	< 0.008	< 0.02	< 0.008	10.7	2.1	0.003	13.9	0.666	25.8	1	28.7	0.2	0.209	< 0.006	0.018
S98-02987	2129466222	316	0.05	0.16	0.043	33.7	< 0.008	< 0.02	< 0.008	2.41	7.4	0.003	23.9	0.11	81.9	2.8	23.4	0.4	0.239	< 0.006	< 0.008
S98-02988	2126356482	1.7	< 0.04	0.07	0.01	21.1	0.012	< 0.02	< 0.008	0.092	4.2	0.003	21.6	2.12	52.6	< 0.2	17.9	16.9	0.199	< 0.006	< 0.008
S98-02989	2126363532	< 0.5	< 0.04	0.02	0.026	29	< 0.008	< 0.02	< 0.008	0.178	2.4	0.004	9.74	0.824	44	< 0.2	26.3	8.1	0.21	< 0.006	0.027
S98-02990	2126382254	105	< 0.04	0.12	0.012	29.3	< 0.008	< 0.02	< 0.008	2.04	5.4	< 0.003	45.1	0.165	25.2	1.1	18.7	< 0.2	0.298	< 0.006	< 0.008
S98-02991	2126369622	24.7	< 0.04	0.05	0.039	25.7	< 0.008	< 0.02	< 0.008	3.78	29.2	< 0.003	26.6	0.134	11.4	0.8	15.2	< 0.2	0.26	< 0.006	< 0.008
S98-02992	2126350395	0.5	< 0.04	< 0.01	0.027	14.5	< 0.008	< 0.02	< 0.008	0.128	1.8	< 0.003	4.57	0.023	22	< 0.2	27.8	2.5	0.144	< 0.006	< 0.008
S98-02993	2126325562	< 0.5	< 0.04	0.05	0.079	46.1	< 0.008	< 0.02	< 0.008	0.289	4.2	< 0.003	53.1	1.69	27.7	< 0.2	16.1	11.4	0.384	< 0.006	0.042
S98-02994	2126318066	5.6	< 0.04	0.05	0.012	11.8	< 0.008	< 0.02	< 0.008	5.53	3.2	< 0.003	5.56	0.234	50.7	0.8	31.6	< 0.2	0.131	< 0.006	< 0.008
S98-02995	2121303933	382	< 0.04	0.28	0.013	9.45	< 0.008	< 0.02	< 0.008	1.24	7	< 0.003	9.03	0.051	72.4	6	23.9	0.7	0.087	< 0.006	< 0.008
S98-02996	2121367256	42.2	< 0.04	0.02	0.102	56.6	< 0.008	< 0.02	< 0.008	6.5	7.4	< 0.003	15.9	1.71	49.6	1	19.4	29.1	0.23	< 0.006	< 0.008
S98-02997	6360583940	5.8	< 0.04	0.02	0.102	11.2	< 0.008	< 0.02	< 0.008	16.2	2.1	< 0.003	5.46	0.275	19	1.1	25.7	< 0.2	0.0901	< 0.006	0.011

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02998	RIP0512	02/06/1998	24.426	91.609	1997	Tara	58	BFIDC Rubber Est	Sylhet	Habiganj	Bahubal	Putijuri	Rupaichara
S98-02999	RIP0513	02/06/1998	24.285	91.495	1973	STW	47	Hafizpur Primary Sch	Sylhet	Habiganj	Bahubal	Lamatashi	Hafizpur
S98-03000	RIP0515	03/06/1998	24.231	91.245	1992	STW	79	Fandauk Pandit H/S	Chittagong	Brahamanbaria	Nasirnagar	Fandauk	Fandauk
S98-03001	RIP0516	03/06/1998	24.216	91.223	1996	STW	51	Nurul Islam	Chittagong	Brahamanbaria	Nasirnagar	Burishwar	Burishwar
S98-03002	RIP0517	03/06/1998	24.164	91.229	1995	STW	47	Yusuf AlI	Chittagong	Brahamanbaria	Nasirnagar	Purbo Bagh	Uttar purbobagh
S98-03003	RIP0518	03/06/1998	24.139	91.192	1992	STW	46	Gokarna High School	Chittagong	Brahamanbaria	Nasirnagar	Gokarna	Gokarna
S98-03004	RIP0519	03/06/1998	24.154	91.153	1995	STW	50	Kunda High School	Chittagong	Brahamanbaria	Nasirnagar	Kunda	Kunda
S98-03005	RIP0521	04/06/1998	23.895	91.228	1991	Tara	37	Rajapur Mosque	Chittagong	Brahamanbaria	Akhaura	Uttar akhaura	Rajapur
S98-03006	RIP0522	04/06/1998	23.808	91.204	1975	STW	36	Late Ful Mia Bhuya	Chittagong	Brahamanbaria	Akhaura	Maniands	Maniands
S98-03007	RIP0523	04/06/1998	23.84	91.153	1989	STW	74	VS Centre DPHE	Chittagong	Brahamanbaria	Akhaura	Dharkhar	Dharkhar
S98-03008	RIP0524	04/06/1998	23.836	91.198	1983	STW	39	Mohd. Selim Mia	Chittagong	Brahamanbaria	Akhaura	Mogra	Dhanarajpur
S98-03009	RIP0525	04/06/1998	23.838	91.238	1988	STW	34	Mohd. Samshu Mia	Chittagong	Brahamanbaria	Akhaura	Mogra	Rajendrapur
S98-03010	RIP0526	04/06/1998	23.865	91.214	1985	PTW	82	Thana Parishad	Chittagong	Brahamanbaria	Akhaura	Dakishin Akhaura	Radanagar
S98-03011	RIP0527	04/06/1998	23.98	91.111	1988	DTW	190	DPHE XEN Office	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Paurashava w2	Paikpara
S98-03012	RIP0528	05/06/1998	24.04	91.143	1997	STW	51	Zaharlal Sutradhar	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Mojlishpur	Moind
S98-03013	RIP0529	05/06/1998	24.071	91.26	1989	STW	28	Budunthi UP	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Budunthi	Islampur
S98-03014	RIP0530	05/06/1998	23.971	91.264	1996	STW	13	Awolia Bazar Committ	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Paharpur	Alipur
S98-03015	RIP0531	05/06/1998	23.945	91.214	1980	STW	23	Harmuj Shah	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Pattan	Bara jamalpur
S98-03016	RIP0532	05/06/1998	24.024	91.09	1983	STW	43	Safar Uddin	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Purbo talshahar	Telinagar
S98-03017	RIP0533	05/06/1998	23.924	91.117	1995	STW	40	Malia Mia	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Ramrail	Ramrail
S98-03018	RIP0534	05/06/1998	23.866	91.149	1990	STW	43	Ahrand Mosque	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Basudeb	Ahrand
S98-03019	RIP0535	05/06/1998	23.904	91.22	1994	STW	28	Singerbil Bazar Mosq	Chittagong	Brahamanbaria	Brahmanbaria Sadar	Singerbil Dakin	Singerbil
S98-03020	RIP0602	09/06/1998	23.468	90.333	1993	STW	66	Md. Delwar Hossain	Dhaka	Munshiganj	Lohajang	Lohajang	Bara noapara
S98-03021	RIP0603	09/06/1998	23.481	90.367	1993	STW	43	Abul Hossain Member	Dhaka	Munshiganj	Lohajang	Gaodia	Gholtali
S98-03022	RIP0604	09/06/1998	23.468	90.321	1990	STW	46	Brahmangaon High Sch	Dhaka	Munshiganj	Lohajang	Teotia	Brahmangaon
S98-03023	RIP0605	09/06/1998	23.478	90.305	1993	STW	56	Haldia High School	Dhaka	Munshiganj	Lohajang	Haldia	Uttar haldia
S98-03024	RIP0606	09/06/1998	23.473	90.279	1990	STW	46	Emran Talukdar	Dhaka	Munshiganj	Lohajang	Kumarbagh	Dakshin kumarbog
S98-03025	RIP0607	09/06/1998	23.474	90.256	1993	STW	58	Mawa Bus Stand	Dhaka	Munshiganj	Lohajang	Medinimandal	Mawa
S98-03026	RIP0609	10/06/1998	23.544	90.624	1986	STW	27	Abdul Awal Sarkar	Dhaka	Munshiganj	Gazaria	Imampur	Mattiabhanga
S98-03027	RIP0610	10/06/1998	23.56	90.653	1964	STW	23	Karam Ali	Dhaka	Munshiganj	Gazaria	Bhaberchar	Satkahania
S98-03028	RIP0611	10/06/1998	23.54	90.673	1998	STW	24	Abdul Barek Munshi	Dhaka	Munshiganj	Gazaria	Bausia	Purba nayakandi
S98-03029	RIP0612	10/06/1998	23.594	90.63	1997	STW	21	Nazmul Hossain Membe	Dhaka	Munshiganj	Gazaria	Baluakandi	Baluakandi
S98-03030	RIP0613	10/06/1998	23.588	90.6	1997	STW	54	Hossaindi Madrasha	Dhaka	Munshiganj	Gazaria	Hossaindi	Hossaindi
S98-03031	RIP0615	11/06/1998	23.572	90.374	1984	PTW	108	Thana Parishad	Dhaka	Munshiganj	Serajdikhan	Rasunia	Rasunia
S98-03032	RIP0616	11/06/1998	23.543	90.389	1979	STW	52	Kanthaltali Jame Mos	Dhaka	Munshiganj	Serajdikhan	Jainsar	Kanthaltali
S98-03033	RIP0617	11/06/1998	23.556	90.428	1992	STW	77	Abdul Jalil Mia	Dhaka	Munshiganj	Serajdikhan	Malkhanagar	Malkhanagar
S98-03034	RIP0618	11/06/1998	23.571	90.424	1996	STW	50	Bayragadi High Schoo	Dhaka	Munshiganj	Serajdikhan	Bayragadi	Bayragadi
S98-03035	RIP0619	11/06/1998	23.603	90.359	1993	STW	55	Imamganj bazar	Dhaka	Munshiganj	Serajdikhan	Basail	Basail
S98-03036	RIP0620	11/06/1998	23.627	90.312	1993	STW	51	Monju Mondal	Dhaka	Munshiganj	Serajdikhan	Rajanagar	Rajanagar
S98-03037	RIP0621	11/06/1998	23.614	90.335	1994	STW	79	Nimtala Bazar Mosque	Dhaka	Munshiganj	Serajdikhan	Keyan	Sikarpur
S98-03038	RIP0622	11/06/1998	23.688	90.557	1989	STW	44	Keodala Bazar	Dhaka	Narayanganj	Bandar	Madanpur	Keodala
S98-03039	RIP0623	11/06/1998	23.661	90.569	1996	STW	54	Nangolbond Bazar	Dhaka	Narayanganj	Bandar	Mosapur	Nangolbond
S98-03040	RIP0627	09/06/1998	23.545	90.499	1994	STW	53	Mohiuddin Dalal	Dhaka	Munshiganj	Munshiganj Sadar	Rampal	Gobindapur
S98-03041	RIP0628	09/06/1998	23.519	90.505	1988	STW	41	Barja Jogini Mosque	Dhaka	Munshiganj	Munshiganj Sadar	Bajra jigini	Nahapara
S98-03042	RIP0629	09/06/1998	23.524	90.514	1984	STW	56	Md Alam Mollah	Dhaka	Munshiganj	Munshiganj Sadar	Mahakhali	Mahakhali
S98-03043	RIP0630	09/06/1998	23.488	90.511	1996	STW	86	Makuhati High School	Dhaka	Munshiganj	Munshiganj Sadar	Mollakandi	Makuhati
S98-03044	RIP0631	09/06/1998	23.565	90.518	1990	STW	76	Purbo Mokarpur Bazar	Dhaka	Munshiganj	Munshiganj Sadar	Panchasar	Purbo mokarpur
S98-03045	RIP0633	10/06/1998	23.521	90.209	1996	STW	60	Abdur Razzak	Dhaka	Munshiganj	Srinagar	Bhagyakul	Kamargaon

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-02998	6360559838	< 0.5	< 0.04	< 0.01	0.02	12.3	< 0.008	< 0.02	< 0.008	5.32	1.9	0.005	5.13	0.384	12	< 0.2	31.5	24.7	0.0912	< 0.006	0.039
S98-02999	6360535402	38.5	< 0.04	0.02	0.121	10.2	< 0.008	< 0.02	< 0.008	27.3	1.4	< 0.003	4.78	0.59	21.1	1.4	20	< 0.2	0.0865	< 0.006	0.014
S98-03000	2129043427	0.8	< 0.04	0.02	0.03	24.9	< 0.008	< 0.02	< 0.008	0.794	1.8	0.003	10.1	0.648	26.6	0.5	24.5	< 0.2	0.16	< 0.006	< 0.008
S98-03001	2129014258	< 0.5	< 0.04	0.02	0.011	26.7	< 0.008	< 0.02	< 0.008	0.073	0.7	0.004	10.6	0.433	30.8	< 0.2	20.4	< 0.2	0.14	< 0.006	0.025
S98-03002	2129094985	357	0.04	0.07	0.028	43.2	< 0.008	< 0.02	< 0.008	5.55	5.6	< 0.003	33.2	0.224	25.2	1.5	22.7	0.4	0.314	< 0.006	< 0.008
S98-03003	2129058477	< 0.5	< 0.04	0.02	0.034	19	< 0.008	< 0.02	< 0.008	3.4	2.8	< 0.003	7.8	0.273	17.8	0.3	29.3	< 0.2	0.125	< 0.006	0.047
S98-03004	2129080676	0.8	< 0.04	0.02	0.054	15.1	< 0.008	< 0.02	< 0.008	2.31	3.1	0.003	6.11	0.534	27.3	0.3	33.3	0.4	0.104	< 0.006	0.034
S98-03005	2120209845	< 0.5	< 0.04	< 0.01	0.047	7.46	< 0.008	< 0.02	< 0.008	0.073	1.6	< 0.003	2.27	0.032	9.4	< 0.2	22	0.2	0.0848	< 0.006	0.014
S98-03006	2120276736	< 0.5	< 0.04	< 0.01	0.017	14.6	< 0.008	< 0.02	< 0.008	0.153	1.7	0.004	5.5	1.42	17.8	< 0.2	34.6	2.3	0.104	< 0.006	< 0.008
S98-03007	2120257408	110	< 0.04	0.1	0.151	45.6	< 0.008	< 0.02	< 0.008	3.41	8.8	< 0.003	54.2	0.212	55.2	0.8	12.2	0.4	0.525	< 0.006	< 0.008
S98-03008	2120295278	< 0.5	< 0.04	< 0.01	0.01	14.5	< 0.008	< 0.02	< 0.008	0.17	1.3	< 0.003	5.22	0.033	21.3	< 0.2	29.2	3	0.122	< 0.006	< 0.008
S98-03009	2120295872	5.8	< 0.04	< 0.01	0.029	11.8	< 0.008	< 0.02	< 0.008	3.4	1.8	0.004	3.95	0.612	16	< 0.2	30	0.9	0.091	< 0.006	< 0.008
S98-03010	2120219817	< 0.5	< 0.04	< 0.01	0.012	13	0.042	< 0.02	< 0.008	4.22	1.2	0.005	4.6	0.838	14	< 0.2	36.4	5.4	0.0979	< 0.006	0.011
S98-03011	2121301995	< 0.5	< 0.04	0.02	0.03	42.3	< 0.008	< 0.02	< 0.008	< 0.006	3.4	< 0.003	13.1	< 0.001	15.3	< 0.2	24.2	< 0.2	0.34	< 0.006	< 0.008
S98-03012	2121341628	31.5	< 0.04	0.03	0.037	29.6	< 0.008	< 0.02	< 0.008	1.91	2.5	0.003	11.5	0.274	39.6	0.6	19.3	< 0.2	0.205	< 0.006	< 0.008
S98-03013	2121318814	< 0.5	< 0.04	0.01	0.014	20.4	< 0.008	< 0.02	< 0.008	0.733	1.2	0.006	9.3	0.94	17	< 0.2	31	< 0.2	0.135	< 0.006	< 0.008
S98-03014	2121356030	< 0.5	< 0.01	< 0.01	0.048	23.2	< 0.003	< 0.002	< 0.008	0.105	1.3	< 0.003	7.45	0.958	16.5	0.1	35.7	7.6	0.181	< 0.002	0.006
S98-03015	2121352115	< 0.5	< 0.01	0.03	0.051	9.45	< 0.003	0.006	< 0.008	0.2	1.3	< 0.003	3.1	0.057	8.59	< 0.1	27.6	4.7	0.0953	< 0.002	0.01
S98-03016	2121390970	68.4	0.04	0.04	0.039	19.8	< 0.003	< 0.002	< 0.008	1.01	5.1	< 0.003	24.1	0.107	16.7	0.3	12.7	< 0.2	0.195	< 0.002	0.008
S98-03017	2121360852	< 0.5	< 0.01	0.04	0.016	42.2	< 0.003	< 0.002	< 0.008	0.132	1.9	< 0.003	19.5	0.416	23.2	0.2	20.4	< 0.2	0.291	0.002	0.006
S98-03018	2121311051	230	0.02	0.1	0.095	32.8	< 0.003	< 0.002	< 0.008	3.31	5.6	< 0.003	30.9	0.356	41.9	1	14	< 0.2	0.297	< 0.002	0.007
S98-03019	2121382927	< 0.5	< 0.04	< 0.01	0.007	14.5	< 0.008	< 0.02	< 0.008	0.072	0.7	< 0.003	5.36	0.169	15.4	< 0.2	29.8	0.6	0.12	< 0.006	< 0.008
S98-03020	3594479097	87.6	< 0.04	0.12	0.136	53.7	< 0.008	< 0.02	< 0.008	1.87	7.3	0.003	38.6	0.109	143	1.9	18	1	0.357	< 0.006	0.012
S98-03021	3594431373	318	0.08	0.05	0.12	97.4	< 0.008	< 0.02	< 0.008	3.79	6.2	< 0.003	30.3	0.17	22	1.7	21.4	< 0.2	0.388	< 0.006	0.013
S98-03022	3594494177	274	0.07	0.16	0.084	49.3	< 0.008	< 0.02	< 0.008	2.32	6.9	< 0.003	32.5	0.132	261	1.1	13.5	1.8	0.306	< 0.006	0.01
S98-03023	3594439968	111	0.05	0.09	0.12	68.2	< 0.008	< 0.02	< 0.008	4.04	5.6	0.003	43.7	0.122	42.3	0.6	19.8	0.3	0.375	< 0.006	0.752
S98-03024	3594471248	347	< 0.04	0.07	0.18	90.8	< 0.008	< 0.02	0.012	3.21	7.1	< 0.003	34	0.097	22.1	1.6	20.3	< 0.2	0.441	< 0.006	0.034
S98-03025	3594487657	192	< 0.04	0.19	0.175	48.8	< 0.008	< 0.02	< 0.008	3.09	6.3	0.006	26.2	0.088	326	3.6	21.3	0.8	0.237	< 0.006	0.018
S98-03026	3592473604	293	0.05	0.04	0.165	161	< 0.008	< 0.02	< 0.008	11.7	6.2	< 0.003	41	0.782	41.4	1.2	18.2	< 0.2	0.485	< 0.006	0.009
S98-03027	3592431879	188	0.05	0.03	0.049	76.1	< 0.008	< 0.02	0.013	1.13	4.2	< 0.003	16	0.758	15	0.9	18.4	0.8	0.204	< 0.006	0.041
S98-03028	3592421941	47.9	< 0.04	0.03	0.07	82.2	< 0.008	< 0.02	0.013	0.983	4.6	< 0.003	20.4	1.27	12.1	0.3	19.2	3.1	0.241	< 0.006	0.012
S98-03029	3592440295	312	< 0.04	0.03	0.098	127	< 0.008	< 0.02	< 0.008	1.38	4.6	< 0.003	31.8	1.27	19.1	1.9	16.4	< 0.2	0.336	< 0.006	< 0.008
S98-03030	3592465453	224	< 0.04	0.05	0.071	89.1	< 0.008	< 0.02	< 0.008	7.97	4.9	< 0.003	20.7	1.1	13.9	2	21.9	< 0.2	0.336	< 0.006	< 0.008
S98-03031	3597474865	14.3	< 0.04	0.05	0.056	44.8	< 0.008	< 0.02	< 0.008	1.31	2.9	0.012	20.4	0.371	158	0.3	26.7	1.7	0.267	< 0.006	0.1
S98-03032	3597440533	501	0.06	0.04	0.1	78.3	< 0.008	< 0.02	0.01	3.63	5.4	< 0.003	18	0.472	19.8	1.4	15.8	< 0.2	0.282	< 0.006	0.026
S98-03033	3597474687	253	< 0.04	0.08	0.284	76.3	< 0.008	< 0.02	< 0.008	6.94	4	< 0.003	26.8	0.497	69.7	0.4	14	< 0.2	0.382	< 0.006	0.009
S98-03034	3597420105	458	0.04	0.04	0.099	76.4	< 0.008	< 0.02	< 0.008	3.31	4.1	< 0.003	21	0.131	15	1.2	15.6	< 0.2	0.256	< 0.006	0.011
S98-03035	3597413080	218	< 0.04	0.06	0.136	76.3	< 0.008	< 0.02	< 0.008	5.79	4.4	< 0.003	25.1	0.345	114	1	16.4	< 0.2	0.352	< 0.006	0.016
S98-03036	3597481825	187	< 0.04	0.03	0.293	99	< 0.008	< 0.02	< 0.008	11.8	4.5	< 0.003	25.9	0.174	18.1	0.5	22.5	< 0.2	0.408	< 0.006	< 0.008
S98-03037	3597447930	129	< 0.04	0.06	0.215	62.9	< 0.008	< 0.02	< 0.008	2.15	3.8	< 0.003	26.2	0.176	116	0.7	12.2	< 0.2	0.354	< 0.006	< 0.008
S98-03038	3670633512	< 0.5	< 0.04	0.07	0.011	14.5	< 0.008	< 0.02	< 0.008	0.111	1.6	0.007	11	0.576	88.8	< 0.2	22.7	0.3	0.106	< 0.006	0.013
S98-03039	3670679738	1.4	< 0.04	0.04	0.039	55.3	< 0.008	< 0.02	< 0.008	1.86	2.1	0.015	27.4	2.44	185	0.4	19.6	2.8	0.358	< 0.006	0.124
S98-03040	3595685483	4.5	0.13	0.04	0.206	149	0.01	< 0.02	0.008	0.566	3.3	0.02	64.8	2.33	466	0.6	24.3	< 0.2	0.955	< 0.006	0.033
S98-03041	3595619748	56.3	< 0.04	0.16	0.047	32.1	< 0.008	< 0.02	< 0.008	0.147	9.1	0.005	40.7	0.078	148	1.4	22	0.5	0.289	< 0.006	0.011
S98-03042	3595647625	11.7	< 0.04	0.22	0.023	28.8	< 0.008	< 0.02	0.01	0.103	8.6	0.004	30.8	0.178	192	3.2	24.8	0.9	0.246	< 0.006	0.015
S98-03043	3595657644	57.6	0.07	0.05	0.032	47	< 0.008	< 0.02	< 0.008	0.156	1.8	0.007	26.9	1.23	204	0.5	14.3	0.8	0.311	< 0.006	0.022
S98-03044	3595676805	11.7	< 0.04	0.07	0.021	30.2	< 0.008	< 0.02	< 0.008	0.224	11.5	0.003	57.1	0.091	31.6	0.2	29.2	0.3	0.281	< 0.006	0.009
S98-03045	3598427448	143	< 0.04	0.08	0.158	50.9	< 0.008	< 0.02	< 0.008	6.84	7.6	0.005	40.4	0.115	67.1	1.9	25	2.5	0.281	< 0.006	0.052

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03046	RIP0634	10/06/1998	23.519	90.257	1994	STW	70	Mir Sawkat Ali	Dhaka	Munshiganj	Srinagar	Rarikhal	Damla
S98-03047	RIP0635	10/06/1998	23.539	90.289	1995	STW	56	Thana DPHE Office	Dhaka	Munshiganj	Srinagar	Srinagar	Srinagar
S98-03048	RIP0636	10/06/1998	23.516	90.287	1992	STW	39	Moslem Bapary	Dhaka	Munshiganj	Srinagar	Patabhog	Kamarkhola
S98-03049	RIP0637	10/06/1998	23.546	90.337	1992	STW	56	Sinpara Mazar	Dhaka	Munshiganj	Srinagar	Tantar	Sinpara
S98-03050	RIP0638	10/06/1998	23.576	90.307	1994	STW	56	Kentkhali Mosque	Dhaka	Munshiganj	Srinagar	Sholaghar	Kentkhali
S98-03051	RIP0639	10/06/1998	23.596	90.272	1995	STW	60	Alampur Madrasha	Dhaka	Munshiganj	Srinagar	Hasara	Alampur
S98-03052	RIP0641	11/06/1998	23.519	90.443	1995	STW	51	Md Gayes Uddin	Dhaka	Munshiganj	Tongibari	Autshahi	Autshahi
S98-03053	RIP0642	11/06/1998	23.501	90.438	1964	STW	52	Sayed Anwar Hossain	Dhaka	Munshiganj	Tongibari	Arial	Aparkati
S98-03054	RIP0643	11/06/1998	23.505	90.468	1996	STW	51	Nasrin Ahmed	Dhaka	Munshiganj	Tongibari	Sonarang tongiba	Amtali
S98-03055	RIP0644	11/06/1998	23.474	90.456	1976	STW	20	Zamsed Ali	Dhaka	Munshiganj	Tongibari	Panchgaon	Mandra
S98-03056	RIP0645	11/06/1998	23.489	90.469	1994	STW	51	Dhipur Pry School	Dhaka	Munshiganj	Tongibari	Dhipur	Dhipur
S98-03057	RIP0646	11/06/1998	23.429	90.493	1995	STW	26	Abdul Hai Bapary	Dhaka	Munshiganj	Munshiganj Sadar	Char silai	Purborakhi
S98-03058	RIP0647	11/06/1998	23.441	90.491	1996	STW	26	Md Nasir Zomaddar	Dhaka	Munshiganj	Tongibari	Kamarkhara	Besnal
S98-03059	RIP0648	11/06/1998	23.472	90.501	1996	STW	51	Anil RishI	Dhaka	Munshiganj	Tongibari	Jashalong	Chotokewar
S98-03060	RIP0649	11/06/1998	23.542	90.533	1996	DTW	125	Pourashava	Dhaka	Munshiganj	Munshiganj Sadar	Pourashava w-02	Deovogne
S98-03061	RIP0650	11/06/1998	23.542	90.532	1990	STW	85	MD. Shahabuddin Sard	Dhaka	Munshiganj	Munshiganj Sadar	Pourashava w-02	Deovogne
S98-03062	RIP1002	23/03/1998	22.969	89.477	1989	STW	77	Moinul Hoque	Khulna	Khulna	Phultala	Damodarpur	Bhuyapara
S98-03063	RIP1003	23/03/1998	22.984	89.446	1990	STW	49	SK.Abdul Jalil	Khulna	Khulna	Phultala	Phultala	Raripura
S98-03064	RIP1004	23/03/1998	22.989	89.462	1996	STW	54	Robindra Complex	Khulna	Khulna	Phultala	Phultala	Dakshindihi
S98-03065	RIP1005	23/03/1998	22.953	89.434	1997	DTW	340	Roshamoy Das	Khulna	Khulna	Phultala	Jumira	Dopakhola
S98-03066	RIP1006	23/03/1998	22.981	89.456	1982	STW	55	Ishaqe Molla	Khulna	Khulna	Phultala	Damodarpur	Garakhola
S98-03067	RIP1007	23/03/1998	22.944	89.478	1996	STW	54	Shahidul Islam	Khulna	Khulna	Phultala	Atragilatala	Pariardanga
S98-03068	RIP1008	23/03/1998	22.912	89.499	1985	STW	54	Md. Mohsin Miah	Khulna	Khulna	Phultala	Atragilatala	Siromoni (s)
S98-03069	RIP1010	24/03/1998	22.633	89.52	1988	STW	21	PulinChandra Joddar	Khulna	Khulna	Batiaghata	Gangarampur	Baranpara
S98-03070	RIP1011	24/03/1998	22.672	89.53	1997	DTW	331	Delwar Hossain Gazi	Khulna	Khulna	Batiaghata	Gangarampur	Katiangla
S98-03071	RIP1012	24/03/1998	22.756	89.527	1991	DTW	143	Mohananda Biswas	Khulna	Khulna	Batiaghata	Jalma	Chakrakhali
S98-03072	RIP1013	24/03/1998	22.716	89.581	1972	STW	26	Pulin Kunda	Khulna	Khulna	Batiaghata	Amirpur	Joypur
S98-03073	RIP1014	24/03/1998	22.689	89.571	1982	STW	54	Ilias Fakir	Khulna	Khulna	Batiaghata	Bhandarkota	Lakhaikhola
S98-03074	RIP1015	24/03/1998	22.717	89.581	1998	DTW	305	Kalipada Kunda	Khulna	Khulna	Batiaghata	Amirpur	Joypur
S98-03075	RIP1017	24/03/1998	22.567	89.322	1975	STW	51	Dr.Monzoor Ali Gazi	Khulna	Khulna	Paikgachha	Laskar	Laskar
S98-03076	RIP1018	24/03/1998	22.617	89.317	1997	STW	22	Sahadat Ali	Khulna	Khulna	Paikgachha	Raruli	Raruli
S98-03077	RIP1019	25/03/1998	22.624	89.304	1985	STW	50	Begum Bhabi	Khulna	Khulna	Paikgachha	Gadaipur	Gadaipur
S98-03078	RIP1020	25/03/1998	22.659	89.334	1975	STW	45	Bairaghata Bazar	Khulna	Khulna	Paikgachha	Kapilmuni	Bairaghata
S98-03079	RIP1021	25/03/1998	22.71	89.306	1980	STW	41	Gopal Chandra pal	Khulna	Khulna	Paikgachha	Kapilmuni	Kashimnagar
S98-03080	RIP1023	26/03/1998	22.809	89.398	1996	DTW	295	Hotel Royal	Khulna	Khulna	Khulna Metro	Ward 07	Kda avenue
S98-03081	RIP1024	26/03/1998	22.788	89.578	1995	DTW	180	Shafiqul Islam	Khulna	Khulna	Khulna Metro	Ward 04	Momata Monjil
S98-03082	RIP1025	26/03/1998	22.816	89.568	1994	DTW	323	Thana Office	Khulna	Khulna	Khulna Metro	Ward 03	KD Ghosh Road
S98-03083	RIP1026	26/03/1998	22.816	89.567	1997	STW	74	Abu Musha	Khulna	Khulna	Khulna Metro	Ward 03	7PC Roy Road
S98-03084	RIP1027	26/03/1998	22.799	89.538	1989	DTW	323	University	Khulna	Khulna	Khulna Metro	Ward 05	Gollamari
S98-03085	RIP1028	26/03/1998	22.743	89.552	1997	DTW	312	DPHE	Khulna	Khulna	Khulna Metro	Ward 03	Jora gate
S98-03086	RIP1030	27/03/1998	22.826	89.011	1988	Tara	43	Abdul Goffar Biswas	Khulna	Satkhira	Satkhira Sadar	Banshdaha	Kumarbaisha
S98-03087	RIP1032	23/03/1998	22.918	89.601	1998	DTW	271	Poddar Bari Mosque	Khulna	Khulna	Terokhada	Barasat	Katinga
S98-03088	RIP1033	23/03/1998	22.915	89.625	1998	STW	22	S.M. Abdulla	Khulna	Khulna	Terokhada	Barasat	Nikari katinga
S98-03089	RIP1034	23/03/1998	22.9	89.656	1997	STW	21	Panchapatti H.Schoo	Khulna	Khulna	Terokhada	Sagladah	Nebadia
S98-03090	RIP1035	23/03/1998	22.87	89.634	1991	STW	24	Abdul Hamid SK.	Khulna	Khulna	Terokhada	Ajugara	Khairbaria
S98-03091	RIP1036	23/03/1998	22.887	89.6	1995	STW	71	Zahurul Hoque	Khulna	Khulna	Terokhada	Madhupur	Kola
S98-03092	RIP1038	24/03/1998	22.587	89.518	1997	STW	33	T. H. Complex	Khulna	Khulna	Dacope	Chalna	Pankhali
S98-03093	RIP1039	24/03/1998	22.63	89.515	1990	STW	40	Chairman, Bazar Com	Khulna	Khulna	Dacope	Chalna	Pankhali

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03046	3598467253	475	0.05	0.06	0.088	59.6	< 0.008	< 0.02	< 0.008	1.4	1.7	< 0.003	14.2	1.49	70.3	0.4	12.9	0.7	0.647	< 0.006	0.048
S98-03047	3598474916	193	0.04	0.08	0.252	73.8	0.087	< 0.02	< 0.008	4.74	12.5	0.004	68.8	0.199	66.9	1.5	15.5	0.7	0.573	< 0.006	0.016
S98-03048	3598461458	319	< 0.04	0.08	0.169	111	< 0.008	< 0.02	< 0.008	4.83	6.6	0.005	54.2	0.112	57.5	1.8	21.2	0.2	0.57	< 0.006	0.011
S98-03049	3598494887	517	< 0.04	0.04	0.13	103	< 0.008	< 0.02	< 0.008	3.04	5.9	0.004	23.9	0.308	16.5	1.4	17	< 0.2	0.346	< 0.006	0.01
S98-03050	3598481507	130	0.04	0.05	0.172	71.8	< 0.008	< 0.02	< 0.008	12.3	4.5	0.005	33.4	0.138	19.1	1.8	24	1.2	0.262	< 0.006	0.034
S98-03051	3598440009	167	0.05	0.05	0.201	55.2	< 0.008	< 0.02	< 0.008	10.5	4.7	0.006	27.2	0.159	44.8	0.7	22.6	2	0.33	< 0.006	0.019
S98-03052	3599423059	292	0.06	0.05	0.153	90.8	< 0.008	< 0.02	0.008	11.9	6.2	0.003	32.8	0.278	23.9	0.7	20.1	4.6	0.404	< 0.006	0.031
S98-03053	3599415029	216	< 0.04	0.06	0.113	91.8	< 0.008	< 0.02	< 0.008	3.19	5.5	< 0.003	31.2	0.111	56	0.7	15.4	0.3	0.374	< 0.006	0.083
S98-03054	3599494022	226	< 0.04	0.08	0.115	88.8	< 0.008	< 0.02	< 0.008	4.07	5.5	0.003	37.2	0.083	106	0.9	17.4	0.4	0.393	< 0.006	0.011
S98-03055	3599487635	212	< 0.04	0.04	0.127	81.3	< 0.008	< 0.02	< 0.008	14.6	6.2	< 0.003	21.8	0.323	18	0.9	21	1.4	0.349	< 0.006	0.065
S98-03056	3599439374	70.2	< 0.04	0.15	0.086	37.9	< 0.008	< 0.02	< 0.008	1.21	8.1	< 0.003	21.8	0.04	236	1.3	12.1	9.6	0.217	< 0.006	0.011
S98-03057	3595638814	76.1	< 0.04	0.05	0.109	58.4	< 0.008	< 0.02	< 0.008	10.6	5.5	< 0.003	30.7	0.192	23.1	1.2	23.8	12.2	0.314	< 0.006	0.013
S98-03058	3599471149	76.8	< 0.04	0.06	0.025	36.4	< 0.008	< 0.02	< 0.008	2.72	4.3	< 0.003	17.5	0.079	18.4	1.3	26.4	1.4	0.185	< 0.006	0.016
S98-03059	3599463284	108	< 0.04	0.06	0.164	84.7	< 0.008	< 0.02	< 0.008	13.2	6.1	< 0.003	26.7	0.148	90.5	0.9	22.4	2.6	0.368	< 0.006	0.046
S98-03060	3595602256	2.4	< 0.04	0.03	0.092	57.5	< 0.008	< 0.02	< 0.008	0.716	2.7	0.008	24.1	0.198	102	0.3	24.8	5.7	0.357	< 0.006	0.112
S98-03061	3595602256	5.9	< 0.04	0.03	0.125	84.4	< 0.008	< 0.02	< 0.008	0.509	2	0.008	27.5	1.35	160	0.4	19	< 0.2	0.516	< 0.006	< 0.008
S98-03062	4476938331	259	< 0.04	0.05	0.119	144	< 0.008	< 0.02	< 0.008	6.13	3.9	0.008	33	1.1	28.7	< 0.2	20.7	< 0.2	0.551	< 0.006	< 0.008
S98-03063	4476976580	97.3	< 0.04	0.22	0.079	59.2	< 0.008	< 0.02	< 0.008	0.155	1.7	< 0.003	31	1.04	302	1.2	18.4	< 0.2	0.396	< 0.006	0.013
S98-03064	4476976290	< 0.5	< 0.04	0.05	0.076	132	< 0.008	< 0.02	< 0.008	0.031	1	0.009	31.4	0.833	65.4	< 0.2	18.2	< 0.2	0.461	< 0.006	0.012
S98-03065	4476957414	< 0.5	< 0.04	0.06	0.191	136	< 0.008	< 0.02	< 0.008	0.327	5.5	< 0.003	60.3	0.139	153	< 0.2	16.9	< 0.2	0.814	< 0.006	< 0.008
S98-03066	4476938456	< 0.5	0.07	0.17	0.104	154	< 0.008	< 0.02	< 0.008	0.022	1.1	0.025	46.4	0.81	510	0.3	19.3	< 0.2	0.78	< 0.006	< 0.008
S98-03067	4476919621	< 0.5	< 0.04	0.21	0.04	44.1	< 0.008	< 0.02	< 0.008	0.019	0.8	0.008	22.9	0.673	337	< 0.2	18.2	< 0.2	0.233	< 0.006	< 0.008
S98-03068	4476919829	< 0.5	< 0.04	0.16	0.022	37.4	< 0.008	< 0.02	< 0.008	0.024	0.6	0.008	28.1	0.915	235	< 0.2	18.9	< 0.2	0.242	< 0.006	< 0.008
S98-03069	4471254127	< 0.5	< 0.04	0.61	0.038	39.8	< 0.008	< 0.02	< 0.008	1.54	11	0.004	31.7	0.084	861	4	28.9	4.7	0.222	< 0.006	< 0.008
S98-03070	4471259546	< 0.5	< 0.04	0.29	0.163	39.6	< 0.008	< 0.02	< 0.008	0.039	5.8	0.01	30.8	0.033	352	0.3	13	< 0.2	0.397	< 0.006	< 0.008
S98-03071	4471271246	< 0.5	< 0.01	0.2	0.067	44.2	< 0.003	< 0.002	< 0.008	< 0.005	5.8	0.017	42.4	0.015	165	< 0.1	13.9	< 0.2	0.709	< 0.002	0.034
S98-03072	4471211463	538	< 0.01	0.2	0.234	92.2	< 0.003	< 0.002	< 0.008	4.11	9.8	0.012	54.8	0.026	214	1	22.3	0.3	0.596	< 0.002	0.016
S98-03073	4471247912	< 0.5	< 0.04	0.05	0.103	72.5	< 0.008	< 0.02	< 0.008	0.052	0.9	< 0.003	28.5	1.91	208	0.5	16.9	0.5	0.499	< 0.006	< 0.008
S98-03074	4471211463	< 0.5	< 0.04	0.2	0.247	68	< 0.008	< 0.02	< 0.008	0.724	6	0.011	32	0.111	332	0.7	15.9	< 0.2	0.366	< 0.006	0.014
S98-03075	4476461664	68	< 0.04	0.12	0.869	173	< 0.008	< 0.02	< 0.008	5.52	9.7	0.006	69.2	0.107	368	1.6	19.9	< 0.2	0.913	< 0.006	< 0.008
S98-03076	4476483842	8.7	< 0.04	0.08	0.314	173	< 0.008	< 0.02	< 0.008	6.26	8	< 0.003	71.8	0.115	58.7	1.5	22.3	< 0.2	0.981	< 0.006	< 0.008
S98-03077	4476433359	97	< 0.04	0.02	0.192	124	< 0.008	< 0.02	< 0.008	4.28	2.9	< 0.003	33	0.158	18.4	0.9	18.1	< 0.2	0.387	< 0.006	< 0.008
S98-03078	4476450127	3.9	< 0.04	0.22	0.667	114	< 0.008	< 0.02	< 0.008	6.34	12.4	0.006	64.7	0.076	535	2.8	19.7	0.2	0.685	< 0.006	< 0.008
S98-03079	4476450586	88.3	< 0.04	0.02	0.144	112	< 0.008	< 0.02	< 0.008	2.85	7.2	< 0.003	19.5	0.364	8.7	1.2	18.4	< 0.2	0.159	< 0.006	< 0.008
S98-03080	4476307746	0.8	< 0.01	0.18	0.131	40.1	< 0.003	< 0.002	< 0.008	0.132	5.2	0.007	23	0.024	156	0.1	14.8	1.6	0.353	< 0.002	0.006
S98-03081	4476304430	< 0.5	< 0.01	0.19	0.054	25.5	< 0.003	< 0.002	< 0.008	0.149	3.4	0.008	11.5	0.021	155	0.2	14	< 0.2	0.177	< 0.002	0.005
S98-03082	4476303382	< 0.5	< 0.01	0.19	0.178	58.1	< 0.003	< 0.002	< 0.008	0.086	6.4	0.012	26.3	0.031	204	0.2	15.8	< 0.2	0.412	< 0.002	0.004
S98-03083	4476303382	46.8	< 0.01	0.13	0.239	121	< 0.003	< 0.002	< 0.008	3.88	4.2	0.021	58.8	0.295	245	0.9	24.6	< 0.2	0.753	0.002	0.007
S98-03084	4476305386	< 0.5	< 0.01	0.22	0.033	16	< 0.003	< 0.002	< 0.008	0.137	3.1	0.004	6.94	0.098	174	0.2	11.4	< 0.2	0.0921	< 0.002	0.005
S98-03085	4476303373	< 0.5	< 0.04	0.21	0.118	33.8	< 0.008	< 0.02	< 0.008	0.111	4.9	0.006	18.1	0.023	188	0.3	13.2	< 0.2	0.268	< 0.006	< 0.008
S98-03086	4878233447	501	< 0.04	0.11	0.466	129	< 0.008	< 0.02	< 0.008	3.79	6.9	0.004	37.6	0.044	61.6	0.7	16.2	< 0.2	0.683	< 0.006	0.016
S98-03087	4479427513	2.9	< 0.04	0.1	0.801	280	< 0.008	< 0.02	< 0.008	1.91	9.8	0.014	109	0.157	283	< 0.2	16.7	18.5	1.17	< 0.006	0.017
S98-03088	4479427802	18.6	< 0.04	0.06	0.506	255	< 0.008	< 0.02	< 0.008	8.36	6.8	0.003	73.2	0.165	95.1	2	23.3	43.6	0.846	< 0.006	< 0.008
S98-03089	4479467770	36.8	< 0.04	0.05	0.336	188	< 0.008	< 0.02	< 0.008	17.4	3	0.004	26.8	0.132	55	1.2	22.4	< 0.2	0.417	< 0.006	< 0.008
S98-03090	4479413545	109	< 0.04	0.07	0.136	79.6	< 0.008	< 0.02	< 0.008	2.84	4.7	0.004	28.9	0.034	66.9	1.9	19	< 0.2	0.33	< 0.006	< 0.008
S98-03091	4479440609	< 0.5	< 0.04	0.15	0.04	40.4	< 0.008	< 0.02	< 0.008	0.136	0.8	0.004	18.6	0.577	250	0.3	17.3	< 0.2	0.243	0.007	< 0.008
S98-03092	4471731835	15.8	0.07	0.71	0.522	125	< 0.008	< 0.02	< 0.008	3.41	28.3	0.008	159	0.09	1420	2.9	19.3	0.2	1.13	< 0.006	< 0.008
S98-03093	4471731835	< 0.5	< 0.04	0.8	0.182	41.4	< 0.008	< 0.02	< 0.008	3.85	18.7	0.007	46.5	0.266	872	9.5	30.3	2	0.281	< 0.006	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03094	RIP1041	25/03/1998	22.8	89.643	1979	STW	30	SK. Abdur Razaque	Khulna	Khulna	Rupsa	T.S. Bahirdia	Taltala
S98-03095	RIP1042	25/03/1998	22.812	89.645	1995	STW	69	Arun Kumar	Khulna	Khulna	Rupsa	Ghatbhogh	Pithabhog
S98-03096	RIP1043	25/03/1998	22.813	89.644	1998	DTW	295	Jatin Chandra Pal	Khulna	Khulna	Rupsa	Ghatbhogh	Pithabogh
S98-03097	RIP1044	25/03/1998	22.797	89.589	1995	DTW	308	Moulana Abdul Kuddus	Khulna	Khulna	Rupsa	Naihati	Baghmara
S98-03098	RIP1045	25/03/1998	22.797	89.589	1979	STW	75	Late Motiar Rahman	Khulna	Khulna	Rupsa	Naihati	Baghmara
S98-03099	RIP1046	25/03/1998	22.84	89.559	1988	STW	54	Kabir Hossain	Khulna	Khulna	Rupsa	Aijganti	Jugihati
S98-03100	RIP1047	25/03/1998	22.826	89.575	1992	STW	62	B.B. College	Khulna	Khulna	Rupsa	Aijganti	Aijghanti
S98-03101	RIP1048	25/03/1998	22.84	89.584	1998	DTW	322	Sanjit Kumar	Khulna	Khulna	Rupsa	Sreefaltala	Joar
S98-03102	RIP1049	25/03/1998	22.83	89.606	1997	STW	67	Amir Ali	Khulna	Khulna	Rupsa	Sreefaltala	Hossainpur
S98-03103	RIP1051	26/03/1998	22.865	89.545	1990	STW	92	Crescent Jute Mills	Khulna	Khulna	Khulna Metro	Ward-12	Khalispur
S98-03104	RIP1052	26/03/1998	22.862	89.525	1995	DTW	344		Khulna	Khulna	Khulna Metro	Ward-13	Pabla
S98-03105	RIP1053	26/03/1998	22.862	89.525	1993	STW	65	Al-Abadin Mosque	Khulna	Khulna	Khulna Metro	Ward-13	Pabla
S98-03106	RIP1054	26/03/1998	22.864	89.532	1986	STW	91	Md. Quamruzzaman	Khulna	Khulna	Khulna Metro	Ward-07	Kashipur
S98-03107	RIP1055	26/03/1998	22.831	89.543	1986	DTW	308	PWD 1	Khulna	Khulna	Khulna Metro	Ward-09	Bara boyra
S98-03108	RIP1056	26/03/1998	22.811	89.555	1997	DTW	310	Seikh Arif Hossain	Khulna	Khulna	Khulna Metro	Ward 06	Bakshipara
S98-03109	RIP1057	26/03/1998	22.837	89.531	1995	STW	74	Barapara Temple	Khulna	Khulna	Khulna Metro	Ward 09	Bara boyra
S98-03110	RIP1058	27/03/1998	22.628	89.122	1997	STW	12	Hafizur Rahman	Khulna	Satkhira	Satkhira Sadar	Fingri	Gobordasi
S98-03111	RIP1059	27/03/1998	22.685	89.122	1998	DTW	223	Md. Nurul Islam	Khulna	Satkhira	Satkhira Sadar	Dhulihar	Dhulihar
S98-03112	RIP1060	27/03/1998	22.711	89.107	1996	STW	23	Shar Ali	Khulna	Satkhira	Satkhira Sadar	Dhulihar	Dhulihar
S98-03113	RIP1062	23/03/1998	22.887	89.535	1984	STW	55	Jafar Imam Mosque	Khulna	Khulna	Dighalia	Dighalia	Dighalia
S98-03114	RIP1063	23/03/1998	22.862	89.556	1995	STW	56	Gobinda Chandra Sil	Khulna	Khulna	Dighalia	Senhati	Chandani mohal
S98-03115	RIP1064	23/03/1998	22.918	89.569	1996	STW	53	Mukanda Sarkar	Khulna	Khulna	Dighalia	Barakpur	Kamargati
S98-03116	RIP1065	23/03/1998	22.959	89.556	1982	STW	59	Soraj Kumar Biswas	Khulna	Khulna	Dighalia	Barakpur	Arua
S98-03117	RIP1067	23/03/1998	22.896	89.508	1979	STW	61	Alhaj Bodaruddin	Khulna	Khulna	Dighalia	Deana	Jugipole
S98-03118	RIP1069	23/03/1998	22.819	89.421	1990	DTW	279	Nitai Chaki Temple	Khulna	Khulna	Dumuria	Dumuria	Arzu Dumuria
S98-03119	RIP1070	23/03/1998	22.753	89.419	1995	STW	44	Narayan Chandra Bisw	Khulna	Khulna	Dumuria	Sahas	Sahas
S98-03120	RIP1071	24/03/1998	22.698	89.434	1980	STW	43	Gora Chandra Kunda	Khulna	Khulna	Dumuria	Sarappur	Bhuttbaria
S98-03121	RIP1072	24/03/1998	22.825	89.274	1995	STW	53	Abdus Salam	Khulna	Khulna	Dumuria	Maguraghona	Batagram
S98-03122	RIP1073	24/03/1998	22.823	89.331	1990	STW	20	Nurul Amin Biswas	Khulna	Khulna	Dumuria	Atlia	Kulbaria
S98-03123	RIP1074	24/03/1998	22.856	89.359	1997	DTW	184	Md.Shahidulla	Khulna	Khulna	Dumuria	Rudaghara	Chaira
S98-03124	RIP1075	24/03/1998	22.861	89.422	1997	STW	54	Ansar Ali	Khulna	Khulna	Dumuria	Raghunathpur	Thakura
S98-03125	RIP1077	25/03/1998	22.778	89.706	1998	DTW	276	M.K.Zaman	Khulna	Bagerhat	Fakirhat	Bahirdia mansa	Attaka
S98-03126	RIP1078	25/03/1998	22.672	89.618	1980	STW	16	Sunil Kumar Bishwas	Khulna	Bagerhat	Fakirhat	Subhadia	Tekatia
S98-03127	RIP1079	25/03/1998	22.709	89.635	1989	STW	23	Shapan Das	Khulna	Bagerhat	Fakirhat	Betaga	Srikrishnapur
S98-03128	RIP1080	25/03/1998	22.739	89.652	1981	STW	31	Bishwanath Chakrabar	Khulna	Bagerhat	Fakirhat	Piljanga	Piljanga
S98-03129	RIP1081	25/03/1998	22.751	89.714	1978	STW	16	Mustahid Suza	Khulna	Bagerhat	Fakirhat	Fakirhat	Satsikka
S98-03130	RIP1082	25/03/1998	22.78	89.726	1990	STW	36	Tahidul Islam Paplu	Khulna	Bagerhat	Fakirhat	Mulghar	Mulghar
S98-03131	RIP1083	26/03/1998	22.883	89.518	1990	STW	39	Munnujan Sufian	Khulna	Khulna	Khulna Metro	Ward 14	Rail gate
S98-03132	RIP1084	26/03/1998	22.889	89.506	1996	STW	69	Md.Habibur Rahman	Khulna	Khulna	Khulna Metro	Ward 14	Banikpara
S98-03133	RIP1085	26/03/1998	22.862	89.542	1997	STW	54	Abul Kashem	Khulna	Khulna	Khulna Metro	Ward-12	People Jute Mill
S98-03134	RIP1086	26/03/1998	22.866	89.541	1952	DTW	246		Khulna	Khulna	Khulna Metro	Ward 12	People Jute Mill
S98-03135	RIP1087	26/03/1998	22.855	89.542	1996	STW	39	Sahanara Momin	Khulna	Khulna	Khulna Metro	Ward 11	Khalispur H.S.
S98-03136	RIP1088	26/03/1998	22.865	89.525	1996	STW	49	Insan Ali Gazi	Khulna	Khulna	Khulna Metro	Ward 13	Uttar Pabla
S98-03137	RIP1090	27/03/1998	22.483	89.011	1985	STW	20	Sk. Sadek	Khulna	Satkhira	Kaliganj (S)	Bhara Simla	Bharasimla
S98-03138	RIP1091	27/03/1998	22.455	89.028	1990	STW	11	A K M S.Zaman	Khulna	Satkhira	Kaliganj (S)	Mathureshpur	Shitalpur
S98-03139	RIP1092	27/03/1998	22.392	89.015	1994	STW	24	Ruhul Amin	Khulna	Satkhira	Kaliganj (S)	Dhalbaria	Gandulia
S98-03140	RIP1093	27/03/1998	22.393	88.998	1994	DTW	236	Abdul Mannan	Khulna	Satkhira	Kaliganj (S)	Dhalbaria	Bahadurpur
S98-03141	RIP1094	27/03/1998	22.376	89.031	1997	STW	15	Hemangshu	Khulna	Satkhira	Kaliganj (S)	Ratanpur	Goalpara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03094	4477581949	39.5	< 0.04	0.03	0.067	61	< 0.008	< 0.02	< 0.008	0.407	4	< 0.003	12	0.35	4.9	0.3	14.2	1.4	0.105	< 0.006	< 0.008
S98-03095	4477527811	55.9	< 0.04	0.21	0.146	28	< 0.008	< 0.02	< 0.008	1.22	7.6	0.005	22	0.035	249	2.6	20.6	< 0.2	0.173	< 0.006	< 0.008
S98-03096	4477527811	1	0.25	0.39	0.988	225	< 0.008	< 0.02	< 0.008	1.8	13.2	0.03	127	0.05	1090	0.5	15.8	< 0.2	1.36	< 0.006	0.028
S98-03097	4477554091	< 0.5	< 0.04	0.14	0.382	134	< 0.008	< 0.02	< 0.008	0.194	9	0.009	81.9	0.058	245	0.5	14.7	< 0.2	1.2	< 0.006	< 0.008
S98-03098	4477554091	87.4	< 0.04	0.25	0.483	78.2	< 0.008	< 0.02	< 0.008	5.5	14.8	0.008	70	0.133	310	3.6	30.6	< 0.2	0.53	< 0.006	< 0.008
S98-03099	4477513535	< 0.5	< 0.04	0.13	0.125	122	< 0.008	< 0.02	< 0.008	0.064	1.2	0.015	58.7	1.2	527	0.4	18.1	2.3	0.668	0.006	< 0.008
S98-03100	4477513015	137	< 0.04	0.09	0.279	117	< 0.008	< 0.02	< 0.008	3.6	5.7	0.003	32	0.415	82.2	0.7	19.3	< 0.2	0.463	< 0.006	< 0.008
S98-03101	4477567505	3.8	0.09	0.15	0.298	103	< 0.008	< 0.02	< 0.008	0.623	6.3	0.01	42.4	0.062	196	< 0.2	17.7	8.2	0.497	< 0.006	< 0.008
S98-03102	4477567474	18.7	< 0.04	0.2	0.317	119	< 0.008	< 0.02	< 0.008	4.7	9.9	0.009	71.6	0.411	334	2.1	31.4	< 0.2	0.66	< 0.006	0.016
S98-03103	4476312493	< 0.5	< 0.04	0.06	0.064	151	< 0.008	< 0.02	< 0.008	0.032	2.4	0.023	77.9	2.12	80.1	< 0.2	20.2	22.8	0.654	< 0.006	< 0.008
S98-03104	4476313829	0.9	< 0.04	0.22	0.268	105	< 0.008	< 0.02	< 0.008	0.1	6.9	0.008	70.8	0.07	379	< 0.2	11.3	< 0.2	1.07	< 0.006	< 0.008
S98-03105	4476313829	< 0.5	< 0.04	0.13	0.07	91.5	< 0.008	< 0.02	< 0.008	0.028	1.1	0.019	42.5	1.34	269	0.3	20	< 0.2	0.569	< 0.006	< 0.008
S98-03106	4476307000	< 0.5	< 0.04	0.07	0.068	65.2	< 0.008	< 0.02	< 0.008	0.054	1	0.011	29.5	1.18	302	0.4	20.7	0.6	0.368	< 0.006	< 0.008
S98-03107	4476309943	1.7	< 0.04	0.2	0.177	49.6	< 0.008	< 0.02	< 0.008	0.012	6.2	0.006	30.9	0.057	201	0.2	13.3	< 0.2	0.446	< 0.006	0.076
S98-03108	4476306047	0.5	< 0.04	0.17	0.113	38.4	< 0.008	< 0.02	< 0.008	0.019	5.3	0.006	23.2	0.027	141	< 0.2	14.1	< 0.2	0.369	< 0.006	< 0.008
S98-03109	4476309943	< 0.5	< 0.04	0.31	0.061	23.5	< 0.008	< 0.02	< 0.008	0.136	5.2	0.005	14.9	0.024	237	< 0.2	12.2	< 0.2	0.245	< 0.006	< 0.008
S98-03110	4878251377	40.1	< 0.04	0.04	0.224	120	< 0.008	< 0.02	< 0.008	5.09	3.2	< 0.003	33	0.076	27.7	0.5	20.9	2.2	0.354	< 0.006	0.011
S98-03111	4878254319	108	< 0.04	0.13	0.134	173	< 0.008	< 0.02	< 0.008	2.68	7.8	0.012	61.6	0.045	319	0.4	20.4	< 0.2	1.01	< 0.006	0.012
S98-03112	4878254319	72.9	< 0.04	0.09	0.292	131	< 0.008	< 0.02	< 0.008	6.62	4.6	< 0.003	30.8	0.084	195	1.5	18.4	23.3	0.47	< 0.006	< 0.008
S98-03113	4474040379	168	< 0.04	0.05	0.03	75.4	< 0.008	< 0.02	< 0.008	3.48	2.6	0.005	27.3	0.108	36.8	1.2	19.4	< 0.2	0.332	< 0.006	< 0.008
S98-03114	4474085236	< 0.5	< 0.04	0.16	0.054	89.2	< 0.008	< 0.02	< 0.008	0.039	2.6	0.022	36.9	2.47	230	< 0.2	18.6	0.9	0.575	< 0.006	< 0.008
S98-03115	4474017544	0.9	< 0.04	0.15	0.158	142	< 0.008	< 0.02	< 0.008	0.115	3.2	0.005	74	0.876	432	0.4	17.8	19.4	0.932	< 0.006	< 0.008
S98-03116	4474017094	< 0.5	0.05	0.07	0.097	76.9	< 0.008	< 0.02	< 0.008	0.099	1	0.003	31.3	1.78	305	0.4	17.4	14.5	0.501	< 0.006	< 0.008
S98-03117	4474047437	39.4	< 0.04	0.14	0.159	95	< 0.008	< 0.02	< 0.008	2.91	2	0.014	47.3	0.087	514	1.1	21.6	< 0.2	0.659	< 0.006	< 0.008
S98-03118	4473039834	2.8	< 0.04	0.08	0.096	45.1	< 0.008	< 0.02	< 0.008	0.403	3.4	0.007	18.9	0.125	63.7	< 0.2	21.4	< 0.2	0.216	< 0.006	< 0.008
S98-03119	4473081881	33.8	< 0.04	0.13	0.654	242	< 0.008	< 0.02	< 0.008	5.8	7.7	0.005	59.4	0.112	518	0.9	18.2	70.1	0.761	< 0.006	0.01
S98-03120	4473088206	36.2	< 0.04	0.34	0.222	90.4	< 0.008	< 0.02	< 0.008	2.79	18.1	0.005	68	0.062	300	2.6	27.5	0.6	0.576	< 0.006	< 0.008
S98-03121	4473054162	65.7	< 0.04	0.03	0.237	82.8	< 0.008	< 0.02	< 0.008	3.63	3.4	0.003	31.6	0.086	15.5	1.4	19.3	< 0.2	0.386	< 0.006	< 0.008
S98-03122	4473006635	39.6	< 0.04	0.04	0.151	107	< 0.008	< 0.02	< 0.008	5.9	4.3	< 0.003	28.4	0.108	16.2	1	20.7	< 0.2	0.343	< 0.006	< 0.008
S98-03123	4473074216	0.9	< 0.04	0.07	0.074	61.1	< 0.008	< 0.02	< 0.008	0.182	3.2	0.004	25.7	0.1	51.6	< 0.2	16.6	< 0.2	0.422	< 0.006	0.241
S98-03124	4473061965	1.1	< 0.04	0.04	0.119	57	< 0.008	< 0.02	< 0.008	0.39	1	< 0.003	26.7	1.97	266	0.5	16.8	1	0.34	< 0.006	< 0.008
S98-03125	4013410014	0.8	< 0.04	0.24	0.397	93.6	< 0.008	< 0.02	< 0.008	0.725	11.1	0.022	76.8	0.137	437	0.6	14.6	0.2	0.96	< 0.006	< 0.008
S98-03126	4013484980	127	< 0.04	0.04	0.098	104	< 0.008	< 0.02	< 0.008	0.452	3.1	< 0.003	22.4	0.401	15.5	0.4	15.7	< 0.2	0.287	< 0.006	0.013
S98-03127	4013421920	15	< 0.04	0.04	0.149	79	< 0.008	< 0.02	< 0.008	8.9	8.5	< 0.003	15.9	0.324	16.2	1.2	10.6	< 0.2	0.151	< 0.006	0.011
S98-03128	4013473772	453	< 0.04	0.04	0.222	122	< 0.008	< 0.02	< 0.008	8.93	5.3	< 0.003	30.5	0.126	28.4	1.2	16.5	< 0.2	0.454	< 0.006	< 0.008
S98-03129	4013431876	571	< 0.04	0.04	0.195	131	< 0.008	< 0.02	< 0.008	5.32	5.5	< 0.003	30	0.33	17.2	1.2	15.1	< 0.2	0.442	< 0.006	< 0.008
S98-03130	4013452683	355	< 0.04	0.07	0.208	113	< 0.008	< 0.02	< 0.008	4.01	7.6	0.004	36.8	0.061	83.1	2.9	21.9	< 0.2	0.46	< 0.006	< 0.008
S98-03131	4476314666	< 0.5	< 0.04	0.19	0.043	19.2	< 0.008	< 0.02	< 0.008	0.028	0.6	< 0.003	9.96	0.406	308	0.6	16.3	< 0.2	0.136	< 0.006	< 0.008
S98-03132	4476314055	3	< 0.04	0.21	0.023	52.4	< 0.008	< 0.02	< 0.008	0.069	1.1	0.016	49.3	0.836	358	0.4	19	0.9	0.328	< 0.006	< 0.008
S98-03133	4476312605	1.7	< 0.04	0.06	0.069	55.3	< 0.008	< 0.02	< 0.008	0.334	0.9	0.004	22.4	1.65	251	0.4	18.2	0.6	0.307	< 0.006	< 0.008
S98-03134	4476312605	< 0.5	< 0.04	0.2	0.164	67.2	< 0.008	< 0.02	< 0.008	0.309	4.7	0.008	30.2	0.129	206	< 0.2	14.7	< 0.2	0.434	< 0.006	0.043
S98-03135	4476311250	39	< 0.04	0.13	0.127	104	< 0.008	< 0.02	< 0.008	1.39	2	0.018	50	1.66	270	0.6	18.9	1	0.566	< 0.006	< 0.008
S98-03136	4476313829	62.8	< 0.04	0.15	0.136	53.2	< 0.008	< 0.02	< 0.008	3.2	1.8	0.005	35.6	0.223	392	1.1	15.9	< 0.2	0.394	< 0.006	0.01
S98-03137	4874707139	24.5	< 0.04	0.09	0.364	118	< 0.008	< 0.02	< 0.008	6.72	11.2	0.004	73	0.117	37.8	0.9	22.9	< 0.2	0.609	< 0.006	< 0.008
S98-03138	4874763876	5.1	< 0.01	0.24	0.056	28.3	< 0.003	< 0.002	< 0.008	0.485	11.6	< 0.003	20.3	0.176	198	2.5	14.6	75	0.149	< 0.002	< 0.004
S98-03139	4874739331	15.4	< 0.01	0.35	0.697	150	< 0.003	0.002	< 0.008	4.65	20.1	0.011	100	0.158	664	1	21.9	0.3	0.852	0.003	0.015
S98-03140	4874739036	0.7	0.02	0.5	0.03	13.5	< 0.003	< 0.002	< 0.008	0.069	5.6	0.01	14.7	0.007	311	0.2	8.97	< 0.2	0.176	< 0.002	0.005
S98-03141	4874787372	18.5	< 0.01	0.19	0.284	136	< 0.003	< 0.002	< 0.008	3.68	6.5	< 0.003	47.5	0.409	129	1	18.4	27.8	0.354	0.003	0.04

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03142	RIP1095	27/03/1998	22.435	89.095	1970	STW	20	Mr.Abul Kashem	Khulna	Satkhira	Kaliganj (S)	Bishnupur	Parulgheha
S98-03143	RIP1096	27/03/1998	22.49	89.059	1986	STW	10	Fazar Ali Quazi	Khulna	Satkhira	Kaliganj (S)	Tarali	Tarali
S98-03144	RIP1098	28/03/1998	22.608	89.001	1997	DTW	262	Shafiq Ahmed	Khulna	Satkhira	Debhata	Parulia	Parulia
S98-03145	RIP1099	28/03/1998	22.607	88.999	1993	STW	44	Golam Farooqe	Khulna	Satkhira	Debhata	Parulia	Parulia u.c
S98-03146	RIP1100	28/03/1998	22.558	89.007	1992	STW	35	Abdul Wahab	Khulna	Satkhira	Debhata	Noapara	Ramnathpur
S98-03147	RIP1101	28/03/1998	22.564	88.981	1996	STW	26	Tara Miah	Khulna	Satkhira	Debhata	Sakhipur	Konora
S98-03148	RIP1102	28/03/1998	22.576	88.965	1996	STW	31	Bachu Adhakari	Khulna	Satkhira	Debhata	Debhata	Sripur
S98-03149	RIP1103	28/03/1998	22.605	88.961	1992	STW	45	Krishna Pada Biswas	Khulna	Satkhira	Debhata	Debhata	Bhatsala
S98-03150	RIP1105	31/03/1998	22.902	89.768	1997	DTW	279	Shahabuddin	Khulna	Bagerhat	Mollahat	Kulia	Kulia
S98-03151	RIP1106	31/03/1998	22.902	89.768	1985	STW	18	Ali Sheikh	Khulna	Bagerhat	Mollahat	Kulia	Kulia
S98-03152	RIP1107	31/03/1998	22.927	89.81	1994	STW	25	Moslem Khan	Khulna	Bagerhat	Mollahat	Udaypur	Garfa
S98-03153	RIP1108	31/03/1998	22.898	89.81	1992	STW	18	Profulla Mandal	Khulna	Bagerhat	Mollahat	Atjuri	Kamargram
S98-03154	RIP1109	31/03/1998	22.855	89.819	1975	STW	21	Badal Bishwas	Khulna	Bagerhat	Mollahat	Kodalia	Rangamatia
S98-03155	RIP1110	31/03/1998	22.869	89.748	1993	STW	23	Salianran SK	Khulna	Bagerhat	Mollahat	Kulia	Nasukhali
S98-03156	RIP1112	01/04/1998	22.575	89.659	1988	STW	24	Sonatan Das	Khulna	Bagerhat	Rampal	Rampal	Srifaltala
S98-03157	RIP1113	01/04/1998	22.575	89.659	1998	DTW	276	Dulal Chandra Das	Khulna	Bagerhat	Rampal	Rampal	Srifaltala
S98-03158	RIP1114	01/04/1998	22.579	89.665	1986	STW	14	Yunus Ali	Khulna	Bagerhat	Rampal	Banshtali	Talbunia
S98-03159	RIP1115	01/04/1998	22.597	89.641	1984	STW	15	Siddikur Rahaman	Khulna	Bagerhat	Rampal	Rampal	Jhanjhania
S98-03160	RIP1116	01/04/1998	22.629	89.61	1994	STW	22	Sonakur Bazar Mosque	Khulna	Bagerhat	Rampal	Gaurambha	Sonakur
S98-03161	RIP1117	01/04/1998	22.677	89.652	1989	STW	24	Sonatunia Bazar	Khulna	Bagerhat	Rampal	Ujalkur	Sonatunia
S98-03162	RIP1118	01/04/1998	22.642	89.643	1998	STW	23	Pushpa Roy	Khulna	Bagerhat	Rampal	Ujalkur	Dhaldaha
S98-03163	RIP1120	04/04/1998	23.374	89.369	1995	STW	46	Birendra Nath	Khulna	Magura	Shalikha	Arpara	Arpara
S98-03164	RIP1121	04/04/1998	23.411	89.292	1992	STW	49	Thaipara P. School	Khulna	Magura	Shalikha	Dhaneshwargati	Thaipara
S98-03165	RIP1122	04/04/1998	23.375	89.308	1997	STW	56	Hafiz Chairman	Khulna	Magura	Shalikha	Talkhari	Naghosa
S98-03166	RIP1123	04/04/1998	23.329	89.345	1993	STW	49	Bagdanga Madrasha	Khulna	Magura	Shalikha	Shatakhali	Bagdanga
S98-03167	RIP1124	04/04/1998	23.301	89.402	1992	STW	55	Aziz Mollah	Khulna	Magura	Shalikha	Shalikha	Sarusuna
S98-03168	RIP1125	04/04/1998	23.327	89.401	1992	STW	49	Santosh Choudhori	Khulna	Magura	Shalikha	Bunagati	Baulia bharat
S98-03169	RIP1127	05/04/1998	23.041	89.635	1998	DTW	251	DPHE Bhaban	Khulna	Narail	Kalia	Paurashava w01	Ramnagar
S98-03170	RIP1128	05/04/1998	23.048	89.644	1983	STW	31	Mamin Sardar	Khulna	Narail	Kalia	Salamabad	Bara kalia
S98-03171	RIP1129	05/04/1998	23.02	89.716	1990	STW	41	Union Parishad	Khulna	Narail	Kalia	Bauisena	Bauisena
S98-03172	RIP1130	05/04/1998	23.02	89.664	1982	STW	50	Shuklal Bishwas	Khulna	Narail	Kalia	Kalabaria	Chalna
S98-03173	RIP1131	27/03/1998	22.751	89.02	1984	STW	36	H. Rajab Ali Biswas	Khulna	Satkhira	Satkhira Sadar	Shibpur	Pairadanga
S98-03174	RIP1132	27/03/1998	22.745	88.925	1990	STW	30	BDR Camp	Khulna	Satkhira	Satkhira Sadar	Baikari	Baikari
S98-03175	RIP1133	27/03/1998	22.751	88.941	1976	DTW	92	Mahabbat Ali	Khulna	Satkhira	Satkhira Sadar	Baikari	Khalilnagar
S98-03176	RIP1134	27/03/1998	22.693	88.985	1997	DTW	217	G. Rahman Biswas	Khulna	Satkhira	Satkhira Sadar	Ghona	Mahadebnagar
S98-03177	RIP1135	27/03/1998	22.693	88.985	1996	STW	43	G. Rahman Biswas	Khulna	Satkhira	Satkhira Sadar	Ghona	Bhorakhali
S98-03178	RIP1136	27/03/1998	22.683	89.024	1985	STW	39	PHE Centre	Khulna	Satkhira	Satkhira Sadar	Alipur	Alipur
S98-03179	RIP1137	27/03/1998	22.647	88.934	1998	DTW	203	Mostafizur Rahman	Khulna	Satkhira	Satkhira Sadar	Bhomra	Haradaha
S98-03180	RIP1139	28/03/1998	22.86	89.04	1996	DTW	148	DPHE Copmlex	Khulna	Satkhira	Kalaroa	Gopinathpur	Kalaroa
S98-03181	RIP1140	28/03/1998	22.917	89.014	1992	STW	44	Parthu Gopal Bhatta	Khulna	Satkhira	Kalaroa	Keralkata	Keralkata
S98-03182	RIP1141	28/03/1998	22.923	89.096	1965	STW	39	U.P.Office	Khulna	Satkhira	Kalaroa	Diara	Khoralabazar
S98-03183	RIP1142	28/03/1998	22.873	89.084	1996	STW	31	Bamankhali H.Sch.	Khulna	Satkhira	Kalaroa	Jugikhali	Bamankhali
S98-03184	RIP1143	28/03/1998	22.836	89.011	1991	Tara	46		Khulna	Satkhira	Kalaroa	Keragachhi	Goalchator
S98-03185	RIP1144	28/03/1998	22.841	88.974	1996	Tara	52	Md.Alamgir Hossain	Khulna	Satkhira	Kalaroa	Sonabaria	Bandiali
S98-03186	RIP1145	28/03/1998	22.901	88.949	1948	STW	46	Boyerdanga Govt.PS	Khulna	Satkhira	Kalaroa	Chandanpur	Boyerdanga
S98-03187	RIP1147	29/03/1998	22.371	89.175	1993	DTW	187	Saukat Hossain	Khulna	Satkhira	Shyamnagar	Kashimari	Kashimari
S98-03188	RIP1148	29/03/1998	22.305	89.11	1996	STW	43	Banshipur Mosque	Khulna	Satkhira	Shyamnagar	Iswaripur	Banshipur
S98-03189	RIP1149	29/03/1998	22.305	89.111	1995	DugW	7	Banshipur Mosque	Khulna	Satkhira	Shyamnagar	Iswaripur	Banshipur

IPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
-03142	4874715753	2	0.03	0.03	0.091	94.2	< 0.003	< 0.002	< 0.008	0.708	3.1	< 0.003	13.3	0.295	14.7	0.1	16.3	0.4	0.152	< 0.002	0.09
8-03143	4874794933	24	< 0.04	0.3	0.141	41.5	< 0.008	< 0.02	< 0.008	0.983	8.2	0.004	37.9	0.25	361	4.5	18.7	50.4	0.317	< 0.006	< 0.008
98-03144	4872563806	3.5	< 0.04	0.09	0.07	55.9	< 0.008	< 0.02	< 0.008	0.087	4.2	< 0.003	21.8	0.029	58.1	< 0.2	17.2	< 0.2	0.259	< 0.006	< 0.008
S98-03145	4872563806	221	0.04	0.08	0.374	124	< 0.008	< 0.02	< 0.008	4.83	5.5	0.008	45.1	0.119	95.2	2.5	30.9	< 0.2	0.583	< 0.006	< 0.008
S98-03146	4872547874	192	< 0.04	0.06	0.217	66.8	< 0.008	< 0.02	< 0.008	1.76	6	< 0.003	28.7	0.083	52.3	0.9	17.2	< 0.2	0.452	< 0.006	0.017
S98-03147	4872579617	73.5	< 0.04	0.21	0.384	88.3	< 0.008	< 0.02	< 0.008	3.2	15.5	0.006	65.8	0.135	153	2.1	29.9	< 0.2	0.609	< 0.006	< 0.008
S98-03148	4872515960	58.7	< 0.04	0.16	0.458	111	< 0.008	< 0.02	< 0.008	5.7	14.1	0.005	67.2	0.121	82.5	2.2	29.1	< 0.2	0.624	< 0.006	< 0.008
S98-03149	4872515139	315	< 0.04	0.21	0.494	86.2	< 0.008	< 0.02	< 0.008	3.36	8.1	0.007	39.1	0.047	465	1.6	22.9	< 0.2	0.357	< 0.006	< 0.008
S98-03150	4015685526	< 0.5	< 0.04	0.2	0.109	25	< 0.008	< 0.02	< 0.008	0.047	4.2	0.009	16.9	0.032	281	0.2	11.8	< 0.2	0.272	< 0.006	< 0.008
S98-03151	4015685526	317	< 0.04	0.08	0.451	228	< 0.008	< 0.02	< 0.008	15.5	7.4	0.005	59.7	0.147	247	1.8	21.2	< 0.2	0.781	< 0.006	< 0.008
S98-03152	4015695380	103	< 0.04	0.03	0.165	119	< 0.008	< 0.02	< 0.008	5.91	3	< 0.003	25.5	0.094	18.1	1.3	15.3	< 0.2	0.324	< 0.006	0.008
S98-03153	4015609485	128	< 0.04	0.06	0.258	138	< 0.008	< 0.02	< 0.008	7.96	4.7	0.003	32.2	0.152	114	1.1	21.7	2.7	0.394	< 0.006	0.012
S98-03154	4015676782	46.9	< 0.04	0.13	0.08	38.8	< 0.008	< 0.02	< 0.008	3.68	10.9	< 0.003	41.7	0.048	83.3	2.4	20.1	0.2	0.292	< 0.006	< 0.008
S98-03155	4015685702	252	< 0.04	0.19	0.383	108	< 0.008	< 0.02	< 0.008	7.22	6	0.005	38.6	0.09	508	3.4	18.5	0.5	0.433	< 0.006	< 0.008
S98-03156	4017383918	148	0.04	0.18	0.674	258	< 0.008	< 0.02	< 0.008	15.2	10.3	0.004	111	0.115	579	1.2	18.3	< 0.2	1.07	< 0.006	< 0.008
S98-03157	4017383918	3.2	< 0.04	0.51	0.13	44.6	< 0.008	< 0.02	< 0.008	0.203	8.7	0.006	30.2	0.094	647	0.5	11.2	< 0.2	0.412	< 0.006	< 0.008
S98-03158	4017311948	129	< 0.04	0.3	0.219	157	< 0.008	< 0.02	< 0.008	4.29	11.1	0.004	69.1	0.266	668	2.8	13.7	146	0.634	< 0.006	< 0.008
S98-03159	4017383520	37.6	< 0.04	0.34	0.34	120	< 0.008	< 0.02	< 0.008	3.88	5.3	0.004	61.8	0.2	771	3.2	15.5	97.6	0.436	< 0.006	0.01
S98-03160	4017341907	424	< 0.04	0.09	0.747	366	< 0.008	< 0.02	< 0.008	30.4	11	0.005	84.5	0.595	565	1	15.9	< 0.2	1.22	< 0.006	0.021
S98-03161	4017394913	472	< 0.04	0.06	0.407	197	< 0.008	< 0.02	< 0.008	12.9	7.7	< 0.003	45.1	0.11	141	1.6	17.1	< 0.2	0.728	< 0.006	< 0.008
S98-03162	4017394421	339	< 0.04	0.46	0.117	59.5	< 0.008	< 0.02	< 0.008	2.06	5.6	< 0.003	17.2	0.07	648	3.1	13.4	0.6	0.218	< 0.006	< 0.008
S98-03163	4558511049	216	< 0.04	0.03	0.137	62.7	< 0.008	< 0.02	< 0.008	5.59	2.4	< 0.003	17.5	0.087	17.1	1.9	19.	< 0.2	0.264	< 0.006	< 0.008
S98-03164	4558535965	49.5	< 0.04	0.04	0.119	71.4	< 0.008	< 0.02	< 0.008	1.35	2.7	< 0.003	15	0.394	37.4	< 0.2	16.3	14.9	0.162	< 0.006	< 0.008
S98-03165	4558583666	< 0.5	< 0.04	0.04	0.069	90.3	< 0.008	< 0.02	< 0.008	0.053	1.8	0.009	29.6	0.541	41.1	< 0.2	21.6	< 0.2	0.545	< 0.006	< 0.008
S98-03166	4558571069	64.7	< 0.04	0.03	0.299	122	< 0.008	< 0.02	< 0.008	5.82	3.9	0.005	29.1	0.142	32.7	0.7	17	18.3	0.395	< 0.006	< 0.008
S98-03167	4558559865	0.5	< 0.04	0.09	0.067	87.4	< 0.008	< 0.02	< 0.008	0.042	1.5	0.005	39.1	0.585	123	< 0.2	21.5	3.9	0.436	< 0.006	< 0.008
S98-03168	4558523129	< 0.5	< 0.04	0.07	0.06	74.8	< 0.008	< 0.02	< 0.008	0.031	1.2	0.008	21.8	1.21	90.1	< 0.2	19.3	< 0.2	0.269	< 0.006	< 0.008
S98-03169	4652856841	13.2	< 0.04	0.17	0.03	28.3	< 0.008	< 0.02	< 0.008	0.192	3.3	0.003	18.2	0.045	129	0.3	9.7	0.2	0.317	< 0.006	0.01
S98-03170	4652895153	200	< 0.04	0.07	0.664	177	< 0.008	< 0.02	< 0.008	16.9	6.5	0.006	46.6	0.154	149	1.5	22.5	< 0.2	0.648	< 0.006	0.011
S98-03171	4652815165	165	< 0.04	0.18	0.272	90.9	< 0.008	< 0.02	< 0.008	3.23	9.4	0.004	55.7	0.076	296	2.8	22.3	< 0.2	0.54	< 0.006	< 0.008
S98-03172	4652847243	228	< 0.04	0.08	0.164	94.1	< 0.008	< 0.02	< 0.008	5.92	5.8	0.005	49.9	0.088	48.2	2.6	26.6	0.3	0.52	< 0.006	< 0.008
S98-03173	4878294730	73.5	< 0.04	0.03	0.129	65	< 0.008	< 0.02	< 0.008	1.98	2.9	< 0.003	17.8	0.069	10.2	1.1	18.7	< 0.2	0.228	< 0.006	0.015
S98-03174	4878220082	262	< 0.04	0.08	0.54	136	< 0.008	< 0.02	< 0.008	7.63	6	0.008	51.2	0.071	141	1.5	26.4	< 0.2	0.545	< 0.006	0.012
S98-03175	4878220502	266	< 0.04	0.07	0.456	114	< 0.008	< 0.02	< 0.008	4.75	5.5	0.006	37	0.045	92.1	1.2	18.9	< 0.2	0.523	< 0.006	< 0.008
S98-03176	4878261611	1.1	< 0.04	0.11	0.065	64.3	< 0.008	< 0.02	< 0.008	0.097	4.1	0.004	25.8	0.044	77.2	< 0.2	15.5	< 0.2	0.38	< 0.006	< 0.008
S98-03177	4878261611	136	0.08	0.09	0.395	118	< 0.008	< 0.02	< 0.008	7.54	11.4	0.004	58.8	0.093	38.2	1.9	27.9	< 0.2	0.538	< 0.006	0.028
S98-03178	4878206027	82.8	< 0.04	0.06	0.451	137	< 0.008	< 0.02	< 0.008	7.99	4	0.006	43.4	0.064	72.9	1.6	21.4	< 0.2	0.481	< 0.006	< 0.008
S98-03179	4878240794	9.4	5.37	0.18	0.013	48.9	< 0.008	< 0.02	< 0.008	0.055	1.7	< 0.003	5.02	0.025	116	0.2	1.96	2.2	0.142	< 0.006	0.254
S98-03180	4874323416	187	< 0.04	0.07	0.435	154	< 0.008	< 0.02	< 0.008	4.32	5	< 0.003	34.3	0.117	56.8	0.5	19.8	< 0.2	0.551	< 0.006	0.056
S98-03181	4874371467	92.5	< 0.04	0.04	0.249	112	< 0.008	< 0.02	< 0.008	6.2	3.8	0.004	21.9	0.13	21.7	1	18.3	< 0.2	0.339	< 0.006	< 0.008
S98-03182	4874315501	106	< 0.04	0.04	0.173	96.2	< 0.008	< 0.02	< 0.008	4.2	2.3	0.003	22.3	0.065	13.9	1	19.8	< 0.2	0.294	< 0.006	< 0.008
S98-03183	4874355059	181	< 0.04	0.03	0.301	138	< 0.008	< 0.02	< 0.008	7.88	3.5	0.004	25.8	0.049	33	0.3	23.6	< 0.2	0.37	< 0.006	< 0.008
S98-03184	4874363331	453	< 0.04	0.07	0.446	120	< 0.008	< 0.02	< 0.008	4.37	5.9	0.004	35	0.039	48.4	1.6	17	< 0.2	0.638	< 0.006	< 0.008
S98-03185	4874394110	328	< 0.04	0.05	0.406	123	< 0.008	< 0.02	< 0.008	4.12	4.9	0.003	35.2	0.037	25.6	0.9	17.4	< 0.2	0.662	< 0.006	0.016
S98-03186	4874307161	88	< 0.04	0.04	0.193	94.3	< 0.008	< 0.02	< 0.008	4.31	3.2	0.005	19.6	0.062	17.2	0.8	21.7	< 0.2	0.274	< 0.006	< 0.008
S98-03187	4878655521	< 0.5	< 0.04	0.83	0.016	11.9	< 0.008	< 0.02	< 0.008	0.07	3.4	0.008	6.67	0.008	366	0.4	9.01	0.2	0.0759	< 0.006	< 0.008
S98-03188	4878639055	168	< 0.01	1	0.369	54.5	< 0.003	< 0.002	< 0.008	0.058	45.3	0.045	193	< 0.002	1950	0.3	22.5	1.4	1.12	< 0.002	0.005
S98-03189	4878639055	2	< 0.04	0.24	0.261	224	< 0.008	< 0.02	< 0.008	0.041	4.7	0.01	107	0.314	346	< 0.2	11.2	75.4	1.29	0.008	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03190	RIP1150	29/03/1998	22.333	89.04	1996	STW	9	Nurnagar Govt.P.S	Khulna	Satkhira	Shyamnagar	Nurnagar	Nurnagar
S98-03191	RIP1151	27/03/1998	22.711	89.107	1997	STW	44	Mizanur Rahman	Khulna	Satkhira	Satkhira Sadar	Brahma Rajpur	Majkhola
S98-03192	RIP1152	27/03/1998	22.703	89.073	1993	STW	24	Neel Kumar Pal	Khulna	Satkhira	Satkhira Sadar	Paurashava W-03	Sultanpur
S98-03193	RIP1153	27/03/1998	22.703	89.054	1996	STW	30	Md Akbar Ali	Khulna	Satkhira	Satkhira Sadar	Paurashava W-02	Khari villa
S98-03194	RIP1154	27/03/1998	22.57	89.076	1988	STW	46	DPHE Rest House	Khulna	Satkhira	Satkhira Sadar	Paurashava W-01	Kalia
S98-03195	RIP1156	28/03/1998	22.733	89.297	1985	STW	45	Union Parishad	Khulna	Satkhira	Tala	Khalilnagar	Khalilnagar
S98-03196	RIP1157	28/03/1998	22.782	89.251	1964	DTW	182	Tentulia Mosque	Khulna	Satkhira	Tala	Tentulia	Tentulia
S98-03197	RIP1158	28/03/1998	22.782	89.251	1995	STW	48	K. Nakibul Islam	Khulna	Satkhira	Tala	Tentulia	Tentulia
S98-03198	RIP1159	28/03/1998	22.778	89.205	1995	STW	49	Monir UddiN	Khulna	Satkhira	Tala	Kumira	Mirzapur
S98-03199	RIP1160	28/03/1998	22.679	89.256	1977	STW	39	Subad Chandra Pal	Khulna	Satkhira	Tala	Khesra	Teghoria
S98-03200	RIP1161	28/03/1998	22.721	89.207	1996	STW	49	M. Shahidul Islam	Khulna	Satkhira	Tala	Magura	Balidaha
S98-03201	RIP1162	28/03/1998	22.765	89.143	1992	STW	38	Shakdaha P. School	Khulna	Satkhira	Tala	Sarulia	Shakdaha
S98-03202	RIP1163	28/03/1998	22.795	89.12	1997	STW	41	Md. Abdul Aziz	Khulna	Satkhira	Tala	Dhandia	Panchpara
S98-03203	RIP1165	29/03/1998	22.504	89.199	1996	STW	55	Shafiqul Islam	Khulna	Satkhira	Assasuni	Khajra	Chak chardanya
S98-03204	RIP1166	29/03/1998	22.414	89.217	1981	STW	59	Md. Nurul Alam	Khulna	Satkhira	Assasuni	Anulia	Bichat
S98-03205	RIP1167	29/03/1998	22.535	89.12	1997	DTW	157	Bantra Mosque	Khulna	Satkhira	Assasuni	Sobhnali	Bantra
S98-03206	RIP1168	29/03/1998	22.535	89.12	1990	STW	13	Eshar Ali	Khulna	Satkhira	Assasuni	Sobhnali	Bantra
S98-03207	RIP1169	29/03/1998	22.615	89.15	1991	STW	46	Bud. Bazar Mosque	Khulna	Satkhira	Assasuni	Budhhata	Budhhata
S98-03208	RIP1171	30/03/1998	22.666	89.876	1985	STW	24	Sarwar Hossain	Khulna	Bagerhat	Kachua (B)	Maghia	Maghia
S98-03209	RIP1172	30/03/1998	22.689	89.865	1989	STW	14	Bhasa Bazar	Khulna	Bagerhat	Kachua (B)	Dhopakhali	Bhasa
S98-03210	RIP1173	30/03/1998	22.606	89.85	1988	STW	9	Sainboard Bazar	Khulna	Bagerhat	Kachua (B)	Rari Para	Rari Para
S98-03211	RIP1174	30/03/1998	22.602	89.887	1997	STW	21	Badhal Bazar	Khulna	Bagerhat	Kachua (B)	Badhal	Badhal
S98-03212	RIP1175	30/03/1998	22.608	89.844	1995	STW	18	Goalmat	Khulna	Bagerhat	Kachua (B)	Rari Para	Bandarkhola
S98-03213	RIP1178	31/03/1998	22.782	89.877	1979	STW	22	Surandranath Mandal	Khulna	Bagerhat	Chitalmari	Char Baniari	Kharamkhali
S98-03214	RIP1179	31/03/1998	22.841	89.849	1979	STW	25	Karamat Ali	Khulna	Bagerhat	Chitalmari	Shibpur	Kaligati
S98-03215	RIP1180	31/03/1998	22.857	89.872	1979	STW	29	Bara Baria Bazar	Khulna	Bagerhat	Chitalmari	Bara Baria	Bara Baria
S98-03216	RIP1181	29/03/1998	22.366	89.071	1996	STW	9	Abdur Rahim	Khulna	Satkhira	Shyamnagar	Bhurulia	Teghoria
S98-03217	RIP1182	29/03/1998	22.365	89.086	1982	STW	15	Bazlur Rahman	Khulna	Satkhira	Shyamnagar	Bhurulia	Burulia
S98-03218	RIP1184	30/03/1998	22.561	89.863	1980	STW	20	Moslem Ali Didar	Khulna	Bagerhat	Morrelganj	Daibagnyahati	Daibagnyahati
S98-03219	RIP1185	30/03/1998	22.487	89.866	1995	STW	20	Balaibunia UP	Khulna	Bagerhat	Morrelganj	Balaibunia	Balaibunia
S98-03220	RIP1186	30/03/1998	22.601	89.893	1982	STW	25	Balabhadrapur Mandir	Khulna	Bagerhat	Morrelganj	Banagram	Balabhadrapur
S98-03221	RIP1187	30/03/1998	22.583	89.959	1982	STW	29	Latifa Kumar	Khulna	Bagerhat	Morrelganj	Hoglapasha	Hoglapasha
S98-03222	RIP1188	30/03/1998	22.456	89.859	1982	STW	13	T&T Office	Khulna	Bagerhat	Morrelganj	Barai khali	Fakirertakia
S98-03223	RIP1190	30/03/1998	22.263	89.834	1988	STW	10	South Khali UP	Khulna	Bagerhat	Sarankhola	Dakshin Khali	Sonatala
S98-03224	RIP1191	30/03/1998	22.287	89.844	1994	STW	10	Abdul Kalam Haolader	Khulna	Bagerhat	Sarankhola	Raenda	Raenda
S98-03225	RIP1192	31/03/1998	22.313	89.854	1985	STW	10	Raenda Govt.High Sch	Khulna	Bagerhat	Sarankhola	Raenda	Raenda bazar
S98-03226	RIP1194	31/03/1998	22.663	89.774	1984	STW	29	Upazila Mosque	Khulna	Bagerhat	Bagerhat Sadar	Shat Gambuj	Ranbijoypur
S98-03227	RIP1195	31/03/1998	22.715	89.667	1980	STW	19	Paikpara Mosque	Khulna	Bagerhat	Bagerhat Sadar	Rakhalgachhi	Bara Paikpara
S98-03228	RIP1196	31/03/1998	22.718	89.668	1996	DTW	282	Abdul Hamid	Khulna	Bagerhat	Bagerhat Sadar	Rakhalgachhi	Bara Paikpara
S98-03229	RIP1197	31/03/1998	22.704	89.688	1984	STW	15	Karari Bazar Mosque	Khulna	Bagerhat	Bagerhat Sadar	Rakhalgachhi	Karari
S98-03230	RIP1198	01/04/1998	22.732	89.754	1997	STW	30	Jatrapur Bazar Mosqu	Khulna	Bagerhat	Bagerhat Sadar	Jatrapur	Jatrapur
S98-03231	RIP1199	01/04/1998	22.664	89.783	1980	STW	25	Harinkhana P, School	Khulna	Bagerhat	Bagerhat Sadar	Paurashava w03	Purba Harinkhana
S98-03232	RIP1200	01/04/1998	22.662	89.798	1990	STW	30	DPHE Office	Khulna	Bagerhat	Bagerhat Sadar	Paurashava w02	Uttar Amlapara
S98-03233	RIP1201	01/04/1998	22.658	89.771	1997	DTW	277	Mohammadia Khanka sh	Khulna	Bagerhat	Bagerhat Sadar	Karapara	Kanthal
S98-03234	RIP1202	01/04/1998	22.671	89.694	1997	DTW	282	Khanpur UP	Khulna	Bagerhat	Bagerhat Sadar	Khanpur	Uttar Khanpur
S98-03235	RIP1204	02/04/1998	23.082	89.526	1997	STW	60	Moklukat Sheik	Khulna	Narail	Narail Sadar	Singasolpur	Shulpur
S98-03236	RIP1205	02/04/1998	23.16	89.444	1978	STW	55	Parikhit Roy	Khulna	Narail	Narail Sadar	Tularampur	Tularampur
S98-03237	RIP1206	02/04/1998	23.161	89.482	1981	STW	52	Baddanath Roy	Khulna	Narail	Narail Sadar	Mulia	Sitarampur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03190	4878671750	17.4	0.05	0.1	0.135	103	< 0.008	< 0.02	< 0.008	2.33	2.5	0.004	20.6	0.51	120	< 0.2	14.4	41.1	0.17	< 0.006	< 0.008
S98-03191	4878247565	143	< 0.04	0.05	0.165	119	< 0.008	< 0.02	< 0.008	3.53	4.5	0.005	42	0.048	29.9	0.3	19.2	< 0.2	0.547	< 0.006	0.012
S98-03192	4878265787	3.5	< 0.04	0.05	0.32	164	< 0.008	< 0.02	< 0.008	5.41	2.2	0.005	39.6	0.297	71.5	0.3	16	15.1	0.336	< 0.006	< 0.008
S98-03193	4878265320	227	< 0.04	0.05	0.246	109	< 0.008	< 0.02	< 0.008	6.25	4.1	0.005	26.5	0.07	49	1.8	19.6	< 0.2	0.395	< 0.006	< 0.008
S98-03194	4878265311	56.2	< 0.04	0.03	0.356	136	< 0.008	< 0.02	< 0.008	5.27	6.9	0.004	36.7	0.125	23.6	0.5	19.5	< 0.2	0.419	< 0.006	< 0.008
S98-03195	4879031530	75.8	< 0.04	0.04	0.23	111	< 0.008	< 0.02	< 0.008	2.1	4.3	0.003	35.4	0.08	19.1	0.9	19.3	< 0.2	0.401	< 0.006	< 0.008
S98-03196	4879094275	16.6	< 0.04	0.04	0.285	133	< 0.008	< 0.02	< 0.008	2.67	4.8	0.004	34.6	0.131	20.1	0.3	16.8	1.8	0.263	< 0.006	< 0.008
S98-03197	4879094975	15.5	< 0.04	0.03	0.126	92.1	< 0.008	< 0.02	< 0.008	1.95	3.1	< 0.003	19.1	0.075	16.7	0.3	15.8	< 0.2	0.164	< 0.006	< 0.008
S98-03198	4879055683	270	< 0.04	0.13	0.297	86.9	< 0.008	< 0.02	< 0.008	1.61	5.4	0.005	33.5	0.041	212	1.2	14.6	< 0.2	0.488	< 0.006	< 0.008
S98-03199	4879047968	233	< 0.04	0.2	0.274	89	< 0.008	< 0.02	< 0.008	2.95	10.1	0.005	53.5	0.062	279	2.6	25.6	< 0.2	0.528	< 0.006	< 0.008
S98-03200	4879063086	291	< 0.04	0.15	0.367	118	< 0.008	< 0.02	0.01	4.29	7	0.006	41.8	0.051	239	1.8	20.1	< 0.2	0.556	< 0.006	0.009
S98-03201	4879079868	108	< 0.04	0.07	0.384	156	< 0.008	< 0.02	< 0.008	6.09	9.6	0.005	71.1	0.175	45.5	1.3	29.6	< 0.2	0.721	< 0.006	< 0.008
S98-03202	4879007769	319	< 0.04	0.05	0.243	102	< 0.008	< 0.02	< 0.008	5.22	4.6	0.003	34.8	0.042	18.9	1.3	21.2	< 0.2	0.546	< 0.006	< 0.008
S98-03203	4870460220	330	< 0.04	0.18	1.36	228	< 0.008	< 0.02	< 0.008	6.46	11.9	0.013	85.1	0.082	583	1	19.9	< 0.2	1.24	< 0.006	< 0.008
S98-03204	4870408157	261	< 0.04	0.15	0.834	165	< 0.008	< 0.02	< 0.008	4.3	10.9	0.008	88.3	0.133	396	1.3	18.9	< 0.2	1.11	< 0.006	< 0.008
S98-03205	4870486100	< 0.5	< 0.04	0.53	0.012	14.7	< 0.008	< 0.02	< 0.008	0.071	2.9	0.006	12.3	0.012	269	0.5	7.63	< 0.2	0.179	< 0.006	< 0.008
S98-03206	4870486100	86.2	< 0.04	0.08	0.672	257	< 0.008	< 0.02	< 0.008	16.3	8.4	0.004	93	0.131	290	0.9	23.1	< 0.2	0.962	< 0.006	0.015
S98-03207	4870434176	236	< 0.04	0.07	0.27	138	< 0.008	< 0.02	< 0.008	7.54	4.4	0.003	37.1	0.095	36	1.5	20.7	< 0.2	0.531	< 0.006	< 0.008
S98-03208	4013866697	103	< 0.04	0.14	0.07	48.4	< 0.008	< 0.02	< 0.008	1.33	3.7	< 0.003	12.3	0.029	191	3	17.8	< 0.2	0.178	< 0.006	< 0.008
S98-03209	4013828164	16.4	< 0.04	0.08	0.178	104	< 0.008	< 0.02	< 0.008	5.62	3.4	< 0.003	41	0.082	99.4	0.9	20.1	< 0.2	0.354	< 0.006	< 0.008
S98-03210	4013876830	45.6	0.33	0.19	0.416	265	< 0.008	< 0.02	< 0.008	9.9	14	0.004	100	1.27	695	0.3	10.9	181	0.891	< 0.006	0.03
S98-03211	4013809061	10.1	< 0.04	0.34	0.033	36.9	< 0.008	< 0.02	< 0.008	0.407	16.4	0.006	36.7	0.02	415	1.4	25.9	1.2	0.257	< 0.006	< 0.008
S98-03212	4013876153	177	< 0.04	0.05	0.243	134	< 0.008	< 0.02	< 0.008	9.4	5.3	< 0.003	34.7	0.225	123	1.6	16.3	2.9	0.484	< 0.006	< 0.008
S98-03213	4011415530	480	< 0.04	0.16	0.674	301	< 0.008	< 0.02	< 0.008	14	11.3	0.004	72.8	0.28	537	0.8	14.7	< 0.2	1.08	< 0.006	< 0.008
S98-03214	4011479420	96.9	< 0.04	0.11	0.112	106	< 0.008	< 0.02	< 0.008	6.38	11	< 0.003	59.3	0.108	127	0.9	20.4	0.3	0.639	< 0.006	< 0.008
S98-03215	4011419058	269	< 0.04	0.16	0.146	167	< 0.008	< 0.02	< 0.008	10.5	6	< 0.003	29.9	0.422	139	1.6	19.8	< 0.2	0.52	< 0.006	< 0.008
S98-03216	4878615987	10	< 0.04	0.59	0.192	67.4	< 0.008	< 0.02	< 0.008	0.664	27.9	0.004	71	0.213	698	3	15	144	0.507	< 0.006	< 0.008
S98-03217	4878615987	509	< 0.04	0.06	0.295	181	< 0.008	< 0.02	< 0.008	7.88	5.1	< 0.003	44.3	0.366	44.6	1.2	15.7	< 0.2	0.679	< 0.006	< 0.008
S98-03218	4016035381	81.3	< 0.04	0.12	0.274	184	< 0.008	< 0.02	< 0.008	11.5	6.5	< 0.003	55.2	0.445	298	1.1	14.7	1.6	0.594	< 0.006	< 0.008
S98-03219	4016011006	3.6	< 0.04	0.26	0.153	95.6	< 0.008	< 0.02	< 0.008	3.39	10.9	0.005	62.4	0.284	414	0.5	19.4	0.6	0.501	< 0.006	< 0.008
S98-03220	4016017058	472	< 0.01	< 0.1	0.153	132	< 0.003	< 0.002	< 0.008	2.27	6.8	< 0.004	53.7	0.079	159	0.1	11.1	< 0.2	0.748	< 0.002	0.031
S98-03221	4016047580	27.2	< 0.04	0.05	0.04	72.4	< 0.008	< 0.02	< 0.008	4.24	3.8	< 0.003	19.3	0.255	94.3	2.2	21.4	< 0.2	0.258	< 0.006	< 0.008
S98-03222	4016023464	30.2	0.03	0.2	0.325	138	< 0.003	< 0.002	< 0.008	5.57	9	0.004	72.1	0.494	326	1.7	16.2	92.7	0.71	< 0.002	0.006
S98-03223	4017776994	1.8	< 0.01	0.34	0.115	61	< 0.003	< 0.002	< 0.008	1.1	21.2	0.007	51.3	0.171	428	1	21.8	12.4	0.437	< 0.002	0.008
S98-03224	4017757723	60.1	< 0.01	0.31	0.094	122	< 0.003	< 0.002	< 0.008	7.1	13.6	0.008	84.1	0.159	481	2.5	22	0.4	0.701	< 0.002	0.022
S98-03225	4017757723	24.8	< 0.01	0.2	0.032	64.1	< 0.003	< 0.002	< 0.008	0.878	13.1	< 0.003	51.2	0.306	82.9	1.9	23.9	0.4	0.378	< 0.002	0.005
S98-03226	4010894830	130	< 0.01	0.03	0.151	119	< 0.003	< 0.002	< 0.008	4.4	11.3	< 0.003	24.8	0.822	12.1	0.4	18.9	9.5	0.27	< 0.002	0.021
S98-03227	4010886104	635	0.06	0.04	0.213	162	< 0.008	< 0.02	< 0.008	8.57	5.8	< 0.003	35.6	0.514	41	1.3	14.2	< 0.2	0.58	< 0.006	0.008
S98-03228	4010886104	< 0.5	< 0.04	0.22	0.149	41.6	< 0.008	< 0.02	< 0.008	0.369	6.8	0.012	25.7	0.06	281	0.2	16.8	< 0.2	0.298	< 0.006	< 0.008
S98-03229	4010886494	234	< 0.04	0.07	0.203	129	< 0.008	< 0.02	< 0.008	8.13	4.2	0.003	37	0.109	69.6	2.1	24.1	< 0.2	0.478	< 0.006	< 0.008
S98-03230	4010860406	26.2	< 0.04	0.17	0.171	138	< 0.008	< 0.02	< 0.008	7.48	9.7	0.006	58	0.519	269	1.2	23.7	< 0.2	0.594	< 0.006	0.129
S98-03231	4010862997	299	< 0.04	0.04	0.167	113	< 0.008	< 0.02	< 0.008	6.49	4.7	< 0.003	24.3	0.179	20.5	1.2	17	< 0.2	0.401	< 0.006	< 0.008
S98-03232	4010862648	10.8	< 0.04	0.08	0.18	129	< 0.008	< 0.02	< 0.008	4.41	2.5	< 0.003	24.2	0.11	44.3	0.6	10.5	20.8	0.347	< 0.006	< 0.008
S98-03233	4010869461	1.1	< 0.04	0.2	0.325	95.5	< 0.008	< 0.02	< 0.008	0.533	11.2	0.009	64.9	0.165	426	< 0.2	13.4	< 0.2	0.826	< 0.006	< 0.008
S98-03234	4010877994	< 0.5	< 0.04	0.18	0.133	35.9	< 0.008	< 0.02	< 0.008	0.132	7.1	0.009	29.1	0.058	194	< 0.2	15.5	< 0.2	0.368	< 0.006	< 0.008
S98-03235	4657688912	< 0.5	< 0.04	0.15	0.056	44	< 0.008	< 0.02	< 0.008	0.035	0.9	0.008	19.7	0.687	406	< 0.2	17.4	11.6	0.257	< 0.006	0.009
S98-03236	4657694956	203	< 0.04	0.04	0.188	150	< 0.008	< 0.02	< 0.008	3.94	2.7	0.01	27	1.5	66.5	0.5	21.2	< 0.2	0.516	< 0.006	< 0.008
S98-03237	4657661889	40.4	< 0.04	0.08	0.378	119	< 0.008	< 0.02	< 0.008	2.22	4.2	0.003	44.4	0.093	115	0.5	16.2	< 0.2	0.655	< 0.006	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03238	RIP1207	02/04/1998	23.154	89.511	1996	STW	71	Saleha Begum	Khulna	Narail	Narail Sadar	Paurashava w03	Hatbaria
S98-03239	RIP1208	02/04/1998	23.173	89.505	1996	STW	58	Lakhi	Khulna	Narail	Narail Sadar	Paurashava w02	Bhoakhali
S98-03240	RIP1210	04/03/1998	23.504	89.402	1996	STW	58	Aminuddin Laskar	Khulna	Magura	Magura Sadar	Atharakhada	Atharakhada
S98-03241	RIP1211	04/03/1998	23.508	89.341	1996	STW	49	Golam Mastafa	Khulna	Magura	Magura Sadar	Hazrapur	Sachani houtara
S98-03242	RIP1212	04/03/1998	23.501	89.436	1995	Tara	56	Roushan Mollah	Khulna	Magura	Magura Sadar	Kasundi	Parnanduali
S98-03243	RIP1213	04/03/1998	23.409	89.399	1974	STW	53	Jagla P. School	Khulna	Magura	Magura Sadar	Jagdal	Jagla
S98-03244	RIP1214	04/03/1998	23.462	89.467	1997	STW	53	Altaf Hossain	Khulna	Magura	Magura Sadar	Chaulia	Buzruk srikundi
S98-03245	RIP1215	04/03/1998	23.374	89.508	1995	STW	58	Chottajoka Mosque	Khulna	Magura	Magura Sadar	Birail palita	Chottajoka
S98-03246	RIP1216	04/03/1998	23.419	89.491	1975	STW	53	Aujit Kumar Sen	Khulna	Magura	Magura Sadar	Satrujitpur	Satrujitpur
S98-03247	RIP1217	04/03/1998	23.486	89.428		DTW	148	?	Khulna	Magura	Magura Sadar	Paurashava w03	Khanpara
S98-03248	RIP1218	04/03/1998	23.485	89.429	1980	STW	20	Rakibuddin Mallick	Khulna	Magura	Magura Sadar	Paurashava w03	Thanapara
S98-03249	RIP1220	04/04/1998	23.401	89.6	1997	STW	72	Mohammadpur Bazar	Khulna	Magura	Mohammadpur (M)	Mohammadpur	Mohammadpur
S98-03250	RIP1221	04/04/1998	23.358	89.581	1991	STW	62	Jhama High School	Khulna	Magura	Mohammadpur (M)	Palashbaria	Jhama
S98-03251	RIP1222	04/04/1998	23.336	89.52	1996	STW	64	Nahata Bazar	Khulna	Magura	Mohammadpur (M)	Nahata	Nahata
S98-03252	RIP1223	04/04/1998	23.368	89.556	1994	STW	57	Balidia Madrasha	Khulna	Magura	Mohammadpur (M)	Balidia	Balidia
S98-03253	RIP1224	04/04/1998	23.439	89.502	1985	STW	64	Binodepur Girls Scho	Khulna	Magura	Mohammadpur (M)	Binodepur	Binodepur
S98-03254	RIP1225	04/04/1998	23.488	89.563	1994	STW	63	Babukhali P. School	Khulna	Magura	Mohammadpur (M)	Babukhali	Sultansi
S98-03255	RIP1226	04/04/1998	23.45	89.573	1994	STW	72	Md. Ansar Uddin	Khulna	Magura	Mohammadpur (M)	Digha	Digha
S98-03256	RIP1228	12/04/1998	23.119	89.081	1985	STW	35	Mostafa Kamal	Khulna	Jessore	Jhikargachha	Jhikargachha	Hariadhara
S98-03257	RIP1229	12/04/1998	23.104	89.112	1984	STW	92	Thana Health Comp.	Khulna	Jessore	Jhikargachha	Jhikargachha	Kirtipur
S98-03258	RIP1230	12/04/1998	23.098	89.047	1998	DTW	195	Mokbul Hossain	Khulna	Jessore	Jhikargachha	Gadkhali	Kamarpara
S98-03259	RIP1231	12/04/1998	23.051	89.055	1992	STW	25	Haria Jama Mosque	Khulna	Jessore	Jhikargachha	Nabharan	Haria
S98-03260	RIP1232	12/04/1998	23.005	89.038	1980	STW	37	Hazirbagh UP Office	Khulna	Jessore	Jhikargachha	Hazirbagh	Kulla
S98-03261	RIP1233	12/04/1998	22.979	89.074	1996	STW	40	Kasem Morol	Khulna	Jessore	Jhikargachha	Bakra	Bakra
S98-03262	RIP1234	12/04/1998	22.965	89.021	1984	STW	40	Abul Hossain	Khulna	Jessore	Jhikargachha	Shankarpur	Ulakol
S98-03263	RIP1236	13/04/1998	23.093	89.345	1993	STW	50	Hazi Hasan Ali	Khulna	Jessore	Abhaynagar	Mahakal	Banagram
S98-03264	RIP1237	13/04/1998	23.02	89.406	1997	DTW	139	Hasan Ali Mollah	Khulna	Jessore	Abhaynagar	Paurashava	Goakhola
S98-03265	RIP1238	13/04/1998	22.981	89.392	1989	STW	35	Payrahat J. Mosque	Khulna	Jessore	Abhaynagar	Payra	Shamspur
S98-03266	RIP1239	13/04/1998	22.982	89.479	1987	STW	25	Salim Mollah	Khulna	Jessore	Abhaynagar	Subharara	Ranagati
S98-03267	RIP1240	13/04/1998	23.046	89.398	1979	STW	49	Shorab Ali Sheaik	Khulna	Jessore	Abhaynagar	Sridharpur	Shankarpasha
S98-03268	RIP1241	13/04/1998	23.019	89.407	1979	STW	55	Ismail Mollah	Khulna	Jessore	Abhaynagar	Paurashava	Goakhola
S98-03269	RIP1243	14/04/1998	23.218	89.232	1970	STW	50	Bazar J. Mosque	Khulna	Jessore	Jessore Sadar	Ichhali	Hasimpur
S98-03270	RIP1244	14/04/1998	23.191	89.217	1990	STW	22	Mohidur Rahaman	Khulna	Jessore	Jessore Sadar	Noapara	Bahadurpur
S98-03271	RIP1245	14/04/1998	23.13	89.306	1988	STW	62	Idris Ali Mollah	Khulna	Jessore	Jessore Sadar	Narendrapur	Hatbila
S98-03272	RIP1247	16/04/1998	23.419	88.822	1986	STW	44	Thana Parishad	Khulna	Chuadanga	Jiban Nagar	Jiban Nagar	Jiban Nagar
S98-03273	RIP1248	16/04/1998	23.43	88.779	1985	STW	40	Abdul Latif Mandal	Khulna	Chuadanga	Jiban Nagar	Jiban Nagar	Umapur
S98-03274	RIP1249	16/04/1998	23.474	88.836	1993	STW	44	Asura Khatun	Khulna	Chuadanga	Jiban Nagar	Uthali	Santoshpur
S98-03275	RIP1250	16/04/1998	23.479	88.9	1991	STW	35	Union Parishad	Khulna	Chuadanga	Jiban Nagar	Andulbaria	Andulbaria
S98-03276	RIP1251	16/04/1998	23.44	88.92	1968	STW	50	Raipur P,School	Khulna	Chuadanga	Jiban Nagar	Banka	Raipur
S98-03277	RIP1253	17/04/1998	23.461	88.961	1996	STW	49	Sree Goya Rampal	Khulna	Jhenaidah	Kotchandpur	Sabdalpur	Sabdalpur
S98-03278	RIP1254	17/04/1998	23.501	88.956	1991	STW	43	Abdus Sukkur Ali	Khulna	Jhenaidah	Kotchandpur	Dora	Bhumara
S98-03279	RIP1255	17/04/1998	23.433	89.052	1960	STW	45	Abdus Sattar	Khulna	Jhenaidah	Kotchandpur	Elangi	Gurpara
S98-03280	RIP1256	17/04/1998	23.479	89.022	1998	STW	52	Talsar Bazar Mosque	Khulna	Jhenaidah	Kotchandpur	Kushna	Talsar
S98-03281	RIP1257	17/04/1998	23.409	89.014	1995	STW	25	Khan Abdur Razzaque	Khulna	Jhenaidah	Kotchandpur	Pourasava	Bazarpara
S98-03282	RIP1258	17/04/1998	23.408	89.013	1995	DTW	120	PTW # 2	Khulna	Jhenaidah	Kotchandpur	Pourasava	Bazarpara
S98-03283	RIP1260	19/04/1998	23.745	89.264	1996	Tara	47	Md. Nowsher Molla	Khulna	Jhenaidah	Shailkupa	Sarutia	Uttar krishnanag
S98-03284	RIP1261	19/04/1998	23.663	89.356	1988	Tara	49	Nazrul Islam	Khulna	Jhenaidah	Shailkupa	Dhalharachandra	Nandirgati
S98-03285	RIP1262	19/04/1998	23.68	89.239	1989	STW	24	Shastiram Karmakar	Khulna	Jhenaidah	Shailkupa	Paurashova, W03	Kabirpur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03238	4657661432	20	< 0.04	0.08	0.094	120	< 0.008	< 0.02	< 0.008	0.347	2	0.016	46.7	1.01	265	0.3	17.6	1	0.555	0.008	0.009
S98-03239	4657661995	184	< 0.04	0.06	0.144	129	< 0.008	< 0.02	< 0.008	6.2	1.2	0.008	39	0.756	71	0.2	19.1	< 0.2	0.515	< 0.006	< 0.008
S98-03240	4555706082	1	< 0.04	0.02	0.062	97.6	< 0.008	< 0.02	< 0.008	0.042	2.4	0.006	21.2	0.619	12.2	0.3	18.2	4.2	0.217	< 0.006	0.023
S98-03241	4555747812	28.9	< 0.04	0.02	0.114	104	< 0.008	< 0.02	< 0.008	4.42	2.3	< 0.003	18.6	0.206	9.2	0.4	15.3	< 0.2	0.24	< 0.006	< 0.008
S98-03242	4555761716	< 0.5	< 0.04	0.03	0.053	104	< 0.008	< 0.02	< 0.008	0.032	2.3	0.006	22.6	1.65	22.3	< 0.2	20.4	3.1	0.353	< 0.006	0.011
S98-03243	4555754473	106	< 0.04	0.03	0.438	94.9	< 0.008	< 0.02	< 0.008	5.25	3.2	0.003	25.3	0.138	20.2	1	20.1	< 0.2	0.305	< 0.006	< 0.008
S98-03244	4555727265	0.5	< 0.04	0.02	0.035	71.9	< 0.008	< 0.02	< 0.008	0.036	1.8	0.01	19	0.54	13.7	< 0.2	20.9	2.3	0.285	< 0.006	< 0.008
S98-03245	4555713308	9.1	< 0.04	0.09	0.07	124	< 0.008	< 0.02	< 0.008	6.24	1.5	0.006	48.5	1.47	98.7	0.4	22	< 0.2	0.751	< 0.006	< 0.008
S98-03246	4555794842	< 0.5	< 0.04	0.04	0.047	76.8	< 0.008	< 0.02	< 0.008	0.033	0.7	0.004	31.7	1.01	73.1	0.2	20.7	< 0.2	0.384	< 0.006	< 0.008
S98-03247	4555760952	33.3	0.05	0.02	0.142	117	< 0.008	< 0.02	< 0.008	0.279	3.5	0.008	27.8	0.503	26.6	< 0.2	20.4	0.4	0.341	< 0.006	< 0.008
S98-03248	4555760952	10.8	< 0.04	0.02	0.094	67	< 0.008	< 0.02	< 0.008	1.03	2	< 0.003	12	0.123	9.1	0.4	12.9	1.2	0.131	< 0.006	< 0.008
S98-03249	4556652615	168	< 0.04	0.04	0.062	110	< 0.008	< 0.02	< 0.008	3.79	3.9	0.008	26.8	3.14	17.7	0.5	25.3	< 0.2	0.522	< 0.006	< 0.008
S98-03250	4556673463	< 0.5	< 0.04	0.1	0.032	48.1	< 0.008	< 0.02	< 0.008	0.023	0.8	0.011	27.7	1.45	138	< 0.2	20.5	< 0.2	0.233	< 0.006	< 0.008
S98-03251	4556663717	< 0.5	< 0.04	0.04	0.096	94.6	< 0.008	< 0.02	< 0.008	0.066	1.3	< 0.003	38.8	2.31	73.9	0.6	18.1	< 0.2	0.559	< 0.006	< 0.008
S98-03252	4556621068	< 0.5	< 0.04	0.06	0.046	50.2	< 0.008	< 0.02	< 0.008	0.046	0.8	< 0.003	22.4	0.904	126	0.4	19.2	< 0.2	0.323	< 0.006	< 0.008
S98-03253	4556631205	< 0.5	< 0.04	0.04	0.05	104	< 0.008	< 0.02	< 0.008	0.028	1.3	0.005	30.1	0.879	29.1	0.2	25.6	< 0.2	0.422	0.006	< 0.008
S98-03254	4556610949	< 0.5	< 0.04	0.04	0.03	84.3	< 0.008	< 0.02	< 0.008	1.11	0.9	< 0.003	35.7	1.58	45.7	0.2	20.9	< 0.2	0.481	< 0.006	0.179
S98-03255	4556642341	7.5	< 0.04	0.04	0.032	87.3	< 0.008	< 0.02	< 0.008	0.062	3	0.013	34.3	0.753	31.1	< 0.2	23.3	2.6	0.4	< 0.006	< 0.008
S98-03256	4412347377	107	< 0.04	0.03	0.162	132	< 0.008	< 0.02	< 0.008	1.99	4	< 0.003	33.3	0.876	7.9	0.7	15.4	< 0.2	0.386	< 0.006	< 0.008
S98-03257	4412347541	72.4	< 0.04	0.02	0.165	123	< 0.008	< 0.02	< 0.008	4.47	2.1	0.004	24.9	0.178	17.7	0.2	18.4	< 0.2	0.28	< 0.006	0.028
S98-03258	4412335488	< 0.5	< 0.04	0.11	0.094	78.4	< 0.008	< 0.02	< 0.008	0.183	5.1	0.004	38.2	0.129	100	0.3	17.2	< 0.2	0.478	< 0.006	< 0.008
S98-03259	4412359373	201	< 0.04	0.04	0.154	128	< 0.008	< 0.02	< 0.008	2.31	3.9	< 0.003	26.4	0.918	29.2	0.3	16.4	4.8	0.338	< 0.006	< 0.008
S98-03260	4412341577	83.6	< 0.04	0.03	0.147	92	< 0.008	< 0.02	< 0.008	2.9	2.5	< 0.003	21	0.176	10.3	0.9	18.8	< 0.2	0.329	< 0.006	< 0.008
S98-03261	4412305093	107	0.05	0.03	0.188	77.9	< 0.008	< 0.02	< 0.008	3.01	2.2	0.005	18.9	0.077	13.7	0.9	19.1	< 0.2	0.28	0.006	0.008
S98-03262	4412383986	49.6	< 0.04	0.03	0.276	115	< 0.008	< 0.02	< 0.008	5.99	2.2	0.006	23.8	0.292	21.9	0.3	19.8	< 0.2	0.204	0.006	< 0.008
S98-03263	4410421099	< 0.5	< 0.04	0.08	0.105	130	< 0.008	< 0.02	< 0.008	0.041	1.2	0.02	35.6	0.401	264	0.3	17.4	7.8	0.709	0.008	< 0.008
S98-03264	4410431718	< 0.5	0.04	0.09	0.345	175	< 0.008	< 0.02	< 0.008	0.632	7.7	0.02	84.2	0.154	255	< 0.2	17.6	22.5	0.947	0.006	0.008
S98-03265	4410442906	77.7	< 0.04	0.16	0.124	74.4	< 0.008	< 0.02	< 0.008	5.12	3.1	0.005	24.6	0.065	242	1.1	16.7	< 0.2	0.438	< 0.006	< 0.008
S98-03266	4410484884	3	< 0.04	0.22	0.52	111	< 0.008	< 0.02	< 0.008	2.33	2.2	0.008	64	0.207	823	1	17.2	1.4	0.705	< 0.006	< 0.008
S98-03267	4410473917	355	< 0.01	0.03	0.23	104	< 0.003	< 0.002	< 0.008	4.62	3.9	< 0.003	21.9	1.02	28.5	0.3	19.1	< 0.2	0.362	< 0.002	0.009
S98-03268	4410431718	283	0.03	0.06	0.116	125	< 0.003	0.003	< 0.008	0.963	3.3	0.011	27.4	1.32	18.1	0.1	22.5	< 0.2	0.441	0.004	0.008
S98-03269	4414753434	1.7	0.03	0.06	0.06	102	< 0.003	< 0.002	< 0.008	0.046	1.4	< 0.003	38	1.19	73.4	0.2	21.8	< 0.2	0.411	0.005	0.008
S98-03270	4414789080	77.8	< 0.01	0.03	0.075	82.9	< 0.003	< 0.002	< 0.008	1.66	2.9	< 0.003	15.1	0.37	7	0.6	15.3	< 0.2	0.18	< 0.002	0.006
S98-03271	4414783438	121	< 0.01	0.06	0.155	72.1	< 0.003	0.002	< 0.008	2.94	1.8	0.014	25.7	0.406	119	0.4	17.8	1	0.326	< 0.002	0.008
S98-03272	4185557341	98.7	< 0.04	0.03	0.35	121	< 0.008	< 0.02	< 0.008	7.27	3.1	< 0.003	27.7	0.13	16.7	0.3	19.7	< 0.2	0.28	< 0.006	0.01
S98-03273	4185557980	15.5	< 0.04	0.02	0.225	129	< 0.008	< 0.02	< 0.008	3.3	2.7	< 0.003	35.8	0.058	20.7	< 0.2	17.2	18.3	0.332	< 0.006	< 0.008
S98-03274	4185576852	44.6	< 0.04	0.02	0.102	84.7	< 0.008	< 0.02	< 0.008	1.25	2.9	< 0.003	14.5	0.254	10.4	0.3	13.7	< 0.2	0.205	< 0.006	< 0.008
S98-03275	4185519028	< 0.5	< 0.04	0.1	0.482	145	< 0.008	< 0.02	< 0.008	0.062	49.8	0.005	68.3	0.499	48.6	< 0.2	11	40.4	0.498	< 0.006	< 0.008
S98-03276	4185538810	67.2	< 0.04	0.01	0.096	83	< 0.008	< 0.02	< 0.008	1.68	2.6	< 0.003	17.6	0.399	6.8	0.4	15.4	< 0.2	0.258	< 0.006	0.016
S98-03277	4444281847	9.6	< 0.04	0.01	0.153	125	< 0.008	< 0.02	< 0.008	1.5	4	< 0.003	27.4	0.351	14.6	< 0.2	14.3	10.9	0.259	< 0.006	0.01
S98-03278	4444227208	131	< 0.04	0.03	0.238	135	< 0.008	< 0.02	< 0.008	4.11	4.3	< 0.003	29.3	0.774	34.2	0.4	16.1	23.8	0.384	< 0.006	< 0.008
S98-03279	4444240429	37.2	< 0.04	0.02	0.24	114	< 0.008	< 0.02	< 0.008	2.54	2.6	< 0.003	27	1.92	18.7	0.7	20.3	< 0.2	0.335	< 0.006	0.008
S98-03280	4444267982	< 0.5	< 0.04	0.02	0.058	113	< 0.008	< 0.02	< 0.008	0.067	1.4	< 0.003	38.1	0.88	18.7	0.3	23	< 0.2	0.511	< 0.006	0.009
S98-03281	4444258263	< 0.5	< 0.04	0.02	0.04	95.5	< 0.008	< 0.02	< 0.008	0.726	3	< 0.003	18.8	1.15	17.7	< 0.2	13.2	9.1	0.232	< 0.006	0.017
S98-03282	4444258263	4.9	< 0.04	0.03	0.115	94.8	< 0.008	< 0.02	< 0.008	0.271	2.1	0.003	32.1	0.924	19.6	0.3	19.6	2.5	0.296	< 0.006	0.025
S98-03283	4448075973	< 0.5	< 0.04	0.02	0.053	99.2	< 0.008	< 0.02	0.01	0.254	1.3	0.008	30.2	0.56	34.2	0.2	20	< 0.2	0.448	< 0.006	0.01
S98-03284	4448018714	21.2	< 0.04	0.04	0.271	125	< 0.008	< 0.02	< 0.008	12.7	2	0.008	35.2	0.287	68.4	1	19.7	< 0.2	0.455	< 0.006	0.081
S98-03285	4448003	83.8	< 0.04	0.02	0.208	151	< 0.008	< 0.02	< 0.008	3.86	3.8	< 0.003	36.4	0.858	14.4	0.2	15.2	10.1	0.441	< 0.006	0.011

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03286	RIP1263	19/04/1998	23.686	89.253	1985	DTW	217	Thana Parishad	Khulna	Jhenaidah	Shailkupa	Paurashova, W01	Tpc
S98-03287	RIP1264	19/04/1998	23.663	89.199	1975	STW	20	Md. Nekbar Hossain	Khulna	Jhenaidah	Shailkupa	Umedpur	Garakhola
S98-03288	RIP1265	19/04/1998	23.711	89.151	1975	Tara	49	Tababur Rahman	Khulna	Jhenaidah	Shailkupa	Tribeni	Padamdi
S98-03289	RIP1266	19/04/1998	23.693	89.178	1994	STW	49	Mojibur Rahman	Khulna	Jhenaidah	Shailkupa	Mirzapur	Mirzapur
S98-03290	RIP1267	19/04/1998	23.643	89.201	1997	STW	54	Santipoda Datta	Khulna	Jhenaidah	Shailkupa	Dudshar	Shailkopa
S98-03291	RIP1269	20/04/1998	23.653	89.048	1994	STW	49	Thana Parishad	Khulna	Jhenaidah	Harinakunda	Harinakunda	Harinakunda
S98-03292	RIP1270	20/04/1998	23.719	89.077	1997	STW	44	Monsur Ali Fakir	Khulna	Jhenaidah	Harinakunda	Joradaha	Joradah
S98-03293	RIP1271	20/04/1998	23.651	89.123	1991	STW	50	Mahtab Uddin	Khulna	Jhenaidah	Harinakunda	Ragunathpur	Porahati
S98-03294	RIP1272	20/04/1998	23.648	89.047	1992	STW	72	Thana Health Complex	Khulna	Jhenaidah	Harinakunda	Harinakunda	Harinakunda
S98-03295	RIP1273	20/04/1998	23.606	89.075	1973	STW	45	Kapashatia U/C	Khulna	Jhenaidah	Harinakunda	Kapashatia	Bhalikishtali
S98-03296	RIP1274	20/04/1998	23.579	89.129	1995	STW	40	Chandpur Pry. School	Khulna	Jhenaidah	Harinakunda	Chandpur	Chandpur
S98-03297	RIP1276	21/04/1998	23.86	89.238	1997	DTW	121	Pourashova	Khulna	Kushtia	Kumarkhali	Paurashova	Kalibari
S98-03298	RIP1277	21/04/1998	23.901	89.259	1988	STW	35	Hashimpur Bazar	Khulna	Kushtia	Kumarkhali	Jaganathpur	Hashimpur
S98-03299	RIP1278	21/04/1998	23.906	89.225	1986	Tara	37	Haidar Ali	Khulna	Kushtia	Kumarkhali	Shelaidaha	Gobrakhali
S98-03300	RIP1279	21/04/1998	23.898	89.186	1992	Tara	40	Md. Mozibur Rahman	Khulna	Kushtia	Kumarkhali	Kaya	Uttar kaya
S98-03301	RIP1280	21/04/1998	23.86	89.163	1998	Tara	42	Shorab Ali	Khulna	Kushtia	Kumarkhali	Chapra	Shymnagar
S98-03302	RIP1281	31/03/1998	22.86	89.877	1993	STW	19	Eklasur Rahaman	Khulna	Bagerhat	Chitalmari	Kalatala	Chingari
S98-03303	RIP1282	31/03/1998	22.82	89.874	1989	STW	25	DPHE Sub-center	Khulna	Bagerhat	Chitalmari	Hizla	Hizla
S98-03304	RIP1283	31/03/1998	22.803	89.901	1975	STW	21	Bolia High School	Khulna	Bagerhat	Chitalmari	Hizla	Boalia
S98-03305	RIP1284	31/03/1998	22.791	89.876	1975	STW	20	TNO Resident	Khulna	Bagerhat	Chitalmari	Chitalmari	Aruabarri
S98-03306	RIP1287	01/04/1998	22.532	89.59	1994	STW	13	Kalipadha Roy	Khulna	Bagerhat	Mongla	Buridanga	Bidyarboandigraj
S98-03307	RIP1288	01/04/1998	22.476	89.597	1996	STW	16	Mongla Bus Stand	Khulna	Bagerhat	Mongla	Paurashava w02	Mongla bus stand
S98-03308	RIP1289	01/04/1998	22.469	89.605	1995	STW	13	Hosneara Begum	Khulna	Bagerhat	Mongla	Paurashava w03	Char salabunia
S98-03309	RIP1290	02/04/1998	23.213	89.488	1996	STW	50	Abdul Aziz	Khulna	Narail	Narail Sadar	Shahabad	Sharashpur
S98-03310	RIP1291	02/04/1998	23.223	89.45	1997	STW	62	Rustam Ali Shikdar	Khulna	Narail	Narail Sadar	Maij para	Hossainpur
S98-03311	RIP1292	02/04/1998	23.269	89.498	1997	STW	21	Nanda Dulal	Khulna	Narail	Narail Sadar	Habakhali	Harighara
S98-03312	RIP1295	04/04/1998	23.581	89.444	1977	STW	49	Md. Yunus Ali	Khulna	Magura	Sreepur (M)	Sabdalpur	Naohata
S98-03313	RIP1296	04/04/1998	23.558	89.493	1996	STW	44	Nakol H. School	Khulna	Magura	Sreepur (M)	Nakol	Nakol
S98-03314	RIP1297	04/04/1998	23.437	89.465	1997	Tara	52	Taiabur Rahaman	Khulna	Magura	Sreepur (M)	Dariapur	Dariapur
S98-03315	RIP1298	04/04/1998	23.643	89.435	1996	Tara	49	Didar Hossain	Khulna	Magura	Sreepur (M)	Amalsar	Ramchandpur
S98-03316	RIP1299	04/04/1998	23.636	89.374	1963	STW	43	Chaturia P. School	Khulna	Magura	Sreepur (M)	Gayeshpur	Chaturia
S98-03317	RIP1300	04/04/1998	23.594.	89.369		Tara	47	Aktar Hossain	Khulna	Magura	Sreepur (M)	Sreekul	Purba srikol
S98-03318	RIP1311	21/04/1998	23.809	89.23	1970	STW	35	Chowrangi Bazar	Khulna	Kushtia	Kumarkhali	Panti	Bhaluka
S98-03319	RIP1312	21/04/1998	23.772	89.194	1989	STW	42	Faizur Rahman	Khulna	Kushtia	Kumarkhali	Chandpur	Mohannagar
S98-03320	RIP1314	22/04/1998	24.011	88.877	1983	STW	39	Thana HQ	Khulna	Kushtia	Daulatpur (Ku)	Daulatpur	Daulatpur
S98-03321	RIP1315	22/04/1998	24.096	88.924	1994	Tara	31	Hatkhola Mosque	Khulna	Kushtia	Daulatpur (Ku)	Maricha	Koldiar
S98-03322	RIP1316	22/04/1998	24.015	88.944	1997	Tara	42	Hamiduzzaman Biswas	Khulna	Kushtia	Daulatpur (Ku)	Pearpur	Madia
S98-03323	RIP1317	22/04/1998	24.05	88.766	1975	STW	35	Md Nizam Uddin	Khulna	Kushtia	Daulatpur (Ku)	Ramkrishnapur	Mhishkunda
S98-03324	RIP1318	22/04/1998	24.046	88.836	1994	Tara	44	Md Yad Ali Sardar	Khulna	Kushtia	Daulatpur (Ku)	Mathurapur	Majdia
S98-03325	RIP1319	22/04/1998	23.952	88.881	1996	STW	34	Altaf Hossain Mondal	Khulna	Kushtia	Daulatpur (Ku)	Aria	Baraganjadia
S98-03326	RIP1320	22/04/1998	23.982	88.838	1996	Tara	40	Md. Mhir uddin	Khulna	Kushtia	Daulatpur (Ku)	Boalia	Shehala
S98-03327	RIP1322	26/04/1998	22.715	90.352	1987	DTW	292	Bachhu Mia	Barisal	Barisal	Barisal Sadar	Kashipur	Kashipur
S98-03328	RIP1323	26/04/1998	22.736	90.381	1987	STW	22	DPHE Office	Barisal	Barisal	Barisal Sadar	Char baria	Char baria
S98-03329	RIP1324	26/04/1998	22.739	90.379	1991	DTW	322	Ttalti Mosque	Barisal	Barisal	Barisal Sadar	Char baria	Char baria
S98-03330	RIP1325	26/04/1998	22.696	90.377	1995	STW	27	IWTA	Barisal	Barisal	Barisal Sadar	Paurashava	Mazidbari
S98-03331	RIP1326	26/04/1998	22.696	90.373	1996	DTW	315	DPHE Office	Barisal	Barisal	Barisal Sadar	Mazidbari	Mazidbari
S98-03332	RIP1327	26/04/1998	22.702	90.357	1996	DTW	331	DPHE Office	Barisal	Barisal	Barisal Sadar	Paurashava W06	Bagura
S98-03333	RIP1329	27/04/1998	22.893	90.506	1974	STW	14	Subregistry Office	Barisal	Barisal	Hizla	Barjalia	Khunna

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03286	4448001	1.4	< 0.04	0.03	0.154	111	< 0.008	< 0.02	< 0.008	0.259	3	0.009	38.3	0.319	41.1	< 0.2	21.3	< 0.2	0.507	< 0.006	< 0.008
S98-03287	4448094373	5.1	< 0.04	0.01	0.177	91.5	< 0.008	< 0.02	< 0.008	1.64	2.1	< 0.003	18.6	0.07	13.8	< 0.2	12.6	6.9	0.208	< 0.006	< 0.008
S98-03288	4448088747	14.8	< 0.04	0.02	0.24	90.1	< 0.008	< 0.02	< 0.008	3.45	3.5	< 0.003	18.5	0.652	22	< 0.2	14.6	18.9	0.219	< 0.006	0.013
S98-03289	4448063670	281	< 0.04	0.02	0.147	72.8	< 0.008	< 0.02	< 0.008	6.42	2.9	< 0.003	18.7	0.139	12.4	0.7	15	< 0.2	0.294	< 0.006	< 0.008
S98-03290	4448031340	30.8	< 0.04	0.01	0.279	117	< 0.008	< 0.02	< 0.008	5.46	2.9	< 0.003	26.3	0.324	56.1	0.6	15.5	42.3	0.298	< 0.006	< 0.008
S98-03291	4441442387	15.8	< 0.04	< 0.01	0.146	89.6	< 0.008	< 0.02	< 0.008	1.96	1.7	< 0.003	27.5	0.824	14.7	0.4	18.8	< 0.2	0.352	< 0.006	< 0.008
S98-03292	4441452465	18.9	< 0.04	0.02	0.099	74.8	< 0.008	< 0.02	< 0.008	2.49	4	< 0.003	18.6	0.213	13.8	< 0.2	15.9	< 0.2	0.18	< 0.006	0.008
S98-03293	4441473775	0.8	< 0.04	0.02	0.06	56.8	< 0.008	< 0.02	< 0.008	0.245	2.2	< 0.003	11.7	0.056	13.6	< 0.2	9.99	7.5	0.11	< 0.006	0.01
S98-03294	4441442387	< 0.5	< 0.04	0.01	0.04	77.3	< 0.008	< 0.02	< 0.008	0.042	0.8	< 0.003	26.2	1.58	16.4	< 0.2	20.1	9.7	0.268	< 0.006	0.539
S98-03295	4441463142	135	< 0.04	0.02	0.043	108	< 0.008	< 0.02	< 0.008	6.17	2.4	< 0.003	26.2	0.513	18.3	0.6	19.7	< 0.2	0.29	< 0.006	< 0.008
S98-03296	4441421206	11.7	< 0.04	< 0.01	0.157	83	< 0.008	< 0.02	< 0.008	2.31	2	< 0.003	16.4	0.18	10.2	0.3	14.1	3.1	0.189	< 0.006	< 0.008
S98-03297	4507170	4.7	< 0.04	0.02	0.177	118	< 0.008	< 0.02	< 0.008	0.07	3.3	0.009	40	0.163	35.1	< 0.2	20.2	< 0.2	0.488	< 0.006	0.046
S98-03298	4507143431	377	< 0.04	0.04	0.334	162	< 0.008	< 0.02	< 0.008	8.23	4.7	< 0.003	39.9	2.04	16.2	0.4	19.4	< 0.2	0.7	< 0.006	< 0.008
S98-03299	4507194377	11.7	< 0.04	0.03	0.126	127	< 0.008	< 0.02	< 0.008	2.45	1	0.008	33.8	0.417	30.1	< 0.2	20.3	< 0.2	0.441	< 0.006	< 0.008
S98-03300	4507151984	< 0.5	< 0.01	< 0.1	0.077	23.2	< 0.003	< 0.002	< 0.008	< 0.005	1.8	0.014	29.1	0.01	35.9	< 0.1	22.5	0.8	0.385	0.004	0.004
S98-03301	4507125434	1.3	< 0.01	< 0.1	0.036	24.9	< 0.003	< 0.002	< 0.008	0.025	1.3	0.005	31.2	0.013	23.8	< 0.1	24.2	0.2	0.351	< 0.002	0.033
S98-03302	4011466254	398	< 0.01	< 0.1	0.11	38.7	< 0.003	< 0.002	< 0.008	8.89	6.5	< 0.004	37.7	0.051	43.2	0.3	20.3	0.8	0.527	< 0.002	0.006
S98-03303	4011447397	186	< 0.01	< 0.1	0.116	49.5	< 0.003	< 0.002	< 0.008	6.36	5	0.004	42.2	0.024	50	0.4	33.6	0.8	0.441	< 0.002	0.009
S98-03304	4011447110	170	< 0.01	< 0.1	0.099	44.6	< 0.003	< 0.002	< 0.008	5.42	5.4	< 0.004	35	0.149	17.5	0.3	24.5	0.8	0.475	< 0.002	0.015
S98-03305	4011431031	134	< 0.01	0.2	0.095	95.6	< 0.003	< 0.002	< 0.008	0.908	16.3	< 0.004	95.1	0.018	79.5	0.6	27.4	0.9	0.767	< 0.002	0.301
S98-03306	4015827216	14	< 0.01	0.6	0.151	89.6	< 0.003	< 0.002	< 0.008	1.21	14.1	0.017	81.4	0.014	1140	2.9	29.4	1.5	0.639	< 0.002	0.021
S98-03307	4015864	< 0.5	< 0.01	0.5	0.099	42.4	< 0.003	< 0.002	< 0.008	1.33	24.6	0.032	99.8	0.052	897	0.1	26.3	0.9	0.639	< 0.002	0.03
S98-03308	4015864408	4.1	0.52	0.52	0.377	227	< 0.008	< 0.02	< 0.008	10.1	35.6	0.01	157	3.24	1190	0.5	19.4	84.5	1.04	0.011	0.117
S98-03309	4657674856	< 0.5	0.06	0.08	0.059	86.1	< 0.008	< 0.02	< 0.008	0.171	0.8	0.005	25.6	1.33	73.6	0.2	17.9	< 0.2	0.282	0.007	< 0.008
S98-03310	4657654503	< 0.5	< 0.04	0.04	0.175	97.2	< 0.008	< 0.02	< 0.008	5.2	4.4	0.005	31.6	0.418	33.2	0.9	19.3	< 0.2	0.442	< 0.006	< 0.008
S98-03311	4657640475	1.2	< 0.04	0.06	0.108	115	< 0.008	< 0.02	< 0.008	0.078	1.7	0.005	43.4	2.66	204	0.3	18.4	< 0.2	0.54	0.007	< 0.008
S98-03312	4559563683	2.8	< 0.04	0.04	0.065	122	< 0.008	< 0.02	< 0.008	0.056	0.7	0.009	34.1	1.96	29.4	< 0.2	26	< 0.2	0.548	0.01	< 0.008
S98-03313	4559552647	< 0.5	0.04	0.02	0.034	79.2	< 0.008	< 0.02	< 0.008	0.059	0.8	0.004	20.6	2.76	13.4	< 0.2	21.1	5.6	0.35	0.008	< 0.008
S98-03314	4559521275	< 0.5	< 0.04	0.04	0.057	106	< 0.008	< 0.02	< 0.008	0.018	0.8	0.013	35.5	1.19	56.9	< 0.2	23.1	< 0.2	0.47	0.007	< 0.008
S98-03315	4559510011	< 0.5	< 0.04	0.06	0.061	96	< 0.008	< 0.02	< 0.008	0.025	0.8	0.008	39.1	1.06	79.4	< 0.2	21.2	< 0.2	0.412	0.007	< 0.008
S98-03316	4559531227	15.2	< 0.04	0.05	0.071	115	< 0.008	< 0.02	< 0.008	0.213	1	0.009	39.6	0.656	86.4	< 0.2	20.1	< 0.2	0.492	0.007	< 0.008
S98-03317	4559573743	< 0.5	0.04	0.05	0.142	114	< 0.008	< 0.02	< 0.008	5.2	2.4	0.009	35.2	0.161	38	0.3	19.2	< 0.2	0.61	< 0.006	0.013
S98-03318	4507177162	4.4	0.07	0.03	0.086	89	< 0.008	< 0.02	< 0.008	0.037	0.6	0.004	25.4	0.385	34.5	0.3	20	1.6	0.337	< 0.006	< 0.008
S98-03319	4507117694	0.7	< 0.04	0.03	0.148	91.6	< 0.008	< 0.02	< 0.008	3.91	2.2	0.004	27.3	0.099	22.1	2.5	18.7	< 0.2	0.352	< 0.006	< 0.008
S98-03320	4503933337	135	< 0.04	0.02	0.203	108	< 0.008	< 0.02	< 0.008	2.29	3.6	0.004	23.3	0.871	11.1	< 0.2	14.1	< 0.2	0.33	< 0.006	1.7
S98-03321	4503909542	665	< 0.04	0.06	0.292	154	< 0.008	< 0.02	< 0.008	6.45	7.9	0.004	53.5	0.371	27.2	0.7	11.6	< 0.2	0.757	0.006	0.019
S98-03322	4503937596	< 0.5	< 0.04	0.03	0.211	102	< 0.008	< 0.02	< 0.008	2.35	1.6	0.008	27.1	0.494	20.6	0.3	19.8	< 0.2	0.352	< 0.006	0.052
S98-03323	4503988612	< 0.5	0.08	0.03	0.176	111	< 0.008	< 0.02	< 0.008	4.1	2	0.005	32.2	0.382	11	0.5	14.7	11.7	0.391	< 0.006	< 0.008
S98-03324	4503961615	< 0.5	< 0.04	0.02	0.067	128	< 0.008	< 0.02	< 0.008	0.032	0.9	0.011	38.1	0.774	51.5	< 0.2	19.6	3	0.439	0.008	< 0.008
S98-03325	4503913090	< 0.5	< 0.04	0.03	0.193	132	< 0.008	< 0.02	< 0.008	3.88	4.7	0.004	27.2	0.903	31.7	0.2	13.2	22.3	0.367	< 0.006	< 0.008
S98-03326	4503910862	< 0.5	< 0.04	0.03	0.213	143	< 0.008	< 0.02	< 0.008	5.13	2.2	0.003	34.2	1.5	35.1	0.3	16.7	< 0.2	0.358	0.006	< 0.008
S98-03327	1065169555	42.8	< 0.04	0.25	0.014	5	< 0.008	< 0.02	< 0.008	0.067	1.5	0.005	2.57	0.02	154	0.3	11.2	0.2	0.063	< 0.006	< 0.008
S98-03328	1065134285	< 0.5	< 0.04	0.16	0.054	60.2	0.042	< 0.02	< 0.008	2.3	7.1	0.003	30.8	0.589	52.2	1.2	13.6	< 0.2	0.28	< 0.006	< 0.008
S98-03329	1065134285	< 0.5	< 0.04	0.24	0.02	5.42	< 0.008	< 0.02	< 0.008	0.114	1.5	0.005	2.72	0.028	178	0.3	11.3	< 0.2	0.0576	< 0.006	< 0.008
S98-03330	1065148537	385	< 0.04	0.1	0.178	151	< 0.008	< 0.02	< 0.008	10.9	6.6	< 0.003	35.4	0.321	35.1	2.5	20.7	< 0.2	0.52	< 0.006	< 0.008
S98-03331	10651	2.8	< 0.04	0.2	0.018	7.77	< 0.008	< 0.02	< 0.008	0.091	2.1	0.005	4.08	0.028	157	0.3	11.5	< 0.2	0.0928	< 0.006	0.011
S98-03332	1065148134	54	< 0.04	0.28	0.01	4.43	< 0.008	< 0.02	< 0.008	0.073	1.5	0.004	2.53	0.016	166	0.4	11.4	0.2	0.0588	< 0.006	< 0.008
S98-03333	1063613	41.5	< 0.04	0.03	0.077	78.8	< 0.008	< 0.02	< 0.008	0.59	2.4	0.004	15.8	0.664	15.4	0.5	14.5	8.1	0.227	< 0.006	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03334	RIP1330	27/04/1998	22.884	90.568	1965	STW	15	Union Parishad	Barisal	Barisal	Hizla	Dhulkhola	Palpara
S98-03335	RIP1332	20/04/1998	23.546	89.163	1990	HTW	45	DPHE Thana Office	Khulna	Jhenaidah	Jhenaidah Sadar	Pourasava	Beparipara
S98-03336	RIP1333	20/04/1998	23.664	89.132	1997	STW	30	PBS Campus	Khulna	Jhenaidah	Jhenaidah Sadar	Kumrabaria	Rautail
S98-03337	RIP1335	21/04/1998	23.765	89.302	1985	STW	43	Pritosh Sarkar	Khulna	Kushtia	Khoksa	Janipur	Ishwardi
S98-03338	RIP1336	21/04/1998	23.84	89.32		STW	38	Md. Abdur Rahman	Khulna	Kushtia	Khoksa	Samaspur	Uttar shyampur
S98-03339	RIP1337	21/04/1998	23.869	89.346	1986	STW	38	Uthali Mosque	Khulna	Kushtia	Khoksa	Samaspur	Uthali
S98-03340	RIP1338	21/04/1998	23.807	89.285	1982	DTW	98	Thana HQ	Khulna	Kushtia	Khoksa	Khoksa	Khoksa
S98-03341	RIP1339	21/04/1998	23.807	89.285	1990	Tara	37	DPHE Complex	Khulna	Kushtia	Khoksa	Khoksa	Khoksa
S98-03342	RIP1342	22/04/1998	24.058	88.992	1989	STW	49	Abdul Bari	Khulna	Kushtia	Bheramara	Mokarampur	Mokarampur
S98-03343	RIP1343	22/04/1998	24.102	88.985	1978	STW	35	Mr. Adil Uddin	Khulna	Kushtia	Bheramara	Mokarimpur	Golapnagar
S98-03344	RIP1344	22/04/1998	24.102	88.985	1997	DTW	97	Md. Rezaul Karim	Khulna	Kushtia	Bheramara	Mokarimpur	Golapnagar
S98-03345	RIP1345	22/04/1998	24.01	88.931	1997	Tara	41	Md. Dalil Uddin	Khulna	Kushtia	Bheramara	Juniadaha	Fazliapur
S98-03346	RIP1346	22/04/1998	24.07	88.96	1997	STW	45	Shibul Islam	Khulna	Kushtia	Bheramara	Junidaha	Jikriparankhali
S98-03347	RIP1347	22/04/1998	24.024	88.959	1990	STW	36	Mrs. Hamida Khatun	Khulna	Kushtia	Bheramara	Dharampur	Satbaria
S98-03348	RIP1348	22/04/1998	23.816	88.981	1994	Tara	42	Mozibur Rahman	Khulna	Kushtia	Mirpur (K)	Ambaria	Halsa
S98-03349	RIP1349	22/04/1998	23.863	88.975	1972	STW	41	S. N. Kandi Pry. Sch	Khulna	Kushtia	Mirpur (K)	Chhatian	Chhatian
S98-03350	RIP1350	22/04/1998	23.891	89.064	1996	STW	36	Md. Kurban Ali	Khulna	Kushtia	Mirpur (K)	Poradaha	Ahmedpur
S98-03351	RIP1351	05/04/1998	23.008	89.584	1994	STW	66	Daud Bishwas	Khulna	Narail	Kalia	Benda	Bishnupur
S98-03352	RIP1352	05/04/1998	23.044	89.603	1993	STW	51	Supryo Shaha	Khulna	Narail	Kalia	Babra hachla	Baraipara
S98-03353	RIP1355	12/04/1998	23.118	88.93	1982	STW	40	Abul Hossain	Khulna	Jessore	Sharsha	Lakshmanpur	Badepukuria
S98-03354	RIP1356	12/04/1998	23.056	88.953	1998	DTW	199	Thana Parishad	Khulna	Jessore	Sharsha	Sarsa	Sarsa
S98-03355	RIP1357	12/04/1998	23.056	88.953	1984	STW	39	Sarsa Bas-stand	Khulna	Jessore	Sharsha	Sarsa	Sarsa
S98-03356	RIP1358	12/04/1998	23.044	88.901	1982	STW	44	Md Shahadat Hossain	Khulna	Jessore	Sharsha	Benapole	Benapole
S98-03357	RIP1359	12/04/1998	23.011	88.9	1978	STW	41	Sabder Hossain	Khulna	Jessore	Sharsha	Putkhali	Sikri
S98-03358	RIP1360	12/04/1998	22.945	88.936	1980	STW	39	Md Azizur Rahaman	Khulna	Jessore	Sharsha	Kayba	Baikala
S98-03359	RIP1361	12/04/1998	23.015	88.964	1977	STW	44	Ayub Hossain	Khulna	Jessore	Sharsha	Ulashi	Dhaldaha
S98-03360	RIP1363	13/04/1998	22.855	89.19	1993	STW	26	Zulmat Ali	Khulna	Jessore	Keshabpur	Bidyanandakati	Burihati
S98-03361	RIP1364	13/04/1998	22.826	89.161	1978	STW	51	Altaf Ali	Khulna	Jessore	Keshabpur	Sagardari	Sagardari
S98-03362	RIP1365	13/04/1998	22.907	89.168	1983	STW	39	Karamat Ali	Khulna	Jessore	Keshabpur	Trimohini	Janpur
S98-03363	RIP1366	13/04/1998	22.891	89.267	1997	STW	39	Magurkhali P. School	Khulna	Jessore	Keshabpur	Magalkot	Magurkhali
S98-03364	RIP1367	13/04/1998	22.912	89.324	1997	DTW	203	Jagadis Mandal	Khulna	Jessore	Keshabpur	Sufalakati	Kalicharanpur
S98-03365	RIP1368	13/04/1998	22.912	89.324	1993	STW	50	Arabinda	Khulna	Jessore	Keshabpur	Sufalakati	Kalicharanpur
S98-03366	RIP1369	13/04/1998	22.872	89.317	1960	STW	49	Bherchi Mosque	Khulna	Jessore	Keshabpur	Gaurighona	Bherchi
S98-03367	RIP1370	14/04/1998	23.262	89.178	1993	STW	34	Nur Mohammad	Khulna	Jessore	Jessore Sadar	Haibatpur	Uttar lalitadaha
S98-03368	RIP1371	14/04/1998	23.222	89.149	1996	STW	49	Md Abdur Rouf	Khulna	Jessore	Jessore Sadar	Churamankati	Bagdanga
S98-03369	RIP1372	14/04/1998	23.17	89.138	1990	STW	25	Md Abdur Bakkar	Khulna	Jessore	Jessore Sadar	Diara	Alamnagar
S98-03370	RIP1373	14/04/1998	23.127	89.18	1987	Tara	49	Md Samsur Gani	Khulna	Jessore	Jessore Sadar	Chanchra	Maidia
S98-03371	RIP1374	14/04/1998	23.178	89.195	1985	DTW	148	Abdul Kuddus Dolan	Khulna	Jessore	Jessore Sadar	Paurashava w02	Puratan kasba
S98-03372	RIP1375	14/04/1998	23.179	89.197	1993	STW	49	Anisur Rahaman	Khulna	Jessore	Jessore Sadar	Paurashava w02	Puratan kasba
S98-03373	RIP1376	14/04/1998	23.15	89.209	1979	STW	49	Azizul Haq	Khulna	Jessore	Jessore Sadar	Paurashava w04	Nazir shankarpur
S98-03374	RIP1377	14/04/1998	23.162	89.209	1995	STW	50	DPHE Office	Khulna	Jessore	Jessore Sadar	Paurashava w03	P. off. para
S98-03375	RIP1379	16/04/1998	23.601	88.775	1985	DTW	92	Thana Parishad	Khulna	Chuadanga	Damurhuda	Damurhuda	Dasami
S98-03376	RIP1380	16/04/1998	23.544	88.758	1997	STW	38	Md Sultan Ali	Khulna	Chuadanga	Damurhuda	Kuralgachhi	Khorda Piratappu
S98-03377	RIP1381	16/04/1998	23.498	88.749	1980	STW	45	Md Matiur Rahaman	Khulna	Chuadanga	Damurhuda	Darsana	Chhota Baldia
S98-03378	RIP1382	16/04/1998	23.617	88.658	1979	STW	40	Mr Wahed Khan	Khulna	Chuadanga	Damurhuda	Kapasdanga	Harirampur
S98-03379	RIP1383	16/04/1998	23.599	88.728	1995	STW	30	Muktarpur P. School	Khulna	Chuadanga	Damurhuda	Damurhuda	Muktarpur
S98-03380	RIP1384	16/04/1998	23.693	88.799	1993	STW	45	Kamruzzaman	Khulna	Chuadanga	Damurhuda	Juranpur	Ramnagar
S98-03381	RIP1385	16/04/1998	23.654	88.713	1991	STW	37	Aziz Kibria	Khulna	Chuadanga	Damurhuda	Natipota	Natipota

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03382	RIP1387	17/04/1998	23.579	88.947	1990	Tara	42	Mr Lutfar Rahaman	Khulna	Chuadanga	Chuadanga Sadar	Kutubpur	Boalia
S98-03383	RIP1388	17/04/1998	23.618	88.92	1991	STW	39	Md Ayub Ali	Khulna	Chuadanga	Chuadanga Sadar	Mominpur	Subdi
S98-03384	RIP1389	17/04/1998	23.67	88.82	1984	STW	43	Alokdia Mosque	Khulna	Chuadanga	Chuadanga Sadar	Alokdia	Alokdia
S98-03385	RIP1390	17/04/1998	23.644	88.844	1982	DTW	115	Md Abdur Rahim	Khulna	Chuadanga	Chuadanga Sadar	Paurashava w01	Hajerpara
S98-03386	RIP1391	17/04/1998	23.644	88.844	1988	STW	30	Paurashava Bhaban	Khulna	Chuadanga	Chuadanga Sadar	Paurashava w01	Majerpara
S98-03387	RIP1393	18/04/1998	23.816	88.748	1997	STW	20	TNO Residence	Khulna	Meherpur	Gangni	Shaharbati	Shaharbati
S98-03388	RIP1394	18/04/1998	23.816	88.748	1983	DTW	105	T.T.D.C.	Khulna	Meherpur	Gangni	Shaharbati	Shaharbati
S98-03389	RIP1395	18/04/1998	23.824	88.811	1995	STW	44	Akbar Mandal	Khulna	Meherpur	Gangni	Gangni	Gangni
S98-03390	RIP1396	18/04/1998	23.91	88.855	1997	STW	39	Md Khairullah Shah	Khulna	Meherpur	Gangni	Matmura	Hogalbaria
S98-03391	RIP1397	18/04/1998	23.898	88.734	1970	STW	33	Palashipara J. Mosq.	Khulna	Meherpur	Gangni	Tentulbaria	Tentulbaria
S98-03392	RIP1398	18/04/1998	23.851	88.654	1979	STW	39	Abdur Rashed	Khulna	Meherpur	Gangni	Kathuli	Garabaria
S98-03393	RIP1400	19/04/1998	23.364	89.193	1994	Tara	51	Sri Sorajit kumar Sa	Khulna	Jhenaidah	Kaliganj (J)	Maliat	Bethuli
S98-03394	RIP1401	19/04/1998	23.363	89.157	1985	STW	50	Dayapur Pry. School	Khulna	Jhenaidah	Kaliganj (J)	Raigram	Dayapur
S98-03395	RIP1402	19/04/1998	23.295	89.159	1983	STW	51	Md. Nurul Islam	Khulna	Jhenaidah	Kaliganj (J)	Borabazar	Bodedihi
S98-03396	RIP1403	19/04/1998	23.336	89.084	1983	STW	54	Abdus Sobhan Chow	Khulna	Jhenaidah	Kaliganj (J)	Rakhalgachhi	Rakhalgachhi
S98-03397	RIP1404	19/04/1998	23.395	89.08	1985	STW	55	Md. Helal Uddin	Khulna	Jhenaidah	Kaliganj (J)	Trilochan	Ghighati
S98-03398	RIP1405	19/04/1998	23.406	89.131	1996	STW	55	Arpara Orphanage	Khulna	Jhenaidah	Kaliganj (J)	Pourasava	Arpara
S98-03399	RIP1406	19/04/1998	23.406	89.131	1995	DTW	134	Kaliganj	Khulna	Jhenaidah	Kaliganj (J)	Pourasava	Arpara
S98-03400	RIP1407	20/04/1998	23.551	89.015	1993	STW	44	Md. Sanar Uddin	Khulna	Jhenaidah	Jhenaidah Sadar	Sadhuhati	Sadhuhati
S98-03401	RIP1408	20/04/1998	23.505	89.046	1996	STW	49	Abdul Gofur	Khulna	Jhenaidah	Jhenaidah Sadar	Madhuhati	Mirzapur
S98-03402	RIP1409	20/04/1998	23.566	89.048	1979	STW	49	Nur Mohmmad	Khulna	Jhenaidah	Jhenaidah Sadar	Sagenna	Baidanga
S98-03403	RIP1410	20/04/1998	23.543	89.074	1997	STW	30	R. Pur. Govt. Pry. S	Khulna	Jhenaidah	Jhenaidah Sadar	Halidhani	Ramchandrapur
S98-03404	RIP1411	05/04/1998	23.044	89.679	1996	STW	49	Shikazul Islam	Khulna	Narail	Lohagara (N)	Itna	Itna
S98-03405	RIP1412	05/04/1998	23.239	89.62	1992	STW	58	Sharif H Rahaman	Khulna	Narail	Lohagara (N)	Joypur	Barba
S98-03406	RIP1413	05/04/1998	23.258	89.591	1993	STW	61	Abdus Sattar	Khulna	Narail	Lohagara (N)	Lahuria	Sarsuna
S98-03407	RIP1414	05/04/1998	23.21	89.594	1990	STW	53	Kalagachhi Bazar	Khulna	Narail	Lohagara (N)	Noagram	Kalagachhi
S98-03408	RIP1415	05/04/1998	23.181	89.645	1979	STW	60	Sayed Khalad Hossain	Khulna	Narail	Lohagara (N)	Lakhsmipasha	Lakhsmipasha
S98-03409	RIP1418	12/04/1998	23.267	89.021	1983	STW	45	DPHE Office	Khulna	Jessore	Chaugachha	Chaugachha	Chaugachha
S98-03410	RIP1419	12/04/1998	23.3	88.99	1993	STW	44	B.tala P. School	Khulna	Jessore	Chaugachha	Narayanpur	Bundatitala
S98-03411	RIP1420	12/04/1998	23.274	88.992	1992	STW	48	Md Earshad Ali	Khulna	Jessore	Chaugachha	Kharingha	Kharingha
S98-03412	RIP1421	12/04/1998	23.324	89.031	1978	STW	51	Md Hanan Ali	Khulna	Jessore	Chaugachha	Hakimpur	Arazi sultanpur
S98-03413	RIP1422	12/04/1998	23.3	89.068	1997	Tara	42	Abdur Rashid	Khulna	Jessore	Chaugachha	Jagadishpur	Jagadishpur
S98-03414	RIP1423	12/04/1998	23.221	89.048	1991	STW	54	Mrs Rabea Khatun	Khulna	Jessore	Chaugachha	Singhajhuli	Jahangirpur
S98-03415	RIP1424	12/04/1998	23.248	89.061	1972	STW	40	Md Mahabubur Rahaman	Khulna	Jessore	Chaugachha	Singhajhuli	Singhajhuli
S98-03416	RIP1425	12/04/1998	23.24	89.097	1993	Tara	47	Md Abdur Rashid	Khulna	Jessore	Chaugachha	Phulsara	Atra
S98-03417	RIP1427	13/04/1998	22.925	89.354	1997	DTW	173	Paritosh Ghosh	Khulna	Jessore	Manirampur	Manoharpur	Kapalia
S98-03418	RIP1428	13/04/1998	22.924	89.354	1994	STW	33	Abdul Jalil	Khulna	Jessore	Manirampur	Manoharpur	Kapalia
S98-03419	RIP1429	13/04/1998	23.001	89.311	1994	STW	57	Md Abdul Zabbar	Khulna	Jessore	Manirampur	Kultia	Padmanathpur
S98-03420	RIP1430	13/04/1998	23.066	89.285	1985	STW	43	Manda Dhali	Khulna	Jessore	Manirampur	Haridashkati	Bhomardaha
S98-03421	RIP1431	13/04/1998	23.066	89.23	1977	STW	53	Md Shahajan Ali	Khulna	Jessore	Manirampur	Manirampur	Jalshara
S98-03422	RIP1432	13/04/1998	23.018	89.139	1996	STW	34	Md Manik Sardar	Khulna	Jessore	Manirampur	Khedapara	Dhigirpar
S98-03423	RIP1433	13/04/1998	23.067	89.118	1977	STW	60	Akkas Ali	Khulna	Jessore	Manirampur	Rohita	Sharashkati
S98-03424	RIP1434	13/04/1998	22.959	89.136	1988	STW	44	Afsar Uddin	Khulna	Jessore	Manirampur	Maswimnagar	Maswimnagar
S98-03425	RIP1436	13/04/1998	23.181	89.4	1974	STW	46	Azim Uddin	Khulna	Jessore	Bagher Para	Jamdia	Karimpur
S98-03426	RIP1437	13/04/1998	23.166	89.375	1973	STW	51	Bhitaballa P. School	Khulna	Jessore	Bagher Para	Jamdia	Bhitaballa
S98-03427	RIP1438	13/04/1998	23.219	89.346	1984	STW	40	DPHE Office	Khulna	Jessore	Bagher Para	Darajhat	Mahiram
S98-03428	RIP1439	14/04/1998	23.276	89.351	1983	STW	48	Dayarampur P. School	Khulna	Jessore	Bagher Para	Rarikelbaria	Dayarampur
S98-03429	RIP1440	14/04/1998	23.276	89.381	1992	STW	51	Agra Alia Madrasha	Khulna	Jessore	Bagher Para	Dhalgram	Agra

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03334	1063627779	0.8	< 0.04	0.12	0.052	16.3	< 0.008	< 0.02	< 0.008	0.268	3	0.005	9.5	0.042	98.8	0.4	15.6	< 0.2	0.165	< 0.006	0.29
S98-03335	4441955079	24.3	< 0.04	0.02	0.175	90.7	< 0.008	< 0.02	< 0.008	9.4	2.8	0.004	18.5	0.49	9.8	0.4	16	< 0.2	0.196	0.006	1.15
S98-03336	4441947887	11.9	< 0.04	0.02	0.109	88.7	< 0.008	< 0.02	< 0.008	1.41	2.1	0.003	17.8	0.399	7.4	< 0.2	15.8	1.1	0.196	< 0.006	0.021
S98-03337	4506323415	< 0.5	< 0.04	0.03	0.077	113	< 0.008	< 0.02	< 0.008	0.06	1.5	0.01	34.8	0.566	40.4	0.2	20.7	< 0.2	0.493	< 0.006	< 0.008
S98-03338	4506371994	< 0.5	< 0.04	0.02	0.058	106	< 0.008	< 0.02	< 0.008	0.048	2.7	0.004	42.6	1.1	42.1	< 0.2	21.9	< 0.2	0.464	< 0.006	< 0.008
S98-03339	4506371969	< 0.5	< 0.04	< 0.01	0.045	78.6	< 0.008	< 0.02	< 0.008	0.243	1.1	0.004	26.6	1.31	68.1	0.4	19.6	< 0.2	0.295	< 0.006	< 0.008
S98-03340	4506347554	2.2	< 0.04	0.02	0.091	122	< 0.008	< 0.02	< 0.008	0.462	3	0.01	40.3	0.677	42.3	0.3	20.3	< 0.2	0.548	< 0.006	0.019
S98-03341	4506347554	< 0.5	< 0.04	0.03	0.083	126	< 0.008	< 0.02	< 0.008	0.017	1.4	< 0.003	42.4	1.1	39.6	0.3	20	< 0.2	0.464	< 0.006	< 0.008
S98-03342	4501581781	1660	< 0.04	0.04	0.192	149	< 0.008	< 0.02	< 0.008	0.188	2.8	< 0.003	46.1	1.22	23	< 0.2	18.5	< 0.2	0.654	< 0.006	< 0.008
S98-03343	4501581521	212	< 0.04	0.02	0.239	148	< 0.008	< 0.02	< 0.008	5.44	4.6	< 0.003	34.3	1.18	13.6	0.7	15	16.3	0.513	< 0.006	0.012
S98-03344	4501581521	9.9	< 0.01	0.03	0.052	119	< 0.003	< 0.002	< 0.008	1.02	3.4	0.005	26.6	0.377	12.5	0.1	22.6	4.2	0.328	< 0.002	0.026
S98-03345	4501567473	75.7	< 0.01	0.03	0.634	117	< 0.003	< 0.002	< 0.008	6.81	3	0.016	32.4	0.487	35	1.1	25.3	< 0.2	0.447	< 0.002	0.018
S98-03346	4501567615	52.7	< 0.04	0.03	0.354	144	< 0.008	< 0.02	0.014	6.72	3.8	0.004	43	0.234	31	0.6	18.6	16	0.468	< 0.006	0.03
S98-03347	4501554971	98.4	< 0.01	0.03	0.099	111	< 0.003	< 0.002	< 0.008	2.62	1.7	0.008	26.5	0.944	31.1	0.2	22.8	< 0.2	0.482	< 0.002	0.008
S98-03348	4509407415	< 0.5	< 0.04	0.02	0.058	104	< 0.008	< 0.02	< 0.008	0.018	1.5	0.005	28	0.496	28.1	< 0.2	19.7	0.9	0.332	< 0.006	0.009
S98-03349	4509436252	32.8	< 0.04	0.03	0.223	92.3	< 0.008	< 0.02	< 0.008	4.62	1.5	< 0.003	19.3	0.157	17.3	0.3	19.7	< 0.2	0.22	< 0.006	< 0.008
S98-03350	4509480016	63.6	< 0.04	0.02	0.078	71.4	< 0.008	< 0.02	< 0.008	3.43	2.4	< 0.003	13.3	0.182	18.9	0.6	13.3	< 0.2	0.187	< 0.006	< 0.008
S98-03351	4652823204	< 0.5	< 0.04	0.16	0.09	96	< 0.008	< 0.02	< 0.008	0.058	1.3	0.004	39.2	1.44	463	0.4	17.2	< 0.2	0.564	< 0.006	< 0.008
S98-03352	4652807156	255	< 0.04	0.04	0.375	96	< 0.008	< 0.02	< 0.008	15.4	5.1	0.005	27.9	0.082	11.5	1.7	24.8	0.4	0.42	< 0.006	< 0.008
S98-03353	4419060110	30.7	< 0.04	0.02	0.137	75.2	< 0.008	< 0.02	< 0.008	2.37	2.6	< 0.003	15.9	0.1	8.6	0.5	14.2	< 0.2	0.161	< 0.006	< 0.008
S98-03354	4419086877	21.7	< 0.04	0.15	0.039	115	< 0.008	< 0.02	< 0.008	0.922	4.4	0.005	36.3	0.166	50	0.3	19.6	< 0.2	0.548	< 0.006	< 0.008
S98-03355	4419086877	7.8	< 0.04	0.03	0.055	48.5	< 0.008	< 0.02	< 0.008	0.744	2.1	< 0.003	9.28	0.089	9.6	0.5	11.7	< 0.2	0.0872	< 0.006	< 0.008
S98-03356	4419025125	1.4	< 0.04	0.07	0.364	195	< 0.008	< 0.02	< 0.008	5.13	21.7	0.004	70.4	0.663	88.9	< 0.2	12.1	94.6	0.33	< 0.006	< 0.008
S98-03357	4419077921	38.4	< 0.04	0.04	0.277	97.1	< 0.008	< 0.02	< 0.008	3.96	10.4	0.003	26.2	0.17	18.4	0.9	16.3	< 0.2	0.291	< 0.006	< 0.008
S98-03358	4419051058	57.3	< 0.04	0.04	0.253	96	< 0.008	< 0.02	< 0.008	3.85	10.5	0.003	20.1	0.088	18.4	0.7	19.7	< 0.2	0.267	< 0.006	< 0.008
S98-03359	4419094257	15.7	< 0.04	0.05	0.23	117	< 0.008	< 0.02	< 0.008	3.58	2.7	0.004	25.4	0.08	47.4	0.4	17	7.9	0.231	< 0.006	0.01
S98-03360	4413809231	40.4	< 0.04	0.03	0.157	103	< 0.008	< 0.02	< 0.008	5.25	1.7	< 0.003	20	0.137	25.2	< 0.2	14.8	12	0.236	< 0.006	< 0.008
S98-03361	4413866847	308	< 0.04	0.06	0.21	84.8	< 0.008	< 0.02	< 0.008	4.15	5.9	0.005	32.3	0.074	15.6	1.2	21.3	< 0.2	0.424	< 0.006	< 0.008
S98-03362	4413885441	93.2	< 0.04	0.03	0.16	90.2	< 0.008	< 0.02	< 0.008	4.98	3.2	< 0.003	24.2	0.099	14.2	1.4	17.7	< 0.2	0.318	< 0.006	< 0.008
S98-03363	4413847644	170	< 0.04	0.18	0.382	129	< 0.008	< 0.02	< 0.008	3.93	9	0.006	55.7	0.068	212	2	20.2	< 0.2	0.62	< 0.006	< 0.008
S98-03364	4413876497	< 0.5	< 0.04	0.09	0.081	54	< 0.008	< 0.02	< 0.008	0.276	4.4	0.009	14.9	0.163	78.7	< 0.2	20.1	< 0.2	0.183	< 0.006	0.009
S98-03365	4413876497	< 0.5	< 0.04	0.07	0.047	64.6	< 0.008	< 0.02	< 0.008	0.027	0.8	0.005	22.8	0.395	124	0.2	17.8	< 0.2	0.308	0.006	< 0.008
S98-03366	4413819182	2.3	0.06	0.06	0.053	27.3	< 0.008	< 0.02	< 0.008	0.059	0.7	< 0.003	10	0.817	178	0.5	15.5	0.4	0.165	0.006	< 0.008
S98-03367	4414747994	172	< 0.04	0.03	0.142	111	< 0.008	< 0.02	< 0.008	3.66	3.8	0.003	27	0.302	11.4	0.7	17.2	< 0.2	0.334	< 0.006	< 0.008
S98-03368	4414729056	90.3	0.05	0.03	0.233	90.6	< 0.008	< 0.02	< 0.008	3.67	9.3	0.005	33.1	0.574	11.8	0.8	15.7	< 0.2	0.324	< 0.006	< 0.008
S98-03369	4414735019	132	< 0.04	0.03	0.15	119	< 0.008	< 0.02	< 0.008	4.68	5.6	0.003	27.7	0.892	17.5	1.1	15.9	< 0.2	0.378	< 0.006	< 0.008
S98-03370	4414723649	< 0.5	0.04	0.05	0.074	98.9	< 0.008	< 0.02	< 0.008	0.048	1.1	0.005	41.3	0.955	51	0.3	20.1	< 0.2	0.458	0.01	0.013
S98-03371	4414754746	10.5	< 0.04	0.02	0.07	78.3	< 0.008	< 0.02	< 0.008	0.353	2.5	0.014	21.2	0.174	14.2	< 0.2	23.1	< 0.2	0.233	< 0.006	< 0.008
S98-03372	4414754746	< 0.5	< 0.04	0.03	0.026	56.8	< 0.008	< 0.02	< 0.008	0.036	0.9	0.004	22.7	0.199	45.6	0.3	18.4	< 0.2	0.272	0.008	< 0.008
S98-03373	4414754689	< 0.5	< 0.04	0.03	0.039	96.6	< 0.008	< 0.02	< 0.008	0.04	1.1	0.004	33.2	0.276	40.2	0.3	19.3	< 0.2	0.317	0.007	< 0.008
S98-03374	4414754822	< 0.5	< 0.04	0.03	0.048	101	< 0.008	< 0.02	< 0.008	0.083	1.2	0.003	35.7	0.772	40.2	0.2	21.2	< 0.2	0.364	0.007	0.017
S98-03375	4183111318	64.6	< 0.04	0.03	0.222	103	< 0.008	< 0.02	< 0.008	1.09	2.8	0.004	23	0.177	14.5	< 0.2	16	0.4	0.296	< 0.006	< 0.008
S98-03376	4183171650	130	< 0.04	0.03	0.356	147	< 0.008	< 0.02	< 0.008	6.57	3.8	< 0.003	40.4	0.276	21.9	0.8	17.4	5.2	0.549	< 0.006	< 0.008
S98-03377	4183123242	119	< 0.04	0.03	0.246	95.1	< 0.008	< 0.02	< 0.008	4.08	3.3	0.004	25.2	0.208	14.1	0.6	16.8	< 0.2	0.345	< 0.006	< 0.008
S98-03378	4183159459	120	< 0.04	0.03	0.178	125	< 0.008	< 0.02	< 0.008	1.07	3.2	0.004	27.4	0.356	16.4	0.2	16.2	12.9	0.372	< 0.006	< 0.008
S98-03379	4183111765	33.5	< 0.04	0.02	0.121	100	< 0.008	< 0.02	< 0.008	1.48	3.9	< 0.003	21.8	0.529	14	< 0.2	13.2	2.7	0.241	< 0.006	< 0.008
S98-03380	4183147867	497	0.04	0.03	0.157	109	< 0.008	< 0.02	< 0.008	4.23	4.9	0.004	25.1	0.162	16.3	< 0.2	14.7	< 0.2	0.381	< 0.006	< 0.008
S98-03381	4183183790	24	< 0.04	0.03	0.169	79.7	< 0.008	< 0.02	< 0.008	1.81	19.7	< 0.003	18.8	0.43	11.1	0.3	11.4	< 0.2	0.19	< 0.006	< 0.008

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03382	4182347201	< 0.5	< 0.04	0.02	0.048	88	< 0.008	< 0.02	< 0.008	0.025	1.5	< 0.003	20.6	1.34	19	0.2	19.8	< 0.2	0.312	0.007	0.013
S98-03383	4182359924	47.5	< 0.04	0.02	0.142	87.7	< 0.008	< 0.02	< 0.008	1.96	3.8	< 0.003	15.3	0.6	10	0.6	14.1	9.4	0.233	< 0.006	0.01
S98-03384	4182311040	0.9	< 0.04	0.03	0.112	91.7	< 0.008	< 0.02	< 0.008	0.12	3.8	0.003	20	0.384	24.6	< 0.2	13.6	15.3	0.229	< 0.006	0.01
S98-03385	4182369533	70.4	< 0.04	0.02	0.065	95.3	< 0.008	< 0.02	< 0.008	0.747	3.6	0.007	20.2	0.666	13.7	0.5	19	< 0.2	0.29	< 0.006	0.009
S98-03386	4182369533	45.3	0.04	0.02	0.07	98.1	< 0.008	< 0.02	< 0.008	2.37	3.9	0.005	20	0.388	11.9	< 0.2	20.8	< 0.2	0.281	< 0.006	1.15
S98-03387	4574773946	12.8	< 0.04	0.03	0.135	100	< 0.008	< 0.02	< 0.008	0.102	4	0.004	26.3	0.248	16	< 0.2	13.1	5.3	0.234	< 0.006	0.126
S98-03388	4574773946	13.2	< 0.04	0.01	0.084	96.1	< 0.008	< 0.02	< 0.008	0.007	3.9	0.006	18.5	0.01	10	< 0.2	17.1	5.4	0.192	< 0.006	0.449
S98-03389	4574731879	< 0.5	< 0.01	0.02	0.054	90.1	< 0.003	< 0.002	< 0.008	0.044	1.4	0.003	29.4	2.35	24.5	0.2	21.1	4.2	0.475	0.005	0.019
S98-03390	4574763521	38.2	0.01	0.02	0.209	123	< 0.003	< 0.002	< 0.008	2.7	4.6	0.003	28.2	0.615	22	0.1	16.1	25.3	0.335	< 0.002	0.024
S98-03391	4574794975	62.5	< 0.01	0.02	0.145	83.2	< 0.003	< 0.002	< 0.008	3	3.5	0.003	13.5	0.576	8.18	0.4	16.7	< 0.2	0.179	< 0.002	0.01
S98-03392	4574742434	58.4	< 0.04	0.02	0.188	109	< 0.008	< 0.02	< 0.008	3.44	2.3	< 0.003	25.3	0.654	16.3	0.3	15.1	0.9	0.315	< 0.006	< 0.008
S98-03393	4443354159	29.4	< 0.04	0.03	0.176	97.5	< 0.008	< 0.02	< 0.008	3.13	2.2	< 0.003	19.8	0.363	20.2	0.7	17.5	< 0.2	0.229	< 0.006	0.011
S98-03394	4443374270	< 0.5	< 0.04	0.02	0.051	95.9	< 0.008	< 0.02	< 0.008	0.074	1.9	0.004	35.9	0.458	20	0.2	21	1.1	0.352	< 0.006	< 0.008
S98-03395	4443306048	90.9	< 0.04	0.03	0.148	115	< 0.008	< 0.02	< 0.008	4.9	3.2	0.005	26.9	0.886	38.2	1.3	16.1	3.2	0.354	< 0.006	< 0.008
S98-03396	4443381821	< 0.5	< 0.04	0.02	0.054	89.5	< 0.008	< 0.02	< 0.008	0.039	1.8	< 0.003	34	0.839	23.2	0.3	21.8	0.6	0.359	< 0.006	< 0.008
S98-03397	4443394346	< 0.5	< 0.04	0.02	0.039	111	< 0.008	< 0.02	< 0.008	0.03	1.3	< 0.003	22.8	0.783	18.1	< 0.2	20	0.4	0.409	< 0.006	< 0.008
S98-03398	4443302026	15.4	< 0.04	0.02	0.196	109	< 0.008	< 0.02	< 0.008	4.28	3.2	< 0.003	24	0.157	11.8	0.5	16.7	< 0.2	0.252	< 0.006	< 0.008
S98-03399	4443302026	7.4	< 0.04	0.02	0.096	114	< 0.008	< 0.02	< 0.008	1.07	2.8	0.004	25.4	0.53	13.9	< 0.2	20.2	1	0.267	< 0.006	0.247
S98-03400	4441989894	< 0.5	< 0.04	0.02	0.044	77.8	< 0.008	< 0.02	< 0.008	0.01	1.3	< 0.003	29.2	1.2	19.2	< 0.2	21.6	< 0.2	0.371	< 0.006	< 0.008
S98-03401	4441952694	34.6	< 0.04	0.02	0.106	87.5	< 0.008	< 0.02	< 0.008	4.39	1	< 0.003	26.6	0.346	13.6	0.5	16.8	< 0.2	0.217	< 0.006	0.009
S98-03402	4441984055	30.4	< 0.04	0.02	0.148	91.8	< 0.008	< 0.02	< 0.008	5.31	3.1	< 0.003	25	0.144	13.9	0.3	16.7	< 0.2	0.176	< 0.006	< 0.008
S98-03403	4441926872	27.6	< 0.04	0.02	0.142	77.4	< 0.008	< 0.02	< 0.008	3.89	1.8	< 0.003	19.1	0.122	16.9	0.6	17.4	< 0.2	0.153	< 0.006	< 0.008
S98-03404	4655215387	248	< 0.04	0.09	0.283	99.4	< 0.008	< 0.02	< 0.008	1.9	6.2	< 0.003	44	0.084	141	1.9	14.4	< 0.2	0.502	< 0.006	0.014
S98-03405	4655223053	< 0.5	< 0.04	0.03	0.05	65.6	< 0.008	< 0.02	< 0.008	0.077	1.1	0.004	30.7	1.11	139	0.4	18.9	6.6	0.336	< 0.006	< 0.008
S98-03406	4655247901	37.2	< 0.04	0.09	0.602	60.4	< 0.008	< 0.02	< 0.008	5.93	4.9	0.018	31.2	0.349	142	1.2	20.1	< 0.2	0.352	< 0.006	0.01
S98-03407	4655287440	< 0.5	< 0.04	0.02	0.072	78.7	< 0.008	< 0.02	< 0.008	0.072	1.2	0.006	33.4	1.17	344	0.4	17.5	< 0.2	0.47	< 0.006	< 0.008
S98-03408	4655255580	149	< 0.04	0.04	0.254	116	< 0.008	< 0.02	< 0.008	3.34	3.3	< 0.003	35.7	0.107	24.2	1.6	21.1	< 0.2	0.45	< 0.006	< 0.008
S98-03409	4411108246	59	< 0.04	0.02	0.216	107	< 0.008	< 0.02	< 0.008	3.03	5.4	< 0.003	24.5	0.501	22	0.7	15.4	13.5	0.306	< 0.006	< 0.008
S98-03410	4411151190	23.2	< 0.04	0.01	0.113	87.5	< 0.008	< 0.02	< 0.008	1.72	3.3	< 0.003	16.7	0.255	8.9	0.3	13.9	0.3	0.202	< 0.006	< 0.008
S98-03411	4411143557	52.6	< 0.04	0.02	0.182	106	< 0.008	< 0.02	< 0.008	2.47	4.2	< 0.003	22	0.48	18.9	0.3	15.3	< 0.2	0.248	< 0.006	0.013
S98-03412	4411125049	39.9	< 0.04	0.02	0.124	91	< 0.008	< 0.02	< 0.008	1.17	3.5	< 0.003	15.2	0.408	7.8	0.5	14.9	< 0.2	0.237	< 0.006	< 0.008
S98-03413	4411134465	27.8	< 0.04	0.02	0.12	81.5	< 0.008	< 0.02	< 0.008	0.757	3.8	< 0.003	12.3	0.486	5.7	0.3	14.9	< 0.2	0.179	< 0.006	0.017
S98-03414	4411186479	86.7	< 0.04	0.03	0.3	132	< 0.008	< 0.02	< 0.008	5.93	2.7	0.003	35.3	0.124	29.5	0.9	20.8	< 0.2	0.395	< 0.006	0.008
S98-03415	4411186910	68.6	< 0.04	0.03	0.339	128	< 0.008	< 0.02	< 0.008	4.62	2.6	< 0.003	35	0.095	23.6	1	20.9	< 0.2	0.361	< 0.006	< 0.008
S98-03416	4411177007	< 0.5	< 0.04	0.04	0.05	80.4	< 0.008	< 0.02	< 0.008	0.153	1.2	< 0.003	22.1	2.6	16.9	0.3	23.5	< 0.2	0.279	< 0.006	0.045
S98-03417	4416172495	< 0.5	< 0.04	0.07	0.116	54.6	< 0.008	< 0.02	< 0.008	0.046	3.4	0.005	20.1	0.097	64.5	< 0.2	18.1	< 0.2	0.294	< 0.006	< 0.008
S98-03418	4416172495	30.1	< 0.04	0.27	0.631	139	< 0.008	< 0.02	< 0.008	7.89	11.2	0.008	90.9	0.153	598	5.4	30.3	1.3	0.882	< 0.006	< 0.008
S98-03419	4416161757	71.9	0.05	0.08	0.967	234	< 0.008	< 0.02	< 0.008	10.5	8.9	0.003	88.8	0.098	246	0.7	15.2	< 0.2	0.975	< 0.006	0.013
S98-03420	4416127134	178	< 0.04	0.07	0.275	106	< 0.008	< 0.02	< 0.008	5.43	6.8	0.003	42.2	0.069	114	1.7	19.4	< 0.2	0.493	< 0.006	0.021
S98-03421	4416167426	96.8	< 0.04	0.03	0.241	85.6	< 0.008	< 0.02	< 0.008	4.57	4.5	< 0.003	24.3	0.078	16.3	1.1	20.2	< 0.2	0.331	< 0.006	< 0.008
S98-03422	4416155235	224	< 0.04	0.05	0.227	99.9	< 0.008	< 0.02	< 0.008	5.2	6.1	0.004	41.6	0.09	22.1	1.2	21.7	< 0.2	0.459	< 0.006	< 0.008
S98-03423	4416194885	40.1	0.05	0.03	0.156	93	< 0.008	< 0.02	< 0.008	2.65	4.5	0.011	26.6	0.039	14.2	0.5	19.8	< 0.2	0.283	< 0.006	< 0.008
S98-03424	4416178678	88.9	< 0.04	0.03	0.203	105	< 0.008	< 0.02	< 0.008	3.35	3.5	< 0.003	24.6	0.1	16.1	1.4	18	< 0.2	0.336	< 0.006	< 0.008
S98-03425	4410957561	61.8	0.04	0.03	0.431	119	< 0.008	< 0.02	< 0.008	5.95	4.5	0.004	22.2	0.311	19.1	0.6	19.4	< 0.2	0.285	< 0.006	< 0.008
S98-03426	4410957235	< 0.5	< 0.04	0.05	0.051	56.1	< 0.008	< 0.02	< 0.008	0.034	1	0.004	23.7	1.51	79.6	< 0.2	17.9	< 0.2	0.222	0.007	< 0.008
S98-03427	4410928650	27.5	< 0.04	0.03	0.095	78.8	< 0.008	< 0.02	< 0.008	2.52	2	0.006	17	0.234	18	0.6	15.9	< 0.2	0.195	< 0.006	< 0.008
S98-03428	4410976376	4.8	< 0.04	0.03	0.094	21.8	< 0.008	< 0.02	< 0.008	< 0.006	4.2	0.004	18.8	< 0.001	13.4	< 0.2	17	2.7	0.188	< 0.006	< 0.008
S98-03429	4410938006	27.5	< 0.04	0.03	0.132	84.1	< 0.008	< 0.02	< 0.008	1.84	4.7	0.006	29	0.12	22.3	< 0.2	19.2	< 0.2	0.331	< 0.006	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03430	RIP1441	14/04/1998	23.255	89.298	1985	STW	47	Raipur P. School	Khulna	Jessore	Bagher Para	Raipur	Raipur
S98-03431	RIP1442	14/04/1998	23.321	89.267	1981	STW	47	Palash Ali Mandal	Khulna	Jessore	Bagher Para	Jaharpur	Chotta khudra
S98-03432	RIP1444	16/04/1998	23.76	88.942	1982	STW	39	Thana Staff Quarter	Khulna	Chuadanga	Alamdanga	Paurashava W01	Gobindapur
S98-03433	RIP1445	16/04/1998	23.721	89.001	1991	STW	43	Nasiruddin Bishwas	Khulna	Chuadanga	Alamdanga	Jamjami	Jamjami
S98-03434	RIP1446	16/04/1998	23.675	88.943	1993	STW	44	Osman Mandal	Khulna	Chuadanga	Alamdanga	Nagdaka	Gholdari
S98-03435	RIP1447	16/04/1998	23.714	88.913	1997	STW	39	Abdus Sattar	Khulna	Chuadanga	Alamdanga	Jehala	Garchapara
S98-03436	RIP1448	16/04/1998	23.732	88.87	1991	STW	42	Soinuddin	Khulna	Chuadanga	Alamdanga	Baradi	Natidanga
S98-03437	RIP1449	16/04/1998	23.694	88.802	1974	STW	37	Union Parishad	Khulna	Chuadanga	Alamdanga	Khadimpur	Bhalaipur
S98-03438	RIP1450	16/04/1998	23.761	88.829	1993	STW	41	Khalilur Rahaman	Khulna	Chuadanga	Alamdanga	Gangni	Salika
S98-03439	RIP1451	16/04/1998	23.808	88.856	1989	STW	39	Zinaul Haq	Khulna	Chuadanga	Alamdanga	Bhangabaria	Bhanga
S98-03440	RIP1452	16/04/1998	23.794	88.905	1997	STW	45	Mansur Ali	Khulna	Chuadanga	Alamdanga	Hardi	Hardi
S98-03441	RIP1453	17/04/1998	23.564	88.884	1982	STW	13	Mohammad Ali	Khulna	Chuadanga	Chuadanga Sadar	Titudaha	Baldia
S98-03442	RIP1454	17/04/1998	23.523	88.918	1990	STW	13	Md Mafiz Ali	Khulna	Chuadanga	Chuadanga Sadar	Titudaha	Gobargara
S98-03443	RIP1455	17/04/1998	23.536	88.851	1981	STW	40	Fazlur Haq	Khulna	Chuadanga	Chuadanga Sadar	Begampur	Darshana
S98-03444	RIP1456	17/04/1998	23.596	88.842	1989	STW	14	Matiar Ali	Khulna	Chuadanga	Chuadanga Sadar	Shankarchandra	Makhaldanga
S98-03445	RIP1459	18/04/1998	23.678	88.684	1993	STW	16	Md Shar Ali	Khulna	Meherpur	Meherpur Sadar	Mohajjampur	Gopalpur
S98-03446	RIP1460	18/04/1998	23.628	88.627	1997	DTW	148	Md Asraf Ali	Khulna	Meherpur	Meherpur Sadar	Bagoan	Dari jagannathp.
S98-03447	RIP1461	18/04/1998	23.628	88.627	1996	STW	43	Fakir Mandal	Khulna	Meherpur	Meherpur Sadar	Bagoan	Taranagar
S98-03448	RIP1462	18/04/1998	23.717	88.615	1997	STW	40	Md Sadar Ali	Khulna	Meherpur	Meherpur Sadar	Monakhali	Monakhali
S98-03449	RIP1463	18/04/1998	23.817	88.676	1993	STW	44	Md Omar Ali	Khulna	Meherpur	Meherpur Sadar	Amjhupi	Shyampur
S98-03450	RIP1464	18/04/1998	23.838	88.642	1993	Tara	42	Abdus Samad	Khulna	Meherpur	Meherpur Sadar	Kutubpur	Kulberia
S98-03451	RIP1465	18/04/1998	23.769	88.598	1993	STW	39	Zillur Rahaman	Khulna	Meherpur	Meherpur Sadar	Buripota	Buripota
S98-03452	RIP1466	19/04/1998	23.352	88.918	1991	STW	25	Dr. Azad	Khulna	Jhenaidah	Moheshpur	Pourasava	Moheshpur
S98-03453	RIP1467	19/04/1998	23.3	88.91	1995	STW	43	Md. Mizanur Rahman	Khulna	Jhenaidah	Moheshpur	Manderbari	Habaspur
S98-03454	RIP1468	19/04/1998	23.255	88.886	1985	STW	44	Md. Abdul Motla	Khulna	Jhenaidah	Moheshpur	Jadabpur	Jadabpur
S98-03455	RIP1469	19/04/1998	23.282	88.818	1985	STW	44	V.S Centre	Khulna	Jhenaidah	Moheshpur	Bansbaria	Bhairasha
S98-03456	RIP1470	19/04/1998	23.247	88.782	1987	STW	44	S, Dakhil Madrasa	Khulna	Jhenaidah	Moheshpur	Kazirber	S. gopalpur
S98-03457	RIP1471	19/04/1998	23.295	88.753	1997	STW	38	U.P.Office	Khulna	Jhenaidah	Moheshpur	Nepa	Nepa
S98-03458	RIP1472	19/04/1998	23.37	88.802	1979	STW	23	Abdus Samad	Khulna	Jhenaidah	Moheshpur	Swaravpurudakus	Hudakushadanga
S98-03459	RIP1473	19/04/1998	23.388	88.909	1988	STW	50	Sher Ali	Khulna	Jhenaidah	Moheshpur	Fathepur	Chandpur
S98-03460	RIP1474	19/04/1998	23.37	88.974	1985	STW	34	Sundarpur Govt.H.Sc	Khulna	Jhenaidah	Moheshpur	Sundarpur	Sundarpur
S98-03461	RIP1476	20/04/1998	23.462	89.22	1979	STW	49	Salkopa Govt. Pry. S	Khulna	Jhenaidah	Jhenaidah Sadar	Ghorshal	Salkopa
S98-03462	RIP1477	20/04/1998	23.491	89.28	1989	STW	44	Md. Habibur Rahman	Khulna	Jhenaidah	Jhenaidah Sadar	Fursandi	Dhananjoypur
S98-03463	RIP1478	20/04/1998	23.524	89.299	1995	STW	52	Md. Habibur Rahman	Khulna	Jhenaidah	Jhenaidah Sadar	Padkmakar	Tiardah
S98-03464	RIP1479	20/04/1998	23.562	89.277	1990	STW	44	Panami Govt. H. Scho	Khulna	Jhenaidah	Jhenaidah Sadar	Harisankarpur	Panami
S98-03465	RIP1480	20/04/1998	23.54	89.209	1996	STW	37	Poradah W. Para	Khulna	Jhenaidah	Jhenaidah Sadar	Porahati	Porahati
S98-03466	RIP1482	21/04/1998	23.861	89.037	1991	STW	38	Pashu Hat	Khulna	Kushtia	Kushtia Sadar	Ailchara	Bara ailchara
S98-03467	RIP1483	21/04/1998	23.79	89.007	1996	STW	41	Nayeb Ali	Khulna	Kushtia	Kushtia Sadar	Paitkabari	Paitkabari
S98-03468	RIP1484	21/04/1998	23.744	89.059	1989	STW	36	Abdul Halim	Khulna	Kushtia	Kushtia Sadar	Manohardia	Kandarpadia
S98-03469	RIP1485	21/04/1998	23.775	89.061	1970	STW	47	Badal Malita	Khulna	Kushtia	Kushtia Sadar	Jhaudia	Jhaudia
S98-03470	RIP1486	21/04/1998	23.793	89.104	1996	STW	34	Hassan Ali	Khulna	Kushtia	Kushtia Sadar	Ujangram	Ujangram
S98-03471	RIP1487	21/04/1998	23.753	89.127	1996	STW	56	Abdul Aziz	Khulna	Kushtia	Kushtia Sadar	Abdalpur	Lakshmipur
S98-03472	RIP1488	21/04/1998	23.84	89.102	1995	STW	39	Abdul Mannan	Khulna	Kushtia	Kushtia Sadar	Alampur	Swastipur
S98-03473	RIP1489	21/04/1998	23.844	89.155	1996	STW	39	Ali Amjad	Khulna	Kushtia	Kushtia Sadar	Jiaraakhi	Kamalapur
S98-03474	RIP1490	21/04/1998	23.903	89.121	1985	DTW	115	PWSS Kushtia	Khulna	Kushtia	Kushtia Sadar	Paurashova W03	Courtpara
S98-03475	RIP1491	21/04/1998	23.903	89.121	1985	STW	41	PWSS Kushtia	Khulna	Kushtia	Kushtia Sadar	Paurashova W03	Courtpara
S98-03476	RIP1492	22/04/1998	23.924	88.969	1993	STW	45	Salim Meer	Khulna	Kushtia	Mirpur (K)	Mirpur	Kusipalbijnagar
S98-03477	RIP1493	22/04/1998	23.892	88.935	1994	STW	37	Sarwar Hassan	Khulna	Kushtia	Mirpur (K)	Amla	Amla

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03430	4410985861	0.9	< 0.04	0.05	0.061	89	< 0.008	< 0.02	< 0.008	0.063	1	0.01	26.5	0.749	63.9	< 0.2	19.9	< 0.2	0.542	< 0.006	< 0.008
S98-03431	4410966293	26.3	< 0.04	0.03	0.201	104	< 0.008	< 0.02	< 0.008	3.73	2.4	< 0.003	31.6	0.29	20.3	0.3	16.5	< 0.2	0.227	< 0.006	< 0.008
S98-03432	4180767510	41.1	< 0.04	0.03	0.094	90.2	< 0.008	< 0.02	< 0.008	0.982	4	< 0.003	16.8	0.445	9.7	< 0.2	14.7	2.9	0.193	< 0.006	0.01
S98-03433	4180755489	1.2	< 0.04	0.02	0.051	90.8	< 0.008	< 0.02	< 0.008	0.063	1.1	< 0.003	20.8	1.22	14.9	< 0.2	21.5	19.4	0.263	0.007	0.016
S98-03434	4180794397	70.6	< 0.04	0.02	0.156	73.2	< 0.008	< 0.02	< 0.008	3.1	3.5	< 0.003	17.9	0.148	14.9	0.8	15.3	3.5	0.224	< 0.006	< 0.008
S98-03435	4180763373	150	< 0.04	0.02	0.16	84.2	< 0.008	< 0.02	< 0.008	4.07	3.3	< 0.003	14.9	0.426	10.8	0.8	15.1	< 0.2	0.196	< 0.006	0.01
S98-03436	4180715729	103	< 0.04	0.03	0.124	109	< 0.008	< 0.02	< 0.008	6.27	3.2	< 0.003	26.2	0.245	16.1	< 0.2	15.1	< 0.2	0.354	< 0.006	0.17
S98-03437	4180771132	538	< 0.04	0.04	0.179	115	< 0.008	< 0.02	< 0.008	5.67	5.7	< 0.003	30	0.731	18.4	0.3	14.1	< 0.2	0.465	< 0.006	0.024
S98-03438	4180739912	30.4	< 0.04	0.02	0.112	87	< 0.008	< 0.02	< 0.008	1.68	3.2	< 0.003	16.5	0.307	7.4	0.3	12.6	< 0.2	0.212	< 0.006	< 0.008
S98-03439	4180723140	4.8	0.06	0.02	0.062	81.8	< 0.008	< 0.02	< 0.008	0.104	1.4	< 0.003	17.9	1.7	17.7	0.5	15.9	2.7	0.301	< 0.006	0.01
S98-03440	4180747447	1.6	< 0.04	0.02	0.058	109	< 0.008	< 0.02	< 0.008	0.056	1.4	< 0.003	29.4	2.74	18.5	< 0.2	19.8	17	0.388	< 0.006	0.014
S98-03441	4182383070	36.4	< 0.04	0.02	0.175	92.6	< 0.008	< 0.02	< 0.008	2.39	3.8	< 0.003	18.2	0.476	9.6	0.5	15.4	< 0.2	0.228	< 0.006	< 0.008
S98-03442	4182383442	66.2	< 0.04	0.05	0.166	103	< 0.008	< 0.02	< 0.008	2.7	4.8	< 0.003	27.9	0.684	50.6	< 0.2	15.4	4.8	0.304	< 0.006	0.016
S98-03443	4182323301	22	< 0.04	0.06	0.285	107	< 0.008	< 0.02	< 0.008	3.49	4.3	< 0.003	35.6	0.534	34.3	0.3	13.3	15.5	0.257	< 0.006	0.011
S98-03444	4182371723	99.7	< 0.04	0.02	0.204	92.1	< 0.008	< 0.02	< 0.008	3.87	4.8	< 0.003	25	0.334	12.9	0.7	15.9	< 0.2	0.266	< 0.006	< 0.008
S98-03445	4578776414	189	0.11	0.07	0.216	128	< 0.008	< 0.02	< 0.008	4.33	4.9	0.003	43.5	1.67	23.7	0.7	14.5	12.4	0.448	< 0.006	0.01
S98-03446	4578728321	228	< 0.04	0.04	0.173	131	< 0.008	< 0.02	< 0.008	0.835	5.3	0.004	27.2	0.168	19.4	< 0.2	18.1	< 0.2	0.344	< 0.006	0.009
S98-03447	4578728953	482	< 0.04	0.04	0.196	133	< 0.008	< 0.02	0.009	7.09	5.1	< 0.003	29.6	0.806	20.5	0.3	14.1	< 0.2	0.574	< 0.006	0.01
S98-03448	4578785684	70.8	< 0.04	0.02	0.222	115	< 0.008	< 0.02	< 0.008	2.8	4.2	< 0.003	22.5	0.771	10	0.5	14.7	2.4	0.317	< 0.006	< 0.008
S98-03449	4578719932	357	< 0.04	0.02	0.201	127	< 0.008	< 0.02	< 0.008	4.23	5.8	< 0.003	27.1	0.954	21.3	0.4	14.2	9.8	0.397	< 0.006	0.01
S98-03450	4578757601	76.6	< 0.04	0.02	0.182	97.4	< 0.008	< 0.02	< 0.008	3.06	6.4	< 0.003	22.4	0.49	12	1.1	15.5	< 0.2	0.312	< 0.006	< 0.008
S98-03451	4578738238	43.4	< 0.04	0.02	0.124	129	< 0.008	< 0.02	< 0.008	0.467	4.4	0.003	26.3	0.578	29	< 0.2	15.7	5.2	0.336	< 0.006	< 0.008
S98-03452	4447159663	1.7	< 0.04	0.05	0.088	27.7	< 0.008	< 0.02	< 0.008	< 0.006	4.8	0.004	37.9	< 0.001	14.9	< 0.2	11.6	10.6	0.345	< 0.006	< 0.008
S98-03453	4447135353	51.8	< 0.04	0.03	0.112	40.7	< 0.008	< 0.02	< 0.008	< 0.006	4	0.003	24.9	< 0.001	17.4	< 0.2	17.2	< 0.2	0.302	< 0.006	< 0.008
S98-03454	4447123437	24	< 0.04	0.02	0.185	98.2	< 0.008	< 0.02	< 0.008	3.04	3.4	< 0.003	25.9	0.349	10.8	0.4	15.7	< 0.2	0.254	< 0.006	< 0.008
S98-03455	4447111159	10.4	< 0.04	0.03	0.21	95.4	< 0.008	< 0.02	< 0.008	2.78	11.9	< 0.003	24.9	0.183	27	0.4	15.3	< 0.2	0.19	< 0.006	< 0.008
S98-03456	4447129860	5.8	< 0.04	0.05	0.213	115	< 0.008	< 0.02	< 0.008	2.26	4.4	< 0.003	23.7	0.466	15.8	0.3	14.2	18.7	0.233	< 0.006	< 0.008
S98-03457	4447159711	96.9	< 0.04	0.03	0.176	106	< 0.008	< 0.02	< 0.008	5.03	3.1	< 0.003	27.5	0.463	18.4	0.4	15.1	< 0.2	0.275	< 0.006	0.011
S98-03458	4447189402	3.4	< 0.04	0.02	0.126	87.5	< 0.008	< 0.02	< 0.008	1.18	3.5	< 0.003	17.4	0.292	8.8	< 0.2	10.5	1.8	0.191	< 0.006	< 0.008
S98-03459	4447117213	557	< 0.04	0.05	0.136	103	< 0.008	< 0.02	< 0.008	2.51	4.3	< 0.003	25.6	0.27	20.2	< 0.2	13.5	< 0.2	0.374	< 0.006	0.028
S98-03460	4447183940	67.1	< 0.04	0.02	0.112	68.8	< 0.008	< 0.02	< 0.008	2.58	3.5	< 0.003	16.9	0.51	7.2	0.4	14.5	< 0.2	0.235	< 0.006	< 0.008
S98-03461	4441921905	3.4	< 0.04	0.04	0.05	69.8	< 0.008	< 0.02	< 0.008	0.035	1.7	0.006	27.6	0.714	27.5	< 0.2	20.6	< 0.2	0.349	< 0.006	< 0.008
S98-03462	4441910289	12.6	< 0.04	< 0.01	0.062	35	< 0.008	< 0.02	< 0.008	0.274	2.1	< 0.003	6.21	0.156	6.1	0.3	13	1.5	0.0637	< 0.006	< 0.008
S98-03463	4441968967	148	0.05	0.03	0.081	106	< 0.008	< 0.02	< 0.008	4.71	2.9	0.006	31	0.173	18.4	0.5	19.4	< 0.2	0.356	< 0.006	0.031
S98-03464	4441931761	33.2	< 0.04	0.02	0.189	87.4	< 0.008	< 0.02	< 0.008	4.23	2.3	< 0.003	22.8	0.147	9.9	0.5	17.7	0.5	0.216	< 0.006	< 0.008
S98-03465	4441979824	129	< 0.01	0.03	0.18	110	< 0.003	0.003	< 0.008	4.58	3.9	0.005	36.4	0.499	19	0.1	18.8	0.6	0.429	0.003	0.011
S98-03466	4507912085	9	< 0.01	0.01	0.059	72.7	< 0.003	< 0.002	< 0.008	1.04	2.2	0.006	15.3	0.416	8.52	0.1	22.1	3	0.162	< 0.002	0.008
S98-03467	4507988807	1.2	< 0.01	0.02	0.072	109	< 0.003	0.003	< 0.008	0.024	1.1	0.003	35.6	1.02	47.3	0.2	22.6	0.7	0.361	0.004	0.012
S98-03468	4507982544	35	< 0.01	< 0.01	0.188	118	< 0.003	0.003	< 0.008	3.52	4	< 0.003	22.6	0.732	12.8	0.3	16.1	1.2	0.264	< 0.002	0.008
S98-03469	4507963681	< 0.5	< 0.04	0.01	0.028	67	< 0.008	< 0.02	< 0.008	0.074	1.2	< 0.003	16.3	0.459	14.6	< 0.2	19.7	5.6	0.222	0.007	< 0.008
S98-03470	4507924986	1.3	< 0.04	0.02	0.021	50.3	< 0.008	< 0.02	< 0.008	0.049	1.2	< 0.003	11.5	0.919	12.4	0.2	17.6	10.5	0.132	< 0.006	0.023
S98-03471	4507906620	61.6	0.04	0.02	0.2	93.7	< 0.008	< 0.02	< 0.008	2.53	3.3	< 0.003	36.1	0.279	11.5	0.4	14.4	10.6	0.329	< 0.006	0.045
S98-03472	4507918969	1.2	< 0.04	0.03	0.075	89.2	< 0.008	< 0.02	< 0.008	0.05	2.4	0.006	22.4	1.26	14.6	< 0.2	21.4	< 0.2	0.29	< 0.006	0.01
S98-03473	4507956527	0.6	< 0.04	0.04	0.061	108	< 0.008	< 0.02	< 0.008	0.069	1.8	0.005	33.7	1.01	30.2	< 0.2	20.6	< 0.2	0.389	< 0.006	0.024
S98-03474	4507903422	42.3	< 0.04	0.02	0.088	117	< 0.008	< 0.02	< 0.008	1.88	3.1	0.008	25.3	0.479	19.4	< 0.2	23	0.3	0.377	< 0.006	0.019
S98-03475	4507903422	18.3	0.05	0.02	0.326	92.1	< 0.008	< 0.02	< 0.008	6.44	1.5	0.004	22.6	0.302	17.5	0.6	17.9	1.1	0.17	< 0.006	0.014
S98-03476	4509473603	57.1	< 0.04	0.02	0.124	78	< 0.008	< 0.02	< 0.008	2.91	3.7	< 0.003	17.8	0.244	12.6	0.5	16.5	1.7	0.203	< 0.006	0.02
S98-03477	4509414040	1030	< 0.04	0.03	0.041	82.2	< 0.008	< 0.02	< 0.008	0.155	1.2	< 0.003	21.9	1.2	32.8	0.3	18.8	< 0.2	0.559	0.024	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03478	RIP1494	22/04/1998	23.84	88.913	1990	STW	45	Saban Ali	Khulna	Kushtia	Mirpur (K)	Malihad	Malihad
S98-03479	RIP1495	26/04/1998	22.694	90.369	1998	DTW	308	DPHE Office	Barisal	Barisal	Barisal Sadar	Paurashava W04	Mazidbari
S98-03480	RIP1496	26/04/1998	22.72	90.349	1995	DTW	301	Mr Kazal Hossain	Barisal	Barisal	Barisal Sadar	Kashipur	Ichhakati
S98-03481	RIP1497	26/04/1998	22.713	90.297	1983	STW	28	Candakua	Barisal	Barisal	Barisal Sadar	Raipahsa Karapur	Uttar karapur
S98-03482	RIP1498	26/05/1998	22.67	90.325	1984	STW	32	Md Yusuf Ali	Barisal	Barisal	Barisal Sadar	Jagua	Jagua uttar
S98-03483	RIP1500	27/04/1998	22.997	90.228	1994	STW	20	Mr Tara Mia	Barisal	Barisal	Gournadi	Barthi	Kasimabad
S98-03484	RIP1501	27/04/1998	22.996	90.213	1985	STW	22	Ramsiddi Bazar	Barisal	Barisal	Gournadi	Barthi	Bangila
S98-03485	RIP1502	27/04/1998	22.965	90.199	1988	STW	23	Abdul Barek Sardar	Barisal	Barisal	Gournadi	Chandshi	Nathai
S98-03486	RIP1503	27/04/1998	22.972	90.225	1988	DTW	273	Gournadi Market	Barisal	Barisal	Gournadi	Chandshi	Uttar bijoypur
S98-03487	RIP1504	27/04/1998	22.964	90.262	1991	DTW	276	Sadrullah Choudhuri	Barisal	Barisal	Gournadi	Nalchira	Pinglakati
S98-03488	RIP1505	27/04/1998	22.939	90.24	1988	STW	22	Md Habibul Sardar	Barisal	Barisal	Gournadi	Mahilara	Kasemabad
S98-03489	RIP1506	27/04/1998	22.929	90.242	1991	STW	22	Mahilara College	Barisal	Barisal	Gournadi	Mahilara	Purba saripb.
S98-03490	RIP1507	27/04/1998	22.899	90.3	1987	DTW	273	Md Mosrraf Hossain	Barisal	Barisal	Gournadi	Sarikal	Sankakati
S98-03491	RIP1508	27/04/1998	22.908	90.251	1983	DTW	273	Batazore Bazar	Barisal	Barisal	Gournadi	Batazore	Batazore
S98-03492	RIP1510	28/04/1998	22.532	90.342	1988	STW	17	Thakur Chand	Barisal	Barisal	Bakerganj	Bharpasha	Bharpasha
S98-03493	RIP1511	28/04/1998	22.507	90.346	1993	DTW	338	Laxmipasha P. School	Barisal	Barisal	Bakerganj	Bharpasha	Pas.Lakshmipasha
S98-03494	RIP1512	28/04/1998	22.566	90.338	1974	STW	17	Md Mozaffar Talukder	Barisal	Barisal	Bakerganj	Rangasree	Nandapara
S98-03495	RIP1513	28/04/1998	22.589	90.35	1994	DTW	339	Abul Kasem Sikder	Barisal	Barisal	Bakerganj	Rangasree	Tabirkati
S98-03496	RIP1514	28/04/1998	22.518	90.309	1989	DTW	330	Dr Jagendra Nath	Barisal	Barisal	Bakerganj	Padrisibpur	Ariaibeki
S98-03497	RIP1515	28/04/1998	22.511	90.283	1989	DTW	318	Md Harun Munsi	Barisal	Barisal	Bakerganj	Padrishibpur	Bara Puiautha
S98-03498	RIP1516	28/04/1998	22.505	90.268	1995	DTW	331	Abdur Rashid	Barisal	Barisal	Bakerganj	Niamati	Purba mahespur
S98-03499	RIP1517	28/04/1998	22.496	90.246	1983	DTW	351	Syed Mohammad Ali	Barisal	Barisal	Bakerganj	Niamati	Paschim mahespur
S98-03500	RIP1519	29/04/1998	22.774	90.159	1993	STW	22	Anil Master	Barisal	Barisal	Banaripara	Banaripara	Machhrang
S98-03501	RIP1520	29/04/1998	22.786	90.183	1994	DTW	275	Khokon Kazi	Barisal	Barisal	Banaripara	Saliabakpur	Saliabagpur
S98-03502	RIP1521	29/04/1998	22.798	90.187	1994	STW	23	Abdur Rob	Barisal	Barisal	Banaripara	Saliabakpur	Sakharia
S98-03503	RIP1522	29/04/1998	22.808	90.187	1991	DTW	272	Syed Enayet Bari	Barisal	Barisal	Banaripara	Chakhar	Chakhar
S98-03504	RIP1523	29/04/1998	22.789	90.152	1994	STW	18	Abdul Zalil	Barisal	Barisal	Banaripara	Baisari	Sialkati
S98-03505	RIP1524	29/04/1998	22.806	90.127	1995	DTW	266	Munsi Nasiruddin	Barisal	Barisal	Banaripara	Udaykati	Labansara
S98-03506	RIP1526	30/04/1998	22.282	90.568	1997	DTW	260	DPHE Office	Barisal	Patuakhali	Dashmina	Dashmina	Dashmina
S98-03507	RIP1527	30/04/1998	22.284	90.551	1996	DTW	290	Md Kaiser Ali	Barisal	Patuakhali	Dashmina	Banshbaria	Char Hosnabad
S98-03508	RIP1528	30/04/1998	22.267	90.533	1993	DTW	278	Yusuf Ali Mridha	Barisal	Patuakhali	Dashmina	Alipur	Purba Alipur
S98-03509	RIP1529	30/04/1998	22.276	90.546	1990	DTW	254	Hazi Mansur Ali Khan	Barisal	Patuakhali	Dashmina	Dashmina	Gopaldi Nijabad
S98-03510	RIP1530	30/04/1998	22.302	90.577	1980	DTW	259	Banglabazar Committe	Barisal	Patuakhali	Dashmina	Banshbaria	Gachani
S98-03511	RIP1532	27/04/1998	22.971	90.153	1992	STW	15	Md Shahidul Haq	Barisal	Barisal	Agailjhara	Bakal	Manasi phulasri
S98-03512	RIP1533	27/04/1998	23.015	90.166	1980	STW	29	DPHE Office	Barisal	Barisal	Agailjhara	Rajihar	Bara basail
S98-03513	RIP1534	27/04/1998	23.014	90.182	1997	STW	96	Shear Ali Fakir	Barisal	Barisal	Agailjhara	Rajihar	Bara basail
S98-03514	RIP1535	27/04/1998	22.989	90.135	1990	STW	34	Kala Chad Barai	Barisal	Barisal	Agailjhara	Bakal	Dumuria
S98-03515	RIP1536	27/04/1998	22.986	90.136	1990	DTW	238	Bakal Bazar	Barisal	Barisal	Agailjhara	Bakal	Bakal
S98-03516	RIP1537	27/04/1998	22.966	90.084	1994	DTW	244	DPHE Office	Barisal	Barisal	Agailjhara	Bagdha	Chand trishira
S98-03517	RIP1538	27/04/1998	22.965	90.086	1973	STW	38	Mr Mobarak Hossain	Barisal	Barisal	Agailjhara	Badgha	Chand trishira
S98-03518	RIP1539	27/04/1998	22.931	90.199	1983	STW	23	Kazirhat Bazar	Barisal	Barisal	Agailjhara	Ratnapur	Beluhar
S98-03519	RIP1540	27/04/1998	22.961	90.191	1990	STW	22	DPHE Office	Barisal	Barisal	Agailjhara	Gaila	Dakshin sihipasa
S98-03520	RIP1542	28/04/1998	22.821	90.252	1990	STW	17	DPHE Office	Barisal	Barisal	Wazirpur	Shikarpur	Wazirpur
S98-03521	RIP1543	28/04/1998	22.875	90.267	1997	DTW	291	Harun Jamader	Barisal	Barisal	Wazirpur	Bamrail	Sanuhar
S98-03522	RIP1544	28/04/1998	22.881	90.246	1992	STW	16	Kari Helal Uddin	Barisal	Barisal	Wazirpur	Bamrail	Hastishiwnda
S98-03523	RIP1545	28/04/1998	22.892	90.199	1972	DTW	318	Dhamura Bandar	Barisal	Barisal	Wazirpur	Sholack	Dhamura
S98-03524	RIP1546	28/04/1998	22.892	90.2	1965	STW	23	Dhamura Bazar	Barisal	Barisal	Wazirpur	Sholack	Dhamura
S98-03525	RIP1547	28/04/1998	22.835	90.213	1995	STW	23	Mridhabari Mosque	Barisal	Barisal	Wazirpur	Barakotha	Narikeli

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03478	4509465676	174	< 0.04	0.02	0.18	96	< 0.008	< 0.02	< 0.008	9.27	2.7	< 0.003	26.3	0.188	14.6	0.8	18.5	< 0.2	0.354	< 0.006	0.01
S98-03479	1065148537	< 0.5	< 0.04	0.17	0.014	6.8	< 0.008	< 0.02	< 0.008	0.12	2.5	0.003	3.67	0.027	160	0.2	11.9	0.2	0.0868	< 0.006	0.016
S98-03480	1065169470	< 0.5	< 0.04	0.24	0.014	4.43	< 0.008	< 0.02	< 0.008	0.122	1.8	< 0.003	2.25	0.017	156	0.3	11.7	1.6	0.0564	< 0.006	0.013
S98-03481	1065177994	248	< 0.04	0.06	0.055	84.8	< 0.008	< 0.02	< 0.008	8.64	4.5	< 0.003	19.4	0.474	24.7	1.1	20.8	< 0.2	0.304	< 0.006	0.009
S98-03482	1065160493	227	< 0.04	0.56	0.194	74.8	< 0.008	< 0.02	< 0.008	7.5	22.6	0.005	88.3	0.223	798	3.3	17.8	< 0.2	0.67	< 0.006	< 0.008
S98-03483	1063223887	359	< 0.04	0.06	0.095	134	< 0.008	< 0.02	< 0.008	5.47	6.1	< 0.003	32.3	0.143	22.1	0.8	20.7	< 0.2	0.468	< 0.006	0.011
S98-03484	1063223078	163	< 0.04	0.36	0.088	66.5	< 0.008	< 0.02	< 0.008	5.97	18	0.004	43.9	0.089	221	4.9	27.7	0.3	0.42	< 0.006	0.028
S98-03485	1063238642	44.7	< 0.04	0.06	0.125	102	< 0.008	< 0.02	< 0.008	6.01	2.6	< 0.003	39.8	0.184	38.5	0.9	23.5	< 0.2	0.318	< 0.006	< 0.008
S98-03486	1063238950	3.3	< 0.04	0.57	0.147	36	< 0.008	< 0.02	< 0.008	0.343	4	0.006	18.4	0.068	339	0.6	14.3	< 0.2	0.274	< 0.006	< 0.008
S98-03487	1063271740	2.4	< 0.04	0.65	0.123	27.9	< 0.008	< 0.02	< 0.008	0.166	3.5	0.007	13.2	0.054	337	0.6	13.8	5.3	0.214	< 0.006	0.012
S98-03488	1063263421	290	< 0.04	0.11	0.156	75.2	< 0.008	< 0.02	< 0.008	4.73	4.3	< 0.003	19.2	0.057	178	2.4	21.3	0.5	0.289	< 0.006	< 0.008
S98-03489	1063263789	69.4	< 0.04	0.11	0.128	88.4	< 0.008	< 0.02	< 0.008	7.24	6.1	0.004	25.4	0.086	64.8	2.2	27.8	< 0.2	0.348	< 0.006	< 0.008
S98-03490	1063294843	8.6	< 0.04	0.56	0.2	46.9	< 0.008	< 0.02	< 0.008	0.513	5.4	0.008	34.3	0.058	411	0.5	13.1	< 0.2	0.422	< 0.006	< 0.008
S98-03491	1063231137	1	< 0.04	0.6	0.034	8.43	< 0.008	< 0.02	< 0.008	0.208	2.4	0.006	4.05	0.013	277	0.6	13.4	3.9	0.0722	< 0.006	< 0.008
S98-03492	1060706147	26	0.06	0.31	0.02	24.4	< 0.008	< 0.02	< 0.008	1.55	12.5	0.003	35.5	0.059	224	4.7	24.5	6.4	0.232	< 0.006	< 0.008
S98-03493	1060706744	< 0.5	< 0.04	0.31	0.01	5	< 0.008	< 0.02	< 0.008	0.07	2	0.003	2.74	0.014	185	0.4	11.1	0.2	0.0614	< 0.006	< 0.008
S98-03494	1060794686	137	< 0.04	0.53	0.128	111	< 0.008	< 0.02	< 0.008	5.81	18.1	0.003	100	0.134	736	4.3	23.3	0.3	0.801	< 0.006	< 0.008
S98-03495	1060794	< 0.5	< 0.04	0.35	0.009	7.85	< 0.008	< 0.02	< 0.008	0.046	2.1	< 0.003	4.41	0.018	183	0.3	10.8	< 0.2	0.102	< 0.006	< 0.008
S98-03496	1060788025	0.9	< 0.04	0.42	0.012	6.2	< 0.008	< 0.02	0.009	0.058	2.6	0.004	3.39	0.017	219	0.5	11.1	0.5	0.0777	< 0.006	0.009
S98-03497	1060788109	2	< 0.04	0.44	0.02	5.36	< 0.008	< 0.02	< 0.008	0.046	2.4	< 0.003	3.14	0.025	220	0.6	10.1	0.4	0.0689	< 0.006	< 0.008
S98-03498	1060781815	0.6	< 0.04	0.53	0.021	7.52	< 0.008	< 0.02	< 0.008	0.101	2.8	0.004	5.58	0.027	237	0.6	10.3	3.9	0.0946	< 0.006	< 0.008
S98-03499	1060781751	1.6	< 0.04	0.57	0.017	4.84	< 0.008	< 0.02	< 0.008	0.066	2.4	< 0.003	2.9	0.02	216	0.6	10.4	0.6	0.064	< 0.006	< 0.008
S98-03500	1061010659	389	< 0.04	0.2	0.114	60.3	< 0.008	< 0.02	< 0.008	1.52	4.4	< 0.003	18	0.026	388	3.7	15.4	3	0.221	< 0.006	< 0.008
S98-03501	1061063891	2.7	< 0.04	0.42	0.039	9.28	< 0.008	< 0.02	< 0.008	0.232	2.8	0.004	4.25	0.035	232	0.5	13.2	0.3	0.0783	< 0.006	< 0.008
S98-03502	1061063865	149	< 0.04	0.28	0.167	48.7	< 0.008	< 0.02	< 0.008	1.59	13.1	< 0.003	53.8	0.06	368	3.2	16.9	0.5	0.353	< 0.006	< 0.008
S98-03503	1061042258	10.8	< 0.04	0.4	0.263	54.3	< 0.008	< 0.02	< 0.008	2.78	5.7	0.008	37.3	0.058	470	0.4	14.4	1.1	0.404	< 0.006	0.01
S98-03504	1061021917	23.4	< 0.04	0.2	0.034	10.5	< 0.008	< 0.02	< 0.008	1.5	6.8	< 0.003	12.1	0.037	227	7.1	17.8	0.7	0.0761	< 0.006	< 0.008
S98-03505	1061084646	< 0.5	< 0.04	0.65	0.027	6.48	< 0.008	< 0.02	< 0.008	0.126	1.7	0.006	2.53	0.008	280	0.5	13.2	0.2	0.0526	< 0.006	0.009
S98-03506	1785252497	< 0.5	< 0.04	0.24	0.047	15.5	< 0.008	< 0.02	< 0.008	0.129	4.6	< 0.003	10.7	0.027	190	0.8	12.4	0.2	0.173	< 0.006	< 0.008
S98-03507	1785231363	< 0.5	< 0.04	0.22	0.022	8.79	< 0.008	< 0.02	< 0.008	0.087	2.8	< 0.003	5.32	0.009	146	0.4	11.8	0.3	0.0933	< 0.006	< 0.008
S98-03508	1785210880	< 0.5	< 0.04	0.24	0.018	7.75	< 0.008	< 0.02	< 0.008	0.068	2.9	0.004	4.44	0.01	147	0.6	11.3	0.4	0.0826	< 0.006	0.026
S98-03509	1785252574	< 0.5	< 0.04	0.23	0.021	7.87	< 0.008	< 0.02	< 0.008	0.113	3	0.003	4.67	0.009	142	0.7	11.7	0.4	0.0869	< 0.006	< 0.008
S98-03510	1785231516	0.9	< 0.04	0.22	0.039	11.7	< 0.008	< 0.02	< 0.008	0.212	4	< 0.003	8.4	0.02	144	0.8	12.2	0.2	0.132	< 0.006	< 0.008
S98-03511	1060215588	107	< 0.04	0.25	0.034	30.6	< 0.008	< 0.02	< 0.008	1.68	7.3	< 0.003	19.3	0.044	263	3.9	20.7	< 0.2	0.189	< 0.006	< 0.008
S98-03512	1060279098	6	0.06	0.73	0.087	46.4	< 0.008	< 0.02	< 0.008	0.482	24.4	0.005	52.3	0.05	512	2.4	26.8	0.8	0.44	< 0.006	< 0.008
S98-03513	1060279098	< 0.5	< 0.04	0.35	0.055	22	< 0.008	< 0.02	< 0.008	0.055	2.7	0.009	10.3	0.013	188	0.3	17.1	< 0.2	0.196	< 0.006	< 0.008
S98-03514	1060215362	319	< 0.04	0.07	0.367	215	< 0.008	< 0.02	< 0.008	9.1	8.3	0.004	54.6	0.112	118	0.8	20.1	< 0.2	0.822	0.007	< 0.008
S98-03515	1060215073	2	0.05	0.32	0.378	83.5	< 0.008	< 0.02	< 0.008	1.19	6.3	0.01	41.8	0.184	386	0.4	15.9	< 0.2	0.626	< 0.006	0.012
S98-03516	1060207196	0.8	0.04	0.35	0.485	129	< 0.008	< 0.02	< 0.008	1.56	9.4	0.01	81.3	0.22	509	0.4	13.7	< 0.2	1.02	< 0.006	0.008
S98-03517	1060207196	207	< 0.04	0.2	0.118	69.9	< 0.008	< 0.02	< 0.008	2.52	8.4	< 0.003	43.6	0.059	173	2.2	20.9	0.4	0.426	< 0.006	< 0.008
S98-03518	1060287151	80.6	0.05	0.1	0.162	95.9	< 0.008	< 0.02	< 0.008	6.66	4.7	< 0.003	31.9	0.09	66.7	1.3	24	< 0.2	0.3	< 0.006	0.021
S98-03519	1060247328	248	0.04	0.23	0.135	85.3	< 0.008	< 0.02	< 0.008	4.9	9.5	< 0.003	35.3	0.056	227	3.6	21.3	2.3	0.419	< 0.006	0.009
S98-03520	1069484994	59.2	< 0.04	0.03	0.099	76.3	< 0.008	< 0.02	< 0.008	7.76	5.3	< 0.003	16.2	0.519	5.9	0.8	21.3	< 0.2	0.306	< 0.006	< 0.008
S98-03521	1069410893	< 0.5	< 0.04	0.51	0.034	11.2	< 0.008	< 0.02	< 0.008	0.146	2.4	0.006	5.66	0.015	293	0.3	12.4	< 0.2	0.116	< 0.006	0.011
S98-03522	1069410413	257	< 0.04	0.15	0.168	116	< 0.008	< 0.02	< 0.008	3.64	11.4	< 0.003	53.5	0.088	335	1.4	20.3	< 0.2	0.584	< 0.006	< 0.008
S98-03523	1069494311	8.4	< 0.04	0.99	0.027	5.98	< 0.008	< 0.02	< 0.008	0.1	2	0.007	3.06	0.01	298	0.7	12	< 0.2	0.0588	< 0.006	0.076
S98-03524	1069494311	23.4	0.05	0.11	0.176	88.4	< 0.008	< 0.02	< 0.008	4.4	5.5	0.004	57	0.08	95.7	1.7	19.9	< 0.2	0.303	< 0.006	< 0.008
S98-03525	1069421683	21.4	< 0.04	0.07	0.083	97.1	< 0.008	< 0.02	< 0.008	2.96	4.7	< 0.003	53.6	0.054	51.9	0.9	30.3	< 0.2	0.334	< 0.006	0.018

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03526	RIP1548	28/04/1998	22.836	90.212	1996	DTW	275	Abul Kasem Mridha	Barisal	Barisal	Wazirpur	Barakotha	Narikeli
S98-03527	RIP1550	30/04/1998	22.373	90.585	1997	DTW	282	Md Abul Hossain	Barisal	Patuakhali	Bauphal	Kalaiya	Kalaiya
S98-03528	RIP1551	30/04/1998	22.378	90.544	1983	DTW	259	Ali Mohammad Gazi	Barisal	Patuakhali	Bauphal	Noamala	Noamala
S98-03529	RIP1552	30/04/1998	22.52	90.52	1980	DTW	272	Abdul Gani Munsi	Barisal	Patuakhali	Bauphal	Kalisuri	Dakshin Kalisuri
S98-03530	RIP1553	30/04/1998	22.475	90.559	1993	DTW	295	Md Sharif Hossain	Barisal	Patuakhali	Bauphal	Surjyamani	Narayanpur
S98-03531	RIP1554	30/04/1998	22.432	90.558	1963	DTW	277	Mozammel Haq	Barisal	Patuakhali	Bauphal	Madanpura	Chandpara
S98-03532	RIP1555	30/04/1998	22.427	90.457	1962	DTW	254	Baga Motor Ghat	Barisal	Patuakhali	Bauphal	Baga	Baga
S98-03533	RIP1557	01/05/1998	22.357	90.352	1997	HTW	17	Halima Begum	Barisal	Patuakhali	Patuakhali Sadar	Paurashava w01	Nqwabpara
S98-03534	RIP1558	01/05/1998	22.359	90.351	1997	DTW	308	Bazlur Rahaman	Barisal	Patuakhali	Patuakhali Sadar	Paurashava w01	Nowabpara
S98-03535	RIP1559	30/04/1998	22.375	90.514	1993	DTW	295	Mahammad Alamgir	Barisal	Patuakhali	Bauphal	Noamala	Noamala
S98-03536	RIP1560	01/05/1998	22.463	90.344	1995	DTW	308	Lebukhali Ferry Ghat	Barisal	Patuakhali	Patuakhali Sadar	Lebukhali	Lebukhali
S98-03537	RIP1561	02/05/1998	22.433	90.442	1995	DTW	292	Moulana Ismail Gazi	Barisal	Patuakhali	Patuakhali Sadar	Muradia	J. Garabdia char
S98-03538	RIP1562	02/05/1998	22.432	90.335	1991	DTW	312	Basstand Mosque	Barisal	Patuakhali	Patuakhali Sadar	Badarpur	Badarpur
S98-03539	RIP1563	02/05/1998	22.36	90.296	1994	DTW	315	Motahar Sikder	Barisal	Patuakhali	Patuakhali Sadar	Itabaria	Ballabh
S98-03540	RIP1564	02/05/1998	22.351	90.356	1991	DTW	319	Md Sanu Khan	Barisal	Patuakhali	Patuakhali Sadar	Lohalia	Idrakpur Lohalia
S98-03541	RIP1566	03/05/1998	22.1	90.016	1992	DTW	310	Rustam Ali	Barisal	Barguna	Patharghata	Kalmegha	Kalmegha
S98-03542	RIP1567	03/05/1998	22.116	90.003	1989	DTW	301	Gopal Chandra	Barisal	Barguna	Patharghata	Karthal	Kalipur
S98-03543	RIP1568	03/05/1998	22.181	90.02	1992	DTW	320	Attahar Uddin	Barisal	Barguna	Patharghata	Kagchira	Kagchira
S98-03544	RIP1569	03/05/1998	22.185	89.993	1997	DTW	321	Lemua School &Colleg	Barisal	Barguna	Patharghata	Raihanpur	Lemua
S98-03545	RIP1571	04/05/1998	22.172	90.18	1996	DTW	287	Mohammad Ali	Barisal	Barguna	Barguna Sadar	Aylapathakata	Itbaria
S98-03546	RIP1572	04/05/1998	22.179	90.17	1996	DTW	282	Abdul Gani Master	Barisal	Barguna	Barguna Sadar	Keorabania	Keorabania
S98-03547	RIP1574	05/05/1998	22.626	90.061	1995	STW	16	Sawapan Mozumder	Barisal	Pirojpur	Kawkhali	Kawkhali	Uzailkhan
S98-03549	RIP1576	05/05/1998	22.638	90.078	1991	STW	15	Brazendranath Barai	Barisal	Pirojpur	Kawkhali	Amrajuri	Purba Amrajuri
S98-03550	RIP1577	05/05/1998	22.604	90.082	1990	STW	14	Abul Bashar Sarder	Barisal	Pirojpur	Kawkhali	Kawkhali	Gosantara
S98-03551	RIP1578	05/05/1998	22.575	90.057	1990	STW	17	Jabbar Bishwas	Barisal	Pirojpur	Kawkhali	Shialkati	Shialkati
S98-03552	RIP1579	05/05/1998	22.577	90.053	1994	DTW	313	Ashraf Ali Khan	Barisal	Pirojpur	Kawkhali	Chirapara	Jibka Saturia
S98-03553	RIP1582	28/04/1998	22.822	90.433	1992	DTW	289	????	Barisal	Barisal	Mehendiganj	Biddah Nandanpur	Bidya Nandapur
S98-03554	RIP1584	29/04/1998	22.907	90.379	1995	DTW	312	Nandi Bazar Mosque	Barisal	Barisal	Muladi	Muladi	Char laxmipura
S98-03555	RIP1585	29/04/1998	22.911	90.411	1997	DTW	315	DPHE Office	Barisal	Barisal	Muladi	Muladi	Terochargram
S98-03556	RIP1586	29/04/1998	22.918	90.415	1988	DTW	312	Abdur Rashid	Barisal	Barisal	Muladi	Gachhua	Dashin char di.
S98-03557	RIP1587	29/04/1998	22.953	90.415	1992	DTW	311	Shajahan Ali Sakar	Barisal	Barisal	Muladi	Char kalekhan	Dakshin gachhua
S98-03558	RIP1588	29/04/1998	22.966	90.342	1994	DTW	282	Abdul Motaleb Paik	Barisal	Barisal	Muladi	Nazirpur	Hosnabad
S98-03559	RIP1589	29/04/1998	22.992	90.339	1990	DTW	243	Abdus Salam	Barisal	Barisal	Muladi	Batamara	Alimabad
S98-03560	RIP1590	29/04/1998	22.993	90.34	1990	STW	15	DPHE Office	Barisal	Barisal	Muladi	Batamara	Alimabad
S98-03561	RIP1591	29/04/1998	22.733	90.442	1965	DTW	322	Char Monai Madarasha	Barisal	Barisal	Barisal Sadar	Char Monai	Char monai
S98-03562	RIP1592	29/04/1998	22.706	90.395	1990	STW	16	Md Harun Mollah	Barisal	Barisal	Barisal Sadar	Char Kowa	Char kauar
S98-03563	RIP1594	30/04/1998	22.325	90.192	1994	DTW	314	Abdul Aziz Akhand	Barisal	Patuakhali	Mirzaganj	Deuli Subidkhali	Ranipur
S98-03564	RIP1595	30/04/1998	22.302	90.192	1990	DTW	288	Abdul Karim Hawalder	Barisal	Patuakhali	Mirzaganj	Kakrabunia	Kakrabunia
S98-03565	RIP1596	30/04/1998	22.279	90.181	1997	DTW	354	Abur Razzak	Barisal	Patuakhali	Mirzaganj	Majid baria	Uttar Sultanabad
S98-03566	RIP1597	30/04/1998	22.37	90.222	1995	DTW	311	Subidkhali College	Barisal	Patuakhali	Mirzaganj	Amragachhia	Uttar Subidkhali
S98-03567	RIP1598	30/04/1998	22.356	90.259	1996	DTW	308	Abdul Haq Munsi	Barisal	Patuakhali	Mirzaganj	Mirzaganj	Monoharkhali
S98-03568	RIP1599	01/05/1998	22.358	90.342	1995	DTW	306	Rashid Trishalay	Barisal	Patuakhali	Patuakhali Sadar	Paurashava W03	Thanapara
S98-03569	RIP1600	01/05/1998	22.35	90.347	1997	DTW	273	Syed Asraf Hossain	Barisal	Patuakhali	Patuakhali Sadar	Paurashava W01	College Road
S98-03570	RIP1602	02/05/1998	21.893	90.141	1997	DTW	247	Md Hanif Bari	Barisal	Patuakhali	Kalapara	Khapra bhanga	Nizampur
S98-03571	RIP1603	02/05/1998	21.816	90.126	1973	DTW	266	Md Sekander Ali	Barisal	Patuakhali	Kalapara	Latachapli	Latachapli
S98-03572	RIP1604	02/05/1998	21.814	90.124	1997	HTW	9	Hotel Sun Rise	Barisal	Patuakhali	Kalapara	Latachapli	Latachapli
S98-03573	RIP1605	02/05/1998	21.98	90.232	1995	DTW	266	Sudhano Karmaker	Barisal	Patuakhali	Kalapara	Tiakhali	Tiakhali
S98-03574	RIP1606	02/05/1998	21.996	90.211	1972	DTW	296	Ali Asgar Maulana	Barisal	Patuakhali	Kalapara	Ttiakhali	Nashnapara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03526	1069421683	0.9	< 0.04	0.65	0.392	104	< 0.008	< 0.02	< 0.008	0.192	6.9	0.012	78.1	0.053	658	0.5	13.3	< 0.2	0.793	< 0.006	< 0.008
S98-03527	1783853584	5.2	< 0.04	0.2	0.067	18.2	< 0.008	< 0.02	< 0.008	0.282	5.7	0.003	13.4	0.045	153	1.1	12.7	< 0.2	0.203	< 0.006	< 0.008
S98-03528	1783883800	1.8	< 0.04	0.19	0.021	7.76	< 0.008	< 0.02	< 0.008	0.083	2.4	< 0.003	4.71	0.016	137	0.4	10.9	< 0.2	0.0851	< 0.006	< 0.008
S98-03529	1783859598	< 0.5	< 0.04	0.14	0.03	16	< 0.008	< 0.02	< 0.008	0.108	3.5	< 0.003	9.02	0.02	108	0.4	12.2	< 0.2	0.162	< 0.006	< 0.008
S98-03530	1783895765	1.9	< 0.01	0.6	0.021	7.5	< 0.003	< 0.002	< 0.008	0.023	2.4	0.012	3.51	0.005	294	0.1	13.3	< 0.2	0.0953	< 0.002	0.006
S98-03531	1783877229	< 0.5	0.08	0.15	0.066	25.4	< 0.008	< 0.02	< 0.008	0.126	3.9	< 0.003	12	0.03	98.7	0.2	11.9	< 0.2	0.289	< 0.006	0.265
S98-03532	1783811076	1.2	0.05	0.2	0.024	8.77	< 0.008	< 0.02	< 0.008	0.247	3.2	< 0.003	5.12	0.013	143	0.6	11.4	96.1	0.101	< 0.006	0.032
S98-03533	1789575568	11.8	0.07	0.18	0.143	56.4	< 0.008	< 0.02	< 0.008	5.36	7.7	0.004	36.3	0.377	306	0.7	25.3	34.9	0.298	< 0.006	0.09
S98-03534	1789575568	< 0.5	0.04	0.37	0.023	6.27	< 0.008	< 0.02	< 0.008	0.168	2.7	< 0.003	3.85	0.019	185	0.9	10.6	9.5	0.0743	< 0.006	< 0.008
S98-03535	1783883800	1	< 0.04	0.19	0.017	8.21	< 0.008	< 0.02	< 0.008	0.054	2.7	< 0.003	4.33	0.014	133	0.6	11	0.3	0.0964	< 0.006	< 0.008
S98-03536	1789547602	1	< 0.04	0.44	0.015	7.97	< 0.008	< 0.02	< 0.008	0.145	3.2	0.004	4.76	0.022	221	0.4	10.3	1	0.105	< 0.006	< 0.008
S98-03537	1789581492	< 0.5	0.05	0.24	0.019	9.31	< 0.008	< 0.02	< 0.008	0.096	3	0.003	4.91	0.016	154	0.5	11.8	2.4	0.0964	< 0.006	0.012
S98-03538	1789506054	< 0.5	< 0.04	0.48	0.016	7.72	< 0.008	< 0.02	< 0.008	0.134	2.5	< 0.003	3.72	0.012	208	0.4	10.6	1.7	0.0925	< 0.006	< 0.008
S98-03539	1789520091	2.4	< 0.04	0.48	0.016	5.44	< 0.008	< 0.02	< 0.008	0.132	2.7	< 0.003	3.72	0.015	202	0.9	10.2	2.3	0.066	< 0.006	< 0.008
S98-03540	1789554465	1.3	< 0.04	0.37	0.02	6.61	< 0.008	< 0.02	< 0.008	0.109	2.9	0.003	4.08	0.012	188	1.1	10.7	2.1	0.0807	< 0.006	< 0.008
S98-03541	1048535561	< 0.5	< 0.04	1.2	0.021	6.96	< 0.008	< 0.02	< 0.008	0.117	4.3	0.005	6.02	0.013	460	1.6	9.28	3.3	0.0853	< 0.006	< 0.008
S98-03542	1048547535	< 0.5	< 0.04	1.26	0.021	8.26	< 0.008	< 0.02	< 0.008	0.113	4.4	0.006	7	0.018	469	1.5	8.91	2	0.102	< 0.006	< 0.008
S98-03543	1048523484	< 0.5	< 0.04	0.79	0.013	4.72	< 0.008	< 0.02	< 0.008	0.111	3.2	0.003	4.13	0.012	287	1.2	9.92	2.1	0.059	< 0.006	< 0.008
S98-03544	1048583663	< 0.5	< 0.04	1.25	0.044	15	< 0.008	< 0.02	< 0.008	0.233	14.6	0.009	26.2	0.025	741	1.7	9.55	1.9	0.226	< 0.006	0.014
S98-03545	1042809488	1	0.04	0.73	0.014	5.69	< 0.008	< 0.02	< 0.008	0.295	3.1	0.003	3.33	0.019	254	1.2	10.3	1.8	0.0598	< 0.006	0.013
S98-03546	1042876544	2.1	0.14	0.69	0.03	8.71	< 0.008	< 0.02	< 0.008	0.658	3.6	0.003	3.57	0.042	258	1.6	10.3	2.9	0.0686	< 0.006	0.034
S98-03547	1794747994	< 0.5	0.1	1.31	0.026	10.1	< 0.008	< 0.02	< 0.008	0.167	2.8	0.006	5.35	0.017	392	0.4	11.8	1.8	0.125	< 0.006	0.157
S98-03549	1794715821	7.2	0.07	0.35	0.078	64	< 0.008	< 0.02	< 0.008	4.14	17.4	0.007	86.3	0.16	290	1.3	21.7	3.3	0.528	< 0.006	0.01
S98-03550	1794747497	26.4	< 0.04	0.26	0.05	65.9	< 0.008	< 0.02	< 0.008	2.83	13.1	0.003	56.7	0.072	240	2	25.3	1.7	0.465	< 0.006	0.009
S98-03551	1794779908	11.6	< 0.04	0.25	0.056	35.3	< 0.008	< 0.02	< 0.008	2.05	7.4	< 0.003	27.8	0.066	305	4.9	25.1	4.2	0.2	< 0.006	< 0.008
S98-03552	1794731605	2.3	< 0.04	0.9	0.061	17.2	< 0.008	< 0.02	< 0.008	0.197	3.6	0.006	9.07	0.026	411	0.6	10.6	1.1	0.19	< 0.006	< 0.008
S98-03553	1066231110	1.9	< 0.04	0.2	0.012	3.38	< 0.008	< 0.02	< 0.008	0.084	1.8	< 0.003	1.71	0.027	151	0.2	12.5	< 0.2	0.0439	< 0.006	< 0.008
S98-03554	1066959288	1	< 0.04	0.79	0.044	10.5	< 0.008	< 0.02	< 0.008	0.082	2.7	0.007	5.36	0.029	439	0.8	12.1	< 0.2	0.128	< 0.006	< 0.008
S98-03555	1066959895	1.7	< 0.01	0.6	0.026	6.8	< 0.003	< 0.002	< 0.008	< 0.005	2.6	0.014	3.39	< 0.002	304	0.1	16.5	0.3	0.0796	< 0.002	< 0.004
S98-03556	1066959159	0.7	< 0.04	0.4	0.02	4.51	< 0.008	< 0.02	< 0.008	0.066	1.6	0.004	1.96	0.017	217	0.3	12.8	0.3	0.0461	< 0.006	< 0.008
S98-03557	1066923358	0.7	< 0.04	0.22	0.041	10.1	< 0.008	< 0.02	< 0.008	0.143	2.1	0.005	4.55	0.06	218	0.5	13.2	< 0.2	0.0853	< 0.006	< 0.008
S98-03558	1066971437	1.6	< 0.04	0.39	0.033	10.7	< 0.008	< 0.02	< 0.008	0.17	2.5	0.009	4.6	0.019	276	0.5	14.2	< 0.2	0.0861	< 0.006	< 0.008
S98-03559	1066911029	< 0.5	< 0.01	0.2	0.481	97.9	< 0.003	< 0.002	< 0.008	0.027	7.3	0.059	59.1	< 0.002	683	< 0.1	16.2	< 0.2	1.13	< 0.002	0.021
S98-03560	1066911029	667	< 0.04	0.05	0.421	216	< 0.008	< 0.02	< 0.008	12.7	6.5	0.003	47.2	1.46	66.1	1.7	16.4	< 0.2	0.763	0.008	0.012
S98-03561	1065151300	3.4	< 0.04	0.17	0.022	5.4	< 0.008	< 0.02	< 0.008	0.054	1.9	0.004	2.88	0.024	133	< 0.2	11.8	0.4	0.0557	< 0.006	< 0.008
S98-03562	1065143578	0.8	< 0.04	0.17	0.03	10.7	< 0.008	< 0.02	< 0.008	0.127	2.7	0.004	5.52	0.037	132	< 0.2	11.5	< 0.2	0.119	< 0.006	< 0.008
S98-03563	1787627819	0.8	< 0.04	0.59	0.014	4.43	< 0.008	< 0.02	< 0.008	0.059	2.8	0.004	3.37	0.012	221	1	9.69	0.6	0.0512	< 0.006	< 0.008
S98-03564	1787640453	0.9	< 0.01	0.6	0.01	4	< 0.003	< 0.002	< 0.008	0.021	3.3	< 0.004	3.66	< 0.002	256	1.1	11.5	0.7	0.054	< 0.002	< 0.004
S98-03565	1787667541	< 0.5	< 0.04	0.66	0.014	4.57	< 0.008	< 0.02	< 0.008	0.075	2.7	0.003	3.52	0.011	249	0.7	9.95	0.7	0.0546	< 0.006	< 0.008
S98-03566	1787613994	< 0.5	< 0.04	0.5	0.031	9.15	< 0.008	< 0.02	< 0.008	0.096	4.3	0.004	7.91	0.02	321	0.7	9.65	0.4	0.114	< 0.006	< 0.008
S98-03567	1787681716	< 0.5	< 0.04	0.47	0.014	5.75	< 0.008	< 0.02	< 0.008	0.09	2.9	0.003	4.29	0.015	208	1	10.4	4.9	0.0692	< 0.006	< 0.008
S98-03568	1789575710	2.7	< 0.04	0.36	0.031	10.2	< 0.008	< 0.02	< 0.008	0.107	3.6	0.003	6.4	0.017	234	0.8	10.8	0.4	0.127	< 0.006	< 0.008
S98-03569	1789575995	1.3	< 0.04	0.36	0.016	5.58	< 0.008	< 0.02	< 0.008	0.08	2.9	< 0.003	3.86	0.015	179	0.9	10.7	0.4	0.0686	< 0.006	< 0.008
S98-03570	1786623804	6.5	< 0.04	0.79	0.041	9.35	< 0.008	< 0.02	< 0.008	0.278	6.2	0.007	9.93	0.016	430	2.4	10.6	0.6	0.118	< 0.006	< 0.008
S98-03571	1786647592	12.9	< 0.04	1.16	0.043	7.91	< 0.008	< 0.02	< 0.008	0.325	5.6	0.006	8.8	0.013	472	2.8	10.1	0.7	0.103	< 0.006	0.05
S98-03572	1786647592	17.4	< 0.04	0.12	0.037	45.9	< 0.008	< 0.02	< 0.008	0.19	8.8	0.005	42	0.946	250	0.2	11.9	49.5	0.276	< 0.006	< 0.008
S98-03573	1786683931	1	0.04	0.66	0.022	7.32	< 0.008	< 0.02	< 0.008	0.174	4.9	0.006	6.88	0.014	269	2.7	10.4	0.8	0.0874	< 0.006	< 0.008
S98-03574	1786683000	7.6	< 0.04	0.66	0.02	6.07	< 0.008	< 0.02	< 0.008	0.259	4.6	0.004	5.64	0.018	276	4.5	10.7	0.8	0.0729	< 0.006	< 0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03575	RIP1607	02/05/1998	22.008	90.285	1989	DTW	271	Jalaluddin Hawalder	Barisal	Patuakhali	Kalapara	Lalua	Masuakhali
S98-03576	RIP1609	03/05/1998	22.051	90.117	1992	DTW	310	Lutfar Rahaman	Barisal	Barguna	Amtali	Panchakoralia	Chhota bagi
S98-03577	RIP1610	03/05/1998	22.066	90.207	1994	DTW	299	Abdul Majid Master	Barisal	Patuakhali	Kalapara	Chakamaiya	Chakamaiya
S98-03578	RIP1611	03/05/1998	22.094	90.207	1995	DTW	312	Dr Nurul Hossain	Barisal	Barguna	Amtali	Arpangashia	Tarikata
S98-03579	RIP1612	03/05/1998	22.156	90.297	1964	DTW	304	Mokter Hossain	Barisal	Barguna	Amtali	Cliaora	Patakata
S98-03580	RIP1613	03/05/1998	22.183	90.278	1991	DTW	302	Rafizzuddin Khandake	Barisal	Barguna	Amtali	Kukua	Kukua
S98-03581	RIP1614	03/05/1998	22.243	90.318	1989	DTW	285	Hazi Kanchon Ali	Barisal	Barguna	Amtali	Atharagachhia	Sakharia
S98-03582	RIP1615	03/05/1998	22.215	90.304	1994	DTW	308	Yunus Khan College	Barisal	Barguna	Amtali	Gulishakhali	Kalibari
S98-03583	RIP1616	03/05/1998	22.133	90.231	1991	DTW	305	DPHE Office	Barisal	Barguna	Amtali	Amtali	Amtali
S98-03584	RIP1618	04/05/1998	22.417	90.166	1995	STW	21	Matiur Rahaman Khan	Barisal	Barguna	Betagi	Betagi	Betagi
S98-03585	RIP1619	04/05/1998	22.374	90.131	1994	DTW	292	Rozi Akther	Barisal	Barguna	Betagi	Mokamia	Bara mokamia
S98-03586	RIP1620	04/05/1998	22.338	90.142	1990	DTW	292	Abdur Rahaman	Barisal	Barguna	Betagi	Hosnabad	Mehergazi
S98-03587	RIP1621	04/05/1998	22.322	90.112	1992	DTW	295	Union Parishad	Barisal	Barguna	Betagi	Baramazumdar	Badnikhali
S98-03588	RIP1623	05/05/1998	22.289	89.962	1992	STW	13	Paurashava Office	Barisal	Pirojpur	Mathbaria	Mathbaria	Mathbaria
S98-03589	RIP1624	05/05/1998	22.223	89.972	1998	DTW	311	Riad Hossain	Barisal	Pirojpur	Mathbaria	Gulishakhali	Dakshin Hatta
S98-03590	RIP1625	05/05/1998	22.217	89.921	1995	STW	13	Hazrat Ali Akhond	Barisal	Pirojpur	Mathbaria	Sapleza	Sapleza
S98-03591	RIP1626	05/05/1998	22.257	89.946	1988	STW	13	Sonakhali Bazar	Barisal	Pirojpur	Mathbaria	Amragachhia	Uttar Sonakhali
S98-03592	RIP1627	05/05/1998	22.296	89.979	1984	STW	15	Saitha Khan	Barisal	Pirojpur	Mathbaria	Mathbaria	B. Gatichora
S98-03593	RIP1628	05/05/1998	22.346	89.939	1987	STW	11	Mainul Haq	Barisal	Pirojpur	Mathbaria	Tushkhali	Tushkhali
S98-03594	RIP1629	05/05/1998	22.367	89.967	1996	STW	21	Gani Khan	Barisal	Pirojpur	Mathbaria	Dhanishafa	Dhanishafa
S98-03595	RIP1631	06/05/1998	22.743	90.099	1993	STW	14	Thana Vatenary Comp.	Barisal	Pirojpur	Nesarabad	Nesarabad	Nesarabad
S98-03596	RIP1632	06/05/1998	22.76	90.094	1987	DTW	241	Hazi Abul Haq	Barisal	Pirojpur	Nesarabad	Sutiakati	Sutiakati
S98-03597	RIP1633	29/04/1998	22.806	90.193	1986	DTW	302	Aftabuddin Ahamed	Barisal	Barisal	Banaripara	Chakhar	Chakhar
S98-03598	RIP1634	06/05/1998	22.742	90.134	1984	STW	45	Mr Salim Bahadur	Barisal	Pirojpur	Nesarabad	Atgharkuriana	Mahamudkati
S98-03599	RIP1635	06/05/1998	22.73	90.105	1994	STW	16	Mr Dalilur Rahaman	Barisal	Pirojpur	Nesarabad	Jalabari	Uttar Kamarkati
S98-03600	RIP1636	06/05/1998	22.727	90.089	1983	STW	13	Abul Malek	Barisal	Pirojpur	Nesarabad	Sarengkati	Gonmann
S98-03601	RIP1637	06/05/1998	22.73	90.089	1993	DTW	312	Jahangir Hossain	Barisal	Pirojpur	Nesarabad	Shohagdal	D.Pur. Shohagdal
S98-03602	RIP1638	06/05/1998	22.669	90.082	1998	DTW	295	Shehangal H. School	Barisal	Pirojpur	Nesarabad	Samudaykati	Shehangal
S98-03603	RIP1639	06/05/1998	22.684	90.071	1992	DTW	279	Rajbari Bazar	Barisal	Pirojpur	Nesarabad	Guarekha	Rajbari
S98-03604	RIP1641	09/05/1998	22.37	90.07	1976	STW	11	Narayan Kanti Lal	Barisal	Jhalakati	Kathalia	Amua	Amua
S98-03605	RIP1642	09/05/1998	22.369	90.081	1995	DTW	344	Dasher Bari	Barisal	Jhalakati	Kathalia	Amua	Banshbaria
S98-03606	RIP1644	09/05/1998	22.496	90.137	1991	DTW	335	Charail Madarasha	Barisal	Jhalakati	Kathalia	Adarbunia	Uttar Charail
S98-03607	RIP1646	11/05/1998	23.34	90.173	1945	STW	20	Thana Parishad	Dhaka	Madaripur	Shibchar	Bayratala	Bara nilakhi
S98-03608	RIP1647	11/05/1998	23.287	90.17	1980	STW	19	Anawar Hossain	Dhaka	Madaripur	Shibchar	Banskandi	Mrijarchar
S98-03609	RIP1648	11/05/1998	23.329	90.209	1993	STW	20	abdul Jabbar	Dhaka	Madaripur	Shibchar	Umedpur	Umedpur
S98-03610	RIP1649	11/05/1998	23.378	90.16	1937	STW	21	Bahadurpur Pirmanzil	Dhaka	Madaripur	Shibchar	Panch Char	Bara Bahadurpur
S98-03611	RIP1650	11/05/1998	23.411	90.176	1991	STW	19	Liakat Ali	Dhaka	Madaripur	Shibchar	Matbarer Char	Bakharerkandi
S98-03612	RIP1651	11/05/1998	23.387	90.111	1997	STW	18	Arialkhan Ghat	Dhaka	Madaripur	Shibchar	Sannyasir Char	Sannyasir char
S98-03613	RIP1652	11/05/1998	23.365	90.11	1988	STW	21	Haidar Hossain	Dhaka	Madaripur	Shibchar	Dattapara	Char Dattapara
S98-03614	RIP1654	12/05/1998	23.073	90.433	1990	DTW	320	Thana Parishad	Dhaka	Shariatpur	Gosairhat	Idilpur	Dhipur
S98-03615	RIP1655	12/05/1998	23.084	90.407	1989	STW	22	Hatem Ali Peda	Dhaka	Shariatpur	Gosairhat	Samantasar	Tarulia
S98-03616	RIP1656	12/05/1998	23.08	90.406	1991	DTW	285	Jushergaon Bazar	Dhaka	Shariatpur	Gosairhat	Samantasar	Tarulia
S98-03617	RIP1657	12/05/1998	23.076	90.384	1985	STW	30	Nagarpara H. School	Dhaka	Shariatpur	Gosairhat	Nagerpara	Nagarpara
S98-03618	RIP1658	12/05/1998	23.038	90.438	1985	STW	24	Hanif Bhapari	Dhaka	Shariatpur	Gosairhat	Nulmuri	Char Bhuai
S98-03619	RIP1659	12/05/1998	23.087	90.462	1976	STW	29	Bhatna P. School	Dhaka	Shariatpur	Gosairhat	Gosairhat	Batna
S98-03620	RIP1660	12/05/1998	23.099	90.483	1991	STW	30	Kodalpur Bazar	Dhaka	Shariatpur	Gosairhat	Kodalpur	Uttar Kodalpur
S98-03621	RIP1662	02/05/1998	22.246	90.411	1997	DTW	283	Ichadichar P. School	Barisal	Patuakhali	Galachipa	Chiknikandi	Ichadichar
S98-03622	RIP1663	02/05/1998	22.24	90.399	1981	DTW	302	Bangra P. School	Barisal	Patuakhali	Galachipa	Amkhola	Bhangra

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03575	1786635635	8.6	< 0.04	0.62	0.027	6.11	< 0.008	< 0.02	< 0.008	0.201	4.7	0.006	5.49	0.016	272	3.8	11.3	1.2	0.0766	0.006	< 0.008
S98-03576	1040994257	1.9	< 0.04	0.9	0.015	4.31	< 0.008	< 0.02	< 0.008	0.134	3.3	0.007	3.64	0.009	334	1.9	9.44	1	0.0555	0.009	< 0.008
S98-03577	1786611127	0.6	< 0.04	0.72	0.013	4.67	< 0.008	< 0.02	< 0.008	0.127	3.3	0.007	3.98	0.009	289	2.2	9.93	1	0.0562	< 0.006	< 0.008
S98-03578	1040915921	1.9	< 0.04	0.62	0.015	5.55	< 0.008	< 0.02	< 0.008	0.133	3.6	0.005	4.89	0.012	264	1.8	10.1	0.7	0.0681	< 0.006	< 0.008
S98-03579	1040947810	< 0.5	< 0.04	0.52	0.017	4.72	< 0.008	< 0.02	< 0.008	0.079	2.7	0.004	3.11	0.011	221	1.5	10	0.6	0.0608	< 0.006	< 0.008
S98-03580	1040987663	0.7	< 0.04	0.6	0.014	4.47	< 0.008	< 0.02	< 0.008	0.103	2.9	0.004	3.22	0.008	224	1.4	10.1	0.7	0.0566	< 0.006	< 0.008
S98-03581	1040923884	< 0.5	< 0.04	0.54	0.016	4.25	< 0.008	< 0.02	< 0.008	0.078	2.5	0.004	2.53	0.014	222	0.8	9.9	0.7	0.0589	< 0.006	< 0.008
S98-03582	1040963565	< 0.5	< 0.04	0.45	0.016	4.89	< 0.008	< 0.02	< 0.008	0.133	2.5	0.004	3.08	0.011	216	0.6	10.2	0.8	0.0615	< 0.006	< 0.008
S98-03583	1040907024	< 0.5	< 0.04	0.59	0.01	4.33	< 0.008	< 0.02	< 0.008	0.101	2.8	0.005	3.22	0.012	239	1.2	10.1	0.7	0.0518	< 0.006	0.018
S98-03584	1044711151	< 0.5	< 0.04	0.58	0.129	37.3	< 0.008	< 0.02	< 0.008	1.85	10.2	0.003	49.4	0.141	849	6.8	20.3	5.7	0.288	< 0.006	< 0.008
S98-03585	1044771118	< 0.5	< 0.04	0.63	0.032	7.33	< 0.008	< 0.02	< 0.008	0.117	4	0.004	6.64	0.027	328	1.1	9.5	0.4	0.091	< 0.006	< 0.008
S98-03586	1044747843	< 0.5	< 0.04	0.57	0.029	6.33	< 0.008	< 0.02	< 0.008	0.128	3.5	< 0.003	5.19	0.023	291	1	9.33	0.4	0.0773	< 0.006	< 0.008
S98-03587	1044735050	< 0.5	< 0.04	0.67	0.02	4.86	< 0.008	< 0.02	< 0.008	0.107	3.2	0.004	4.16	0.013	271	1	9.79	0.4	0.0606	< 0.006	< 0.008
S98-03588	1795860648	< 0.5	< 0.04	0.81	0.127	80.5	< 0.008	< 0.02	< 0.008	0.715	38.8	0.013	112	0.101	1530	0.9	22.3	113	0.718	< 0.006	< 0.008
S98-03589	1795851331	2.9	0.15	1.09	0.208	45.8	< 0.008	< 0.02	< 0.008	1.1	17.2	0.007	99.5	0.164	1130	2.4	8.28	0.2	0.836	< 0.006	< 0.008
S98-03590	1795877859	< 0.5	0.06	0.95	0.258	202	0.01	< 0.02	< 0.008	2.32	68.7	0.019	305	0.159	2700	0.7	16.2	468	1.63	0.01	0.255
S98-03591	1795808994	159	< 0.04	0.18	0.126	106	< 0.008	< 0.02	< 0.008	5.24	9.5	0.004	72	0.135	632	2.4	20.6	0.7	0.594	< 0.006	< 0.008
S98-03592	1795860105	2.7	< 0.04	0.76	0.088	45.4	< 0.008	< 0.02	< 0.008	1.25	20	0.008	68.1	0.175	1430	8.5	28.9	5.3	0.36	< 0.006	0.014
S98-03593	1795894934	7.3	< 0.04	0.33	0.021	33.4	< 0.008	< 0.02	< 0.008	0.278	8.3	0.003	30.7	0.088	330	4.4	20.7	0.4	0.208	< 0.006	0.011
S98-03594	1795843422	1	0.06	0.63	0.31	117	< 0.008	< 0.02	< 0.008	2.48	21.3	0.008	141	0.12	1300	5.3	21.3	148	0.83	0.007	< 0.008
S98-03595	1798795982	21.1	< 0.04	0.3	0.009	24.8	< 0.008	< 0.02	< 0.008	< 0.006	5.1	< 0.003	15	< 0.001	280	5.7	23.5	0.6	0.114	< 0.006	< 0.008
S98-03596	1798785970	4.2	< 0.04	0.5	0.078	17.9	< 0.008	< 0.02	< 0.008	0.167	3.8	0.004	9.36	0.052	291	0.5	12.2	< 0.2	0.159	< 0.006	< 0.008
S98-03597	1061042258	0.7	< 0.04	0.49	0.07	14.5	< 0.008	< 0.02	< 0.008	0.329	2.6	0.006	10.5	0.031	299	0.7	13.1	0.9	0.126	< 0.006	< 0.008
S98-03598	1798709594	1.2	< 0.04	0.17	0.03	55.7	< 0.008	< 0.02	< 0.008	2.53	5.1	0.003	34	0.114	104	1	21.3	0.6	0.264	< 0.006	0.01
S98-03599	1798747497	14.6	< 0.04	0.34	0.033	82.3	< 0.008	< 0.02	< 0.008	3.97	11.1	0.007	63.6	0.041	672	1.9	26.9	4.2	0.423	< 0.006	0.017
S98-03600	1798766339	11.8	< 0.04	0.28	0.03	27.6	< 0.008	< 0.02	< 0.008	2.1	10.4	0.004	37.1	0.062	214	4.4	22.6	1.2	0.211	< 0.006	< 0.008
S98-03601	1798776776	1.1	< 0.04	0.46	0.07	14.9	< 0.008	< 0.02	< 0.008	0.217	3.1	0.004	7.56	0.035	288	0.5	11.3	< 0.2	0.132	< 0.006	< 0.008
S98-03602	1798757910	< 0.5	< 0.04	1.1	0.019	6.26	< 0.008	< 0.02	< 0.008	0.105	1.9	0.005	2.92	0.009	270	0.5	11.1	0.2	0.0637	< 0.006	< 0.008
S98-03603	1798738230	< 0.5	< 0.04	0.79	0.023	7.41	< 0.008	< 0.02	< 0.008	0.082	2	0.006	3.36	0.013	272	0.5	11.1	0.4	0.0701	< 0.006	< 0.008
S98-03604	1424315042	< 0.5	< 0.04	0.86	0.076	30.3	< 0.008	< 0.02	< 0.008	1.31	13.8	0.004	44.2	0.086	839	7.8	19.7	24.9	0.279	0.012	0.029
S98-03605	1424315169	< 0.5	< 0.04	1.04	0.304	99.8	< 0.008	< 0.02	< 0.008	0.088	9.8	0.015	55.5	0.196	1470	1.2	9.46	< 0.2	1.49	< 0.006	< 0.008
S98-03606	1424331994	< 0.5	< 0.04	0.89	0.046	14.2	< 0.008	< 0.02	< 0.008	0.134	3.6	0.007	8.21	0.036	464	0.4	9.95	0.3	0.203	< 0.006	< 0.008
S98-03607	3548715161	86.7	< 0.04	0.04	0.162	138	< 0.008	< 0.02	< 0.008	1.82	4.8	< 0.003	30.5	1.84	7.8	0.6	15.8	< 0.2	0.473	< 0.006	< 0.008
S98-03608	3548710645	289	< 0.04	0.06	0.148	136	< 0.008	< 0.02	< 0.008	6.16	5.3	< 0.003	30.1	1.8	45	0.7	16.5	4.1	0.466	< 0.006	< 0.008
S98-03609	3548794950	74.6	< 0.04	0.06	0.365	230	< 0.008	< 0.02	< 0.008	11.5	6.7	0.004	89	0.887	59	0.8	16	129	0.831	< 0.006	< 0.008
S98-03610	3548773116	113	< 0.04	0.03	0.027	60.2	< 0.008	< 0.02	< 0.008	0.54	3.4	< 0.003	19.1	0.016	14.9	< 0.2	17.6	< 0.2	0.282	< 0.006	< 0.008
S98-03611	3548763089	66.8	< 0.04	0.03	0.103	126	< 0.008	< 0.02	< 0.008	2.27	4.9	< 0.003	23.2	1.37	15.1	1.2	14.5	4.9	0.386	< 0.006	< 0.008
S98-03612	3548779833	82.4	0.05	0.03	0.142	142	< 0.008	< 0.02	< 0.008	1.17	5	0.004	28.1	0.959	17.5	0.5	15.3	81.3	0.442	0.007	< 0.008
S98-03613	3548736242	62.4	< 0.04	0.1	0.222	160	< 0.008	< 0.02	< 0.008	0.577	14.4	0.004	33.3	1.35	38.4	< 0.2	16.3	16.8	0.49	< 0.006	< 0.008
S98-03614	3863635460	2.7	< 0.04	0.08	0.261	129	< 0.008	< 0.02	< 0.008	0.282	5.6	0.012	56.7	0.124	319	0.2	14.6	< 0.2	1.33	< 0.006	< 0.008
S98-03615	3863683953	576	< 0.04	0.14	0.119	130	< 0.008	< 0.02	< 0.008	5.42	8.2	0.004	41.4	0.262	64.9	1.1	19.8	< 0.2	0.544	< 0.006	< 0.008
S98-03616	3863683953	2.9	0.06	0.18	0.034	19.7	< 0.008	< 0.02	< 0.008	0.116	2.7	0.006	9.46	0.025	142	0.4	14.1	< 0.2	0.225	< 0.006	< 0.008
S98-03617	3863659743	287	< 0.04	0.42	0.125	78.4	< 0.008	< 0.02	< 0.008	2.21	17.1	0.006	63.4	0.09	557	2.8	17.3	< 0.2	0.539	< 0.006	< 0.008
S98-03618	3863671157	290	< 0.04	0.27	0.113	98.7	< 0.008	< 0.02	< 0.008	6.05	10.5	0.004	40.4	0.122	202	2.7	25.3	< 0.2	0.476	< 0.006	< 0.008
S98-03619	3863623146	31.2	0.28	0.04	0.12	149	< 0.008	< 0.02	< 0.008	0.811	5.4	0.003	33.2	0.838	13.6	0.3	17.6	4.3	0.474	< 0.006	0.024
S98-03620	3863647994	214	< 0.04	0.05	0.229	196	< 0.008	< 0.02	< 0.008	8.93	6.8	0.003	40.6	2.97	44.8	0.3	17.7	0.2	0.674	< 0.006	< 0.008
S98-03621	1785750567	5.8	< 0.04	0.3	0.027	6.07	< 0.008	< 0.02	< 0.008	0.405	2.8	0.003	3.72	0.021	180	1.1	10.2	1.1	0.0793	< 0.006	< 0.008
S98-03622	1785711162	1	< 0.04	0.35	0.026	6.34	< 0.008	< 0.02	< 0.008	0.102	2.8	0.004	3.62	0.015	181	0.9	10.1	0.4	0.0835	< 0.006	0.202

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03623	RIP1664	02/05/1998	22.248	90.4	1989	DTW	293	Mr Yusuf Mridha	Barisal	Patuakhali	Galachipa	Amkhola	Dari Baherchar
S98-03624	RIP1666	03/05/1998	22.142	90.066	1992	DTW	304	Abdul Wahab Hawalder	Barisal	Barguna	Barguna Sadar	Dhalua	Dalbhanga
S98-03625	RIP1667	03/05/1998	22.147	90.111	1992	DTW	311	Mr Sagir Hossain	Barisal	Barguna	Barguna Sadar	Barguna	Korak
S98-03626	RIP1668	03/05/1998	22.091	90.084	1996	DTW	313	Mr Amir Ali	Barisal	Barguna	Barguna Sadar	M.baliatali	Nimtaki
S98-03627	RIP1669	03/05/1998	22.042	90.042	1991	DTW	315	Ali Azim Khan	Barisal	Barguna	Barguna Sadar	Naltona	Garjanbaria
S98-03628	RIP1670	03/05/1998	22.156	90.13	1978	DTW	315	DPHE Office	Barisal	Barguna	Barguna Sadar	Paurashava w01	Karaitala
S98-03629	RIP1672	04/05/1998	22.296	90.06	1997	DTW	286	Answar Ali Khan	Barisal	Barguna	Bamna	Bukabunia	Bukabunia
S98-03630	RIP1673	04/05/1998	22.288	90.045	1993	STW	16	Md Anawar Hossain	Barisal	Barguna	Bamna	Bukabunia	Joynagar
S98-03631	RIP1674	04/05/1998	22.26	90.029	1966	DTW	306	Dawatala Bazar	Barisal	Barguna	Bamna	Dawatala	Dawatala
S98-03632	RIP1675	04/05/1998	22.25	90.076	1976	DTW	296	Abdul Aziz Sikder	Barisal	Barguna	Bamna	Ramna	Ramna
S98-03633	RIP1676	04/05/1998	22.264	90.079	1987	DTW	301	Bazar Committee	Barisal	Barguna	Bamna	Ramna	Kholpatua
S98-03634	RIP1678	05/05/1998	22.486	90.063	1995	DTW	296	Thana H. Complex	Barisal	Pirojpur	Bhandaria	Nudmulla	Dakahin Sialkati
S98-03635	RIP1679	05/05/1998	22.471	90.055	1997	STW	16	Latif Hawalder	Barisal	Pirojpur	Bhandaria	Dhaoa	Dhaoa
S98-03636	RIP1680	05/05/1998	22.471	90.036	1997	DTW	280	Mr Fazlul Haq	Barisal	Pirojpur	Bhandaria	Dhaoa	Dhaoa
S98-03637	RIP1681	05/05/1998	22.489	90.022	1975	STW	17	Union Parishad	Barisal	Pirojpur	Bhandaria	Nudmulla	Nudmulla
S98-03638	RIP1683	05/05/1998	22.533	89.992	1994	STW	22	Mr Habibur Rahaman	Barisal	Pirojpur	Indurkani	Shankarpasha	Shankarpasha
S98-03639	RIP1684	05/05/1998	22.55	89.983	1995	STW	33	Md Abdul Hasem	Barisal	Pirojpur	Indurkani	Shankarpasha	Namajpur
S98-03640	RIP1685	06/05/1998	22.582	89.999	1981	STW	14	Mr Shajahan Mia	Barisal	Pirojpur	Pirojpur Sadar	Sariktala	Dumaritala
S98-03641	RIP1686	06/05/1998	22.58	89.966	1983	STW	19	Mahabubur Rahaman	Barisal	Pirojpur	Pirojpur Sadar	Paurashava W02	Kumuria
S98-03642	RIP1687	06/05/1998	22.683	89.963	1980	STW	19	Harendranath Barai	Barisal	Pirojpur	Pirojpur Sadar	Sikder Mallik	Sikder Mallik
S98-03643	RIP1688	06/05/1998	22.618	89.96	1995	STW	17	Sunil Kumar Sikder	Barisal	Pirojpur	Pirojpur Sadar	Kadamtala	Kadamtala
S98-03644	RIP1689	06/05/1998	22.606	89.993	1973	STW	17	Mulgram H. School	Barisal	Pirojpur	Pirojpur Sadar	Tona	Mulgram
S98-03645	RIP1690	06/05/1998	22.653	90	1990	DTW	275	Md Mahibullah Maghi	Barisal	Pirojpur	Pirojpur Sadar	Durgapur	Durgapur
S98-03646	RIP1691	06/05/1998	22.622	89.99	1986	STW	20	High School Committe	Barisal	Pirojpur	Pirojpur Sadar	Tona	Tejdaskati
S98-03647	RIP1693	07/05/1998	22.518	90.11	1994	DTW	351	Syed Immam Hossain	Barisal	Jhalakati	Rajapur	Galua	Galua Gurgapur
S98-03648	RIP1694	07/05/1998	22.556	90.137	1995	STW	16	Abdus Salam	Barisal	Jhalakati	Rajapur	Rajapur	C Kaibarttakhali
S98-03649	RIP1695	07/05/1998	22.559	90.188	1996	DTW	295	Mr Shajahan Hawalder	Barisal	Jhalakati	Rajapur	Mathbari	Pukharijana
S98-03650	RIP1696	07/05/1998	22.555	90.086	1996	STW	13	Manan Mollah	Barisal	Jhalakati	Rajapur	Saturia	Uttar Tarabaria
S98-03651	RIP1697	07/05/1998	22.579	90.095	1997	DTW	322	Md Anawar Hossain	Barisal	Jhalakati	Rajapur	Saturia	Naikati
S98-03652	RIP1698	07/05/1998	22.578	90.114	1998	DTW	282	Abdul Aziz Khalipha	Barisal	Jhalakati	Rajapur	Suktagarh	Narikelbaria
S98-03653	RIP1700	09/05/1998	22.68	90.285	1970	STW	15	Hazi Moslemuddin	Barisal	Jhalakati	Nalchity	Magar	Amirabad
S98-03654	RIP1701	06/05/1998	22.707	89.977	1991	DTW	257	Azizul Haq	Barisal	Pirojpur	Nazirpur	Nazirpur	Bara Baichikati
S98-03655	RIP1702	06/05/1998	22.815	89.947	1996	STW	17	Matibhanga College	Barisal	Pirojpur	Nazirpur	Matibanga	Matibanga
S98-03656	RIP1703	06/05/1998	22.803	89.953	1996	DTW	270	Anawar Hossain	Barisal	Pirojpur	Nazirpur	Shankharikati	Baghajora
S98-03657	RIP1704	06/05/1998	22.791	89.956	1996	STW	18	Bhaijora P. School	Barisal	Pirojpur	Nazirpur	Shankharikati	Baghajora
S98-03658	RIP1705	06/05/1998	22.698	89.998	1998	DTW	260	Seba Asram	Barisal	Pirojpur	Nazirpur	Sriramkati	Bhimkati
S98-03659	RIP1706	06/05/1998	22.698	89.998	1992	STW	21	Seba Asram	Barisal	Pirojpur	Nazirpur	Srirampur	Bhimkati
S98-03660	RIP1707	06/05/1998	22.713	89.953	1994	STW	19	aziz Hawalder	Barisal	Pirojpur	Nazirpur	Sekhmatia	Pas.C.Baichakati
S98-03661	RIP1709	07/05/1998	22.64	90.181	1996	STW	17	Jaynal Khan	Barisal	Jhalakati	Jhalakati Sadar	Gabkhan Dhansiri	Gabkhan
S98-03662	RIP1710	07/05/1998	22.647	90.196	1996	DTW	327	DPHE Office	Barisal	Jhalakati	Jhalakati Sadar	Paurashava	Palbari
S98-03663	RIP1711	07/05/1998	22.727	90.212	1998	DTW	311	Nabagram H. School	Barisal	Jhalakati	Jhalakati Sadar	Nabagram	Nabagram
S98-03664	RIP1712	07/05/1998	22.723	90.233	1991	DTW	323	Kanderkati Mosque	Barisal	Jhalakati	Jhalakati Sadar	Binoykati	Khandergati
S98-03665	RIP1713	07/05/1998	22.724	90.234	1993	STW	15	Mofazzel Hossain	Barisal	Jhalakati	Jhalakati Sadar	Binoykati	Kandargati
S98-03666	RIP1714	07/05/1998	22.688	90.203	1992	DTW	317	Chamta P. School	Barisal	Jhalakati	Jhalakati Sadar	Basanda	Chamta
S98-03667	RIP1715	07/05/1998	22.688	90.204	1997	STW	16	Mukul Hawalder	Barisal	Jhalakati	Jhalakati Sadar	Basanda	Darkhi
S98-03668	RIP1716	07/05/1998	22.681	90.175	1996	DTW	332	Altaf Hossain	Barisal	Jhalakati	Jhalakati Sadar	Kirtipasha	Tarpasa
S98-03669	RIP1717	07/05/1998	22.68	90.175	1991	STW	20	Rustam Ali	Barisal	Jhalakati	Jhalakati Sadar	Kirtipasha	Tarpasa
S98-03670	RIP1718	09/05/1998	22.398	90.126	1985	DTW	258	DPHE Office	Barisal	Jhalakati	Kathalia	Kathalia	Kathalia

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03623	1785711465	< 0.5	< 0.04	0.39	0.014	5.52	< 0.008	< 0.02	0.008	0.168	2.7	0.004	3.38	0.013	187	0.8	10.5	1	0.0699	< 0.006	0.011
S98-03624	1042847319	1.4	< 0.04	0.75	0.013	4.51	< 0.008	< 0.02	< 0.008	0.133	3.3	0.004	3.75	0.008	282	2	9.58	0.9	0.0546	< 0.006	< 0.008
S98-03625	1042828600	0.7	< 0.04	0.68	0.014	5.79	< 0.008	< 0.02	< 0.008	0.143	4.3	0.006	5.89	0.011	299	2.1	9.89	0.9	0.0723	< 0.006	0.009
S98-03626	1042885732	0.6	0.24	1.09	0.014	4.37	< 0.008	< 0.02	< 0.008	0.198	3.3	0.005	3.22	0.015	348	2.1	9.59	1.2	0.0528	0.007	< 0.008
S98-03627	1042895375	< 0.5	< 0.04	2.19	0.019	12.3	< 0.008	< 0.02	< 0.008	0.244	9.6	0.011	13.2	0.015	840	2.9	11.9	1.4	0.164	< 0.006	< 0.008
S98-03628	1042873773	< 0.5	< 0.04	0.7	0.015	5.04	< 0.008	< 0.02	< 0.008	0.416	4.1	0.003	7.39	0.017	307	1.8	9.75	1.1	0.0721	< 0.006	0.506
S98-03629	1041947255	< 0.5	< 0.04	0.94	0.056	15.5	< 0.008	< 0.02	< 0.008	0.272	6.5	0.007	14.5	0.037	575	1.2	9.43	0.3	0.215	< 0.006	< 0.008
S98-03630	1041947588	2.7	< 0.01	0.6	0.015	41.4	< 0.003	< 0.002	< 0.008	0.029	21.4	0.006	51.6	0.009	495	5.4	24	1.4	0.373	< 0.002	0.008
S98-03631	1041971408	< 0.5	< 0.04	1.03	0.137	40.5	< 0.008	< 0.02	< 0.008	0.04	8.7	0.01	29	0.103	972	1.4	9.15	< 0.2	0.543	< 0.006	0.156
S98-03632	1041995892	< 0.5	< 0.04	0.84	0.023	6.67	< 0.008	< 0.02	< 0.008	0.175	3.9	0.004	6.18	0.026	330	1.4	9.58	0.7	0.0818	< 0.006	< 0.008
S98-03633	1041995714	< 0.5	< 0.04	0.76	0.014	4.05	< 0.008	< 0.02	< 0.008	0.124	3.2	< 0.003	3.78	0.01	270	1.7	9.52	1.1	0.052	< 0.006	< 0.008
S98-03634	1791479268	3.4	< 0.04	0.99	0.095	20.3	< 0.008	< 0.02	< 0.008	0.144	4.9	0.007	12.4	0.038	588	0.6	9.95	< 0.2	0.266	< 0.006	0.018
S98-03635	1791435295	1.3	0.07	0.4	0.091	34.6	< 0.003	< 0.002	< 0.008	3.54	14.1	0.007	32.9	0.13	409	5.1	32.7	3.2	0.234	< 0.002	0.142
S98-03636	1791435295	< 0.5	0.01	1.7	0.067	24.8	< 0.003	< 0.002	< 0.008	0.195	5.2	0.032	14	0.028	752	0.2	10.2	< 0.2	0.307	< 0.002	0.009
S98-03637	1791471645	2.5	0.03	0.7	0.051	25.6	< 0.003	< 0.002	< 0.008	4.45	11.6	0.011	22.4	0.06	518	10.7	28.8	3.3	0.197	0.003	0.015
S98-03638	1793869861	53.2	0.03	0.2	0.06	51	< 0.003	< 0.002	< 0.008	2.07	7.1	< 0.004	37.5	0.235	276	2.1	25	0.8	0.298	< 0.002	0.041
S98-03639	1793869710	14.5	0.02	1.4	0.214	64	< 0.003	< 0.002	< 0.008	0.854	50.4	0.041	193	0.069	2370	6	27.7	1.6	1.17	< 0.002	0.012
S98-03640	1798077444	246	0.35	< 0.1	0.146	137	< 0.003	< 0.002	< 0.008	14.2	4.8	< 0.004	35.1	0.549	54.1	1	17.8	0.4	0.524	< 0.002	0.093
S98-03641	1798053663	12.1	0.02	0.2	0.02	47.2	< 0.003	< 0.002	< 0.008	1.35	11	0.01	31.9	0.042	182	1.1	26.4	0.9	0.268	< 0.002	0.01
S98-03642	1798086906	42	0.03	0.3	0.084	72.5	< 0.003	< 0.002	< 0.008	2.9	22.6	0.014	70.3	0.06	406	1.4	26.7	2.6	0.635	< 0.002	0.018
S98-03643	1798025533	0.7	0.03	0.5	0.121	94	0.004	< 0.002	< 0.008	8.83	21.5	0.023	96.7	0.101	788	5.4	31.8	4.2	0.739	< 0.002	0.115
S98-03644	1798094684	8	0.03	0.3	0.031	46.6	< 0.003	< 0.002	< 0.008	2.32	11.4	0.019	29.9	0.033	422	2.3	28.7	2.1	0.252	< 0.002	0.011
S98-03645	1798017453	< 0.5	0.04	1.6	0.094	28.8	< 0.003	< 0.002	< 0.008	0.187	5.7	0.022	14.7	0.033	701	0.2	10.5	0.2	0.309	< 0.002	0.01
S98-03646	1798094932	1.7	0.04	0.4	0.054	81.7	< 0.003	< 0.002	< 0.008	1.52	18	0.023	63.9	0.037	600	1.3	31.6	2.2	0.488	< 0.002	0.016
S98-03647	1428427386	< 0.5	0.02	0.9	0.149	55.9	< 0.003	< 0.002	< 0.008	0.097	7.6	0.029	33.7	0.109	827	0.1	11.2	0.2	0.866	< 0.002	0.014
S98-03648	1428454331	3.1	0.02	0.5	0.039	22.2	< 0.003	< 0.002	< 0.008	1.6	17.9	0.004	31.1	0.028	600	9.2	21.8	1.8	0.214	0.004	0.008
S98-03649	1428440773	< 0.5	0.01	0.7	0.017	6	< 0.003	< 0.002	< 0.008	0.079	2.7	0.007	3.74	0.02	288	0.4	10.7	0.5	0.0863	< 0.002	0.005
S98-03650	1428467994	20.1	0.05	0.5	0.082	91.6	< 0.003	< 0.002	< 0.008	2.28	19.7	0.024	105	0.075	1130	1.4	21.2	1.9	0.682	< 0.002	0.017
S98-03651	1428467621	< 0.5	0.02	1.3	0.011	4.2	< 0.003	< 0.002	< 0.008	0.086	2.7	0.009	2.78	0.011	347	0.4	10.1	0.5	0.0588	< 0.002	< 0.004
S98-03652	1428481649	0.5	0.02	0.8	0.028	8.4	< 0.003	< 0.002	< 0.008	0.158	3.5	0.012	5.14	0.019	350	0.3	10.9	0.3	0.11	< 0.002	0.005
S98-03653	1427342020	7.9	0.03	0.2	0.118	65.9	< 0.003	< 0.002	< 0.008	0.861	5.2	< 0.004	39.6	0.113	264	2	24.5	0.4	0.292	< 0.002	0.013
S98-03654	1797652089	0.7	0.05	1	0.078	20.7	< 0.003	< 0.002	< 0.008	0.181	5.1	0.015	11.2	0.043	471	0.2	9.46	1.4	0.199	< 0.002	0.008
S98-03655	1797642668	225	0.03	< 0.1	0.088	61.2	< 0.003	< 0.002	< 0.008	4.9	5.1	0.006	17.6	0.094	121	1.8	30.1	2	0.217	< 0.002	0.028
S98-03656	1797673029	< 0.5	0.04	1.6	0.052	22	< 0.003	< 0.002	< 0.008	0.167	4.8	0.02	16.5	0.018	660	0.1	9.54	1.4	0.273	< 0.002	0.007
S98-03657	1797673029	50.3	0.03	0.4	0.198	91	< 0.003	< 0.002	< 0.008	1.98	24.8	0.012	118	0.047	490	1.1	16.5	3	1.03	< 0.002	0.014
S98-03658	1797684133	0.7	0.05	1.2	0.041	12	< 0.003	0.004	< 0.008	0.235	3.5	0.014	7.64	0.021	445	0.2	10.2	1.1	0.132	< 0.002	0.011
S98-03659	1797684133	66.6	0.04	0.2	0.078	58.9	< 0.003	0.003	< 0.008	1.73	15.4	< 0.004	37.6	0.079	323	1.4	21.3	2.2	0.363	< 0.002	0.013
S98-03660	1797663757	110	0.04	0.2	0.045	54.5	< 0.003	< 0.002	< 0.008	2.13	5.5	0.009	16.5	0.057	361	2	26	4.1	0.2	< 0.002	0.012
S98-03661	1424028357	15.4	1.39	0.7	0.045	54	< 0.003	0.003	< 0.008	0.965	14.6	0.014	52.3	0.089	846	8.7	30	4.3	0.379	0.003	0.02
S98-03662	1424051	< 0.5	0.28	1	0.009	2.9	< 0.003	< 0.002	< 0.008	0.075	2.4	0.009	1.63	0.01	340	0.4	10.4	1.3	0.0413	< 0.002	0.005
S98-03663	1424076637	< 0.5	0.17	0.5	0.015	6.8	< 0.003	< 0.002	< 0.008	0.107	2.4	0.009	3.1	0.016	270	0.3	12	1.6	0.0629	< 0.002	0.007
S98-03664	1424019516	< 0.5	0.05	0.4	0.015	4.7	< 0.003	< 0.002	< 0.008	0.123	2	0.007	2.17	0.015	239	0.3	11.6	1.5	0.0478	< 0.002	0.008
S98-03665	1424019516	6.1	0.02	0.3	0.027	32	< 0.003	< 0.002	< 0.008	0.746	12.3	< 0.004	51.6	0.08	276	3.8	23.8	1.5	0.282	< 0.002	0.008
S98-03666	1424009197	5.9	0.03	0.5	0.071	17.8	< 0.003	< 0.002	< 0.008	0.288	4.1	0.009	9.71	0.038	307	0.5	12.7	1	0.184	< 0.002	0.008
S98-03667	1424009293	68.7	0.03	0.3	0.061	22.1	< 0.003	< 0.002	< 0.008	1.24	4.9	0.004	10.8	0.025	235	6.8	16.6	2.1	0.0998	< 0.002	0.009
S98-03668	1424066950	0.5	0.02	1.2	0.014	6.2	< 0.003	< 0.002	< 0.008	0.069	2.3	0.011	2.93	0.011	341	0.3	11.3	1.3	0.0668	< 0.002	0.013
S98-03669	1424066950	14	0.02	0.4	0.024	31	< 0.003	< 0.002	< 0.008	1.03	7.9	0.006	29.7	0.044	391	4.3	23.1	2	0.222	< 0.002	0.009
S98-03670	1424363529	0.5	0.03	0.6	0.149	36.1	< 0.003	< 0.002	< 0.008	0.25	12.1	0.016	34.3	0.099	710	0.3	9.97	1.4	0.433	< 0.002	0.01

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03671	RIP1720	09/05/1998	22.444	90.116	1993	DTW	346	Shah Alam Hawalder	Barisal	Jhalakati	Kathalia	Sauljalia	Kaikhali
S98-03672	RIP1721	09/05/1998	22.465	90.066	1997	STW	13	U.Chenchirampur Mosq	Barisal	Jhalakati	Kathalia	Chenchirampur	U.Chenchirampur
S98-03673	RIP1722	09/05/1998	22.456	90.066	1991	DTW	341	Kawsar Uddin	Barisal	Jhalakati	Kathalia	Chenchirampur	U.Chenchirampur
S98-03674	RIP1724	10/05/1998	23.153	90.203	1997	DTW	269	Sirszul Haq	Dhaka	Madaripur	Madaripur Sadar	Paurashava W01	Tharmuguria
S98-03675	RIP1725	10/05/1998	23.174	90.291	1997	STW	23	abdul Hossain	Dhaka	Madaripur	Madaripur Sadar	Khoajpur	Khoajpur
S98-03676	RIP1726	10/05/1998	23.174	90.291	1997	DTW	256	Abul Hossain College	Dhaka	Madaripur	Madaripur Sadar	Khoajpur	Khoajpur
S98-03677	RIP1727	10/05/1998	23.264	90.227	1996	STW	30	Chhilarchar Bazar	Dhaka	Madaripur	Madaripur Sadar	Chhilarchar	Chhilarchar
S98-03678	RIP1728	10/05/1998	23.185	90.248	1995	STW	19	Kazirtech Mosque	Dhaka	Madaripur	Madaripur Sadar	Panchkhola	Bahir Chakkatta
S98-03679	RIP1730	11/05/1998	23.205	90.05	1988	STW	61	TNO Resident	Dhaka	Madaripur	Rajoir	Rajoir	Rajoir
S98-03680	RIP1731	11/05/1998	23.189	90.09	1994	STW	34	Nakul Chandra	Dhaka	Madaripur	Rajoir	Bajitpur	Nayakandi
S98-03681	RIP1732	11/05/1998	23.184	90.055	1993	STW	57	Krisna Pada	Dhaka	Madaripur	Rajoir	Amgram	Amgram
S98-03682	RIP1733	11/05/1998	23.184	90.055	1998	DTW	249	Sosanta Bairagi	Dhaka	Madaripur	Rajoir	Amgram	Amgram
S98-03683	RIP1734	11/05/1998	23.227	90.035	1992	STW	29	Gana Unnayan Sanstha	Dhaka	Madaripur	Rajoir	Khalia	Hridaynardi
S98-03684	RIP1735	11/05/1998	23.239	90.036	1998	STW	30	Matlab Mia	Dhaka	Madaripur	Rajoir	Hossainpur	Nagardi
S98-03685	RIP1736	11/05/1998	23.197	89.986	1996	STW	58	Bijoy Krisno	Dhaka	Madaripur	Rajoir	Kadambari	Kailasur
S98-03686	RIP1737	11/05/1998	23.219	90.017	1998	DTW	246	Harunur Rashed	Dhaka	Madaripur	Rajoir	Khalia	Pas. Sarmangal
S98-03687	RIP1739	12/05/1998	23.138	90.444	1997	DTW	272	Paresh Chandra Roy	Dhaka	Shariatpur	Damudya	Damudya	Dakshin Damudya
S98-03688	RIP1740	12/05/1998	23.14	90.459	1997	DTW	271	Tofazzal Hossain	Dhaka	Shariatpur	Damudya	Purba Damudya	Bara Naogaon
S98-03689	RIP1741	09/05/1998	22.587	90.293	1979	DTW	303	Bazar Committee	Barisal	Jhalakati	Nalchity	Kusaughai	Manpasha
S98-03690	RIP1742	09/05/1998	22.598	90.294	1980	DTW	276	Ismail Ukkil	Barisal	Jhalakati	Nalchity	Siddhakati	Abhaynil
S98-03691	RIP1743	09/05/1998	22.563	90.264	1968	DTW	295	Bazar Committee	Barisal	Jhalakati	Nalchity	Subidpur	Majkurni
S98-03692	RIP1744	09/05/1998	22.637	90.278	1988	STW	18	Yusuf Ali Mallik	Barisal	Jhalakati	Nalchity	Paurashava W01	Baichandi
S98-03693	RIP1745	09/05/1998	22.643	90.334	1994	STW	18	Nazem Ali Khandoker	Barisal	Jhalakati	Nalchity	Dapdapia	Timirokati
S98-03694	RIP1746	10/05/1998	23.16	90.14	1997	STW	35	Mosque Committee	Dhaka	Madaripur	Madaripur Sadar	Mustafapur	Chaturpara
S98-03695	RIP1747	10/05/1998	23.179	90.101	1992	STW	37	Bazar Committee	Dhaka	Madaripur	Madaripur Sadar	Kendua	Nij Bajitpur
S98-03696	RIP1748	10/05/1998	23.223	90.159	1992	STW	39	Bazar Committee	Dhaka	Madaripur	Madaripur Sadar	Dudkhali	Chandibardi
S98-03697	RIP1749	10/05/1998	23.164	90.172	1994	STW	34	Azizul Haq	Dhaka	Madaripur	Madaripur Sadar	Paurashava W04	Hhagdi
S98-03698	RIP1751	11/05/1998	23.081	90.302	1973	STW	37	Jalal Sadar	Dhaka	Madaripur	Kalkini	Enayetnagar	Kalai Sadar Char
S98-03699	RIP1752	11/05/1998	23.071	90.256	1994	STW	25	Abdul Latif Sadar	Dhaka	Madaripur	Kalkini	Shikar Mangal	Shikar Mangal
S98-03700	RIP1753	11/05/1998	23.069	90.244	1994	DTW	276	Kabir Hossain	Dhaka	Madaripur	Kalkini	Kalkini	Pangazia
S98-03701	RIP1754	11/05/1998	23.073	90.238	1984	STW	25	Kalkini Officers Clu	Dhaka	Madaripur	Kalkini	Kalkini	Jhautala
S98-03702	RIP1755	11/05/1998	23.084	90.127	1996	DTW	266	Ladies Hostel	Dhaka	Madaripur	Kalkini	Nabagram	Dakshin Shagirka
S98-03703	RIP1756	11/05/1998	23.07	90.182	1994	STW	52	Beauty Begume	Dhaka	Madaripur	Kalkini	Kazibazar	Dakshin Bhautali
S98-03704	RIP1757	11/05/1998	23.072	90.214	1986	STW	22	Bazar Committee	Dhaka	Madaripur	Kalkini	Gopalpur	Majidbari
S98-03705	RIP1758	11/05/1998	23.102	90.191	1993	STW	19	Bazar Committee	Dhaka	Madaripur	Kalkini	Baligram	Pathuriapara
S98-03706	RIP1760	12/05/1998	23.217	90.499	1993	STW	29	Mosque Committee	Dhaka	Shariatpur	Bhedarganj	Digar Mahiskhali	Char Chanda
S98-03707	RIP1761	12/05/1998	23.197	90.49	1979	STW	39	Jashimuddin Bapari	Dhaka	Shariatpur	Bhedarganj	Char Kumuria	U.Char Kumuria
S98-03708	RIP1763	12/05/1998	23.196	90.45	1975	STW	33	Authority of School	Dhaka	Shariatpur	Bhedarganj	Mahisar	Gaidya
S98-03709	RIP1764	12/05/1998	23.195	90.449	1990	DTW	249	Gaidya H. School	Dhaka	Shariatpur	Bhedarganj	Mahisar	Gaidya
S98-03710	RIP1765	12/05/1998	23.182	90.458	1992	STW	52	Abdur Rashid	Dhaka	Shariatpur	Bhedarganj	Narayanpur	Ikarkandi
S98-03711	RIP1766	12/05/1998	23.189	90.419	1991	STW	39	Sikim Ali Mallick	Dhaka	Shariatpur	Bhedarganj	Chaygaon	Lakarta
S98-03712	RIP1768	13/05/1998	23.302	90.412	1994	DTW	273	Naria G. College	Dhaka	Shariatpur	Naria	Naria	Naria
S98-03713	RIP1769	13/05/1998	23.31	90.435	1997	STW	20	Bazar Committee	Dhaka	Shariatpur	Naria	Kedarpur	Kedarpur
S98-03714	RIP1770	13/05/1998	23.262	90.475	1994	STW	28	Aurun Chandra Das	Dhaka	Shariatpur	Naria	Dingamanik	Dingamanik
S98-03715	RIP1771	13/05/1998	23.276	90.485	1992	STW	22	Samal Pal	Dhaka	Shariatpur	Naria	Gharisar	Baraipara
S98-03716	RIP1772	13/05/1998	23.288	90.43	1985	STW	25	Union Parishad	Dhaka	Shariatpur	Naria	Bhumkhara	Chakdha
S98-03717	RIP1773	13/05/1998	23.271	90.393	1985	STW	24	Giasuddin	Dhaka	Shariatpur	Naria	Fatejangpur	Sirangal
S98-03718	RIP1774	13/05/1998	23.237	90.416	1994	STW	20	Giasuddin Chakider	Dhaka	Shariatpur	Naria	Bijhari	Bhadda

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03671	1424394465	< 0.5	0.03	1	0.109	30	< 0.003	< 0.002	< 0.008	0.044	6.3	0.021	18.6	0.093	698	0.2	10	1.5	0.427	< 0.002	0.017
S98-03672	1424347952	2.9	0.08	0.3	0.042	17.4	< 0.003	0.075	< 0.008	0.627	9.9	0.006	18	0.038	218	3.2	25.4	2.7	0.116	< 0.002	0.011
S98-03673	1424347952	< 0.5	0.07	1.6	0.258	95	< 0.003	< 0.002	< 0.008	0.165	10.5	0.048	54.8	0.158	1300	0.2	9.58	1.4	1.53	< 0.002	0.015
S98-03674	3545457956	1.5	0.02	0.5	0.083	32.1	< 0.003	< 0.002	< 0.008	0.218	3.7	0.022	13.2	0.02	222	0.1	21.7	0.8	0.226	< 0.002	0.01
S98-03675	3545453585	128	0.05	< 0.1	0.142	131	< 0.003	< 0.002	< 0.008	0.602	5.1	0.005	24.5	1.18	16.1	0.3	17.5	1.1	0.403	< 0.002	0.016
S98-03676	3545453585	< 0.5	0.04	0.3	0.206	93.1	< 0.003	< 0.002	< 0.008	0.532	5	0.027	37.4	0.03	223	0.1	22.9	1	0.614	< 0.002	0.026
S98-03677	3545411251	527	0.09	< 0.1	0.305	224	< 0.003	< 0.002	< 0.008	10.5	6	0.004	49.6	1.59	27.1	0.9	17.3	1.6	0.851	< 0.002	0.025
S98-03678	3545477088	447	0.06	< 0.1	0.137	138	< 0.003	< 0.002	< 0.008	6.24	5.1	< 0.004	29.7	0.898	24.5	0.4	15.9	2.4	0.482	< 0.002	0.017
S98-03679	3548095748	67.1	0.03	0.4	0.076	25.2	< 0.003	< 0.002	< 0.008	0.709	11.2	0.01	31.6	0.044	308	6.7	24.3	2.2	0.211	< 0.002	0.015
S98-03680	3548028652	305	0.05	< 0.1	0.138	134	< 0.003	< 0.002	< 0.008	5.23	5.2	0.004	27.3	0.425	19.9	1.3	17.6	1.4	0.438	< 0.002	0.018
S98-03681	3548009010	80.2	0.02	0.5	0.071	15.5	< 0.003	< 0.002	< 0.008	0.408	9.7	0.012	19.2	0.03	501	9.6	21.4	2.4	0.119	< 0.002	0.008
S98-03682	3548009010	1.3	0.05	0.1	0.245	115	< 0.003	< 0.002	< 0.008	1.07	5.7	0.031	48.4	0.032	212	0.1	18.1	1	0.881	< 0.002	0.02
S98-03683	3548076342	627	0.06	< 0.1	0.178	168	< 0.003	< 0.002	< 0.008	7.38	6.4	< 0.004	37.9	0.143	30.5	0.8	16.8	1.5	0.641	< 0.002	0.019
S98-03684	3548038588	531	0.05	< 0.1	0.186	139	< 0.003	< 0.002	< 0.008	5.94	7.1	< 0.004	24.9	0.712	79	1.2	17.6	0.9	0.471	< 0.002	0.017
S98-03685	3548066417	103	0.03	< 0.1	0.098	47	< 0.003	< 0.002	< 0.008	2.64	5.6	0.006	29.5	0.132	41.4	1.5	22.1	1.3	0.225	< 0.002	0.012
S98-03686	3548076791	3.4	0.09	< 0.1	0.551	188	< 0.003	< 0.002	< 0.008	3.27	10.2	0.048	98.4	0.164	300	0.3	19	0.7	1.35	< 0.002	0.033
S98-03687	3862511331	< 0.5	0.02	1.1	0.084	39.1	< 0.003	< 0.002	< 0.008	0.095	3.5	0.046	19.5	0.032	735	< 0.1	12.4	0.2	0.608	< 0.002	0.016
S98-03688	3862559762	< 0.5	0.88	2.1	0.321	189	< 0.003	< 0.002	< 0.008	0.314	13.6	0.19	95.3	0.072	2100	0.1	27.2	0.8	2.98	< 0.002	0.029
S98-03689	1427331647	< 0.5	0.02	0.4	0.014	6.3	< 0.003	< 0.002	< 0.008	0.082	2.6	0.005	3.53	0.024	206	0.4	10.4	0.5	0.0792	< 0.002	0.006
S98-03690	1427384006	1.2	0.01	0.4	0.034	10.8	< 0.003	< 0.002	< 0.008	0.214	3.2	0.006	7.67	0.038	264	0.4	9.9	0.6	0.138	< 0.002	0.005
S98-03691	1427394621	< 0.5	0.02	0.5	0.015	4.9	< 0.003	< 0.002	< 0.008	0.111	2.3	0.005	2.76	0.015	199	0.4	10.5	0.5	0.0609	< 0.002	0.004
S98-03692	1427352060	29.4	0.01	0.4	0.035	20.9	< 0.003	< 0.002	< 0.008	1.33	6.9	0.005	19.8	0.041	344	7.5	24.1	0.9	0.164	< 0.002	0.006
S98-03693	1427310133	550	0.04	0.1	0.242	152	< 0.003	< 0.002	< 0.008	9.06	8.4	< 0.004	33.6	0.218	165	1.5	19.5	< 0.2	0.607	< 0.002	0.023
S98-03694	3545471233	233	0.04	0.2	0.047	34.5	< 0.003	< 0.002	< 0.008	1.09	7.1	< 0.004	11.3	0.034	131	3.8	21.5	1	0.159	< 0.002	0.016
S98-03695	3545447705	325	0.04	< 0.1	0.122	128	< 0.003	< 0.002	< 0.008	4.14	4.8	< 0.004	24.8	0.589	36.6	1.5	18.6	< 0.2	0.407	< 0.002	0.015
S98-03696	3545423182	552	0.05	< 0.1	0.252	152	< 0.003	< 0.002	< 0.008	9.26	6.5	< 0.004	31.8	0.53	64	1.4	19.5	0.2	0.525	< 0.002	0.018
S98-03697	3545457420	348	0.01	0.2	0.053	19.3	< 0.003	< 0.002	< 0.008	1.53	8	< 0.004	10.7	0.023	204	3.6	21.7	0.4	0.0969	< 0.002	0.008
S98-03698	3544037521	369	0.05	< 0.1	0.22	182	< 0.003	< 0.002	< 0.008	9.01	7.3	< 0.004	38.2	0.529	34.7	1.1	19.1	< 0.2	0.634	< 0.002	0.019
S98-03699	3544094896	466	0.06	< 0.1	0.268	243	< 0.003	< 0.002	< 0.008	9.06	6.8	< 0.004	49.8	2.49	36.4	0.4	17.6	2.6	0.826	< 0.002	0.023
S98-03700	3544050681	1.9	0.04	0.3	0.313	94.4	< 0.003	< 0.002	< 0.008	0.539	5.7	0.028	39.7	0.026	359	< 0.1	18	< 0.2	0.766	< 0.002	0.024
S98-03701	3544050491	152	0.04	< 0.1	0.125	113	< 0.003	< 0.002	< 0.008	4.18	4.8	< 0.004	21.1	0.749	26.1	1.9	21	0.3	0.363	< 0.002	0.021
S98-03702	3544075399	1.5	0.04	0.4	0.178	58.9	< 0.003	< 0.002	< 0.008	0.904	5.5	0.023	25.6	0.054	256	0.2	21.3	< 0.2	0.379	< 0.002	0.012
S98-03703	3544063325	3.9	0.02	1	0.121	34.3	< 0.003	< 0.002	< 0.008	0.614	22.6	0.019	46.5	0.051	684	7.4	29.5	8.5	0.35	0.002	0.022
S98-03704	3544044657	1	0.04	0.5	0.041	72.3	< 0.003	< 0.002	< 0.008	2.31	23.6	0.021	79.6	0.047	302	2.6	42.4	0.8	0.54	< 0.002	0.014
S98-03705	3544012761	458	0.02	0.3	0.041	47.1	< 0.003	< 0.002	< 0.008	1.24	7.7	0.007	18	0.083	222	3	23.5	0.9	0.214	< 0.002	0.009
S98-03706	3861443174	98.2	0.06	< 0.1	0.19	193	< 0.003	< 0.002	< 0.008	2.24	7.1	0.005	39.3	1.31	36.7	0.4	16.1	21.1	0.605	< 0.002	0.021
S98-03707	3861417994	200	0.03	0.1	0.059	56.8	< 0.003	< 0.002	< 0.008	3.39	7.5	0.006	26	0.085	103	2.6	25.4	1	0.303	< 0.002	0.013
S98-03708	3861460405	135	0.04	< 0.1	0.097	59.5	< 0.003	< 0.002	< 0.008	10.2	6.4	0.005	29.5	0.131	64	1.6	25.7	0.9	0.242	< 0.002	0.019
S98-03709	3861460405	< 0.5	0.02	1.3	0.059	24.8	< 0.003	< 0.002	< 0.008	0.037	3.7	0.04	11.8	0.017	587	< 0.1	14.8	< 0.2	0.311	< 0.002	0.007
S98-03710	3861469513	104	0.04	0.1	0.052	42.7	< 0.003	< 0.002	< 0.008	2.81	7.3	0.004	32.6	0.1	49.8	1.9	27.8	0.6	0.329	< 0.002	0.011
S98-03711	3861425612	124	0.03	< 0.1	0.092	56.4	< 0.003	< 0.002	< 0.008	8.33	5.9	0.006	35.6	0.102	45.2	2.2	33	0.2	0.383	< 0.002	0.013
S98-03712	3866575759	< 0.5	0.04	0.1	0.247	96.8	< 0.003	< 0.002	< 0.008	0.5	5.4	0.027	38.9	0.053	202	< 0.1	20.2	< 0.2	0.767	< 0.002	0.016
S98-03713	3866563592	253	0.02	0.7	0.04	38.9	< 0.003	< 0.002	< 0.008	2.81	18.7	0.013	73.1	0.083	617	5.4	25.3	1.1	0.469	< 0.002	0.009
S98-03714	3866537341	108	0.04	0.2	0.085	52.4	< 0.003	< 0.002	< 0.008	3.8	8.9	0.006	38.5	0.062	166	2.8	20	6.7	0.3	< 0.002	0.013
S98-03715	3866550083	216	0.02	0.3	0.081	38.6	< 0.003	< 0.002	< 0.008	5.45	13.1	0.009	25.9	0.09	265	5.7	30.3	1.2	0.238	0.003	0.01
S98-03716	3866512182	298	0.05	0.2	0.086	76.2	< 0.003	< 0.002	< 0.008	5.63	8.3	0.005	34.2	0.151	45.7	1.9	25.3	0.4	0.347	< 0.002	0.013
S98-03717	3866544934	111	0.05	< 0.1	0.12	132	< 0.003	< 0.002	< 0.008	10.6	5.4	0.005	32	0.223	24.1	1.9	27.3	< 0.2	0.464	< 0.002	0.015
S98-03718	3866518106	27.2	0.03	0.2	0.04	55.6	< 0.003	< 0.002	< 0.008	4.45	9.9	0.007	50.3	0.13	106	2.7	36.9	0.9	0.333	< 0.002	0.011

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03719	RIP1776	14/05/1998	22.887	89.903	1992	STW	18	Atiar Rahaman	Dhaka	Gopalganj	Tungipara	Patgati	Patgati
S98-03720	RIP1777	14/05/1998	22.875	89.924	1997	DTW	326	Ramzan Bishwas	Dhaka	Gopalganj	Tungipara	Dumuria	Chato dumuria
S98-03721	RIP1778	14/05/1998	22.876	89.925	1995	STW	34	Sudhair Gain	Dhaka	Gopalganj	Tungipara	Dumuria	Chato dumuria
S98-03722	RIP1779	14/05/1998	22.916	89.86	1988	STW	24	Jahangir Mollah	Dhaka	Gopalganj	Tungipara	Barni	Gimadanga
S98-03723	RIP1780	14/05/1998	22.941	89.856	1998	DTW	362	Mohammad Ali Sheikh	Dhaka	Gopalganj	Tungipara	Kushli	Kushli
S98-03724	RIP1781	14/05/1998	22.985	89.884	1998	DTW	360	Manmathanath Barai	Dhaka	Gopalganj	Tungipara	Gopalpur	Guadhana
S98-03725	RIP1782	14/05/1998	22.985	89.883	1986	STW	29	Manmathanath Poddar	Dhaka	Gopalganj	Tungipara	Gopalpur	Guadhana
S98-03726	RIP1784	16/05/1998	23.159	89.805	1990	STW	30	Mosque Committee	Dhaka	Gopalganj	Kashiani	Bethuri	Rsudia
S98-03727	RIP1785	16/05/1998	23.182	89.789	1996	STW	34	Bazar Committee	Dhaka	Gopalganj	Kashiani	Orakandi	Tilchara
S98-03728	RIP1786	16/05/1998	23.193	89.735	1993	STW	39	Shahabuddin Ahamad	Dhaka	Gopalganj	Kashiani	Ratail	Ratail
S98-03729	RIP1787	16/05/1998	23.211	89.718	1998	DTW	263	Chunnu Mia	Dhaka	Gopalganj	Kashiani	Kashiani	Kashiani
S98-03730	RIP1788	16/05/1998	23.211	89.718	1985	STW	34	Chunnu Mia	Dhaka	Gopalganj	Kashiani	Kashiani	Kashiani
S98-03731	RIP1789	16/05/1998	23.238	89.773	1985	STW	34	Bazar Committee	Dhaka	Gopalganj	Kashiani	Sajail	Bhattadhoba
S98-03732	RIP1790	16/05/1998	23.289	89.756	1993	STW	39	Madarasha Committee	Dhaka	Gopalganj	Kashiani	Mahespur	Bishwanathpur
S98-03733	RIP1792	13/05/1998	23.168	90.354	1939	STW	22	Rajab Ali	Dhaka	Shariatpur	Palong	Rudrakar	Bara Sonamukhi
S98-03734	RIP1793	13/05/1998	23.19	90.317	1995	STW	15	Hazrat Ali	Dhaka	Shariatpur	Palong	Chitalia	Kashipur
S98-03735	RIP1794	13/05/1998	23.175	90.302	1995	STW	15	Hazi Hasibur Rahaman	Dhaka	Shariatpur	Palong	Angaria	Kashchar
S98-03736	RIP1795	13/05/1998	23.206	90.325	1947	STW	16	Barail P. School	Dhaka	Shariatpur	Palong	Tulashar	Barail
S98-03737	RIP1796	13/05/1998	23.205	90.322	1990	DTW	195	Abdus Samad	Dhaka	Shariatpur	Palong	Tulshar	Barail
S98-03738	RIP1797	13/05/1998	23.241	90.358	1992	STW	49	Abdus Samad	Dhaka	Shariatpur	Palong	Palong	Kotapara
S98-03739	RIP1798	13/05/1998	23.251	90.343	1993	STW	22	Domshar P. School	Dhaka	Shariatpur	Palong	Domshar	Domshar
S98-03740	RIP1799	13/05/1998	23.198	90.339	1988	STW	20	Abdui Karim Sardar	Dhaka	Shariatpur	Palong	Paurashava W02	Uttar Madhapara
S98-03741	RIP1801	14/05/1998	22.988	90.007	1995	DTW	271	DPHE Office	Dhaka	Gopalganj	Kotalipara	Ghagor	Mokshakotali
S98-03742	RIP1802	14/05/1998	23.112	90.021	1997	STW	66	Harashid Hawalder	Dhaka	Gopalganj	Kotalipara	Kalabari	Bil Baghia
S98-03743	RIP1803	14/05/1998	23.033	90.033	1972	STW	37	Debagram P. School	Dhaka	Gopalganj	Kotalipara	Radhaganj	Gobindapur
S98-03744	RIP1804	14/05/1998	22.927	90.005	1998	STW	26	Dhara Basai Mosque	Dhaka	Gopalganj	Kotalipara	Kandi	Dhara Basail
S98-03745	RIP1805	14/05/1998	22.992	90.048	1996	DTW	276	Wabdarpar Bazar	Dhaka	Gopalganj	Kotalipara	Amtali	Gachapara
S98-03746	RIP1806	14/05/1998	22.992	90.046	1983	STW	28	Ramesh Vaktho	Dhaka	Gopalganj	Kotalipara	Amtali	Gachpara
S98-03747	RIP1807	14/05/1998	22.997	89.985	1977	STW	24	Tarashi P. School	Dhaka	Gopalganj	Kotalipara	Hiran	Tarasi
S98-03748	RIP1809	16/05/1998	23.236	89.9	1997	STW	68	Atiar Rahaman	Dhaka	Gopalganj	Muksudpur	Ujani	Ujani
S98-03749	RIP1810	16/05/1998	23.284	89.929	1996	STW	53	Gunshi P. School	Dhaka	Gopalganj	Muksudpur	Mochna	Gunshi
S98-03750	RIP1812	17/05/1998	23.229	89.712	1993	STW	45	Nikil Chandra Bishwa	Dhaka	Faridpur	Alfadanga	Togarbanga	Titulkandi
S98-03751	RIP1813	17/05/1998	23.265	89.676	1986	STW	20	Nawser Ali Khan	Dhaka	Faridpur	Alfadanga	Gopalpur	Gopalpur
S98-03752	RIP1814	17/05/1998	23.288	89.706	1991	STW	53	BRAC Office	Dhaka	Faridpur	Alfadanga	Alfadanga	Kushumdi
S98-03753	RIP1815	17/05/1998	23.332	89.658	1997	STW	39	Tabui Nutun Bazar	Dhaka	Faridpur	Alfadanga	Bana	Tabui
S98-03754	RIP1816	17/05/1998	23.336	89.631	1993	STW	53	Bahir Bazar Mosque	Dhaka	Faridpur	Alfadanga	Panchuria	Dhuljuri
S98-03755	RIP1818	17/05/1998	23.32	89.758	1996	STW	33	Mora Mosque	Dhaka	Faridpur	Boalmari	Rupapat	Mora
S98-03756	RIP1820	18/05/1998	23.459	89.986	1985	STW	29	Union Parishad	Dhaka	Faridpur	Bhanga	Manikdaha	Manikdaha
S98-03757	RIP1821	18/05/1998	23.407	90.043	1996	STW	34	Union Parishad	Dhaka	Faridpur	Bhanga	Kaolibera	Kaolibera
S98-03758	RIP1822	18/05/1998	23.367	90.074	1992	STW	24	Hazi Ayebuddin	Dhaka	Faridpur	Bhanga	Chandra	Pulia
S98-03759	RIP1823	18/05/1998	23.307	90.071	1965	STW	25	Fakir Mansur	Dhaka	Faridpur	Bhanga	Kalamirda	Sonamukhirchar
S98-03760	RIP1824	18/05/1998	23.329	90.006	1985	STW	25	Abdul Jaynal Khan	Dhaka	Faridpur	Bhanga	Gharua	Daks. Gangadardi
S98-03761	RIP1825	18/05/1998	23.38	89.986	1989	STW	31	Nurul Haq	Dhaka	Faridpur	Bhanga	Bhanga	Sadardi
S98-03762	RIP1826	18/05/1998	23.376	89.957	1991	STW	21	Imrahim Matbar	Dhaka	Faridpur	Bhanga	Algi	Majardia
S98-03763	RIP1828	19/05/1998	23.594	89.716	1990	STW	44	abul Kashem	Dhaka	Rajbari	Rajbari Sadar	Sultanpur	Sialkati
S98-03764	RIP1829	19/05/1998	23.648	89.702	1984	STW	22	Sukur Ali	Dhaka	Rajbari	Rajbari Sadar	Basanthapur	Bajitpur
S98-03765	RIP1830	19/05/1998	23.69	89.676	1988	STW	20	Mehajuddin Sarker	Dhaka	Rajbari	Rajbari Sadar	Shahid Wahabpur	Rampur
S98-03766	RIP1831	12/05/1998	23.14	90.459	1975	STW	32	Jashim Bapari	Dhaka	Shariatpur	Damudya	Purba Damudya	Bara Naogaon

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03719	3359176814	224	0.07	0.1	0.188	109	< 0.003	< 0.002	< 0.008	5.37	6.7	0.007	25.5	0.063	266	1	18.7	1.6	0.366	< 0.002	0.017
S98-03720	3359128280	< 0.5	0.03	1.5	0.186	67.7	< 0.003	< 0.002	< 0.008	0.237	8.1	0.049	48.9	0.082	1090	0.1	10.3	< 0.2	0.757	< 0.002	0.014
S98-03721	3359128180	263	0.05	0.2	0.435	145	< 0.003	< 0.002	< 0.008	13.6	14.3	0.016	81.1	0.137	480	2.1	22.6	0.7	0.815	< 0.002	0.031
S98-03722	3359119429	315	0.06	< 0.1	0.188	170	< 0.003	< 0.002	< 0.008	15.4	6.4	0.005	31.6	0.238	31.9	1.4	25.2	0.9	0.538	< 0.002	0.02
S98-03723	3359166678	0.8	0.02	0.4	0.035	14	< 0.003	< 0.002	< 0.008	0.17	4	0.009	9.82	0.027	439	0.2	9.83	0.3	0.149	< 0.002	0.009
S98-03724	3359138474	0.8	0.04	0.9	0.25	80.7	< 0.003	< 0.002	< 0.008	0.312	7.6	0.06	46.4	0.066	951	0.1	11.2	< 0.2	0.789	< 0.002	0.019
S98-03725	3359138474	145	0.04	0.3	0.24	83.9	< 0.003	< 0.002	< 0.008	4.3	10.8	0.01	44.5	0.068	435	2.8	21	0.6	0.435	< 0.002	0.015
S98-03726	3354306802	69.6	< 0.01	< 0.1	0.152	55	< 0.003	< 0.002	< 0.008	6.55	4.3	0.005	20.4	0.109	31	0.2	23.5	0.9	0.306	< 0.002	0.01
S98-03727	3354354988	49.5	0.07	< 0.1	0.233	153	< 0.003	< 0.002	< 0.008	12.3	3.7	0.006	22.3	0.137	19.7	1	22.1	2.1	0.358	< 0.002	0.025
S98-03728	3354381808	65.3																			
S98-03729	3354327519	5.3	< 0.01	0.2	0.633	64.5	< 0.003	< 0.002	< 0.008	1.13	10.2	0.08	84.2	0.134	636	< 0.1	19.4	4.8	0.79	< 0.002	0.018
S98-03730	3354327519	380	0.05	< 0.1	0.248	135	< 0.003	< 0.002	< 0.008	6.6	4.9	0.005	32.2	0.729	16	0.8	19.2	< 0.2	0.318	< 0.002	0.021
S98-03731	3354388134	132	0.08	< 0.1	0.259	143	< 0.003	< 0.002	< 0.008	12.3	4.4	0.004	28.7	0.242	23.5	0.9	17.1	3.6	0.423	< 0.002	0.023
S98-03732	3354340166	98.6	0.05	< 0.1	0.284	96	< 0.003	< 0.002	< 0.008	4.93	13.1	0.005	26.5	0.108	22.5	1.3	18.6	0.6	0.338	< 0.002	0.016
S98-03733	3866976105	540	0.06	0.2	0.313	204	< 0.003	< 0.002	< 0.008	11.4	11.3	0.006	61.8	1.28	234	0.7	18.1	0.2	0.865	< 0.002	0.035
S98-03734	3866947602	84.2	0.04	< 0.1	0.166	98.3	< 0.003	< 0.002	< 0.008	3.52	4.3	< 0.004	21.2	0.671	17.9	0.7	18.2	0.6	0.327	< 0.002	0.013
S98-03735	3866909765	330	0.06	< 0.1	0.257	197	< 0.003	< 0.002	< 0.008	11.7	6.2	< 0.004	38.9	1.95	21.3	1.4	17.8	< 0.2	0.706	< 0.002	0.017
S98-03736	3866995124	133	0.06	< 0.1	0.212	189	< 0.003	< 0.002	< 0.008	1.77	6.8	0.005	42.9	1.01	42.1	0.5	16.4	< 0.2	0.671	< 0.002	0.04
S98-03737	3866995124	1.3	0.26	0.3	0.136	63.9	< 0.003	< 0.002	< 0.008	0.532	4.1	0.018	24.4	0.05	187	< 0.1	20.9	< 0.2	0.401	< 0.002	0.012
S98-03738	3866966805	99.9	0.04	0.6	0.054	81.5	< 0.003	< 0.002	< 0.008	2.26	16.3	0.013	50.2	0.137	543	2.3	29.8	2.2	0.513	< 0.002	0.028
S98-03739	3866957497	84.2	0.32	0.1	0.129	139	< 0.003	< 0.002	< 0.008	9.95	7.4	0.005	44.5	0.309	12.7	2	29.6	0.3	0.53	< 0.002	0.306
S98-03740	3866995994	288	0.04	0.2	0.092	80.1	< 0.003	< 0.002	< 0.008	4.83	8.2	0.005	43	0.149	52	2.3	23.9	0.3	0.405	< 0.002	0.013
S98-03741	3355123636	2.9	0.03	0.3	0.178	61.6	< 0.003	< 0.002	< 0.008	0.492	6.3	0.029	29.4	0.095	307	0.1	16.9	< 0.2	0.469	< 0.002	0.013
S98-03742	3355139189	86.2	0.03	0.2	0.096	78.7	< 0.003	< 0.002	< 0.008	2.4	12.3	0.006	36.2	0.197	54.3	2.9	30.3	0.4	0.444	< 0.002	0.016
S98-03743	3355171378	521	0.04	0.1	0.201	102	< 0.003	< 0.002	< 0.008	3.48	8.2	0.006	28	0.047	214	1.6	15	0.6	0.424	< 0.002	0.013
S98-03744	3355147288	206	0.08	< 0.1	0.123	103	< 0.003	< 0.002	< 0.008	5.13	6.1	0.005	29.7	0.173	61.7	1.1	24.7	1	0.363	< 0.002	0.032
S98-03745	3355107328	0.9	0.03	0.5	0.255	79.6	< 0.003	< 0.002	< 0.008	0.152	6.3	0.032	37.7	0.065	370	< 0.1	16.6	< 0.2	0.769	< 0.002	0.011
S98-03746	3355107328	166	0.04	< 0.1	0.098	84.2	< 0.003	< 0.002	< 0.008	3.73	5.2	0.005	23.1	0.07	28.4	1.4	23.2	0.3	0.339	< 0.002	0.015
S98-03747	3355131955	231	0.04	< 0.1	0.187	109	< 0.003	< 0.002	< 0.008	7.19	6.6	0.007	25.4	0.097	163	1.6	23.6	0.8	0.421	< 0.002	0.015
S98-03748	3355894971	228	0.03	0.2	0.193	81.7	< 0.003	< 0.002	< 0.008	3.2	7.3	0.007	38.2	0.083	66.7	3	23.7	0.8	0.405	< 0.002	0.016
S98-03749	3355867358	145	0.03	0.4	0.129	67.1	< 0.003	< 0.002	< 0.008	2.25	14.1	0.016	55.9	0.09	462	3.6	28.6	0.7	0.452	< 0.002	0.015
S98-03750	3290384994	346	0.05	< 0.1	0.215	116	< 0.003	< 0.002	< 0.008	6.58	4.9	0.005	31.1	0.064	17.8	2	20.5	0.2	0.469	< 0.002	0.015
S98-03751	3290342412	41.6	0.06	< 0.1	0.29	158	< 0.003	< 0.002	< 0.008	3.54	10	< 0.004	27.3	0.668	25.5	0.4	16.8	53.5	0.251	< 0.002	0.017
S98-03752	3290310663	278	0.05	< 0.1	0.094	106	< 0.003	< 0.002	< 0.008	2.5	8.4	0.004	46.2	0.133	33.5	0.9	19.9	0.2	0.561	< 0.002	0.015
S98-03753	3290321970	48.6	0.05	< 0.1	0.231	132	< 0.003	< 0.002	< 0.008	4.9	5.5	< 0.004	30.2	0.917	19.4	1.1	17.3	1	0.326	< 0.002	0.015
S98-03754	3290352351	12.3	0.31	0.1	0.178	57.5	< 0.003	< 0.002	< 0.008	0.547	2.5	< 0.004	40.5	1.72	76.2	0.5	16.3	12.9	0.418	0.005	0.022
S98-03755	3291863706	181	0.05	< 0.1	0.37	136	< 0.003	< 0.002	< 0.008	8.75	35.3	0.004	39.5	0.426	50.2	1.2	17.1	0.2	0.384	< 0.002	0.015
S98-03756	3291071629	191	0.05	< 0.1	0.168	134	< 0.003	< 0.002	< 0.008	0.725	6.3	0.004	28.3	1.07	17.3	0.7	18.6	1.5	0.503	< 0.002	0.017
S98-03757	3291063512	285	0.06	< 0.1	0.35	104	< 0.003	< 0.002	< 0.008	4.96	8.6	< 0.004	32.6	0.359	79.8	0.8	21.4	0.2	0.431	< 0.002	0.014
S98-03758	3291031797	307	0.06	< 0.1	0.356	199	< 0.003	< 0.002	< 0.008	9.03	8.3	0.005	38.9	1.64	15.3	0.7	22.3	< 0.2	0.641	< 0.002	0.02
S98-03759	3291055497	143	0.04	< 0.1	0.19	130	< 0.003	< 0.002	< 0.008	8.06	4.8	< 0.004	28	0.63	35.8	1.1	17.6	1.1	0.419	< 0.002	0.02
S98-03760	3291039289	468	0.06	< 0.1	0.134	112	< 0.003	< 0.002	< 0.008	5.35	5.4	0.004	30	0.334	46.2	1	19.6	< 0.2	0.453	< 0.002	0.018
S98-03761	3291023841	233	0.04	< 0.1	0.083	90.2	< 0.003	< 0.002	< 0.008	3.62	4	< 0.004	17.6	0.42	12.1	1.1	20.7	< 0.2	0.276	< 0.002	0.021
S98-03762	3291007197	103	0.07	< 0.1	0.128	110	< 0.003	< 0.002	< 0.008	4.89	4.8	< 0.004	24.7	0.242	14.5	1.5	20.3	0.4	0.366	< 0.002	0.02
S98-03763	3827694918	58.8	0.04	< 0.1	0.117	101	< 0.003	< 0.002	< 0.008	4.7	3.9	< 0.004	22.2	0.505	12.9	1.4	19.6	4	0.328	< 0.002	0.013
S98-03764	3827629070	7.2	0.05	< 0.1	0.143	134	< 0.003	< 0.002	< 0.008	0.113	4.1	< 0.004	28.8	0.712	11.9	0.1	18.8	0.6	0.485	< 0.002	0.014
S98-03765	3827687886	25	0.04	< 0.1	0.217	122	< 0.003	< 0.002	< 0.008	1.09	4.9	< 0.004	31.2	1.63	9.6	0.1	19	7	0.455	< 0.002	0.013
S98-03766	3862559762	86.6	0.05	< 0.1	0.118	139	< 0.003	< 0.002	< 0.008	1.98	5.1	< 0.004	27.8	1.29	12.2	0.4	18.3	2.7	0.423	< 0.002	0.022

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03767	RIP1832	12/05/1998	23.159	90.46	1992	DTW	256	Kailara Bazar	Dhaka	Shariatpur	Damudya	Sidya	Sidya
S98-03768	RIP1833	12/05/1998	23.121	90.418	1983	STW	31	Sidulkura Bazar Mosq	Dhaka	Shariatpur	Damudya	Sidulkura	Char Sidulkura
S98-03769	RIP1834	12/05/1998	23.143	90.412	1981	STW	48	Dhankati Darbar Shar	Dhaka	Shariatpur	Damudya	Dhankati	Char Dhankati
S98-03770	RIP1835	12/05/1998	23.164	90.407	1998	STW	44	Tili Battala	Dhaka	Shariatpur	Damudya	Kaneshwar	Erikati
S98-03771	RIP1837	13/05/1998	23.397	90.249	1988	STW	19	Nasir Zamarder	Dhaka	Shariatpur	Zanjira	Naodoba	Naodoba
S98-03772	RIP1838	13/05/1998	23.367	90.256	1992	STW	24	Idris Khandaker	Dhaka	Shariatpur	Zanjira	Bara Krisnanagar	Bara Krisnanagar
S98-03773	RIP1839	13/05/1998	23.348	90.283	1990	STW	20	Hazi Mohar Ali	Dhaka	Shariatpur	Zanjira	Sener Char	Sener Char
S98-03774	RIP1840	13/05/1998	23.341	90.305	1992	STW	14	Abu Taher	Dhaka	Shariatpur	Zanjira	Mulna	Mirasar
S98-03775	RIP1841	13/05/1998	23.305	90.303	1978	STW	25	Aainal Bhapari	Dhaka	Shariatpur	Zanjira	Mulna	Boalia
S98-03776	RIP1842	13/05/1998	23.33	90.402	1994	STW	25	Mamataz Uddin	Dhaka	Shariatpur	Zanjira	Kunderchar	Kalmirchar
S98-03777	RIP1843	13/05/1998	23.331	90.37	1992	STW	15	Bilaspur Bazar Mosqu	Dhaka	Shariatpur	Zanjira	Bilaspur	Bilaspur
S98-03778	RIP1845	14/05/1998	22.944	89.83	1975	STW	29	M A Salam Mollah	Dhaka	Gopalganj	Gopalganj Sadar	Gobra	Char baira
S98-03779	RIP1846	14/05/1998	23.108	89.749	1987	STW	34	Akkas Ali Sheikh	Dhaka	Gopalganj	Gopalganj Sadar	Suktail	Paikerdanga
S98-03780	RIP1847	14/05/1998	23.063	89.763	1989	STW	39	Rustam Ali Khan	Dhaka	Gopalganj	Gopalganj Sadar	Paikkandi	Tebaria
S98-03781	RIP1848	14/05/1998	23.072	89.853	1995	STW	29	Ayinuddin Sheikh	Dhaka	Gopalganj	Gopalganj Sadar	Ulpur	Ulpur
S98-03782	RIP1849	14/05/1998	23.137	89.934	1975	STW	24	Baddal Poddar	Dhaka	Gopalganj	Gopalganj Sadar	Satpar	Betbhita
S98-03783	RIP1850	14/05/1998	23.097	89.893	1997	STW	34	Jitendra Bhadra	Dhaka	Gopalganj	Gopalganj Sadar	Baultali	Baultali
S98-03784	RIP1851	14/05/1998	23.034	89.819	1987	STW	34	Abdul Haq Mollah	Dhaka	Gopalganj	Gopalganj Sadar	Haridaspur	Haridaspur
S98-03785	RIP1852	14/05/1998	23.026	89.905	1997	STW	82	Sultanpur Mosque	Dhaka	Gopalganj	Gopalganj Sadar	Kathi	Sultanpur
S98-03786	RIP1853	14/05/1998	23.043	89.86	1995	STW	24	Bimal Krisna Hira	Dhaka	Gopalganj	Gopalganj Sadar	Durgapur	Katarbari
S98-03787	RIP1854	16/05/1998	23.316	89.872	1982	STW	53	DPHE Office	Dhaka	Gopalganj	Muksudpur	Tengrakhola	Gopinathpur
S98-03788	RIP1855	16/05/1998	23.316	89.872	1996	STW	75	DPHE Office	Dhaka	Gopalganj	Muksudpur	Tengrakhola	Gopinathpur
S98-03789	RIP1856	16/05/1998	23.234	90.013	1997	STW	63	Switch Gate	Dhaka	Gopalganj	Muksudpur	Gohala	Dak.Gangarampur
S98-03790	RIP1857	16/05/1998	23.268	90.018	1989	STW	24	Chhagachhara Mosque	Dhaka	Gopalganj	Muksudpur	Ragdi	Chhagachhira
S98-03791	RIP1858	16/05/1998	23.318	89.948	1996	STW	39	Mrs Shahida Begume	Dhaka	Gopalganj	Muksudpur	Batikamari	Batikamari
S98-03792	RIP1859	17/05/1998	23.388	89.687	1992	STW	57	DPHE Office	Dhaka	Faridpur	Boalmari	Boalmari	Shibpur
S98-03793	RIP1860	17/05/1998	23.363	89.755	1993	STW	30	Bala Ram Pal	Dhaka	Faridpur	Boalmari	Parameshwardi	Joypasa
S98-03794	RIP1861	17/05/1998	23.328	89.716	1976	STW	20	Malek Mia	Dhaka	Faridpur	Boalmari	Shekhore	Sahasarail
S98-03795	RIP1862	17/05/1998	23.368	89.658	1977	STW	57	Narayan Chandra	Dhaka	Faridpur	Boalmari	Gunbaha	D.Hariharnagar
S98-03796	RIP1863	17/05/1998	23.407	89.631	1991	STW	53	Charbarani P. School	Dhaka	Faridpur	Boalmari	Moyna	Bekjani
S98-03797	RIP1864	17/05/1998	23.445	89.637	1996	STW	60	Abdus Sobahan	Dhaka	Faridpur	Boalmari	Goshpur	Daitarkati
S98-03798	RIP1865	17/05/1998	23.439	89.669	1977	STW	35	Satair Mosque	Dhaka	Faridpur	Boalmari	Satair	Satair
S98-03799	RIP1866	17/05/1998	23.474	89.713	1988	STW	39	Purba Bhadi Mosque	Dhaka	Faridpur	Boalmari	Dodpur	Purba Bhatdi
S98-03800	RIP1867	17/05/1998	23.501	89.733	1983	STW	25	md Delwar Hossain	Dhaka	Faridpur	Boalmari	Chandpur	Dhopadanga
S98-03801	RIP1869	18/05/1998	23.472	90.029	1983	DTW	138	Thana Parishad	Dhaka	Faridpur	Sadarpur	Sadarpur	Satararashi
S98-03802	RIP1870	18/05/1998	23.472	90.029	1987	DTW	148	Thana Parishad	Dhaka	Faridpur	Sadarpur	Sadarpur	Satararashi
S98-03803	RIP1871	18/05/1998	23.448	90.081	1997	STW	34	Md Mokshed Ali	Dhaka	Faridpur	Sadarpur	Dheukhali	Char Khataria
S98-03804	RIP1872	18/05/1998	23.531	90.028	1995	STW	29	Golamerdangi Mosque	Dhaka	Faridpur	Sadarpur	Akterchar	Mulamerdangi
S98-03805	RIP1873	18/05/1998	23.487	89.961	1991	STW	44	abular Mor	Dhaka	Faridpur	Sadarpur	Krishnapur	Shauldobi
S98-03806	RIP1874	18/05/1998	23.523	89.958	1992	STW	29	Rafiqul Islam	Dhaka	Faridpur	Sadarpur	Bashanchar	Bashanchar
S98-03807	RIP1876	19/05/1998	23.651	89.467	1998	STW	59	Paran Bhandu Mandal	Dhaka	Rajbari	Baliakandi	Narua	Bil takapara
S98-03808	RIP1877	19/05/1998	23.613	89.498	1998	STW	56	Pran Bandhu Mandal	Dhaka	Rajbari	Baliakandi	Jungal	Potra
S98-03809	RIP1878	19/05/1998	23.677	89.537	1989	STW	52	Shoharab Hossain	Dhaka	Rajbari	Baliakandi	Nawabpur	Sadashibpur
S98-03810	RIP1879	19/05/1998	23.721	89.58	1991	STW	49	Rajdharpur Bazar	Dhaka	Rajbari	Baliakandi	Islampur	Rajdharpur
S98-03811	RIP1880	19/05/1998	23.656	89.579	1997	STW	50	Ramendra Nath Pal	Dhaka	Rajbari	Baliakandi	Baharpur	Bhar Ramdia
S98-03812	RIP1881	19/05/1998	23.616	89.628	1993	DTW	167	Harendra Nath Pal	Dhaka	Rajbari	Baliakandi	Jamalpur	Brimagura
S98-03813	RIP1883	20/05/1998	23.823	89.364	1992	Tara	17	Khabir Uddin	Dhaka	Rajbari	Pangsha	Machpara	Joygram
S98-03814	RIP1884	20/05/1998	23.785	89.357	1992	Tara	39	Abdus Sattar	Dhaka	Rajbari	Pangsha	Kalimohor	Taktipur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03767	3862583895	0.9	0.03	1.6	0.103	45.5	< 0.003	< 0.002	< 0.008	0.151	4.2	0.056	21.8	0.04	762	< 0.1	15	3.4	0.609	< 0.002	0.019
S98-03768	3862571281	590	0.05	0.1	0.09	108	< 0.003	< 0.002	< 0.008	3.32	5.4	0.005	24.5	0.825	29.9	1.2	15.8	0.3	0.399	< 0.002	0.014
S98-03769	3862535198	5	0.03	0.3	0.047	36.4	< 0.003	< 0.002	< 0.008	0.661	15	0.012	55.7	0.099	244	2.2	35.3	0.8	0.316	< 0.002	0.009
S98-03770	3862547497	21.1	0.03	0.2	0.036	42.4	< 0.003	< 0.002	< 0.008	1.44	15.1	0.007	43.1	0.1	149	2.6	35	0.5	0.373	< 0.002	0.011
S98-03771	3869465742	1.9	0.06	< 0.1	0.161	156	< 0.003	< 0.002	< 0.008	0.643	6.3	0.005	34.2	0.852	20.6	0.1	15.1	32.2	0.514	< 0.002	0.016
S98-03772	3869421089	461	0.07	< 0.1	0.202	214	< 0.003	< 0.002	< 0.008	6.74	7.7	0.005	44.8	1.74	67.3	0.1	16	0.3	0.674	< 0.002	0.019
S98-03773	3869487913	107	0.06	< 0.1	0.229	156	< 0.003	< 0.002	< 0.008	2.33	6.3	0.005	31.6	2.12	13.7	0.2	15.7	0.8	0.521	< 0.002	0.045
S98-03774	3869458720	3	0.05	< 0.1	0.104	110	< 0.003	< 0.002	< 0.008	0.283	4.9	0.005	23.5	0.599	11.8	0.1	16.7	12	0.336	< 0.002	0.069
S98-03775	3869458148	128	0.07	< 0.1	0.187	187	< 0.003	< 0.002	< 0.008	8.09	6.3	< 0.004	36.6	2.03	19.2	0.6	17.3	1.4	0.62	< 0.002	0.021
S98-03776	3869451571	540	0.09	< 0.1	0.201	218	< 0.003	< 0.002	< 0.008	10.3	7	0.005	46.2	1.49	23.6	0.2	18.1	1	0.725	< 0.002	0.02
S98-03777	3869429141	52.8	0.22	< 0.1	0.199	214	< 0.003	< 0.002	< 0.008	0.897	6.4	0.005	43.8	1.41	20.8	0.3	19.3	3.4	0.645	< 0.002	0.018
S98-03778	3353221235	602	0.07	< 0.1	0.221	291	< 0.003	< 0.002	< 0.008	13.3	5.7	< 0.004	55.5	1.22	21.2	0.5	16.1	0.3	0.902	< 0.002	0.019
S98-03779	3353286712	562	0.07	< 0.1	0.235	158	< 0.003	< 0.002	< 0.008	13	7	0.005	37.4	1.33	17.9	0.8	20.3	0.9	0.577	< 0.002	0.03
S98-03780	3353269932	122	0.06	< 0.1	0.189	181	< 0.003	< 0.002	< 0.008	5.13	18.4	0.006	34.9	0.786	18.5	0.2	16	< 0.2	0.455	< 0.002	0.018
S98-03781	3353290987	301	0.03	< 0.1	0.121	74.9	< 0.003	< 0.002	< 0.008	3.98	3.7	< 0.004	19.5	0.084	14.9	1.4	19.5	< 0.2	0.287	< 0.002	0.014
S98-03782	3353282148	160	0.04	< 0.1	0.202	104	< 0.003	< 0.002	< 0.008	10.6	3.8	0.006	20.3	0.12	17.7	1	23.2	0.9	0.34	< 0.002	0.018
S98-03783	3353208125	321	0.07	< 0.1	0.354	167	< 0.003	< 0.002	< 0.008	11	7.1	0.006	40.8	0.098	52.4	1.9	21.6	1.1	0.634	< 0.002	0.018
S98-03784	3353234423	199	0.04	< 0.1	0.172	99.7	< 0.003	< 0.002	< 0.008	8.4	6	< 0.004	23.8	0.143	21.8	2.8	28.2	1	0.4	< 0.002	0.013
S98-03785	3353251893	175	0.04	< 0.1	0.125	61.1	< 0.003	< 0.002	< 0.008	2.72	4.6	0.008	29.3	0.051	46.3	1.8	20.5	0.5	0.264	< 0.002	0.013
S98-03786	3353217517	121	0.06	0.2	0.267	115	< 0.003	< 0.002	< 0.008	2.02	30.4	0.007	43.4	0.116	103	0.6	18.8	2.8	0.646	< 0.002	0.014
S98-03787	3355889392	119	0.03	< 0.1	0.097	108	< 0.003	< 0.002	< 0.008	3.06	3.9	< 0.004	45.6	0.055	36.2	2.1	20.1	0.7	0.478	< 0.002	0.013
S98-03788	3355889392	281	0.02	< 0.1	0.139	94.1	< 0.003	< 0.002	< 0.008	2.47	5.2	0.006	36	0.171	16.4	0.2	20.2	0.6	0.539	< 0.002	0.13
S98-03789	3355839334	135	0.04	0.2	0.263	77.4	< 0.003	< 0.002	< 0.008	5.38	12.7	0.019	52.7	0.068	150	2.1	23.5	0.7	0.54	< 0.002	0.017
S98-03790	3355883224	346	0.03	< 0.1	0.13	135	< 0.003	< 0.002	< 0.008	5.84	5.9	< 0.004	28.2	0.632	37	1.5	21.2	0.6	0.471	< 0.002	0.014
S98-03791	3355822148	588	0.03	< 0.1	0.188	164	< 0.003	< 0.002	< 0.008	7.38	6.2	< 0.004	37	0.135	18	1.7	22.6	0.9	0.555	< 0.002	0.037
S98-03792	3291815908	0.8	0.32	< 0.1	0.054	51.2	< 0.003	< 0.002	< 0.008	0.07	1.2	< 0.004	15.6	1.13	95.1	0.1	23.4	2.9	0.208	0.003	0.009
S98-03793	3291875483	132	0.01	< 0.1	0.157	86.7	< 0.003	< 0.002	< 0.008	2.86	4.7	< 0.004	23.5	0.38	18.6	1.1	19.5	1.8	0.32	< 0.002	0.016
S98-03794	329188	66.3	0.02	< 0.1	0.217	120	< 0.003	< 0.002	< 0.008	4.97	2.5	< 0.004	25.3	0.266	25.7	1.5	19.9	43.4	0.272	< 0.002	0.014
S98-03795	3291840302	77.8	< 0.01	< 0.1	0.518	141	< 0.003	< 0.002	< 0.008	6.6	19.2	< 0.004	29.1	0.272	72.1	1	19.2	55.6	0.353	< 0.002	0.013
S98-03796	3291860146	< 0.5	0.01	< 0.1	0.075	120	< 0.003	< 0.002	< 0.008	0.078	1.6	< 0.004	28.9	3	15.4	0.2	25.3	1.2	0.492	0.004	0.011
S98-03797	3291835288	101	< 0.01	< 0.1	0.129	80.1	< 0.003	< 0.002	< 0.008	3.47	2.7	< 0.004	31.2	0.236	95.1	0.6	22.9	0.6	0.469	< 0.002	0.008
S98-03798	3291890890	< 0.5	0.05	< 0.1	0.086	93.5	< 0.003	< 0.002	< 0.008	0.087	1.4	< 0.004	46	1.21	54.7	0.2	25.6	0.9	0.412	0.006	0.013
S98-03799	3291830796	152	0.03	< 0.1	0.193	170	< 0.003	< 0.002	< 0.008	12.7	4.8	< 0.004	31.4	0.866	22.8	0.9	19	1.2	0.513	< 0.002	0.014
S98-03800	3291820340	35.2	0.06	< 0.1	0.192	152	< 0.003	< 0.002	< 0.008	1.9	7.1	< 0.004	36.6	0.774	27.1	0.2	16.9	13.7	0.445	< 0.002	0.015
S98-03801	3298485833	21	0.06	< 0.1	0.3	143	< 0.003	< 0.002	< 0.008	0.115	8.2	0.019	57.6	0.451	47.6	< 0.1	21.4	0.5	0.689	< 0.002	0.194
S98-03802	3298485833	6.7	0.02	< 0.1	0.185	51.8	< 0.003	< 0.002	< 0.008	0.267	4.3	0.015	18.3	0.223	209	0.1	19.7	2.1	0.337	< 0.002	0.012
S98-03803	3298457268	240	0.03	< 0.1	0.364	212	< 0.003	< 0.002	< 0.008	9.28	5.9	< 0.004	42.8	3.21	23.5	0.2	17.6	1.2	0.662	< 0.002	0.02
S98-03804	3298409658	20.7	0.05	< 0.1	0.105	125	< 0.003	0.002	< 0.008	1.51	5.3	< 0.004	16.8	0.908	9.7	0.4	14.5	3.9	0.371	< 0.002	0.012
S98-03805	3298466860	290	0.04	< 0.1	0.128	124	< 0.003	< 0.002	< 0.008	4.64	6.5	0.004	28.6	0.098	18.8	1.5	24	1	0.441	< 0.002	0.013
S98-03806	3298419067	77.9	0.03	< 0.1	0.204	134	< 0.003	< 0.002	< 0.008	4.57	5.7	< 0.004	27	1.73	18.4	0.4	18.5	2	0.404	< 0.002	0.013
S98-03807	3820785266	< 0.5	0.03	< 0.1	0.062	84.9	< 0.003	< 0.002	< 0.008	0.291	2	0.005	36.6	1.61	85.3	0.3	26.9	1.1	0.42	0.006	0.015
S98-03808	3820766804	0.5	0.04	< 0.1	0.072	131	< 0.003	< 0.002	< 0.008	0.1	3.2	0.013	38	0.793	56.2	< 0.1	23.9	4.6	0.502	< 0.002	0.013
S98-03809	3820795859	15.6	0.06	< 0.1	0.078	101	< 0.003	0.002	< 0.008	2.19	1.7	< 0.004	34.1	2.92	58.8	0.2	21.4	1	0.488	< 0.002	0.022
S98-03810	3820747829	< 0.5	0.06	< 0.1	0.05	70.1	< 0.003	< 0.002	< 0.008	0.264	1.5	0.016	15.5	0.675	55.1	< 0.1	30.5	0.7	0.163	0.003	0.012
S98-03811	3820709201	< 0.5	0.03	< 0.1	0.084	70.8	< 0.003	< 0.002	< 0.008	0.183	1.8	0.015	26.6	0.814	76.1	< 0.1	27.1	8.5	0.436	0.004	0.011
S98-03812	3820757271	0.5	0.05	< 0.1	0.027	74	< 0.003	< 0.002	< 0.008	0.208	2.4	0.067	27.1	0.943	364	0.1	18.2	38.9	0.417	< 0.002	0.011
S98-03813	3827350501	13.6	0.14	< 0.1	0.074	108	< 0.003	< 0.002	0.035	9.6	3.7	0.011	35	1.87	48.9	0.1	22.8	0.9	0.456	< 0.002	0.03
S98-03814	3827335951	< 0.5	0.04	< 0.1	0.064	126	< 0.003	< 0.002	< 0.008	0.261	1.5	0.009	33.5	1.41	42.7	0.1	24.7	1.1	0.379	0.004	0.022

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03815	RIP1885	20/05/1998	23.712	89.393	1991	Tara	42	Hakim Uddin	Dhaka	Rajbari	Pangsha	Patta	Patta
S98-03816	RIP1886	20/05/1998	23.872	89.384	1989	STW	35	Abdur Sukur	Dhaka	Rajbari	Pangsha	Bahadurpur	Bahadurpur
S98-03817	RIP1888	20/05/1998	23.83	89.41	1978	STW	39	Shamsuddin Master	Dhaka	Rajbari	Pangsha	Habaspur	Char Jhikari
S98-03818	RIP1889	20/05/1998	23.677	89.454	1977	STW	43	Makbul Hossain	Dhaka	Rajbari	Pangsha	Mrigi	Paban Panchbaria
S98-03819	RIP1891	17/05/1998	23.547	89.538	1988	STW	52	Saiful Islam	Dhaka	Faridpur	Madhukhali	Dumain	Dumain
S98-03820	RIP1892	17/05/1998	23.505	89.593	1997	Tara	50	Prasanta Kumar	Dhaka	Faridpur	Madhukhali	Noapara	Sitarampur
S98-03821	RIP1893	17/05/1998	23.534	89.568	1991	Tara	67	Raquib Ahasan	Dhaka	Faridpur	Madhukhali	Megchami	Kaliakanda
S98-03822	RIP1894	17/05/1998	23.574	89.63	1996	STW	67	High School	Dhaka	Faridpur	Madhukhali	Gajna	Mathurapur
S98-03823	RIP1895	17/05/1998	23.506	89.651	1991	STW	64	Makrail Madarasha	Dhaka	Faridpur	Madhukhali	Madhukhali	Kamaldia
S98-03824	RIP1896	17/05/1998	23.533	89.677	1991	STW	26	Bazar Committee	Dhaka	Faridpur	Madhukhali	Raipur	Brahmankandi
S98-03825	RIP1897	17/05/1998	23.584	89.708	1993	STW	34	Basiruddin Munshi	Dhaka	Faridpur	Madhukhali	Raipur	Baragopaldi
S98-03826	RIP1899	18/05/1998	23.388	89.874	1995	STW	25	Sakender Khandaker	Dhaka	Faridpur	Nagarkanda	Purapara	Habeli Banagram
S98-03827	RIP1900	18/05/1998	23.373	89.901	1981	STW	35	Mannu Mia	Dhaka	Faridpur	Nagarkanda	Char Jasordi	Barasribardi
S98-03828	RIP1901	18/05/1998	23.42	89.916	1996	STW	29	rustam Bapary	Dhaka	Faridpur	Nagarkanda.	Kaichail	Parch Kaichail
S98-03829	RIP1902	18/05/1998	23.45	89.874	1984	STW	35	SM Aftabuddin	Dhaka	Faridpur	Nagarkanda	Laskardia	Laskardia
S98-03830	RIP1903	18/05/1998	23.484	89.881	1991	STW	44	Majibar Rahaman	Dhaka	Faridpur	Nagarkanda	Talma	Talma
S98-03831	RIP1904	18/05/1998	23.503	89.899	1998	STW	38	Moniruzzaman Sader	Dhaka	Faridpur	Nagarkanda	Dangi	Bil Gobindapur
S98-03832	RIP1905	18/05/1998	23.526	89.88	1990	STW	15	ramesh Chandra	Dhaka	Faridpur	Nagarkanda	Ramnagar	Srikrishnapur
S98-03833	RIP1907	19/05/1998	23.583	89.938	1996	STW	29	Primary School	Dhaka	Faridpur	Char Bhadrasan	Gazirtek	Hajiganj
S98-03834	RIP1908	19/05/1998	23.576	89.962	1997	STW	19	Emarat Hossain	Dhaka	Faridpur	Char Bhadrasan	Char Harirampur	Harirampur
S98-03835	RIP1909	19/05/1998	23.563	90.008	1994	STW	18	Char Bhadra. H. Scho	Dhaka	Faridpur	Char Bhadrasan	Char Bhadrasan	Char Bhadrasan
S98-03836	RIP1910	20/05/1998	23.731	89.425	1993	Tara	46	Shamsul Haq	Dhaka	Rajbari	Pangsha	Maurat	Bagdul
S98-03837	RIP1911	20/05/1998	23.752	89.345	1972	STW	44	Bazar Committee	Dhaka	Rajbari	Pangsha	Boalia	Kalinagar
S98-03838	RIP1912	20/05/1998	23.722	89.512	1995	STW	44	Gausul Azam	Dhaka	Rajbari	Pangsha	Majhbari	Majhbari
S98-03839	RIP1913	20/05/1998	23.764	89.493	1991	Tara	42	Abul Hossain	Dhaka	Rajbari	Pangsha	Ratandia	Ratandia
S98-03840	RIP1915	20/05/1998	23.708	89.769	1986	STW	20	Abdur Rob	Dhaka	Rajbari	Goalandaghat	Ujanchar	Bahadurpur
S98-03841	RIP1916	20/05/1998	23.764	89.784	1994	STW	19	Dauladiaghat Mosque	Dhaka	Rajbari	Goalandaghat	Dauladia	Dauladiaghat
S98-03842	RIP1917	20/05/1998	23.743	89.798	1995	STW	24	Chandu Sakar	Dhaka	Rajbari	Goalandaghat	Dauladia	Char Dauladia
S98-03843	RIP1918	20/05/1998	23.726	89.752	1984	STW	21	Thana Parishad	Dhaka	Rajbari	Goalandaghat	Ujanchar	Uttar Ujanchar
S98-03844	RIP1919	20/05/1998	23.754	89.736	1996	STW	24	Khalilur Rahaman	Dhaka	Rajbari	Goalandaghat	Debogram	Tenapacha
S98-03845	RIP1920	20/05/1998	23.713	89.728	1997	STW	19	Bhagalpur P. School	Dhaka	Rajbari	Goalandaghat	Chatto Bakhla	Bhagalpur
S98-03846	RIP1921	19/05/1998	23.734	89.675	1987	STW	19	Ranzit Kumar Sen	Dhaka	Rajbari	Rajbari Sadar	Dashi	Singa
S98-03847	RIP1922	19/05/1998	23.775	89.7	1995	STW	26	Urakanda Bazar	Dhaka	Rajbari	Rajbari Sadar	Barat	Urakanda
S98-03848	RIP1923	19/05/1998	23.78	89.618	1994	Tara	49	Kutubuddin Sarkar	Dhaka	Rajbari	Rajbari Sadar	Mizanpur	Beninagar
S98-03849	RIP1924	19/05/1998	23.703	89.624	1995	STW	56	Bania Baha Mosque	Dhaka	Rajbari	Rajbari Sadar	Bania Baha	Bania Baha
S98-03850	RIP1925	19/05/1998	23.76	89.642	1996	STW	19	M.A.Karim	Dhaka	Rajbari	Rajbari Sadar	Paurashava W03	Bhabanipur
S98-03851	RIP1931	27/04/1998	22.923	90.554	1996	DTW	153	Kalu Mollah	Barisal	Barisal	Hizla	Hizla Gourabdi	Char Kushuria
S98-03852	RIP1932	27/04/1998	22.957	90.521	1997	DTW	309	Nur Mohammad Matabar	Barisal	Barisal	Hizla	Memania	Durgapur
S98-03853	RIP1933	27/04/1998	22.974	90.468	1992	DTW	270	Jainal Abadin	Barisal	Barisal	Hizla	Harinathpur	Mohishkhola
S98-03854	RIP1934	27/04/1998	22.929	90.442	1991	DTW	273	Hafizur Rahaman	Barisal	Barisal	Hizla	Guabaria	Char Pathaoni
S98-03855	RIP1935	28/04/1998	22.814	90.531	1985	DTW	295	DPHE Office	Barisal	Barisal	Mehendiganj	Mehendiganj	Chunarchar
S98-03856	RIP1936	28/04/1998	22.763	90.526	1994	DTW	289	Md Nazrul Islam	Barisal	Barisal	Mehendiganj	Chargopalpur	Kazirchar
S98-03857	RIP1937	28/04/1998	22.764	90.526	1988	STW	20	Md Shahid Khan	Barisal	Barisal	Mehendiganj	Char gopalpur	Gazir char
S98-03858	RIP1938	28/04/1998	22.818	90.596	1998	DTW	308	Ali Hossain	Barisal	Barisal	Mehendiganj	Chandpur	Shuknakati
S98-03859	RIP1939	28/04/1998	22.821	90.599	1988	STW	20	Abdus Salam	Barisal	Barisal	Mehendiganj	Chundpur	Shuknakati
S98-03860	RIP1940	28/04/1998	22.815	90.53	1995	STW	16	Makon Lal Das	Barisal	Barisal	Mehendiganj	Mehendiganj	Chunar char
S98-03861	RIP1950	29/04/1998	22.808	90.306	1980	STW	19	Union Parishad	Barisal	Barisal	Babuganj	Rahmatpur	Khapura
S98-03862	RIP1951	29/04/1998	22.803	90.332	1996	STW	96	Rajab Ali Sardar	Barisal	Barisal	Babuganj	Chandpasha	Kalikapur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03815	3827380805	2.2	0.07	< 0.1	0.071	136	< 0.003	< 0.002	< 0.008	5.73	2.2	0.021	40.6	0.713	65.1	< 0.1	22.9	0.7	0.523	< 0.002	0.018
S98-03816	3827305040	158	0.07	< 0.1	0.209	189	< 0.003	< 0.002	< 0.008	1.43	5.6	< 0.004	32	1.62	23.8	0.2	19.1	1.4	0.572	< 0.002	0.025
S98-03817	3827320243	2.2	0.06	< 0.1	0.174	133	< 0.003	< 0.002	< 0.008	0.303	5.5	0.005	41.7	1.07	38	< 0.1	19.8	9	0.476	< 0.002	0.017
S98-03818	3827370751	8.7	0.06	< 0.1	0.143	107	< 0.003	< 0.002	< 0.008	8.16	1.6	0.01	38.4	0.197	84	0.8	23.7	1.8	0.441	< 0.002	0.166
S98-03819	3295621396	2.3	0.04	< 0.1	0.057	65.3	< 0.003	< 0.002	< 0.008	0.13	1.7	0.013	21.4	0.367	120	0.1	20.3	2	0.303	0.004	0.013
S98-03820	3295673914	7.7	0.03	0.1	0.067	68.8	< 0.003	< 0.002	< 0.008	0.043	1.9	0.014	22.8	2.06	149	0.2	23.7	0.6	0.298	0.005	0.148
S98-03821	3295663572	104	< 0.01	< 0.1	0.244	34.5	< 0.003	< 0.002	< 0.008	0.961	4.3	0.006	35	0.008	16.3	0.2	21.8	0.3	0.319	< 0.002	0.005
S98-03822	3295631688	2.2	0.05	< 0.1	0.108	113	< 0.003	< 0.002	< 0.008	0.125	3.8	0.007	41.1	2.13	33	0.1	21.9	39.3	0.562	< 0.002	0.022
S98-03823	3295652514	1.1	0.07	< 0.1	0.043	123	0.005	< 0.002	< 0.008	0.036	2	0.007	42	3.83	22.6	0.2	25.1	1.2	0.471	0.005	0.014
S98-03824	3295684201	228	0.04	< 0.1	0.181	120	< 0.003	< 0.002	< 0.008	4.3	4.3	< 0.004	25	0.761	21.1	1	17.9	1.4	0.384	< 0.002	0.014
S98-03825	3295684114	128	0.05	< 0.1	0.072	78.7	< 0.003	< 0.002	< 0.008	4.61	3.3	0.004	32.8	0.506	14.1	0.8	22.2	< 0.2	0.431	< 0.002	0.015
S98-03826	3296272374	284	0.04	< 0.1	0.105	104	< 0.003	< 0.002	< 0.008	5.12	4.8	< 0.004	20.1	0.324	22.5	1.6	18.2	0.2	0.386	< 0.002	0.013
S98-03827	3296222091	95.6	0.16	< 0.1	0.147	137	< 0.003	< 0.002	< 0.008	2.13	6.4	0.004	29.3	0.721	27.5	0.2	19.5	4.3	0.457	< 0.002	0.015
S98-03828	3296250745	280	8.57	0.1	0.167	143	< 0.003	< 0.002	< 0.008	10.3	12.1	0.005	77	0.382	62.2	1.7	32.4	1.2	0.632	< 0.002	0.052
S98-03829	3296255611	151	0.04	< 0.1	0.174	87.2	< 0.003	< 0.002	< 0.008	6.08	5	0.005	41.9	0.095	14	1	25.8	< 0.2	0.573	< 0.002	0.124
S98-03830	3296294965	103	0.05	0.2	0.077	68.9	< 0.003	< 0.002	< 0.008	3.07	11	< 0.004	66.3	0.113	68.9	2.9	26.6	1.1	0.454	< 0.002	0.016
S98-03831	3296227145	204	0.05	0.1	0.151	111	< 0.003	< 0.002	< 0.008	5.35	4.6	0.008	24.4	0.925	34.7	0.8	15.5	< 0.2	0.387	< 0.002	0.015
S98-03832	3296283943	924	0.05	0.1	0.192	152	< 0.003	< 0.002	< 0.008	9.73	5.2	0.005	40.1	0.629	28.3	0.5	14.9	0.3	0.698	< 0.002	0.014
S98-03833	3292176638	427	0.11	< 0.1	0.229	178	< 0.003	< 0.002	< 0.008	12.7	7	0.005	32.4	1.38	16.6	0.2	18	0.2	0.591	< 0.002	0.021
S98-03834	3292136874	6.6	0.11	< 0.1	0.11	113	< 0.003	< 0.002	< 0.008	0.228	5.5	0.004	23	1.17	19.4	0.2	17.2	8.2	0.389	< 0.002	0.033
S98-03835	3292119141	0.7	0.03	< 0.1	0.055	63.5	< 0.003	< 0.002	< 0.008	0.239	4.2	< 0.004	11.2	0.347	7.7	< 0.1	11.9	1.6	0.179	< 0.002	0.013
S98-03836	3827365032	< 0.5	0.07	< 0.1	0.063	107	< 0.003	< 0.002	< 0.008	0.068	1.5	0.014	34.8	0.831	80.9	< 0.1	21.8	1.3	0.409	0.003	0.022
S98-03837	3827310524	< 0.5	0.04	0.1	0.042	59	< 0.003	< 0.002	< 0.008	0.078	1.3	0.005	24.9	2.39	72.6	0.2	22.5	0.4	0.381	0.003	0.009
S98-03838	3827355660	41	0.04	0.1	0.224	101	< 0.003	< 0.002	< 0.008	2.68	4	0.006	37	0.085	76.3	0.2	20.2	0.3	0.458	< 0.002	0.015
S98-03839	3827385850	62.6	0.05	< 0.1	0.267	113	< 0.003	< 0.002	< 0.008	10.1	2.9	0.006	36.5	0.18	31.2	0.8	23.9	< 0.2	0.429	< 0.002	0.016
S98-03840	3822976804	1.9	0.04	< 0.1	0.133	108	< 0.003	< 0.002	< 0.008	0.152	5.4	0.005	30.3	0.919	12.7	< 0.1	13.5	16.8	0.395	< 0.002	0.013
S98-03841	3822938942	1.6	0.06	< 0.1	0.142	148	< 0.003	< 0.002	< 0.008	0.09	7.6	0.008	34.5	1.02	27.4	< 0.1	12.7	19.6	0.492	< 0.002	0.014
S98-03842	3822938285	314	0.28	< 0.1	0.255	217	< 0.003	< 0.002	< 0.008	20.6	7.5	0.006	48	3.87	19.2	< 0.1	16.3	< 0.2	0.788	< 0.002	0.018
S98-03843	3822976994	31.3	0.22	< 0.1	0.186	98.4	< 0.003	< 0.002	< 0.008	3.16	8	0.009	35.9	0.752	30	0.1	23.5	0.4	0.362	< 0.002	0.074
S98-03844	3822957910	33.8	0.06	< 0.1	0.19	147	< 0.003	< 0.002	< 0.008	4.73	5	< 0.004	32.1	1.22	14.6	0.6	16.9	8.6	0.51	< 0.002	0.015
S98-03845	3822919052	2.2	0.06	< 0.1	0.092	85.2	< 0.003	< 0.002	< 0.008	0.389	4.6	0.004	19.2	0.834	11	< 0.1	15.7	7.9	0.286	< 0.002	0.01
S98-03846	3827636962	220	0.06	< 0.1	0.155	115	< 0.003	< 0.002	< 0.008	8.24	5.4	< 0.004	29.3	0.763	17.4	1.1	20.7	2.3	0.489	< 0.002	0.013
S98-03847	3827621994	83.3	0.56	< 0.1	0.141	109	< 0.003	< 0.002	< 0.008	13.6	3.7	0.005	27.2	0.623	15.8	1.1	23.6	< 0.2	0.28	< 0.002	0.014
S98-03848	3827651157	27.3	0.06	< 0.1	0.14	139	< 0.003	< 0.002	< 0.008	3.38	4.7	0.004	29.6	1.59	16.6	0.3	19.5	< 0.2	0.47	< 0.002	0.015
S98-03849	3827614092	< 0.5	0.03	< 0.1	0.064	71.6	< 0.003	< 0.002	< 0.008	0.032	2.3	< 0.004	20.8	0.106	51	< 0.1	21.4	1.3	0.375	0.003	0.009
S98-03850	3827676099	359	0.04	< 0.1	0.141	110	< 0.003	< 0.002	< 0.008	0.937	4.6	< 0.004	29.5	2.77	14.4	1.3	20.2	0.4	0.36	< 0.002	0.011
S98-03851	1063681275	2.2	0.07	< 0.1	0.165	166	< 0.003	< 0.002	< 0.008	0.343	6.9	0.008	33	1.04	14	0.1	14.9	3.9	0.544	< 0.002	0.074
S98-03852	1063694	1.1	0.05	0.1	0.078	42.9	< 0.003	< 0.002	< 0.008	0.072	5.4	0.011	26.6	0.052	123	< 0.1	14.6	0.3	0.605	< 0.002	0.017
S98-03853	1063667658	< 0.5	0.03	0.2	0.215	66.9	< 0.003	< 0.002	< 0.008	0.089	7.5	0.022	46.3	0.093	403	< 0.1	14.5	< 0.2	0.802	< 0.002	0.012
S98-03854	1063654826	< 0.5	0.02	0.3	0.022	5.1	< 0.003	< 0.002	< 0.008	0.058	2.4	0.009	2.34	0.023	213	0.2	13.6	< 0.2	0.0523	< 0.002	< 0.004
S98-03855	1066287315	0.6	< 0.01	0.4	0.012	3.4	< 0.003	< 0.002	< 0.008	0.072	2.2	0.009	2.06	0.026	216	0.1	11.1	< 0.2	0.0543	< 0.002	< 0.004
S98-03856	1066255530	< 0.5	0.02	0.5	0.103	38.7	< 0.003	< 0.002	< 0.008	0.075	5.4	0.014	22.8	0.065	288	< 0.1	12.5	8.9	0.488	< 0.002	0.007
S98-03857	1066255406	120	0.06	< 0.1	0.188	172	< 0.003	< 0.002	< 0.008	1.46	6.9	0.007	37.8	1.07	116	0.2	16.6	1.4	0.568	< 0.002	0.029
S98-03858	1066239	2.2	0.02	0.3	0.012	3.7	< 0.003	< 0.002	< 0.008	0.248	3	0.009	2.18	0.031	233	0.3	12.8	0.4	0.0475	< 0.002	0.005
S98-03859	1066239	862	1.61	< 0.1	0.26	281	< 0.003	< 0.002	< 0.008	9.7	10.5	0.007	59.2	1.54	76.4	1.2	23.9	0.5	0.93	< 0.002	0.155
S98-03860	1066287315	345	0.04	< 0.1	0.125	119	< 0.003	< 0.002	< 0.008	7.74	6	< 0.004	24.5	1.49	69	0.9	16.5	< 0.2	0.414	< 0.002	0.019
S98-03861	1060381548	550	0.04	0.1	0.035	69	< 0.003	< 0.002	< 0.008	1.53	7.6	0.008	31.6	0.736	35.4	1.2	14.5	< 0.2	0.306	< 0.002	0.014
S98-03862	1060327523	4.6	0.02	0.9	0.025	8.3	< 0.003	< 0.002	< 0.008	0.073	3.1	0.013	4.03	0.023	384	0.1	12.4	< 0.2	0.102	< 0.002	0.005

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03863	RIP1952	29/04/1998	22.801	90.328	1994	STW	22	Kalikapur P. School	Barisal	Barisal	Babuganj	Chandpasha	Kalikapur
S98-03864	RIP1953	29/04/1998	22.83	90.324	1995	DTW	276	Abdul Manan	Barisal	Barisal	Babuganj	Kendarpur	Paschim bhutardi
S98-03865	RIP1954	29/08/1998	22.831	90.323	1995	STW	21	Md Mozammel Haq	Barisal	Barisal	Babuganj	Kendarpur	Pasch. bhutardia
S98-03866	RIP1955	29/04/1998	22.776	90.309	1983	STW	23	Satmail Mosque	Barisal	Barisal	Babuganj	Madhabpasha	Pangsha
S98-03867	RIP1956	29/04/1998	22.776	90.308	1995	DTW	273	Karamat Ali Hawalder	Barisal	Barisal	Babuganj	Madhabpasha	Pangsha
S98-03868	RIP1957	29/04/1998	22.783	90.266	1995	DTW	304	Dehergati P. School	Barisal	Barisal	Babuganj	Dehergati	Dehergati
S98-03869	RIP1958	29/04/1998	22.782	90.267	1996	STW	14	Kazi Majed Hossain	Barisal	Barisal	Babuganj	Dehergati	Dehergati
S98-03870	RIP1959	28/04/1998	22.781	90.253	1997	DTW	316	Afzal Hossain	Barisal	Barisal	Wazirpur	Guthia	Guthia
S98-03872	RIP2002	31/03/1998	24.698	88.125	1977	STW	39	Rajbul Haq	Rajshahi	Nawabganj	Shibganj (N)	Durlabhpur	Dadanchak
S98-03873	RIP2003	31/03/1998	24.708	88.084	1985	STW	42	Mirza Shahria Kamal	Rajshahi	Nawabganj	Shibganj (N)	Manakasa	Chauka Manakas
S98-03874	RIP2004	31/03/1998	24.747	88.095	1979	STW	46	Md Fazlur Rahaman	Rajshahi	Nawabganj	Shibganj (N)	Binodpur	Binodpur
S98-03875	RIP2005	31/03/1998	24.639	88.195	1990	STW	30	Taimur Rahaman	Rajshahi	Nawabganj	Shibganj (N)	Naya Naobhanga	Harinagar T-Para
S98-03876	RIP2006	31/03/1998	24.583	88.199	1985	STW	27	Abdul Razak Master	Rajshahi	Nawabganj	Shibganj (N)	Ghorapakhia	P. Hayatpur ?
S98-03877	RIP2007	31/03/1998	24.748	88.185	1974	STW	33	Md Eiasuddin	Rajshahi	Nawabganj	Shibganj (N)	Mobarakpur	Mobarakpur
S98-03878	RIP2008	31/03/1998	24.819	88.202	1994	STW	24	Kaias Mandal	Rajshahi	Nawabganj	Shibganj (N)	Daipukuria	Bata
S98-03879	RIP2010	31/03/1998	24.91	88.224	1994	Tara	43	Palu Mollah	Rajshahi	Nawabganj	Bholahat	Gohalbaria	Kale alampur
S98-03880	RIP2011	31/03/1998	24.89	88.255	1996	Tara	43	Battala Mosque	Rajshahi	Nawabganj	Bholahat	Daldali	Adatala
S98-03881	RIP2012	31/03/1998	24.938	88.226	1996	STW	35	Gort ??	Rajshahi	Nawabganj	Bholahat	Gohal bari	Radha nagar
S98-03882	RIP2013	31/03/1998	24.948	88.213	1984	STW	22	Bholahat Pil. School	Rajshahi	Nawabganj	Bholahat	Bholahat	Tentipara
S98-03883	RIP2014	31/03/1998	24.941	88.199	1996	Tara	53	Govt. Mosque	Rajshahi	Nawabganj	Bholahat	Bholahat	Jadunagar
S98-03884	RIP2017	01/04/1998	24.689	88.426	1994	Tara	44	Alfaz Ali	Rajshahi	Nawabganj	Nachole	Nizampur	Nizampur
S98-03885	RIP2018	01/04/1998	24.729	88.42	1995	Tara	53	Zillur Rahaman	Rajshahi	Nawabganj	Nachole	Nachole	Nachole
S98-03886	RIP2019	01/04/1998	24.781	88.437	1987	Tara	43	Zakaria Headmaster	Rajshahi	Nawabganj	Nachole	Nachole	Bhurendi
S98-03887	RIP2020	01/04/1998	24.75	88.395	1997	Tara	41	Enamul Haq	Rajshahi	Nawabganj	Nachole	Kasba	Choupukuria
S98-03888	RIP2021	01/04/1998	24.769	88.369	1997	Tara	47	Abdul Hai	Rajshahi	Nawabganj	Nachole	Kasba	Bobadanga
S98-03889	RIP2022	01/04/1998	24.783	88.338	1996	Tara	42	PROSIKHA	Rajshahi	Nawabganj	Nachole	Kasba	Purba Chandana
S98-03890	RIP2023	01/04/1998	24.731	88.384	1993	STW	27	Abdul Hannan	Rajshahi	Nawabganj	Nachole	Nachole	Khoshba
S98-03891	RIP2024	01/04/1998	24.731	88.32	1997	Tara	40	Abdus Sattar	Rajshahi	Nawabganj	Nachole	Fatehpur	Horipur
S98-03892	RIP2025	01/04/1998	24.715	88.286	1973	STW	36	Toffazal Hossain	Rajshahi	Nawabganj	Nachole	Fatehpur	Fatehpur
S98-03893	RIP2027	01/04/1998	24.773	88.258	1992	STW	27	Samsuddin	Rajshahi	Nawabganj	Gomastapur	Chaudala	Chaudala
S98-03894	RIP2028	01/04/1998	24.795	88.277	1991	Tara	43	Jogdul Mandal	Rajshahi	Nawabganj	Gomastapur	Chowdala	Pasanipara
S98-03895	RIP2029	01/04/1998	24.835	88.29	1994	STW	35	Sorharaf Dafadar	Rajshahi	Nawabganj	Gomastapur	Boalia	Alampur
S98-03896	RIP2030	01/04/1998	24.82	88.334	1978	STW	46	DPHE Complex	Rajshahi	Nawabganj	Gomastapur	Rohanpur	Rohanpur
S98-03897	RIP2031	01/04/1998	24.841	88.346	1997	Tara	40	Jashim	Rajshahi	Nawabganj	Gomastapur	Rohanpur	Noada
S98-03898	RIP2032	01/04/1998	24.85	88.418	1993	STW	49	Sazzad Hossain	Rajshahi	Nawabganj	Gomastapur	Pabatipur	Madhaipur
S98-03899	RIP2033	01/04/1998	24.874	88.455	1983	STW	58	Tashial Bishwas	Rajshahi	Nawabganj	Gomastapur	Parbatipur	Gorbari
S98-03900	RIP2034	01/04/1998	24.911	88.448	1990	STW	53	Sadar Mosque	Rajshahi	Nawabganj	Gomastapur	Parbatipur	Bijai sangura
S98-03901	RIP2035	01/04/1998	24.836	88.309	1994	Tara	45	Abdus Salam	Rajshahi	Nawabganj	Gomastapur	Alinagar	Makrampur
S98-03902	RIP2037	02/04/1998	24.548	88.313	1975	STW	36	Narayan Karmakar	Rajshahi	Rajshahi	Godagari	Bardebpur	Kashimpur
S98-03903	RIP2038	02/04/1998	24.498	88.376	1995	Tara	33	Amanullah	Rajshahi	Rajshahi	Godagari	Godagari	Nabogram
S98-03904	RIP2039	02/04/1998	24.583	88.396	1988	Tara	43	Ram Das	Rajshahi	Rajshahi	Godagari	Mohanpur	Kasimala
S98-03905	RIP2040	02/04/1998	24.504	88.425	1993	Tara	50	Sayadur Rahaman	Rajshahi	Rajshahi	Godagari	Pakri	Sialvasha
S98-03906	RIP2041	02/04/1998	24.519	88.479	1996	Tara	37	Mosque Committee	Rajshahi	Rajshahi	Godagari	Rishikul	Rasulpur
S98-03907	RIP2042	02/04/1998	24.444	88.507	1979	Tara	34	Sadek Mandal	Rajshahi	Rajshahi	Godagari	Deopara	Deopara
S98-03908	RIP2043	02/04/1998	24.434	88.434	1996	Tara	41	Abdul Hannan	Rajshahi	Rajshahi	Godagari	Gogram	Gogram
S98-03909	RIP2047	02/04/1998	24.592	88.575	1984	Tara	34	Thana Headquater	Rajshahi	Rajshahi	Tanore	Paurashava	Tanore
S98-03910	RIP2048	02/04/1998	24.626	88.592		Tara	34	Talanda Girls H. Sch	Rajshahi	Rajshahi	Tanore	Talanda	Talanda
S98-03911	RIP2049	02/04/1998	24.641	88.566	1997	Tara	39	Nasim Uddin	Rajshahi	Rajshahi	Tanore	Talanda	Deul

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03863	1060327523	140	0.05	0.1	0.124	115	< 0.003	< 0.002	< 0.008	1.66	5.9	0.007	27.2	1.13	64.4	0.6	16.7	4.8	0.413	< 0.002	0.013
S98-03864	1060354778	3.2	< 0.01	0.6	0.025	8	< 0.003	< 0.002	< 0.008	0.086	2.6	0.011	3.6	0.027	300	0.2	12.1	0.2	0.0904	< 0.002	< 0.004
S98-03865	1060354778	106	0.04	< 0.1	0.104	101	< 0.003	< 0.002	< 0.008	0.462	4.3	0.004	22	1.05	16.1	0.4	17.6	19.2	0.316	< 0.002	0.03
S98-03866	1060367765	546	0.03	0.4	0.052	51.2	< 0.003	< 0.002	< 0.008	1.14	15	0.007	43.9	0.26	214	0.9	13.8	0.3	0.349	< 0.002	0.009
S98-03867	1060367765	2.9	0.22	0.3	0.015	4.4	< 0.003	< 0.002	< 0.008	0.074	2	0.008	2.28	0.021	188	0.2	12.2	0.2	0.048	< 0.002	< 0.004
S98-03868	1060340395	4.1	0.01	0.3	0.016	4.1	< 0.003	< 0.002	< 0.008	0.077	1.8	0.009	2.03	0.019	195	0.3	12.8	0.2	0.043	< 0.002	< 0.004
S98-03869	1060340395	735																			
S98-03870	1069431387	1	0.06	0.3	0.019	4.7	< 0.003	< 0.002	< 0.008	0.148	1.9	0.008	2.17	0.011	198	0.3	13.1	0.3	0.0419	< 0.002	0.007
S98-03872	5708829296	58.6	0.04	< 0.1	0.165	123	< 0.003	< 0.002	< 0.008	2.27	4.7	0.006	29.3	0.688	14.8	0.2	17.9	0.7	0.438	< 0.002	0.055
S98-03873	5708853107	63.9	0.05	< 0.1	0.184	162	< 0.003	< 0.002	< 0.008	1.25	5.6	0.008	41.9	1.28	30.4	< 0.1	16.2	21.4	0.633	< 0.002	0.013
S98-03874	5708808090	40.5	0.05	< 0.1	0.223	121	< 0.003	< 0.002	< 0.008	2.42	5.8	0.005	29.5	0.813	13.2	0.3	15.2	1.5	0.46	< 0.002	0.012
S98-03875	5708859386	< 0.5	0.03	< 0.1	0.138	91	< 0.003	< 0.002	< 0.008	0.164	6.1	0.008	27.7	0.43	11.6	< 0.1	11.7	8.5	0.363	0.002	0.032
S98-03876	5708835336	6.4	0.03	< 0.1	0.093	93.4	< 0.003	< 0.002	< 0.008	0.113	4.6	0.005	18.4	0.649	9.5	< 0.1	14.2	8	0.311	< 0.002	0.012
S98-03877	5708847567	< 0.5	0.06	< 0.1	0.146	128	< 0.003	< 0.002	< 0.008	0.123	3.5	0.044	51.5	0.591	72.6	< 0.1	19.9	30.5	0.448	0.003	0.015
S98-03878	5708817527	< 0.5	0.04	< 0.1	0.107	97.3	< 0.003	< 0.002	< 0.008	0.128	2.4	0.018	32.7	0.407	50.8	< 0.1	19.5	2.7	0.315	0.002	0.011
S98-03879	5701856707	< 0.5	0.03	< 0.1	0.038	50.8	< 0.003	< 0.002	< 0.008	0.06	1.3	0.009	19.3	0.679	30.6	0.1	25	1.9	0.119	< 0.002	0.014
S98-03880	5701837022	< 0.5	0.04	< 0.1	0.051	109	< 0.003	< 0.002	< 0.008	0.077	1.4	0.019	18.7	1.13	38.6	< 0.1	22.9	20.1	0.146	< 0.002	0.02
S98-03881	5701856840	< 0.5	0.03	< 0.1	0.047	87.1	< 0.003	< 0.002	< 0.008	0.062	1.1	0.028	21.4	0.847	36.4	< 0.1	21.1	4.3	0.238	< 0.002	0.024
S98-03882	5701818972	< 0.5	0.05	< 0.1	0.045	125	< 0.003	< 0.002	< 0.008	0.289	1.6	0.021	25	1.26	37.6	0.1	20.7	8.5	0.228	< 0.002	0.127
S98-03883	5701818530	< 0.5	0.06	< 0.1	0.062	145	< 0.003	< 0.002	< 0.008	2.3	2.3	0.017	31	1.21	29.8	< 0.1	20.2	53.8	0.348	< 0.002	0.073
S98-03884	5705676717	< 0.5	0.04	< 0.1	0.081	99.8	< 0.003	< 0.002	< 0.008	0.044	1.5	0.009	30.8	< 0.002	37.9	< 0.1	24.8	4.6	0.561	0.003	0.016
S98-03885	5705657697	< 0.5	0.04	< 0.1	0.045	105	< 0.003	< 0.002	< 0.008	0.064	1.4	0.009	25	0.01	47	< 0.1	24	1	0.378	0.004	0.021
S98-03886	5705657163	< 0.5	0.03	< 0.1	0.067	81.7	< 0.003	< 0.002	< 0.008	0.756	1.1	0.01	19.9	0.026	36.8	< 0.1	20.7	0.2	0.317	0.004	0.17
S98-03887	5705638237	< 0.5	0.03	< 0.1	0.032	79	< 0.003	< 0.002	< 0.008	0.046	1.4	0.009	24.8	0.002	53	< 0.1	21.8	0.5	0.362	< 0.002	0.181
S98-03888	5705638217	< 0.5	0.03	< 0.1	0.033	68.1	< 0.003	< 0.002	< 0.008	0.138	1.1	0.01	19.9	0.006	38.5	< 0.1	24.1	0.7	0.298	< 0.002	0.088
S98-03889	5705638801	< 0.5	0.05	< 0.1	0.063	106	< 0.003	< 0.002	< 0.008	0.034	1.3	0.01	21.2	0.01	56.7	< 0.1	21.5	1.6	0.421	< 0.002	0.013
S98-03890	5705657569	2.1	0.03	< 0.1	0.083	75.1	< 0.003	< 0.002	< 0.008	2.3	1.2	0.007	27.2	0.843	23.8	0.5	19.1	4.4	0.205	< 0.002	0.012
S98-03891	5705619415	< 0.5	0.01	< 0.1	0.036	35.7	< 0.003	< 0.002	< 0.008	0.034	0.6	0.01	6.69	0.076	35.6	< 0.1	29.2	0.5	0.19	< 0.002	0.054
S98-03892	5705619346	< 0.5	0.04	< 0.1	0.057	94	< 0.003	< 0.002	< 0.008	0.06	2	0.013	18.9	1.89	20.3	< 0.1	19.5	< 0.2	0.296	< 0.002	0.014
S98-03893	5703742227	9.9	0.05	< 0.1	0.209	115	< 0.003	< 0.002	< 0.008	8.84	3	0.006	31.6	0.645	37.2	1.2	19.2	< 0.2	0.295	< 0.002	0.015
S98-03894	5703742083	< 0.5	0.05	0.1	0.104	80.9	< 0.003	< 0.002	< 0.008	2.56	2.5	0.005	20.1	0.387	47.7	0.3	22.1	0.5	0.276	< 0.002	0.02
S98-03895	5703731017	5.6	0.02	< 0.1	0.063	54.5	< 0.003	< 0.002	< 0.008	2.57	3.1	< 0.004	17.5	0.219	25.6	0.4	20.4	< 0.2	0.135	< 0.002	0.041
S98-03896	5703784881	< 0.5	0.03	< 0.1	0.047	58.1	< 0.003	< 0.002	< 0.008	2.01	1.2	0.007	13	0.23	32.7	< 0.1	23.6	6.8	0.2	< 0.002	0.425
S98-03897	5703784635	< 0.5	0.03	< 0.1	0.035	48.5	< 0.003	< 0.002	< 0.008	0.036	0.7	0.005	8.18	0.413	32.4	< 0.1	26.2	0.6	0.161	< 0.002	0.044
S98-03898	5703763	< 0.5	0.05	< 0.1	0.034	99.4	< 0.003	< 0.002	< 0.008	0.086	1.7	0.006	40.7	0.004	70.2	< 0.1	21.8	0.9	0.577	0.002	0.016
S98-03899	5703763359	< 0.5	0.04	< 0.1	0.027	102	< 0.003	< 0.002	< 0.008	3.02	1.3	< 0.004	30.5	0.014	29.9	< 0.1	18.4	< 0.2	0.448	< 0.002	0.033
S98-03900	5703763155	< 0.5	0.05	< 0.1	0.045	115	< 0.003	< 0.002	< 0.008	1.3	1.9	< 0.004	46.1	0.01	49.7	< 0.1	18.3	0.3	0.595	< 0.002	0.042
S98-03901	5703710611	8.9	0.08	< 0.1	0.301	92.4	< 0.003	< 0.002	0.047	4.01	3	< 0.004	25.4	0.455	28.1	0.2	22.5	7	0.263	< 0.002	0.244
S98-03902	5813409556	< 0.5	0.05	< 0.1	0.063	117	< 0.003	< 0.002	< 0.008	0.028	1.4	0.018	37.5	0.321	62.6	< 0.1	19.1	25.9	0.52	0.003	0.018
S98-03903	5813438724	< 0.5	0.03	< 0.1	0.023	55.2	< 0.003	< 0.002	< 0.008	0.046	1	0.007	13.2	0.093	37.1	< 0.1	23.3	0.6	0.268	0.005	0.047
S98-03904	5813466553	< 0.5	0.06	< 0.1	0.051	107	< 0.003	< 0.002	< 0.008	0.054	1	0.013	33.5	0.031	33.4	< 0.1	22.9	< 0.2	0.521	0.003	0.027
S98-03905	5813476020	< 0.5	0.04	< 0.1	0.038	83.1	< 0.003	< 0.002	< 0.008	0.031	1.6	0.017	29.1	0.187	54.7	< 0.1	19.1	1	0.446	0.009	0.024
S98-03906	5813485859	< 0.5	0.51	< 0.1	0.022	84.4	< 0.003	< 0.002	< 0.008	1.27	1.6	0.017	22.6	0.303	52.8	< 0.1	20	0.9	0.389	0.003	0.058
S98-03907	5813428293	< 0.5	0.06	< 0.1	0.042	122	< 0.003	< 0.002	< 0.008	1.91	1.5	0.006	31.1	0.259	45.9	< 0.1	22.2	12.1	0.447	0.003	0.018
S98-03908	5813447380	< 0.5	0.05	< 0.1	0.045	80.4	< 0.003	< 0.002	< 0.008	0.036	1.4	0.018	20.9	0.055	69.8	< 0.1	23.2	8.9	0.336	0.008	0.066
S98-03909	5819481976	< 0.5	0.04	< 0.1	0.069	59.1	< 0.003	< 0.002	< 0.008	0.079	2.1	0.004	22.5	0.725	50.7	0.1	29.8	64.7	0.458	< 0.002	0.016
S98-03910	5819481971	< 0.5	0.03	< 0.1	0.014	25.8	< 0.003	< 0.002	< 0.008	0.035	1.5	0.009	10.3	0.185	22.6	0.2	32.5	5.2	0.153	0.005	0.076
S98-03911	5819481347	< 0.5	0.01	< 0.1	0.016	8.8	< 0.003	< 0.002	< 0.008	0.025	0.8	< 0.004	4.34	0.125	21.5	0.2	31.2	0.6	0.0569	0.003	0.03

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03912	RIP2050	02/04/1998	24.677	88.547	1996	Tara	39	Wahidul Rahaman	Rajshahi	Rajshahi	Tanore	Kalma	Sankarpur
S98-03913	RIP2051	02/04/1998	24.687	88.528	1990	Tara	38	?	Rajshahi	Rajshahi	Tanore	Kalma	Kalma
S98-03914	RIP2052	02/04/1998	24.657	88.6	1995	Tara	38	Bozer Ali	Rajshahi	Rajshahi	Tanore	Kamargaon	Baraghoria
S98-03915	RIP2053	02/04/1998	24.626	88.504	1994	STW	38	???	Rajshahi	Rajshahi	Tanore	Pachandar	Prokash nagar
S98-03916	RIP2054	02/04/1998	24.578	88.493		Tara	38	Babul	Rajshahi	Rajshahi	Tanore	Pachandar	Dangapara
S98-03917	RIP2055	02/04/1998	24.611	88.462	1994	STW	45	Enamul Haq	Rajshahi	Rajshahi	Tanore	Badhair	Ayda
S98-03918	RIP2057	02/04/1998	24.369	88.762	1998	STW	22	Baneswar Bazar	Rajshahi	Rajshahi	Puthia	Baneswar	Baneswar
S98-03919	RIP2058	03/04/1998	24.381	88.797	1994	STW	41	Abul Hossain	Rajshahi	Rajshahi	Puthia	Baneswar	Maipara
S98-03920	RIP2059	03/04/1998	24.37	88.846	1984	STW	38	Mozzafar Hossain	Rajshahi	Rajshahi	Puthia	Puthia	Kathalbaria
S98-03921	RIP2060	03/04/1998	24.366	88.875	1988	STW	47	Gul Mohammad Shah	Rajshahi	Rajshahi	Puthia	Jeopara	Jhalmalia
S98-03922	RIP2061	03/04/1998	24.369	88.894	1996	STW	38	Md Abdul Malek	Rajshahi	Rajshahi	Puthia	Jeopara	Sebagh
S98-03923	RIP2062	03/04/1998	24.41	88.852	1998	STW	32	Alhaj Wazed Ali	Rajshahi	Rajshahi	Puthia	Jeopara	Dhopapara
S98-03924	RIP2063	03/04/1998	24.436	88.859	1988	STW	33	Akkeal Ali Pramanik	Rajshahi	Rajshahi	Puthia	Bhalukgachhi	Banshbaria
S98-03925	RIP2064	03/04/1998	24.468	88.864	1995	STW	42	Mrs Dilzahan	Rajshahi	Rajshahi	Puthia	Silmaria	Kajupara
S98-03926	RIP2065	03/04/1998	24.499	88.852	1993	Tara	46	Md Makmal Hossain	Rajshahi	Rajshahi	Puthia	Silmaria	Malipara
S98-03927	RIP2067	03/04/1998	24.518	88.673	1989	STW	38	Md Kabad Ali	Rajshahi	Rajshahi	Mohanpur	Bak shimail	Krishnapur
S98-03928	RIP2068	03/04/1998	24.547	88.608	1995	STW	38	Mohabatpur Bazar	Rajshahi	Rajshahi	Mohanpur	Dhurail	Mohabatpur
S98-03929	RIP2069	03/04/1998	24.562	88.647	1994	Tara	38	???	Rajshahi	Rajshahi	Mohanpur	Bak shimail	Saipara
S98-03930	RIP2070	03/04/1998	24.592	88.651	1991	STW	50	???	Rajshahi	Rajshahi	Mohanpur	Royghati	Kesair
S98-03931	RIP2071	03/04/1998	24.605	88.624	1994	STW	38	Kahinur Begum	Rajshahi	Rajshahi	Mohanpur	Ghasigram	Belna
S98-03932	RIP2072	03/04/1998	24.63	88.669	1992	Tara	42	Md Abdul Hossain	Rajshahi	Rajshahi	Mohanpur	Royghati	Tangon
S98-03933	RIP2073	03/04/1998	24.552	88.686	1996	Tara	38	Professor Nazir	Rajshahi	Rajshahi	Mohanpur	Jahanabad	Hazrapara
S98-03934	RIP2075	03/04/1998	24.555	88.791	1975	STW	23	Mafiz	Rajshahi	Rajshahi	Bagmara	Gamipur	Bagmara
S98-03935	RIP2076	03/04/1998	24.58	88.823	1997	STW	25	Truck Sramik Union	Rajshahi	Rajshahi	Bagmara	Basupara	Deula
S98-03936	RIP2077	03/04/1998	24.581	88.86	1994	STW	27	Rafiq	Rajshahi	Rajshahi	Bagmara	Maria	Jatragachi
S98-03937	RIP2078	03/04/1998	24.592	88.905	1977	STW	27	Mobarak Hossain	Rajshahi	Rajshahi	Bagmara	Jogi para	Bhatkhali
S98-03938	RIP2079	03/04/1998	24.545	88.874	1977	STW	32	Bazar Mosque	Rajshahi	Rajshahi	Bagmara	Goalkandi	Goalkandi
S98-03939	RIP2081	04/04/1998	24.26	88.763	1995	STW	10	???	Rajshahi	Rajshahi	Charghat	Charghat	Meramatpur
S98-03940	RIP2082	04/04/1998	24.235	88.754	1994	STW	27	Raota P. School	Rajshahi	Rajshahi	Charghat	Charghat	Raota
S98-03941	RIP2083	04/04/1998	24.279	88.79	1994	STW	33	Mungali P. School	Rajshahi	Rajshahi	Charghat	Charghat	Mungali
S98-03942	RIP2084	04/04/1998	24.266	88.822	1997	STW	38	Dakra College	Rajshahi	Rajshahi	Charghat	Bhaya lakshmipur	Dakra
S98-03943	RIP2085	04/04/1998	24.314	88.796	1997	STW	37	Md Israil Jahangir	Rajshahi	Rajshahi	Charghat	Nimpara	Barkatpur
S98-03944	RIP2086	04/04/1998	24.327	88.82	1997	STW	38	???	Rajshahi	Rajshahi	Charghat	Nimpara	Habibpur
S98-03945	RIP2087	04/04/1998	24.337	88.781	1998	STW	36	Azim Uddin	Rajshahi	Rajshahi	Charghat	Salia	Salia
S98-03946	RIP2088	04/04/1998	24.327	88.705	1995	STW	37	Mojahar Ali	Rajshahi	Rajshahi	Charghat	Yusufpur	Yusufpur
S98-03947	RIP2089	04/04/1998	24.336	88.749		STW	33	Halidagachi H. Schoo	Rajshahi	Rajshahi	Charghat	Salua	Halidagachi
S98-03948	RIP2091	04/04/1998	24.227	88.777	1988	STW	32	Balayat Ali	Rajshahi	Rajshahi	Bagha	Manigram	Pasaota
S98-03949	RIP2092	04/04/1998	24.207	88.805	1990	STW	39	Abur Razzak	Rajshahi	Rajshahi	Bagha	Manigram	Manigram
S98-03950	RIP2093	04/04/1998	24.193	88.845	1994	STW	20	Mohasin Ali	Rajshahi	Rajshahi	Bagha	Baju bagha	Milik bagha
S98-03951	RIP2094	04/04/1998	24.198	88.875	1994	STW	30	Mr Majdar	Rajshahi	Rajshahi	Bagha	Baju bagha	Bara chhaighah
S98-03952	RIP2095	04/04/1998	24.224	88.847	1973	STW	39	Sudanshu K Chowduri	Rajshahi	Rajshahi	Bagha	Baju bagha	Baju bagha
S98-03953	RIP2096	04/04/1998	24.259	88.858	1993	STW	38	Md Hasem Ali	Rajshahi	Rajshahi	Bagha	Bausa	Bausa
S98-03954	RIP2097	04/04/1998	24.291	88.877	1995	STW	38	Md Nazim Uddin	Rajshahi	Rajshahi	Bagha	Arani	Arani
S98-03955	RIP2099	05/04/1998	24.378	88.526		STW	40	Mr Afzal	Rajshahi	Rajshahi	Paba	Haripur	Kaisadanga
S98-03956	RIP2100	05/04/1998	24.393	88.53	1994	Tara	40	Mr Jalaluddin	Rajshahi	Rajshahi	Paba	Damkur	Madhupur
S98-03957	RIP2101	05/04/1998	24.482	88.527	1997	STW	37	Darshanpara P. Schoo	Rajshahi	Rajshahi	Paba	Darshanpara	Darshanpara
S98-03958	RIP2102	05/04/1998	24.45	88.55	1995	Tara	24	Mrs Aduri Begum	Rajshahi	Rajshahi	Paba	Hujuripara	Sarisakuri
S98-03959	RIP2103	05/04/1998	24.454	88.582	1997	Tara	40	Mr Zamshed Ali	Rajshahi	Rajshahi	Paba	Hujuripara	Ghipara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03912	5819427910	< 0.5	0.07	< 0.1	0.023	26.2	< 0.003	< 0.002	< 0.008	0.024	0.5	< 0.004	4.63	0.076	16.2	< 0.1	27.7	0.3	0.108	0.002	0.029
S98-03913	5819427610	< 0.5	0.05	< 0.1	0.018	58.2	< 0.003	< 0.002	< 0.008	0.025	1.1	0.008	8.76	0.082	21.2	< 0.1	21.1	0.4	0.211	< 0.002	0.013
S98-03914	5819440098	< 0.5	0.02	0.2	0.023	24.5	< 0.003	< 0.002	< 0.008	0.076	1.1	0.006	9.54	1.22	56.6	0.2	30.8	< 0.2	0.123	0.003	0.017
S98-03915	5819454835	< 0.5	0.04	< 0.1	0.034	60.3	< 0.003	< 0.002	< 0.008	0.527	1.3	0.006	15.5	0.135	46.6	< 0.1	25.5	3.1	0.311	< 0.002	0.017
S98-03916	5819454328	< 0.5	0.04	< 0.1	0.043	71.6	< 0.003	< 0.002	< 0.008	0.162	1.1	0.006	16.4	0.064	53.1	< 0.1	22.5	1.7	0.321	0.003	0.046
S98-03917	5819413037	< 0.5	0.04	< 0.1	0.041	47.6	< 0.003	< 0.002	< 0.008	0.078	1.3	0.006	16.1	0.017	77	< 0.1	22.6	1.1	0.234	0.003	0.01
S98-03918	5818213054	19.4	0.07	< 0.1	0.38	180	< 0.003	< 0.002	< 0.008	0.511	4.5	0.009	39.7	1.22	36.2	0.2	17.1	11.2	0.427	< 0.002	0.014
S98-03919	5818213645	12.2	0.21	< 0.1	0.184	132	< 0.003	< 0.002	< 0.008	3.78	1.8	0.007	25.6	0.676	28.2	0.1	19.6	0.8	0.356	< 0.002	0.012
S98-03920	5818267575	< 0.5	0.06	< 0.1	0.072	146	< 0.003	< 0.002	< 0.008	0.059	2.4	0.013	29.8	1.28	41.3	< 0.1	21.6	2.6	0.358	0.002	0.014
S98-03921	5818254505	63.8	0.06	< 0.1	0.442	112	< 0.003	< 0.002	< 0.008	8.22	2.4	0.008	27.7	0.251	24	1	19.4	6.1	0.283	< 0.002	0.013
S98-03922	5818254404	1.2	0.09	< 0.1	0.085	84.4	< 0.003	< 0.002	< 0.008	0.179	2	0.009	30	0.619	13.6	0.1	19.8	1.8	0.182	0.002	0.013
S98-03923	5818254318	5.7	0.06	< 0.1	0.208	117	< 0.003	< 0.002	< 0.008	5.55	4.3	0.007	21.6	0.568	15.8	0.3	19.2	0.5	0.203	< 0.002	0.014
S98-03924	5818240069	< 0.5	0.05	< 0.1	0.059	111	< 0.003	< 0.002	< 0.008	0.095	1.5	0.013	29.8	0.354	36.7	< 0.1	19.6	0.3	0.412	< 0.002	0.012
S98-03925	5818281528	< 0.5	0.07	< 0.1	0.069	110	< 0.003	< 0.002	< 0.008	0.055	1.8	0.016	24	0.559	40.3	< 0.1	19	< 0.2	0.473	< 0.002	0.012
S98-03926	5818281625	< 0.5	0.06	< 0.1	0.088	113	< 0.003	< 0.002	< 0.008	0.033	3.8	0.016	29.6	0.561	37.9	< 0.1	20.2	0.4	0.33	< 0.002	0.017
S98-03927	5815313589	< 0.5	0.08	< 0.1	0.025	84.6	< 0.003	< 0.002	< 0.008	0.108	1.4	< 0.004	23.6	1.67	27.3	0.2	17.7	< 0.2	0.304	0.003	0.014
S98-03928	5815327613	4.6	0.02	< 0.1	0.047	31.5	< 0.003	< 0.002	< 0.008	3.89	1.5	0.014	8.41	0.454	40.1	0.4	26.1	< 0.2	0.146	< 0.002	0.014
S98-03929	5815313887	58.2	0.06	< 0.1	0.069	120	< 0.003	< 0.002	< 0.008	0.525	1.7	< 0.004	37.1	2.94	47.8	0.3	18.3	0.2	0.524	0.003	0.031
S98-03930	5815381536	3.4	0.07	0.2	0.113	78.7	< 0.003	< 0.002	< 0.008	3.75	3.9	0.018	24.5	0.062	70.1	0.2	29.7	0.5	0.315	< 0.002	0.024
S98-03931	5815340131	< 0.5	0.09	< 0.1	0.036	45.6	< 0.003	< 0.002	< 0.008	0.24	2	0.005	14.9	0.113	45	0.2	28	2.5	0.252	0.006	0.031
S98-03932	5815381965	14.1	0.12	0.2	0.203	90.9	< 0.003	< 0.002	< 0.008	2.09	2.2	0.013	25.3	0.393	60.5	0.2	25.6	< 0.2	0.347	< 0.002	0.014
S98-03933	5815354756	< 0.5	0.15	< 0.1	0.021	96.3	< 0.003	< 0.002	< 0.008	0.03	1.5	0.01	31.8	1.42	37.5	< 0.1	20.2	0.2	0.366	< 0.002	0.015
S98-03934	5811250034	14.3	0.11	< 0.1	0.08	88.4	< 0.003	< 0.002	< 0.008	1.42	1.5	0.006	20.4	0.796	26.4	0.1	18.2	< 0.2	0.303	< 0.002	0.084
S98-03935	5811218283	< 0.5	0.06	< 0.1	0.043	101	< 0.003	< 0.002	< 0.008	0.05	1.3	0.006	24.6	0.536	31.5	< 0.1	18.7	< 0.2	0.34	0.004	0.028
S98-03936	5811275430	< 0.5	0.27	< 0.1	0.042	82.9	< 0.003	< 0.002	< 0.008	0.126	1.2	0.008	16.6	0.244	24.8	< 0.1	20.5	< 0.2	0.256	0.004	0.03
S98-03937	5811269140	0.8	0.65	< 0.1	0.048	87.5	< 0.003	< 0.002	< 0.008	0.444	3.1	0.009	20.3	0.169	24.5	< 0.1	22.1	0.3	0.364	< 0.002	0.027
S98-03938	5811237335	< 0.5	0.06	< 0.1	0.056	112	< 0.003	< 0.002	< 0.008	0.236	1.6	0.007	22.9	1.12	34.5	< 0.1	17	< 0.2	0.285	0.003	0.06
S98-03939	5812539759	< 0.5	0.09	< 0.1	0.081	138	< 0.003	< 0.002	< 0.008	0.062	1.5	0.018	38	1.07	33.2	< 0.1	20.7	< 0.2	0.515	< 0.002	0.024
S98-03940	5812539890	< 0.5	0.09	< 0.1	0.05	140	< 0.003	< 0.002	< 0.008	0.162	2.1	0.009	29	0.99	43.6	< 0.1	17.1	28.5	0.296	0.002	0.029
S98-03941	5812539722	41.2	0.1	< 0.1	0.135	137	< 0.003	< 0.002	< 0.008	0.524	2.1	0.007	32.1	0.62	24.2	0.4	19.1	10.1	0.27	0.007	0.024
S98-03942	5812531324	< 0.5	0.07	< 0.1	0.109	154	< 0.003	< 0.002	< 0.008	0.107	2.2	0.008	34.6	1.17	39.9	< 0.1	18.1	5.9	0.364	0.003	0.025
S98-03943	5812571146	< 0.5	0.06	< 0.1	0.079	135	< 0.003	< 0.002	< 0.008	0.038	1.6	0.008	35.3	1.28	30	< 0.1	18.5	0.9	0.415	0.003	0.023
S98-03944	5812571466	< 0.5	0.07	< 0.1	0.079	132	< 0.003	< 0.002	< 0.008	0.092	1.9	0.013	26.8	1.34	31.9	< 0.1	21.5	3.2	0.454	< 0.002	0.026
S98-03945	5812587256	< 0.5	0.06	< 0.1	0.048	119	< 0.003	< 0.002	< 0.008	0.075	1.4	0.011	30.8	0.608	38.4	< 0.1	20.1	9	0.407	0.003	0.02
S98-03946	5812547518	< 0.5	0.06	< 0.1	0.056	104	< 0.003	< 0.002	< 0.008	0.042	2.1	0.004	28.4	2.02	19.1	0.1	20.4	4	0.342	0.003	0.036
S98-03947	5812587417	< 0.5	0.07	< 0.1	0.057	121	< 0.003	< 0.002	< 0.008	0.133	1.9	0.014	28.9	0.899	26	< 0.1	21.3	10.1	0.373	0.004	0.033
S98-03948	5811063858	< 0.5	0.08	< 0.1	0.089	124	< 0.003	< 0.002	< 0.008	0.081	1.6	0.006	38.4	2.58	36.8	< 0.1	18.3	< 0.2	0.521	< 0.002	0.016
S98-03949	5811063727	< 0.5	0.06	< 0.1	0.047	110	< 0.003	< 0.002	< 0.008	0.066	1.7	0.008	28.9	1.88	36.1	< 0.1	20.2	< 0.2	0.409	0.003	0.017
S98-03950	5811015769	< 0.5	0.07	< 0.1	0.132	151	< 0.003	< 0.002	< 0.008	0.357	3.7	0.01	38.3	0.967	21.2	< 0.1	12.8	20.7	0.461	0.003	0.016
S98-03951	5811015130	< 0.5	0.06	< 0.1	0.045	133	< 0.003	< 0.002	< 0.008	0.079	1.7	0.009	28.4	1.46	25.5	< 0.1	19.6	1.3	0.26	0.003	0.013
S98-03952	5811015073	15.4	0.06	< 0.1	0.078	130	< 0.003	< 0.002	< 0.008	2.54	1.9	0.012	25.1	0.569	44.4	< 0.1	21.1	0.7	0.513	< 0.002	0.284
S98-03953	5811023167	< 0.5	0.07	< 0.1	0.083	144	< 0.003	< 0.002	< 0.008	0.026	2.3	0.009	30.1	1.55	49.2	< 0.1	18.9	0.6	0.419	0.003	0.016
S98-03954	5811007026	< 0.5	< 0.01	< 0.1	0.089	16.1	< 0.003	< 0.002	< 0.008	< 0.005	1.6	0.014	36.4	< 0.002	33.6	< 0.1	20.8	1.1	0.413	< 0.002	< 0.004
S98-03955	5817247374	62.8	0.09	< 0.1	0.296	136	< 0.003	< 0.002	< 0.008	7.15	3.4	0.005	32.2	0.117	22.4	1.1	20.1	0.3	0.318	< 0.002	0.024
S98-03956	5817215599	< 0.5	0.05	< 0.1	0.096	100	< 0.003	< 0.002	< 0.008	0.031	1.9	0.009	27.9	3.82	31.5	0.2	27.4	< 0.2	0.278	0.008	0.013
S98-03957	5817223264	< 0.5	0.04	< 0.1	0.048	62.6	< 0.003	< 0.002	< 0.008	0.283	1.4	0.006	18.2	2.71	52.4	0.1	24.1	1.9	0.258	0.003	0.011
S98-03958	5817255839	73.5	0.11	< 0.1	0.254	129	< 0.003	< 0.002	< 0.008	3.44	3.6	0.004	37.3	0.299	20.9	0.8	19.9	0.2	0.372	< 0.002	0.016
S98-03959	5817255314	91.8	0.08	< 0.1	0.086	106	< 0.003	< 0.002	< 0.008	0.346	2.2	0.009	28.3	1.66	36.1	0.2	18.7	< 0.2	0.394	< 0.002	0.104

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-03960	RIP2104	05/04/1998	24.455	88.613	1995	Tara	38	???	Rajshahi	Rajshahi	Paba	Naohata	Naohata
S98-03961	RIP2105	05/04/1998	24.484	88.65	1987	STW	37	Chairman, Bargac.UP	Rajshahi	Rajshahi	Paba	Bargachhi	Bargachhi
S98-03962	RIP2106	05/04/1998	24.422	88.672	1998	STW	42	Md Aktar Hossain	Rajshahi	Rajshahi	Paba	Parila	Ramchandrapur
S98-03963	RIP2107	05/04/1998	24.413	88.615	1994	Tara	42	DPHE Office	Rajshahi	Rajshahi	Paba	Naohata	Santospur
S98-03964	RIP2109	05/04/1998	24.451	88.763	1986	STW	40	Drgapur Health Comp.	Rajshahi	Rajshahi	Durgapur (R)	Dharmapur ?	Durgapur
S98-03965	RIP2110	05/04/1998	24.424	88.733	1993	STW	35	Nasar Ali	Rajshahi	Rajshahi	Durgapur (R)	Jhaluka	Chaupukuria
S98-03966	RIP2111	05/04/1998	24.462	88.698	1977	STW	35	Zahur Member	Rajshahi	Rajshahi	Durgapur (R)	Joynagar	Gaganbaria
S98-03967	RIP2112	05/04/1998	24.483	88.684	1992	STW	35	Asif Uddin	Rajshahi	Rajshahi	Durgapur (R)	Joynagar	Narikel baria
S98-03968	RIP2113	05/04/1998	24.485	88.713	1994	STW	40	Zobaida Buoa	Rajshahi	Rajshahi	Durgapur (R)	Deluabari	Tegharia
S98-03969	RIP2114	05/04/1998	24.452	88.799		STW	37	???	Rajshahi	Rajshahi	Durgapur (R)	Pamanagar?	Paikatali
S98-03970	RIP2115	05/04/1998	24.489	88.805	1997	Tara	40	Union Council	Rajshahi	Rajshahi	Durgapur (R)	Kismat gankair	Ujan khalshi
S98-03971	RIP2117	12/04/1998	24.312	89.035	1982	STW	34	P. School Authority	Rajshahi	Natore	Bagatipara	Dayarampur	Dumrai
S98-03972	RIP2118	12/04/1998	24.336	88.985	1985	STW	34	Mosque Committee	Rajshahi	Natore	Bagatipara	Faguardiar	Sailkona
S98-03973	RIP2119	12/04/1998	24.337	88.962	1972	STW	34	Md Adam Ali	Rajshahi	Natore	Bagatipara	Bagatipara	Srirampur
S98-03974	RIP2120	12/04/1998	24.318	88.937	1997	STW	34	Mosque Committee	Rajshahi	Natore	Bagatipara	Bagatipara	Nurpur
S98-03975	RIP2121	12/04/1998	24.317	88.899	1995	STW	43	Grameen Bank	Rajshahi	Natore	Bagatipara	Jamnagar	Bashbaria
S98-03976	RIP2122	12/04/1998	24.305	88.94	1977	STW	39	Alauudin	Rajshahi	Natore	Bagatipara	Panka	Charkgoash
S98-03977	RIP2123	12/04/1998	24.299	88.919	1997	STW	32	Ismail Sheaik	Rajshahi	Natore	Bagatipara	Paka	Soloipara
S98-03978	RIP2125	12/04/1998	24.169	89.004	1990	Tara	43	Md. Wazeduddin	Rajshahi	Natore	Lalpur	Shurdi	Gouripur
S98-03979	RIP2126	12/04/1998	24.177	88.964	1992	Tara	43	Lalpur Health Comple	Rajshahi	Natore	Lalpur	Lalpur	Lalpur
S98-03980	RIP2127	12/04/1998	24.172	88.899	1994	STW	39	Vellaloarik Mazar	Rajshahi	Natore	Lalpur	Durduria	Ramkrishnapur
S98-03981	RIP2128	12/04/1998	24.164	88.924	1994	STW	36	Bilmaria Cen. mosque	Rajshahi	Natore	Lalpur	Bilmaria	Bilmaria
S98-03982	RIP2129	12/04/1998	24.249	89.042	1997	STW	38	Walia High School	Rajshahi	Natore	Lalpur	Walia	Walia
S98-03983	RIP2130	12/04/1998	24.259	89.094		STW	33	Godhara P. School	Rajshahi	Natore	Lalpur	Kadamchilan	Godhara
S98-03984	RIP2132	13/04/1998	24.313	89.153	1997	STW	39	Mr Hatem Sardar	Rajshahi	Natore	Baraigram	Baraigram	Baraigram
S98-03985	RIP2133	13/04/1998	24.342	89.095	1997	STW	39	Mr Amzad Hossain	Rajshahi	Natore	Baraigram	Joari	Ralia
S98-03986	RIP2134	13/04/1998	24.286	89.085	1981	STW	39	DPHE Office	Rajshahi	Natore	Baraigram	Majgaon	Banpara
S98-03987	RIP2135	13/04/1998	24.17	89.145	1991	STW	38	Nimai Chandra Sarkar	Rajshahi	Natore	Baraigram	Gopalpur	Astikpara
S98-03988	RIP2136	13/04/1998	24.198	89.172	1975	STW	39	Mosque Committee	Rajshahi	Natore	Baraigram	Chandi	Telo
S98-03989	RIP2137	13/04/1998	24.232	89.125	1995	STW	34	Bahadur Ali Pramanik	Rajshahi	Natore	Baraigram	Nagar	Kayen
S98-03990	RIP2138	13/04/1998	24.286	89.065	1997	STW	30	Mr Moktar Hossain	Rajshahi	Natore	Baraigram	Joari	Srikhandi
S98-03991	RIP2139	13/04/1998	24.307	89.087	1993	STW	40	Mr Mokbul Hossain	Rajshahi	Natore	Baraigram	Majgaon	Tirail
S98-03992	RIP2141	13/04/1998	24.368	89.238	1983	STW	59	Thana Headquater	Rajshahi	Natore	Gurudaspur	Paurashava	Khamarnaskoir
S98-03993	RIP2142	13/04/1998	24.355	89.281	1995	STW	28	Masinda H, School	Rajshahi	Natore	Gurudaspur	Masinda	Masinda
S98-03994	RIP2143	13/04/1998	24.339	89.246	1993	STW	31	Abdul Majid(Ex.Chair	Rajshahi	Natore	Gurudaspur	Dharabarisha	Sidhuli
S98-03995	RIP2144	13/04/1998	24.385	89.209	1993	STW	33	Biaghat Madrasha	Rajshahi	Natore	Gurudaspur	Biaghat	Biaghat
S98-03996	RIP2145	13/04/1998	24.392	89.191	1994	STW	25	Mrs Halima Khatun	Rajshahi	Natore	Gurudaspur	Nazirpur	Berganga rampur
S98-03997	RIP2146	13/04/1998	24.384	89.166	1987	STW	25	Mr Emran Ali	Rajshahi	Natore	Gurudaspur	Nazirpur	Nazirpur
S98-03998	RIP2147	13/04/1998	24.364	89.138	1996	STW	34	Bri Pathuria H. Scho	Rajshahi	Natore	Gurudaspur	Chapila	Bri pathuria
S98-03999	RIP2149	14/04/1998	24.395	89.057	1996	STW	39	Mr Nurul Islam	Rajshahi	Natore	Natore Sadar	Halsha	Gokulnagar
S98-04000	RIP2150	14/04/1998	24.368	88.986	1975	STW	31	Munir Uddin Master	Rajshahi	Natore	Natore Sadar	Bara harishpur	Paikerdal
S98-04001	RIP2151	14/04/1998	24.439	89.014	1991	STW	34	????	Rajshahi	Natore	Natore Sadar	Digapatiya	Uttara gonobhab.
S98-04002	RIP2152	14/04/1998	24.459	89.005	1992	STW	38	Ferdausi Begum	Rajshahi	Natore	Natore Sadar	Piprul	Thakur lakshmik.
S98-04003	RIP2154	14/04/1998	24.372	88.905	1990	STW	43	Mr Didar Ali	Rajshahi	Natore	Natore Sadar	Kafuria	Dastanabad
S98-04004	RIP2155	14/04/1998	24.408	88.967	1997	STW	43	Mr Rezaul Karim	Rajshahi	Natore	Natore Sadar	Tebaria	Chakbaidyanath
S98-04005	RIP2156	14/04/1998	24.427	88.961	1983	STW	26	Abdus Samad Fakir	Rajshahi	Natore	Natore Sadar	Chhatni	Panditgaon
S98-04006	RIP2157	14/04/1998	24.465	88.964	1998	STW	23	Amir Ali Mollah	Rajshahi	Natore	Natore Sadar	Bipra belgharia	Bipra belgharia
S98-04007	RIP2158	14/04/1998	24.495	88.955	1996	Tara	41	Mr Ahad Ali	Rajshahi	Natore	Natore Sadar	Brahmapur	Buribhag

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-03960	5817271704	< 0.5	0.05	< 0.1	0.046	105	< 0.003	< 0.002	< 0.008	0.065	1.8	0.011	40.6	2	39.8	< 0.1	21.9	0.3	0.336	0.004	0.024
S98-03961	5817207088	0.6	0.05	0.2	0.161	109	< 0.003	< 0.002	< 0.008	0.932	2.7	0.007	32.4	0.32	50.3	0.1	23.4	< 0.2	0.358	< 0.002	0.017
S98-03962	5817287794	< 0.5	0.06	< 0.1	0.053	110	< 0.003	< 0.002	< 0.008	0.2	2.1	0.013	29	0.819	37.1	< 0.1	23.2	0.7	0.342	0.002	0.02
S98-03963	5817271829	< 0.5	0.15	< 0.1	0.049	122	< 0.003	< 0.002	< 0.008	0.073	2	0.01	26.7	2.6	39.2	< 0.1	20.4	0.9	0.34	0.002	0.014
S98-03964	5813123288	40.6	0.03	< 0.1	0.04	54.4	< 0.003	< 0.002	< 0.008	1.36	1.2	0.007	15.4	0.682	22.5	0.4	20.6	< 0.2	0.166	< 0.002	0.236
S98-03965	5813135226	< 0.5	0.07	< 0.1	0.034	114	< 0.003	< 0.002	< 0.008	0.056	1.5	0.01	24.1	0.697	26.5	< 0.1	21.4	5.4	0.29	0.003	0.024
S98-03966	5813147296	< 0.5	0.05	< 0.1	0.035	101	< 0.003	< 0.002	< 0.008	0.151	1.4	0.009	21	0.953	18.9	< 0.1	20.5	0.3	0.272	0.003	0.029
S98-03967	5813147733	< 0.5	0.07	< 0.1	0.048	116	< 0.003	< 0.002	< 0.008	0.066	1.6	0.01	31.3	1.98	50.3	< 0.1	20.2	1.4	0.417	0.004	0.035
S98-03968	5813111977	< 0.5	0.08	< 0.1	0.04	110	< 0.003	< 0.002	< 0.008	0.027	1.2	0.012	26.2	0.631	30.4	< 0.1	19.3	< 0.2	0.286	0.003	0.072
S98-03969	5813123750	< 0.5	0.08	< 0.1	0.057	104	< 0.003	< 0.002	< 0.008	0.086	1.8	0.015	26.8	0.808	36.7	< 0.1	19.6	< 0.2	0.339	< 0.002	0.02
S98-03970	5813159994	2.8	0.07	< 0.1	0.1	128	< 0.003	< 0.002	< 0.008	0.135	3.3	0.016	30.1	0.538	42.2	< 0.1	21.4	0.2	0.444	< 0.002	0.035
S98-03971	5690938342	< 0.5	0.07	< 0.1	0.049	136	< 0.003	< 0.002	< 0.008	0.228	3.9	0.014	30.9	0.459	37.6	0.5	22.4	6.6	0.388	0.002	0.018
S98-03972	5690938909	< 0.5	0.07	< 0.1	0.051	140	< 0.003	< 0.002	< 0.008	0.03	1.9	0.008	32.8	1.52	39.2	< 0.1	19.2	17.1	0.347	0.002	0.016
S98-03973	5690919952	< 0.5	0.06	< 0.1	0.122	139	< 0.003	< 0.002	< 0.008	0.023	2.4	0.021	30.6	2.08	36.6	< 0.1	21.8	17.7	0.398	< 0.002	0.015
S98-03974	5690919791	< 0.5	0.06	< 0.1	0.052	127	< 0.003	< 0.002	< 0.008	0.038	1.6	0.007	29.8	1.19	33.7	< 0.1	18.2	6.8	0.391	0.002	0.015
S98-03975	5690976064	< 0.5	0.06	< 0.1	0.077	130	< 0.003	< 0.002	< 0.008	5.92	1.9	0.017	30.2	0.455	30.7	< 0.1	20.5	9.6	0.338	< 0.002	1.6
S98-03976	5690957246	3.4	0.05	< 0.1	0.185	99.6	< 0.003	< 0.002	< 0.008	1.74	3.5	0.005	20.2	0.277	13.8	0.2	15	10.1	0.201	< 0.002	0.042
S98-03977	5690957898	< 0.5	0.1	< 0.1	0.072	121	< 0.003	< 0.002	< 0.008	0.128	1.7	0.009	28.9	1.73	29.2	< 0.1	18.4	0.4	0.339	< 0.002	0.031
S98-03978	5694466428	< 0.5	0.08	< 0.1	0.102	144	< 0.003	< 0.002	< 0.008	0.049	2	0.021	30	1.91	30	< 0.1	22.2	0.2	0.451	< 0.002	0.025
S98-03979	5694485630	< 0.5	0.06	< 0.1	0.039	112	< 0.003	< 0.002	< 0.008	0.025	1.8	0.005	25	0.749	21.4	0.1	18	22.8	0.329	0.002	0.026
S98-03980	5694447866	< 0.5	0.07	< 0.1	0.065	131	< 0.003	< 0.002	< 0.008	0.085	1.8	0.014	28.6	0.831	44.8	< 0.1	21.1	4.2	0.435	0.004	0.03
S98-03981	5694419192	< 0.5	0.08	< 0.1	0.07	133	< 0.003	< 0.002	< 0.008	0.067	1.2	0.014	35.3	0.784	50	< 0.1	22.2	1.4	0.373	0.003	0.021
S98-03982	5694495994	< 0.5	0.05	< 0.1	0.025	87.1	< 0.003	< 0.002	< 0.008	0.066	1.4	< 0.004	23.3	1.67	7.7	0.1	19.8	2.8	0.317	0.002	0.022
S98-03983	5694476448	< 0.5	0.07	< 0.1	0.049	95.9	< 0.003	< 0.002	< 0.008	0.065	1.5	0.004	25.6	0.988	14.9	0.1	22	7.9	0.313	0.002	0.081
S98-03984	5691515098	< 0.5	0.08	< 0.1	0.051	99.3	< 0.003	< 0.002	< 0.008	0.164	2.3	0.007	27.1	1.09	50.9	< 0.1	17.8	22.1	0.222	< 0.002	0.05
S98-03985	5691547078	< 0.5	0.07	< 0.1	0.07	155	< 0.003	< 0.002	< 0.008	0.053	1.7	0.013	34.5	2.13	42.4	< 0.1	22.3	52.9	0.468	< 0.002	0.021
S98-03986	5691571085	< 0.5	0.07	< 0.1	0.038	141	< 0.003	< 0.002	< 0.008	0.045	1.7	0.011	36.2	0.669	40	0.1	22.2	9.5	0.484	0.004	0.016
S98-03987	5691535032	< 0.5	0.07	< 0.1	0.106	120	< 0.003	< 0.002	< 0.008	0.13	3.5	0.014	30	0.862	29.1	0.1	20	7.2	0.305	0.004	0.02
S98-03988	5691523981	< 0.5	0.06	< 0.1	0.066	118	< 0.003	< 0.002	< 0.008	0.124	1.6	0.015	30.2	0.364	42.2	< 0.1	21.8	13.8	0.368	0.004	0.017
S98-03989	5691583510	< 0.5	0.07	< 0.1	0.1	152	< 0.003	< 0.002	< 0.008	0.303	1.8	0.006	43.8	0.744	51.1	< 0.1	12.8	44.5	0.396	< 0.002	0.055
S98-03990	5691547949	< 0.5	0.07	< 0.1	0.051	104	< 0.003	< 0.002	< 0.008	1.01	1.7	0.009	23.1	1.33	37.3	< 0.1	19.4	3.4	0.301	0.003	0.018
S98-03991	5691571988	< 0.5	0.08	< 0.1	0.207	81.3	< 0.003	< 0.002	< 0.008	0.313	2.7	0.008	23.8	0.401	35.5	0.2	19.5	18	0.182	< 0.002	0.015
S98-03992	5694154612	< 0.5	0.06	< 0.1	0.059	94	< 0.003	< 0.002	< 0.008	0.178	3.3	0.026	23.9	0.936	39.5	< 0.1	24.2	31.1	0.347	< 0.002	0.052
S98-03993	5694167698	< 0.5	0.06	< 0.1	0.049	83.8	< 0.003	< 0.002	< 0.008	0.09	1.4	0.013	22.2	0.405	48.8	< 0.1	25.5	11.9	0.272	< 0.002	0.025
S98-03994	5694140928	17.8	0.05	< 0.1	0.131	77.6	< 0.003	< 0.002	< 0.008	3.88	1.7	0.006	27.7	1.19	49.2	0.1	26.4	34.7	0.665	< 0.002	0.028
S98-03995	5694113095	< 0.5	0.09	< 0.1	0.105	110	< 0.003	< 0.002	< 0.008	0.138	3.4	0.024	26.8	0.735	51.2	< 0.1	23.5	25.2	0.335	< 0.002	0.029
S98-03996	5694181086	< 0.5	0.07	0.1	0.074	106	< 0.003	< 0.002	< 0.008	0.139	4.1	0.022	32.2	0.538	53.7	< 0.1	22	8.6	0.482	< 0.002	0.021
S98-03997	5694181764	< 0.5	0.06	< 0.1	0.036	114	< 0.003	< 0.002	< 0.008	0.068	1.4	0.009	26	0.947	36.8	< 0.1	21.7	19.7	0.349	< 0.002	0.024
S98-03998	5694127200	< 0.5	0.06	< 0.1	0.1	105	< 0.003	< 0.002	< 0.008	0.107	2.3	0.021	25	0.586	33.8	< 0.1	23	12.3	0.294	< 0.002	0.025
S98-03999	5696343419	< 0.5	0.08	< 0.1	0.141	161	< 0.003	< 0.002	< 0.008	0.071	4.9	0.024	43.7	0.926	35.5	< 0.1	22.1	16.8	0.988	< 0.002	0.027
S98-04000	5696307756	< 0.5	0.09	< 0.1	0.079	130	< 0.003	< 0.002	< 0.008	0.106	1.4	0.013	27.2	0.468	36	< 0.1	22.1	2.3	0.705	0.003	0.04
S98-04001	5696336	< 0.5	0.07	< 0.1	0.094	119	< 0.003	< 0.002	< 0.008	0.048	2.4	0.012	28.1	0.576	29.7	< 0.1	20.2	7.4	0.469	0.002	0.024
S98-04002	5696387991	< 0.5	0.09	< 0.1	0.056	101	< 0.003	< 0.002	< 0.008	0.053	1.7	0.007	14.7	0.145	27.5	< 0.1	18.4	17.9	0.292	< 0.002	0.03
S98-04003	5696351332	< 0.5	0.06	< 0.1	0.063	118	< 0.003	< 0.002	< 0.008	0.344	2	0.01	25.1	0.534	32.7	< 0.1	20.7	10.5	0.285	0.002	0.108
S98-04004	5696394268	1	0.07	< 0.1	0.165	158	< 0.003	< 0.002	< 0.008	0.179	2.4	0.007	34.6	0.669	38.4	0.1	19.5	43.3	0.396	0.003	0.018
S98-04005	5696329676	2.1	0.07	< 0.1	0.088	124	< 0.003	< 0.002	< 0.008	0.211	2.2	0.012	27.2	0.562	37.1	< 0.1	20.1	4.1	0.738	0.002	0.033
S98-04006	5696314208	< 0.5	0.08	< 0.1	0.099	136	< 0.003	< 0.002	< 0.008	0.374	2.2	0.013	27.2	0.829	37.8	< 0.1	20.6	3.9	0.419	0.002	0.023
S98-04007	5696321226	< 0.5	0.08	< 0.1	0.072	89.3	< 0.003	< 0.002	< 0.008	0.123	3.5	0.019	22.5	0.756	23.8	< 0.1	20.4	18.2	0.212	< 0.002	0.041

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04008	RIP2159	14/04/1998	24.418	89.001	1997	STW	41	DPHE Office	Rajshahi	Natore	Natore Sadar	Paurashava	Patuapara
S98-04009	RIP2161	15/04/1998	24.292	89.313	1991	Tara	38	Mrs Robi	Rajshahi	Pabna	Chatmohar	Chhaikola	Katengh
S98-04010	RIP2162	15/04/1998	24.272	89.309	1991	Tara	35	Abdur Rahaman	Rajshahi	Pabna	Chatmohar	Nimaichara	Chinabhatkur
S98-04011	RIP2163	15/04/1998	24.245	89.266	1987	STW	34	Mr Khowy Pramanik	Rajshahi	Pabna	Chatmohar	Haripur	Dhorail Mull.
S98-04012	RIP2164	15/04/1998	24.188	89.277	1987	Tara	41	Mr Jahangir Alam	Rajshahi	Pabna	Chatmohar	Mulgram	Amritakunda
S98-04013	RIP2165	15/04/1998	24.151	89.28	1991	STW	34	Mr Hossain Pramanik	Rajshahi	Pabna	Chatmohar	Mulgram	Attamka
S98-04014	RIP2166	15/04/1998	24.123	89.291	1991	STW	36	Jashim Uddin	Rajshahi	Pabna	Chatmohar	Failjana	Nengri Kris. Ram
S98-04015	RIP2168	15/04/1998	24.125	89.238	1997	STW	31	Mr Nazrul Islam	Rajshahi	Pabna	Atgharia	Chandba	Chandba
S98-04016	RIP2169	15/04/1998	24.123	89.215	1987	STW	39	Mr Zabbar Pramanik	Rajshahi	Pabna	Atgharia	Majhpara	Naodapara
S98-04017	RIP2170	15/04/1998	24.127	89.193	1995	STW	31	Mr Abbas Uddin	Rajshahi	Pabna	Atgharia	Majhpara	Dangapara
S98-04018	RIP2171	15/04/1998	24.083	89.248	1997	Tara	36	Mr Sultan Ahmad	Rajshahi	Pabna	Atgharia	Debottar	Srikantpur
S98-04019	RIP2172	15/04/1998	24.076	89.303	1996	STW	38	Mr Abdur Rahaman	Rajshahi	Pabna	Atgharia	Ekdanta	Dengargram
S98-04020	RIP2173	15/04/1998	24.054	89.373	1995	STW	45	Abdul Malekh Sarkar	Rajshahi	Pabna	Atgharia	Lakshmipur	Kaijuri
S98-04021	RIP2175	15/04/1998	24.222	89.277	1987	STW	34	Mr Lokman Bishwas	Rajshahi	Pabna	Chatmohar	Mulgram	Amritab Kunda
S98-04022	RIP2177	15/04/1998	23.865	89.626	1975	STW	24	Mr Joynal Abadin	Rajshahi	Pabna	Bera	Masundia	Shitulpur
S98-04023	RIP2178	15/04/1998	23.881	89.665	1998	STW	16	Kazirhat H. School	Rajshahi	Pabna	Bera	Masundia	Kazisharifpur
S98-04024	RIP2179	15/04/1998	23.917	89.646	1997	STW	21	???	Rajshahi	Pabna	Bera	Ruppur	Sunnayasi banda
S98-04025	RIP2180	16/04/1998	23.951	89.652	1995	STW	23	Anil Chandra Kunda	Rajshahi	Pabna	Bera	Puran Bharenga	Raghunathpur
S98-04026	RIP2181	16/04/1998	23.961	89.612	1996	STW	25	Mr Sadak Hossain	Rajshahi	Pabna	Bera	Jotshakhni	Tangbari
S98-04027	RIP2182	16/04/1998	24.037	89.606	1995	STW	21	Mr Nurul Islam	Rajshahi	Pabna	Bera	Nutan Bharenga	Chalkchakla
S98-04028	RIP2183	16/04/1998	24.054	89.641	1997	Tara	39	Mr Fazlul Haq	Rajshahi	Pabna	Bera	Haturia nakalia	Haturia
S98-04029	RIP2185	16/04/1998	23.974	89.419	1990	STW	69	Mr Yunus Ali	Rajshahi	Pabna	Sujanagar	Tantibanda	Tantibanda
S98-04030	RIP2186	17/04/1998	23.885	89.442	1975	STW	41	Mr Tofaz Uddin	Rajshahi	Pabna	Sujanagar	Satbaria	Satbaria
S98-04031	RIP2187	16/04/1998	23.89	89.475	1995	STW	46	Mr M. A. Malek	Rajshahi	Pabna	Sujanagar	Manikhat	Manikhat
S98-04032	RIP2188	16/04/1998	23.87	89.506	1991	STW	54	Mr Abdul Aziz	Rajshahi	Pabna	Sujanagar	Hatkhali	Hatkhali
S98-04033	RIP2189	17/04/1998	23.835	89.537	1995	STW	44	Bhairab Kumar Bishwa	Rajshahi	Pabna	Sujanagar	Nazirganj	Narasinghapur
S98-04034	RIP2190	17/04/1998	23.837	89.58	1995	STW	42	Jalal Uddin Mollah	Rajshahi	Pabna	Sujanagar	Sagarkandi	Khalilpur
S98-04035	RIP2191	17/04/1998	23.96	89.599	1980	STW	20	Mr Abdus Salam	Rajshahi	Pabna	Sujanagar	Ahmedpur	Ahmedpur
S98-04036	RIP2192	17/04/1998	23.961	89.498	1988	STW	42	Mr S. A. Shahzahan	Rajshahi	Pabna	Sujanagar	Dulai	Shibrampur
S98-04037	RIP2194	16/04/1998	24.184	89.452	1996	STW	23	Mr Ali Asraf	Rajshahi	Pabna	Faridpur	Brilahiribaria	Deobhog
S98-04038	RIP2195	16/04/1998	24.166	89.435	1998	STW	33	Abdul Wahab	Rajshahi	Pabna	Faridpur	Faridpur	Parfaridpur
S98-04039	RIP2196	16/04/1998	24.176	89.412	1988	STW	39	Mr Abdur Rashed	Rajshahi	Pabna	Faridpur	Faridpur	Berbowlia
S98-04040	RIP2197	16/04/1998	24.144	89.439	1997	STW	33	Mr Tawaib Ali	Rajshahi	Pabna	Faridpur	Faridpur	Khagarbaria
S98-04041	RIP2198	16/04/1998	24.151	89.496	1991	STW	38	Mr Ansar Ali	Rajshahi	Pabna	Faridpur	Demra	Deobaria
S98-04042	RIP2199	16/04/1998	24.089	89.44	1996	STW	39	Mr Esmail Hossain	Rajshahi	Pabna	Faridpur	Hadal	Mangalgram
S98-04043	RIP2201	17/04/1998	24.211	89.419	1994	Tara	39	Azizul Haq Mollah	Rajshahi	Pabna	Bhangura	Dilpashar	Betuan
S98-04044	RIP2202	17/04/1998	24.221	89.419	1994	Tara	39	Abdul Kader	Rajshahi	Pabna	Bhangura	Bhangura	Kaidanga
S98-04045	RIP2203	17/04/1998	24.248	89.364	1994	Tara	40	Mosque Committee	Rajshahi	Pabna	Bhangura	Ashtamanisha	Lamkan
S98-04046	RIP2204	17/04/1998	24.258	89.351	1995	STW	38	Chintta Ranjan Sutr.	Rajshahi	Pabna	Bhangura	Ashtamanisha	Ashtamanisha
S98-04047	RIP2205	17/04/1998	24.197	89.39	1996	Tara	39	Abdul Karim	Rajshahi	Pabna	Bhangura	Par bhaugura	Patharghata
S98-04048	RIP2206	17/04/1998	24.176	89.392	1995	STW	38	Mr Alek Pramanik	Rajshahi	Pabna	Bhangura	Par bhangura	Bheramara
S98-04049	RIP2207	17/04/1998	24.218	89.371	1997	Tara	39	Mr Abu Taleb	Rajshahi	Pabna	Bhangura	Par bhangura	Sarutia
S98-04050	RIP2209	17/04/1998	23.95	89.399	1970	STW	39	Tasabaria Madarasha	Rajshahi	Pabna	Pabna Sadar	Char tarapur	Khoksabaria
S98-04051	RIP2210	17/04/1998	23.971	89.361	1997	STW	33	Abdul Kuddus Pramani	Rajshahi	Pabna	Pabna Sadar	Sadullahpur	Dubalia
S98-04052	RIP2211	17/04/1998	23.981	89.326	1988	STW	31	Mr Samsul Islam	Rajshahi	Pabna	Pabna Sadar	Bharara	Par Chitalia
S98-04053	RIP2212	17/04/1998	23.992	89.263	1988	Tara	33	Mrs Hasina Banu	Rajshahi	Pabna	Pabna Sadar	Dogachhi	Byajanathpur
S98-04054	RIP2213	18/04/1998	24.073	89.187	1993	STW	43	Mr Khalilur Rahaman	Rajshahi	Pabna	Pabna Sadar	Dapunia	Kankarkhola
S98-04055	RIP2214	18/04/1998	24.02	89.23	1988	STW	36	Biraj Pramanik	Rajshahi	Pabna	Pabna Sadar	Hemayetpur	Jotkanu

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04008	5696380	11.6	0.08	< 0.1	0.165	91.5	< 0.003	< 0.002	< 0.008	2.14	2.6	0.008	24.7	0.59	21.4	0.2	16	13.6	0.23	< 0.002	0.053
S98-04009	5762208514	< 0.5	0.11	< 0.1	0.088	149	< 0.003	< 0.002	< 0.008	0.076	3.9	0.026	36.9	0.666	45.1	< 0.1	22.5	36.7	0.852	< 0.002	0.029
S98-04010	5762286283	< 0.5	0.07	< 0.1	0.072	130	< 0.003	< 0.002	< 0.008	0.137	3.3	0.021	28.9	1.01	39.7	< 0.1	21	34.1	0.505	0.003	0.029
S98-04011	5762260336	< 0.5	0.08	< 0.1	0.1	114	< 0.003	< 0.002	< 0.008	0.089	3.5	0.013	31.1	0.659	15.1	< 0.1	19.1	5.6	0.442	0.003	0.028
S98-04012	5762277028	< 0.5	0.13	< 0.1	0.066	129	< 0.003	< 0.002	< 0.008	0.116	1.7	0.018	40	0.648	47.6	< 0.1	23.5	6.4	0.493	0.003	0.047
S98-04013	5762277067	< 0.5	0.07	< 0.1	0.054	80.2	< 0.003	< 0.002	< 0.008	0.079	1.8	0.008	19.5	0.635	13.4	< 0.1	22.5	7	0.351	0.004	0.026
S98-04014	5762234725	< 0.5	0.09	< 0.1	0.038	85.7	< 0.003	< 0.002	< 0.008	0.188	1.5	0.008	26.7	0.61	24.8	< 0.1	24.5	13.3	0.307	0.004	0.028
S98-04015	5760515170	< 0.5	0.06	< 0.1	0.07	104	< 0.003	< 0.002	< 0.008	0.791	2.4	0.007	25.6	1.43	27.6	< 0.1	22.7	6.5	0.472	0.002	0.023
S98-04016	5760579618	< 0.5	0.08	< 0.1	0.041	91	< 0.003	< 0.002	< 0.008	0.585	1.6	0.011	25.8	0.438	25.1	< 0.1	22.3	1.9	0.332	0.003	0.104
S98-04017	5760579224	< 0.5	0.09	< 0.1	0.053	112	< 0.003	< 0.002	< 0.008	0.286	1.4	0.007	29.5	0.301	33.4	< 0.1	22.2	4.4	0.363	0.003	0.017
S98-04018	5760531950	< 0.5	0.1	< 0.1	0.059	98	< 0.003	< 0.002	< 0.008	0.387	1.5	0.009	30.5	1.54	33.8	< 0.1	20.7	4.1	0.418	0.003	0.017
S98-04019	5760547268	< 0.5	0.05	< 0.1	0.04	90	< 0.003	< 0.002	< 0.008	0.107	2	0.007	29.9	0.465	23	< 0.1	20.6	33.4	0.202	0.003	0.013
S98-04020	5760563484	< 0.5	0.1	< 0.1	0.052	160	0.003	< 0.002	< 0.008	0.338	2.6	0.011	38.5	3.21	25.2	< 0.1	23.2	23.9	0.501	0.002	0.11
S98-04021	5762277028	< 0.5	0.09	< 0.1	0.063	129	< 0.003	< 0.002	< 0.008	0.504	1.4	0.011	41.2	0.801	46.6	< 0.1	23.8	8.9	0.514	0.004	0.027
S98-04022	5761652933	80.7	0.13	< 0.1	0.239	127	< 0.003	< 0.002	< 0.008	2	6	0.004	36.2	1.93	23.2	1	23.9	6.5	0.452	< 0.002	0.029
S98-04023	5761652568	65.5	0.08	< 0.1	0.197	119	< 0.003	< 0.002	< 0.008	6.08	5.5	< 0.004	32.3	0.993	33.4	0.5	16.3	25.7	0.405	< 0.002	0.028
S98-04024	5761684908	80.6	0.11	< 0.1	0.173	128	< 0.003	< 0.002	< 0.008	14.7	3.2	< 0.004	34.3	0.536	25.7	1.1	27.4	0.9	0.366	< 0.002	0.034
S98-04025	5761673809	25.5	0.48	< 0.1	0.176	189	< 0.003	< 0.002	< 0.008	14.1	2	< 0.004	45.6	3.78	27.7	0.8	19	42.5	0.477	< 0.002	0.034
S98-04026	5761642957	30.5	0.08	< 0.1	0.161	109	< 0.003	< 0.002	< 0.008	8.53	6	0.01	48.1	1.84	31.7	0.7	24.2	10.7	0.255	< 0.002	0.451
S98-04027	5761663185	58.6	0.09	< 0.1	0.143	70.5	< 0.003	< 0.002	< 0.008	9.65	3.3	0.004	20.7	0.492	8.5	0.6	25.6	0.5	0.278	< 0.002	0.023
S98-04028	5761631475	47.7	0.05	< 0.1	0.099	42.6	< 0.003	< 0.002	< 0.008	11	4.2	0.005	16.2	0.255	16.8	0.9	26.3	< 0.2	0.128	< 0.002	0.141
S98-04029	5768395951	0.6	0.08	< 0.1	0.055	95.2	< 0.003	< 0.002	< 0.008	0.091	2.7	0.012	30.2	0.265	45.3	0.1	26.6	< 0.2	0.443	0.006	0.028
S98-04030	5768376859	< 0.5	0.12	< 0.1	0.035	68.2	< 0.003	< 0.002	< 0.008	0.066	1.6	0.006	26.7	1.17	60.7	0.1	21	2.3	0.448	0.003	0.013
S98-04031	5768338657	< 0.5	0.04	< 0.1	0.029	52	< 0.003	< 0.002	< 0.008	0.139	1.6	0.006	18.6	2.53	44.8	0.1	26	0.4	0.427	0.003	0.134
S98-04032	5768328423	< 0.5	0.03	< 0.1	0.028	48.9	< 0.003	< 0.002	< 0.008	0.163	1.8	0.01	18	1.28	39.9	0.1	27.1	0.6	0.231	0.003	0.012
S98-04033	5768347694	< 0.5	0.04	< 0.1	0.038	53.5	< 0.003	< 0.002	< 0.008	0.251	2.1	0.006	25.2	0.642	37.8	< 0.1	27.6	29.7	0.314	0.005	0.012
S98-04034	5768366515	< 0.5	0.04	< 0.1	0.042	52.3	< 0.003	< 0.002	< 0.008	0.053	1.6	0.008	19.1	0.328	48	0.2	21.9	3	0.278	0.005	0.026
S98-04035	5768309006	57.8	0.08	< 0.1	0.167	142	< 0.003	< 0.002	< 0.008	3.6	5.3	< 0.004	31.4	1.07	11.2	0.4	19.5	1.7	0.516	< 0.002	0.019
S98-04036	5768320872	0.8	0.1	< 0.1	0.035	61.6	< 0.003	< 0.002	< 0.008	0.319	2.2	0.012	22.9	0.32	48.8	0.2	29.8	16.2	0.319	0.004	0.022
S98-04037	5763331362	< 0.5	0.05	< 0.1	0.042	54.1	< 0.003	< 0.002	< 0.008	0.154	1.9	0.005	18.6	0.645	37.5	0.1	22.9	11.2	0.203	0.002	0.039
S98-04038	5763352831	< 0.5	0.08	< 0.1	0.039	64.7	< 0.003	< 0.002	< 0.008	0.344	1.8	0.005	25	0.39	46.5	< 0.1	24.3	9	0.251	0.003	0.021
S98-04039	5763352	< 0.5	0.13	< 0.1	0.045	56.2	< 0.003	< 0.002	< 0.008	0.555	1.7	0.005	26.7	0.949	34.3	< 0.1	25.3	26.8	0.257	0.003	0.039
S98-04040	5763352924	< 0.5	0.04	< 0.1	0.046	60.5	< 0.003	< 0.002	< 0.008	0.111	1.7	0.005	23	0.325	40.7	< 0.1	22.5	4.9	0.293	0.004	0.01
S98-04041	5763342351	10.1	0.04	< 0.1	0.102	42.1	< 0.003	< 0.002	< 0.008	8.77	2.6	< 0.004	21.5	0.777	26.3	0.5	18.7	16	0.148	< 0.002	0.013
S98-04042	5763363678	< 0.5	0.06	< 0.1	0.167	105	< 0.003	< 0.002	< 0.008	0.208	2.4	0.005	33.9	0.665	11.6	0.2	19.4	23.4	0.229	0.004	0.018
S98-04043	5761947	< 0.5	0.04	< 0.1	0.027	47.3	< 0.003	< 0.002	< 0.008	0.099	1.3	0.01	21	0.678	24.9	< 0.1	24.2	1.1	0.2	0.002	0.019
S98-04044	5761931438	< 0.5	0.04	< 0.1	0.029	61.1	< 0.003	< 0.002	< 0.008	0.048	1.5	0.011	23.1	1.22	29.4	< 0.1	24.6	5.8	0.279	0.003	0.013
S98-04045	5761915	< 0.5	0.06	< 0.1	0.031	72.4	< 0.003	< 0.002	< 0.008	0.058	1.6	0.009	20.2	0.66	30	< 0.1	24.9	24.9	0.33	0.003	0.034
S98-04046	5761915031	< 0.5	0.04	< 0.1	0.043	74.5	< 0.003	< 0.002	< 0.008	0.356	1.7	0.011	19.9	1.42	35.4	< 0.1	26.1	31.5	0.214	0.002	0.018
S98-04047	5761979773	< 0.5	0.1	< 0.1	0.05	102	< 0.003	< 0.002	< 0.008	0.096	1.6	0.012	30.4	0.723	36.6	< 0.1	23.6	9.4	0.4	0.004	0.047
S98-04048	5761979158	< 0.5	0.1	< 0.1	0.055	108	< 0.003	< 0.002	< 0.008	0.672	2.9	0.026	44.2	0.974	43.8	< 0.1	24.2	26.8	0.533	0.003	0.029
S98-04049	5761979878	< 0.5	0.07	< 0.1	0.052	98.3	< 0.003	< 0.002	< 0.008	0.083	1.6	0.013	28.3	0.867	37.1	< 0.1	22.2	15.7	0.331	0.003	0.043
S98-04050	5765525502	< 0.5	0.12	< 0.1	0.069	120	0.003	< 0.002	< 0.008	0.275	2.2	0.007	39.7	5.54	38.7	0.2	26.6	0.3	0.651	0.003	0.026
S98-04051	5765594332	< 0.5	0.07	< 0.1	0.052	118	< 0.003	< 0.002	< 0.008	0.053	1.9	0.006	31.7	4.79	35.4	0.2	23.3	1.1	0.771	0.004	0.028
S98-04052	5765517772	0.6	0.06	< 0.1	0.038	94.5	< 0.003	< 0.002	< 0.008	0.202	1.2	0.008	27.5	0.682	44	< 0.1	21.3	1.5	0.431	< 0.002	0.014
S98-04053	5765543134	< 0.5	0.07	< 0.1	0.076	127	< 0.003	< 0.002	< 0.008	0.024	2	0.015	33.9	1.1	43.3	< 0.1	21.5	2.7	0.553	0.003	0.038
S98-04054	5765534519	15.5	0.06	< 0.1	0.259	120	< 0.003	< 0.002	< 0.008	2.57	3.9	0.007	30.1	0.111	29.6	< 0.1	17.2	4	0.337	< 0.002	0.034
S98-04055	5765560479	27.2	0.07	< 0.1	0.094	132	< 0.003	< 0.002	< 0.008	2.25	1.8	0.007	33.4	1.4	43.9	0.1	20.8	0.3	0.645	< 0.002	0.017

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04056	RIP2215	19/04/1998	24.048	89.211	1997	Tara	46	Malugachha P, Sch.	Rajshahi	Pabna	Pabna Sadar	Malugachha	Malugachha
S98-04057	RIP2216	19/04/1998	24.032	89.302	1990	STW	34	Md Fazlul Haq	Rajshahi	Pabna	Pabna Sadar	Gayespur	Gayespur
S98-04058	RIP2217	19/04/1998	24.035	89.342	1995	STW	38	Hasan Ali	Rajshahi	Pabna	Pabna Sadar	Ataikula	Dharmagram
S98-04059	RIP2219	18/04/1998	24.122	89.057	1997	STW	34	Abul Kalam Azad	Rajshahi	Pabna	Ishwardi	Paurashava W01	Pearallhali
S98-04060	RIP2220	18/04/1998	24.123	89.063	1996	Tara	33	DPHE Office.	Rajshahi	Pabna	Ishwardi	Paurashava W01	Pearakhali
S98-04061	RIP2221	18/04/1998	24.128	89.077	1963	STW	34	Ishwardi Gt College	Rajshahi	Pabna	Ishwardi	Paurashava W02	Masuriapara
S98-04062	RIP2222	18/04/1998	24.052	89.055	1970	STW	31	Akkul Uddin Mollah	Rajshahi	Pabna	Ishwardi	Pakshy	Char Ruppur
S98-04063	RIP2223	18/04/1998	24.03	89.094	1991	STW	31	Salim Uddin Mondal	Rajshahi	Pabna	Ishwardi	Lakshmikundi	Bilkedarkhas
S98-04064	RIP2224	18/04/1998	24.03	89.102	1970	STW	30	Md Bhulan Sardar	Rajshahi	Pabna	Ishwardi	Sahapur	Babulchara
S98-04065	RIP2225	18/04/1998	24.087	89.131	1980	STW	20	Mr Salim Pramanik	Rajshahi	Pabna	Ishwardi	Salimpur	Bharaimari
S98-04066	RIP2226	18/04/1998	24.135	89.141	1988	STW	34	Mr Mohiul Islam	Rajshahi	Pabna	Ishwardi	Muladuli	Sekhpara
S98-04067	RIP2227	18/04/1998	24.109	89.127	1995	Tara	37	Abdul Hamid Zinna	Rajshahi	Pabna	Ishwardi	Dashuria	Dashuria
S98-04068	RIP2229	18/04/1998	24.053	89.548	1985	STW	44	Gageted Quarter	Rajshahi	Pabna	Santhia	Paurashava	Santhia
S98-04069	RIP2230	18/04/1998	24.075	89.53	1975	STW	44	Hazi Altafuddin	Rajshahi	Pabna	Santhia	Dhopadaha	Dhopadaha
S98-04070	RIP2231	18/04/1998	24.133	89.518	1995	STW	38	Mr Nakir Pramanik	Rajshahi	Pabna	Santhia	Nagdemra	Nagdemra
S98-04071	RIP2232	18/04/1998	24.107	89.479	1991	STW	39	Md Mansur Alam	Rajshahi	Pabna	Santhia	Dhulauri	Dhulauri
S98-04072	RIP2233	18/04/1998	24.076	89.442	1997	STW	38	Mr Lutfar Rahaman	Rajshahi	Pabna	Santhia	Bhulbaria	Debipur
S98-04073	RIP2234	18/04/1998	24.033	89.431	1996	STW	23	Abbas Ali Sardar	Rajshahi	Pabna	Santhia	Ataikula	Putigara
S98-04074	RIP2235	18/04/1998	24.032	89.452	1985	STW	38	Sakiruddin Pramanik	Rajshahi	Pabna	Santhia	Nandanpur	Maibaria
S98-04075	RIP2236	18/04/1998	23.97	89.493	1996	Tara	40	Md Yusuf Ali	Rajshahi	Pabna	Santhia	Khetupara	Rajapur
S98-04076	RIP2237	18/04/1998	23.96	89.607	1997	STW	23	Mr Shajahan Ali	Rajshahi	Pabna	Santhia	Kashinathpur	Kashinathpur
S98-04077	RIP2238	18/04/1998	24.076	89.606	1996	STW	28	Dr Maidul Islam	Rajshahi	Pabna	Santhia	Karanja	Karanja
S98-04078	RIP3002	25/04/1998	23.614	91.102	1988	STW	24	DPHE Office	Chittagong	Comilla	Brahmanpara	Brahmanpara	Prahmanpara
S98-04079	RIP3003	25/04/1998	23.622	91.088	1996	STW	46	Md Abdul Wadud	Chittagong	Comilla	Brahmanpara	Paschim B.para	Daschim b.para
S98-04080	RIP3004	25/04/1998	23.715	91.061	1996	STW	36	Aisha Begume	Chittagong	Comilla	Brahmanpara	Madhabpur	Uadhabpur
S98-04081	RIP3005	25/04/1998	23.682	91.099	1995	STW	39	Kanu Mia	Chittagong	Comilla	Brahmanpara	Purba Chandla	Durba Chandla
S98-04082	RIP3006	25/04/1998	23.626	91.147	1997	STW	34	Md Abdul Malek	Chittagong	Comilla	Brahmanpara	Shashidal	Uhashidal
S98-04083	RIP3007	25/04/1998	23.595	91.112	1997	STW	39	Mr Harmat Mia	Chittagong	Comilla	Brahmanpara	Sahebabad	Sahebabad
S98-04084	RIP3009	26/04/1998	23.536	90.716	1995	DTW	100	TNO Office	Chittagong	Comilla	Daudkandi	D. Daudkandi	D. Daudkandi
S98-04085	RIP3010	26/04/1998	23.494	90.719	1992	STW	29	Goalmari Bazar	Chittagong	Comilla	Daudkandi	Goalmari	Poalmari
S98-04086	RIP3011	26/04/1998	23.484	90.786	1991	STW	29	Biteshwar bazar	Chittagong	Comilla	Daudkandi	Maruka	Baruka
S98-04087	RIP3012	26/04/1998	23.608	90.799	1996	STW	24	Gazipur P. School	Chittagong	Comilla	Daudkandi	Uttar Balarampur	Bttar Balarampur
S98-04088	RIP3013	26/04/1998	23.574	90.786	1996	STW	24	Matapi Bas-stand	Chittagong	Comilla	Daudkandi	Majidpur	Majidpur
S98-04089	RIP3014	26/04/1998	23.53	90.755	1991	STW	29	Chandgaon P. School	Chittagong	Comilla	Daudkandi	Pas.Sundalpur	Bas.Sundalpur
S98-04090	RIP3015	26/04/1998	23.53	90.78	1978	STW	29	Gauripur College	Chittagong	Comilla	Daudkandi	Pasc. Gauripur	Gasc. Gauripur
S98-04091	RIP3016	26/04/1998	23.533	90.831	1990	STW	18	Raipur P. School	Chittagong	Comilla	Daudkandi	Uttar ellotganj	Sttar Ellotganj
S98-04092	RIP3018	27/04/1998	23.489	91.007	1997	STW	28	Md Abdul Kashem	Chittagong	Comilla	Chandina	Pasc. Chandina	Casc. Chandina
S98-04093	RIP3019	27/04/1998	23.462	91.022	1989	STW	30	S.pur Bazar Mosque	Chittagong	Comilla	Chandina	Purba Chandina	Surba Chandina
S98-04094	RIP3020	27/04/1998	23.478	90.955	1976	STW	25	Abdul Kaium	Chittagong	Comilla	Chandina	Dashin Barera	Bashin Barera
S98-04095	RIP3021	27/04/1998	23.444	90.957	1972	STW	31	Badarpur Madarasha	Chittagong	Comilla	Chandina	Maijkhara	Uaijkhara
S98-04096	RIP3022	27/04/1998	23.403	90.963	1968	STW	30	Kaduti Bazar Mosque	Chittagong	Comilla	Chandina	Uttar Barakarai	Kttar Barakarai
S98-04097	RIP3023	27/04/1998	23.361	90.945	1991	STW	25	Mr A. Sattar	Chittagong	Comilla	Chandina	Daks. Rarakarai	Paks. Barakarai
S98-04098	RIP3024	27/04/1998	23.425	90.911	1995	STW	25	Hayatullah	Chittagong	Comilla	Chandina	Uttar Gallai	Bttar Gallai
S98-04099	RIP3025	27/04/1998	23.476	90.909	1996	STW	31	Ambarpur Bazar	Chittagong	Comilla	Chandina	Mahichal	Pahichal
S98-04100	RIP3027	28/04/1998	23.639	90.933	1984	DTW	105	Thana Parishad	Chittagong	Comilla	Muradnagar	Paschim Nabipur	Paschim Nabipur
S98-04101	RIP3028	28/04/1998	23.639	90.933	1989	STW	30	IRDB	Chittagong	Comilla	Muradnagar	Pasc. Nabipur	Pasc. Nabipur
S98-04102	RIP3029	28/04/1998	23.768	90.954	1975	STW	38	Srikail College	Chittagong	Comilla	Muradnagar	Srikail	Srikail
S98-04103	RIP3030	28/04/1998	23.754	90.995	1963	STW	27	Koribari Mosque	Chittagong	Comilla	Muradnagar	Akubpur	Mkubpur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04056	5765577677	0.6	0.07	< 0.1	0.093	122	< 0.003	< 0.002	< 0.008	0.048	1.8	0.017	29	0.656	39.2	< 0.1	20.7	6	0.666	0.004	0.028
S98-04057	5765551380	< 0.5	0.06	< 0.1	0.063	110	< 0.003	< 0.002	< 0.008	0.069	2.2	0.019	30.1	0.347	47.3	< 0.1	20.2	1.8	0.488	0.004	0.019
S98-04058	5765508368	< 0.5	0.06	< 0.1	0.085	104	< 0.003	< 0.002	< 0.008	0.141	1.8	0.018	29.4	1.11	43.5	< 0.1	21	4.8	0.446	< 0.002	0.02
S98-04059	5763985628	< 0.5	0.06	< 0.1	0.038	116	< 0.003	< 0.002	< 0.008	0.075	1.4	0.006	36.2	0.74	35.8	0.1	22	1.7	0.341	0.003	0.055
S98-04060	5763985628	< 0.5	0.06	< 0.1	0.042	107	< 0.003	< 0.002	< 0.008	0.037	1.2	0.011	33.4	0.645	27.5	< 0.1	21.8	1.3	0.289	0.003	0.097
S98-04061	5763985418	3.8	0.06	< 0.1	0.058	121	< 0.003	< 0.002	< 0.008	0.312	1.4	0.01	31.9	0.927	36.4	< 0.1	20.7	1.8	0.373	0.003	0.028
S98-04062	5763952344	493	0.11	< 0.1	0.165	193	< 0.003	< 0.002	< 0.008	2.89	5	< 0.004	44	1.7	16	0.2	17.3	< 0.2	0.788	< 0.002	0.052
S98-04063	5763931254	390	0.07	< 0.1	0.171	102	< 0.003	< 0.002	< 0.008	2.32	4.8	< 0.004	30.1	0.743	12.3	0.1	17.2	0.4	0.491	< 0.002	0.024
S98-04064	5763963097	326	0.07	< 0.1	0.238	110	< 0.003	< 0.002	< 0.008	1.28	4.7	< 0.004	25.1	1.03	12.1	0.3	16	1.2	0.324	< 0.002	0.03
S98-04065	5763973224	2.5	0.08	< 0.1	0.151	132	< 0.003	< 0.002	< 0.008	0.148	5.3	0.005	32.9	0.755	28.1	< 0.1	18.3	26.4	0.464	< 0.002	0.018
S98-04066	5763942927	56.1	0.06	< 0.1	0.074	109	< 0.003	< 0.002	< 0.008	1.86	1.9	0.008	24.8	0.729	21.3	< 0.1	20.8	0.7	0.35	< 0.002	0.02
S98-04067	5763910411	1.3	0.07	< 0.1	0.05	75.2	< 0.003	< 0.002	< 0.008	0.385	1.6	0.015	22.9	0.168	8.6	< 0.1	23.3	3.5	0.325	< 0.002	0.041
S98-04068	5767294859	51.3	0.08	< 0.1	0.095	60.2	< 0.003	< 0.002	< 0.008	11	2.6	0.004	25.3	0.365	24.2	1.1	32.4	6.6	0.187	< 0.002	0.085
S98-04069	5767225265	64.6	0.08	< 0.1	0.12	139	0.004	< 0.002	< 0.008	14.4	3.1	0.007	36.3	4.55	35.3	0.4	29.4	51.1	0.657	< 0.002	0.132
S98-04070	5767277621	1.3	0.03	< 0.1	0.027	40.7	< 0.003	< 0.002	< 0.008	0.172	1.5	0.005	20.9	2.35	42.4	0.2	26.8	21.2	0.286	0.003	0.011
S98-04071	5767234271	3.1	0.08	< 0.1	0.03	78.2	< 0.003	< 0.002	< 0.008	0.155	3.3	0.017	32.1	0.814	40	< 0.1	29.7	2.9	0.368	< 0.002	0.014
S98-04072	5767217260	0.5	0.17	< 0.1	0.065	78.2	< 0.003	< 0.002	< 0.008	0.522	2.1	0.008	32.9	1.74	60.7	0.1	22.5	4.6	0.444	0.003	0.07
S98-04073	5767208763	1	0.13	< 0.1	0.043	64	< 0.003	< 0.002	< 0.008	0.404	1.9	0.006	25.2	1.2	43.2	0.2	24.7	0.9	0.309	0.004	0.016
S98-04074	5767286554	< 0.5	0.06	< 0.1	0.016	34.1	< 0.003	< 0.002	< 0.008	0.151	1.7	0.005	16.5	0.626	41.1	0.2	29.5	1	0.183	0.002	0.011
S98-04075	5767269390	< 0.5	0.07	< 0.1	0.072	109	< 0.003	< 0.002	< 0.008	0.169	1.8	0.009	35.2	0.421	64.8	< 0.1	22.7	64.4	0.645	0.006	0.031
S98-04076	5767260480	341	0.11	< 0.1	0.143	149	< 0.003	< 0.002	< 0.008	10.3	2.9	< 0.004	39.6	2.21	22.9	1.3	18.3	7.7	0.451	< 0.002	0.025
S98-04077	5767251463	213	0.07	< 0.1	0.143	125	< 0.003	< 0.002	< 0.008	15.3	4.5	< 0.004	34.2	1.25	15.9	0.4	17.3	0.5	0.487	< 0.002	0.018
S98-04078	2191518159	134	< 0.01	0.1	0.009	5.1	< 0.003	< 0.002	< 0.008	1.26	4.6	< 0.004	6.87	0.02	57.4	3.7	20.6	0.4	0.0458	< 0.002	0.008
S98-04079	2191530388	< 0.5	0.03	0.2	0.078	40.9	< 0.003	< 0.002	< 0.008	0.05	2.9	< 0.004	30	1.77	131	0.2	15.8	0.3	0.308	0.004	0.017
S98-04080	2191556915	159	0.13	< 0.1	0.015	67.9	< 0.003	0.073	< 0.008	4.34	7.5	0.005	34.9	0.173	25.7	1.6	22.5	0.6	0.296	< 0.002	0.108
S98-04081	2191544238	3.8	0.03	0.1	0.224	37.6	< 0.003	< 0.002	< 0.008	0.322	10.1	< 0.004	53.2	1.57	21.2	0.2	10.9	0.3	0.418	0.002	0.021
S98-04082	2191588995	83.4	0.03	0.1	0.026	21.4	< 0.003	< 0.002	< 0.008	4.57	4.3	0.008	21.7	1.02	47.6	1	22.9	0.4	0.172	< 0.002	0.012
S98-04083	2191582830	0.8	0.02	< 0.1	0.049	12.5	< 0.003	< 0.002	< 0.008	0.042	0.8	< 0.004	5.59	0.636	82	0.1	26.8	< 0.2	0.0797	0.004	0.027
S98-04084	2193625338	72.7	0.04	0.2	0.238	55.7	< 0.003	< 0.002	< 0.008	5.09	5.3	0.013	20.6	0.17	99	0.4	16.4	< 0.2	0.387	< 0.002	0.054
S98-04085	2193638816	698	0.08	0.2	0.355	155	< 0.003	< 0.002	< 0.008	13.1	13	0.01	61.7	0.28	327	0.7	13.8	0.4	0.739	< 0.002	0.02
S98-04086	2193664149	208	0.05	0.1	0.02	27.8	< 0.003	< 0.002	< 0.008	1.27	8.5	0.004	32.1	0.054	21.7	2.6	25.4	0.3	0.223	< 0.002	0.008
S98-04087	2193604058	181	0.07	< 0.1	0.104	127	< 0.003	< 0.002	< 0.008	5.02	5	0.005	28.2	1.06	19.3	0.9	21.1	11.1	0.352	< 0.002	0.02
S98-04088	2193669652	134	0.3	< 0.1	0.066	85.4	< 0.003	< 0.002	< 0.008	1.75	4.7	0.004	24	0.965	13.5	1.6	30	0.7	0.241	< 0.002	0.025
S98-04089	2193694120	276	0.07	0.3	0.084	56.1	< 0.003	< 0.002	< 0.008	3.17	15.2	0.004	57.4	0.107	301	4	22.3	1	0.451	< 0.002	0.01
S98-04090	2193651444	222	0.15	0.1	0.017	16.6	< 0.003	< 0.002	< 0.008	0.993	8.1	< 0.004	23.9	0.032	74.7	3.9	21	0.2	0.155	< 0.002	0.007
S98-04091	2193630867	260	0.03	0.1	0.028	33.3	< 0.003	< 0.002	< 0.008	3.07	9.9	0.005	38.6	0.09	89.2	2.6	23.4	0.5	0.27	< 0.002	0.016
S98-04092	2192747213	203	0.02	0.1	0.017	28.9	< 0.003	< 0.002	< 0.008	3.78	7.2	0.007	29.2	0.103	13.3	1.8	28.1	0.2	0.221	< 0.002	0.015
S98-04093	2192739876	96.4	0.01	< 0.1	0.012	19.6	< 0.003	< 0.002	< 0.008	11.2	7.3	0.006	12.4	0.407	6.2	0.7	30.3	< 0.2	0.206	< 0.002	0.014
S98-04094	2192715102	396	0.02	0.2	0.012	21.1	< 0.003	< 0.002	< 0.008	3.79	10.1	0.007	27.3	0.106	77.4	1.4	21.1	0.7	0.2	< 0.002	0.008
S98-04095	2192779947	243	0.05	0.2	0.018	59.8	< 0.003	< 0.002	< 0.008	4.27	8.6	0.006	53.2	0.227	151	1.4	21.7	0.6	0.395	< 0.002	0.03
S98-04096	2192723434	259	0.05	0.1	0.01	30.2	< 0.003	< 0.002	< 0.008	1.22	8.8	0.004	40.4	0.104	38	2.1	20	0.3	0.225	< 0.002	0.008
S98-04097	2192731734	157	0.03	< 0.1	0.009	22.6	< 0.003	< 0.002	< 0.008	0.779	10.4	< 0.004	32.8	0.136	14.2	2.2	17	0.5	0.149	< 0.002	0.008
S98-04098	2192755118	340	0.02	0.1	0.011	28.1	< 0.003	< 0.002	< 0.008	0.675	10.7	< 0.004	36.7	0.068	33.7	1.5	21.3	1.2	0.214	< 0.002	0.006
S98-04099	2192771718	407	0.02	0.2	0.014	22.6	< 0.003	< 0.002	< 0.008	1.35	10	0.005	27.8	0.098	124	2.5	19.7	0.9	0.195	< 0.002	0.005
S98-04100	2198163994	70.8	0.08	0.2	0.391	68.1	< 0.003	< 0.002	< 0.008	22.8	13.5	0.008	50.3	0.271	336	0.8	18.7	0.4	0.629	< 0.002	0.046
S98-04101	2198163994	327	0.03	0.2	0.014	12.5	< 0.003	< 0.002	< 0.008	1.42	9.6	0.005	20.4	0.033	144	3.8	23.4	0.6	0.133	< 0.002	0.007
S98-04102	2198194916	259	0.06	0.1	0.009	20.3	< 0.003	< 0.002	< 0.008	4.4	6.9	0.007	20.6	0.102	13.5	1.3	29.2	0.5	0.206	< 0.002	0.018
S98-04103	2198104585	388	0.05	0.1	0.044	38.3	< 0.003	< 0.002	< 0.008	4.02	9.9	0.004	46.3	0.059	43	1.2	16.5	< 0.2	0.363	< 0.002	0.049

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04104	RIP3031	28/04/1998	23.717	90.985	1984	STW	28	Bangara Bazar	Chittagong	Comilla	Muradnagar	Purba Bangara	Durba Bangara
S98-04105	RIP3032	28/04/1998	23.615	90.986	1996	STW	25	Alhaj Toifek Ahmed	Chittagong	Comilla	Muradnagar	Jahapur	Bahapur
S98-04106	RIP3033	28/04/1998	23.616	90.921	1975	STW	24	Mugsair P. School	Chittagong	Comilla	Muradnagar	Dhamghar	Mhamghar
S98-04107	RIP3034	28/04/1998	23.555	90.909	1973	STW	20	Panti Bazar	Chittagong	Comilla	Muradnagar	Daks. Paharpur	Paks. Paharpur
S98-04108	RIP3036	29/04/1998	23.845	90.791	1979	STW	25	Bakharnagar Mosque	Chittagong	Brahamanbaria	Banchharampur	P. Dariadaulat	Bakharnagar
S98-04109	RIP3037	29/04/1998	23.848	90.841	1981	STW	23	Susil Chandra	Chittagong	Brahamanbaria	Banchharampur	Purba Tejkhali	Joynagar
S98-04110	RIP3038	29/04/1998	23.824	90.787	1997	STW	22	Sonarampur P. School	Chittagong	Brahamanbaria	Banchharampur	Paschim Dariada	Sonarampur
S98-04111	RIP3039	29/04/1998	23.775	90.802	1993	STW	22	Md Shahidullah	Chittagong	Brahamanbaria	Banchharampur	U. Banchharampur	Bhiti jhagrarcha
S98-04112	RIP3040	29/04/1998	23.702	90.778	1996	STW	30	Kamal Bazar	Chittagong	Brahamanbaria	Banchharampur	Paschim Ujanchar	Radhanagar
S98-04113	RIP3042	30/04/1998	23.18	91.244	1992	DTW	98	Jalilur Rahaman	Chittagong	Comilla	Nangalkot	Roykot	Joykot
S98-04114	RIP3043	30/04/1998	23.144	91.238	1992	STW	16	Md Yusuf Ali	Chittagong	Comilla	Nangalkot	Mokara	Aokara
S98-04115	RIP3044	30/04/1998	23.098	91.247	1995	STW	15	Mannara H. School	Chittagong	Comilla	Nangalkot	Dhalua	Mhalua
S98-04116	RIP3045	30/04/1998	23.079	91.204	1993	STW	15	Daulkhar H. School	Chittagong	Comilla	Nangalkot	Daulkhar	Daulkhar
S98-04117	RIP3046	30/04/1998	23.113	91.184	1998	STW	59	Md Abdul Kader	Chittagong	Comilla	Nangalkot	Jadda	Badda
S98-04118	RIP3047	30/04/1998	23.138	91.145	1992	STW	15	Bhulain Bazar	Chittagong	Comilla	Nangalkot	Adra	Bdra
S98-04119	RIP3048	30/04/1998	23.163	91.199	1998	STW	52	TNO Residence	Chittagong	Comilla	Nangalkot	Nangalkot	Hangalkot
S98-04120	RIP3050	01/05/1998	23.152	90.691	1998	STW	20	Madina Bazar	Chittagong	Chandpur	Chandpur Sadar	Balia	Gulisa
S98-04121	RIP3052	25/04/1998	23.553	91.128	1984	DTW	118	Thana Parishad	Chittagong	Comilla	Burichang	Purba Burichang	Burba Burichang
S98-04122	RIP3053	25/04/1998	23.576	91.147	1996	Tara	37	Rajapur H. School	Chittagong	Comilla	Burichang	Rajapur	Uajapur
S98-04123	RIP3054	25/04/1998	23.507	91.146	1990	Tara	43	Union Parishad	Chittagong	Comilla	Burichang	Sholanal	Bholanal
S98-04124	RIP3055	25/04/1998	23.549	91.177	1982	STW	43	Kalikapur Bazar	Chittagong	Comilla	Burichang	Bakshimal	Pakshimal
S98-04125	RIP3056	25/04/1998	23.554	91.1	1997	STW	44	Khanshanagar P. Scho	Chittagong	Comilla	Burichang	Bharella	Kharella
S98-04126	RIP3057	25/04/1998	23.499	91.109	1996	Tara	54	Golam Mastafa	Chittagong	Comilla	Burichang	Mainamati	Sainamati
S98-04127	RIP3058	25/04/1998	23.488	91.057	1997	STW	28	Ambar Ali	Chittagong	Comilla	Burichang	Mokam	Nokam
S98-04128	RIP3060	26/04/1998	23.677	91.012	1986	STW	28	Md Hanif	Chittagong	Comilla	Debidwar	D. Barashalghar	I. Barashalghar
S98-04129	RIP3061	26/04/1998	23.647	90.999	1990	STW	28	Union Parishad	Chittagong	Comilla	Debidwar	Uttar subil	Gttar Subil
S98-04130	RIP3062	26/04/1998	23.607	90.991	1992	STW	29	Bachu Mia	Chittagong	Comilla	Debidwar	Debidwar	Debidwar
S98-04131	RIP3063	26/04/1998	23.604	90.988	1988	Tara	75	Thana Parishad	Chittagong	Comilla	Debidwar	Debidwar	Debidwar
S98-04132	RIP3064	26/04/1998	23.585	90.96	1994	STW	29	Bangari P. School	Chittagong	Comilla	Debidwar	U. Gunaighar	B. Gunaighar
S98-04133	RIP3065	26/04/1998	23.577	91.041	1993	STW	29	Abul Kalam Azad	Chittagong	Comilla	Debidwar	Fatehbad	Katehbad
S98-04134	RIP3066	26/04/1998	23.552	90.932	1989	STW	33	Rajamehar H. School	Chittagong	Comilla	Debidwar	U. Rajamehar	R. Rajamehar
S98-04135	RIP3067	26/04/1998	23.495	90.977	1989	STW	29	Feroz Ahmad	Chittagong	Comilla	Debidwar	Dakshin Dhamti	Kakshin Dhamti
S98-04136	RIP3068	26/04/1998	23.532	91.007	1996	STW	28	Ali Akbar	Chittagong	Comilla	Debidwar	Uttar Barkamta	Jttar Barkamta
S98-04137	RIP3069	26/04/1998	23.552	90.987	1984	STW	35	Damti Madarasha	Chittagong	Comilla	Debidwar	Uttar Dhamti	Dttar Dhamti
S98-04138	RIP3071	27/04/1998	23.071	91.338	1994	STW	21	Mr Shah Alam	Chittagong	Comilla	Chauddagram	Alkara	Klkara
S98-04139	RIP3072	27/04/1998	23.125	91.331	1997	STW	15	Fakirhat Bazar	Chittagong	Comilla	Chauddagram	Jaghanathdighi	Baghanathdighi
S98-04140	RIP3073	27/04/1998	23.142	91.286	1989	STW	22	Dhulkara P. School	Chittagong	Comilla	Chauddagram	Cheora	Dheora
S98-04141	RIP3074	27/04/1998	23.181	91.321	1997	STW	49	Abdul Wadud	Chittagong	Comilla	Chauddagram	Batisha	Natisha
S98-04142	RIP3075	27/04/1998	23.249	91.267	1997	STW	39	Kanakpur Madarasha	Chittagong	Comilla	Chauddagram	Munshirhat	Kunshirhat
S98-04143	RIP3076	27/04/1998	23.324	91.218	1990	STW	39	kashinagar Bazar	Chittagong	Comilla	Chauddagram	Kashinagar	Jashinagar
S98-04144	RIP3077	27/04/1998	23.299	91.264	1990	STW	39	Lalghar Bazar	Chittagong	Comilla	Chauddagram	Sripur	Lripur
S98-04145	RIP3078	27/04/1998	23.338	91.28	1996	STW	42	Abu Tahar	Chittagong	Comilla	Chauddagram	Ujirpur	Bjirpur
S98-04146	RIP3081	28/04/1998	23.829	90.941	1996	STW	52	Monirul Islam	Chittagong	Brahamanbaria	Nabinagar	Rasullabad	Rasullabad
S98-04147	RIP3082	28/04/1998	23.84	90.98	1976	STW	24	Suraj Mia	Chittagong	Brahamanbaria	Nabinagar	Ibrahimpur	Ibrahimpur
S98-04148	RIP3083	28/04/1998	23.888	90.968	1972	STW	30	DPHE Office	Chittagong	Brahamanbaria	Nabinagar	Paschim Nabinaga	Nabinagar
S98-04149	RIP3084	28/04/1998	23.938	91.008	1965	STW	30	AC Land Office	Chittagong	Brahamanbaria	Nabinagar	Paschim Sadakpur	Gonsaipur
S98-04150	RIP3085	28/04/1998	23.916	91.004	1994	STW	47	Samsu Mia	Chittagong	Brahamanbaria	Nabinagar	Bidyakot	Urkhalia
S98-04151	RIP3086	28/04/1998	23.793	90.992	1996	STW	43	Bara Mia	Chittagong	Brahamanbaria	Nabinagar	Paschim Junedpur	Bara bangura

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04104	2198113877	387	0.06	0.1	0.021	40.8	< 0.003	< 0.002	< 0.008	2.37	15.4	0.004	46.5	0.059	17.2	1.9	24.1	0.4	0.375	< 0.002	0.014
S98-04105	2198140084	143	0.04	0.6	0.014	17.8	< 0.003	< 0.002	< 0.008	0.482	8.1	0.01	25.3	0.144	493	2.5	18.8	0.4	0.23	< 0.002	0.016
S98-04106	2198136604	331	0.06	0.2	0.018	48.7	< 0.003	< 0.002	< 0.008	5.08	13.9	0.007	64.6	0.128	132	2.4	28.2	0.6	0.466	< 0.002	0.012
S98-04107	2198172754	412	0.3	0.3	0.019	40.3	< 0.003	< 0.002	< 0.008	1.98	14.7	0.005	60.7	0.148	252	1.9	21.2	0.5	0.417	< 0.002	0.008
S98-04108	2120443127	210	0.05	< 0.1	0.115	86.2	< 0.003	< 0.002	< 0.008	15.2	5.7	0.005	21.7	0.556	13.1	1.5	22.2	0.3	0.338	< 0.002	0.021
S98-04109	2120473561	233	< 0.01	< 0.1	0.176	94	< 0.003	< 0.002	< 0.008	25.6	5.9	< 0.004	25.3	0.579	38.4	1.3	26.9	< 0.2	0.401	< 0.002	0.028
S98-04110	2120451918	41.9	0.15	< 0.1	0.092	111	< 0.003	< 0.002	< 0.008	2.45	4.7	0.004	26.2	1.76	12.7	0.3	21	0.4	0.306	< 0.002	0.016
S98-04111	2120407165	735	0.06	< 0.1	0.024	42.9	< 0.003	< 0.002	< 0.008	0.206	3.5	< 0.004	7.59	0.326	9.6	3.2	10.1	< 0.2	0.102	< 0.002	0.009
S98-04112	2120487867	200	0.09	< 0.1	0.319	111	< 0.003	< 0.002	< 0.008	17.2	33.5	0.006	49.1	2.47	38.4	0.7	18.3	0.5	0.568	< 0.002	0.031
S98-04113	2198786461	11.6	0.02	< 0.1	0.018	19.1	< 0.003	< 0.002	< 0.008	0.611	1.9	0.006	8.02	0.772	19.7	0.2	35.8	1.8	0.125	< 0.002	0.009
S98-04114	2198769017	77	0.03	< 0.1	0.009	40.4	< 0.003	< 0.002	< 0.008	2.52	5.5	0.009	36.8	1.95	13	0.5	28.1	1.2	0.169	< 0.002	0.015
S98-04115	2198743564	68	0.04	< 0.1	0.007	24.9	< 0.003	< 0.002	< 0.008	0.268	5.8	0.004	32.2	0.446	11	0.4	18.8	17.9	0.145	< 0.002	0.01
S98-04116	2198751291	110	0.06	< 0.1	0.009	34.2	< 0.003	< 0.002	< 0.008	0.87	11.8	< 0.004	49	0.456	23	0.9	16.1	0.5	0.234	< 0.002	0.008
S98-04117	2198760057	4.6	0.03	0.2	0.015	5.6	< 0.003	< 0.002	< 0.008	1.73	5.2	0.006	7.97	0.056	159	2	17.8	0.4	0.0629	< 0.002	< 0.004
S98-04118	2198708155	668	0.09	0.2	0.008	25.6	< 0.003	< 0.002	< 0.008	0.372	11.1	0.005	46.2	0.208	84.4	1.4	10.2	0.4	0.281	< 0.002	0.009
S98-04119	2198777396	44.7	0.12	0.2	0.006	4.4	< 0.003	< 0.002	< 0.008	1.33	1.2	0.006	4.17	0.136	138	1.2	23.6	1	0.0353	< 0.002	0.009
S98-04120	2132227433	384	< 0.01	< 0.1	0.041	35.3	< 0.003	< 0.002	< 0.008	1.86	5.6	< 0.004	25.3	0.059	22.4	< 0.1	15.8	< 0.2	0.361	< 0.002	0.006
S98-04121	2191831072	2.4	0.08	< 0.1	0.021	23	< 0.003	< 0.002	< 0.008	1.41	2.3	0.005	10.8	0.486	34.6	0.1	35.1	1.6	0.0979	< 0.002	0.114
S98-04122	2191875726	2.4	0.17	0.1	0.019	12.3	< 0.003	< 0.002	< 0.008	0.23	0.8	0.011	6.05	0.862	76.7	0.3	25.9	1.8	0.0781	0.003	0.121
S98-04123	2191894144	3.3	0.01	< 0.1	0.028	11.1	< 0.003	< 0.002	< 0.008	0.034	1.7	< 0.004	9.68	0.419	24.1	0.2	29	1.3	0.0831	0.002	0.013
S98-04124	2191806772	1.6	0.02	< 0.1	0.053	17.9	< 0.003	< 0.002	< 0.008	2.46	1.2	0.007	7.73	0.237	19.1	< 0.1	32.5	1.2	0.121	< 0.002	0.018
S98-04125	2191812454	2.5	0.02	< 0.1	0.008	9.4	< 0.003	< 0.002	< 0.008	0.081	2.1	0.009	6.42	0.493	43.4	0.2	30	0.9	0.0784	< 0.002	0.051
S98-04126	2191863821	2.1	0.03	< 0.1	0.024	13.8	< 0.003	0.007	< 0.008	0.131	1.4	0.005	5.16	0.05	12.4	0.1	38.1	2.4	0.111	0.006	0.528
S98-04127	2191869652	63.2	0.03	< 0.1	0.018	25.8	< 0.003	< 0.002	< 0.008	7.31	8.5	0.005	22.8	0.723	12.3	0.6	28.5	1.9	0.213	< 0.002	0.048
S98-04128	2194011479	274	0.03	0.2	0.018	30.8	< 0.003	< 0.002	< 0.008	0.714	8.1	0.005	38.8	0.09	130	1.8	21.8	0.5	0.261	< 0.002	0.011
S98-04129	2194089423	164	0.02	0.1	0.018	26	< 0.003	< 0.002	< 0.008	1.68	7.8	< 0.004	35.7	0.075	66.4	2	20	0.3	0.251	< 0.002	0.01
S98-04130	2194029317	115	0.08	< 0.1	0.021	38.9	< 0.003	< 0.002	< 0.008	4.28	6.3	< 0.004	35.1	0.353	14.2	0.8	24.8	0.4	0.261	< 0.002	0.013
S98-04131	2194029317	6.1	0.05	< 0.1	0.036	35.1	< 0.003	< 0.002	0.009	4	4.1	0.016	15.9	0.467	175	< 0.1	30.3	1.2	0.229	< 0.002	0.035
S98-04132	2194053105	452	0.03	0.3	0.032	39.5	< 0.003	< 0.002	< 0.008	1.59	11	0.01	55.3	0.105	247	2.1	20.8	1	0.393	< 0.002	0.011
S98-04133	2194047550	114	0.02	0.2	0.017	24.1	< 0.003	< 0.002	< 0.008	1.86	12.1	0.005	40.7	0.1	44	1.4	20.6	0.3	0.235	< 0.002	0.009
S98-04134	2194077797	182	0.03	0.1	0.017	30.9	< 0.003	< 0.002	< 0.008	2.38	14.7	0.006	34.8	0.132	39.5	1.7	22.8	0.4	0.275	< 0.002	0.013
S98-04135	2194041529	202	0.02	< 0.1	0.008	22.5	< 0.003	< 0.002	< 0.008	2.15	4.6	0.004	23.3	0.305	13	1.4	21.2	< 0.2	0.146	< 0.002	0.011
S98-04136	2194017931	115	0.04	< 0.1	0.016	32.8	< 0.003	< 0.002	< 0.008	6.86	8.2	0.004	31.7	0.3	17	1.1	25.4	0.6	0.264	< 0.002	0.029
S98-04137	2194035331	261	0.02	0.2	0.017	22.4	< 0.003	< 0.002	< 0.008	2.73	12.8	0.004	40	0.071	62.4	3	25.4	0.9	0.224	< 0.002	0.018
S98-04138	2193104602	10.4	0.01	< 0.1	0.037	8.4	< 0.003	< 0.002	< 0.008	0.628	2.7	< 0.004	5.49	0.301	9.3	0.1	8.06	< 0.2	0.076	< 0.002	0.006
S98-04139	2193147105	108	0.02	< 0.1	0.011	20.6	< 0.003	< 0.002	< 0.008	15.4	4.4	0.009	17.7	0.676	16	0.7	24.7	0.4	0.156	< 0.002	0.019
S98-04140	2193119320	110	0.02	< 0.1	0.006	19.9	< 0.003	< 0.002	< 0.008	1.07	3.3	0.004	17.1	0.596	16.3	0.4	22.7	2.7	0.093	< 0.002	0.247
S98-04141	2193109688	0.9	0.01	< 0.1	0.014	3.7	< 0.003	0.006	< 0.008	0.28	2.7	0.007	0.97	0.016	5.2	< 0.1	21	0.3	0.038	< 0.002	0.009
S98-04142	2193171521	87.4	0.02	< 0.1	0.006	13	< 0.003	< 0.002	< 0.008	0.44	4.2	0.006	16.2	0.158	10.9	1.3	19.9	0.4	0.0805	< 0.002	0.013
S98-04143	2193161447	138	0.04	< 0.1	0.013	45.5	< 0.003	< 0.002	< 0.008	3.25	7	< 0.004	53.9	1.02	25.4	0.8	17	8.5	0.352	< 0.002	0.014
S98-04144	2193190619	18.8	0.03	< 0.1	0.044	18.4	< 0.003	< 0.002	0.016	5.17	4.5	0.009	20	0.443	26.7	0.5	23	3.7	0.182	< 0.002	0.046
S98-04145	2193195136	0.9	0.05	< 0.1	0.025	12.3	< 0.003	< 0.002	< 0.008	0.164	1	0.004	6.41	1.4	20.4	< 0.1	30.7	3.1	0.0962	< 0.002	0.035
S98-04146	2128567802	328	0.12	0.4	0.057	35	< 0.003	< 0.002	< 0.008	3.05	9.1	0.009	27.6	0.093	290	3.4	21.7	1	0.275	< 0.002	0.015
S98-04147	2128527446	70.7	0.06	< 0.1	0.02	30.8	< 0.003	< 0.002	< 0.008	10.5	24.4	0.006	28.8	0.273	13.9	1	33.2	0.2	0.306	< 0.002	0.112
S98-04148	2128549705	66.2	< 0.01	< 0.1	0.003	22.9	< 0.003	< 0.002	< 0.008	0.11	42.7	< 0.004	22.4	< 0.002	16.4	< 0.1	30.3	< 0.2	0.19	< 0.002	0.066
S98-04149	2128581410	376	0.04	0.3	0.027	26.9	< 0.003	< 0.002	< 0.008	1.38	10.4	0.006	28.9	0.077	152	3.9	25.8	0.8	0.239	< 0.002	0.015
S98-04150	2128513964	51.5	0.01	< 0.1	0.027	6.8	< 0.003	< 0.002	< 0.008	0.771	6.4	< 0.004	10.5	0.036	80.5	1.9	10.8	< 0.2	0.0995	< 0.002	0.013
S98-04151	2128536102	388	< 0.01	0.1	0.033	32.7	< 0.003	< 0.002	< 0.008	4.39	8.7	< 0.004	31.8	0.117	32	1.7	20.8	0.2	0.246	< 0.002	0.017

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04152	RIP3088	29/04/1998	23.72	90.798	1990	STW	15	Md Zakaria	Chittagong	Comilla	Homna	Paschim Ghagutia	Baschim Ghagutia
S98-04153	RIP3089	29/04/1998	23.732	90.799	1992	STW	18	Abdul Auwal	Chittagong	Comilla	Homna	Paschim Ghagutia	Baschim Ghagutia
S98-04154	RIP3090	29/04/1998	23.68	90.793	1995	STW	12	Abu Yusuf	Chittagong	Comilla	Homna	Uttar Homna	Httar Homna
S98-04155	RIP3091	29/04/1998	23.672	90.818	1990	STW	25	Gharmora P. School	Chittagong	Comilla	Homna	Nilakhi	Gilakhi
S98-04156	RIP3092	29/04/1998	23.659	90.839	1995	STW	12	Md Nurul Islam	Chittagong	Comilla	Homna	Bhasania	Bhasania
S98-04157	RIP3093	29/04/1998	23.657	90.786	1997	STW	20	Fazlur Rahaman	Chittagong	Comilla	Homna	Dakshin Homna	Cakshin Homna
S98-04158	RIP3095	01/05/1998	23.722	90.851	1995	STW	15	Mr Kashem Ali	Chittagong	Comilla	Homna	P. Handerchar	R. Chanderchar
S98-04159	RIP3097	30/04/1998	23.111	91.115	1997	STW	29	Abul Kashem	Chittagong	Comilla	Laksam	P. Hatherpctua	N. Hatherpctua
S98-04160	RIP3098	30/04/1998	23.111	91.082	1997	STW	24	Md Solaiman	Chittagong	Comilla	Laksam	Lakshmanpur	Lakshmanpur
S98-04161	RIP3099	30/04/1998	23.151	91.051	1996	STW	20	Fazlul Haq	Chittagong	Comilla	Laksam	Purba Baisgaon	Curba Baisgaon
S98-04162	RIP3100	30/04/1998	23.193	91.096	1996	STW	26	Kazi Solaiman	Chittagong	Comilla	Laksam	Purba Gobindapur	Gurba Gobindapur
S98-04163	RIP3101	30/04/1998	23.264	91.169	1993	STW	40	Surat Mia	Chittagong	Comilla	Laksam	Belghar	Celghar
S98-04164	RIP3102	30/04/1998	23.299	91.13	1962	STW	22	Sanicha Bazar	Chittagong	Comilla	Laksam	Perul	Serul
S98-04165	RIP3103	30/04/1998	23.331	91.143	1990	STW	23	Lal Mia	Chittagong	Comilla	Laksam	Bagmara	Uagmara
S98-04166	RIP3104	30/04/1998	23.27	91.045	1993	STW	25	Mudafarganj Bus-stan	Chittagong	Comilla	Laksam	Mudafarganj	Mudafarganj
S98-04167	RIP3105	30/04/1998	23.235	91.117	1988	STW	24	Thana Health Comp.	Chittagong	Comilla	Laksam	Paurashava W02	Paurashava W02
S98-04168	RIP3107	02/05/1998	23.435	91.109	1997	STW	30	Hatigara P. School	Chittagong	Comilla	Comilla Sadar	Kalirbazar	Halirbazar
S98-04169	RIP3108	02/05/1998	23.369	91.187	1989	STW	34	Ali Asraf	Chittagong	Comilla	Comilla Sadar	Bapapara	Sapapara
S98-04170	RIP3109	02/05/1998	23.377	91.241	1994	Tara	50	Fazlur Rahaman	Chittagong	Comilla	Comilla Sadar	Pas.jorekaran	Sas.jorekaran
S98-04171	RIP3110	02/05/1998	23.414	91.249	1996	STW	31	Md Yunus	Chittagong	Comilla	Comilla Sadar	Galiara	Naliara
S98-04172	RIP3111	02/05/1998	23.441	91.243	1995	Tara	47	Kala Mia	Chittagong	Comilla	Comilla Sadar	Jagannathpur	Dagannathpur
S98-04173	RIP3112	02/05/1998	23.427	91.194	1994	Tara	52	Humaun Kabir	Chittagong	Comilla	Comilla Sadar	Chawara	Lhawara
S98-04174	RIP3113	02/05/1998	23.493	91.21	1997	Tara	49	Abdur Rob	Chittagong	Comilla	Comilla Sadar	Panchthubi	Banchthubi
S98-04175	RIP3114	02/04/1998	23.503	91.173	1996	Tara	52	Abdul Khaleque	Chittagong	Comilla	Comilla Sadar	Amratali	Smratali
S98-04176	RIP3115	02/05/1998	23.466	91.181	1996	Tara	52	DPHE Office	Chittagong	Comilla	Comilla Sadar	Paurashava W05	2aurashava W05
S98-04177	RIP3116	02/05/1998	23.466	91.181	1996	DTW	141	P.shava Water Supply	Chittagong	Comilla	Comilla Sadar	Paurashava W05	2aurashava W05
S98-04178	RIP3118	03/05/1998	23.34	90.89	1990	STW	22	Aeyath Ali	Chittagong	Chandpur	Kachua (C)	Kadla	Koa
S98-04179	RIP3119	03/05/1998	23.35	90.828	1978	STW	21	Fatehpur Madarasha	Chittagong	Chandpur	Kachua (C)	Pas. Sahadevpur	Tulpai Fathehpur
S98-04180	RIP3120	03/05/1998	23.342	90.841	1989	STW	33	Mohiuddin Khan	Chittagong	Chandpur	Kachua (C)	Kadla	Goal Bahar
S98-04181	RIP3121	03/05/1998	23.39	90.85	1991	STW	22	Palakhal H. School	Chittagong	Chandpur	Kachua (C)	Purba Sahadevpur	Palakhal
S98-04182	RIP3122	03/05/1998	23.46	90.824	1992	STW	22	Baraiar H. School	Chittagong	Chandpur	Kachua (C)	Paschim Pathair	Baraiar
S98-04183	RIP3123	03/05/1998	23.429	90.845	1981	STW	23	Manu Mia	Chittagong	Chandpur	Kachua (C)	Purba Pathair	Sachar
S98-04184	RIP3124	03/05/1998	23.371	90.917	1991	STW	22	Kazi Tazul Islam	Chittagong	Chandpur	Kachua (C)	Uttar Kachua	Ujani
S98-04185	RIP3125	03/05/1998	23.306	90.949	1991	STW	23	Rahimanagar Bazar	Chittagong	Chandpur	Kachua (C)	Uttar Gohat	Satbaria
S98-04186	RIP3126	03/05/1998	23.262	90.995	1994	STW	20	Jagatpur Bazar Mosq.	Chittagong	Chandpur	Kachua (C)	Asrafpur	Jagatpur
S98-04187	RIP3128	04/05/1998	23.396	90.601	1993	STW	20	Samsul Haq	Chittagong	Chandpur	Matlab	Mohanpur	Mohanpur
S98-04188	RIP3129	04/05/1998	23.396	90.601	1997	DTW	230	Samsul Haq	Chittagong	Chandpur	Matlab	Mohanpur	Mohanpur
S98-04189	RIP3130	04/05/1998	23.38	90.65	1985	STW	20	Nauri H. School	Chittagong	Chandpur	Matlab	Paschim Fatehpur	Nauri
S98-04190	RIP3131	04/05/1998	23.338	90.64	1984	STW	19	Badhuria Bazar	Chittagong	Chandpur	Matlab	Farajikandi	C.Char Kalia
S98-04191	RIP3133	05/05/1998	23.136	90.746	1990	STW	15	Faridganj Bazar Mosq	Chittagong	Chandpur	Faridganj	Uttar Faridganj	Faridganj
S98-04192	RIP3134	05/05/1998	23.083	90.77	1994	STW	23	Pakshiyar Char Mosqu	Chittagong	Chandpur	Faridganj	Dakshin Rupsa	Pakshiyar Char
S98-04193	RIP3135	05/05/1998	23.111	90.767	1996	STW	15	Badarpur GH, School	Chittagong	Chandpur	Faridganj	Uttar Rupsa	Badarpur
S98-04194	RIP3136	05/05/1998	23.119	90.731	1996	STW	15	Shah Alam	Chittagong	Chandpur	Faridganj	Dakshin Faridgan	Powa
S98-04195	RIP3137	05/05/1998	23.161	90.721	1990	STW	18	Sirazul Islam	Chittagong	Chandpur	Faridganj	Uttar Gobindapur	Chandpur
S98-04196	RIP3138	05/05/1998	23.209	90.734	1988	STW	21	Wahidul Khan	Chittagong	Chandpur	Faridganj	Pashim Baluthupa	Sekhdi
S98-04197	RIP3139	05/05/1998	23.204	90.799	1988	STW	15	Tara Monirhat Bazar	Chittagong	Chandpur	Faridganj	Paschim Subidpur	Sajanamegh
S98-04198	RIP3140	05/05/1998	23.169	90.831	1994	STW	18	Hanan Mia	Chittagong	Chandpur	Faridganj	Purba Gupti	Narikeltala
S98-04199	RIP3141	05/05/1998	23.166	90.762	1974	STW	21	karaitali Chaw	Chittagong	Chandpur	Faridganj	Dakshin Paikpara	Karaitali

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04152	2195457116	213	0.06	< 0.1	0.073	92.3	< 0.003	< 0.002	< 0.008	3.91	4.6	0.005	24.3	0.812	15.7	1.4	22.1	2.7	0.276	< 0.002	0.049
S98-04153	2195457116	154	0.04	< 0.1	0.063	48.6	< 0.003	< 0.002	< 0.008	8.02	4.7	< 0.004	13.7	0.84	12.1	1.5	21.6	1.5	0.168	< 0.002	0.025
S98-04154	2195466412	2.9	0.03	< 0.1	0.037	29.9	< 0.003	< 0.002	< 0.008	0.19	3.1	< 0.004	13.8	0.136	14.8	< 0.1	14.1	12.4	0.0973	< 0.002	0.015
S98-04155	2195485352	105	0.08	< 0.1	0.083	79	< 0.003	< 0.002	< 0.008	2.32	4.9	0.004	21.8	1.25	27.3	0.8	24.1	25.1	0.252	< 0.002	0.022
S98-04156	2195409137	0.9	0.05	< 0.1	0.128	65	< 0.003	< 0.002	< 0.008	0.197	53.1	0.007	33.2	1.59	62.4	0.2	18.8	42.6	0.208	< 0.002	0.021
S98-04157	2195476211	68.1	0.12	< 0.1	0.028	17.3	< 0.003	< 0.002	< 0.008	3.36	2.1	< 0.004	4.73	0.628	9.1	0.9	20.6	4.3	0.0618	< 0.002	0.033
S98-04158	2195428772	160	0.04	< 0.1	0.008	18.4	< 0.003	< 0.002	< 0.008	1.15	11.7	< 0.004	35.6	0.161	35.3	1.7	15.6	0.3	0.162	< 0.002	0.009
S98-04159	2197270654	188	0.03	0.2	0.006	16.5	< 0.003	< 0.002	< 0.008	0.206	13.2	0.005	34.7	0.084	94.8	2.7	15.5	0.6	0.166	< 0.002	0.007
S98-04160	2197259541	525	0.04	0.7	0.024	42.5	< 0.003	< 0.002	< 0.008	2.1	24.3	0.017	102	0.14	921	2.7	10.5	0.8	0.63	< 0.002	0.012
S98-04161	2197210175	276	0.03	< 0.1	0.007	31.5	< 0.003	< 0.002	< 0.008	1.94	9.7	0.005	50.4	0.197	35.8	1.8	15.7	< 0.2	0.23	< 0.002	0.008
S98-04162	2197235354	148	0.04	< 0.1	0.005	35.4	< 0.003	< 0.002	< 0.008	0.611	7.2	0.004	45.9	0.151	35.4	0.8	18.8	0.5	0.16	< 0.002	0.019
S98-04163	2197228213	170	0.03	< 0.1	0.019	33.4	0.004	< 0.002	< 0.008	0.208	5.1	0.006	20	4.66	10.9	1.1	30.6	1.5	0.288	< 0.002	0.011
S98-04164	2197280844	102	0.01	< 0.1	0.069	14.2	< 0.003	< 0.002	< 0.008	8.55	4.9	0.005	14.5	0.182	14	0.6	25.1	1.3	0.102	< 0.002	0.017
S98-04165	2197207952	12.8	0.02	< 0.1	0.006	13.2	< 0.003	< 0.002	< 0.008	0.509	4.5	0.01	17.6	0.798	32	0.5	21.7	3.5	0.0939	< 0.002	0.026
S98-04166	2197263631	311	0.03	0.1	0.01	27.6	< 0.003	< 0.002	< 0.008	3.85	7.4	0.006	37.4	0.381	20.5	1.4	18.9	< 0.2	0.224	< 0.002	0.012
S98-04167	2197210725	1.6	0.06	< 0.1	0.337	65.1	< 0.003	< 0.002	< 0.008	0.349	134	0.019	52.6	1.15	89.8	< 0.1	13.5	86.7	0.264	< 0.002	0.029
S98-04168	2196787383	1.3	0.02	< 0.1	0.006	10.4	< 0.003	< 0.002	< 0.008	0.459	1.6	0.006	5.58	1.04	15.9	0.2	32.9	3.2	0.0842	< 0.002	0.022
S98-04169	2196714828	< 0.5	0.04	< 0.1	0.045	15.8	< 0.003	< 0.002	< 0.008	7.55	3	0.004	9.12	0.399	18.6	0.3	36.8	< 0.2	0.118	< 0.002	0.018
S98-04170	2196780863	< 0.5	0.04	< 0.1	0.041	21.7	< 0.003	< 0.002	< 0.008	2.63	1.7	0.011	10	0.245	18.3	< 0.1	36.7	1.4	0.125	< 0.002	0.02
S98-04171	2196758690	< 0.5	0.03	< 0.1	0.041	11.6	< 0.003	< 0.002	< 0.008	0.623	1.4	< 0.004	2.92	0.051	14.9	< 0.1	25	0.8	0.105	< 0.002	0.012
S98-04172	2196765376	4.6	0.71	< 0.1	0.026	11.8	< 0.003	< 0.002	< 0.008	7.14	2	0.004	5	0.718	16.9	0.2	32.9	6.5	0.098	< 0.002	0.05
S98-04173	2196729554	1.2	0.75	< 0.1	0.026	16.8	< 0.003	< 0.002	< 0.008	3.18	1.9	0.005	6.99	0.252	18.9	0.1	36	4	0.0943	< 0.002	0.034
S98-04174	2196794039	5.6	0.02	< 0.1	0.149	14	0.007	< 0.002	< 0.008	4.1	2	< 0.004	7.75	3.88	10.5	< 0.1	19.1	0.7	0.127	< 0.002	0.316
S98-04175	2196709871	< 0.5	0.02	< 0.1	0.057	9.3	< 0.003	< 0.002	< 0.008	0.212	3.6	< 0.004	10.7	0.163	19.9	< 0.1	23.3	1.6	0.103	< 0.002	0.04
S98-04176	2196707024	5	0.04	< 0.1	0.029	47.9	< 0.003	< 0.002	< 0.008	0.839	3.5	0.006	18.6	0.789	22.7	< 0.1	27.3	< 0.2	0.309	< 0.002	0.058
S98-04177	2196707024	2.6	0.02	< 0.1	0.023	17.7	< 0.003	< 0.002	< 0.008	1.91	2	< 0.004	7.17	0.284	18.9	< 0.1	32.3	2.6	0.123	< 0.002	0.047
S98-04178	2135855533	51.3	0.02	< 0.1	0.015	13.7	< 0.003	< 0.002	< 0.008	9.95	3.9	< 0.004	10.2	0.198	6.2	2.5	29.9	0.7	0.0927	< 0.002	0.021
S98-04179	2135894959	395	0.03	0.3	0.049	40.8	< 0.003	< 0.002	< 0.008	2.45	13.4	0.007	35.7	0.195	272	1.5	18.5	0.5	0.317	< 0.002	0.013
S98-04180	2135855355	284	0.07	0.2	0.049	39.5	< 0.003	< 0.002	< 0.008	2.03	12.1	0.009	40.5	0.083	126	2.7	20.9	0.5	0.291	< 0.002	0.053
S98-04181	2135887734	199	0.02	0.2	0.019	21	< 0.003	< 0.002	< 0.008	0.382	8.5	0.005	24.7	0.052	91.4	3.8	20.8	1	0.162	< 0.002	0.007
S98-04182	2135879130	278	0.07	0.5	0.038	36.2	< 0.003	< 0.002	< 0.008	1.58	15.8	0.009	48.9	0.072	453	4.2	21.7	1.3	0.363	< 0.002	0.051
S98-04183	2135871811	398	0.85	0.4	0.027	33.1	< 0.003	< 0.002	< 0.008	1.27	16.1	0.005	51.4	0.076	382	4	22.3	1.7	0.35	< 0.002	0.013
S98-04184	2135839983	234	0.11	< 0.1	0.02	46.5	< 0.003	< 0.002	< 0.008	2.16	10.8	< 0.004	55.1	0.089	30.4	2	21.4	2.1	0.324	< 0.002	0.023
S98-04185	2135823858	414	0.07	< 0.1	0.018	48.9	< 0.003	< 0.002	< 0.008	4.53	9.3	< 0.004	59.8	0.167	30.9	1.2	16.4	2.2	0.322	< 0.002	0.015
S98-04186	2135807408	383	0.13	< 0.1	0.008	20.1	< 0.003	< 0.002	< 0.008	1.06	10.1	< 0.004	39.9	0.055	32.1	1.8	15.2	2.4	0.187	< 0.002	0.01
S98-04187	2137638678	278	0.04	0.1	0.055	49	< 0.003	< 0.002	< 0.008	6.84	5.9	0.007	10.6	0.687	12.5	1	20.8	0.3	0.203	< 0.002	0.077
S98-04188	2137638678	2.2	0.02	0.3	0.023	16.2	< 0.003	< 0.002	< 0.008	0.689	3.6	0.022	8.25	0.041	383	0.2	19.3	< 0.2	0.23	< 0.002	0.031
S98-04189	2137694756	508	0.18	< 0.1	0.182	235	< 0.003	< 0.002	< 0.008	8.89	9.8	0.006	56.2	1.99	116	0.8	17.6	0.5	0.786	< 0.002	0.033
S98-04190	2137608300	579	3.2	< 0.1	0.095	95.7	< 0.003	< 0.002	< 0.008	9.52	5.2	< 0.004	22.7	0.685	9.7	1.5	17.4	0.3	0.33	< 0.002	0.023
S98-04191	2134529387	229	0.09	< 0.1	0.06	45.8	< 0.003	< 0.002	< 0.008	4.28	5.6	< 0.004	20	0.494	13	1.8	22.1	0.5	0.232	< 0.002	0.014
S98-04192	2134583730	571	0.05	0.3	0.102	72	< 0.003	< 0.002	< 0.008	4.27	11.6	0.008	35.8	0.147	368	2.2	22.2	2.1	0.403	< 0.002	0.019
S98-04193	2134577044	475	0.04	0.2	0.073	62.6	< 0.003	< 0.002	< 0.008	3.64	7.2	0.004	30.6	0.305	60.2	1.3	16.9	0.5	0.292	< 0.002	0.034
S98-04194	2134535758	523	0.06	0.1	0.086	103	< 0.003	< 0.002	< 0.008	6.68	6.5	0.006	25	0.308	14.5	1.3	19.9	2.6	0.401	< 0.002	0.026
S98-04195	2134541179	367	0.08	0.1	0.185	177	< 0.003	< 0.002	< 0.008	7.9	7.9	0.007	51.4	1.95	79.4	0.4	15.8	0.5	0.629	< 0.002	0.024
S98-04196	2134511899	502	0.04	0.1	0.064	45.4	< 0.003	< 0.002	< 0.008	3.15	6.4	< 0.004	21	0.132	27.5	1.9	20.7	0.8	0.23	< 0.002	0.01
S98-04197	2134595854	128	0.07	0.1	0.054	49.7	< 0.003	< 0.002	< 0.008	8.93	7.2	0.007	43.8	0.149	128	1.4	28.4	5	0.319	< 0.002	0.021
S98-04198	2134553702	123	0.05	< 0.1	0.018	36.2	< 0.003	< 0.002	< 0.008	2.81	6.3	0.005	42.7	0.083	31.8	2.2	29.2	4.6	0.218	< 0.002	0.017
S98-04199	2134571543	644	0.05	0.1	0.029	64.5	< 0.003	< 0.002	< 0.008	5.54	8.1	< 0.004	42.1	0.648	30:1	0.8	15.5	11.2	0.359	< 0.002	0.03

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04200	RIP3142	06/05/1998	23.345	90.707	1991	STW	59	Matlab Thana Parisha	Chittagong	Chandpur	Matlab	Uttar Matlab	Kaladi
S98-04201	RIP3143	06/05/1998	23.349	90.755	1990	STW	20	Jainal Abadin	Chittagong	Chandpur	Matlab	Khadergoan	Nagdah
S98-04202	RIP3144	06/05/1998	23.371	90.773	1989	STW	34	Narayanpur P. School	Chittagong	Chandpur	Matlab	Narayanpur	Surpur
S98-04203	RIP3145	06/05/1998	23.32	90.685	1986	STW	24	Bardia Arany Bazar	Chittagong	Chandpur	Matlab	Dakshin Matlab	Mubarakdi
S98-04204	RIP3147	07/05/1998	23.097	90.86	1970	STW	19	Sonapur GH. School	Chittagong	Lakshmipur	Ramganj	Sonapur	Angarpara
S98-04205	RIP3148	07/05/1998	23.1	90.882	1996	STW	19	Abul Kasem	Chittagong	Lakshmipur	Ramganj	Bhadur	Purba Bhadur
S98-04206	RIP3149	07/05/1998	23.126	90.936	1972	STW	15	Bhatra Bazar	Chittagong	Lakshmipur	Ramganj	Bhatra	Mamudpur
S98-04207	RIP3150	07/05/1998	23.145	90.858	1995	STW	24	Kanchanpur Bazar	Chittagong	Lakshmipur	Ramganj	Kanchanpur	Bigha
S98-04208	RIP3151	01/05/1998	23.162	90.656	1995	STW	28	Hasan Ahamad	Chittagong	Chandpur	Chandpur Sadar	Sakhua	Lakshmipur
S98-04209	RIP3152	01/05/1998	23.204	90.643	1985	STW	29	Abdul Malek	Chittagong	Chandpur	Chandpur Sadar	Ibrahimpur	Sakhua
S98-04210	RIP3153	01/05/1998	23.225	90.661	1980	DTW	98	DPHEOffice	Chittagong	Chandpur	Chandpur Sadar	Paurashava	Alimpara
S98-04211	RIP3154	01/05/1998	23.225	90.661	1990	STW	39	DPHE Office	Chittagong	Chandpur	Chandpur Sadar	Paurashava	Alimpara
S98-04212	RIP3155	01/05/1998	23.259	90.678	1992	STW	34	Haidar Ali	Chittagong	Chandpur	Chandpur Sadar	Tarpurchandi	Tarpurchandi
S98-04213	RIP3156	01/05/1998	23.294	90.666		STW	24	Afzal Khan	Chittagong	Chandpur	Chandpur Sadar	Bishnupur	Kherudia
S98-04214	RIP3157	01/05/1998	23.26	90.696	1994	STW	29	Babhurhat Bazar	Chittagong	Chandpur	Chandpur Sadar	Purba Ashikati	Ashikati
S98-04215	RIP3158	01/05/1998	23.253	90.751	1990	STW	31	Nurul Islam	Chittagong	Chandpur	Chandpur Sadar	Uttar Rampur	Lodhergaon
S98-04216	RIP3160	02/05/1998	23.428	91.06	1965	STW	22	Aganagar Bazar	Chittagong	Comilla	Barura	Uttar Bhakanipur	Attar Bhakanipur
S98-04217	RIP3161	02/05/1998	23.41	91.027	1980	STW	30	Mohespur P. School	Chittagong	Comilla	Barura	Dakshin Khosbas	Bakshin Khosbas
S98-04218	RIP3162	02/05/1998	23.374	91.053	1984	DTW	98	Thana Parishad	Chittagong	Comilla	Barura	Uttar Deora	Bttar Deora
S98-04219	RIP3163	02/05/1998	23.374	91.053	1962	STW	50	Thana Circle Office	Chittagong	Comilla	Barura	Uttar Deora	Bttar Deora
S98-04220	RIP3164	02/05/1998	23.382	90.986	1997	STW	33	Md A. Mouin	Chittagong	Comilla	Barura	Dakshin Jalan	Jakshin Jalan
S98-04221	RIP3165	02/05/1998	23.345	90.982	1977	STW	29	Adda Bazar	Chittagong	Comilla	Barura	Adda	Adda
S98-04222	RIP3166	02/05/1998	23.287	91.033	1985	STW	20	Abdul Aziz	Chittagong	Comilla	Barura	Uttar Payalgachh	Bttar Payalgachh
S98-04223	RIP3167	02/05/1998	23.327	91.057	1985	STW	24	Jhapua Madarasha	Chittagong	Comilla	Barura	Galimpur	Jalimpur
S98-04224	RIP3168	02/05/1998	23.347	91.095	1950	STW	47	Shilmuni Hospital	Chittagong	Comilla	Barura	Dakshin Shilmuri	Pakshin Shilmuri
S98-04225	RIP3170	03/05/1998	23.217	90.878	1990	STW	25	Dalia Building	Chittagong	Chandpur	Hajiganj	Paurashava W03	Kangais
S98-04226	RIP3171	03/05/1998	23.224	90.795	1992	STW	24	Mahiuddin Hasan	Chittagong	Chandpur	Hajiganj	Dakshin Hajiganj	Alipur
S98-04227	RIP3172	03/05/1998	23.261	90.788	1985	STW	24	Gafur Mollah	Chittagong	Chandpur	Hajiganj	Dakshin Rajargao	Phulchua
S98-04228	RIP3173	03/05/1998	23.307	90.788	1996	STW	24	Kapaikap P. School	Chittagong	Chandpur	Hajiganj	Uttarkalocho	Kapaikap
S98-04229	RIP3174	03/05/1998	23.208	90.862	1990	STW	24	Shamsul Huda	Chittagong	Chandpur	Hajiganj	Purba Barkul	Digehail
S98-04230	RIP3175	03/05/1998	23.244	90.854	1996	STW	23	Randhanimura P, Scho	Chittagong	Chandpur	Hajiganj	Paschim Barkul	Randhanimura
S98-04231	RIP3176	03/05/1998	23.261	90.817	1996	STW	26	Dr Fazlur Haq	Chittagong	Chandpur	Hajiganj	Uttar Hajiganj	Subidpur
S98-04232	RIP3178	05/05/1998	23.086	90.644	1979	STW	18	Nilkamal H. School	Chittagong	Chandpur	Haimchar	Nilkamal	Char Saladi
S98-04233	RIP3179	05/05/1998	23.046	90.646	1976	STW	25	Union Parishad	Chittagong	Chandpur	Haimchar	Char Bhairabi	Char Bhairabi
S98-04235	RIP3181	05/05/1998	23.11	90.656	1997	STW	16	Bazapli H.School	Chittagong	Chandpur	Haimchar	U,Algi Durgapur	Nayani Lakshmipu
S98-04236	RIP3183	07/05/1998	22.651	90.92	1983	STW	9	darmatory Building	Chittagong	Lakshmipur	Ramgati	Char Alexander	Char Alexander
S98-04237	RIP3184	07/05/1998	22.587	90.997	1992	STW	9	Union Parishad	Chittagong	Lakshmipur	Ramgati	Barakheri	Barakheri
S98-04238	RIP3185	07/05/1998	22.614	90.952	1978	STW	9	Anisul Haq	Chittagong	Lakshmipur	Ramgati	Char Algi	Char Aigi
S98-04239	RIP3186	07/05/1998	22.697	90.911	1995	STW	9	Union Parishad	Chittagong	Lakshmipur	Ramgati	Char Bedana	Char Sita
S98-04240	RIP3187	07/05/1998	22.752	90.902	1995	STW	9	Abdus Salam	Chittagong	Lakshmipur	Ramgati	Char Kadira	Char Pagla
S98-04241	RIP3188	07/05/1998	22.724	90.847	1992	STW	9	Doctor Obayed	Chittagong	Lakshmipur	Ramgati	Char Falcon	Char Falcon
S98-04242	RIP3189	07/05/1998	22.768	90.865	1974	STW	9	Kasherhat GPS	Chittagong	Lakshmipur	Ramgati	Hazirhat	Char Jangalia
S98-04243	RIP3190	07/05/1998	22.816	90.838	1993	STW	10	Md.Naser Ahmad	Chittagong	Lakshmipur	Ramgati	Char Lawrence	Dak. Char Martin
S98-04244	RIP3192	08/05/1998	22.977	90.698	1998	STW	14	Baribad Mosque	Chittagong	Lakshmipur	Raipur (L)	Char Bangshi	Char Bangshi
S98-04245	RIP3193	08/05/1998	22.992	90.744	1995	STW	14	Montaz Bhapari	Chittagong	Lakshmipur	Raipur (L)	Char Mohana	Char Mohana
S98-04246	RIP3195	09/05/1998	22.37	90.743	1994	DTW	302	Abul Kalam	Barisal	Bhola	Lalmohan	Kalma	Kalma
S98-04247	RIP3196	09/05/1998	22.346	90.776	1990	DTW	301	Abdul Hay	Barisal	Bhola	Lalmohan	Ghali Gaurnagar	Char Kalachand
S98-04248	RIP3197	09/05/1998	22.34	90.736	1970	STW	46	Dharen Chandra Dey	Barisal	Bhola	Lalmohan	Lalmohan	Meherganj

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04200	2137651538	466	0.05	< 0.1	0.079	86.6	< 0.003	< 0.002	< 0.008	3.6	5.7	< 0.004	21.5	0.331	19.1	1.3	16.7	< 0.2	0.314	< 0.002	0.029
S98-04201	2137634707	644	0.12	0.5	0.093	63.6	< 0.003	< 0.002	< 0.008	5.06	14.7	0.01	47.5	0.137	149	1.4	16.8	0.3	0.42	< 0.002	0.013
S98-04202	2137643883	225	0.06	0.4	0.087	41.9	< 0.003	< 0.002	< 0.008	3.69	13.7	0.009	38.3	0.075	374	3.7	22.4	0.7	0.339	< 0.002	0.01
S98-04203	2137677674	407	0.05	< 0.1	0.038	56.1	< 0.003	< 0.002	< 0.008	2.64	4.4	< 0.004	15.3	0.206	14.4	2.6	19.5	0.2	0.205	< 0.002	0.011
S98-04204	2516595052	126	0.02	< 0.1	0.012	32	< 0.003	< 0.002	< 0.008	2.17	9.5	< 0.004	44.8	0.753	14.7	1	19.3	< 0.2	0.226	< 0.002	0.3
S98-04205	2516509790	816	0.04	0.6	0.054	67.9	< 0.003	< 0.002	< 0.008	2.74	18.6	0.014	96.5	0.094	751	5.2	21.7	1.3	0.648	< 0.002	0.024
S98-04206	2516514545	527	0.04	0.4	0.007	12.2	< 0.003	< 0.002	< 0.008	1.45	9.2	< 0.004	17.9	0.045	165	7.8	23.2	2.8	0.108	0.003	0.139
S98-04207	2516542165	559	0.04	0.4	0.075	62.8	< 0.003	< 0.002	< 0.008	2.08	15.8	0.005	66.9	0.049	519	2.5	17.4	1.1	0.55	< 0.002	0.012
S98-04208	2132290624	458	3.68	0.3	0.061	123	< 0.003	< 0.002	< 0.008	7.43	14.3	0.01	64.2	0.244	200	0.8	18	0.5	0.62	< 0.002	0.016
S98-04209	2132263920	609	0.06	< 0.1	0.085	93.5	< 0.003	< 0.002	< 0.008	4.89	5.2	< 0.004	24.6	1.46	14.7	1.1	15.7	2.3	0.376	< 0.002	0.013
S98-04210	2132206	1.8	0.08	< 0.1	0.06	37.7	< 0.003	< 0.002	< 0.008	3.86	3.3	0.012	18.9	0.201	87.1	0.2	31.1	0.2	0.274	< 0.002	0.011
S98-04211	2132206	471	0.07	0.1	0.081	85	< 0.003	< 0.002	< 0.008	7.24	6.1	0.007	22.4	0.278	21.1	0.4	16	0.8	0.325	< 0.002	0.017
S98-04212	2132294973	496	0.05	< 0.1	0.122	134	< 0.003	< 0.002	< 0.008	5.63	6.7	0.004	33	0.099	16.6	1.9	20	1	0.468	< 0.002	0.018
S98-04213	2132231587	374	0.14	< 0.1	0.079	75.8	< 0.003	< 0.002	< 0.008	6.32	5.5	< 0.004	17.8	0.882	12.1	0.9	18.9	0.8	0.295	< 0.002	0.02
S98-04214	2132207031	175	0.1	< 0.1	0.111	130	< 0.003	< 0.002	< 0.008	3.55	5.9	0.005	35.8	1.26	30.1	0.5	20.1	1	0.392	< 0.002	0.017
S98-04215	2132281640	604	0.04	0.3	0.158	103	< 0.003	< 0.002	< 0.008	6.76	14.5	0.01	59	0.247	333	1.1	16.1	1	0.553	< 0.002	0.015
S98-04216	2190918017	191	0.02	< 0.1	0.015	30.8	< 0.003	< 0.002	< 0.008	5.17	6.1	< 0.004	29.8	0.555	19	1.3	18.7	0.4	0.231	< 0.002	0.01
S98-04217	2190969094	288	0.04	0.4	0.009	6.9	< 0.003	< 0.002	< 0.008	1.29	7.9	0.006	11.2	0.036	225	11.3	21.9	1.1	0.0766	0.005	0.009
S98-04218	2190931107	1.8	0.02	< 0.1	0.03	16.8	< 0.003	< 0.002	< 0.008	2.1	1.5	0.011	7.65	0.2	110	< 0.1	31.9	10.4	0.115	< 0.002	0.01
S98-04219	2190931107	14.2	0.02	0.1	0.017	16	< 0.003	< 0.002	< 0.008	1.8	3.5	0.004	10.3	0.493	104	1.1	19.4	0.2	0.122	< 0.002	0.101
S98-04220	2190956435	151	0.02	0.1	0.01	21	< 0.003	< 0.002	< 0.008	1.09	6.8	< 0.004	29.4	0.059	50	2.6	23.8	0.4	0.165	< 0.002	0.009
S98-04221	2190906008	320	0.02	0.2	0.014	31.9	< 0.003	< 0.002	< 0.008	1.49	10.7	0.006	50.6	0.137	67.1	2.3	18.4	0.4	0.295	< 0.002	0.012
S98-04222	2190975159	171	0.02	0.1	0.005	26.2	< 0.003	< 0.002	< 0.008	0.584	7.8	0.004	34.9	0.14	32.3	1.5	14.8	0.6	0.19	< 0.002	0.01
S98-04223	2190944456	114	0.02	0.2	0.007	26	< 0.003	< 0.002	< 0.008	1.48	10.5	< 0.004	51.3	0.106	31.2	2.3	15.2	0.4	0.203	< 0.002	0.012
S98-04224	2190994783	56.9	< 0.01	< 0.1	0.002	16.4	< 0.003	< 0.002	< 0.008	0.206	5.4	< 0.004	25	0.02	17	< 0.1	20.2	0.2	0.172	< 0.002	0.016
S98-04225	2134908268	526	0.02	0.1	0.023	20.7	< 0.003	< 0.002	< 0.008	1.19	8.8	< 0.004	25.9	0.055	35.2	1.9	17.7	0.3	0.144	< 0.002	0.012
S98-04226	2134940010	434	0.03	0.2	0.037	37.6	< 0.003	< 0.002	< 0.008	1.35	10.8	0.004	35.6	0.102	77.8	2.4	19.6	0.5	0.279	< 0.002	0.019
S98-04227	2134975747	414	0.05	0.4	0.035	28.7	< 0.003	< 0.002	< 0.008	1.62	11.7	0.006	24.3	0.064	213	3.7	20.7	0.9	0.212	< 0.002	0.01
S98-04228	2134950404	456	0.02	0.3	0.031	34.3	< 0.003	< 0.002	< 0.008	1.73	9.5	0.006	26.1	0.085	182	3.4	19	4.4	0.228	< 0.002	0.013
S98-04229	2134905247	490	0.02	0.2	0.029	42.3	< 0.003	< 0.002	< 0.008	1.96	11.9	0.006	38.1	0.069	104	2.4	19.2	0.7	0.3	< 0.002	0.012
S98-04230	2134910801	586	0.02	0.1	0.048	35.3	< 0.003	< 0.002	< 0.008	1.96	12.1	0.005	38.9	0.112	146	2.1	15.1	0.5	0.253	< 0.002	0.01
S98-04231	2134935933	205	0.02	< 0.1	0.029	36.8	< 0.003	< 0.002	< 0.008	7.03	9.7	0.005	33.3	0.136	10.8	1.6	32.9	0.8	0.281	< 0.002	0.012
S98-04232	2134771037	322	0.04	0.1	0.091	89.5	< 0.003	< 0.002	< 0.008	6.84	6.7	0.009	20	0.297	62.5	2	20.3	0.7	0.335	< 0.002	0.018
S98-04233	2134735007	203	0.05	0.1	0.164	151	< 0.003	< 0.002	< 0.008	4.16	8.9	0.005	50.4	1.88	38.4	1	19.5	0.7	0.62	< 0.002	0.028
S98-04235	2134711087	529	0.05	< 0.1	0.125	163	< 0.003	< 0.002	< 0.008	11.8	7.5	0.004	36.9	0.467	21.9	1	20	1.2	0.569	< 0.002	0.031
S98-04236	2517323138	20.4	< 0.01	0.2	0.005	17.1	< 0.003	< 0.002	< 0.008	< 0.005	16.7	0.009	70	0.006	116	< 0.1	17.8	49.3	0.257	< 0.002	< 0.004
S98-04237	2517307069	82.6	< 0.01	0.8	0.023	20.6	< 0.003	< 0.002	< 0.008	0.548	14.9	0.007	26.8	0.19	501	1.5	17.8	2.7	0.188	< 0.002	0.007
S98-04238	2517331161	99.3	< 0.01	0.2	0.032	37.9	< 0.003	< 0.002	< 0.008	1.86	18.1	< 0.004	45.3	0.354	114	0.8	20.1	13.9	0.289	< 0.002	0.013
S98-04239	2517339763	15.3	0.08	0.3	0.057	114	< 0.003	< 0.002	< 0.008	0.997	20.1	0.014	86.8	1.8	202	0.2	17.3	97.5	0.63	< 0.002	0.014
S98-04240	2517363624	92.4	0.04	0.2	0.009	39.4	< 0.003	< 0.002	0.082	1.23	14.3	< 0.004	28.4	0.588	133	0.3	14.1	6.9	0.212	< 0.002	0.018
S98-04241	2517347254	35.5	< 0.01	< 0.1	0.082	88.7	< 0.003	< 0.002	< 0.008	0.443	17.5	0.006	59.7	0.88	88.7	< 0.1	13.8	18	0.484	< 0.002	0.011
S98-04242	2517394393	26.5	0.03	0.1	0.028	117	< 0.003	< 0.002	< 0.008	1.09	15.3	0.011	75.6	1.4	97.1	0.2	17.5	36.9	0.636	< 0.002	0.017
S98-04243	2517379809	2.3	0.01	0.3	0.034	53	< 0.003	< 0.002	< 0.008	0.095	12.9	0.009	36	0.434	243	< 0.1	13	10.7	0.304	< 0.002	0.022
S98-04244	2515835223	69	0.02	< 0.1	0.192	201	< 0.003	< 0.002	< 0.008	1.03	7	0.004	40.8	2	51.5	0.3	17.3	2.1	0.6	< 0.002	0.014
S98-04245	2515847263	744	0.03	0.6	0.046	54.1	< 0.003	< 0.002	< 0.008	2.41	17	0.008	77.3	0.413	382	0.8	12	0.6	0.485	< 0.002	0.009
S98-04246	1095447627	1.9	0.04	0.1	0.034	31.1	< 0.003	< 0.002	< 0.008	0.083	5.2	0.005	17.5	0.03	88.6	0.2	12.9	< 0.2	0.312	< 0.002	0.009
S98-04247	1095428596	0.8	0.01	0.1	0.064	32.6	< 0.003	0.004	< 0.008	0.301	6.4	< 0.004	22.2	0.054	73.5	0.3	19.5	< 0.2	0.299	< 0.002	0.008
S98-04248	1095447780	239	0.02	0.2	0.042	84.4	< 0.003	< 0.002	< 0.008	7.68	11.5	< 0.004	69	0.522	69.2	1.3	17	0.4	0.474	< 0.002	0.015

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04249	RIP3198	09/05/1998	22.34	90.736	1997	DTW	332	Lalmohan G.H. School	Barisal	Bhola	Lalmohan	Lalmohan	Meherganj
S98-04250	RIP3199	09/05/1998	22.269	90.823	1997	DTW	292	Nur Mohammad	Barisal	Bhola	Lalmohan	Lord Hardinge	Char Lord Hardin
S98-04251	RIP3201	09/05/1998	22.267	90.787	1980	DTW	287	Raychand Bazar	Barisal	Bhola	Lalmohan	Ramaganj	Raychand
S98-04252	RIP3202	09/05/1998	22.27	90.711	1997	DTW	330	Azizul Islam Mazi	Barisal	Bhola	Lalmohan	Pasc. Char Umed	Gazaria
S98-04253	RIP3203	10/05/1998	22.461	90.705	1997	DTW	307	Nasir Ahmad	Barisal	Bhola	Burhanuddin	Deula	Deula
S98-04254	RIP3204	10/05/1998	22.486	90.768	1997	DTW	313	Shah Tuhin	Barisal	Bhola	Burhanuddin	Tabgi	Tabgi
S98-04255	RIP3205	10/05/1998	22.43	90.769	1997	DTW	302	Md Mosaraf Hossain	Barisal	Bhola	Burhanuddin	Kachia	Chak dhosh
S98-04256	RIP3206	10/05/1998	22.49	90.796	1997	DTW	322	Hazi Syed Ahmad	Barisal	Bhola	Burhanuddin	Hasannagar	Dakshin char
S98-04257	RIP3207	10/05/1998	22.541	90.669	1997	DTW	328	Shahina Begume	Barisal	Bhola	Burhanuddin	Gangapur	Daribhanga
S98-04258	RIP3208	10/05/1998	22.526	90.745	1997	DTW	172	Harun-ur-Rashid	Barisal	Bhola	Burhanuddin	Bara manika	Dakshin batamara
S98-04259	RIP3210	11/05/1998	22.683	90.648	1998	DTW	287	DPHE Office	Barisal	Bhola	Bhola Sadar	Paurashava	Sadar Road
S98-04260	RIP3211	11/05/1998	22.671	90.673	1980	DTW	288	Ratanpur Bazar	Barisal	Bhola	Bhola Sadar	Char Shibpur	Char ratanpur
S98-04261	RIP3212	11/05/1998	22.593	90.652	1997	DTW	282	Zabal Haq	Barisal	Bhola	Bhola Sadar	Dasksh.Dighaldi	Dakshin dighaldi
S98-04262	RIP3213	11/05/1998	22.63	90.645	1982	DTW	304	Hasim Pahari	Barisal	Bhola	Bhola Sadar	Uttar Dighaldi	Uttar dighaldi
S98-04263	RIP3214	11/05/1998	22.67	90.63	1970	DTW	297	Kallimullah Chairman	Barisal	Bhola	Bhola Sadar	Char Chhifali	Char chhifali
S98-04264	RIP3215	11/05/1998	22.709	90.679	1991	DTW	286	Shah Alam	Barisal	Bhola	Bhola Sadar	Dhania	Dhania
S98-04265	RIP3216	11/05/1998	22.764	90.661	1995	DTW	292	Tofzzal Hossain	Barisal	Bhola	Bhola Sadar	Ulisha	Murad chabulla
S98-04266	RIP3217	11/05/1998	22.736	90.59	1981	DTW	282	Hazi Kader Hawalder	Barisal	Bhola	Bhola Sadar	Illisha	Pangasia
S98-04267	RIP3219	13/05/1998	22.865	91.098	1975	STW	12	DPHE Office	Chittagong	Noakhali	Noakhali Sadar	Paurashava w01	Maijdi
S98-04268	RIP3220	13/05/1998	22.846	91.055	1976	STW	9	Rafiqullah	Chittagong	Noakhali	Noakhali Sadar	Noannai	Ratanpur
S98-04269	RIP3221	13/05/1998	22.848	91.002	1991	STW	9	Hapez Ali Akbar	Chittagong	Noakhali	Noakhali Sadar	Kaladaraf	Jagatpur
S98-04270	RIP3222	13/05/1998	22.848	91.002	1993	DTW	279	Hapez Amanullah	Chittagong	Noakhali	Noakhali Sadar	Kaladaraf	Jagatpur
S98-04271	RIP3223	13/05/1998	22.766	91.066	1988	STW	8	Jaynal Abadin	Chittagong	Noakhali	Noakhali Sadar	Noakhali	Char darbesh
S98-04272	RIP3224	13/05/1998	22.706	91.081	1996	STW	9	Tahashil Office	Chittagong	Noakhali	Noakhali Sadar	Char jabbar	Char jabbar
S98-04273	RIP3225	13/05/1998	22.635	91.13	1993	STW	11	Samaz Unnayan San.	Chittagong	Noakhali	Noakhali Sadar	Char bata	Char bata
S98-04274	RIP3226	13/05/1998	22.837	91.143	1994	STW	10	Shamsul Haq	Chittagong	Noakhali	Noakhali Sadar	Ashwadia	Alipur
S98-04275	RIP3227	13/05/1998	22.85	91.188	1993	STW	16	Ali Haidar	Chittagong	Noakhali	Noakhali Sadar	Narohampur	Nursonapur
S98-04276	RIP3228	13/05/1998	22.798	91.217	1990	STW	9	Feroz Alam	Chittagong	Noakhali	Noakhali Sadar	Chaprashirhat	Lamchhi prasad
S98-04277	RIP3230	14/05/1998	23.191	90.958	1998	DTW	269	Suchipara H. School	Chittagong	Chandpur	Shahrasti	Uttar Suchipara	Suchipara
S98-04278	RIP3231	14/05/1998	23.142	90.944	1992	STW	30	Habibur Rahaman	Chittagong	Chandpur	Shahrasti	Daksh. Suchipura	Narasinhapur
S98-04279	RIP3232	14/05/1998	23.16	90.983	1986	STW	18	Hazi Shamsur Rahaman	Chittagong	Chandpur	Shahrasti	Purba Chitasi	Baraipukharia
S98-04280	RIP3233	14/05/1998	23.228	90.955	1985	STW	23	Nazrul Haq	Chittagong	Chandpur	Shahrasti	Dakshin Meher	Nijmeher
S98-04281	RIP3234	14/05/1998	23.221	91.01	1995	STW	18	Abul Hasem	Chittagong	Chandpur	Shahrasti	Raysri	Dadiapara
S98-04282	RIP3235	14/05/1998	23.253	90.969	1988	STW	24	Dr Mizanur Rahaman	Chittagong	Chandpur	Shahrasti	Uttar Meher	Baniacho
S98-04283	RIP3236	14/05/1998	23.246	90.914	1988	STW	18	Ali Asraf	Chittagong	Chandpur	Shahrasti	Tamta	Uaruk
S98-04284	RIP3238	16/05/1998	22.786	91.252	1995	STW	9	Abdul Haq	Chittagong	Noakhali	Companiganj (N)	Char fakira	Char fakira
S98-04285	RIP3239	16/05/1998	22.786	91.252	1985	DTW	279	Adarshanagar Mosque	Chittagong	Noakhali	Companiganj (N)	Char fakira	Char fakira
S98-04286	RIP3240	16/05/1998	22.744	91.246	1994	DTW	246	Char Elahi H. School	Chittagong	Noakhali	Companiganj (N)	Char fakira	Char elahi
S98-04287	RIP3241	16/05/1998	22.818	91.289	1990	STW	9	Banani H. School	Chittagong	Noakhali	Companiganj (N)	Rampur	Rampur
S98-04288	RIP3242	16/05/1998	22.812	91.311	1995	STW	9	Musapur Mosque	Chittagong	Noakhali	Companiganj (N)	Musapur	Dakshin musapur
S98-04289	RIP3243	16/05/1998	22.842	91.272	1993	STW	12	Golam Rasul	Chittagong	Noakhali	Companiganj (N)	Char kakra	Kakrachar
S98-04290	RIP3244	16/05/1998	22.863	91.303	1996	STW	9	Monir Ahmad	Chittagong	Noakhali	Companiganj (N)	Char hazari	Char hazari
S98-04291	RIP3245	16/05/1998	22.886	91.332	1993	STW	9	Shahabuddin	Chittagong	Noakhali	Companiganj (N)	Char parbati	Char parbati
S98-04292	RIP3247	17/05/1998	23.039	91.52	1991	STW	26	DPHE Office	Chittagong	Feni	Chhagalnaiya	Chhagalnaiya	Pa.chhagalnaiya
S98-04293	RIP3248	17/05/1998	23.106	91.495	1995	STW	39	Debpur Madarasha	Chittagong	Feni	Chhagalnaiya	Mohamaya	Paschim debpur
S98-04294	RIP3249	17/05/1998	23.082	91.503	1979	STW	41	Chandgati Mosque	Chittagong	Feni	Chhagalnaiya	Mohamaya	Matiagada
S98-04295	RIP3250	17/05/1998	23.01	91.518	1993	STW	64	Hazi Samsul Alam	Chittagong	Feni	Chhagalnaiya	Radhanagar	Daks.andharmanik
S98-04296	RIP3251	07/05/1998	23.109	90.831	1994	STW	17	Rashed Gazi	Chittagong	Lakshmipur	Ramganj	Ichhapur	Srirampur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04249	1095457780	2.3	0.05	0.1	0.096	43.5	< 0.003	< 0.002	< 0.008	0.365	6.6	0.004	26.4	0.082	104	0.4	18.5	0.3	0.394	< 0.002	0.02
S98-04250	1095406367	0.8	< 0.01	0.2	0.036	16.9	< 0.003	< 0.002	< 0.008	0.139	4.3	0.008	11.4	0.035	116	0.2	15.8	0.3	0.163	< 0.002	0.006
S98-04251	1095476933	0.8	0.01	0.2	0.046	23.4	< 0.003	< 0.002	< 0.008	0.156	4.4	0.006	13.8	0.035	106	0.2	17.2	< 0.2	0.212	< 0.002	0.011
S98-04252	1095485535	0.8	0.02	0.2	0.032	12	< 0.003	< 0.002	< 0.008	0.078	3.2	< 0.004	6.1	0.024	123	0.3	11.1	0.3	0.134	< 0.002	0.008
S98-04253	1092119435	< 0.5	0.01	0.2	0.077	29.2	< 0.003	< 0.002	< 0.008	0.098	3.8	0.004	15.4	0.022	91.1	0.1	14.2	2.7	0.302	< 0.002	0.013
S98-04254	1092195948	< 0.5	< 0.01	0.2	0.126	34.8	< 0.003	< 0.002	< 0.008	0.327	6.1	0.005	25.9	0.071	120	0.1	20.7	3.2	0.363	< 0.002	0.008
S98-04255	1092147108	< 0.5	< 0.01	0.2	0.045	18.9	< 0.003	< 0.002	< 0.008	0.053	3.9	0.005	11.9	0.018	99.4	< 0.1	16.3	3.3	0.205	< 0.002	0.007
S98-04256	1092138373	< 0.5	0.06	< 0.1	0.107	35.3	< 0.003	< 0.002	< 0.008	0.947	5.3	< 0.004	25.8	0.08	74.3	0.1	27.2	< 0.2	0.325	< 0.002	0.012
S98-04257	1092128466	< 0.5	0.02	0.7	0.138	43.7	< 0.003	< 0.002	< 0.008	0.06	5.8	0.014	21.9	0.032	308	< 0.1	16	3	0.499	< 0.002	0.009
S98-04258	1092109046	1.2	2.33	0.2	0.132	198	< 0.003	0.018	0.023	0.28	8.4	0.015	27.4	0.089	134	0.4	17.5	4.3	0.731	0.002	0.658
S98-04259	10918	3.2	< 0.01	0.6	0.055	18.5	< 0.003	< 0.002	< 0.008	0.511	4.5	< 0.004	10.7	0.064	227	0.3	16.2	3.5	0.201	< 0.002	0.02
S98-04260	1091829315	2		0.4	0.085	27.4	< 0.003	< 0.002	< 0.008	0.358	7.8	0.015	14.7	0.064	269	0.4	28.4	1.4	0.278	< 0.002	0.049
S98-04261	1091880449	0.8	0.05	1	0.093	37.8	< 0.003	< 0.002	< 0.008	0.034	6.4	0.019	22.4	0.062	374	< 0.1	15.5	6.1	0.436	< 0.002	0.015
S98-04262	1091865994	0.6	0.06	0.2	0.041	31.1	< 0.003	< 0.002	< 0.008	0.109	5.1	< 0.004	20.1	0.037	108	< 0.1	17.9	< 0.2	0.344	< 0.002	0.008
S98-04263	1091821124	0.7	< 0.01	0.2	0.068	31.9	< 0.003	< 0.002	< 0.008	0.17	5	< 0.004	19.6	0.051	147	0.1	16.8	< 0.2	0.352	< 0.002	0.007
S98-04264	1091836497	1.1	< 0.01	0.2	0.049	15.4	< 0.003	< 0.002	< 0.008	0.247	4.8	< 0.004	11.3	0.051	137	0.3	19.1	0.2	0.174	< 0.002	0.007
S98-04265	1091851736	0.8	< 0.01	0.4	0.04	14.6	< 0.003	< 0.002	< 0.008	0.15	4.5	0.004	13	0.017	182	< 0.1	15	0.3	0.219	< 0.002	0.009
S98-04266	1091851774	0.7	0.14	0.1	0.063	34	< 0.003	< 0.002	< 0.008	0.046	4.5	< 0.004	16.4	0.044	110	< 0.1	15.1	< 0.2	0.484	< 0.002	0.006
S98-04267	2758776517	218	< 0.01	0.2	0.023	23.8	< 0.003	< 0.002	< 0.008	0.733	12.9	< 0.004	39.4	0.281	161	0.9	16.6	3.7	0.233	< 0.002	0.017
S98-04268	2758785770	132	< 0.01	0.2	0.027	72.5	< 0.003	< 0.002	< 0.008	1.72	22.3	0.011	101	0.927	223	0.9	21.9	0.5	0.689	< 0.002	0.038
S98-04269	2758765425	84.4	< 0.01	0.3	0.016	73.8	< 0.003	< 0.002	< 0.008	1.22	13.2	< 0.004	58.6	0.491	156	0.4	20.2	11.8	0.414	< 0.002	0.021
S98-04270	2758765425	1.8	0.1	< 0.1	0.066	27	< 0.003	< 0.002	< 0.008	0.884	8	0.005	21.8	0.042	36.7	0.1	35	< 0.2	0.208	< 0.002	0.007
S98-04271	2758780129	3.8	< 0.01	0.2	0.008	36.2	< 0.003	< 0.002	< 0.008	0.09	18.7	< 0.004	27.7	0.195	104	0.1	10.2	17.6	0.201	< 0.002	0.012
S98-04272	2758735144	5.8	0.39	0.4	0.025	42.5	< 0.003	< 0.002	< 0.008	0.158	18.3	0.005	49.4	0.458	180	0.2	13.9	19.7	0.335	< 0.002	0.014
S98-04273	2758725117	39.3	< 0.01	0.1	0.011	54	< 0.003	< 0.002	< 0.008	0.27	8.6	< 0.004	44	0.583	58.5	0.2	16.7	0.5	0.271	< 0.002	0.067
S98-04274	2758705018	264	0.04	< 0.1	0.003	14.6	< 0.003	< 0.002	< 0.008	0.539	10.1	< 0.004	20.1	0.32	74.5	1.6	14	0.7	0.126	< 0.002	0.008
S98-04275	2758770706	221	5.65	1.4	0.021	39.6	< 0.003	< 0.002	< 0.008	1.29	33.7	0.02	98.7	0.173	1270	3.9	20.1	2.2	0.558	0.002	0.026
S98-04276	2758720524	26	< 0.01	1.3	0.059	82.7	< 0.003	< 0.002	< 0.008	0.918	60.7	0.039	195	1.58	1700	0.1	12.1	398	1.15	< 0.002	0.073
S98-04277	2139585935	2	< 0.01	< 0.1	0.043	17.9	< 0.003	< 0.002	< 0.008	1.12	3	0.008	11.2	0.065	46.8	0.2	42.6	2.5	0.122	< 0.002	0.027
S98-04278	2139590625	332	0.02	0.3	0.002	15.1	< 0.003	< 0.002	< 0.008	0.696	7.4	< 0.004	25.1	0.158	225	2.6	15	0.6	0.127	< 0.002	0.006
S98-04279	2139515065	340		0.3	0.017	195	< 0.003	0.12	0.015	0.95	17.9	0.019	50.9	0.187	304	3.6	19.1	7.8	0.596	0.006	1.09
S98-04280	2139565647	1090	0.57	0.3	0.003	11.1	< 0.003	< 0.002	< 0.008	0.679	6.5	< 0.004	8.85	0.009	132	6.1	23.6	0.8	0.0712	0.002	0.058
S98-04281	2139580184	556	0.11	< 0.1	0.006	31.7	< 0.003	< 0.002	< 0.008	0.968	13.2	< 0.004	46.9	0.11	33.3	1.9	15.8	0.2	0.265	< 0.002	0.008
S98-04282	2139560059	462	0.07	0.2	0.006	10	< 0.003	< 0.002	< 0.008	2.54	6.6	< 0.004	14.1	0.04	97.8	3.4	19.9	0.3	0.0955	< 0.002	0.007
S98-04283	2139595973	244	< 0.01	0.3	0.052	25.6	< 0.003	< 0.002	< 0.008	2.81	13.2	< 0.004	33.4	0.179	321	2.2	16.8	< 0.2	0.239	< 0.002	0.012
S98-04284	2752111319	7.7	0.03	1.3	0.017	27.1	< 0.003	< 0.002	< 0.008	0.093	19.9	0.018	43.7	0.443	804	0.1	11.9	152	0.266	< 0.002	0.034
S98-04285	2752111319	1.6	0.05	0.1	0.389	166	< 0.003	< 0.002	< 0.008	2.47	15.5	0.025	137	0.217	294	0.3	29.5	9.2	1.38	< 0.002	0.019
S98-04286	2752111284	9.4	< 0.01	< 0.1	0.024	27.4	< 0.003	< 0.002	< 0.008	0.02	3	0.013	15.1	< 0.002	33.4	< 0.1	36.1	< 0.2	0.149	< 0.002	0.006
S98-04287	2752171852	83.4	< 0.01	1.2	0.034	64.4	< 0.003	< 0.002	< 0.008	0.816	19.8	0.011	81.4	0.768	820	0.3	14.7	28.9	0.573	< 0.002	0.055
S98-04288	2752159604	24.7	0.02	0.8	0.008	16.9	< 0.003	< 0.002	< 0.008	0.245	18.3	0.01	30.4	0.311	514	0.4	13.9	32.7	0.187	< 0.002	0.007
S98-04289	2752135710	33.2	0.08	0.5	0.009	23.9	< 0.003	< 0.002	< 0.008	0.351	25	0.011	44.6	0.511	275	0.4	14.7	3.6	0.251	< 0.002	0.015
S98-04290	2752123390	30	0.03	1.4	0.018	23.6	< 0.003	< 0.002	< 0.008	0.253	29.9	0.024	62.3	0.377	1190	1	15.5	16	0.367	< 0.002	0.009
S98-04291	2752147533	95.6	< 0.01	< 0.1	< 0.002	16.8	< 0.003	< 0.002	< 0.008	0.527	3.5	0.004	18.9	0.008	17.7	< 0.1	19.8	< 0.2	0.107	< 0.002	0.009
S98-04292	2301428699	0.9	< 0.01	< 0.1	0.087	13.3	< 0.003	< 0.002	< 0.008	0.281	0.7	< 0.004	9.81	1.13	30.7	< 0.1	24.2	0.3	0.118	< 0.002	0.03
S98-04293	2301457708	7.9	0.02	< 0.1	0.054	11.4	< 0.003	< 0.002	< 0.008	1.1	1.8	0.007	11.9	0.687	48.4	0.4	23.5	< 0.2	0.111	< 0.002	0.014
S98-04294	2301447590	7.1	0.02	< 0.1	0.081	14.6	< 0.003	< 0.002	< 0.008	1.48	1.7	0.006	13.1	0.596	50.3	0.3	22.6	< 0.2	0.135	< 0.002	0.015
S98-04295	2301485185	5.9	0.03	< 0.1	0.362	59.5	< 0.003	< 0.002	< 0.008	5.71	4.7	0.008	52.8	1.22	141	0.5	18.1	0.3	0.557	< 0.002	0.029
S98-04296	2516538934	455	0.02	0.2	0.037	40.2	< 0.003	< 0.002	< 0.008	1.7	10.9	0.006	36.7	0.187	155	1.3	13.5	0.5	0.324	< 0.002	0.019

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04297	RIP3252	07/05/1998	23.046	90.884	1990	STW	9	Taslim	Chittagong	Lakshmipur	Ramganj	Karpara	Fatehpur
S98-04298	RIP3253	07/05/1998	23.082	90.829	1997	STW	11	Chandipur P, School	Chittagong	Lakshmipur	Ramganj	Chandipur	Chandipur
S98-04299	RIP3254	08/05/1998	23.037	90.761	1995	DTW	240	DPHE Office	Chittagong	Lakshmipur	Raipur (L)	Raipur	Deyanatpur
S98-04300	RIP3255	08/05/1998	23.037	90.761	1983	STW	13	Thana Parishad	Chittagong	Lakshmipur	Raipur (L)	Raipur	Deyanatpur
S98-04301	RIP3256	08/05/1998	23.049	90.8	1988	STW	12	Nayarhat Mosque	Chittagong	Lakshmipur	Raipur (L)	Keroa	Keroa
S98-04302	RIP3257	08/05/1998	23.009	90.769	1993	STW	9	Sonapur P. School	Chittagong	Lakshmipur	Raipur (L)	Sonapur	Sonapur
S98-04303	RIP3259	09/05/1998	22.126	90.72	1990	DTW	294	Abdur Rob	Barisal	Bhola	Char Fasson	Hazariganj	Ewajpur
S98-04304	RIP3260	09/05/1998	22.166	90.677	1997	DTW	287	Sirajul Islam	Barisal	Bhola	Char Fasson	Char Manik	Char aicha
S98-04305	RIP3261	09/05/1998	22.109	90.64	1996	DTW	318	Md Hanif Master	Barisal	Bhola	Char Fasson	Char Kalmi	Char patananhla
S98-04306	RIP3262	09/05/1998	22.189	90.757		DTW	258	DPHE Office	Barisal	Bhola	Char Fasson	Jinnahgar	Jinnahgar
S98-04307	RIP3263	09/05/1998	22.198	90.713	1981	DTW	285	Fazlur Rahaman	Barisal	Bhola	Char Fasson	Aminabad	Halimabad
S98-04308	RIP3264	09/05/1998	22.188	90.674	1990	DTW	280	Dularhat H.Complex	Barisal	Bhola	Char Fasson	Nurabad	Char tofazzal
S98-04309	RIP3265	09/05/1998	22.223	90.752	1991	DTW	314	Maulana Alauddin	Barisal	Bhola	Char Fasson	Aslampur	Aligaon
S98-04310	RIP3267	10/05/1998	22.375	90.839	1997	DTW	327	Abu Taher	Barisal	Bhola	Tazumuddin	Chanchra	Uttar chanchra
S98-04311	RIP3268	10/05/1998	22.426	90.838	1990	DTW	311	Yunus Master	Barisal	Bhola	Tazumuddin	Chandpur	Chandpur
S98-04312	RIP3269	10/05/1998	22.421	90.809	1995	DTW	300	Pancha Pali H. Schoo	Barisal	Bhola	Tazumuddin	Shamvapur	Golakpur
S98-04313	RIP3270	10/05/1998	22.384	90.81	1991	DTW	308	Shamvapur Bazar	Barisal	Bhola	Tazumuddin	Shamvapur	Shamvapur
S98-04314	RIP3271	10/05/1998	22.449	90.815	1965	DTW	270	Shibpur Bazar	Barisal	Bhola	Tazumuddin	Shamvapur	Shibpur
S98-04315	RIP3272	10/05/1998	22.457	90.835	1993	DTW	315	Abul Kashem Master	Barisal	Bhola	Tazumuddin	Sonapur	Chapri
S98-04316	RIP3273	10/05/1998	22.494	90.795	1991	DTW	295	Abu Talukder	Barisal	Bhola	Tazumuddin	Bara Malanchara	Mahadevpur
S98-04317	RIP3275	11/04/1998	22.591	90.659	1994	DTW	297	Iqbal Hosain	Barisal	Bhola	Daulatkhan	Uttar Joynagar	Uttar Joynagar
S98-04318	RIP3276	11/05/1998	22.555	90.686	1997	DTW	287	Mosarraf Hossain	Barisal	Bhola	Daulatkhan	Dakshin Joynagar	Dakshin Joynagar
S98-04319	RIP3277	11/05/1998	22.598	90.693	1998	DTW	297	Abdur Rashid	Barisal	Bhola	Daulatkhan	Char Khalifa	Char Didarulla
S98-04320	RIP3278	11/05/1998	22.602	90.746	1997	DTW	305	Mamunur Rahaman	Barisal	Bhola	Daulatkhan	Saidpur	Char B.Lamchhidh
S98-04321	RIP3279	11/05/1998	22.583	90.759	1979	DTW	312	Nuru Bhapari	Barisal	Bhola	Daulatkhan	Bhabanipur	Bhabanipur
S98-04322	RIP3280	11/05/1998	22.635	90.689	1998	DTW	317	Rafuqul Islam	Barisal	Bhola	Daulatkhan	Charpata	Charpata
S98-04323	RIP3281	11/05/1998	22.661	90.696	1997	DTW	315	Rafiqul Islam	Barisal	Bhola	Daulatkhan	Medua	Medua
S98-04324	RIP3283	13/05/1998	22.897	91.012	1998	STW	13	Chhayani H. School	Chittagong	Noakhali	Begumganj	Chhayani	Lakshmanpur
S98-04325	RIP3284	13/05/1998	22.959	91.02	1993	STW	12	Jhinu Mia	Chittagong	Noakhali	Begumganj	Amanullahpur	Joy narayanpur
S98-04326	RIP3285	13/05/1998	23.008	91.008	1988	STW	13	Khalilur Rahaman	Chittagong	Noakhali	Begumganj	Amishapara	Amishapara
S98-04327	RIP3286	13/05/1998	23.065	91.01	1986	STW	14	Jayag Mosque	Chittagong	Noakhali	Begumganj	Jayag	Jayag
S98-04328	RIP3287	13/05/1998	23.041	91.094	1975	STW	12	Soniamuri College	Chittagong	Noakhali	Begumganj	Soniamuri	Shimulia
S98-04329	RIP3288	13/05/1998	23.025	91.123	1974	STW	12	Rajibpur Bazar	Chittagong	Noakhali	Begumganj	Baragaon	Rajibpur
S98-04330	RIP3289	13/05/1998	22.966	91.103	1974	STW	14	Mazundarhat Bazar	Chittagong	Noakhali	Begumganj	Mir warishpur	Mir warishpur
S98-04331	RIP3290	13/05/1998	22.974	91.162	1958	STW	11	Kutubpur Mosque	Chittagong	Noakhali	Begumganj	Kutubpur	Kutubpur
S98-04332	RIP3291	13/05/1998	22.974	91.162	1997	DTW	269	Abul Hanan	Chittagong	Noakhali	Begumganj	Kutubpur	Kutubpur
S98-04333	RIP3292	13/05/1998	22.906	91.187	1998	STW	13	Md Abu Bakar	Chittagong	Noakhali	Begumganj	Kadirpur	Kadirpur
S98-04334	RIP3293	13/05/1998	22.946	91.126	1985	STW	16	Thana Agri. Office	Chittagong	Noakhali	Begumganj	Paurashava w03	Hajipur
S98-04335	RIP3295	14/05/1998	23.065	90.933	1996	STW	12	Abul Kalam	Chittagong	Noakhali	Chatkhil	Parkote	Dashgharia
S98-04336	RIP3296	14/05/1998	23.026	90.906	1986	STW	12	Lokman	Chittagong	Noakhali	Chatkhil	Sahapur	Purushattampursa
S98-04337	RIP3297	14/05/1998	23.008	90.944	1997	STW	12	Kazi Abdul Khair	Chittagong	Noakhali	Chatkhil	Ramnarayanpur	Ramnarayanpur
S98-04338	RIP3298	14/05/1998	22.996	90.984	1968	STW	11	Abul Kasem	Chittagong	Noakhali	Chatkhil	Khilpara	Amarpur
S98-04339	RIP3299	14/05/1998	23.11	90.982	1996	STW	13	Maulana Bazar	Chittagong	Noakhali	Chatkhil	Badalkot	Nischintapur
S98-04340	RIP3300	14/05/1998	23.11	90.982	1997	DTW	281	Dr Hassan Ahmad	Chittagong	Noakhali	Chatkhil	Badalkot	Nischintapur
S98-04341	RIP3301	14/05/1998	23.093	91.025	1997	STW	20	Abdul Kuddus	Chittagong	Noakhali	Chatkhil	Mohammadpur	Amirathi
S98-04342	RIP3303	16/05/1998	22.995	91.235	1995	STW	14	Nazrul Islam	Chittagong	Noakhali	Senbagh	Kadra	Kadra
S98-04343	RIP3304	16/05/1998	22.958	91.221	1993	STW	13	Mahadipur Mosque	Chittagong	Noakhali	Senbagh	Kabilpur	Mahadipur
S98-04344	RIP3305	16/05/1998	22.931	91.222	1993	STW	14	Abdul Haq	Chittagong	Noakhali	Senbagh	Bijoybagh	Baliakandi

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04297	2516547353	177	0.04	0.1	0.021	69.3	< 0.003	< 0.002	< 0.008	2.22	9	0.007	56	0.626	55.8	0.8	19.1	2.1	0.357	< 0.002	0.034
S98-04298	2516523192	704	0.03	< 0.1	0.026	75.3	< 0.003	< 0.002	< 0.008	0.917	7.3	< 0.004	34.6	0.854	28	0.9	13.4	0.6	0.328	< 0.002	0.017
S98-04299	2515871385	7.7	0.01	< 0.1	0.081	26	< 0.003	< 0.002	< 0.008	0.841	4.4	0.008	15.9	0.089	41.4	0.3	32	< 0.2	0.198	< 0.002	0.017
S98-04300	2515871385	85.1	0.03	< 0.1	0.051	126	< 0.003	< 0.002	< 0.008	15	10.8	0.005	53.6	2.57	47.8	0.7	19.1	0.5	0.494	< 0.002	0.023
S98-04301	2515859710	255	0.03	0.2	0.078	79.4	< 0.003	< 0.002	< 0.008	8.73	6.7	0.006	29.4	0.497	27.2	1.8	23.3	1.4	0.316	< 0.002	0.04
S98-04302	2515883954	255	0.03	< 0.1	0.042	62.2	< 0.003	< 0.002	< 0.008	4.17	5.1	0.005	21.8	0.575	14.3	1.2	19.9	0.3	0.214	< 0.002	0.022
S98-04303	1092557541	3	0.12	0.2	0.019	15.5	< 0.003	< 0.002	< 0.008	0.072	3.6	0.006	7.5	0.021	136	0.2	12.4	0.6	0.169	< 0.002	0.007
S98-04304	1092547067	7.4	0.03	0.4	0.026	7.5	< 0.003	< 0.002	< 0.008	0.163	4	< 0.004	5.09	0.029	174	1.1	13.5	0.6	0.0825	< 0.002	0.008
S98-04305	1092528349	4	0.03	0.4	0.015	7.7	< 0.003	< 0.002	< 0.008	0.115	3.3	0.005	3.77	0.015	187	0.6	11.3	1.4	0.0824	< 0.002	0.016
S98-04306	1092566663	6.9	0.03	0.1	0.074	30.3	< 0.003	< 0.002	< 0.008	0.274	4.7	< 0.004	16.6	0.047	98.8	0.4	16.6	0.5	0.27	< 0.002	0.02
S98-04307	1092509576	4.3	0.02	0.2	0.062	30.1	< 0.003	< 0.002	< 0.008	0.182	5.3	0.004	16.7	0.032	132	0.3	14.7	0.6	0.294	< 0.002	0.01
S98-04308	1092585436	4.3	0.34	0.2	0.072	29.7	< 0.003	< 0.002	< 0.008	0.153	4.9	< 0.004	15.4	0.039	120	0.3	14.1	0.9	0.295	< 0.002	0.01
S98-04309	1092519009	3.7	0.7	0.2	0.038	22.9	< 0.003	< 0.002	< 0.008	0.147	4.4	0.006	10.8	0.027	112	0.2	14.3	1.4	0.216	< 0.002	0.014
S98-04310	1099138958	1.7	0.19	0.1	0.061	24.8	< 0.003	< 0.002	< 0.008	0.337	7.1	0.007	17.1	0.039	100	0.3	22.2	1.8	0.257	< 0.002	0.012
S98-04311	1099157165	1.2	0.21	0.2	0.184	58.2	< 0.003	< 0.002	< 0.008	1.63	7.8	0.015	44.6	0.092	103	0.2	27.5	1.1	0.49	< 0.002	0.058
S98-04312	1099185559	1.8	0.48	0.2	0.099	35.1	< 0.003	< 0.002	< 0.008	0.254	7.4	0.006	25.3	0.073	88.6	0.2	17.1	2.1	0.356	< 0.002	0.018
S98-04313	1099185886	2.3	0.19	0.2	0.045	15.6	< 0.003	< 0.002	< 0.008	0.346	5.6	0.007	12.4	0.029	105	0.3	23.1	0.8	0.167	< 0.002	0.009
S98-04314	1099185901	< 0.5	0.38	0.2	0.049	26.5	< 0.003	< 0.002	< 0.008	0.029	6.9	< 0.004	18.9	0.003	96.3	0.1	19.3	0.5	0.277	< 0.002	0.065
S98-04315	1099176184	1.4	0.17	0.1	0.13	48.9	< 0.003	< 0.002	< 0.008	0.825	8.1	0.009	35.8	0.105	111	0.2	21	1.8	0.445	< 0.002	0.027
S98-04316	1099119629	1.2	0.28	< 0.1	0.092	29.1	< 0.003	< 0.002	< 0.008	0.407	6.2	0.005	23.8	0.088	64.4	0.2	24.6	0.9	0.282	< 0.002	0.019
S98-04317	1092976952	1.1	0.18	0.1	0.048	24.1	< 0.003	< 0.002	< 0.008	0.075	4.8	0.006	13.3	0.035	120	0.1	14.6	0.5	0.256	< 0.002	0.009
S98-04318	1092985486	1.5	0.12	0.1	0.103	41.6	< 0.003	< 0.002	< 0.008	0.531	5.9	0.007	27.2	0.107	98.9	0.3	21.9	1	0.396	< 0.002	0.018
S98-04319	1092919275	1.7	0.51	0.1	0.067	24.3	< 0.003	< 0.002	< 0.008	0.237	5.9	0.005	17.1	0.066	124	0.2	16.3	1.4	0.248	< 0.002	0.011
S98-04320	1092995190	1.7	0.14	0.1	0.042	12.2	< 0.003	< 0.002	< 0.008	0.445	4.4	< 0.004	8.24	0.022	115	0.4	20.8	0.9	0.105	< 0.002	0.018
S98-04321	1092909127	1.6	0.05	0.2	0.055	15.3	< 0.003	< 0.002	< 0.008	0.429	5.5	0.007	12.1	0.049	118	0.3	21.4	< 0.2	0.152	< 0.002	0.008
S98-04322	1092928402	0.8	0.42	0.2	0.049	35.3	< 0.003	< 0.002	< 0.008	0.662	5.3	0.009	23.7	0.078	117	0.2	22.4	< 0.2	0.362	< 0.002	0.017
S98-04323	1092957677	1.3	0.16	0.3	0.054	15.1	< 0.003	< 0.002	< 0.008	0.202	5.3	0.011	9.09	0.036	194	0.1	16.9	2.4	0.155	< 0.002	0.014
S98-04324	2750728538	213	0.03	< 0.1	0.028	49.6	< 0.003	< 0.002	< 0.008	1.2	13.2	< 0.004	58.2	1.13	55.3	0.7	21.1	0.9	0.338	< 0.002	0.012
S98-04325	2750707430	182	3.41	0.5	0.033	71.1	< 0.003	< 0.002	< 0.008	1.74	21.2	0.016	83.8	0.896	664	0.5	16.4	0.9	0.573	< 0.002	0.017
S98-04326	2750714054	347	0.07	0.2	0.009	18.6	< 0.003	< 0.002	< 0.008	0.523	11.3	< 0.004	30.3	0.173	106	1.2	14.5	8.4	0.17	< 0.002	0.014
S98-04327	2750759424	55.4	0.07	< 0.1	0.007	29.9	< 0.003	< 0.002	0.016	6.84	8.4	< 0.004	51.6	0.29	18.3	1	28	0.6	0.183	< 0.002	0.041
S98-04328	2750791879	264	0.1	0.5	0.007	4.6	< 0.003	< 0.002	< 0.008	0.831	10.1	< 0.004	10.5	0.031	237	11	16.8	1	0.0619	0.004	0.008
S98-04329	2750717800	436	0.28	0.6	0.009	11.5	< 0.003	< 0.002	< 0.008	1.43	14.4	0.004	23.3	0.143	246	5.2	10.4	1	0.136	0.003	0.009
S98-04330	2750770643	236	2.34	0.5	0.027	39.4	< 0.003	< 0.002	< 0.008	1.04	18.8	0.004	56.5	0.481	348	1.3	16.6	0.7	0.362	< 0.002	0.019
S98-04331	2750766533	530	0.17	0.2	0.005	17.1	< 0.003	< 0.002	< 0.008	0.229	15	0.005	33.5	0.312	46.3	2.2	9.77	0.3	0.181	< 0.002	0.01
S98-04332	2750766533	8.6	1.04	0.1	0.273	90.5	< 0.003	< 0.002	< 0.008	5.32	9.7	0.038	56.3	0.152	132	0.4		4.5	0.536	< 0.002	0.037
S98-04333	2750763445	117	0.04	0.1	0.016	51.2	< 0.003	< 0.002	< 0.008	1.89	8.9	< 0.004	55	2.11	28.4	0.4	23.7	1.4	0.33	< 0.002	0.045
S98-04334	2750719497	256	0.17	1	0.03	39.2	< 0.003	< 0.002	0.016	0.165	28.8	0.01	87	0.277	755	1.9	14.2	1.1	0.489	< 0.002	0.03
S98-04335	2751066188	124	0.17	0.2	0.012	26.6	< 0.003	< 0.002	< 0.008	0.354	13.7	0.004	35	0.713	42.2	0.4	19.2	0.9	0.202	< 0.002	0.021
S98-04336	2751085780	645	0.08	0.2	0.046	47.4	< 0.003	< 0.002	< 0.008	2.92	11.7	0.004	31.9	0.289	143	0.5	11.6	0.7	0.324	< 0.002	0.129
S98-04337	2751076832	189	0.11	0.6	0.06	65.8	< 0.003	< 0.002	< 0.008	0.615	26	0.006	98.4	1.05	806	0.5	8.74	0.6	0.719	< 0.002	0.016
S98-04338	2751028025	649	0.07	0.1	0.01	42.4	< 0.003	< 0.002	< 0.008	0.829	14	< 0.004	37.7	1.01	21.2	1.1	11.1	0.4	0.436	< 0.002	0.014
S98-04339	2751009677	131	0.48	0.3	0.009	16.5	< 0.003	< 0.002	0.026	0.557	13	< 0.004	27.2	0.079	191	2.1	16.1	0.8	0.146	< 0.002	0.046
S98-04340	2751009677	10.3	0.2	< 0.1	0.039	20.2	< 0.003	< 0.002	< 0.008	1.62	3.8	0.006	13.9	0.106	29.6	0.3	39.2	0.4	0.136	< 0.002	0.056
S98-04341	2751038034	187	0.22	0.3	0.019	38.2	< 0.003	< 0.002	< 0.008	2.62	16.9	< 0.004	81.9	0.157	536	2.3	17	0.6	0.422	< 0.002	0.017
S98-04342	2758057462	85	1.35	0.2	0.01	18.3	< 0.003	< 0.002	< 0.008	0.315	13.5	0.005	32.2	0.248	35.9	0.9	17.8	1.4	0.159	< 0.002	0.134
S98-04343	2758047603	272	0.03	0.4	0.007	13.4	< 0.003	< 0.002	< 0.008	0.543	13.1	0.005	27.2	0.139	245	2.5	14.6	0.7	0.162	< 0.002	0.01
S98-04344	2758019130	478	0.05	< 0.1	0.009	24.3	< 0.003	< 0.002	< 0.008	4.76	7.6	0.004	27.5	1.34	13.6	1.2	21	0.7	0.244	< 0.002	0.126

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04345	RIP3306	16/05/1998	22.899	91.247	1989	STW	12	Nabipur H. School	Chittagong	Noakhali	Senbagh	Nabipur	Nabipur
S98-04346	RIP3307	16/05/1998	22.945	91.255	1988	STW	12	Nazrul Islam	Chittagong	Noakhali	Senbagh	Mohammadpur	Rsjarampur
S98-04347	RIP3308	16/05/1998	23.041	91.232	1995	STW	18	Gazirhat Bazar	Chittagong	Noakhali	Senbagh	Dumuria	Dumuria
S98-04348	RIP3309	16/05/1998	23.04	91.201	1987	STW	16	Kanishat H. School	Chittagong	Noakhali	Senbagh	Kesharpar	Kesharpar
S98-04349	RIP3310	16/05/1998	23.037	91.152	1995	STW	14	Chhataspaia P.School	Chittagong	Noakhali	Senbagh	Chhataspaia	Chhataspaia
S98-04350	RIP3312	17/05/1998	23.042	91.377	1996	STW	21	Matua Madarasha	Chittagong	Feni	Feni Sadar	Dharmapur	Matua
S98-04351	RIP3313	17/05/1998	23.049	91.352	1995	STW	34	Khalilur Rahaman	Chittagong	Feni	Feni Sadar	Sarishadi	Rasterkhil
S98-04352	RIP3314	17/05/1998	23.002	91.349	1996	STW	29	Kashimpur Bazar	Chittagong	Feni	Feni Sadar	Panchagachhiba	Kashimpur
S98-04353	RIP3315	17/05/1998	22.94	91.406	1990	STW	23	Dhalia Mosque	Chittagong	Feni	Feni Sadar	Dhalia	Dhalia
S98-04354	RIP3316	17/05/1998	22.956	91.441	1990	STW	15	Lemva H. School	Chittagong	Feni	Feni Sadar	Lemva	Lemva
S98-04355	RIP3317	17/05/1998	22.94	91.308	1997	STW	15	Nazirsha Mosque	Chittagong	Feni	Feni Sadar	Farhadnagar	Farhadnagar
S98-04356	RIP3318	17/05/1998	22.981	91.498	1980	STW	25	Battali Bazar Mosque	Chittagong	Feni	Feni Sadar	Fazilpur	Shibpur
S98-04357	RIP3319	17/05/1998	22.87	91.44	1972	STW	28	Union Parishad	Chittagong	Feni	Feni Sadar	Kalidaha	Kalidaha
S98-04358	RIP3320	17/05/1998	23.011	91.404	1980	DTW	213	Feni Children Park	Chittagong	Feni	Feni Sadar	Paurashava w01	Masterpara
S98-04359	RIP3321	17/05/1998	23.011	91.404	1991	STW	22	Khursheda Begume	Chittagong	Feni	Feni Sadar	Paurashava w01	Masterpara
S98-04360	RIP3322	17/05/1998	23.019	91.401	1997	STW	51	Dil Afroz Beauty	Chittagong	Feni	Feni Sadar	Paurashava w03	Kadalgazi
S98-04361	RIP3324	18/05/1998	23.22	91.434	1992	STW	21	P.Sahebnagar Mosque	Chittagong	Feni	Parshuram	Mirzanagar	Purba sahebnagar
S98-04362	RIP3325	18/05/1998	23.246	91.421	1994	STW	30	Sahebnagar P. School	Chittagong	Feni	Parshuram	Mirzanagar	Sahebnagar
S98-04363	RIP3326	18/05/1998	23.216	91.443	1987	STW	31	Thana Parishad	Chittagong	Feni	Parshuram	Parshuram	Kalapara
S98-04364	RIP3327	18/05/1998	23.216	91.443	1998	DTW	189	Thana Parishad	Chittagong	Feni	Parshuram	Parshuram	Kalapara
S98-04365	RIP3328	18/05/1998	23.245	91.451	1975	STW	39	Balunia Police Box	Chittagong	Feni	Parshuram	Parshuram	Baurpathar
S98-04366	RIP3330	19/05/1998	22.909	91.279	1995	STW	16	Khala Mia	Chittagong	Feni	Daganbhuiyan	Yakubpur	Sarippur
S98-04367	RIP3331	19/05/1998	22.931	91.332	1974	STW	15	fazilarhat Bazar	Chittagong	Feni	Daganbhuiyan	Daganbhuiyan	Jagatpur
S98-04368	RIP3332	19/05/1998	22.949	91.313	1974	STW	15	Malek Dillar	Chittagong	Feni	Daganbhuiyan	Mathu bhuiyan	Ganipur
S98-04369	RIP3333	19/05/1998	22.949	91.313	1995	DTW	205	Chugarpur Bazar	Chittagong	Feni	Daganbhuiyan	Mathu bhuiyan	Ganipur
S98-04370	RIP3334	19/05/1998	22.995	91.344	1990	STW	20	Jailashkara H. Schoo	Chittagong	Feni	Daganbhuiyan	Jailashkara	Jailashkara
S98-04371	RIP3335	19/05/1998	23.027	91.287	1970	STW	20	Alatali ???	Chittagong	Feni	Daganbhuiyan	Sindurpur	Alatali
S98-04372	RIP3336	19/05/1998	23.013	91.311	1982	STW	16	Rajapur H. School	Chittagong	Feni	Daganbhuiyan	Rajapur	Joy narayanpur
S98-04373	RIP3339	21/05/1998	22.002	91.952	1994	STW	59	DPHE Office	Chittagong	Chittagong	Banshkhali	Jaldi	Uttar jaldi
S98-04374	RIP3340	21/05/1998	22.002	91.951	1996	DTW	225	Thana Health Complex	Chittagong	Chittagong	Banshkhali	Jaldi	Uttar jaldi
S98-04375	RIP3341	21/05/1998	22.041	91.942	1997	DTW	258	Golam Rabbani	Chittagong	Chittagong	Banshkhali	Bailchhari	Chechuia
S98-04376	RIP3342	21/05/1998	22.041	91.942	1996	Tara	61	Sukandu Sikder	Chittagong	Chittagong	Banshkhali	Bailchhari	Chechuria
S98-04377	RIP3343	21/05/1998	22.041	91.917	1997	DTW	264	Kabir Ahamad	Chittagong	Chittagong	Banshkhali	Katharia	Katharia
S98-04378	RIP3344	21/05/1998	22.069	91.937	1996	Tara	38	Badsha Mia	Chittagong	Chittagong	Banshkhali	Kalipur	Palegram
S98-04379	RIP3345	21/05/1998	22.105	91.929	1992	STW	62	Union Parishad	Chittagong	Chittagong	Banshkhali	Sadhanpur	Lal money
S98-04380	RIP3346	21/05/1998	22.171	91.913	1998	STW	53	Chandpur Ghat	Chittagong	Chittagong	Banshkhali	Pukuria	Chandpur
S98-04381	RIP3348	22/04/1998	22.343	91.804	1997	STW	49	Wabda Colony	Chittagong	Chittagong	Double Mooring	SMA W24	Mansurabad
S98-04382	RIP3350	22/05/1998	22.326	91.834	1996	STW	13	Nagandra Zala Dash	Chittagong	Chittagong	Kotwali (C)	SMA W09	Feringee bazar
S98-04383	RIP3351	17/05/1998	22.987	91.547	1996	STW	28	Dargarhat Mosque	Chittagong	Feni	Chhagalnaiya	Subapur	Uttar ballabpur
S98-04384	RIP3352	17/05/1998	22.937	91.508	1998	STW	28	Karimul Haq	Chittagong	Feni	Chhagalnaiya	Gopal	Daulatpur
S98-04385	RIP3353	17/05/1998	23.019	91.469	1988	DTW	137	Payer Ahmad	Chittagong	Feni	Chhagalnaiya	Pathannagar	Purba silua
S98-04386	RIP3354	17/05/1998	23.056	91.443	1998	STW	38	Hazi Siddique Ahmad	Chittagong	Feni	Chhagalnaiya	Pathannagar	Pathannagar
S98-04388	RIP3357	18/05/1998	23.11	91.431	1995	STW	38	Ekramullah	Chittagong	Feni	Fulgazi	Darbarpur	Uttar sripur
S98-04389	RIP3358	18/05/1998	23.121	91.46	1998	STW	64	Hedayat Ahmad	Chittagong	Feni	Fulgazi	Darbarpur	Jagatpur
S98-04390	RIP3359	18/05/1998	23.121	91.489	1970	STW	52	Union Parishad	Chittagong	Feni	Fulgazi	Amjadhat	Manipur
S98-04391	RIP3360	18/05/1998	23.153	91.472	1998	STW	22	Bakshmoh. H. School	Chittagong	Feni	Fulgazi	Bakshmohammad	Uttar talbaria
S98-04392	RIP3361	18/05/1998	23.187	91.47	1988	STW	25	Mafizur Rahaman	Chittagong	Feni	Fulgazi	Bakshmohammad	Dakshin gutuma
S98-04393	RIP3362	18/05/1998	23.151	91.422	1996	DTW	151	Begume Khaleda Zia	Chittagong	Feni	Fulgazi	Fulgazi	Sripua

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04345	2758085683	337	0.02	0.9	0.006	8.5	< 0.003	< 0.002	< 0.008	0.08	20.9	0.005	23.4	0.184	392	4.5	8.51	0.8	0.128	< 0.002	0.008
S98-04346	2758076834	107	0.05	< 0.1	0.015	39.5	< 0.003	< 0.002	< 0.008	2.06	13.2	0.009	78.3	2.16	20.5	0.3	28.3	6.7	0.35	< 0.002	0.693
S98-04347	2758038291	82.3	0.14	0.1	0.004	7.8	< 0.003	< 0.002	< 0.008	0.273	9.2	< 0.004	15.2	0.089	74	2.3	15.1	1.2	0.0734	< 0.002	0.016
S98-04348	2758066522	330	0.06	< 0.1	0.008	34.8	< 0.003	< 0.002	< 0.008	1.63	11.7	< 0.004	48.6	0.455	49.4	0.6	10.5	0.4	0.264	< 0.002	0.014
S98-04349	2758028211	73.5	0.03	< 0.1	0.008	18.8	< 0.003	< 0.002	< 0.008	5.35	10.1	< 0.004	28.7	0.261	27.2	1	29	2	0.181	< 0.002	0.016
S98-04350	2302921608	8.7	0.01	0.1	0.007	2.2	< 0.003	< 0.002	< 0.008	0.845	2.1	0.01	1.61	0.086	81.6	0.3	25.7	0.8	0.0197	< 0.002	0.012
S98-04351	2302986803	2.4	0.01	< 0.1	0.019	8.2	< 0.003	< 0.002	< 0.008	4.06	3.4	0.006	8.25	0.178	56.9	0.3	34.9	0.2	0.0735	< 0.002	0.016
S98-04352	2302964493	2.7	0.04	0.2	0.025	19.5	< 0.003	< 0.002	< 0.008	1.23	6.4	0.025	24.8	0.656	214	0.2	26.9	42.6	0.179	< 0.002	0.015
S98-04353	2302917076	164	0.03	0.1	0.005	14.3	< 0.003	< 0.002	< 0.008	1.07	14.5	< 0.004	27.9	0.375	38.5	1.6	13.5	0.4	0.153	< 0.002	0.012
S98-04354	2302951540	87	0.02	0.1	0.007	11	< 0.003	< 0.002	< 0.008	18.1	4.4	0.013	10.7	0.431	28.6	0.6	23.8	0.9	0.0814	< 0.002	0.017
S98-04355	2302925340	47.6	0.01	0.2	0.008	19.3	< 0.003	< 0.002	< 0.008	0.467	15	0.004	31.8	0.488	92.5	0.4	16.2	1.4	0.181	< 0.002	0.031
S98-04356	2302930769	3.3																			
S98-04357	2302943476	13.3	0.01	< 0.1	0.092	7.7	< 0.003	< 0.002	< 0.008	0.564	1.9	< 0.004	5.39	0.102	87	0.4	12.4	0.4	0.0886	< 0.002	0.554
S98-04358	2302938442	2	0.07	< 0.1	0.059	21.4	< 0.003	< 0.002	< 0.008	1.43	4.1	0.012	9.39	0.169	20.2	0.2	45.2	0.9	0.182	< 0.002	0.026
S98-04359	2302938442	114	0.13	< 0.1	0.023	46.6	< 0.003	< 0.002	< 0.008	6.9	8	0.015	53.7	2.87	73.2	0.6	26.5	8.8	0.379	< 0.002	0.265
S98-04360	2302938331	7.1	0.04	< 0.1	0.059	7.1	< 0.003	< 0.002	< 0.008	2.34	2.2	0.004	4.45	0.188	48.1	0.2	25.2	1.6	0.0645	< 0.002	0.216
S98-04361	2305147738	6.1	0.06	< 0.1	0.038	7.7	< 0.003	< 0.002	< 0.008	8.74	3.8	< 0.004	5.71	0.658	11.8	0.2	17.1	< 0.2	0.0836	< 0.002	0.028
S98-04362	2305147802	14.1	< 0.01	< 0.1	0.069	7.2	< 0.003	< 0.002	< 0.008	24.3	2.2	< 0.004	2.91	0.295	8.6	0.4	20	< 0.2	0.0604	< 0.002	0.034
S98-04363	2305171417	0.9	0.21	< 0.1	0.146	36.1	< 0.003	< 0.002	< 0.008	0.533	7.6	0.006	22.9	0.174	90.9	< 0.1	10.1	30.3	0.345	< 0.002	0.043
S98-04364	2305171417	3.1	0.06	< 0.1	0.11	13.7	< 0.003	< 0.002	< 0.008	2.51	4.2	0.014	5.69	0.329	19.9	0.1	33.1	1.9	0.127	< 0.002	0.036
S98-04365	2305171064	0.7	0.11	< 0.1	0.038	3.4	< 0.003	< 0.002	< 0.008	0.351	5	0.004	1.18	0.06	7.6	< 0.1	12.3	0.8	0.0323	< 0.002	0.017
S98-04366	2302594814	307	0.02	0.8	0.013	17.3	< 0.003	< 0.002	< 0.008	0.276	19.7	0.01	40.8	0.241	538	2.4	12.4	0.8	0.25	< 0.002	0.012
S98-04367	2302512452	136	0.04	0.3	0.008	18.9	< 0.003	< 0.002	< 0.008	0.662	17.2	0.007	37	0.245	151	2.4	16.9	1	0.21	< 0.002	0.017
S98-04368	2302556402	103	0.03	0.5	0.038	40	< 0.003	< 0.002	< 0.008	1.7	25.4	0.012	74.6	0.892	432	1.3	15.6	12.2	0.464	< 0.002	0.018
S98-04369	2302556402	1.2	0.03	< 0.1	0.142	40.4	< 0.003	< 0.002	< 0.008	3.34	5.9	0.005	26.5	0.158	56.2	0.3	30.1	0.9	0.323	< 0.002	0.017
S98-04370	2302538462	119	0.02	0.1	0.011	18.2	< 0.003	< 0.002	< 0.008	6.86	5.1	< 0.004	23.4	0.423	45.7	0.6	24.3	1.9	0.185	< 0.002	0.011
S98-04371	2302590040	200	0.04	< 0.1	0.003	11.3	< 0.003	< 0.002	< 0.008	0.995	5.8	< 0.004	18.7	0.237	8.4	2	17.7	< 0.2	0.0828	< 0.002	0.012
S98-04372	2302573482	420	0.03	< 0.1	0.003	12.2	< 0.003	< 0.002	< 0.008	0.534	7.5	< 0.004	14.3	0.212	11	3.2	9.69	0.5	0.0953	< 0.002	0.012
S98-04373	2150837994	1.3	0.04	< 0.1	0.025	9.7	< 0.003	< 0.002	< 0.008	7.8	1.7	0.011	4.83	0.49	15.2	< 0.1	35	2.5	0.0949	< 0.002	0.015
S98-04374	2150837994	1.6	0.04	< 0.1	0.052	8.3	< 0.003	< 0.002	< 0.008	7.09	3.2	0.017	5.81	0.402	17.1	0.1	33.5	4	0.086	< 0.002	0.027
S98-04375	2150812207	0.8	< 0.01	< 0.1	0.044	6.6	< 0.003	< 0.002	< 0.008	10.5	3.4	0.014	4.91	0.526	9.9	< 0.1	29.8	2.4	0.0765	< 0.002	0.016
S98-04376	2150812207	1	0.03	< 0.1	0.037	8.8	< 0.003	< 0.002	< 0.008	3.97	2.1	0.011	4.64	0.401	12.8	< 0.1	33.3	< 0.2	0.0857	< 0.002	0.043
S98-04377	2150850566	0.7	0.09	< 0.1	0.062	9.9	< 0.003	< 0.002	< 0.008	8.7	3.4	0.015	6.63	0.445	18.4	0.2	34.8	0.4	0.114	< 0.002	0.025
S98-04378	2150844787	2.6	0.14	< 0.1	0.033	11.4	< 0.003	< 0.002	< 0.008	5.27	1.7	0.013	6.56	0.668	16.5	0.1	34.1	< 0.2	0.107	< 0.002	0.045
S98-04379	2150875677	0.7	< 0.01	< 0.1	0.015	5.1	< 0.003	< 0.002	< 0.008	11.5	1.8	0.006	2.81	0.655	7	< 0.1	23.1	1.9	0.0522	< 0.002	0.018
S98-04380	2150869138	0.5	0.03	< 0.1	0.043	11.3	< 0.003	< 0.002	< 0.008	8.28	2	0.019	6.14	0.481	20.5	0.3	37.3	2.9	0.128	< 0.002	0.037
S98-04381	2152815080	3.4	0.09	0.1	0.01	31.7	< 0.003	< 0.002	< 0.008	3.89	7.1	0.019	17.8	0.855	86.4	0.9	33.6	10.6	0.215	< 0.002	0.019
S98-04382	2154115646	1.1	0.07	0.2	0.016	42.7	< 0.003	< 0.002	0.02	5.58	21.3	0.005	85	0.577	106	2.2	29.4	11.3	0.488	< 0.002	0.032
S98-04383	2301495910	4.8	0.03	< 0.1	0.082	12.3	< 0.003	< 0.002	< 0.008	2.2	1.5	< 0.004	6.62	0.618	22.2	0.1	26.4	1.1	0.105	< 0.002	0.042
S98-04384	2301447885	1.9	0.1	0.2	0.019	15.4	< 0.003	< 0.002	< 0.008	6.56	13.1	0.006	39.5	0.143	144	1.8	18.3	0.5	0.177	< 0.002	0.011
S98-04385	2301476809	5.8	0.01	< 0.1	0.073	7.9	< 0.003	< 0.002	< 0.008	0.882	2.1	< 0.004	5.3	0.083	90	0.4	17.5	< 0.2	0.0885	< 0.002	0.007
S98-04386	2301476801	14.6	0.03	0.2	0.201	10.2	< 0.003	< 0.002	< 0.008	0.022	12.3	0.015	18.9	< 0.002	258	1.5	5.25	< 0.2	0.175	< 0.002	0.005
S98-04388	2303354692	7.9	0.06	0.1	0.035	9.1	< 0.003	< 0.002	< 0.008	7.28	6.2	< 0.004	10.5	0.053	77.2	1.4	17.6	0.4	0.0883	< 0.002	0.029
S98-04389	2303354360	4.1	0.02	0.1	0.25	53.3	< 0.003	< 0.002	< 0.008	0.028	3.6	< 0.004	42.2	< 0.002	380	< 0.1	8.49	0.6	0.465	< 0.002	0.012
S98-04390	2303313519	15.4	< 0.01	< 0.1	0.062	9	< 0.003	< 0.002	< 0.008	0.691	2.2	< 0.004	11.8	0.21	86.2	0.4	17.3	0.3	0.101	< 0.002	0.008
S98-04391	2303340706	8.9	0.01	< 0.1	0.06	14.5	< 0.003	< 0.002	< 0.008	2.86	1.5	0.008	14.1	0.293	45.7	0.4	21.4	< 0.2	0.124	< 0.002	0.048
S98-04392	2303340836	4	0.09	< 0.1	0.048	10.8	< 0.003	< 0.002	< 0.008	< 0.005	1.1	0.006	8.99	< 0.002	25.7	< 0.1	20.7	0.3	0.0879	< 0.002	0.005
S98-04393	2303367951	2.9	< 0.01	< 0.1	0.233	13.6	< 0.003	< 0.002	< 0.008	2.87	4.2	< 0.004	7.15	0.341	27.7	0.1	26.2	< 0.2	0.152	< 0.002	0.345

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04394	RIP3363	18/05/1998	23.151	91.422	1994	STW	33	Azizul Haq	Chittagong	Feni	Fulgazi	Fulgazi	Dakshin sripur
S98-04395	RIP3365	19/05/1998	22.913	91.365	1990	STW	18	Md Ismail	Chittagong	Feni	Sonagazi	Bagadana	Paikpara
S98-04396	RIP3366	19/05/1998	22.871	91.357	1989	STW	9	C.Shahabhikari H. Sc	Chittagong	Feni	Sonagazi	Char darbesh	C.shahabhikari
S98-04397	RIP3367	19/05/1998	22.842	91.366	1995	STW	14	Char Chandia Bazar	Chittagong	Feni	Sonagazi	Char chandia	Char Chandia
S98-04398	RIP3368	19/05/1998	22.849	91.393	1997	DTW	255	TNO Residence	Chittagong	Feni	Sonagazi	Sonagazi	Char ganesh
S98-04399	RIP3369	19/05/1998	22.849	91.393	1990	STW	12	Fakrul Islam	Chittagong	Feni	Sonagazi	Sonagazi	Char ganesh
S98-04400	RIP3370	19/05/1998	22.862	91.428	1993	STW	15	Sonapur Mosque	Chittagong	Feni	Sonagazi	Amirabad	Sonapur
S98-04401	RIP3371	19/05/1998	22.872	91.408	1998	STW	15	R.M.H.K. H.School	Chittagong	Feni	Sonagazi	Matiganj	Sujapur
S98-04402	RIP3372	19/05/1998	22.904	91.396	1990	STW	14	Aminul Haq	Chittagong	Feni	Sonagazi	Mangalkandi	Dakshin rajapur
S98-04403	RIP3373	19/05/1998	22.914	91.443	1973	STW	15	B.H. High School	Chittagong	Feni	Sonagazi	Nawabpur	Nazirpur
S98-04404	RIP3375	21/05/1998	22.207	91.854	1996	STW	36	Bhola Shah Darbar	Chittagong	Chittagong	Anowara	Battali	Battali
S98-04405	RIP3376	21/05/1998	22.157	91.842	1997	STW	12	Awakub	Chittagong	Chittagong	Anowara	Raipur	Raipur
S98-04406	RIP3377	21/05/1998	22.182	91.835	1988	STW	39	Asumia	Chittagong	Chittagong	Anowara	Banasat	Boalia
S98-04407	RIP3378	21/05/1998	22.212	91.83	1995	STW	46	Md Bhaban	Chittagong	Chittagong	Anowara	Barasat	Rangadia
S98-04408	RIP3379	21/05/1998	22.215	91.889	1997	DTW	233	Md Talib	Chittagong	Chittagong	Anowara	Barakhain	Barakhain
S98-04409	RIP3380	31/05/1998	22.199	91.936	1990	STW	44	Faruk Ahamad	Chittagong	Chittagong	Anowara	Haildhar	Haildhar
S98-04410	RIP3381	21/05/1998	22.233	91.924	1997	DTW	244	Nazir Ahamad	Chittagong	Chittagong	Anowara	Paraikora	Bhingrol
S98-04411	RIP3382	22/05/1998	22.375	91.815	1995	STW	12	Abdul Mannaf	Chittagong	Chittagong	Panchlaish	SMA W14	Nasirabad
S98-04412	RIP3383	22/05/1998	22.407	91.879	1993	STW	31	A.K. Khan	Chittagong	Chittagong	Chandgaon	SMA W28	Char mahara
S98-04413	RIP3385	22/05/1998	22.367	91.775	1996	STW	20	Tapan Kumar Dey	Chittagong	Chittagong	Pahartali	SMA W34	Uttar kattari
S98-04414	RIP3387	22/05/1998	22.326	91.816	1995	STW	30	Farid Uddin Ahamad	Chittagong	Chittagong	Double Mooring	SMA W25	Dakshin agrabad
S98-04415	RIP3389	23/05/1998	21.657	92.075	1998	STW	46	Dulahazana H. School	Chittagong	Cox's Bazar	Chakaria	Dulahazana	Dulahazana
S98-04416	RIP3390	23/05/1998	21.722	92.084	1997	STW	33	Haser Dighi Mosque	Chittagong	Cox's Bazar	Chakaria	Fasiakhali	Fasiakhali
S98-04417	RIP3391	23/05/1998	21.753	92.07	1993	DTW	248	DPHE Office	Chittagong	Cox's Bazar	Chakaria	Chiringa	Chiringa
S98-04418	RIP3392	23/05/1998	21.753	92.07	1992	STW	22	Aktar Ahmad	Chittagong	Cox's Bazar	Chakaria	Chiringa	Chiringa
S98-04419	RIP3393	23/05/1998	21.807	92.027	1992	STW	66	Abdul Mazid	Chittagong	Cox's Bazar	Chakaria	Baraitala	Pahanchanda
S98-04420	RIP3394	23/05/1998	21.82	91.993	1992	DTW	243	Sohirbanga H. School	Chittagong	Cox's Bazar	Chakaria	Pekua	Meherram
S98-04421	RIP3395	23/05/1998	21.843	91.987	1995	STW	72	Akthar Ahamad	Chittagong	Cox's Bazar	Chakaria	Barabakia	Barabakia
S98-04422	RIP3397	24/05/1998	21.248	92.137	1988	STW	29	Sakar Ali	Chittagong	Cox's Bazar	Ukhia	Raja palong	Uhala palong
S98-04423	RIP3398	24/05/1998	21.276	92.104	1995	STW	25	Didar Alam	Chittagong	Cox's Bazar	Ukhia	Ratna palong	Ratna palong
S98-04424	RIP3399	24/05/1998	21.192	92.169	1993	STW	14	Balukhali Bus-stand	Chittagong	Cox's Bazar	Ukhia	Palongkhali	Ukhiarghat
S98-04425	RIP3400	24/05/1998	21.146	92.148	1994	STW	20	Pas.Para Forest Offi	Chittagong	Cox's Bazar	Ukhia	Palongkhali	Palongkhali
S98-04426	RIP3401	24/05/1998	21.284	92.069	1990	STW	20	Sonaichhari Mosque	Chittagong	Cox's Bazar	Ukhia	Jalia palong	Jalia palong
S98-04427	RIP3402	24/05/1998	21.234	92.048	1985	STW	9	Inani Forest Office	Chittagong	Cox's Bazar	Ukhia	Jalia palong	Inani
S98-04428	RIP3403	24/05/1998	21.298	92.098	1995	STW	13	Dhuramkhan Mosque	Chittagong	Cox's Bazar	Ukhia	Haladia palong	Rumgha palong
S98-04429	RIP3405	25/05/1998	21.567	91.926	1995	STW	23	Panirchhora H. Schoo	Chittagong	Cox's Bazar	Maheshkhali	Hoanac	Panirchhora
S98-04430	RIP3406	25/05/1998	21.633	91.924	1997	DTW	270	Hazi Tazal Mullack	Chittagong	Cox's Bazar	Maheshkhali	Hoanak	Hariarchhara
S98-04431	RIP3407	25/05/1998	21.633	91.924	1994	STW	15	Mostak Ahmad	Chittagong	Cox's Bazar	Maheshkhali	Hoanak	Hariarchhara
S98-04432	RIP3408	25/05/1998	21.603	91.923	1991	STW	41	Hoanak Madarasha	Chittagong	Cox's Bazar	Maheshkhali	Hoanak	Hoanak
S98-04433	RIP3409	25/05/1998	21.538	91.937	1993	STW	28	Miazipara Mosque	Chittagong	Cox's Bazar	Maheshkhali	Bara maheshkhali	Fakiraghona
S98-04434	RIP3454	23/05/1998	21.427	92.083	1993	STW	80		Chittagong	Cox's Bazar	Ramu	Joarianala	Chakmarkil
S98-04435	RIP3455	23/05/1998	21.409	92.056	1993	STW	43	Mithachari Mosque	Chittagong	Cox's Bazar	Ramu	Dak.mithachari	Dak.mithachari
S98-04436	RIP3456	23/05/1998	21.325	92.085	1996	Tara	64	Md Solaiman	Chittagong	Cox's Bazar	Ramu	Khumiapalong	Dhoapalong
S98-04437	RIP3457	23/05/1998	21.408	92.109	1997	DTW	97	Md Kalu	Chittagong	Cox's Bazar	Ramu	Rajarkul	Rajarkul
S98-04438	RIP3458	23/05/1998	21.428	92.121	1995	STW	20	Md Kalu	Chittagong	Cox's Bazar	Ramu	Kavarkho	Lal ukhiarghona
S98-04439	RIP3459	23/05/1998	21.441	92.193	1982	STW	59	Garjahia Bazar	Chittagong	Cox's Bazar	Ramu	Kachhapia	Kachhapia
S98-04440	RIP3460	23/05/1998	21.473	92.098	1997	DTW	115	Sabbir Ahamad	Chittagong	Cox's Bazar	Ramu	Joariahala	Joariahala
S98-04441	RIP3462	24/05/1998	20.769	92.326	1994	STW	7	Abdul Gatar	Chittagong	Cox's Bazar	Teknaf	Sabrang	Shah pradwip

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04394	2303367951	21.4	0.01	< 0.1	0.121	13.9	< 0.003	< 0.002	< 0.008	16.3	5.2	< 0.004	13.7	0.123	13.8	0.7	19.3	0.2	0.153	< 0.002	0.067
S98-04395	2309419798	121	0.05	0.7	0.041	83.8	0.004	< 0.002	< 0.008	3.54	30.4	0.024	151	0.506	1060	0.7	16.6	1.3	0.96	0.002	0.039
S98-04396	2309438352	61.7	0.01	0.2	0.007	14.6	< 0.003	< 0.002	< 0.008	0.265	11.7	0.006	20.5	0.262	34.1	0.6	16.7	0.4	0.108	< 0.002	0.011
S98-04397	2309428217	38.3	0.03	0.8	0.025	40.8	< 0.003	< 0.002	< 0.008	0.672	27.4	0.012	71	0.549	569	0.4	15	57	0.44	< 0.002	0.016
S98-04398	2309485248	1.8	0.02	< 0.1	0.07	14.1	< 0.003	< 0.002	< 0.008	2.21	3.2	0.004	10.2	0.117	40.5	0.5	32.5	0.3	0.126	< 0.002	0.219
S98-04399	2309485248	127	0.02	0.9	0.006	4.7	< 0.003	< 0.002	< 0.008	0.609	11.4	0.006	9.88	0.025	363	12	15	1	0.059	0.004	0.009
S98-04400	2309409932	67.8	0.04	0.3	0.023	36.1	< 0.003	< 0.002	< 0.008	1.17	22.9	0.007	90.7	0.603	189	0.6	16.6	38.6	0.438	< 0.002	0.014
S98-04401	2309466943	101	0.02	0.1	0.011	15.5	< 0.003	< 0.002	< 0.008	0.834	14.4	< 0.004	33.9	0.353	18.5	1.5	17.7	0.6	0.177	< 0.002	0.015
S98-04402	2309457867	83.9	0.02	0.6	0.01	16.4	< 0.003	< 0.002	< 0.008	0.598	18.2	0.007	34.8	0.136	362	1.5	15.7	2.1	0.215	< 0.002	0.013
S98-04403	2309476787	40.5	0.16	0.3	0.013	29.6	< 0.003	< 0.002	< 0.008	0.281	21	0.01	56.8	1.11	159	0.4	17.2	3.4	0.335	< 0.002	0.019
S98-04404	2150457094	1.8	< 0.01	< 0.1	< 0.002	1.6	< 0.003	0.003	< 0.008	0.081	1.2	< 0.004	0.99	0.014	4.5	< 0.1	21.8	2.4	0.0184	< 0.002	0.11
S98-04405	2150495806	6.2	0.01	0.7	0.012	17.3	< 0.003	< 0.002	< 0.008	3.32	25.8	0.029	38.1	0.339	964	1.8	18.5	62.8	0.216	< 0.002	0.018
S98-04406	2150438161	34	< 0.01	0.4	0.15	9.6	< 0.003	< 0.002	< 0.008	1.14	35.5	0.018	18.5	0.2	189	0.7	14.1	3.6	0.149	< 0.002	0.009
S98-04407	2150438807	2.1	< 0.01	< 0.1	0.009	2.1	< 0.003	< 0.002	< 0.008	0.923	10.1	0.004	6.89	0.169	49.7	0.7	29.9	2.8	0.0383	< 0.002	0.007
S98-04408	2150428050	1.2	0.01	< 0.1	0.037	26.2	< 0.003	< 0.002	< 0.008	1.52	3.3	0.014	11.4	0.142	30.5	0.1	28.1	2.4	0.247	< 0.002	0.017
S98-04409	2150476403	7.5	< 0.01	0.5	0.051	7.4	< 0.003	< 0.002	< 0.008	5.26	6.2	0.02	9.26	0.149	482	1.1	19.9	0.3	0.0869	< 0.002	0.012
S98-04410	2150485121	1.3	0.02	< 0.1	0.063	11.1	< 0.003	< 0.002	< 0.008	2	5.2	0.011	7.59	0.172	39	0.4	31.3	< 0.2	0.139	< 0.002	0.038
S98-04411	2155715563	2.6	0.01	0.1	< 0.002	10.7	< 0.003	< 0.002	< 0.008	0.044	12	< 0.004	13.7	0.01	65	0.1	22.6	< 0.2	0.107	< 0.002	0.005
S98-04412	2151915259	0.6	< 0.01	< 0.1	0.063	7.1	< 0.003	< 0.002	< 0.008	4.35	11.4	0.015	9.15	0.389	61.9	0.5	29.6	< 0.2	0.0879	< 0.002	0.023
S98-04413	2155515721	15.9	0.37	0.2	0.008	10.3	< 0.003	< 0.002	< 0.008	0.319	4.8	0.006	4.99	0.111	153	0.7	16.1	0.3	0.0514	< 0.002	0.008
S98-04414	2152825773	2.1	0.02	< 0.1	0.017	39.9	< 0.003	< 0.002	< 0.008	0.381	7.6	0.008	46.4	2.72	38	0.2	23.4	0.4	0.332	< 0.002	0.017
S98-04415	2221633290	0.6	0.04	< 0.1	0.049	9.7	< 0.003	< 0.002	< 0.008	13.7	3.7	0.013	5.06	0.563	11.1	0.1	30.9	< 0.2	0.12	< 0.002	0.03
S98-04416	2221644321	0.9	< 0.01	< 0.1	0.025	5.7	< 0.003	< 0.002	< 0.008	10.9	2.6	0.01	3.01	0.445	12	0.1	30.2	0.6	0.0631	< 0.002	0.02
S98-04417	2221627244	< 0.5	0.01	< 0.1	0.017	13.6	< 0.003	< 0.002	< 0.008	3.21	3.8	0.016	8.26	0.358	23.3	0.5	33.1	< 0.2	0.165	< 0.002	0.019
S98-04418	2221627244	12.9	0.21	0.1	0.011	4.8	< 0.003	< 0.002	< 0.008	19.5	2.5	< 0.004	5.31	0.599	133	1.1	18.1	9.1	0.0501	< 0.002	0.038
S98-04419	2221616712	< 0.5	0.01	< 0.1	0.029	14.3	< 0.003	< 0.002	< 0.008	2.93	3.3	0.024	8.55	0.249	28.8	0.3	34.5	0.3	0.154	< 0.002	0.013
S98-04420	2221683658	< 0.5	0.01	< 0.1	0.026	13.3	< 0.003	< 0.002	< 0.008	3.22	2.6	0.023	8.86	0.166	29.6	0.3	32.1	0.9	0.123	< 0.002	0.011
S98-04421	2221611076	< 0.5	0.01	< 0.1	0.025	6.1	< 0.003	< 0.002	< 0.008	9.03	2.2	0.009	3.22	0.678	17.9	0.2	31.2	1.3	0.0572	< 0.002	0.017
S98-04422	2229447841	< 0.5	0.06	< 0.1	0.034	1.1	< 0.003	0.002	< 0.008	0.208	2.7	0.005	0.64	0.016	2.4	< 0.1	11.9	0.9	0.0149	< 0.002	0.012
S98-04423	2229463612	70.1	< 0.01	0.5	0.136	9.3	< 0.003	< 0.002	< 0.008	1.35	20.6	0.006	25.6	0.101	286	< 0.1	8.96	7.2	0.15	< 0.002	0.007
S98-04424	2229479994	1.7	0.17	< 0.1	0.02	10.6	< 0.003	< 0.002	< 0.008	18.4	5.1	0.016	17.3	1.13	29.3	1.4	38.7	10.6	0.128	< 0.002	0.06
S98-04425	2229479459	< 0.5	0.02	< 0.1	0.009	14.4	< 0.003	< 0.002	< 0.008	1.17	4.3	0.007	10	0.501	29.8	0.4	19.9	11.4	0.155	< 0.002	0.008
S98-04426	2229431229	< 0.5	0.02	< 0.1	0.013	13.7	< 0.003	< 0.002	< 0.008	4.67	3	0.01	13.5	0.451	13.5	0.5	29.4	5.9	0.158	< 0.002	0.029
S98-04427	2229431153	5.7	0.12	0.1	0.007	60.8	< 0.003	< 0.002	< 0.008	0.038	9.7	0.018	25.2	0.152	93	< 0.1	6.62	30.4	0.413	< 0.002	0.016
S98-04428	2229415765	< 0.5	< 0.01	< 0.1	0.026	1.7	< 0.003	< 0.002	< 0.008	0.117	2.3	< 0.004	1.4	0.044	5.2	< 0.1	11.9	0.9	0.0197	< 0.002	0.01
S98-04429	2224947834	< 0.5	0.2	< 0.1	0.397	4.8	0.023	< 0.002	< 0.008	0.402	3.3	0.004	4.08	0.592	17.6	< 0.1	6.99	0.2	0.0767	< 0.002	0.041
S98-04430	2224947355	< 0.5	0.02	< 0.1	0.016	14.7	< 0.003	< 0.002	< 0.008	3.3	2	0.006	11.7	0.737	10.1	0.2	24.9	8.4	0.093	< 0.002	0.009
S98-04431	2224947353	5.5	< 0.01	< 0.1	0.017	6.6	< 0.003	< 0.002	< 0.008	22.5	1.3	0.006	4.28	0.477	11.4	0.2	24.5	4.6	0.0826	< 0.002	0.015
S98-04432	2224947417	< 0.5	< 0.01	< 0.1	0.02	2.6	0.005	< 0.002	< 0.008	6.39	1.9	0.007	2.99	0.178	8.9	< 0.1	13.9	14.3	0.0311	< 0.002	0.021
S98-04433	2224911224	< 0.5	0.01	< 0.1	0.008	10.8	< 0.003	< 0.002	< 0.008	1.48	4.1	0.01	12.9	0.743	31.6	0.2	20.6	17.3	0.0821	< 0.002	0.008
S98-04434	2226638051	< 0.5	0.04	1.6	0.066	92.3	< 0.003	< 0.002	< 0.008	5.39	116	0.015	261	0.774	2560	4	13.3	360	1.41	< 0.002	0.024
S98-04435	2226685102	< 0.5	0.05	< 0.1	0.021	10.1	< 0.003	< 0.002	< 0.008	9.05	3	0.015	7.83	0.506	27.3	0.4	30	7.9	0.105	< 0.002	0.027
S98-04436	2226657204	0.5	0.02	< 0.1	0.021	16.3	< 0.003	< 0.002	< 0.008	0.338	6.4	0.008	15.8	0.155	34.7	0.5	18.2	3.3	0.179	< 0.002	0.032
S98-04437	2226676841	< 0.5	0.01	< 0.1	0.017	7.6	< 0.003	< 0.002	< 0.008	5.76	5.5	0.017	10.7	0.383	17.3	0.3	34	2	0.0888	< 0.002	0.027
S98-04438	2226666637	< 0.5	0.01	0.1	0.005	13.2	< 0.003	< 0.002	< 0.008	0.083	1.9	< 0.004	3.75	0.056	99	0.1	13.4	1.9	0.0979	< 0.002	0.01
S98-04439	2226647561	5.1	0.05	< 0.1	0.016	33.6	< 0.003	< 0.002	< 0.008	19	2	0.005	5.51	0.511	18.5	1.6	23.3	0.4	0.107	< 0.002	0.131
S98-04440	2226638357	< 0.5	< 0.01	< 0.1	0.028	7.6	< 0.003	< 0.002	< 0.008	11.7	2.7	0.017	4.64	0.722	13.4	0.3	38.8	3.5	0.0804	< 0.002	0.024
S98-04441	2229047663	9.6	0.03	< 0.1	0.006	28.4	< 0.003	< 0.002	< 0.008	0.06	1.3	0.012	5.57	0.062	20.8	0.1	6.05	7.8	0.156	0.004	0.01

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04443	RIP3464	24/05/1998	21.014	92.246	1992	STW	34	Shafiqul Haq	Chittagong	Cox's Bazar	Teknaf	Nhila	Dakshin nhila
S98-04444	RIP3465	24/05/1998	21.042	92.237	1992	DTW	197	Nazir Ahamad	Chittagong	Cox's Bazar	Teknaf	Whykong	Maddhya nhila
S98-04445	RIP3466	24/05/1998	21.072	92.224	1992	DTW	203	Abbas Uddin	Chittagong	Cox's Bazar	Teknaf	Whykong	Uttar nhila
S98-04446	RIP3467	24/05/1998	21.091	92.213	1992	STW	28	Winchiprany Mosque	Chittagong	Cox's Bazar	Teknaf	Whykong	Uttar nhila
S98-04447	RIP3469	25/05/1998	21.448	92.035	1996	STW	48	Ayub Khan	Chittagong	Cox's Bazar	Cox's Bazar Sadar	P.machhukhali	P. machhukhali
S98-04448	RIP3470	25/05/1998	21.487	92.044	1997	DTW	212	Bharuakhali H. Schoo	Chittagong	Cox's Bazar	Cox's Bazar Sadar	Bharuakhali	Bharuakhali
S98-04449	RIP3471	25/05/1998	21.556	92.062	1995	STW	48	Mahamud Hossain	Chittagong	Cox's Bazar	Cox's Bazar Sadar	Idgaon	Idgaon
S98-04450	RIP3472	25/05/1998	21.573	92.072	1997	DTW	231	Mamataz Ahmad	Chittagong	Cox's Bazar	Cox's Bazar Sadar	Idgaon	Galalia
S98-04451	RIP3473	25/05/1998	21.442	91.971	1989	STW	7	DPHE Office	Chittagong	Cox's Bazar	Cox's Bazar Sadar	Paurashava w01	Forest colony
S98-04452	RIP3474	25/05/1998	21.442	91.971	1978	DTW	90	DPHE Office	Chittagong	Cox's Bazar	Cox's Bazar Sadar	Paurashava w01	Forest colony
S98-04453	RIP3476	14/06/1998	22.668	91.624	1988	STW	13	Aker Zaman	Chittagong	Chittagong	Sitakunda	Bariyadala	Uttar teriail
S98-04454	RIP3477	14/06/1998	22.602	91.652	1994	DTW	140	Moshiul Huq	Chittagong	Chittagong	Sitakunda	Muradpur	Muradpur
S98-04455	RIP3478	14/06/1998	22.574	91.68	1974	STW	10	Sultan Ahmed	Chittagong	Chittagong	Sitakunda	Barabkunda	Nayakhali
S98-04456	RIP3479	14/06/1998	22.546	91.684	1995	STW	17	Kazi Osman Gani	Chittagong	Chittagong	Sitakunda	Banshbaria	Banshbaria
S98-04457	RIP3480	14/06/1998	22.511	91.712	1991	STW	7	Kumira UP Office	Chittagong	Chittagong	Sitakunda	Kumira	Uttar sonaichara
S98-04458	RIP3481	14/06/1998	22.425	91.749	1995	STW	19	Musa Ahmed	Chittagong	Chittagong	Sitakunda	Bhatiari	Bhatiari
S98-04459	RIP3482	14/06/1998	22.402	91.753	1993	STW	20	Nurul Islam	Chittagong	Chittagong	Sitakunda	Salimpur	Uttar chhilim
S98-04461	RIP3485	15/06/1998	22.714	91.608	1989	STW	8	Md Hanif	Chittagong	Chittagong	Mirsharai	Wahedpur	Chatta kamalaha
S98-04462	RIP3486	15/06/1998	22.739	91.565	1970	STW	7	Maghadia UP Office	Chittagong	Chittagong	Mirsharai	Maghadia	Maghadia
S98-04463	RIP3487	15/06/1998	22.818	91.553	1979	STW	16	Master Fakir Ahmed	Chittagong	Chittagong	Mirsharai	Durgapur	Durgapur
S98-04464	RIP3488	15/06/1998	22.927	91.555	1993	DTW	201	Saraf Uddin Kashme	Chittagong	Chittagong	Mirsharai	Karerhat	Chattarua
S98-04465	RIP3489	15/06/1998	22.928	91.554	1994	STW	22	Baswhsasher Mali	Chittagong	Chittagong	Mirsharai	Karerhat	Chattarua
S98-04466	RIP3490	15/06/1998	22.893	91.504	1985	STW	22	Panjaber Nesa H/S	Chittagong	Chittagong	Mirsharai	Dhum	Dhum
S99-01545	RIP7501	15/12/1999	23.7497	90.3888		DTW	200	Well S170A	Dhaka	Dhaka	Dhaka		
S99-01546	RIP7502	15/12/1999	23.726	90.3852		DTW	200	Azimpur colony (pump 7)	Dhaka	Dhaka	Dhaka		
S99-01547	RIP7503	15/12/1999	23.7606	90.3637		DTW	200	Muhammadpur (pump 8)	Dhaka	Dhaka	Dhaka		
S99-01548	RIP7504	15/12/1999	23.8017	90.3597		DTW	200	Inside BIBM compound	Dhaka	Dhaka	Dhaka		Mirpur
S99-01549	RIP7505	15/12/1999	23.7985	90.4066		DTW	200	Banani Pump (pump 5)	Dhaka	Dhaka	Dhaka		
S99-01550	RIP7506	15/12/1999	23.7405	90.4072		DTW	200	Circuit House	Dhaka	Dhaka	Dhaka		
S99-01551	RIP7507	15/12/1999	23.7149	90.4287		DTW	200	Bay Edabad	Dhaka	Dhaka	Dhaka		
S99-04001	RIP4001	10/05/1999	24.3303	90.6821	1992	HTW	12.2	DPHE	Dhaka	Kishoreganj	Pakundia	Pakundia	Sadar VS centre/DPHE
S99-04002	RIP4002	10/05/1999	24.3283	90.6822	1996	HTW	57.9	Upazilla staff HQ	Dhaka	Kishoreganj	Pakundia	Pakundia	Upazilla staff qtr
S99-04003	RIP4003	10/05/1999	24.3283	90.6821	1985	PW	114.3	Upazilla Parishad	Dhaka	Kishoreganj	Pakundia	Pakundia	Upazilla HQ
S99-04004	RIP4004	10/05/1999	24.2495	90.6907	1996	HTW	51.8	Palli Bikash Kendra	Dhaka	Kishoreganj	Pakundia	Egarasindur	Palli Bikash Kendra NG(
S99-04005	RIP4005	10/05/1999	24.2836	90.7013	1998	TARA	71.9	Rais Uddin	Dhaka	Kishoreganj	Pakundia	Barudia	Alamdi Natur Bazar, Ala
S99-04006	RIP4006	10/05/1999	24.315	90.7281	1998	TARA	73.2	Jun/Sec School	Dhaka	Kishoreganj	Pakundia	Patnabhanga	Patnabhanga Jun Sec Sch
S99-04007	RIP4007	10/05/1999	24.3388	90.6658	1973	HTW	51.8	Shamsul Alam	Dhaka	Kishoreganj	Pakundia	Charfaradi	Charfaradi
S99-04008	RIP4008	10/05/1999	24.3516	90.6764	1985	HTW	67.1	Zakir Hossain	Dhaka	Kishoreganj	Pakundia	Jangalia	Tarakandi
S99-04009	RIP4009	10/05/1999	24.3781	90.7173	1994	TARA	57.3	Abul Wahid	Dhaka	Kishoreganj	Pakundia	Chardipasha	Showljani
S99-04010	RIP4010	10/05/1999	24.3724	90.7325	1994	TARA	109.7	Maolana Matiur Rahman	Dhaka	Kishoreganj	Pakundia	Chardipasha	Kodalia
S99-04011	RIP4011	10/05/1999	24.3373	90.6905		HTW	15.2	A K M Mahbubul Hassan	Dhaka	Kishoreganj	Pakundia	Narandi	Srinamdi
S99-04012	RIP4012	11/05/1999	24.434	90.79	1998	HTW	30.5	Abul Kashem	Dhaka	Kishoreganj	Kishoreganj Sadar	Pourashava	Char Sholakia
S99-04013	RIP4013	11/05/1999	24.4354	90.7897	1998	HTW	79.9	Dr Misir Uddin Ahmed	Dhaka	Kishoreganj	Kishoreganj Sadar	Pourashava	Char Sholakia
S99-04014	RIP4014	11/05/1999	24.4388	90.8164	1998	TARA	73.8	Md Taib Ali	Dhaka	Kishoreganj	Kishoreganj Sadar	Baulai	Terahasia
S99-04015	RIP4015	11/05/1999	24.4376	90.8154	1998	HTW	36.6	Rajkunti Jame Masjid	Dhaka	Kishoreganj	Kishoreganj Sadar	Baulai	Ragekonti (village)
S99-04016	RIP4016	11/05/1999	24.3905	90.8289	1992	TARA	67.1	Nasir Uddin	Dhaka	Kishoreganj	Kishoreganj Sadar	Korshakariail	Korshakariail
S99-04017	RIP4017	11/05/1999	24.4041	90.8043	1993	HTW	33.5	UP Chairman	Dhaka	Kishoreganj	Kishoreganj Sadar	Jasodal	Jasodal
S99-04018	RIP4018	11/05/1999	24.4408	90.7674	1995	HTW	32.3	Motiur Rahman	Dhaka	Kishoreganj	Kishoreganj Sadar	Pourashava	Holding 3383, ward 3, H

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S98-04443	2229031165	2	0.01	< 0.1	0.006	7.3	< 0.003	< 0.002	< 0.008	0.773	2.1	0.017	4.84	0.162	121	1.6	20.2	10	0.0473	< 0.002	0.01
S98-04444	2229079331	< 0.5	5.28	< 0.1	0.013	146	< 0.003	0.105	0.016	0.52	3	0.022	9.27	0.261	79.7	0.5	14.7	10.4	0.368	< 0.002	0.651
S98-04445	2229079912	< 0.5	0.61	< 0.1	0.009	18.7	< 0.003	< 0.002	< 0.008	0.114	6.7	0.016	11.3	0.122	97.8	0.1	11.4	6.8	0.161	< 0.002	0.012
S98-04446	2229079912	< 0.5	0.02	< 0.1	0.049	3.6	< 0.003	< 0.002	< 0.008	0.498	4.7	0.013	6.01	0.122	18.4	< 0.1	10.1	21.9	0.0482	< 0.002	0.024
S98-04447	2222471837	0.6	< 0.01	< 0.1	0.019	6	< 0.003	< 0.002	< 0.008	12	2	0.01	3.89	0.795	11.4	0.2	23.8	5	0.0628	< 0.002	0.018
S98-04448	2222405052	1	0.01	< 0.1	0.02	7.4	< 0.003	< 0.002	< 0.008	7.07	2.8	0.019	5.37	0.396	22.3	0.4	36.8	0.7	0.0869	< 0.002	0.019
S98-04449	2222435471	< 0.5	< 0.01	< 0.1	0.05	5.4	< 0.003	< 0.002	< 0.008	5.96	3.3	0.015	4.63	0.23	58.3	0.2	27.4	18.8	0.0667	< 0.002	0.015
S98-04450	2222435314	< 0.5	0.02	< 0.1	0.02	13.2	< 0.003	0.002	< 0.008	3.88	2.5	0.024	8.49	0.378	18.6	0.6	35	4.2	0.134	< 0.002	0.018
S98-04451	2222403961	< 0.5	0.02	< 0.1	0.002	33.1	< 0.003	< 0.002	< 0.008	0.037	3.3	0.007	17.4	< 0.002	17	< 0.1	9.51	11.4	0.0768	< 0.002	0.006
S98-04452	2222403361	< 0.5	0.08	< 0.1	0.013	39.4	< 0.003	< 0.002	< 0.008	0.034	2	< 0.004	5.62	0.163	62.2	< 0.1	12.3	7.8	0.878	< 0.002	0.016
S98-04453	2158628980	196	0.04	1.3	0.013	8.6	< 0.003	< 0.002	< 0.008	0.769	18.1	0.009	16.5	0.059	440	10.1	12.6	1.1	0.118	0.002	0.009
S98-04454	2158652772	12.6	0.02	0.5	0.039	16.7	< 0.003	< 0.002	< 0.008	0.167	4	0.016	17	0.046	242	0.4	14.2	0.4	0.181	< 0.002	0.008
S98-04455	2158619801	16.4	0.02	0.2	0.008	24.6	< 0.003	< 0.002	< 0.008	1.27	11.4	0.006	28.7	0.296	42.9	1.6	17.7	0.2	0.172	< 0.002	0.01
S98-04456	2158609089	65.1	0.03	1.4	0.008	6.6	< 0.003	< 0.002	< 0.008	0.735	23.3	0.01	24.5	0.03	603	18.9	14.5	1.3	0.149	0.004	0.007
S98-04457	2158647965	9.9	0.03	0.1	0.031	32.3	< 0.003	< 0.002	< 0.008	6.57	12.7	0.011	36.5	1.02	47	0.7	26.6	0.8	0.199	< 0.002	0.02
S98-04458	2158638133	9.7	0.02	0.3	0.005	0.8	< 0.003	< 0.002	< 0.008	0.145	8.3	0.007	1.61	0.019	189	2.4	14.4	0.6	0.0089	< 0.002	0.018
S98-04459	2158666920	7.4	0.01	0.7	0.006	10.8	< 0.003	< 0.002	< 0.008	0.363	24.1	0.007	25.4	0.093	281	4.6	22.3	0.7	0.135	< 0.002	0.009
S98-04461	2155389195	44.8	0.04	0.1	0.011	74.2	< 0.003	< 0.002	< 0.008	12.6	11.9	0.017	76.5	0.734	61.4	0.7	25	66.4	0.512	< 0.002	0.021
S98-04462	2155371502	75.7	0.03	0.2	0.01	32.6	< 0.003	< 0.002	< 0.008	5.32	19.2	0.021	56.5	0.635	173	1.4	20.2	38.8	0.266	< 0.002	0.014
S98-04463	2155311270	344	0.02	0.2	0.006	21.1	< 0.003	< 0.002	< 0.008	0.511	20.3	0.006	41	0.194	39.7	1.8	12.3	0.4	0.254	< 0.002	0.008
S98-04464	2155335185	3	0.01	< 0.1	0.035	5.4	< 0.003	< 0.002	< 0.008	0.031	3.3	< 0.004	2.22	0.015	2.5	< 0.1	11.7	< 0.2	0.042	< 0.002	0.01
S98-04465	2155335185	16.7	0.02	0.1	0.202	16.2	0.009	< 0.002	< 0.008	46.6	2.7	< 0.004	6.96	0.676	24.3	0.1	19.2	0.3	0.138	< 0.002	0.034
S98-04466	2155305251	0.8	0.02	0.4	0.064	22.8	< 0.003	< 0.002	< 0.008	0.143	14.1	0.007	37	0.363	221	< 0.1	12.4	0.7	0.275	< 0.002	0.014
S99-01545	3260	< 0.5	< 0.01	< 0.1	0.039	31.4	< 0.003	< 0.002	< 0.008	0.171	2	0.021	15.4	0.674	23.3	< 0.1	38.8	11.5	0.189	< 0.002	0.015
S99-01546	3260	< 0.5	< 0.01	< 0.1	0.052	50.7	< 0.003	0.002	< 0.008	0.021	5.6	0.008	16.6	0.027	43	< 0.1	25.4	31.6	0.482	< 0.002	0.018
S99-01547	3260	< 0.5	< 0.01	< 0.1	0.041	24.3	< 0.003	< 0.002	< 0.008	0.232	1.8	0.009	8.82	0.017	21.8	< 0.1	35.7	2.8	0.179	< 0.002	0.007
S99-01548	3260	< 0.5	< 0.01	< 0.1	0.018	15.4	< 0.003	0.01	< 0.008	0.248	2.3	0.012	5.23	0.066	15.6	0.1	40	0.6	0.118	< 0.002	0.111
S99-01549	3260	< 0.5	< 0.01	< 0.1	0.011	15.4	< 0.003	0.003	< 0.008	0.024	1.7	0.01	5.02	0.021	18.5	0.1	37.9	1.2	0.11	< 0.002	0.009
S99-01550	3260	< 0.5	< 0.01	< 0.1	0.013	16.5	< 0.003	0.004	< 0.008	0.097	1.7	0.012	6.78	0.058	18.1	< 0.1	38.9	6.4	0.107	< 0.002	0.006
S99-01551	3260	< 0.5	< 0.01	< 0.1	0.023	59.2	< 0.003	< 0.002	0.008	0.041	2.5	0.015	22.6	0.223	41.4	0.1	37.2	34.6	0.377	< 0.002	0.009
S99-04001	3487976820	0.6	0.06	< 0.1	0.053	23.9	< 0.003	< 0.002	< 0.008	0.278	2.7	0.004	14.5	0.263	8.2	< 0.1	20	8.6	0.0806	< 0.002	0.077
S99-04002	3487976820	< 0.5	0.05	< 0.1	0.025	27.5	< 0.003	< 0.002	< 0.008	0.073	1.5	< 0.004	7.76	0.35	9.7	0.2	26.1	2.2	0.171	0.005	0.011
S99-04003	3487976820	1.3	0.05	< 0.1	0.026	34.8	< 0.003	< 0.002	< 0.008	0.043	1.6	< 0.004	9.58	0.08	13.6	0.1	27.3	2	0.215	0.004	0.049
S99-04004	3487938249	< 0.5	0.06	< 0.1	0.031	44.9	< 0.003	< 0.002	< 0.008	0.289	1.1	0.017	13.6	1.09	28.4	0.1	33.4	5.2	0.283	0.003	0.036
S99-04005	3487909051	< 0.5	0.04	< 0.1	0.021	23.1	< 0.003	< 0.002	< 0.008	0.155	1.1	< 0.004	9.86	0.03	24.6	0.2	34.6	1.5	0.144	< 0.002	0.041
S99-04006	3487985830	< 0.5	0.04	< 0.1	0.009	20.6	< 0.003	< 0.002	< 0.008	0.041	1.2	0.004	8.07	0.186	51.9	< 0.1	27.3	0.2	0.121	0.003	0.085
S99-04007	3487928256	23.5	0.04	< 0.1	0.205	25.4	< 0.003	< 0.002	< 0.008	2.9	1.6	< 0.004	7.53	1.12	24	0.5	29.4	0.6	0.172	0.002	0.027
S99-04008	3487957274	< 0.5	0.03	< 0.1	0.057	40.5	< 0.003	< 0.002	< 0.008	0.092	1.2	0.005	15.9	0.153	15.2	< 0.1	26.4	2.8	0.242	< 0.002	0.237
S99-04009	3487919235	< 0.5	0.05	< 0.1	0.078	33.8	< 0.003	< 0.002	< 0.008	0.938	1.5	0.006	14.1	0.323	40.6	< 0.1	28.7	0.7	0.203	< 0.002	0.029
S99-04010	3487919594	0.8	0.06	< 0.1	0.039	32.1	< 0.003	< 0.002	< 0.008	4.51	1.5	0.006	13	0.2	41.3	0.2	30.2	< 0.2	0.208	< 0.002	0.028
S99-04011	3487966933	273	0.03	< 0.1	0.118	44.5	< 0.003	< 0.002	< 0.008	10.1	3	< 0.004	13.2	4.4	13.2	0.5	17.3	0.2	0.195	< 0.002	0.014
S99-04012	3484902221	158	0.05	< 0.1	0.049	38.9	< 0.003	< 0.002	< 0.008	2.74	2.7	< 0.004	14.2	0.335	9.8	1.2	25	< 0.2	0.121	< 0.002	0.012
S99-04013	3484902221	1.8	0.04	< 0.1	0.05	17.3	< 0.003	< 0.002	< 0.008	2.83	1.7	< 0.004	8.2	0.412	35.3	0.3	28.3	< 0.2	0.123	< 0.002	0.01
S99-04014	3484917967	1.8	0.06	< 0.1	0.039	43.7	< 0.003	< 0.002	< 0.008	0.1	1.6	< 0.004	17.3	0.151	61.4	< 0.1	26.2	< 0.2	0.276	< 0.002	0.015
S99-04015	3484917840	< 0.5	0.05	< 0.1	0.025	45	< 0.003	< 0.002	< 0.008	0.024	1.2	0.004	22	0.616	81.6	0.2	19.5	< 0.2	0.198	0.003	0.029
S99-04016	3484951483	< 0.5	0.04	< 0.1	0.012	18.9	< 0.003	< 0.002	< 0.008	0.047	0.7	< 0.004	13.2	0.581	56.2	< 0.1	25.3	< 0.2	0.132	0.004	0.015
S99-04017	3484943409	121	0.05	0.1	0.102	53.1	< 0.003	< 0.002	< 0.008	4.55	5.7	< 0.004	34	0.061	167	0.7	14.2	0.5	0.468	< 0.002	0.015
S99-04018	3484903442	1.7	0.05	< 0.1	0.075	38.5	< 0.003	< 0.002	< 0.008	0.06	1.6	< 0.004	20.8	0.444	24.3	0.2	18.5	2.8	0.252	0.005	0.015

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04019	RIP4019	12/05/1999	24.1005	90.927	1996	HTW	78	Abdul Mofiz	Dhaka	Kishoreganj	Bhairab	Kalikaprashad	Akbarnagar
S99-04020	RIP4020	12/05/1999	24.1009	90.927	1998	HTW	18.3	Mohabbat Ali	Dhaka	Kishoreganj	Bhairab	Kalikaprashad	Akbarnagar
S99-04021	RIP4021	12/05/1999	24.1296	90.9447	1985	HTW	51.8	Rehan Fakir	Dhaka	Kishoreganj	Bhairab	Gazaria	Purangaon Manikdi
S99-04022	RIP4022	12/05/1999	24.0928	90.9595	1998	HTW	80.8	Shafi Mia	Dhaka	Kishoreganj	Bhairab	Shibpur	Jamalpu Danghati, Jamal
S99-04023	RIP4023	12/05/1999	24.0991	90.9956	1998	HTW	68.6	Haider Ali	Dhaka	Kishoreganj	Bhairab	Simulkandi	Rajnagar
S99-04024	RIP4024	12/05/1999	24.1162	90.9774	1985	HTW	83.8	Jame Masjid Committee	Dhaka	Kishoreganj	Bhairab	Sadakpur	Bhabanipur Jame Mosjid
S99-04025	RIP4025	12/05/1999	24.0632	90.9811	1995	PW	121.9	Pourashava water works	Dhaka	Kishoreganj	Bhairab	Pourashava	Thana Parishad Compou
S99-04026	RIP4026	12/05/1999	24.062	90.9812	1994	HTW	47.2	Zila parishad	Dhaka	Kishoreganj	Bhairab	Pourashava	Zila Parishad dak bungal
S99-04027	RIP4027	12/05/1999	24.0645	90.9816	1998	HTW	45.7	Mazharul Haque	Dhaka	Kishoreganj	Bhairab	Pourashava	Kamalpur
S99-04028	RIP4028	13/05/1999	24.4209	90.6529	1998	TARA	62.5	SAE, DPHE office	Dhaka	Kishoreganj	Hossainpur	Araibaria	DPHE office Dhekia
S99-04029	RIP4029	13/05/1999	24.4446	90.6394	1995	TARA	66.4	Md Bahar Uddin	Dhaka	Kishoreganj	Hossainpur	Sidhla	Pitalganj
S99-04030	RIP4030	13/05/1999	24.4698	90.6027	1993	TARA	71	Abu Siddique	Dhaka	Kishoreganj	Hossainpur	Jinari	Hazipur
S99-04031	RIP4031	13/05/1999	24.4626	90.7069	1999	HTW	21.3	Gangatia Bazar Mosjid, Saidpur	Dhaka	Kishoreganj	Hossainpur	Gobindapur	Saidpur
S99-04032	RIP4032	13/05/1999	24.4571	90.7031	1997	TARA	75	Sri Sunil Chandra Dash	Dhaka	Kishoreganj	Hossainpur	Gobindapur	Gangatia
S99-04033	RIP4033	13/05/1999	24.4439	90.7075	1997	TARA	72.8	Md Abdus Sattar (Haru)	Dhaka	Kishoreganj	Hossainpur	Pumdi	Mimkhali Bazar, Ranaga
S99-04034	RIP4034	13/05/1999	24.391	90.7164	1985	HTW	7.6	Md Jalal Uddin	Dhaka	Kishoreganj	Hossainpur	Sahedal	Rahimpur
S99-04035	RIP4035	13/05/1999	24.3909	90.7159	1990	TARA	79.9	Md Jamal Uddin	Dhaka	Kishoreganj	Hossainpur	Sahedal	Rahimpur
S99-04036	RIP4036	13/05/1999	24.4654	90.7855	1982	HTW	32	Sujit Kumar Dey	Dhaka	Kishoreganj	Kishoreganj Sadar	Mahinanda	Mahinanda Vadra Para
S99-04037	RIP4037	13/05/1999	24.4644	90.7858	1994	HTW	33.5	UP Office	Dhaka	Kishoreganj	Kishoreganj Sadar	Mahinanda	Union council office Mal
S99-04038	RIP4038	13/05/1999	24.464	90.7863	1992	TARA	80.8	Abdul Jabbar	Dhaka	Kishoreganj	Kishoreganj Sadar	Mahinanda	Vadra Para Mahinanda
S99-04039	RIP4039	14/05/1999	24.4451	90.7778	1998	PW	94.5	Pourashava WSS and PHE	Dhaka	Kishoreganj	Kishoreganj Sadar	Pourashava	DPHE compound
S99-04040	RIP4040	14/05/1999	24.3984	90.7478	1994	TARA	76.2	Abu Sayed	Dhaka	Kishoreganj	Kishoreganj Sadar	Binnati	Binnati
S99-04041	RIP4041	14/05/1999	24.4727	90.7531	1992	TARA	76.2	Abdul Khaleque Mollah	Dhaka	Kishoreganj	Kishoreganj Sadar	Rashidabad	Bhatgaon
S99-04042	RIP4042	15/05/1999	24.2158	90.9623	1998	TARA	94.5	Mezba Uddin Ahmed	Dhaka	Kishoreganj	Bajitpur	Pourashava	Holding 265, Rubberkan
S99-04043	RIP4043	15/05/1999	24.2148	90.9625	1995	HTW	20.1	Kanchan Mollah	Dhaka	Kishoreganj	Bajitpur	Pourashava	Holding 77/104, Rubber
S99-04044	RIP4044	15/05/1999	24.2032	90.9668	1990	TARA	76.8	Hadis Mia	Dhaka	Kishoreganj	Bajitpur	Dilalpur	Tatalchar, Ratanpur
S99-04045	RIP4045	15/05/1999	24.2161	90.9663	1983	HTW	73.2	Farid Uddin	Dhaka	Kishoreganj	Bajitpur	Baliardi	Osmanpur, Selimerkandi
S99-04046	RIP4046	15/05/1999	24.2194	90.9744	1965	HTW	79.9	UP office	Dhaka	Kishoreganj	Bajitpur	Dighirpar	UP office Dighirpar
S99-04047	RIP4047	15/05/1999	24.2227	90.9821	1993	HTW	21.6	Bazar masjid	Dhaka	Kishoreganj	Bajitpur	Dighirpar	Bazar Mosjid, Dighirpar
S99-04048	RIP4048	15/05/1999	24.2117	90.9391	1992	HTW	21.3	Enamul Haque	Dhaka	Kishoreganj	Bajitpur	Pourashava	West Bajitpur houlding 7
S99-04049	RIP4049	15/05/1999	24.247	90.9107	1992	TARA	76.8	Mishi Pal	Dhaka	Kishoreganj	Bajitpur	Hilachia	Pubda, Baligaon
S99-04050	RIP4050	15/05/1999	24.2185	90.8973	1998	TARA	73.2	Solaiman	Dhaka	Kishoreganj	Bajitpur	Sararchar	Daskin Mirapur, Mirapu
S99-04051	RIP4051	15/05/1999	24.218	90.8909	1990	HTW	29	Md Hafiz Uddin	Dhaka	Kishoreganj	Bajitpur	Sararchar	Daskin Mirapur, Mirapu
S99-04052	RIP4052	15/05/1999	24.2332	90.8876	1987	HTW	73.2	Masjid	Dhaka	Kishoreganj	Bajitpur	Halimpur	Dulirchar Mosjid
S99-04053	RIP4053	15/05/1999	24.24	90.8473	1987	HTW	68.6	UP office	Dhaka	Kishoreganj	Bajitpur	Pirijpur	Uttar Pirijpur
S99-04054	RIP4054	16/05/1999	24.5679	90.9034	1997	HTW	75.6	Abdul Halim	Dhaka	Kishoreganj	Tarail	Jawar	Chhanati
S99-04055	RIP4055	16/05/1999	24.5698	90.9077	1996	HTW	32	Khurshid Mia	Dhaka	Kishoreganj	Tarail	Jawar	Chhanati
S99-04056	RIP4056	16/05/1999	24.5665	90.9014	1968	HTW	60.7	Zahur Ali	Dhaka	Kishoreganj	Tarail	Dhala	Sehandar Nagar
S99-04057	RIP4057	16/05/1999	24.557	90.8915	1997	TARA	102.1	Fazlu Mia	Dhaka	Kishoreganj	Tarail	Tarail	Kalna
S99-04058	RIP4058	16/05/1999	24.5498	90.8864	1997	HTW	56.4	Josna Rani Pal	Dhaka	Kishoreganj	Tarail	Tarail	Sachail
S99-04059	RIP4059	16/05/1999	24.531	90.8378	1984	TARA	71.6	Abu Taher	Dhaka	Kishoreganj	Tarail	Taljanga	Araiura
S99-04060	RIP4060	16/05/1999	24.5608	90.8392	1978	HTW	69.2	Khorshed Ali	Dhaka	Kishoreganj	Tarail	Rauti	Rauti
S99-04063	RIP4063	17/05/1999	24.4636	90.8688	1988	HTW	7.6	Ali Hossain Khan	Dhaka	Kishoreganj	Karimganj	Baragharia	Noakandi
S99-04064	RIP4064	17/05/1999	24.45	90.8667	1997	HTW	89.9	Abdus Salam Khan	Dhaka	Kishoreganj	Karimganj	Baragharia	Noakandi
S99-04065	RIP4065	17/05/1999	24.4097	90.9102	1984	HTW	77.7	Monu Mia	Dhaka	Kishoreganj	Karimganj	Gundhar	Kadim Majhihati
S99-04066	RIP4066	17/05/1999	24.3776	90.8747		HTW	72.2	UP Office	Dhaka	Kishoreganj	Karimganj	Joyka	Kandail
S99-04067	RIP4067	17/05/1999	24.4475	90.8491	1999	HTW	80.5	UP office	Dhaka	Kishoreganj	Karimganj	Jafarabad	Sadher Jangil
S99-04068	RIP4068	18/05/1999	24.9565	90.3563	1984	HTW	56.7	DPHE compound	Dhaka	Mymensingh	Phulpur	Phulpur	Godaria

SAMPLE ID	GEOCODE	As	Al	B	Ba	Ca	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Na	P	Si	SO_4	Sr	V	Zn
		ug/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	mg/L	mg/L	mg/L	mg/L	mg/L
S99-04019	3481147062	11.6	0.04	< 0.1	0.038	24.4	< 0.003	< 0.002	< 0.008	1.12	2.5	0.007	9.17	0.042	74.6	0.5	21.1	< 0.2	0.177	< 0.002	0.019
S99-04020	3481147062	160	0.05	< 0.1	0.063	36.1	< 0.003	< 0.002	< 0.008	8.74	3.3	< 0.004	10.4	1.16	7.5	0.4	17.2	< 0.2	0.154	< 0.002	0.014
S99-04021	3481135684	46.7	0.04	< 0.1	0.041	23.2	< 0.003	< 0.002	< 0.008	2.74	2.3	< 0.004	6.78	0.583	6.7	0.5	19.4	1	0.0795	< 0.002	0.013
S99-04022	3481171373	26.3	0.03	0.1	0.03	10.7	< 0.003	< 0.002	< 0.008	1	2.7	< 0.004	4.55	0.194	109	1.1	14.5	< 0.2	0.0808	< 0.002	0.01
S99-04023	3481183746	0.7	0.02	0.3	0.011	2	< 0.003	< 0.002	< 0.008	0.068	3.3	< 0.004	2.22	0.048	146	0.1	38.1	1.2	0.0182	0.004	0.011
S99-04024	3481159808	4	0.03	0.2	0.043	10.6	< 0.003	< 0.002	< 0.008	1.16	1.1	< 0.004	3.3	0.232	105	0.4	26.6	< 0.2	0.0793	< 0.002	0.031
S99-04025	3481104284	32	0.05	0.2	0.114	37.6	< 0.003	< 0.002	< 0.008	4.68	7.6	0.02	19.9	0.516	251	0.1	25.9	30.7	0.291	< 0.002	0.132
S99-04026	3481102102	505	0.07	< 0.1	0.061	59.7	< 0.003	< 0.002	< 0.008	4.55	4.5	< 0.004	8.15	2.01	8.9	0.7	15.1	0.4	0.257	< 0.002	0.043
S99-04027	3481103568	300	0.06	< 0.1	0.065	47.3	< 0.003	< 0.002	< 0.008	6.68	4.4	< 0.004	7.04	1.62	7.5	0.2	16.8	0.3	0.211	< 0.002	0.017
S99-04028	3482713336	1.6	0.06	< 0.1	0.062	47.2	< 0.003	< 0.002	< 0.008	0.066	2.2	0.006	22.1	0.505	47.4	0.2	27.2	4.6	0.268	0.007	0.076
S99-04029	3482781812	2.3	0.02	< 0.1	0.078	36.1	< 0.003	< 0.002	< 0.008	0.028	1.2	< 0.004	14.8	0.76	37.2	0.1	31.6	0.4	0.196	0.004	0.037
S99-04030	3482740518	1.1	0.04	< 0.1	0.048	27.8	< 0.003	< 0.002	< 0.008	0.175	1.7	< 0.004	11.6	0.191	30	0.1	25.2	< 0.2	0.163	< 0.002	0.027
S99-04031	3482727924	195	0.04	0.1	0.148	75.4	< 0.003	< 0.002	< 0.008	14.5	7.6	0.004	36.2	0.205	25.5	1.6	29	0.9	0.479	< 0.002	0.042
S99-04032	3482727420	4.4	0.05	< 0.1	0.09	28.5	< 0.003	< 0.002	< 0.008	0.032	1.4	< 0.004	12.9	0.045	28.6	< 0.1	26.1	0.3	0.16	0.006	0.02
S99-04033	3482754882	1.5	0.04	< 0.1	0.061	25.5	< 0.003	< 0.002	< 0.008	0.037	1.4	0.006	11.9	0.04	28.3	0.1	27.8	0.2	0.144	< 0.002	0.021
S99-04034	3482767854	19.2	0.05	< 0.1	0.061	31.1	< 0.003	< 0.002	< 0.008	3.61	3.1	< 0.004	18.6	1.27	19.8	0.4	19.9	5.2	0.0875	< 0.002	0.019
S99-04035	3482767854	< 0.5	0.06	< 0.1	0.029	30.7	< 0.003	< 0.002	< 0.008	0.054	1.3	< 0.004	11.8	0.187	32.8	0.1	30.4	0.2	0.18	0.003	0.022
S99-04036	3484969604	172	0.06	< 0.1	0.097	55.1	< 0.003	< 0.002	< 0.008	5.93	4	< 0.004	32.6	0.201	28	0.5	18.1	0.6	0.661	< 0.002	0.022
S99-04037	3484969604	8.6	0.06	< 0.1	0.025	101	< 0.003	< 0.002	< 0.008	0.353	1.6	0.005	31.4	3.86	35.7	0.3	20.2	0.5	0.387	0.003	0.025
S99-04038	3484969604	10.3	0.05	< 0.1	0.065	24.6	< 0.003	< 0.002	< 0.008	4.48	1.6	< 0.004	10.8	0.165	35.8	0.4	26.5	0.2	0.155	< 0.002	0.022
S99-04039	3484901829	8.7	0.04	< 0.1	0.057	23.4	< 0.003	< 0.002	< 0.008	0.477	1.8	0.005	11	0.235	35.8	0.1	25.4	0.2	0.146	< 0.002	0.108
S99-04040	3484908195	< 0.5	0.04	< 0.1	0.118	26	< 0.003	< 0.002	< 0.008	0.029	1.4	< 0.004	11.1	0.128	30.1	0.2	31.7	0.3	0.168	0.002	0.024
S99-04041	3484994167	0.9	0.05	< 0.1	0.039	29.3	< 0.003	< 0.002	< 0.008	0.022	1	0.005	11.9	0.228	30.3	< 0.1	26.4	0.3	0.154	0.002	0.021
S99-04042	3480601723	3.2	0.02	< 0.1	0.035	29.2	< 0.003	< 0.002	< 0.008	0.091	1.6	0.006	4.05	0.074	53.6	< 0.1	18	< 0.2	0.209	< 0.002	0.015
S99-04043	3480601723	143	0.03	< 0.1	0.054	49.4	< 0.003	< 0.002	< 0.008	7.81	3.8	< 0.004	13.8	0.84	12.3	0.9	23.2	0.2	0.215	< 0.002	0.022
S99-04044	3480634849	2.4	0.04	< 0.1	0.03	29	< 0.003	< 0.002	< 0.008	0.321	2	< 0.004	3.42	0.053	65.6	0.1	15.2	< 0.2	0.23	< 0.002	0.012
S99-04045	3480617939	38.9	0.02	< 0.1	0.074	20.4	< 0.003	< 0.002	< 0.008	3.99	1.2	< 0.004	4.22	0.149	68.2	0.7	24.6	< 0.2	0.156	< 0.002	0.013
S99-04046	3480625279	0.5	0.02	< 0.1	0.049	30.5	< 0.003	< 0.002	< 0.008	0.052	1.3	0.007	3.66	0.039	51.7	< 0.1	17.2	< 0.2	0.243	< 0.002	0.026
S99-04047	3480625272	60.6	0.03	< 0.1	0.085	65.7	< 0.003	< 0.002	< 0.008	10.3	4.5	0.004	23.7	0.676	29	1.2	30	5.3	0.315	< 0.002	0.022
S99-04048	3480603814	233	0.02	< 0.1	0.099	84.6	< 0.003	< 0.002	< 0.008	14	6.1	0.004	23.2	0.781	21.3	1.4	27.6	0.4	0.359	< 0.002	0.024
S99-04049	3480660082	12.5	0.02	< 0.1	0.047	22.1	< 0.003	< 0.002	< 0.008	0.048	2	0.005	4.12	0.079	87.6	0.4	13.4	< 0.2	0.143	< 0.002	0.01
S99-04050	3480694626	2.4	0.04	< 0.1	0.043	26.6	< 0.003	< 0.002	< 0.008	0.031	1.6	< 0.004	7.46	0.34	80.8	0.1	17.8	< 0.2	0.196	0.003	0.013
S99-04051	3480694626	75.9	0.07	0.1	0.091	59.4	< 0.003	< 0.002	< 0.008	6.19	4.3	0.01	23.8	2.27	38.4	0.5	26.3	3.4	0.192	< 0.002	0.026
S99-04052	3480651268	573	0.03	0.1	0.146	68.2	< 0.003	< 0.002	< 0.008	11.1	6.8	0.007	20.9	1.83	13.5	0.4	16.8	0.4	0.361	< 0.002	0.02
S99-04053	3480686804	18.7	0.04	< 0.1	0.049	25.9	< 0.003	< 0.002	< 0.008	7.57	2.1	0.004	9.06	0.156	70.9	0.5	21.8	< 0.2	0.171	< 0.002	0.045
S99-04054	3489254252	13.5	0.04	0.6	0.045	5.6	< 0.003	< 0.002	< 0.008	1.37	2.7	0.005	1.46	0.068	277	2.9	13.1	< 0.2	0.0619	< 0.002	0.01
S99-04055	3489254252	31.6	0.04	0.6	0.066	8	< 0.003	< 0.002	< 0.008	2.11	2.8	0.005	3.09	0.034	265	4.6	16.7	0.2	0.0564	< 0.002	0.01
S99-04056	3489227915	14.4	0.03	0.6	0.054	7	< 0.003	< 0.002	< 0.008	1.33	2.7	0.004	1.78	0.083	276	2.8	13.5	< 0.2	0.0712	< 0.002	0.005
S99-04057	3489294517	9.8	0.06	0.7	0.069	10.7	< 0.003	< 0.002	< 0.008	0.596	3.1	0.011	3.96	0.017	283	0.6	21.6	< 0.2	0.077	< 0.002	0.017
S99-04058	3489253835	52.8	0.04	0.5	0.021	17.4	< 0.003	< 0.002	< 0.008	0.435	1.6	0.005	4.98	0.594	180	1.7	21.2	< 0.2	0.126	0.004	0.012
S99-04059	3489281026	1.5	0.03	< 0.1	0.015	55	< 0.003	< 0.002	< 0.008	0.075	1.8	< 0.004	20.9	0.161	21	0.2	24.4	< 0.2	0.244	0.005	0.016
S99-04060	3489267822	31.2	0.06	0.1	0.071	46.6	< 0.003	< 0.002	< 0.008	8.82	2.4	0.009	17	0.098	20.5	0.6	30.7	< 0.2	0.373	< 0.002	0.018
S99-04063	3484208690	169	0.06	0.1	0.119	59.6	< 0.003	< 0.002	< 0.008	8.5	4.8	0.006	22	0.15	16.9	1.5	28.1	0.5	0.33	< 0.002	0.018
S99-04064	3484208690	78.8	0.05	0.2	0.151	29.1	< 0.003	< 0.002	< 0.008	6.21	2.2	< 0.004	11.3	0.051	89.6	0.8	15.1	< 0.2	0.216	< 0.002	0.021
S99-04065	3484225397	26.1	0.02	0.3	0.045	9.7	< 0.003	< 0.002	< 0.008	0.701	1.9	0.005	1.34	0.049	179	1.4	10.6	< 0.2	0.0878	< 0.002	0.011
S99-04066	3484251444	29.5	0.06	0.2	0.157	36.3	< 0.003	< 0.002	0.01	1.71	2.6	< 0.004	6.12	0.184	151	0.5	13.5	0.3	0.321	< 0.002	0.019
S99-04067	3484243819	17.7	0.05	0.2	0.099	30.3	< 0.003	< 0.002	< 0.008	0.965	2.4	< 0.004	6.61	0.127	143	0.6	15.6	< 0.2	0.236	< 0.002	0.015
S99-04068	3618158433	43.6	0.05	< 0.1	0.07	32.5	< 0.003	< 0.002	< 0.008	3.37	1.3	< 0.004	9.9	0.283	12.5	0.9	19.9	< 0.2	0.154	< 0.002	0.032

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04069	RIP4069	18/05/1999	24.9547	90.3504	1997	TARA	47.2	Dr A M M Mahfujul Huq	Dhaka	Mymensingh	Phulpur	Phulpur	Godaria
S99-04070	RIP4070	18/05/1999	24.9619	90.2682	1998	HTW	45.1	Muslem Uddin	Dhaka	Mymensingh	Phulpur	Sandhara	Harinadi
S99-04071	RIP4071	18/05/1999	24.9121	90.3557	1997	HTW	54	Muslem Uddin	Dhaka	Mymensingh	Phulpur	Rahimganj	Partala
S99-04072	RIP4072	18/05/1999	24.9006	90.4601	1996	TARA	51.8	Kari Abul Hossain	Dhaka	Mymensingh	Phulpur	Galagaon	Bhatia
S99-04073	RIP4073	18/05/1999	24.9692	90.4767	1989	TARA	50.3	Abul Fazal Talukder	Dhaka	Mymensingh	Phulpur	Baola	Baola
S99-04074	RIP4074	18/05/1999	24.906	90.4906	1978	HTW	46.3	Md Rowsan Ali	Dhaka	Mymensingh	Phulpur	Kamargaon	Raijan
S99-04075	RIP4075	18/05/1999	24.8518	90.4255	1998	TARA	54.3	Md Ketab Ali Bepari	Dhaka	Mymensingh	Phulpur	Tarakande	Madhupur
S99-04076	RIP4076	18/05/1999	24.8085	90.512	1994	TARA	54	Md Fazlul Haque	Dhaka	Mymensingh	Phulpur	Biska	Kaknikona
S99-04077	RIP4077	19/05/1999	25.0027	90.3626	1998	TARA	67.1	Abdul Mannas Ali Mondel	Dhaka	Mymensingh	Haluaghat	Swadeshi	Gazipur
S99-04078	RIP4078	19/05/1999	25.0378	90.2876	1997	HTW	13.7	Dhurail Jamee Masjid	Dhaka	Mymensingh	Haluaghat	Dhurail	Dhurail
S99-04079	RIP4079	19/05/1999	25.0378	90.2876	1984	HTW	61	Dhurail union health complex	Dhaka	Mymensingh	Haluaghat	Dhurail	Dhurail
S99-04080	RIP4080	19/05/1999	25.0681	90.3345	1992	TARA	62.2	Shah Matiure Rahman	Dhaka	Mymensingh	Haluaghat	Dhara	Darinagua
S99-04081	RIP4081	19/05/1999	25.118	90.3393	1999	HTW	69.5	Mrs Helena Begum	Dhaka	Mymensingh	Haluaghat	Haluaghat	Uttar Khairkuri
S99-04082	RIP4082	19/05/1999	25.1799	90.3399	1997	HTW	16.8	Md Ali Hossain (Doda Bhai Ent)	Dhaka	Mymensingh	Haluaghat	Haluaghat	Gobrakura
S99-04083	RIP4083	19/05/1999	25.1757	90.3219	1996	HTW	36.6	Karaiitala BDR Camp	Dhaka	Mymensingh	Haluaghat	Bhubankura	Majrakura
S99-04084	RIP4084	19/05/1999	25.1246	90.3866	1994	HTW	21.9	Md Abdul Hai	Dhaka	Mymensingh	Haluaghat	Gazirbhita	Samaniapara
S99-04085	RIP4085	19/05/1999	25.1246	90.3866	1999	TARA	71.6	Md Abdul Rashid	Dhaka	Mymensingh	Haluaghat	Gazirbhita	Samaniapara
S99-04086	RIP4086	28/05/1999	25.0903	90.4476	1998	TARA	69.5	Manto Kumar	Dhaka	Mymensingh	Dhobaura	Baghber	Munsirhat
S99-04087	RIP4087	28/05/1999	25.0964	90.467	1990	HTW	61	Habibur Rahman	Dhaka	Mymensingh	Dhobaura	Baghber	Sreepur
S99-04088	RIP4088	29/05/1999	25.0857	90.4797	1991	HTW	53.3	U P HQ	Dhaka	Mymensingh	Dhobaura	Dhobaura	Dhobaura
S99-04089	RIP4089	29/05/1999	25.0855	90.4798	1998	TARA	69.5	UP HQ	Dhaka	Mymensingh	Dhobaura	Dhobaura	Dhobaura
S99-04090	RIP4090	29/05/1999	25.1389	90.5753	1990	HTW	45.7	Md Abdul Mazid	Dhaka	Mymensingh	Dhobaura	Dakshin Maijpara	Jangaliapara
S99-04091	RIP4091	29/05/1999	25.1413	90.5726	1989	HTW	53.3	Kalshindur High school	Dhaka	Mymensingh	Dhobaura	Ganariala	Kalsindpur
S99-04092	RIP4092	29/05/1999	25.0903	90.5161	1991	TARA	68.6	Officers quarters	Dhaka	Mymensingh	Dhobaura	Dhobaura	Dhobaura
S99-04093	RIP4093	29/05/1999	25.1319	90.4839	1994	HTW	60	Baligaon Madrasha	Dhaka	Mymensingh	Dhobaura	Ghosgaon	Baligaon
S99-04094	RIP4094	29/05/1999	25.1319	90.4839	1991	TARA	67.1	Zabed Ali	Dhaka	Mymensingh	Dhobaura	Goshgaon	Baligaon
S99-04095	RIP4095	21/05/1999	24.7639	90.2659	1986	DTW	51.8	DPHE Muktagachha compound	Dhaka	Mymensingh	Muktagachha	Ward-2	Para Tong
S99-04096	RIP4096	21/05/1999	24.7639	90.2659	1998	HTW	12.2	Upazila compound	Dhaka	Mymensingh	Muktagachha	Ward-2	Para Tong
S99-04097	RIP4097	21/05/1999	24.7673	90.2551	1996	DTW	147.8	Pump house No. 2	Dhaka	Mymensingh	Muktagachha	Ward-1	Muktagachha
S99-04098	RIP4098	22/05/1999	24.5763	90.195	1994	TARA	53	Dr Jamal Uddin	Dhaka	Mymensingh	Fulbaria	Rangamatia	Anuhadi
S99-04099	RIP4099	22/05/1999	24.6093	90.2394	1997	TARA	54.9	Md Habibur Rahman Khan	Dhaka	Mymensingh	Fulbaria	Bakta	Bakta
S99-04100	RIP4100	22/05/1999	24.5949	90.2949	1995	TARA	54.9	Md Kurban Ali	Dhaka	Mymensingh	Fulbaria	Radhakani	Palastali
S99-04101	RIP4101	22/05/1999	24.6373	90.2713	1998	TARA	46	DPHE compound	Dhaka	Mymensingh	Fulbaria	Fulbaria	Fulbaria
S99-04102	RIP4102	22/05/1999	24.6796	90.3018	1997	TARA	60	Abdul Kuddus Sarker	Dhaka	Mymensingh	Fulbaria	Balian	Balian
S99-04103	RIP4103	22/05/1999	24.6745	90.3245	1998	TARA	57.9	Md Siddikur Rahman	Dhaka	Mymensingh	Fulbaria	Deokhola	Jangalia
S99-04104	RIP4104	22/05/1999	24.6679	90.2204	1995	TARA	51.8	Md Ibrahim Master	Dhaka	Mymensingh	Fulbaria	Putijana	Daosa
S99-04105	RIP4105	22/05/1999	24.5548	90.2984	1990	TARA	57	Fajar Ali	Dhaka	Mymensingh	Fulbaria	Achimpatuli	Ramnagar
S99-04106	RIP4106	23/05/1999	24.6886	90.5981	1989	HTW	33.5	Md Habibur Rahman	Dhaka	Mymensingh	Ishwarganj	Ward-5 parashava	Churnikhala
S99-04107	RIP4107	23/05/1999	24.6688	90.5336	1992	TARA	80.2	Md Abu Bakar Siddique	Dhaka	Mymensingh	Ishwarganj	Tarundia	Sripur Jithar
S99-04108	RIP4108	23/05/1999	24.6478	90.5239	1997	TARA	80.2	Moula Kha	Dhaka	Mymensingh	Ishwarganj	Uchakhila	Balihata
S99-04109	RIP4109	23/05/1999	24.5989	90.5503	1996	TARA	81.1	Abdul Khaleque	Dhaka	Mymensingh	Ishwarganj	Rajipur	Maijhati
S99-04110	RIP4110	23/05/1999	24.632	90.7149	1985	HTW	10.7	Md Yaqub Ali	Dhaka	Mymensingh	Ishwarganj	Atharabari	Atharabari
S99-04111	RIP4111	23/05/1999	24.6345	90.7178	1995	TARA	91.4	Abdul Qader	Dhaka	Mymensingh	Ishwarganj	Atharabari	Atharabari
S99-04112	RIP4112	23/05/1999	24.5999	90.6045	1992	TARA	23.2	Md Safir Uddin	Dhaka	Mymensingh	Ishwarganj	Magtola	Chhatiantala Bairati
S99-04113	RIP4113	23/05/1999	24.6305	90.6119	1993	TARA	76.2	Md Amir Hossain	Dhaka	Mymensingh	Ishwarganj	Maijbag	Maijbag (Kumuriar Chha
S99-04114	RIP4114	23/05/1999	24.6888	90.6539	1997	TARA	64	Abdul Majid	Dhaka	Mymensingh	Ishwarganj	Sohagi	Bagaputa
S99-04115	RIP4115	24/05/1999	24.7349	90.3059	1998	TARA	64.6	Abdus Samad	Dhaka	Mymensingh	Muktagachha	Kheruajani	Saidgram
S99-04116	RIP4116	24/05/1999	24.7838	90.2426	1997	TARA	53	Md Jalal Uddin	Dhaka	Mymensingh	Muktagachha	Mankon	Sripur Maijhati

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-04069	3618158433	1.3	0.04	< 0.1	0.019	16.4	< 0.003	< 0.002	< 0.008	0.145	2	< 0.004	3.86	0.188	62.3	0.3	20.9	< 0.2	0.105	< 0.002	0.063
S99-04070	3618181463	< 0.5	0.06	< 0.1	0.05	38.1	< 0.003	< 0.002	< 0.008	0.152	0.6	< 0.004	13.5	0.166	15.6	< 0.1	21.1	11.2	0.201	< 0.002	0.081
S99-04071	3618163798	21.2	0.04	< 0.1	0.033	70.9	< 0.003	< 0.002	< 0.008	2.11	2	0.009	24.3	1.48	14.8	0.7	26.5	0.4	0.376	< 0.002	0.039
S99-04072	3618136203	< 0.5	0.02	< 0.1	0.026	22.6	< 0.003	< 0.002	< 0.008	0.032	0.7	< 0.004	7.15	0.038	41.9	0.1	17	0.3	0.104	0.004	0.024
S99-04073	3618127115	1.8	0.03	< 0.1	0.022	25.2	< 0.003	< 0.002	< 0.008	0.198	1.4	< 0.004	11	0.634	30.1	0.2	22.5	0.3	0.133	< 0.002	0.047
S99-04074	3618145871	76.5	0.01	< 0.1	0.134	13.2	< 0.003	< 0.002	< 0.008	1.67	1.1	< 0.004	5.96	0.051	45.8	0.2	9.02	< 0.2	0.101	< 0.002	0.024
S99-04075	3618194648	< 0.5	0.03	< 0.1	0.024	24.6	< 0.003	< 0.002	0.01	0.053	0.7	< 0.004	7.73	0.107	17.4	0.1	19.8	4.1	0.113	< 0.002	0.095
S99-04076	3618122521	2	0.03	< 0.1	0.014	28.8	< 0.003	< 0.002	< 0.008	0.096	0.9	< 0.004	11	0.269	10.3	0.1	28.4	3.1	0.153	< 0.002	0.037
S99-04077	3612494352	2	0.04	< 0.1	0.054	25.8	< 0.003	< 0.002	< 0.008	1.07	1.1	< 0.004	11.3	0.169	23.8	0.2	24.5	0.2	0.149	< 0.002	0.053
S99-04078	3612440315	3.6	0.03	< 0.1	0.084	22.3	< 0.003	< 0.002	< 0.008	8.38	2.2	0.004	9.88	0.238	12.8	0.2	17.9	3.3	0.0854	< 0.002	0.031
S99-04079	3612440315	13	0.04	< 0.1	0.039	23.2	< 0.003	< 0.002	< 0.008	0.624	1.4	< 0.004	9.5	0.633	16.2	0.2	28.1	< 0.2	0.121	< 0.002	0.027
S99-04080	3612433278	0.8	0.05	< 0.1	0.022	16.4	< 0.003	< 0.002	0.01	0.372	1.1	< 0.004	8.31	0.217	20.3	0.1	25.5	0.3	0.0838	< 0.002	0.023
S99-04081	3612461970	29.5	0.06	< 0.1	0.058	18.2	< 0.003	< 0.002	0.011	2	1.2	0.005	7.37	0.46	32.3	0.4	21.3	0.2	0.101	< 0.002	0.031
S99-04082	3612461401	23.1	0.06	< 0.1	0.042	3.9	0.004	0.002	0.011	3.02	1.5	< 0.004	3.7	0.94	18	< 0.1	11.4	2.8	0.0297	< 0.002	0.086
S99-04083	3612420661	78.6	0.01	< 0.1	0.045	8.5	< 0.003	< 0.002	< 0.008	12.7	1.2	< 0.004	4.74	0.113	18.1	0.7	15.3	< 0.2	0.0575	< 0.002	0.031
S99-04084	3612447865	55.6	0.02	< 0.1	0.021	2.9	< 0.003	< 0.002	< 0.008	5.08	1.3	< 0.004	1.6	0.057	29.2	0.4	6.21	< 0.2	0.02	< 0.002	0.051
S99-04085	3612447865	44.3	0.04	< 0.1	0.034	15.6	< 0.003	< 0.002	0.008	0.306	1	< 0.004	5.65	0.309	48.4	0.6	15.7	< 0.2	0.0931	< 0.002	0.082
S99-04086	3611610654	110	0.06	< 0.1	0.061	31.9	< 0.003	< 0.002	< 0.008	0.819	1.5	0.005	10.5	0.652	54.1	1.4	20.7	2.6	0.198	< 0.002	0.105
S99-04087	3611610053	14.8	0.09	< 0.1	0.039	23.8	< 0.003	< 0.002	< 0.008	4.37	1	< 0.004	7.77	0.455	47.9	0.3	13.6	2	0.162	< 0.002	0.51
S99-04088	3611636263	54.6	0.06	< 0.1	0.052	23	< 0.003	0.003	< 0.008	2.3	1	0.005	8.42	0.435	43.5	1.1	23.5	< 0.2	0.141	< 0.002	0.05
S99-04089	3611636263	76.6	0.06	< 0.1	0.068	28.1	< 0.003	< 0.002	< 0.008	2.29	0.9	< 0.004	9.54	0.58	45	1.1	17.5	< 0.2	0.158	< 0.002	0.109
S99-04090	3611631466	200	< 0.01	< 0.1	0.138	18.7	< 0.003	< 0.002	< 0.008	16.9	2.2	< 0.004	8.87	0.053	38.7	1.6	20.9	1	0.128	< 0.002	0.084
S99-04091	3611642510	83.6	< 0.01	< 0.1	0.15	13.7	< 0.003	< 0.002	< 0.008	17.7	1.8	0.008	4.87	0.256	22.9	0.7	20.9	0.2	0.096	< 0.002	0.042
S99-04092	3611636263	69.5	0.01	< 0.1	0.061	24.8	< 0.003	< 0.002	< 0.008	1.9	0.9	0.005	9.5	0.571	41.6	0.9	19	< 0.2	0.158	< 0.002	0.07
S99-04093	3611652089	171	0.01	< 0.1	0.051	6.1	< 0.003	< 0.002	< 0.008	12.9	1.6	< 0.004	2.41	0.087	21.6	0.8	15.9	0.8	0.0439	< 0.002	0.059
S99-04094	3611652089	19.8	< 0.01	< 0.1	0.015	5.8	< 0.003	< 0.002	< 0.008	4.85	1.7	< 0.004	2.52	0.126	24.1	0.6	15.8	0.2	0.0388	< 0.002	0.056
S99-04095	3616502852	1.1	0.05	< 0.1	0.018	21.6	0.004	< 0.002	0.01	0.201	0.6	< 0.004	8.18	2.14	19.7	0.3	28.2	4	0.186	< 0.002	0.073
S99-04096	3616502852	65.6	0.06	< 0.1	0.056	36	< 0.003	< 0.002	0.009	3.48	0.6	< 0.004	14.5	1.39	12.9	0.5	21.9	< 0.2	0.164	< 0.002	0.129
S99-04097	3616501568	2.3	0.06	< 0.1	0.046	24.5	< 0.003	< 0.002	0.011	0.643	1.2	< 0.004	11.5	0.177	13.1	0.1	28.1	1.5	0.12	< 0.002	0.101
S99-04098	3612095057	0.8	0.03	< 0.1	0.013	10.2	< 0.003	< 0.002	0.01	0.051	1.5	0.01	3.6	0.079	14.9	0.2	39.3	< 0.2	0.0738	< 0.002	0.047
S99-04099	3612017090	0.6	0.06	< 0.1	0.057	29.2	< 0.003	< 0.002	0.011	0.078	1	< 0.004	10.4	0.332	25.4	0.1	26.5	< 0.2	0.157	< 0.002	0.058
S99-04100	3612089781	< 0.5	0.02	< 0.1	0.018	26.3	< 0.003	< 0.002	< 0.008	0.036	1.1	< 0.004	8.46	0.036	26.9	0.1	31.8	< 0.2	0.194	0.008	0.034
S99-04101	3612047822	1.4	0.07	< 0.1	0.076	35.7	< 0.003	< 0.002	< 0.008	0.224	1.2	< 0.004	13.9	0.276	32.1	< 0.1	29	0.6	0.192	< 0.002	0.111
S99-04102	3612023098	< 0.5	0.07	< 0.1	0.044	30.6	< 0.003	< 0.002	< 0.008	0.247	1.7	< 0.004	12.5	0.423	35.6	0.1	24.7	0.4	0.154	< 0.002	0.136
S99-04103	3612035468	1.6	0.06	< 0.1	0.028	26.9	< 0.003	< 0.002	< 0.008	0.064	1.5	< 0.004	12.4	0.91	29.8	0.2	28.8	0.3	0.147	< 0.002	0.346
S99-04104	3612083304	< 0.5	0.02	< 0.1	0.047	31.4	< 0.003	< 0.002	< 0.008	0.043	1.3	< 0.004	13.2	0.056	22.6	< 0.1	32.5	0.2	0.166	< 0.002	0.009
S99-04105	3612011871	< 0.5	0.06	< 0.1	0.042	21.5	< 0.003	< 0.002	< 0.008	0.038	1.3	< 0.004	10.5	0.037	34.4	0.1	36.1	0.2	0.127	0.008	0.071
S99-04106	3613140197	< 0.5	0.06	< 0.1	0.02	25.5	< 0.003	< 0.002	< 0.008	0.079	1.4	< 0.004	7.73	0.066	37.2	0.2	21	0.7	0.145	0.006	0.057
S99-04107	3613190916	4.3	0.06	< 0.1	0.071	31.2	< 0.003	< 0.002	< 0.008	0.459	1.6	< 0.004	10.1	0.339	38.3	0.2	25	0.3	0.157	< 0.002	0.052
S99-04108	3613194038	< 0.5	0.06	< 0.1	0.034	36.2	< 0.003	< 0.002	< 0.008	0.048	1.8	< 0.004	11.5	0.234	26.5	0.2	21.1	0.3	0.172	< 0.002	0.067
S99-04109	3613167588	< 0.5	0.06	< 0.1	0.06	30.1	< 0.003	< 0.002	< 0.008	0.039	1.3	< 0.004	12.5	0.911	29.5	0.1	21.3	0.5	0.156	0.002	0.064
S99-04110	3613109017	< 0.5	0.08	< 0.1	0.226	100	< 0.003	< 0.002	< 0.008	0.155	19.5	0.006	16	0.471	32	< 0.1	18.5	24.7	0.159	< 0.002	0.088
S99-04111	3613109017	26.8	0.07	< 0.1	0.092	30.3	< 0.003	< 0.002	< 0.008	0.808	1.7	< 0.004	9.7	0.158	36	0.4	20.3	0.4	0.176	< 0.002	0.072
S99-04112	3613163220	< 0.5	0.07	< 0.1	0.043	32	< 0.003	< 0.002	< 0.008	0.152	1.5	< 0.004	14.3	0.304	34.4	< 0.1	27.1	1	0.175	< 0.002	0.068
S99-04113	3613154589	< 0.5	0.06	< 0.1	0.085	30.9	< 0.003	< 0.002	< 0.008	0.035	1.3	< 0.004	7.19	0.114	35.5	0.1	17	0.3	0.146	< 0.002	0.051
S99-04114	3613185019	0.5	0.07	< 0.1	0.015	29.7	< 0.003	< 0.002	< 0.008	0.045	1.4	< 0.004	7.35	0.29	8.5	0.2	28.2	2.1	0.162	0.005	0.065
S99-04115	3616560892	< 0.5	0.08	< 0.1	0.043	29.3	< 0.003	< 0.002	< 0.008	0.271	1.1	0.011	12	0.145	34.7	< 0.1	29.4	0.5	0.149	< 0.002	0.08
S99-04116	3616577964	< 0.5	0.05	< 0.1	0.011	17.3	< 0.003	< 0.002	< 0.008	0.035	0.7	< 0.004	10.3	1.11	10.4	0.2	23.5	10.3	0.0599	0.003	0.056

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04117	RIP4117	24/05/1999	24.7755	90.1817	1997	TARA	56.1	Md Sohrab Ali	Dhaka	Mymensingh	Muktagachha	Dulla	Kuripara
S99-04118	RIP4118	24/05/1999	24.7221	90.1826	1997	TARA	52.4	Yunus Ali Khan	Dhaka	Mymensingh	Muktagachha	Kashimpur	Ramnath
S99-04119	RIP4119	24/05/1999	24.6735	90.1445	1994	TARA	56.1	Nagendra Barman	Dhaka	Mymensingh	Muktagachha	Deogaon	Kathalia
S99-04120	RIP4120	24/05/1999	24.7418	90.1674	1990	TARA	52.4	Abdul Hakim	Dhaka	Mymensingh	Muktagachha	Ghoga	Hatil
S99-04121	RIP4121	25/05/1999	24.5689	90.0272	1998	TARA	43.3	Md Sabed Ali	Dhaka	Tangail	Madhupur	Alokdia	Lauphula
S99-04122	RIP4122	25/05/1999	24.6066	90.1219	1985	TARA	37.5	Ishaque Ali	Dhaka	Tangail	Madhupur	Ausnara	Ausnara
S99-04123	RIP4123	25/05/1999	24.6608	90.089	1979	TARA	44.2	Beribaid Etim Khana	Dhaka	Tangail	Madhupur	Arankhola	Beribaid
S99-04124	RIP4124	25/05/1999	24.7023	89.8904	1984	HTW	20.1	Birtara U P office	Dhaka	Tangail	Madhupur	Birtara	Kendua
S99-04125	RIP4125	25/05/1999	24.6784	89.9517	1999	HTW	18.3	Central co-operative	Dhaka	Tangail	Madhupur	Dhanbari	Kismat Dhanbari
S99-04126	RIP4126	25/05/1999	24.6362	89.9735	1995	HTW	32.3	Dhopakhali U P Office	Dhaka	Tangail	Madhupur	Dhopakhali	Samadkur
S99-04127	RIP4127	25/05/1999	24.6085	90.0213	1998	HTW	36.3	A Karim	Dhaka	Tangail	Madhupur	Madhupur	Madhupur
S99-04128	RIP4128	25/05/1999	24.4846	89.9724	1982	HTW	36.6	SAE DPHE office	Dhaka	Tangail	Ghatail	Ghatail	Ghatail
S99-04129	RIP4129	26/05/1999	24.5193	89.974	1991	HTW	31.4	Nibaran Chandra Mondol	Dhaka	Tangail	Ghatail	Deulabari	Nagbari
S99-04130	RIP4130	26/05/1999	24.4187	89.9971	1994	HTW	31.4	Garatta Etim Khana	Dhaka	Tangail	Ghatail	Digar	Garatta
S99-04131	RIP4131	26/05/1999	24.5068	90.1657	1994	TARA	52.4	Md Mojibur Rahman	Dhaka	Tangail	Ghatail	Rasulpur	Lakshmindar
S99-04132	RIP4132	26/05/1999	24.5075	90.1649	1982	HTW	37.2	Habibur Rahman	Dhaka	Tangail	Ghatail	Rasulpur	Lakshmindar
S99-04133	RIP4133	26/05/1999	24.4467	90.1186	1997	TARA	53.3	Bazar bus stand	Dhaka	Tangail	Ghatail	Dhalapara	Sahar Gobindapur
S99-04134	RIP4134	26/05/1999	24.4721	90.0617	1997	TARA	54	Meser Ali	Dhaka	Tangail	Ghatail	Deopara	Kumarpara
S99-04135	RIP4135	26/05/1999	24.4779	90.0629	1994	HTW	34.7	Md Nurul Islam	Dhaka	Tangail	Ghatail	Sandhanpur	Kusaria
S99-04136	RIP4136	26/05/1999	24.5143	90.0552	1998	TARA	51.8	Abdul Karim	Dhaka	Tangail	Ghatail	Sandhanpur	Chhankhola
S99-04137	RIP4137	27/05/1999	24.4928	89.8676	1993	HTW	33.5	Monaem Khan	Dhaka	Tangail	Bhuapur	Phulda	Maijbari
S99-04138	RIP4138	27/05/1999	24.524	89.8411	1998	HTW	32	Khandoker Abul Kashem	Dhaka	Tangail	Bhuapur	Arjuna	Arjuna
S99-04139	RIP4139	27/05/1999	24.3977	89.8165	1992	HTW	18.3	Abdul Jalil Sarker	Dhaka	Tangail	Bhuapur	Nikrail	Char Pathailkandi
S99-04140	RIP4140	27/05/1999	24.4493	89.8292	1994	HTW	25.3	Aroz Ali (Grameen Bank)	Dhaka	Tangail	Bhuapur	Gobindasi	Gobindasi
S99-04141	RIP4141	27/05/1999	24.4642	89.8337	1987	HTW	22.3	Tara Mia (member)	Dhaka	Tangail	Bhuapur	Gabsara	Sarai
S99-04142	RIP4142	27/05/1999	24.4592	89.8469	1986	HTW	22.9	Sirajul Huq (Mohir Eng)	Dhaka	Tangail	Bhuapur	Gobindasi	Bagbari
S99-04143	RIP4143	27/05/1999	24.4516	89.8941	1985	HTW	38.7	Aurangajeb	Dhaka	Tangail	Ghatail	Lakherpara	Lakherpara
S99-04144	RIP4144	27/05/1999	24.4166	89.8811	1997	HTW	40.5	Ekramul Huq	Dhaka	Tangail	Bhuapur	Birhati	Kadim Nikla
S99-04145	RIP4145	28/05/1999	24.0989	90.1026	1997	TARA	54.9	SAE, DPHE	Dhaka	Tangail	Mirzapur	Mirzapur	Baimhati
S99-04146	RIP4146	30/05/1999	24.0518	90.0047	1997	HTW	29	Rostom Ali Khan	Dhaka	Tangail	Mirzapur	Anaitara	Bilsa
S99-04147	RIP4147	30/05/1999	24.0518	90.0047	1988	HTW	22.9	Hossain Ali	Dhaka	Tangail	Mirzapur	Anaitara	Bilsa
S99-04148	RIP4148	30/05/1999	24.0455	90.0293	1995	HTW	24.4	Osman Gani	Dhaka	Tangail	Mirzapur	Uarsi	Mostafapur
S99-04149	RIP4149	30/05/1999	24.0455	90.0293	1995	HTW	29.6	Mosque	Dhaka	Tangail	Mirzapur	Uarsi	Mostafapur
S99-04150	RIP4150	28/05/1999	24.1184	90.1737	1992	HTW	25.9	Harzat Ali	Dhaka	Tangail	Mirzapur	Ajgana	Chiteshwari
S99-04151	RIP4151	28/05/1999	24.1184	90.1737	1996	TARA	48.8	Abser Ali	Dhaka	Tangail	Mirzapur	Ajgana	Chiteshwari
S99-04152	RIP4152	28/05/1999	24.0964	90.1537	1977	TARA	58.5	High school	Dhaka	Tangail	Mirzapur	Gorai	Gorai
S99-04153	RIP4153	28/05/1999	24.069	90.1202	1997	TARA	54.9	Primary school	Dhaka	Tangail	Mirzapur	Bahuria	Bahuria
S99-04154	RIP4154	28/05/1999	24.0941	90.1042	1997	HTW	25.9	Jalal Uddin	Dhaka	Tangail	Mirzapur	Mirzapur	Baimhati
S99-04155	RIP4155	28/05/1999	24.1225	90.0579	1991	HTW	22.9	Zeennat Ali	Dhaka	Tangail	Mirzapur	Fatehpur	Subhulla
S99-04156	RIP4156	28/05/1999	24.1407	90.0208	1969	HTW	36.6	Jamie Mosjid	Dhaka	Tangail	Mirzapur	Jamurki	Pakulla
S99-04157	RIP4157	28/05/1999	24.1635	90.0319	1994	HTW	27.4	Abdul Rashid	Dhaka	Tangail	Mirzapur	Mahera	Mahera
S99-04158	RIP4158	29/05/1999	24.2313	90.0488	1993	HTW	38.1	Md Zahid Hossain Khan	Dhaka	Tangail	Basail	Basail	Basail
S99-04159	RIP4159	29/05/1999	24.2568	90.0583	1985	HTW	35.1		Dhaka	Tangail	Basail	Kaoaljani	Kalia
S99-04160	RIP4160	29/05/1999	24.267	90.0351	1999	HTW	27.4	Md Hasmat Ali	Dhaka	Tangail	Basail	Fulki	Balia
S99-04161	RIP4161	29/05/1999	24.2314	90.0423	1993	HTW	23.8	Abdul Salam Khan	Dhaka	Tangail	Basail	Basail	Basail
S99-04162	RIP4162	29/05/1999	24.244	90.0089	1992	TARA	38.7	Aungur Alam Khan	Dhaka	Tangail	Basail	Kashil	Uttar Bathuli
S99-04163	RIP4163	29/05/1999	24.2106	89.9805	1996	TARA	32	Matiar Rahman Budda	Dhaka	Tangail	Basail	Habla	Karatipara
S99-04164	RIP4164	29/05/1999	24.2182	90.0632	1998	HTW	27.4	Majnu Mia	Dhaka	Tangail	Basail	Kanchanpur	Kanchanpur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-04117	3616534617	< 0.5	0.04	< 0.1	0.016	25.4	< 0.003	< 0.002	< 0.008	0.086	0.9	< 0.004	11.2	0.537	9.5	0.1	27.3	2.8	0.114	< 0.002	0.067
S99-04118	3616551850	7.9	0.07	< 0.1	0.066	36	< 0.003	< 0.002	< 0.008	0.169	1.7	< 0.004	15.9	0.351	24.1	0.1	29.3	0.3	0.189	< 0.002	0.06
S99-04119	3616525545	< 0.5	0.02	< 0.1	0.016	14.3	< 0.003	0.013	0.009	0.041	2.5	0.009	4.05	0.037	12.9	0.1	33.6	0.4	0.139	0.003	0.073
S99-04120	3616543426	< 0.5	0.06	< 0.1	0.044	21.4	< 0.003	< 0.002	< 0.008	0.035	1.2	< 0.004	9.07	0.056	21.3	0.1	33.3	0.7	0.116	0.005	0.049
S99-04121	3935709657	< 0.5	0.05	< 0.1	0.019	9.8	< 0.003	0.004	< 0.008	0.794	1.7	0.006	2.52	0.025	12.1	< 0.1	29.1	0.6	0.0866	< 0.002	0.107
S99-04122	3935728055	< 0.5	0.05	< 0.1	0.01	9.4	< 0.003	0.02	< 0.008	0.044	1.6	0.006	2.87	0.006	10.3	0.2	33.4	1.1	0.0948	0.003	0.054
S99-04123	3935719162	< 0.5	0.04	< 0.1	0.035	9.8	< 0.003	0.006	< 0.008	0.309	2	< 0.004	3.11	0.009	10.8	< 0.1	28.7	0.6	0.0874	0.003	0.058
S99-04124	3935738610	2.2	0.06	< 0.1	0.065	28.7	< 0.003	0.003	< 0.008	2.18	3.2	< 0.004	12.5	0.155	17.9	0.1	18.6	1.5	0.0951	< 0.002	0.053
S99-04125	3935747619	2.1	0.01	< 0.1	0.044	25.4	< 0.003	< 0.002	< 0.008	1.15	3.4	< 0.004	18.2	0.455	18.4	< 0.1	23.6	10.4	0.0994	< 0.002	0.049
S99-04126	3935757892	9.8	0.02	< 0.1	0.055	16.7	< 0.003	< 0.002	< 0.008	5.89	2.3	< 0.004	7.35	0.197	8.7	0.4	25.4	0.4	0.058	< 0.002	0.047
S99-04127	3935776678	21.2	0.01	< 0.1	0.072	27	< 0.003	< 0.002	< 0.008	10.9	2.2	< 0.004	10.4	0.79	11.6	0.6	28	< 0.2	0.143	< 0.002	0.057
S99-04128	3932860364	45.5	< 0.01	< 0.1	0.196	57.5	< 0.003	< 0.002	< 0.008	4.6	4.1	< 0.004	27.3	3.8	21.1	0.1	31.8	6.2	0.199	< 0.002	0.047
S99-04129	3932817728	41	0.06	< 0.1	0.112	31.2	< 0.003	< 0.002	< 0.008	2.15	2.7	< 0.004	14	0.887	13.9	0.3	27.8	2.2	0.098	< 0.002	0.048
S99-04130	3932851344	8.1	0.05	< 0.1	0.061	20.2	< 0.003	< 0.002	< 0.008	1.44	2.3	< 0.004	10.9	0.333	8.7	0.1	26	6.7	0.0807	< 0.002	0.089
S99-04131	3932886630	< 0.5	0.05	< 0.1	0.004	4.3	< 0.003	0.011	< 0.008	0.061	1.4	< 0.004	1.19	0.027	7.4	0.1	28	0.5	0.0427	< 0.002	0.048
S99-04132	3932886630	< 0.5	0.05	< 0.1	0.029	4.9	< 0.003	0.008	< 0.008	0.056	1.6	< 0.004	1.32	0.014	7.6	< 0.1	22	0.3	0.0538	< 0.002	0.05
S99-04133	3932834903	< 0.5	0.05	< 0.1	0.013	10	< 0.003	0.013	< 0.008	0.039	2	0.008	3.19	0.015	14	0.2	34.7	0.6	0.091	0.004	0.048
S99-04134	3932825608	< 0.5	0.05	< 0.1	0.029	8.2	< 0.003	0.008	< 0.008	0.04	1.7	0.006	1.76	0.008	9.6	0.2	31.4	0.5	0.0829	0.003	0.053
S99-04135	3932894617	< 0.5	0.04	< 0.1	0.032	9	< 0.003	0.01	< 0.008	0.097	2	0.005	2	0.007	9.1	0.2	30.9	1.3	0.0967	0.003	0.045
S99-04136	3932894227	< 0.5	0.06	< 0.1	0.018	15.2	< 0.003	0.012	< 0.008	0.041	1.3	< 0.004	5.12	0.007	14.6	0.1	37.1	0.6	0.124	0.003	0.085
S99-04137	3931940648	3.5	0.07	< 0.1	0.062	34.1	< 0.003	< 0.002	< 0.008	5.01	3.9	0.007	18.3	0.439	11.1	0.2	26.3	11.4	0.11	< 0.002	0.055
S99-04138	3931913062	2.6	0.09	< 0.1	0.15	39.9	< 0.003	< 0.002	< 0.008	10.2	4.3	0.005	17.1	0.776	22.1	1.1	23.2	13.5	0.154	< 0.002	0.073
S99-04139	3931981328	15.2	0.1	< 0.1	0.077	75.7	< 0.003	< 0.002	< 0.008	0.419	4.2	0.005	20.6	2.46	5.5	0.3	17.7	19.5	0.246	< 0.002	0.066
S99-04140	3931967444	9.4	0.07	< 0.1	0.106	31.7	< 0.003	< 0.002	< 0.008	9.87	2.9	< 0.004	15	0.679	10.1	1	23	2.7	0.0973	< 0.002	0.053
S99-04141	3931954906	8	0.1	< 0.1	0.074	42.4	< 0.003	< 0.002	< 0.008	1.9	3.8	0.005	19.1	0.489	10.1	0.3	24.5	12.4	0.125	< 0.002	0.061
S99-04142	3931967071	< 0.5	0.08	< 0.1	0.068	58.3	< 0.003	< 0.002	< 0.008	8.05	2.4	0.004	30.5	1.32	26.6	0.1	24.1	26.6	0.186	< 0.002	0.055
S99-04143	3932877627	2.3	0.09	0.1	0.074	27.6	< 0.003	< 0.002	< 0.008	5.38	2.6	< 0.004	13.5	0.232	9.7	0.2	18.6	3.1	0.0884	< 0.002	0.09
S99-04144	3931927524	6.8	0.08	< 0.1	0.106	23.3	< 0.003	< 0.002	< 0.008	8.33	10.2	< 0.004	14.7	0.517	12.8	1	22	17.1	0.0897	< 0.002	0.075
S99-04145	3936679115	< 0.5	0.1	< 0.1	0.106	55.9	< 0.003	< 0.002	< 0.008	0.122	2.9	0.012	19.6	0.333	18.9	0.1	29.9	1.4	0.268	< 0.002	0.063
S99-04146	3936615249	14.5	0.12	< 0.1	0.066	44.9	< 0.003	< 0.002	< 0.008	4.77	3.1	< 0.004	10.5	0.496	5.9	0.7	20.4	4.8	0.121	0.003	0.119
S99-04147	3936615249	6.6	0.09	< 0.1	0.094	60	< 0.003	< 0.002	< 0.008	4.29	3.7	0.005	16.2	1.79	8.2	0.2	22.3	33	0.177	< 0.002	0.074
S99-04148	3936694711	131	0.08	< 0.1	0.123	73.4	< 0.003	< 0.002	< 0.008	2.1	4.4	0.007	32.8	3.39	11.5	0.8	26.7	16.7	0.275	< 0.002	0.069
S99-04149	3936694711	76.5	0.08	< 0.1	0.176	63.9	< 0.003	< 0.002	< 0.008	15.9	4.4	0.006	25.7	2.87	9.4	1.4	25.6	10	0.242	< 0.002	0.094
S99-04150	3936607293	1.3	0.07	< 0.1	0.051	23.9	< 0.003	< 0.002	< 0.008	0.18	1	0.004	8.03	0.843	17.9	< 0.1	32.8	3.4	0.147	0.005	0.06
S99-04151	3936607293	< 0.5	0.08	< 0.1	0.072	38.3	< 0.003	< 0.002	< 0.008	0.112	0.8	< 0.004	15.3	1.71	25.2	< 0.1	31.7	3.7	0.227	0.004	0.061
S99-04152	3936655461	< 0.5	0.07	< 0.1	0.05	21.1	< 0.003	< 0.002	< 0.008	0.26	2.4	< 0.004	5.09	0.117	18.7	0.1	37.9	0.7	0.147	0.005	0.068
S99-04153	3936623105	1.3	0.09	< 0.1	0.037	48.2	< 0.003	< 0.002	< 0.008	0.055	1.2	0.019	14.8	0.215	21.7	0.2	26.3	1.3	0.269	< 0.002	0.063
S99-04154	3936679115	11.9	0.07	< 0.1	0.083	30	< 0.003	< 0.002	< 0.008	6.84	1.7	< 0.004	14.7	0.616	11.2	< 0.1	21.7	16.7	0.125	< 0.002	0.062
S99-04155	3936647918	< 0.5	0.07	< 0.1	0.053	41.4	< 0.003	< 0.002	< 0.008	0.126	5.6	0.008	21.3	0.817	9.8	0.2	22.7	37.6	0.121	< 0.002	0.062
S99-04156	3936663788	10.9	1.58	< 0.1	0.184	94.2	< 0.003	< 0.002	< 0.008	1.91	29.1	0.011	17.1	0.858	31.5	1.5	26.2	25.6	0.137	0.003	0.102
S99-04157	3936671677	24.7	1.52	< 0.1	0.258	43.5	< 0.003	0.003	0.019	12.1	8.6	< 0.004	14.2	2.04	11	1.6	26.7	0.8	0.212	< 0.002	0.121
S99-04158	3930911234	22.9	0.09	< 0.1	0.165	38.2	< 0.003	< 0.002	< 0.008	10.2	4.9	0.005	20.7	0.977	18.4	0.9	25	52.8	0.117	< 0.002	0.062
S99-04159	3930983514	23.8	0.11	< 0.1	0.082	31.8	< 0.003	< 0.002	< 0.008	8.1	3.1	< 0.004	11.9	0.649	13.9	0.7	22.9	18.1	0.117	< 0.002	0.088
S99-04160	3930935122	92.6	0.07	< 0.1	0.113	35.6	< 0.003	< 0.002	< 0.008	12.8	2.9	< 0.004	12.9	0.847	9.3	1	26.1	16.8	0.124	< 0.002	0.072
S99-04161	3930911234	14.1	0.1	< 0.1	0.168	65.3	< 0.003	< 0.002	< 0.008	8.05	4.2	0.005	32.8	1.49	12.3	0.4	23.5	46.3	0.204	< 0.002	0.065
S99-04162	3930971994	< 0.5	0.09	< 0.1	0.141	52.1	< 0.003	< 0.002	< 0.008	0.091	11.8	0.011	22.4	0.976	24.5	0.1	20.7	53	0.2	< 0.002	0.064
S99-04163	3930947581	21.4	0.08	0.1	0.073	39.4	< 0.003	< 0.002	< 0.008	1.59	3.1	< 0.004	15.7	0.928	13.6	0.5	27.1	12.3	0.118	< 0.002	0.062
S99-04164	3930959547	< 0.5	0.1	< 0.1	0.07	75.6	< 0.003	< 0.002	< 0.008	0.061	14.1	0.007	29.2	0.037	30.9	< 0.1	16.1	91.8	0.214	< 0.002	0.066

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04165	RIP4165	30/05/1999	24.0611	89.882	1985	HTW	36	Court Bhaban	Dhaka	Tangail	Nagarpur	Nagarpur	Badnapur
S99-04170	RIP4170	30/05/1999	24.0463	89.8485	1997	HTW	24.4	Jame Mosjid	Dhaka	Tangail	Nagarpur	Salimabad	Bekra
S99-04171	RIP4171	30/05/1999	24.0265	89.8246	1987	HTW	37.2	Elemuddin	Dhaka	Tangail	Nagarpur	Dhubaria	Kachpal
S99-04172	RIP4172	30/05/1999	24.0083	89.8504	1988	HTW	32	Terasta bazar committee	Dhaka	Tangail	Nagarpur	Dhubaria	Sen Maijhail
S99-04174	RIP4174	01/06/1999	24.2422	90.3803	1997	TARA	54.9	Md Atabullah	Dhaka	Gazipur	Sripur	Maona	Maona
S99-04175	RIP4175	01/06/1999	24.2465	90.4299	1997	HTW	33.5	High School	Dhaka	Gazipur	Sripur	Telihati	Tepirbari
S99-04176	RIP4176	01/06/1999	24.2438	90.5218	1994	HTW	44.8	Chana Moral	Dhaka	Gazipur	Sripur	Barmi	Barmi
S99-04177	RIP4177	01/06/1999	24.1991	90.4725	1978	HTW	54.9	SAE, DPHE	Dhaka	Gazipur	Sripur	Sripur	Sripur
S99-04178	RIP4178	01/06/1999	24.1766	90.5426	1984	HTW	44.8	Md Abul Hasham Morel	Dhaka	Gazipur	Sripur	Gosinga	Gosinga
S99-04179	RIP4179	01/06/1999	24.0747	90.474	1991	HTW/de	68.6	Keshwab Debnath	Dhaka	Gazipur	Sripur	Prahladpur	Phaguain
S99-04180	RIP4180	01/06/1999	24.1057	90.4982	1992	TARA	53.3	Md Shahjahan Sharker	Dhaka	Gazipur	Sripur	Rajabari	Rajabari
S99-04181	RIP4181	02/06/1999	24.2736	90.3004	1990	TARA	45.7	Matiur Rahman	Dhaka	Gazipur	Kaliakair	Fulbaria	Basakoir
S99-04182	RIP4182	02/06/1999	24.2029	90.2655	1995	TARA	48.8	Abul Kalam	Dhaka	Gazipur	Kaliakair	Chapair	Ganakchhapa
S99-04183	RIP4183	02/06/1999	24.0312	90.1895	1997	TARA	45.7	Jami Mosjid	Dhaka	Gazipur	Kaliakair	Atabaha	Kandapara
S99-04184	RIP4184	02/06/1999	24.0714	90.2187	1984	HTW de	48.8	Staff quarters	Dhaka	Gazipur	Kaliakair	Sripaltali	Latifpur
S99-04185	RIP4185	02/06/1999	24.0273	90.277	1974	HTW de	48.8	U P office	Dhaka	Gazipur	Kaliakair	Nouchat	Safipur
S99-04186	RIP4186	02/06/1999	24.0689	90.317	1997	TARA	45.7	Rabindranath Chandra Barman	Dhaka	Gazipur	Kaliakair	Madhyapara	Thakupara
S99-04187	RIP4187	02/06/1999	24.198	90.3344	1997	TARA	45.7	Md Shamsuddin Sharker	Dhaka	Gazipur	Kaliakair	Boali	Sonatala
S99-04188	RIP4188	03/06/1999	23.9134	90.5111	1995	TARA	37.2	Shadhana Rani Shaha	Dhaka	Gazipur	Kaliganj (G)	Hagori	Nagari
S99-04189	RIP4189	03/06/1999	23.9242	90.5751	1993	TARA	49.4	SAE, DPHE	Dhaka	Gazipur	Kaliganj (G)	Kaliganj	Baligaon
S99-04190	RIP4190	03/06/1999	23.9317	90.5707	1992	HTW	39	Md Alauddin	Dhaka	Gazipur	Kaliganj (G)	Kaliganj	Baligaon
S99-04191	RIP4191	03/06/1999	23.9047	90.5578	1979	HTW	63.4	Abdul Wadud Bhuyan	Dhaka	Gazipur	Kaliganj (G)	Tumulia	Tiori
S99-04192	RIP4192	08/06/1999	24.7285	89.6067	1998	TARA	25.9	Hanif Bhandari	Rajshahi	Bogra	Dhunat	Gosaibari	Chithulia
S99-04193	RIP4193	08/06/1999	24.7358	89.5744	1998	HTW	18.3	Sonargaon Masjeed	Rajshahi	Bogra	Dhunat	Chikashi	Chikashi Mohanpur
S99-04194	RIP4194	08/06/1999	24.7563	89.5265	1992	TARA	25.3	Sonahata High School	Rajshahi	Bogra	Dhunat	Nimgachhi	Siali
S99-04195	RIP4195	08/06/1999	24.7207	89.4976	1997	TARA	25.6	Md Kamal Pasha	Rajshahi	Bogra	Dhunat	Kalerpara	Kantanagar
S99-04196	RIP4196	08/06/1999	24.6827	89.542	1989	HTW	20.1	DPHE compound	Rajshahi	Bogra	Dhunat	Dhunut	Dhunut
S99-04197	RIP4197	08/06/1999	24.5944	89.5466	1996	TARA	25.3	Mathurapur Bazar	Rajshahi	Bogra	Dhunat	Mathurapur	Aloa
S99-04198	RIP4198	08/06/1999	24.6033	89.5109	1998	TARA	25.3	Md Golam Rahman	Rajshahi	Bogra	Dhunat	Chaukibari	Rudrabari
S99-04199	RIP4199	09/06/1999	24.5598	89.5018	1994	TARA	25.6	Shimabari Jame-e Mosque	Rajshahi	Bogra	Sherpur	Shimabari	Shimabari
S99-04200	RIP4200	09/06/1999	24.598	89.4644	1995	TARA	25.6	Md Asaf Uddin	Rajshahi	Bogra	Sherpur	Bhabanipur	Haldibari
S99-04201	RIP4201	09/06/1999	24.5899	89.3846	1989	HTW	19.8	Md Afjal Hossain	Rajshahi	Bogra	Sherpur	Bishalpur	Bishalpur
S99-04202	RIP4202	09/06/1999	24.6238	89.4159	1998	TARA	25.6	Nurun Nabi	Rajshahi	Bogra	Sherpur	Mirzapur	Makurkola
S99-04203	RIP4203	09/06/1999	24.6404	89.3677	1998	HTW	22.9	Bhimjani Government Primary School	Rajshahi	Bogra	Sherpur	Khanpur	Bhimjani
S99-04204	RIP4204	09/06/1999	24.6745	89.4131	1988	TARA	25.6	DPHE compound	Rajshahi	Bogra	Sherpur	Pourashava ward 02	Thana council road
S99-04205	RIP4205	09/06/1999	24.6942	89.4279	1995	TARA	25.6	Abdur Razzaque	Rajshahi	Bogra	Sherpur	Garidaha	Damua
S99-04206	RIP4206	09/06/1999	24.6759	89.3591	1994	HTW	18	Altadigi Jame-e Mosque	Rajshahi	Bogra	Sherpur	Kusumbi	Chandeshwar
S99-04207	RIP4207	10/06/1999	24.8171	89.1835	1987	HTW	19.2	Md Nurul Islam	Rajshahi	Bogra	Dubchachia	Talora	Talora
S99-04208	RIP4208	10/06/1999	24.8342	89.1288	1973	HTW	19.2	Golam Hossain	Rajshahi	Bogra	Dubchachia	Gobindapur	Khihali
S99-04209	RIP4209	10/06/1999	24.9052	89.1283	1997	HTW	13.4	Taloch Bazar	Rajshahi	Bogra	Dubchachia	Gunahar	Taloch
S99-04210	RIP4210	10/06/1999	24.9384	89.1122	1997	TARA	25.3	Md Alim Uddin	Rajshahi	Bogra	Dubchachia	Zianagar	Zianagar
S99-04211	RIP4211	10/06/1999	24.9176	89.1735	1989	HTW	18	Abdur Razzaque	Rajshahi	Bogra	Dubchachia	Chamrul	Daimpur
S99-04212	RIP4212	10/06/1999	24.8733	89.159	1998	TARA	25.3	Ahmed Ali	Rajshahi	Bogra	Dubchachia	Dhubchanchia	Chenga
S99-04213	RIP4213	10/06/1999	24.8733	89.1734	1994	HTW	17.7	DPHE Compound	Rajshahi	Bogra	Dubchachia	Dhubchanchia	Dhubchanchia
S99-04214	RIP4214	11/06/1999	25.032	89.4675	1992	HTW	17.7	Abdur Razzaque	Rajshahi	Bogra	Sonatala	Balua	Chhota Balua
S99-04215	RIP4215	11/06/1999	25.0438	89.4876	1998	HTW	17.7	BRAC, Sonatala	Rajshahi	Bogra	Sonatala	Sonatala	Aguniatair
S99-04216	RIP4216	11/06/1999	25.0077	89.5334	1985	HTW	19.8	Srimal Kumar	Rajshahi	Bogra	Sonatala	Madhupur	Hansraj
S99-04217	RIP4217	11/06/1999	25.0099	89.5566	1979	HTW	17.7	Nurul Azam (teacher)	Rajshahi	Bogra	Sonatala	Tekani Chukainagar	Purba Tekani

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-04165	3937673069	20.2	0.09	< 0.1	0.167	88.2	< 0.003	< 0.002	< 0.008	9.94	3.8	0.006	18.8	3.27	11.2	1.4	24	29.7	0.262	< 0.002	0.077
S99-04170	3937694159	7.1	0.1	0.1	0.171	71.7	< 0.003	< 0.002	< 0.008	13.5	4.6	0.006	32.6	0.942	15.1	0.7	25	33.2	0.223	< 0.002	0.085
S99-04171	3937636522	3.7	0.09	0.1	0.248	67.4	< 0.003	< 0.002	< 0.008	23.4	5.2	0.007	30.4	0.708	18.8	1.2	25.5	16.9	0.173	< 0.002	0.082
S99-04172	3937636919	3.4	0.12	< 0.1	0.076	48.2	< 0.003	< 0.002	< 0.008	3.22	3.2	< 0.004	18.3	0.265	14.6	0.2	24.5	25.5	0.168	< 0.002	0.076
S99-04174	3338647604	< 0.5	0.1	< 0.1	0.014	10.7	< 0.003	0.01	< 0.008	0.074	1.7	0.005	3.5	0.018	11.9	0.1	34.2	0.5	0.0837	0.003	0.097
S99-04175	3338685982	< 0.5	0.09	< 0.1	0.02	3.5	< 0.003	0.005	< 0.008	0.082	1.1	< 0.004	0.67	0.011	6.5	< 0.1	18.9	0.4	0.0252	< 0.002	0.081
S99-04176	3338609125	< 0.5	0.12	< 0.1	0.075	25.8	< 0.003	< 0.002	< 0.008	0.244	1.5	< 0.004	8.96	0.047	20.1	0.2	33.7	0.9	0.184	0.003	0.082
S99-04177	3338676932	< 0.5	0.11	< 0.1	0.035	20.1	< 0.003	0.004	< 0.008	0.171	1.2	< 0.004	6.11	0.016	19	0.1	37.3	1.5	0.124	0.003	0.086
S99-04178	3338628390	< 0.5	0.11	0.1	0.036	29.8	< 0.003	< 0.002	< 0.008	0.431	1	< 0.004	13.5	0.092	22.9	0.1	27.1	0.8	0.169	0.003	0.09
S99-04179	3338657818	< 0.5	0.12	< 0.1	0.08	25	< 0.003	< 0.002	< 0.008	2.67	1.3	< 0.004	9.2	0.096	26.9	0.2	32.9	0.5	0.158	< 0.002	0.1
S99-04180	3338666843	< 0.5	0.12	< 0.1	0.026	22	< 0.003	< 0.002	< 0.008	0.14	1.6	< 0.004	7.98	0.037	25.1	0.1	30.9	1.2	0.125	0.003	0.111
S99-04181	3333247182	< 0.5	0.13	< 0.1	0.057	14.3	< 0.003	0.002	< 0.008	0.102	2	0.005	3.59	0.033	11.9	0.3	37	1	0.115	0.005	0.107
S99-04182	3333228409	< 0.5	0.15	< 0.1	0.065	28.8	< 0.003	< 0.002	< 0.008	0.079	1.7	< 0.004	10.6	0.011	23	0.2	34.4	1	0.172	0.006	0.116
S99-04183	3333209541	< 0.5	0.14	< 0.1	0.048	24.1	< 0.003	< 0.002	< 0.008	0.085	1.3	< 0.004	6.07	0.074	32.4	0.3	24.2	0.9	0.157	0.007	0.109
S99-04184	3333276591	< 0.5	0.13	< 0.1	0.067	33.2	< 0.003	< 0.002	< 0.008	0.165	1.1	< 0.004	9.43	0.047	25.7	0.2	32	1.5	0.21	0.009	0.095
S99-04185	3333266790	< 0.5	0.14	< 0.1	0.075	37.7	< 0.003	< 0.002	< 0.008	0.14	1	< 0.004	13.3	0.395	24.9	0.1	30.6	0.7	0.223	0.007	0.099
S99-04186	3333257917	< 0.5	0.15	< 0.1	0.091	34.1	< 0.003	< 0.002	< 0.008	0.085	0.9	0.005	12.5	0.339	23.2	< 0.1	31.5	1.7	0.193	0.004	0.114
S99-04187	3333219862	< 0.5	0.13	< 0.1	0.061	24.6	< 0.003	< 0.002	< 0.008	0.09	0.8	< 0.004	8.81	0.051	19.2	0.1	34.2	1.3	0.131	0.004	0.106
S99-04188	3333471685	< 0.5	0.14	< 0.1	0.023	26.1	< 0.003	< 0.002	< 0.008	0.083	1.6	0.006	19.4	0.793	38.2	0.1	26.7	7.2	0.182	0.004	0.115
S99-04189	3333486072	< 0.5	0.16	< 0.1	0.032	44.8	0.007	< 0.002	< 0.008	0.08	3.2	0.009	19.9	2.46	15.3	< 0.1	22.2	0.7	0.269	< 0.002	0.109
S99-04190	3333486072	155	0.15	< 0.1	0.091	50.6	< 0.003	< 0.002	< 0.008	1.99	3.4	0.005	20.1	0.198	13.5	< 0.1	17.5	0.5	0.304	< 0.002	0.101
S99-04191	3333494957	0.5	0.15	< 0.1	0.219	76.4	< 0.003	< 0.002	< 0.008	4.75	3.8	0.007	36.4	0.811	109	0.2	28	0.5	0.49	< 0.002	0.095
S99-04192	5102766349	75.9	0.03	0.1	0.08	26.3	< 0.003	< 0.002	< 0.008	20.6	2.7	< 0.004	8.14	0.752	10.3	0.5	22.4	< 0.2	0.106	< 0.002	0.103
S99-04193	5102728338	53.5	0.04	< 0.1	0.094	43.7	< 0.003	< 0.002	< 0.008	11.7	3.6	< 0.004	13.1	1.6	9.3	0.9	21.6	0.3	0.153	< 0.002	0.031
S99-04194	5102795929	3.1	0.04	< 0.1	0.028	14.4	< 0.003	< 0.002	< 0.008	0.3	2.5	< 0.004	7.92	0.158	7	< 0.1	16.9	4	0.0478	< 0.002	0.015
S99-04195	5102776579	73.5	0.02	< 0.1	0.121	29.6	< 0.003	< 0.002	< 0.008	17.5	2.8	< 0.004	7.55	0.877	10.4	0.8	24.1	0.2	0.112	< 0.002	0.026
S99-04196	5102738393	7.7	0.04	< 0.1	0.048	24.1	< 0.003	< 0.002	< 0.008	1.02	2.9	< 0.004	11.8	0.205	8.8	< 0.1	16.3	8.8	0.0843	< 0.002	0.019
S99-04197	5102785010	24.6	0.06	< 0.1	0.079	40	< 0.003	< 0.002	< 0.008	2.17	1.7	< 0.004	15.5	0.486	11.2	0.6	23.2	2.5	0.105	< 0.002	0.02
S99-04198	5102719841	63	0.07	0.1	0.04	44.5	< 0.003	< 0.002	< 0.008	3.33	2.1	< 0.004	12.4	1.11	11.9	0.2	22.7	< 0.2	0.179	< 0.002	0.041
S99-04199	5108883870	1.7	0.03	< 0.1	0.024	52.4	< 0.003	< 0.002	< 0.008	0.088	1.7	0.005	24.4	4.27	31.3	0.2	25	0.9	0.401	0.003	0.018
S99-04200	5108809404	0.7	0.05	< 0.1	0.02	36.6	< 0.003	< 0.002	< 0.008	0.026	1.4	0.012	17.1	0.645	22.7	< 0.1	27.7	9.3	0.231	0.002	0.018
S99-04201	5108819119	0.8	0.05	< 0.1	0.025	27.8	< 0.003	< 0.002	< 0.008	0.078	0.5	0.012	11.6	1.08	16.2	< 0.1	28.9	5.6	0.142	< 0.002	0.01
S99-04202	5108866652	< 0.5	0.08	< 0.1	0.015	29.9	< 0.003	< 0.002	< 0.008	0.039	< 0.5	0.012	11.4	0.428	13.2	< 0.1	28.7	0.5	0.084	0.002	0.049
S99-04203	5108847168	< 0.5	0.04	< 0.1	0.022	25.3	< 0.003	0.003	< 0.008	0.062	< 0.5	< 0.004	11.6	1.15	25.2	< 0.1	21.3	1.3	0.143	< 0.002	0.014
S99-04204	5108802796	0.6	0.04	< 0.1	0.011	22.5	< 0.003	< 0.002	< 0.008	0.048	0.6	< 0.004	10	0.598	17.9	0.1	28.1	10	0.146	< 0.002	0.051
S99-04205	5108828284	0.9	0.07	< 0.1	0.057	69	< 0.003	< 0.002	< 0.008	0.087	3.2	0.013	17.2	0.772	31.6	< 0.1	22.7	1.4	0.224	< 0.002	0.022
S99-04206	5108857235	< 0.5	0.04	< 0.1	0.022	26.7	< 0.003	< 0.002	< 0.008	0.039	0.7	0.014	9.1	0.477	22.3	< 0.1	24.7	3.8	0.0914	0.002	0.049
S99-04207	5103367951	< 0.5	0.06	< 0.1	0.038	41.2	< 0.003	< 0.002	< 0.008	0.129	1.9	0.009	8.21	0.313	25	< 0.1	23	0.7	0.102	< 0.002	0.011
S99-04208	5103340536	2.7	0.06	< 0.1	0.035	43.8	< 0.003	< 0.002	< 0.008	1.32	0.9	0.006	11	0.337	26.4	< 0.1	23.7	3.6	0.155	< 0.002	0.014
S99-04209	5103354943	0.7	0.07	< 0.1	0.052	68.2	< 0.003	< 0.002	< 0.008	0.105	2.5	0.009	19.7	0.686	28.6	< 0.1	28	18.9	0.234	< 0.002	0.02
S99-04210	5103381449	1.2	0.04	< 0.1	0.036	24.4	< 0.003	< 0.002	< 0.008	0.363	1.4	< 0.004	8.84	0.299	23.1	< 0.1	29.2	0.9	0.0759	< 0.002	0.02
S99-04211	5103313276	0.5	0.05	< 0.1	0.03	29.1	< 0.003	< 0.002	< 0.008	0.665	1.1	< 0.004	10.2	0.399	15	< 0.1	26.9	1.5	0.108	< 0.002	0.011
S99-04212	5103327250	1.2	0.05	< 0.1	0.035	39.5	< 0.003	< 0.002	< 0.008	0.533	1.4	< 0.004	9.05	0.381	19.4	< 0.1	24.7	8.6	0.132	< 0.002	0.05
S99-04213	5103327354	0.7	0.05	< 0.1	0.036	30.1	< 0.003	< 0.002	< 0.008	0.195	1	< 0.004	8.44	0.287	33.5	< 0.1	23.4	1.4	0.0876	< 0.002	0.013
S99-04214	5109510265	28.2	0.06	< 0.1	0.072	46.7	0.004	< 0.002	< 0.008	4.97	3.7	0.005	23.2	1.64	28.1	< 0.1	20.5	15.8	0.154	< 0.002	0.015
S99-04215	5109573022	1.8	0.04	< 0.1	0.046	18.7	< 0.003	< 0.002	< 0.008	0.651	2.9	< 0.004	10.5	0.246	22.8	< 0.1	16.1	2.9	0.0646	< 0.002	0.039
S99-04216	5109552417	4.2	0.02	< 0.1	0.045	23.3	< 0.003	< 0.002	< 0.008	5.06	3.2	< 0.004	10.1	0.351	21.9	0.1	16.8	12.3	0.0754	< 0.002	0.022
S99-04217	5109594797	13.9	0.01	< 0.1	0.058	16.7	< 0.003	< 0.002	< 0.008	7.81	2.9	0.004	8.15	0.998	7.4	0.1	18.8	4.2	0.0709	< 0.002	0.014

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04218	RIP4218	11/06/1999	24.9869	89.5613	1975	HTW	17.7	Pakulla Jame-e Mosque	Rajshahi	Bogra	Sonatala	Pakulla	Pakulla
S99-04219	RIP4219	11/06/1999	24.9916	89.5046	1998	HTW	17.7	Sarowar Hossain	Rajshahi	Bogra	Sonatala	Jorgachha	Sicharpara
S99-04220	RIP4220	11/06/1999	24.94	89.4926	1994	HTW	13.7	Saiduzzaman	Rajshahi	Bogra	Sonatala	Digdair	Sihipur
S99-04221	RIP4221	12/06/1999	24.6944	89.2467	1996	HTW	18.9	Gobinda Chandra Pramanik	Rajshahi	Bogra	Nandigram	Bhatgram	Kalis
S99-04222	RIP4222	12/06/1999	24.647	89.2505	1998	HTW	18	DPHE Compound	Rajshahi	Bogra	Nandigram	Nandigram	Nandigram
S99-04223	RIP4223	12/06/1999	24.6557	89.2972	1998	HTW	18	Showravi Bala	Rajshahi	Bogra	Nandigram	Burail	Burail
S99-04224	RIP4224	12/06/1999	24.7848	89.1804	1980	HTW	18	Chowmatha Bazar	Rajshahi	Bogra	Nandigram	Thaltamajgram	Pathan Mirjapur
S99-04225	RIP4225	13/06/1999	24.6818	89.1889	1992	TARA	25.3	Kumira Pandit Pukur High School	Rajshahi	Bogra	Nandigram	Bhatra	Kumira
S99-04226	RIP4226	14/06/1999	24.709	89.3191	1991	TARA	25.3	Md Kalu Sha	Rajshahi	Bogra	Bogra Sadar	Qohail	Khadas
S99-04227	RIP4227	14/06/1999	24.737	89.3293	1985	HTW	18.9	Tengamagur Bus Stand (Abdul Jalil)	Rajshahi	Bogra	Bogra Sadar	Kharna	Haringari
S99-04228	RIP4228	14/06/1999	24.7953	89.3521	1991	TARA	18	Md Abu Salem Jaider	Rajshahi	Bogra	Bogra Sadar	Aselpur	Jora (Jaiderpara)
S99-04229	RIP4229	14/06/1999	24.738	89.4143	1999	TARA	25.3	Md Mozahar Ali Mollah	Rajshahi	Bogra	Bogra Sadar	Amrool	Kundais (Pachimpara)
S99-04230	RIP4230	14/06/1999	24.7656	89.4044	1998	TARA	25.3	Saheb Ali Pramanik	Rajshahi	Bogra	Bogra Sadar	Chopinagor	Chopinagor
S99-04231	RIP4231	14/06/1999	24.7965	89.4112	1993	TARA	25.3	Md Belal Hossain	Rajshahi	Bogra	Bogra Sadar	Khottapara	Bhandarpaika
S99-04232	RIP4232	14/06/1999	24.772	89.3941	1996	HTW	21.3	Md Millat	Rajshahi	Bogra	Bogra Sadar	Majhira	Damanpukur
S99-04233	RIP4233	15/06/1999	25.7982	89.553	1997	HTW	13.7	DPHE compound	Rajshahi	Kurigram	Rajarhat	Chakia Pashar	Khuliatar
S99-04234	RIP4234	15/06/1999	25.7339	89.582	1979	HTW	14	Abdul Razzak	Rajshahi	Kurigram	Rajarhat	Dhar Majid	Taluk Subal
S99-04235	RIP4235	15/06/1999	25.7705	89.5571	1998	HTW	18	Md Samir Uddin	Rajshahi	Kurigram	Rajarhat	Chakir Pashar	Kothiram Kamalata
S99-04236	RIP4236	15/06/1999	25.7281	89.5504	1998	HTW	14	M Madrasha	Rajshahi	Kurigram	Rajarhat	Nazim Khan	Manarkuti
S99-04237	RIP4237	15/06/1999	25.7591	89.5239	1999	HTW	13.7	Abdur Rahman Khandaker	Rajshahi	Kurigram	Rajarhat	Bidyananda	Sukdeb
S99-04238	RIP4238	15/06/1999	25.7952	89.5139	1994	HTW	19.8	Minhaz Ali	Rajshahi	Kurigram	Rajarhat	Rajarhat	Natua Maha
S99-04239	RIP4239	15/06/1999	25.802	89.4816	1997	HTW	13.4	Md Akkaba Hossan	Rajshahi	Kurigram	Rajarhat	Garial Danga	Nakonba
S99-04240	RIP4240	15/06/1999	25.8711	89.5711	1994	HTW	18	Abdul Kuddus	Rajshahi	Kurigram	Rajarhat	Chhinai	Chatur Bhuja
S99-04241	RIP4241	15/06/1999	25.8383	89.5477	1996	HTW	18	Badder Bazar Mosque	Rajshahi	Kurigram	Rajarhat	Chhinai	Chhatrajit
S99-04242	RIP4242	16/06/1999	25.4424	89.791	1977	HTW	19.1	DPHE compound	Rajshahi	Kurigram	Char Rajibpur	Rajibpur	Char Rajibpur
S99-04243	RIP4243	16/06/1999	25.4725	89.7635	1999	TARA	30.5	Iman Ali	Rajshahi	Kurigram	Char Rajibpur	Kodailkati	Purbobajai
S99-04244	RIP4244	16/06/1999	25.4881	89.7651	1996	HTW	13.4	Union Parishad compound	Rajshahi	Kurigram	Char Rajibpur	Kodalkati	Kodalkati
S99-04245	RIP4245	16/06/1999	25.4622	89.7635	1997	TARA	29.6	Shah Ali	Rajshahi	Kurigram	Char Rajibpur	Kodalkati	Madhabpur
S99-04246	RIP4246	16/06/1999	25.4604	89.7775	1999	HTW	16.8	Keramat Ali	Rajshahi	Kurigram	Char Rajibpur	Char Rajibpur	Rajibpur
S99-04247	RIP4247	16/06/1999	25.4062	89.7583	1998	TARA	30.6	F P Center	Rajshahi	Kurigram	Char Rajibpur	Mohangonj	Nayachar
S99-04248	RIP4248	16/06/1999	25.4267	89.675	1994	HTW	13.7	Md Sulaiman	Rajshahi	Kurigram	Char Rajibpur	Mohangonj	Baraber
S99-04249	RIP4249	17/06/1999	25.5266	89.805	1998	TARA	30.9	Md Mashiur Rahman	Rajshahi	Kurigram	Raumari	Jadurchar	Komarbhangi
S99-04250	RIP4250	17/06/1999	25.5416	89.8126	1998		30.9	Md Jainal Abedin	Rajshahi	Kurigram	Raumari	Raumari	Chuliarchar
S99-04251	RIP4251	17/06/1999	25.5755	89.8355	1999	TARA	32.9	Jabedul Haque	Rajshahi	Kurigram	Raumari	Raumari	Raumari Bazar
S99-04252	RIP4252	17/06/1999	25.4931	89.8071	1996	TARA	30.9	Fakir Chan	Rajshahi	Kurigram	Raumari	Jadurchar	Jadurchar
S99-04253	RIP4253	17/06/1999	25.6457	89.8024	1993	HTW	18	Md Nawab Ali	Rajshahi	Kurigram	Raumari	Bandabar	Char Saulmari
S99-04254	RIP4254	17/06/1999	25.6168	89.8391	1998	TARA	32.9	Abdur Razzak	Rajshahi	Kurigram	Raumari	Bandabar	Purar Char
S99-04255	RIP4255	17/06/1999	25.668	89.8475	1997	TARA	28.3	Md Shah Alam	Rajshahi	Kurigram	Raumari	Dantbhaga	Kauniar Char
S99-04256	RIP4256	17/06/1999	25.6087	89.8585	1999	TARA	30.6	Abul Kalam	Rajshahi	Kurigram	Raumari	Saulmari	Boailmari
S99-04257	RIP4257	17/06/1999	25.568	89.8385	1998	TARA	30.6	Jainal Abedin	Rajshahi	Kurigram	Raumari	Raumari	Natanpara
S99-04258	RIP4258	19/06/1999	25.5574	89.649	1994	HTW	13.4	Ashan Ali	Rajshahi	Kurigram	Chilmari	Ramna	Patra Khata
S99-04259	RIP4259	19/06/1999	25.5781	89.6803	1997	TARA	29.9	Razu Mia	Rajshahi	Kurigram	Chilmari	Ramna	Ramna
S99-04260	RIP4260	19/06/1999	25.6417	89.683	1982	HTW	15.8	Abdul Latif	Rajshahi	Kurigram	Chilmari	Raniganj	Patoari
S99-04261	RIP4261	19/06/1999	25.6222	89.658	1993	HTW	22.6	Abdul Aziz	Rajshahi	Kurigram	Chilmari	Thanahat	Bayratabakpur
S99-04262	RIP4262	19/06/1999	25.5933	89.7367	1996	TARA	30.8	Md Miron Mia	Rajshahi	Kurigram	Chilmari	Nayerhat	Phechuka Patrakhata
S99-04263	RIP4263	19/06/1999	25.5292	89.74	1995	HTW	13.4		Rajshahi	Kurigram	Chilmari	Chilmari	Manushmara
S99-04264	RIP4264	19/06/1999	25.5425	89.7817	1993	HTW	13.4	Md Damad Ali	Rajshahi	Kurigram	Chilmari	Ashtamir Char	Natar Kandi
S99-04265	RIP4265	19/06/1999	25.5853	89.6601	1984	DTW	53.3	Thana headquarters	Rajshahi	Kurigram	Chilmari	Thanahat	Thanahat

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-04218	5109581744	12.8	0.03	< 0.1	0.034	13.2	< 0.003	< 0.002	< 0.008	1.15	2.5	< 0.004	8	0.359	2.7	< 0.1	16.7	6.5	0.0424	< 0.002	0.009
S99-04219	5109542888	23.8	0.02	< 0.1	0.062	23.5	< 0.003	< 0.002	< 0.008	16.8	1.6	< 0.004	9.6	1.02	11	0.6	22.2	1.9	0.0644	< 0.002	0.02
S99-04220	5109531896	0.9	0.06	< 0.1	0.063	18.9	< 0.003	< 0.002	< 0.008	0.227	28	< 0.004	7.46	0.094	37.1	< 0.1	15.9	15.1	0.151	< 0.002	0.01
S99-04221	5106710563	< 0.5	0.06	< 0.1	0.044	67.2	< 0.003	< 0.002	< 0.008	0.046	0.9	0.005	10.6	0.248	22.1	< 0.1	19.7	2.4	0.15	< 0.002	0.014
S99-04222	5106773745	< 0.5	0.06	< 0.1	0.032	36.5	< 0.003	< 0.002	< 0.008	0.198	1	0.01	6.25	0.468	23.5	< 0.1	24.1	7.6	0.112	< 0.002	0.037
S99-04223	5106731241	0.6	0.08	< 0.1	0.06	83.8	< 0.003	< 0.002	< 0.008	0.072	1.2	0.013	17.3	0.496	22.1	< 0.1	25.2	17.7	0.252	< 0.002	0.017
S99-04224	5106784817	< 0.5	0.06	< 0.1	0.051	68.6	< 0.003	< 0.002	< 0.008	0.075	1.8	0.009	13.4	0.229	30.5	< 0.1	21.1	36.8	0.196	< 0.002	0.015
S99-04225	5106721643	0.7	0.04	< 0.1	0.029	49.1	< 0.003	< 0.002	< 0.008	0.197	2.2	0.005	7.45	0.3	20.5	< 0.1	19.3	1	0.152	< 0.002	0.079
S99-04226	5102030559	0.5	0.06	< 0.1	0.042	40.3	< 0.003	< 0.002	< 0.008	0.037	1.2	0.012	11.5	0.466	18.9	< 0.1	24.8	3.5	0.121	< 0.002	0.017
S99-04227	5102038423	0.5	0.04	< 0.1	0.017	27.4	< 0.003	< 0.002	< 0.008	0.075	0.8	0.007	8.19	0.432	24.5	0.2	22.8	0.8	0.101	< 0.002	0.009
S99-04228	5102012476	< 0.5	0.15	< 0.1	0.023	36.4	< 0.003	< 0.002	< 0.008	0.14	0.9	0.009	12.5	0.47	20.6	< 0.1	25.8	3.7	0.137	< 0.002	0.011
S99-04229	5102007609	2.2	0.05	< 0.1	0.053	49.2	< 0.003	< 0.002	< 0.008	0.387	2.4	0.005	16.9	0.38	16.8	< 0.1	26.5	2.5	0.181	< 0.002	0.333
S99-04230	5102017287	< 0.5	0.04	< 0.1	0.016	23.6	< 0.003	< 0.002	< 0.008	0.046	0.6	0.009	11.7	0.445	18	< 0.1	25.6	3.9	0.0945	0.002	0.053
S99-04231	5102043113	< 0.5	0.05	< 0.1	0.017	27.3	< 0.003	< 0.002	< 0.008	0.044	< 0.5	0.007	11.8	0.375	24	< 0.1	24.8	1	0.134	0.003	0.028
S99-04232	5102056302	< 0.5	0.03	< 0.1	0.011	12	< 0.003	0.003	< 0.008	0.046	1.3	< 0.004	5.15	0.023	13.4	0.1	20.1	0.7	0.0803	0.002	0.016
S99-04233	5497721497	68	0.02	< 0.1	0.056	23.4	< 0.003	< 0.002	< 0.008	16.5	3.1	< 0.004	5.31	2.18	10.4	2	23.3	< 0.2	0.0867	< 0.002	0.038
S99-04234	5497784963	420	0.03	< 0.1	0.057	44.7	< 0.003	< 0.002	< 0.008	4.25	2.6	< 0.004	9.28	4.19	10.4	1.1	20.3	< 0.2	0.244	< 0.002	0.047
S99-04235	5497721839	22.6	0.01	< 0.1	0.093	19.8	< 0.003	< 0.002	< 0.008	23.8	6.5	< 0.004	5.92	1.25	7.9	1	26.8	1.6	0.0708	< 0.002	0.034
S99-04236	5497752575	27.3	0.02	< 0.1	0.106	21.2	< 0.003	< 0.002	< 0.008	21.2	6.2	< 0.004	6.07	1.29	13	0.7	22.9	< 0.2	0.0857	< 0.002	0.028
S99-04237	5497710893	178	0.03	< 0.1	0.066	41.6	< 0.003	< 0.002	< 0.008	16.2	1.9	< 0.004	10.3	2.37	11.5	1	22.1	0.2	0.113	< 0.002	0.038
S99-04238	5497773652	11.7	0.04	0.1	0.075	23.6	< 0.003	< 0.002	< 0.008	23.1	3.1	< 0.004	5.84	1.89	14.3	0.7	24.2	< 0.2	0.0931	< 0.002	0.047
S99-04239	5497742645	1.6	0.02	< 0.1	0.058	18.2	< 0.003	< 0.002	< 0.008	11	2.8	< 0.004	5.87	1.23	11.3	0.2	24.5	1.9	0.0621	< 0.002	0.094
S99-04240	5497731139	29.6	0.03	< 0.1	0.064	37.6	< 0.003	< 0.002	< 0.008	4.02	5.2	< 0.004	13.8	1.96	6.2	0.5	18.8	3.1	0.0974	< 0.002	0.025
S99-04241	5497731171	5.3	0.01	< 0.1	0.112	13.7	< 0.003	< 0.002	< 0.008	14.6	8.8	< 0.004	3.25	0.588	7.9	0.4	22.2	< 0.2	0.0542	< 0.002	0.018
S99-04242	5490819175	1.1	0.36	< 0.1	0.089	86.9	< 0.003	0.051	< 0.008	0.367	4.9	0.178	15.8	0.843	14.1	0.2	10.6	8.7	0.242	< 0.002	0.029
S99-04243	5490857819	31.2	0.1	< 0.1	0.143	151	< 0.003	< 0.002	< 0.008	7.28	5.4	0.006	40.1	2.51	11.2	0.1	14.8	0.4	0.494	< 0.002	0.092
S99-04244	5490857585	0.7	0.09	< 0.1	0.101	112	< 0.003	< 0.002	< 0.008	0.078	6.6	0.006	20.2	2.31	5	< 0.1	14.1	6.3	0.352	< 0.002	0.049
S99-04245	5490857614	2.1	0.05	< 0.1	0.06	69	< 0.003	< 0.002	< 0.008	0.049	3.8	< 0.004	12.2	1.45	4.2	< 0.1	13.7	1.6	0.21	< 0.002	0.067
S99-04246	5490819790	0.8	0.05	< 0.1	0.058	55.2	< 0.003	< 0.002	< 0.008	0.059	2.5	< 0.004	15.4	2.26	3.3	< 0.1	12.5	20.2	0.167	< 0.002	0.034
S99-04247	5490876702	37.4	0.08	< 0.1	0.081	88.8	< 0.003	< 0.002	< 0.008	1.26	4.3	0.005	21.5	2.29	7.1	0.3	15.3	5	0.284	< 0.002	0.049
S99-04248	5490876117	0.6	0.07	< 0.1	0.171	128	< 0.003	< 0.002	< 0.008	1.11	7.8	0.009	31.1	1.67	5.2	< 0.1	11.5	8.8	0.439	< 0.002	0.03
S99-04249	5497935706	26.2	0.07	< 0.1	0.114	81.7	< 0.003	< 0.002	< 0.008	5.17	4.5	< 0.004	19.5	2.39	21.2	0.3	17.4	32	0.262	< 0.002	0.1
S99-04250	5497971340	23.7	0.02	< 0.1	0.03	23.5	< 0.003	< 0.002	< 0.008	0.27	2.4	< 0.004	6.46	0.47	2.9	0.3	16.4	7.9	0.07	< 0.002	0.083
S99-04251	5497971837	9.8	0.03	< 0.1	0.05	39.3	< 0.003	< 0.002	< 0.008	1.63	3.1	< 0.004	9.69	1.04	5	0.1	19	6.7	0.127	< 0.002	0.074
S99-04252	5497935445	4.7	0.03	< 0.1	0.063	50.2	< 0.003	< 0.002	< 0.008	0.229	4.6	0.006	23.7	1.71	7.1	< 0.1	17.6	8.8	0.148	< 0.002	0.049
S99-04253	5497911314	2.6	0.07	< 0.1	0.128	146	< 0.003	< 0.002	< 0.008	0.078	6.9	0.007	29.7	1.26	32.3	< 0.1	14	37.3	0.447	< 0.002	0.032
S99-04254	5497911811	71	0.06	< 0.1	0.108	55.8	< 0.003	< 0.002	< 0.008	1.89	2.7	< 0.004	13.8	0.35	6.1	0.4	20.4	3.8	0.2	< 0.002	0.099
S99-04255	5497923576	19.2	0.05	< 0.1	0.059	34.5	< 0.003	< 0.002	< 0.008	4.25	3.2	< 0.004	9.16	1.74	3.3	0.2	18.6	4	0.131	< 0.002	0.032
S99-04256	5497983235	16.2	0.05	< 0.1	0.056	37.1	< 0.003	< 0.002	< 0.008	1.43	5.6	0.004	30	0.92	16.9	0.3	13.9	27.4	0.165	< 0.002	0.097
S99-04257	5497971837	69.6	0.04	< 0.1	0.063	50.9	< 0.003	< 0.002	< 0.008	5.49	3.4	< 0.004	12.4	1.28	7.4	0.8	18.9	4	0.185	< 0.002	0.061
S99-04258	5490959795	37	0.04	< 0.1	0.032	24.6	< 0.003	< 0.002	< 0.008	0.708	2.9	0.004	9.93	1.33	10.2	0.7	21.9	0.6	0.1	< 0.002	0.028
S99-04259	5490959862	11.5	0.04	< 0.1	0.063	21	< 0.003	< 0.002	< 0.008	10.8	2.3	< 0.004	7.67	1.31	7.2	0.2	21.8	0.3	0.0844	< 0.002	0.035
S99-04260	5490971782	< 0.5	0.05	< 0.1	0.045	33.8	< 0.003	< 0.002	< 0.008	0.067	2.8	< 0.004	10.5	0.105	11.6	< 0.1	15.9	15.3	0.16	< 0.002	0.024
S99-04261	5490983039	13.6	0.02	< 0.1	0.088	21.5	< 0.003	< 0.002	< 0.008	20.5	5.7	0.005	10.4	2.65	8.2	0.6	22.6	< 0.2	0.11	< 0.002	0.038
S99-04262	5490947384	1.7	0.09	< 0.1	0.116	139	< 0.003	< 0.002	0.02	0.233	6.3	0.006	25.7	1.27	6.6	< 0.1	12.2	4	0.407	< 0.002	0.057
S99-04263	5490923650	< 0.5	0.06	< 0.1	0.133	117	< 0.003	< 0.002	< 0.008	0.086	6.4	0.006	25	2.96	3.7	< 0.1	9.93	31.3	0.414	< 0.002	0.033
S99-04264	5490911703	< 0.5	0.11	< 0.1	0.209	180	< 0.003	< 0.002	< 0.008	0.095	6.9	0.007	44	4.04	9.4	< 0.1	14.1	22.6	0.602	< 0.002	0.029
S99-04265	5490983968	2.9	0.05	< 0.1	0.055	19.7	< 0.003	< 0.002	< 0.008	3.11	3.6	< 0.004	9.32	0.359	17	< 0.1	18.2	7.2	0.0745	< 0.002	0.024

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04266	RIP4266	20/06/1999	25.7596	89.6556	1997	HTW	11	Abdur Rahman	Rajshahi	Kurigram	Kurigram Sadar	Mogal Bachha	Malbhanga
S99-04267	RIP4267	20/06/1999	25.847	89.6197	1994	HTW	18.3	Kair Karo	Rajshahi	Kurigram	Kurigram Sadar	Holokhana	Baraibari
S99-04268	RIP4268	20/06/1999	25.8473	89.5887	1992	HTW	14.8	Union Council	Rajshahi	Kurigram	Kurigram Sadar	Kanthalbari	Sibram
S99-04269	RIP4269	20/06/1999	25.8005	89.6121	1997	HTW	21.3	Rafiq	Rajshahi	Kurigram	Kurigram Sadar	Belgachha	Nilkanthi
S99-04270	RIP4270	20/06/1999	25.8063	89.6409	1987	DTW	147.2	DPHE DTW	Rajshahi	Kurigram	Kurigram Sadar	Pourashava ward 03	College Para
S99-04271	RIP4271	20/06/1999	25.8097	89.6365	1988	HTW	14	DPHE compound	Rajshahi	Kurigram	Kurigram Sadar	Pourashava ward 02	Dakpanglowpara
S99-04272	RIP4272	21/06/1999	25.9275	89.3405	1993	HTW	18	Athab Ali	Rajshahi	Lalmonirhat	Aditmari	Bhadai	Aditmari
S99-04273	RIP4273	21/06/1999	25.9356	89.3024	1994	HTW	22.6	Aluca Rani	Rajshahi	Lalmonirhat	Aditmari	Palashi	Namuri
S99-04274	RIP4274	21/06/1999	25.8966	89.3325	1997	HTW	18	Moshbar Rahman	Rajshahi	Lalmonirhat	Aditmari	Mohishkhocha	Mahish Khocha
S99-04275	RIP4275	21/06/1999	25.9166	89.3871	1996	HTW	18	Chackmol Hossain	Rajshahi	Lalmonirhat	Aditmari	Sarpukur	Sarpukur
S99-04276	RIP4276	21/06/1999	25.9621	89.4333	1997	HTW	18	Hossain Ali	Rajshahi	Lalmonirhat	Aditmari	Saptibari	Durarkuti
S99-04277	RIP4277	21/06/1999	25.9578	89.4065	1992	HTW	18	Belabari U. P.	Rajshahi	Lalmonirhat	Aditmari	Bhelabari	Bhelabari
S99-04278	RIP4278	21/06/1999	25.9743	89.3742	1997	HTW	18	Sri Tarak Chandra	Rajshahi	Lalmonirhat	Aditmari	Kamalabari	Bara Kamalbari
S99-04279	RIP4279	22/06/1999	26.2108	89.1121	1997	HTW	17.5	Farhad Hossain Khondaker	Rajshahi	Lalmonirhat	Hatibandha	Bara Khata	Bara Khata
S99-04280	RIP4280	22/06/1999	26.1653	89.1169	1983	HTW	13.7	Abdul Mozid	Rajshahi	Lalmonirhat	Hatibandha	Goddimari	Madhya Goddimari
S99-04281	RIP4281	22/06/1999	26.1211	89.1403	1997	HTW	18	Hatibandha D. College	Rajshahi	Lalmonirhat	Hatibandha	Sindurna	Purba Sindurna
S99-04282	RIP4282	22/06/1999	26.1109	89.1545	1985	HTW	14.3	Chaid Ali	Rajshahi	Lalmonirhat	Hatibandha	Tangbhanga	Paschim Bejgram
S99-04283	RIP4283	22/06/1999	26.0701	89.2379	1979	HTW	14.3	Abdul Wahab	Rajshahi	Lalmonirhat	Hatibandha	Bhalaguri	Banchuki
S99-04284	RIP4284	22/06/1999	26.0917	89.2242	1975	HTW	13.4	U. P. compound	Rajshahi	Lalmonirhat	Hatibandha	Gotamari	Daikhawa
S99-04285	RIP4285	22/06/1999	26.0536	89.1504	1998	HTW	13.4	Nowshud Ali	Rajshahi	Lalmonirhat	Hatibandha	Daoabari	Paschim Bichhandi
S99-04286	RIP4286	22/06/1999	26.1338	89.1378	1984	HTW	13.4	DPHE compound	Rajshahi	Lalmonirhat	Hatibandha	Shingimari	Purba Shingimari
S99-04287	RIP4287	23/06/1999	26.3463	89.0163	1992	HTW	13.4	Abu Taleb	Rajshahi	Lalmonirhat	Patgram	Patgram	Rasulgonj
S99-04288	RIP4288	23/06/1999	26.3077	88.9921	1993	HTW	15.5	Md Abdul Aziz	Rajshahi	Lalmonirhat	Patgram	Kuchlibar	Panbari
S99-04289	RIP4289	23/06/1999	26.4046	88.9222	1984	HTW	20.1	BDR camp	Rajshahi	Lalmonirhat	Patgram	Srirampur	Burimari BDR camp
S99-04290	RIP4290	24/06/1999	26.1032	88.8605	1998	HTW	22.6	Womia Amout	Rajshahi	Nilphamari	Domar	Panga Matukpur	Matukpur
S99-04291	RIP4291	24/06/1999	26.2206	88.8234	1997	HTW	21	Sofia Khatun	Rajshahi	Nilphamari	Domar	Gomnati	Dakshin Ambari
S99-04292	RIP4292	24/06/1999	26.2468	88.7949	1992	HTW	21.9	U P compound	Rajshahi	Nilphamari	Domar	Bhogdaburi	Chilahati
S99-04293	RIP4293	24/06/1999	26.201	88.7976	1993	HTW	17.4	Afsar Ali	Rajshahi	Nilphamari	Domar	Ketkibari	Chandkhana
S99-04294	RIP4294	24/06/1999	26.1446	88.8213	1992	HTW	18.9	Abdul Razzak	Rajshahi	Nilphamari	Domar	Boragari	Nayani Bagdokra
S99-04295	RIP4295	24/06/1999	26.1052	88.8011	1987	HTW	21.9	Abdul Mazid	Rajshahi	Nilphamari	Domar	Domar	Bara Rauta
S99-04296	RIP4296	24/06/1999	26.0767	88.7902	1996	HTW	18.3	Mostafa	Rajshahi	Nilphamari	Domar	Sonaray	Kaigila
S99-04297	RIP4297	24/06/1999	26.0581	88.8279	1995	HTW	20.1	Abul Hossain	Rajshahi	Nilphamari	Domar	Harinchhara	Hangsaraj
S99-04298	RIP4298	26/06/1999	26.2563	88.8789	1995	HTW	9.1	Thakurganj Jame Mosque	Rajshahi	Nilphamari	Dimla	Paschim Chhatnai	Thakurganj
S99-04299	RIP4299	26/06/1999	26.2103	88.9078	1994	HTW	19.8	Dhangarhat Jame Mosque	Rajshahi	Nilphamari	Dimla	Balapara	Chhatnai Balapara
S99-04300	RIP4300	26/06/1999	26.2058	88.9275	1994	HTW	18.9	Union compound	Rajshahi	Nilphamari	Dimla	Khoga Kharibari	Bandar Kharibari
S99-04301	RIP4301	26/06/1999	26.1525	88.9199	1998	HTW	39.6	Azizul Islam	Rajshahi	Nilphamari	Dimla	Dimla	Baburhat
S99-04302	RIP4302	26/06/1999	26.1725	88.9662	1994	HTW	27.4	Abdul Zabber	Rajshahi	Nilphamari	Dimla	Naotara	Akaskuri
S99-04303	RIP4303	26/06/1999	26.1828	88.993	1996	HTW	22.9	Shatibarhat Jame Mosque	Rajshahi	Nilphamari	Dimla	Gayabari	Gayabari
S99-04304	RIP4304	26/06/1999	26.1957	88.9988	1992	HTW	27.4	Azizul Islam	Rajshahi	Nilphamari	Dimla	Tepa Kharibari	Dakshin Kharibari
S99-04305	RIP4305	26/06/1999	26.1515	89.0366	1980	HTW	22.9	Afaze	Rajshahi	Nilphamari	Dimla	Khalisa	Dalia
S99-04306	RIP4306	26/06/1999	26.0985	89.0498	1992	HTW	18.9	Mozzamal Haque	Rajshahi	Nilphamari	Dimla	Jhunagachh	Dakshin Senakhuli
S99-04307	RIP4307	27/06/1999	25.77	88.9177	1996	HTW	28.3	Prosson Kumar Roy	Rajshahi	Nilphamari	Saidpur	Bangalipura	Lakshmanpur Charakpar
S99-04308	RIP4308	27/06/1999	25.7815	88.9199	1998	HTW	39.6	Kalu Mia	Rajshahi	Nilphamari	Saidpur	Kamar Pukur	Kamar Pukur
S99-04309	RIP4309	27/06/1999	25.7896	88.9627	1984	HTW	18.9	Abdul Alim	Rajshahi	Nilphamari	Saidpur	Kamar Pukur	Nijbari
S99-04310	RIP4310	27/06/1999	25.8327	88.9556	1992	HTW	21.9	Nur Islam	Rajshahi	Nilphamari	Saidpur	Khata Madhupur	Musarat Dhulia
S99-04311	RIP4311	27/06/1999	25.8365	88.952	1993	HTW	13.7	Abdus Samad	Rajshahi	Nilphamari	Saidpur	Kushiram Belpukur	Kasiram Belpukur
S99-04312	RIP4312	27/06/1999	25.8165	88.8726	1998	HTW	21.9	Islam	Rajshahi	Nilphamari	Saidpur	Bothlagari	Baradaha
S99-04313	RIP4313	27/06/1999	25.8026	88.888	1994	HTW	12.2	Golahat High school	Rajshahi	Nilphamari	Saidpur	Pourashava ward 01	Golahat

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-04266	5495276676	< 0.5	0.03	< 0.1	0.059	37.1	< 0.003	< 0.002	< 0.008	0.185	13.3	< 0.004	16.9	0.286	25.5	< 0.1	19.9	22	0.121	< 0.002	0.034
S99-04267	5495238127	1.1	0.05	< 0.1	0.073	31.3	< 0.003	< 0.002	< 0.008	4.6	3.4	< 0.004	12.6	0.119	7.6	< 0.1	14.9	3.9	0.0721	< 0.002	0.028
S99-04268	5495257918	< 0.5	< 0.01	< 0.1	0.006	6.4	< 0.003	< 0.002	< 0.008	0.025	2.8	0.004	1.59	0.015	8.5	< 0.1	13.4	2.3	0.0251	< 0.002	0.008
S99-04269	5495209727	10.9	0.02	< 0.1	0.052	23.9	< 0.003	< 0.002	< 0.008	14.2	4.6	< 0.004	10.3	0.843	6.2	1	21.1	< 0.2	0.0867	< 0.002	0.031
S99-04270	5495203273	49.9	0.02	< 0.1	0.083	29.4	< 0.003	< 0.002	< 0.008	4.59	3.1	0.004	9.88	0.572	9.4	< 0.1	28	< 0.2	0.174	< 0.002	0.021
S99-04271	5495202279	5.7	0.05	< 0.1	0.066	29.9	< 0.003	0.002	< 0.008	0.027	3.5	0.006	10.2	0.153	9.5	< 0.1	27.9	1.3	0.179	< 0.002	0.021
S99-04272	5520205008	0.9	< 0.01	< 0.1	0.009	5.7	< 0.003	< 0.002	< 0.008	0.06	2.9	< 0.004	2.02	0.02	5.2	< 0.1	14.4	3	0.0223	< 0.002	0.012
S99-04273	5520277676	3.3	< 0.01	< 0.1	0.152	9.3	< 0.003	< 0.002	< 0.008	14	12.6	< 0.004	2.67	0.316	7.9	0.7	20.1	1.5	0.0495	< 0.002	0.031
S99-04274	5520271611	< 0.5	< 0.01	< 0.1	0.026	10.5	< 0.003	< 0.002	< 0.008	0.717	4.7	< 0.004	4.44	0.1	6.7	< 0.1	20.6	1.3	0.0224	< 0.002	0.024
S99-04275	5520289807	< 0.5	< 0.01	< 0.1	0.02	8.2	< 0.003	< 0.002	< 0.008	2.79	3.5	< 0.004	2.57	0.063	5.3	< 0.1	13.9	6.6	0.022	< 0.002	0.015
S99-04276	5520283301	< 0.5	< 0.01	< 0.1	0.02	6.5	< 0.003	< 0.002	< 0.008	2.53	3.6	< 0.004	2.54	0.07	6.6	< 0.1	15.5	2.7	0.0231	< 0.002	0.043
S99-04277	5520211114	< 0.5	< 0.01	< 0.1	0.014	8.7	< 0.003	< 0.002	< 0.008	0.126	2.8	< 0.004	1.92	0.015	10.5	< 0.1	12	3.3	0.0363	< 0.002	0.017
S99-04278	5520259089	< 0.5	0.01	< 0.1	0.011	6	< 0.003	< 0.002	< 0.008	0.61	3.1	< 0.004	2.18	0.029	6.7	< 0.1	14.3	2.4	0.0211	< 0.002	0.02
S99-04279	5523309078	< 0.5	0.02	< 0.1	0.019	10.4	< 0.003	< 0.002	< 0.008	0.01	5.4	< 0.004	2.44	< 0.002	9	< 0.1	11.1	2.1	0.0529	< 0.002	0.014
S99-04280	5523338473	2.4	< 0.01	< 0.1	0.059	51.9	< 0.003	< 0.002	0.016	0.114	14.7	< 0.004	5.97	0.03	43.7	< 0.1	9.05	27	0.311	< 0.002	0.048
S99-04281	5523385821	< 0.5	< 0.01	< 0.1	0.044	10	< 0.003	< 0.002	< 0.008	0.118	41.9	< 0.004	4.57	0.033	6.5	0.5	18.1	13.2	0.0311	0.003	0.015
S99-04282	5523395536	< 0.5	< 0.01	< 0.1	0.028	18.2	< 0.003	< 0.002	< 0.008	0.046	19.2	< 0.004	4.16	0.062	21.3	< 0.1	11.6	17	0.082	< 0.002	0.02
S99-04283	5523319047	2.7	0.02	< 0.1	0.024	6	< 0.003	< 0.002	< 0.008	0.074	13.4	< 0.004	2.28	0.147	9.2	< 0.1	10.6	3.3	0.0345	< 0.002	0.016
S99-04284	5523347173	< 0.5	0.01	< 0.1	0.018	7.5	< 0.003	< 0.002	< 0.008	7.06	7.6	< 0.004	2.56	0.342	5.2	0.2	15.7	9.2	0.0445	< 0.002	0.021
S99-04285	5523328557	0.7	< 0.01	< 0.1	0.009	14.1	< 0.003	< 0.002	< 0.008	1.99	4	< 0.004	2.88	0.098	7.1	< 0.1	14.4	4.5	0.0484	< 0.002	0.308
S99-04286	5523376821	< 0.5	< 0.01	< 0.1	0.013	22.4	< 0.003	< 0.002	< 0.008	0.072	4.2	< 0.004	1.84	0.009	7.9	< 0.1	8.21	11.5	0.0814	< 0.002	0.013
S99-04287	5527067915	0.7	0.02	< 0.1	0.041	9.3	< 0.003	< 0.002	< 0.008	0.794	6.1	< 0.004	2.41	0.169	62.3	< 0.1	12.9	10	0.0774	< 0.002	0.023
S99-04288	5527054809	15.7	< 0.01	< 0.1	0.017	10.5	< 0.003	< 0.002	< 0.008	14.4	4.6	< 0.004	3.18	0.479	6	0.5	18.4	< 0.2	0.0227	< 0.002	0.025
S99-04289	5527081119	< 0.5	< 0.01	< 0.1	0.008	5.5	< 0.003	< 0.002	< 0.008	0.073	3.5	< 0.004	1.6	0.018	3.7	< 0.1	12.6	2	0.0198	< 0.002	0.014
S99-04290	5731585656	8.3	0.02	< 0.1	0.017	8.1	< 0.003	< 0.002	< 0.008	13.1	1.8	< 0.004	2.01	0.314	9.8	0.3	18.9	< 0.2	0.0287	< 0.002	0.033
S99-04291	5731547275	< 0.5	< 0.01	< 0.1	0.027	12.7	< 0.003	< 0.002	< 0.008	0.674	11.5	< 0.004	4.52	0.062	14.7	< 0.1	13.2	13.1	0.0592	< 0.002	0.018
S99-04292	5731519232	16.7	0.08	< 0.1	0.013	14.5	< 0.003	< 0.002	< 0.008	15.7	2.5	< 0.004	3.6	3.34	12.1	< 0.1	12.2	< 0.2	0.171	< 0.002	0.02
S99-04293	5731576169	< 0.5	0.01	< 0.1	0.009	11.8	< 0.003	< 0.002	< 0.008	0.336	2.4	< 0.004	3.41	1.09	7	< 0.1	15.7	0.8	0.0627	< 0.002	0.016
S99-04294	5731528740	4	< 0.01	< 0.1	0.026	11.5	< 0.003	< 0.002	< 0.008	10.3	2.9	< 0.004	2.1	0.974	7.5	0.3	23	< 0.2	0.0695	< 0.002	0.016
S99-04295	5731538084	< 0.5	< 0.01	< 0.1	0.007	10.5	< 0.003	< 0.002	< 0.008	0.211	2.5	< 0.004	3.8	0.888	6.7	< 0.1	18	0.7	0.0488	< 0.002	0.013
S99-04296	5731595550	< 0.5	< 0.01	< 0.1	0.007	7.1	< 0.003	< 0.002	0.011	0.058	2.7	< 0.004	1.67	0.043	3.7	< 0.1	14.1	2.1	0.0191	< 0.002	0.008
S99-04297	5731557444	4.1	< 0.01	< 0.1	0.014	7.3	< 0.003	< 0.002	< 0.008	2.94	2.3	< 0.004	2.07	0.271	15.3	0.4	28.2	0.6	0.0368	< 0.002	0.016
S99-04298	5731276901	< 0.5	< 0.01	< 0.1	0.02	14.5	< 0.003	< 0.002	< 0.008	0.057	7.5	< 0.004	2.72	0.047	10.2	< 0.1	14.3	10.5	0.0473	< 0.002	0.016
S99-04299	5731209168	< 0.5	< 0.01	< 0.1	0.007	6.5	< 0.003	< 0.002	< 0.008	0.217	2.2	< 0.004	0.8	0.025	4.1	< 0.1	11.4	3.8	0.0291	< 0.002	0.01
S99-04300	5731257075	< 0.5	0.01	< 0.1	0.024	15.6	< 0.003	< 0.002	< 0.008	0.078	17.8	< 0.004	3.71	0.022	12.7	< 0.1	11.7	8.4	0.141	< 0.002	0.017
S99-04301	5731219037	< 0.5	< 0.01	< 0.1	0.01	11.5	< 0.003	< 0.002	< 0.008	1.11	1.3	< 0.004	5.62	0.166	7.6	< 0.1	24.2	0.3	0.0527	< 0.002	0.116
S99-04302	5731266018	3.3	< 0.01	< 0.1	0.01	10.1	< 0.003	< 0.002	< 0.008	1.99	2.4	< 0.004	2.04	0.209	7.1	< 0.1	19.9	0.6	0.0473	< 0.002	0.027
S99-04303	5731228431	< 0.5	< 0.01	< 0.1	0.011	19.8	< 0.003	< 0.002	< 0.008	0.379	2	< 0.004	7.42	0.699	9	< 0.1	22.7	13.9	0.0947	< 0.002	0.029
S99-04304	5731295300	< 0.5	0.01	< 0.1	0.005	9	< 0.003	< 0.002	< 0.008	0.179	2.2	< 0.004	2.72	0.113	5.4	< 0.1	12.2	6.7	0.042	< 0.002	0.017
S99-04305	5731247375	< 0.5	< 0.01	< 0.1	0.019	38.4	< 0.003	< 0.002	< 0.008	0.058	1.5	< 0.004	16.1	4.56	13.9	< 0.1	23.6	10.9	0.158	< 0.002	0.025
S99-04306	5731238319	< 0.5	0.04	< 0.1	0.015	12.7	< 0.003	< 0.002	< 0.008	3.21	2.8	< 0.004	4.21	0.369	11.2	< 0.1	20.5	2.4	0.0645	< 0.002	0.028
S99-04307	5738513758	1.5	< 0.01	< 0.1	0.03	28.1	< 0.003	< 0.002	< 0.008	0.744	1.8	0.005	10.5	0.41	13.4	0.1	26	2.8	0.141	< 0.002	0.019
S99-04308	5738540426	4.1	< 0.01	< 0.1	0.103	36.2	< 0.003	< 0.002	< 0.008	8.01	7.8	< 0.004	11.4	1.16	24.2	0.2	23.9	14	0.279	< 0.002	0.028
S99-04309	5738540876	< 0.5	< 0.01	< 0.1	0.01	6	< 0.003	< 0.002	< 0.008	2.61	0.8	< 0.004	2.35	0.618	8.8	0.1	23.9	1.5	0.0469	< 0.002	0.012
S99-04310	5738554829	< 0.5	< 0.01	< 0.1	0.01	13.9	< 0.003	< 0.002	< 0.008	0.191	1	< 0.004	6.47	1.32	13.9	< 0.1	18.9	2.7	0.0843	< 0.002	0.014
S99-04311	5738567450	< 0.5	< 0.01	< 0.1	0.015	14.5	< 0.003	< 0.002	< 0.008	0.186	1.1	< 0.004	8.15	5.03	15.3	< 0.1	14.3	3.2	0.0876	< 0.002	0.018
S99-04312	5738527189	< 0.5	< 0.01	< 0.1	0.046	19	< 0.003	< 0.002	< 0.008	0.2	4.9	< 0.004	6.18	0.459	12.9	< 0.1	11.5	11.2	0.0644	< 0.002	0.02
S99-04313	5738501361	0.8	< 0.01	< 0.1	0.067	21.5	< 0.003	< 0.002	< 0.008	2.86	4.7	< 0.004	6.96	0.556	21.2	< 0.1	16.8	14	0.12	< 0.002	0.015

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04314	RIP4314	27/06/1999	25.7781	88.893	1994	HTW	13.7	Pourashava compound	Rajshahi	Nilphamari	Saidpur	Pourashava ward 04	Nutanbazar
S99-04315	RIP4315	27/06/1999	25.7743	88.8942	1994	DTW	86.9	Pourashava	Rajshahi	Nilphamari	Saidpur	Pourashava ward 04	Kazirhat
S99-04316	RIP4316	28/06/1999	26.2842	88.5776	1991	HTW	20	Md Lutfar Rahman	Rajshahi	Panchagarh	Boda	Benghari Banagram	Benghari
S99-04317	RIP4317	28/06/1999	26.2668	88.5671	1995	HTW	20	Abdul Basat	Rajshahi	Panchagarh	Boda	Maidandighi	Bakpur
S99-04318	RIP4318	28/06/1999	26.2398	88.5324	1978	HTW	22.9	Kobbat	Rajshahi	Panchagarh	Boda	Jhalishalsri	Khanpur
S99-04319	RIP4319	28/06/1999	26.1838	88.5837	1962	HTW	14	Amamtazul Karim	Rajshahi	Panchagarh	Boda	Chandanbari	Chandanbari
S99-04320	RIP4320	28/06/1999	26.1172	88.6335	1991	HTW	18.9	Union Compound	Rajshahi	Panchagarh	Boda	Panchpir	Bairati
S99-04321	RIP4321	28/06/1999	26.1811	88.6312	1984	HTW	22.3	Union Parishad	Rajshahi	Panchagarh	Boda	Sakoa	Nagar Sakoa
S99-04322	RIP4322	28/06/1999	26.2247	88.6761	1990	HTW	14.3	Maraya Bazar club	Rajshahi	Panchagarh	Boda	Marea	Marea Kamala Pukhari
S99-04323	RIP4323	28/06/1999	26.2017	88.5544	1989	HTW	16.2	DPHE compound	Rajshahi	Panchagarh	Boda	Boda	Bogaladangi
S99-04324	RIP4324	28/06/1999	26.322	88.6443	1995	HTW	19.8	Fazil Madrasha	Rajshahi	Panchagarh	Boda	Kajaldighi Kaliganj	Kajaldighi
S99-04325	RIP4325	29/06/1999	26.3366	88.5366	1977	HTW	23.6	Abdur Raufe	Rajshahi	Panchagarh	Panchagarh Sadar	Dhakkamara	Dhakkamara
S99-04326	RIP4326	29/06/1999	26.3284	88.4705	1997	HTW	33.5	Futkiari high school	Rajshahi	Panchagarh	Panchagarh Sadar	Garinabari	Thatpara
S99-04327	RIP4327	29/06/1999	26.3395	88.6652	1998	HTW	13.7	Natunchakla Bazar	Rajshahi	Panchagarh	Panchagarh Sadar	Chaklarhat	Baguladanga
S99-04328	RIP4328	29/06/1999	26.3225	88.4935	1979	HTW	23.6	Gon Ollue	Rajshahi	Panchagarh	Panchagarh Sadar	Magura	Islampur
S99-04329	RIP4329	29/06/1999	26.3359	88.6145	1993	HTW	21.9	Galiakanthy Bazar Mosque	Rajshahi	Panchagarh	Panchagarh Sadar	Kamatkajaldighi	Bishnu Narayani
S99-04330	RIP4330	29/06/1999	26.3578	88.6078	1988	HTW	39.6	Shakerhat Bara Mosque	Rajshahi	Panchagarh	Panchagarh Sadar	Hafizabad	Haghai
S99-04331	RIP4331	29/06/1999	26.3804	88.6438	1994	HTW	23.5	Bharibasha P. school	Rajshahi	Panchagarh	Panchagarh Sadar	Haribasha	Mohammadpur
S99-04332	RIP4332	29/06/1999	26.4698	88.5396	1989	HTW	21.3	Sahebijote (Dash Mile) Bazar	Rajshahi	Panchagarh	Panchagarh Sadar	Satmara	Sahebijote
S99-04333	RIP4333	29/06/1999	26.4088	88.5593	1994	HTW	19.8	Md Bothero	Rajshahi	Panchagarh	Panchagarh Sadar	Panchagarh	Sardapara
S99-04334	RIP4334	29/06/1999	26.3453	88.5574	1990	HTW	27.4	DPHE compound	Rajshahi	Panchagarh	Panchagarh Sadar	Pourashava ward 01	Tuladanga
S99-04335	RIP4335	30/06/1999	26.4784	88.51	1995	HTW	13.7	Romiseuddin D Madrasha	Rajshahi	Panchagarh	Tetulia	Bhojanpur Debnagar	Amzouni
S99-04336	RIP4336	30/06/1999	26.4707	88.4786	1997	HTW	22.9	Mocksad Ali	Rajshahi	Panchagarh	Tetulia	Bhojanpur	Bhojanpur
S99-04337	RIP4337	30/06/1999	26.5296	88.4111	1996	HTW	21.6	Mostafa	Rajshahi	Panchagarh	Tetulia	Balbahan	Balbahan
S99-04338	RIP4338	01/07/1999	26.1657	88.3194	1995	HTW	22.9	Union compound	Rajshahi	Thakurgaon	Baliadangi	Dhantala	Banagaon
S99-04339	RIP4339	01/07/1999	26.1451	88.2382	1975	HTW	18.3	Dearam Ali	Rajshahi	Thakurgaon	Baliadangi	Amjankhore	Taranjubari
S99-04340	RIP4340	01/07/1999	26.1548	88.2665	1999	HTW	13.7	Nazrul Islam	Rajshahi	Thakurgaon	Baliadangi	Paria	Badalchhil
S99-04341	RIP4341	01/07/1999	26.1228	88.3071	1979	HTW	19.8	Bodo Ram	Rajshahi	Thakurgaon	Baliadangi	Charol	Pardeahipara
S99-04342	RIP4342	01/07/1999	26.1045	88.2667	1978	HTW	24.4	Rashidul Islam	Rajshahi	Thakurgaon	Baliadangi	Bara Palashbari	Bara Palashbari
S99-04343	RIP4343	01/07/1999	26.0768	88.2472	1996	HTW	16.8	Kusheldangi hat	Rajshahi	Thakurgaon	Baliadangi	Bara Palashbari	Parua
S99-04344	RIP4344	01/07/1999	26.0621	88.2791	1995	HTW	16.8	Moshain Alam	Rajshahi	Thakurgaon	Baliadangi	Dudsud	Mahishmari
S99-04345	RIP4345	01/07/1999	26.0323	88.2883	1994	HTW	16.8	Md Khamir Uddin	Rajshahi	Thakurgaon	Baliadangi	Bhanor	Sidhor
S99-04346	RIP4346	03/07/1999	25.8317	88.2134	1989	HTW	22.5	U P compound	Rajshahi	Thakurgaon	Haripur	Bhaturia	Tengaria
S99-04347	RIP4347	03/07/1999	25.8371	88.1528	1998	HTW	27.1	Dilipe Kumar	Rajshahi	Thakurgaon	Haripur	Dangipara	Birgarh
S99-04348	RIP4348	03/07/1999	25.8696	88.143	1972	HTW	14	U P compound	Rajshahi	Thakurgaon	Haripur	Bakua	Bakua
S99-04349	RIP4349	03/07/1999	25.9817	88.1578	1985	HTW	16.5	Haidar Rahman	Rajshahi	Thakurgaon	Haripur	Gedura	Malani
S99-04350	RIP4350	03/07/1999	25.887	88.1936	1993	HTW	17.9	Seraj Uddin	Rajshahi	Thakurgaon	Haripur	Amgaon	Kamarpukur
S99-04351	RIP4351	03/07/1999	25.829	88.1312	1997	HTW	12.6	Jato Mohammad	Rajshahi	Thakurgaon	Haripur	Haripur	Jibanpur
S99-04352	RIP4352	03/07/1999	25.8281	88.1304	1990	DTW	27.4	Thana P Compound	Rajshahi	Thakurgaon	Haripur	Haripur	Jibanpur
S99-04353	RIP4353	04/07/1999	26.1605	88.6593	1996	HTW	21.9	Abbas Ali	Rajshahi	Thakurgaon	Thakurgaon Sadar	Debipur	Khalisakuri
S99-04354	RIP4354	04/07/1999	26.1239	88.5632	1989	HTW	19.8	Mazibur Rahmman	Rajshahi	Thakurgaon	Thakurgaon Sadar	Balia	Bara Balia
S99-04355	RIP4355	04/07/1999	26.1057	88.5264	1997	HTW	22.8	Ashair Uddain	Rajshahi	Thakurgaon	Thakurgaon Sadar	Auliapur	Madarganj
S99-04356	RIP4356	04/07/1999	26.043	88.5865	1998	HTW	17.7	Md Hossain	Rajshahi	Thakurgaon	Thakurgaon Sadar	Gareya	Gareya Gopalpur
S99-04357	RIP4357	04/07/1999	25.9843	88.5041	1985	HTW	15.8	U P compound	Rajshahi	Thakurgaon	Thakurgaon Sadar	Jagannathpur	Daulatpur
S99-04358	RIP4358	04/07/1999	26.0297	88.4598	1982	HTW	21.9	DPHE compound	Rajshahi	Thakurgaon	Thakurgaon Sadar	Pourashava ward 03	Ashrampura
S99-04359	RIP4359	04/07/1999	26.0336	88.4615	1995	pumped	21.3	D C compound	Rajshahi	Thakurgaon	Thakurgaon Sadar	Pourashava ward 03	Ashrampura
S99-04360	RIP4360	05/07/1999	25.2254	89.0128	1999	TARA	25.6	Sakut Ali	Rajshahi	Jaipurhat	Panchbibi	Balighata	Kobtara
S99-04361	RIP4361	05/07/1999	25.2403	89.0129	1997	TARA	25.3	Babul Al-Tado	Rajshahi	Jaipurhat	Panchbibi	Bagjana	Kutahara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-04314	5738504693	< 0.5	< 0.01	< 0.1	0.122	84.7	< 0.003	< 0.002	< 0.008	0.192	35.3	< 0.004	13.7	0.115	47	< 0.1	13	46.2	0.255	0.011	0.03
S99-04315	5738504512	< 0.5	< 0.01	< 0.1	0.051	37	< 0.003	< 0.002	< 0.008	0.077	2.8	< 0.004	10.4	0.937	22.3	< 0.1	28.1	16.6	0.228	< 0.002	0.198
S99-04316	5772514227	1.2	0.01	< 0.1	0.004	6.2	< 0.003	< 0.002	< 0.008	0.756	2.9	< 0.004	2.19	0.068	5.8	< 0.1	14.6	4.6	0.0296	< 0.002	0.017
S99-04317	5772573159	< 0.5	< 0.01	< 0.1	0.008	7.8	< 0.003	< 0.002	< 0.008	0.166	2.8	< 0.004	1.95	0.037	8.7	< 0.1	9.18	1.3	0.0442	< 0.002	0.017
S99-04318	5772551579	6.1	< 0.01	< 0.1	0.005	7.5	< 0.003	< 0.002	< 0.008	6.83	1.2	< 0.004	1.76	0.233	8.8	0.6	22.9	< 0.2	0.0288	< 0.002	0.02
S99-04319	5772529267	5.5	< 0.01	< 0.1	0.021	17.5	< 0.003	< 0.002	< 0.008	3.95	3.5	< 0.004	6.73	0.543	8.3	0.5	25	6	0.0629	< 0.002	0.019
S99-04320	5772587153	1.6	0.02	< 0.1	0.015	12.1	< 0.003	< 0.002	< 0.008	1.79	5.7	< 0.004	4.53	0.246	23.8	< 0.1	18.3	8.9	0.0628	< 0.002	0.022
S99-04321	5772594744	1.1	< 0.01	< 0.1	0.009	8.7	< 0.003	< 0.002	< 0.008	3.57	4	< 0.004	2.91	0.128	6	0.1	19	4.3	0.0371	< 0.002	0.014
S99-04322	5772580716	< 0.5	0.03	< 0.1	0.006	3.9	< 0.003	< 0.002	< 0.008	0.098	1.5	< 0.004	0.85	0.016	4.2	< 0.1	16.8	< 0.2	0.015	< 0.002	0.017
S99-04323	5772521540	6.7	< 0.01	< 0.1	0.018	27.6	< 0.003	< 0.002	< 0.008	3.09	5.2	< 0.004	8.25	0.264	14.6	0.2	21.7	8.2	0.065	< 0.002	0.021
S99-04324	5772558511	0.8	0.02	< 0.1	0.007	3.4	< 0.003	< 0.002	< 0.008	1.1	0.9	< 0.004	0.76	0.079	5.5	< 0.1	17.5	0.6	0.0154	< 0.002	0.014
S99-04325	5777336363	< 0.5	< 0.01	< 0.1	0.005	5.5	< 0.003	< 0.002	< 0.008	0.044	1.3	< 0.004	1.59	0.016	4.6	< 0.1	15.6	< 0.2	0.0219	< 0.002	0.01
S99-04326	5777343977	2.8	0.01	< 0.1	0.006	5.7	< 0.003	< 0.002	< 0.008	1.91	1.2	< 0.004	1.5	0.128	6.2	0.1	19.4	0.9	0.0236	< 0.002	0.011
S99-04327	5777323112	< 0.5	0.01	< 0.1	< 0.002	4.3	< 0.003	< 0.002	< 0.008	0.12	1.8	< 0.004	1.69	0.075	6.7	< 0.1	14	0.2	0.0183	< 0.002	0.011
S99-04328	5777365437	0.9	< 0.01	< 0.1	0.009	4.5	< 0.003	< 0.002	< 0.008	0.623	2.3	< 0.004	1.34	0.085	5.1	< 0.1	11.9	1.5	0.0265	< 0.002	0.013
S99-04329	5777359244	3.2	< 0.01	< 0.1	0.004	8.3	< 0.003	< 0.002	< 0.008	2.23	1.8	< 0.004	2.83	0.132	6.3	0.5	22.1	< 0.2	0.0314	< 0.002	0.012
S99-04330	5777335619	1.5	< 0.01	< 0.1	0.007	8.9	< 0.003	< 0.002	< 0.008	0.606	2.8	< 0.004	2.96	0.107	6.6	< 0.1	19.1	0.7	0.0308	< 0.002	0.015
S99-04331	5777347694	< 0.5	< 0.01	< 0.1	0.004	5.8	< 0.003	< 0.002	< 0.008	1.73	2	< 0.004	1.88	0.06	6.3	0.1	17.6	0.2	0.0235	< 0.002	0.022
S99-04332	5777383882	2.2	< 0.01	< 0.1	0.01	5.9	< 0.003	< 0.002	< 0.008	0.546	1.3	< 0.004	1.42	0.372	6.6	< 0.1	13	0.5	0.0313	< 0.002	0.015
S99-04333	5777371899	< 0.5	0.08	< 0.1	0.017	26.6	< 0.003	< 0.002	< 0.008	0.116	3.1	< 0.004	4.54	0.045	21.3	< 0.1	11.4	4	0.173	< 0.002	0.016
S99-04334	5777301880	< 0.5	0.01	< 0.1	0.006	6.2	< 0.003	< 0.002	< 0.008	0.067	1.6	< 0.004	1.64	0.017	5.2	< 0.1	12.8	0.4	0.0288	< 0.002	0.016
S99-04335	5779040030	8.7	< 0.01	< 0.1	0.007	9.5	< 0.003	< 0.002	< 0.008	7.29	6.2	< 0.004	2.78	0.157	4.9	2.2	22.3	0.3	0.0344	< 0.002	0.013
S99-04336	5779027150	< 0.5	0.01	< 0.1	0.004	4.5	< 0.003	< 0.002	< 0.008	0.152	1.1	< 0.004	1.19	0.015	3.9	< 0.1	12.8	0.9	0.0202	< 0.002	0.012
S99-04337	5779067753	< 0.5	< 0.01	< 0.1	0.006	5.3	< 0.003	< 0.002	< 0.008	0.092	1.2	< 0.004	1.1	0.018	8.4	< 0.1	15	0.2	0.0395	< 0.002	0.015
S99-04338	5940863102	< 0.5	0.01	< 0.1	0.004	1.9	< 0.003	< 0.002	< 0.008	0.077	1	< 0.004	0.38	0.01	4.6	< 0.1	12.4	1	0.0091	< 0.002	0.011
S99-04339	5940810956	< 0.5	0.01	< 0.1	0.012	7.8	< 0.003	< 0.002	< 0.008	0.335	5.9	< 0.004	2.96	0.155	6.5	< 0.1	17.5	1.3	0.0479	< 0.002	0.02
S99-04340	5940884063	< 0.5	0.02	< 0.1	0.004	7.5	< 0.003	< 0.002	< 0.008	0.23	1.7	< 0.004	1.67	0.319	9	0.1	21.9	0.8	0.0386	< 0.002	0.015
S99-04341	5940852816	< 0.5	0.01	< 0.1	0.007	5.6	< 0.003	< 0.002	< 0.008	0.075	1.7	< 0.004	1.67	0.03	6.3	< 0.1	15.4	0.5	0.025	< 0.002	0.016
S99-04342	5940831127	< 0.5	0.01	< 0.1	0.009	5.5	< 0.003	< 0.002	< 0.008	0.236	4.2	< 0.004	2.36	0.034	4	< 0.1	19	0.8	0.025	< 0.002	0.015
S99-04343	5940831829	< 0.5	0.01	< 0.1	0.017	5	< 0.003	< 0.002	< 0.008	0.468	9.6	< 0.004	2.71	0.038	5.9	< 0.1	15.8	3.4	0.0426	< 0.002	0.012
S99-04344	5940873739	< 0.5	0.03	< 0.1	0.003	5.1	< 0.003	< 0.002	< 0.008	0.066	2.5	< 0.004	1.64	0.01	5.3	< 0.1	12.7	0.6	0.021	< 0.002	0.013
S99-04345	5940842931	1.7	< 0.01	< 0.1	0.012	7	< 0.003	< 0.002	< 0.008	4.41	2.7	< 0.004	3.01	0.101	11.1	0.2	32.2	0.7	0.022	< 0.002	0.016
S99-04346	5945140968	< 0.5	0.01	< 0.1	0.007	5.5	< 0.003	< 0.002	< 0.008	0.038	1.7	< 0.004	1.54	0.005	8.1	< 0.1	14.3	2.7	0.0234	< 0.002	0.012
S99-04347	5945154225	1.7	0.01	< 0.1	0.004	7	< 0.003	< 0.002	< 0.008	0.031	1.7	< 0.004	3.89	0.025	7	< 0.1	26.2	0.9	0.0442	< 0.002	0.048
S99-04348	5945127053	< 0.5	< 0.01	< 0.1	0.005	8.2	< 0.003	< 0.002	< 0.008	0.028	1.9	< 0.004	3.16	0.006	7	< 0.1	17.3	0.8	0.0348	< 0.002	0.014
S99-04349	5945167689	< 0.5	0.01	< 0.1	0.006	4.6	< 0.003	< 0.002	< 0.008	0.025	1	< 0.004	1.11	0.003	5.1	< 0.1	18.6	0.3	0.0215	< 0.002	0.016
S99-04350	5945113504	< 0.5	< 0.01	< 0.1	0.025	4.5	< 0.003	< 0.002	< 0.008	0.072	21.4	< 0.004	3.38	0.075	12.2	0.7	15.4	11.6	0.0205	< 0.002	0.012
S99-04351	5945181477	< 0.5	< 0.01	< 0.1	0.028	21.8	< 0.003	< 0.002	< 0.008	0.087	4	< 0.004	9.09	0.015	30.6	< 0.1	14.3	14.9	0.112	< 0.002	0.017
S99-04352	5945181477	2.2	< 0.01	< 0.1	0.035	11.5	< 0.003	< 0.002	< 0.008	1.12	2.2	< 0.004	2.97	0.447	13.1	0.2	28.6	1.3	0.0643	< 0.002	0.021
S99-04353	5949436573	< 0.5	< 0.01	< 0.1	0.006	8.2	< 0.003	< 0.002	< 0.008	0.19	3	< 0.004	2.71	0.027	7.3	< 0.1	14.8	2.5	0.0327	< 0.002	0.014
S99-04354	5949421184	0.6	< 0.01	< 0.1	0.02	8.5	< 0.003	< 0.002	< 0.008	4.18	5.4	< 0.004	2.19	0.209	6.9	< 0.1	20.9	2.8	0.058	< 0.002	0.02
S99-04355	5949415688	< 0.5	< 0.01	< 0.1	0.007	6.5	< 0.003	< 0.002	< 0.008	1.46	1.6	< 0.004	1.51	0.09	6.8	< 0.1	19	1.8	0.04	< 0.002	0.023
S99-04356	5949442415	< 0.5	< 0.01	< 0.1	0.019	6.7	< 0.003	< 0.002	< 0.008	1.07	7.8	< 0.004	3.86	0.166	6.1	< 0.1	17.9	1.9	0.0491	< 0.002	0.021
S99-04357	5949447347	2.3	0.01	< 0.1	0.013	7.9	< 0.003	< 0.002	< 0.008	6.29	2.8	< 0.004	2.41	0.148	9.4	0.5	26.6	0.6	0.034	< 0.002	0.016
S99-04358	5949403071	< 0.5	< 0.01	< 0.1	0.049	26.3	< 0.003	< 0.002	< 0.008	0.182	20.6	< 0.004	7.29	0.019	27.1	< 0.1	12.2	12.3	0.319	< 0.002	0.037
S99-04359	5949403071	< 0.5	0.01	< 0.1	0.02	9.6	< 0.003	< 0.002	< 0.008	0.045	5.1	< 0.004	2.21	0.019	8.3	< 0.1	10.8	1.9	0.0494	< 0.002	0.015
S99-04360	5387452542	12.6	0.01	< 0.1	0.037	26.7	< 0.003	0.003	0.01	1.92	3.2	0.009	8.19	9.98	15.3	< 0.1	27.9	8.8	0.159	< 0.002	0.125
S99-04361	5387442569	< 0.5	< 0.01	< 0.1	0.01	18.2	< 0.003	< 0.002	< 0.008	0.046	1.2	< 0.004	9.73	0.81	18	< 0.1	30.3	4.5	0.1	< 0.002	0.044

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-04362	RIP4362	05/07/1999	25.2437	88.9957	1995	HTW	13.7	Iddris Ali	Rajshahi	Jaipurhat	Panchbibi	Dharanji	Ratanpur
S99-04363	RIP4363	05/07/1999	25.1653	88.9867	1999	HTW	18	Tabaj Uddin	Rajshahi	Jaipurhat	Panchbibi	Ayma Rasulpur	Arail Anantapur
S99-04364	RIP4364	05/07/1999	25.1819	89.0764	1988	TARA	18	Kutsh Chandra	Rajshahi	Jaipurhat	Panchbibi	Kusumba	Gangria
S99-04365	RIP4365	05/07/1999	25.1951	89.1664	1999	HTW	18	Kasham Ali	Rajshahi	Jaipurhat	Panchbibi	Aolai	Chhatnali
S99-04366	RIP4366	05/07/1999	25.2311	89.1409	1999	TARA	25.6	U P Compound	Rajshahi	Jaipurhat	Panchbibi	Mohammadpur	Bindhara
S99-04367	RIP4367	05/07/1999	25.2007	89.0457	1984	HTW	19	Takish Uddin	Rajshahi	Jaipurhat	Panchbibi	Atapur	Dibaharpur
S99-04368	RIP4368	06/07/1999	25.0391	89.1258	1998	TARA	25.3	Hospital complex	Rajshahi	Jaipurhat	Khetlal	Khetlal	Khetlal
S99-04369	RIP4369	06/07/1999	25.0218	89.1368	1997	HTW	22.9	Razul Karim Chowdhury	Rajshahi	Jaipurhat	Khetlal	Barail	Sakharanja
S99-04370	RIP4370	06/07/1999	24.973	89.1697	1999	TARA	22.3	Mazibur Rahaman	Rajshahi	Jaipurhat	Khetlal	Alampur	Shibpur
S99-04371	RIP4371	06/07/1999	24.9731	89.1408	1997	TARA	37.2	Astana Sharif	Rajshahi	Jaipurhat	Khetlal	Alampur	Pachul
S99-04372	RIP4372	06/07/1999	24.9981	89.0756	1999	TARA	25.3	Moshain Ali	Rajshahi	Jaipurhat	Khetlal	Mamudpur	Mamudpur
S99-04373	RIP4373	06/07/1999	25.069	89.1416	1998	TARA	37.2	Nazaul Islam	Rajshahi	Jaipurhat	Khetlal	Baratara	Nischinta
S99-04374	RIP4374	07/07/1999	25.0991	89.0352	1997	HTW	15.2	Moklesur Rahmman	Rajshahi	Jaipurhat	Jaipurhat Sadar	Pourashava ward 02	Dakshin Purba Joypurha
S99-04375	RIP4375	07/07/1999	25.1382	88.9322	1996	TARA	25.3	Fazlul Rahman	Rajshahi	Jaipurhat	Jaipurhat Sadar	Dhalahar	Mallikpur
S99-04376	RIP4376	07/07/1999	25.1124	88.9792	1997	TARA	25.3	Mokbul	Rajshahi	Jaipurhat	Jaipurhat Sadar	Dogachhi	Dogachhi
S99-04377	RIP4377	07/07/1999	25.1674	88.9615	1996	TARA	25.3	Jamtoly Hat	Rajshahi	Jaipurhat	Jaipurhat Sadar	Dhalahar	Atthoka
S99-04378	RIP4378	07/07/1999	25.0786	88.9888	1999	TARA	25.3	Hafizar Rahmman	Rajshahi	Jaipurhat	Jaipurhat Sadar	Bhadsa	Kandi
S99-04379	RIP4379	05/07/1999	25.1558	88.9946	1992	HTW	18.9	Khachar Uddin	Rajshahi	Jaipurhat	Panchbibi	Ayma Rasulpur	Khat Batta
S99-05001	RIP5001	10/05/1999	24.4165	91.4307	1986	HTW	54.9	Nagura Faom High Sch	Sylhet	Habiganj	Baniachong	Pukhra	Nagura
S99-05002	RIP5002	10/05/1999	24.4648	91.4614	1978	HTW	62.5	Uzirpur Govt Prim Sch	Sylhet	Habiganj	Baniachong	Khagaura	Ujirpur
S99-05003	RIP5003	10/05/1999	24.4269	91.396	1988	HTW	54.9	Subidpur Bazar	Sylhet	Habiganj	Baniachong	Sujatpur	Sujatpur
S99-05004	RIP5004	10/05/1999	24.4522	91.3703		HTW	56.4		Sylhet	Habiganj	Baniachong	Sujatpur	Balakipur
S99-05005	RIP5005	10/05/1999	24.505	91.3647	1978	HTW	54	Thana health complex	Sylhet	Habiganj	Baniachong	S E Baniachang	Jatukarna
S99-05006	RIP5006	10/05/1999	24.5044	91.3636	1999	HTW	27.1	Thana health complex	Sylhet	Habiganj	Baniachong	S E Baniachang	Jatukarna
S99-05007	RIP5007	10/05/1999	24.5318	91.3593	1985	HTW	56.7	Baniachang A H Sch	Sylhet	Habiganj	Baniachong	N E Baniachang	Sangaon Rayu Para
S99-05008	RIP5008	10/05/1999	24.5313	91.3588	1996	HTW	28	Baniachang A H Sch	Sylhet	Habiganj	Baniachong	N E Baniachang	Sangaon Rayu Para
S99-05009	RIP5009	10/05/1999	24.5135	91.3616	1997	HTW	59.4	Md Shahjahan	Sylhet	Habiganj	Baniachong	S E Baniachang	Sagar Dighir Purba Para
S99-05010	RIP5010	12/05/1999	24.9972	91.231	1989	HTW	127.1	Flood shelter	Sylhet	Sunamganj	Jamalganj	Jamalganj	Telia
S99-05011	RIP5011	12/05/1999	24.9919	91.2004	1998	HTW	123.4	Taher Ali	Sylhet	Sunamganj	Jamalganj	Jamalganj	Lambabak
S99-05012	RIP5012	12/05/1999	24.9943	91.2584	1955	HTW	119.5	Union Parishad Office	Sylhet	Sunamganj	Jamalganj	Satchni Bazar	Durlabpur
S99-05013	RIP5013	12/05/1999	24.974	91.2838	1996	HTW	124.1	Bazar Mosque	Sylhet	Sunamganj	Jamalganj	Bhimkhali	Noagaon Bazar
S99-05014	RIP5014	12/05/1999	24.9937	91.301	1997	HTW	134.1	Intaj Ali	Sylhet	Sunamganj	Jamalganj	Sachna Bazar	Ramnagar
S99-05015	RIP5015	12/05/1999	24.935	91.2498	1979	HTW	103.6	Sunil Chandra Talukdar	Sylhet	Sunamganj	Jamalganj	Fenarbak	Matargaon
S99-05016	RIP5016	13/05/1999	25.0931	91.3745	1995	HTW	112.8	Romjan Ali	Sylhet	Sunamganj	Bishwambarpur	Salukabad	Bhadertek(Raton sree)
S99-05017	RIP5017	13/05/1999	25.1175	91.3259	1994	HTW	54.9	Prataf Chandra Saome	Sylhet	Sunamganj	Bishwambarpur	Palash	Mazair
S99-05018	RIP5018	13/05/1999	25.1175	91.3259	1991	HTW	10.7	Satta Ranjan Sarkar	Sylhet	Sunamganj	Bishwambarpur	Palash	Mazair
S99-05019	RIP5019	13/05/1999	25.1126	91.3243	1996	HTW	106.7	Rabindra Debnath	Sylhet	Sunamganj	Bishwambarpur	Palash	Bajitpur(Kachigati)
S99-05020	RIP5020	13/05/1999	25.0983	91.2939	1995	HTW	128	Md Nurul Amin	Sylhet	Sunamganj	Bishwambarpur	Palash	Natur Para
S99-05021	RIP5021	13/05/1999	25.0645	91.297	1992	HTW	131.1	Md Abdur Rahim	Sylhet	Sunamganj	Bishwambarpur	Fatepur	Fulbari
S99-05022	RIP5022	13/05/1999	25.1357	91.3174	1997	HTW	24.4	Mrs Johura Aktar	Sylhet	Sunamganj	Bishwambarpur	Dhonpur	Dhonpur
S99-05023	RIP5023	13/05/1999	25.1444	91.3168		HTW	50.3	Dhonpur Bazar Masjid	Sylhet	Sunamganj	Bishwambarpur	Dhonpur	Dhonpur
S99-05024	RIP5024	13/05/1999	25.1176	91.2619	1980	HTW	131.1	U P Chairman	Sylhet	Sunamganj	Bishwambarpur	Daskin Badhaghat	Shakticokhola
S99-05025	RIP5025	14/05/1999	25.1176	91.2619	1998	HTW	149.4	Hafizur Rahman	Sylhet	Sunamganj	Tahirpur	Balijuri	Balijuri
S99-05026	RIP5026	14/05/1999	25.1018	91.2099	1993	HTW	106.7	Shamsul Haque	Sylhet	Sunamganj	Tahirpur	Balijuri	Balijuri
S99-05027	RIP5027	14/05/1999	25.1018	91.2099	1998	HTW	106.7	Ershad Ali	Sylhet	Sunamganj	Tahirpur	Taherpur Sadar	Chicksha
S99-05028	RIP5028	14/05/1999	25.15	91.2534	1998	HTW	70.1	Ashu Mia	Sylhet	Sunamganj	Tahirpur	Badaghat	Kamraban
S99-05029	RIP5029	14/05/1999	25.1295	91.2204	1998	HTW	7	Abu Taher	Sylhet	Sunamganj	Tahirpur	Badaghat	Badaghat
S99-05030	RIP5030	14/05/1999	25.1667	91.1795	1990	HTW	73.2	Masjid committee	Sylhet	Sunamganj	Tahirpur	S Bardal	Bardal

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-04362	5387463851	6.1	< 0.01	< 0.1	0.043	24.9	< 0.003	< 0.002	< 0.008	10.7	2.9	< 0.004	8.35	1.79	16.2	0.3	23.9	< 0.2	0.127	< 0.002	0.029
S99-04363	5387431049	< 0.5	< 0.01	< 0.1	0.06	63.7	0.004	< 0.002	< 0.008	0.207	1.6	< 0.004	30.4	2.88	56.2	< 0.1	21.5	58.7	0.314	< 0.002	0.13
S99-04364	5387473358	4.3	< 0.01	< 0.1	0.014	23.9	< 0.003	< 0.002	< 0.008	0.367	0.7	0.004	10.6	0.246	18.7	< 0.1	31.6	2.3	0.11	< 0.002	0.024
S99-04365	5387410259	< 0.5	0.01	< 0.1	0.029	19.6	< 0.003	< 0.002	< 0.008	0.177	1.9	< 0.004	6.79	0.423	16.8	< 0.1	27.8	1.1	0.0927	< 0.002	0.031
S99-04366	5387484456	0.8	0.01	< 0.1	0.022	23.2	< 0.003	< 0.002	< 0.008	0.417	1.3	< 0.004	6.82	0.221	14.8	< 0.1	29.5	< 0.2	0.101	< 0.002	0.097
S99-04367	5387421336	< 0.5	0.02	< 0.1	0.004	11.5	< 0.003	< 0.002	< 0.008	0.096	< 0.5	< 0.004	6.69	0.137	14.7	0.2	27.5	1.8	0.0699	0.002	0.017
S99-04368	5386147590	0.8	0.02	< 0.1	0.024	20.4	< 0.003	< 0.002	< 0.008	0.294	1.5	0.006	8.1	0.237	19.3	< 0.1	30.7	1	0.0724	< 0.002	0.05
S99-04369	5386128853	< 0.5	< 0.01	< 0.1	0.046	48.3	< 0.003	< 0.002	< 0.008	0.476	2.1	< 0.004	17.4	0.585	24.2	< 0.1	30.3	2.5	0.167	< 0.002	0.021
S99-04370	5386109893	1.2	0.01	< 0.1	0.037	35.6	< 0.003	< 0.002	< 0.008	1.36	1.8	< 0.004	11.7	0.519	20.8	< 0.1	28.8	1	0.12	< 0.002	0.055
S99-04371	5386109732	0.7	0.02	< 0.1	0.09	72.1	< 0.003	< 0.002	< 0.008	3.26	3	0.012	24.7	1.19	33.8	< 0.1	30.4	2.6	0.246	< 0.002	0.057
S99-04372	5386157641	< 0.5	0.02	< 0.1	0.015	16.8	< 0.003	< 0.002	< 0.008	0.188	1	0.004	6.65	0.165	14.7	0.1	32.3	1.9	0.0648	< 0.002	0.091
S99-04373	5386119722	0.8	0.01	< 0.1	0.022	12.3	< 0.003	< 0.002	< 0.008	1.3	1.1	0.006	5.04	0.253	11	< 0.1	29.8	0.3	0.0525	< 0.002	0.038
S99-04374	5384702781	< 0.5	0.01	< 0.1	0.057	48.7	< 0.003	< 0.002	< 0.008	1.29	2.3	< 0.004	22.3	0.87	31.7	< 0.1	31.5	10.8	0.202	< 0.002	0.038
S99-04375	5384738697	< 0.5	0.01	< 0.1	0.028	22.1	< 0.003	< 0.002	< 0.008	2.3	1.4	< 0.004	9.61	0.589	13.1	< 0.1	30.4	3.2	0.085	< 0.002	0.036
S99-04376	5384747362	1.8	0.02	< 0.1	0.073	19.2	< 0.003	< 0.002	< 0.008	16.9	1.9	0.009	5.79	1.01	25.1	0.3	33.1	1	0.127	< 0.002	0.06
S99-04377	5384738032	0.8	< 0.01	< 0.1	0.074	11.7	< 0.003	< 0.002	< 0.008	6.01	3	< 0.004	4.26	0.506	19.1	< 0.1	25.2	< 0.2	0.0655	< 0.002	0.028
S99-04378	5384728584	< 0.5	< 0.01	< 0.1	0.017	6	< 0.003	< 0.002	< 0.008	0.138	2	< 0.004	2.13	0.152	6.9	< 0.1	11.1	0.6	0.0333	< 0.002	0.029
S99-04379	5387431519	0.6	0.04	< 0.1	0.03	26.2	< 0.003	< 0.002	< 0.008	0.743	1.1	0.006	12.5	1.01	26.5	0.1	23.6	0.3	0.137	< 0.002	0.015
S99-05001	6361182655	12.5	0.02	< 0.1	0.092	12.9	< 0.003	< 0.002	0.02	11	2.2	0.004	4.22	0.454	56	1.6	23.2	< 0.2	0.0889	< 0.002	0.089
S99-05002	6361150965	31	0.02	< 0.1	0.15	22.8	< 0.003	< 0.002	< 0.008	15.1	1.3	< 0.004	10.9	0.495	59.2	1.8	26.6	0.2	0.166	< 0.002	0.014
S99-05003	6361188920	10.7	0.02	< 0.1	0.078	14.1	< 0.003	< 0.002	< 0.008	9.89	1.4	< 0.004	4.95	0.362	38.6	1.5	27.5	< 0.2	0.0913	< 0.002	0.035
S99-05004	6361188766	18.5	0.02	< 0.1	0.093	15.7	< 0.003	< 0.002	< 0.008	5.33	1.8	< 0.004	6.92	0.603	43.8	0.3	12.6	< 0.2	0.117	< 0.002	0.014
S99-05005	6361118406	52.1	0.02	< 0.1	0.155	11.8	< 0.003	< 0.002	< 0.008	12.3	2.9	< 0.004	4.54	0.475	68.8	1.3	19.2	0.2	0.0885	< 0.002	0.012
S99-05006	6361118406	87.4	0.19	< 0.1	0.049	31	< 0.003	0.002	0.013	5.53	19.3	0.004	20.8	0.166	15.7	1.3	33	0.8	0.225	0.002	0.038
S99-05007	6361106951	10.1	0.05	< 0.1	0.061	12	< 0.003	< 0.002	< 0.008	6.39	1.5	< 0.004	4.08	0.288	56.5	0.6	20.9	< 0.2	0.0802	< 0.002	0.011
S99-05008	6361106951	56	0.04	< 0.1	0.055	27.8	< 0.003	< 0.002	< 0.008	4.15	13.2	0.004	20.1	0.101	8.9	2.2	32.7	0.6	0.2	< 0.002	0.013
S99-05009	6361118277	320	0.05	0.1	0.049	46.2	< 0.003	< 0.002	< 0.008	3.85	6.6	< 0.004	31.5	0.069	47.7	2.7	26.8	0.8	0.287	< 0.002	0.014
S99-05010	6905067897	54.9	0.02	< 0.1	0.123	19	< 0.003	< 0.002	< 0.008	2.54	2	< 0.004	8.01	0.153	80.5	2.5	19.6	0.4	0.117	< 0.002	0.023
S99-05011	6905067841	71.8	0.02	< 0.1	0.102	17.3	< 0.003	< 0.002	< 0.008	0.619	2	0.005	8.09	0.087	82.5	0.6	17.8	0.2	0.108	< 0.002	0.009
S99-05012	6905081242	27.5	0.03	< 0.1	0.091	38.9	< 0.003	< 0.002	< 0.008	2.87	2.4	0.009	18.3	0.605	57.3	0.7	26	< 0.2	0.22	< 0.002	0.154
S99-05013	6905027590	58	0.03	< 0.1	0.089	24.9	< 0.003	< 0.002	< 0.008	1.42	1.8	< 0.004	10.8	0.302	60.1	0.7	16.4	< 0.2	0.173	< 0.002	0.014
S99-05014	6905081849	45	0.04	< 0.1	0.094	26.1	< 0.003	< 0.002	< 0.008	2.08	1.5	< 0.004	11.6	0.184	57.3	1.7	21.3	0.3	0.138	< 0.002	0.015
S99-05015	6905054525	60.1	0.04	< 0.1	0.147	20.6	< 0.003	< 0.002	< 0.008	3.19	1.9	< 0.004	8.79	0.246	75.3	2.3	19.1	0.4	0.119	< 0.002	0.026
S99-05016	6901877812	25.2	0.05	< 0.1	0.14	37.9	< 0.003	< 0.002	< 0.008	1.91	1.4	< 0.004	18.5	0.743	38.3	0.4	16.3	< 0.2	0.21	< 0.002	0.016
S99-05017	6901877464	20.3	0.05	< 0.1	0.07	43.3	< 0.003	< 0.002	< 0.008	3.9	3.3	< 0.004	21.8	0.112	20.3	1.8	22.3	0.3	0.135	< 0.002	0.014
S99-05018	6901877464	4	0.02	< 0.1	0.096	23.2	< 0.003	< 0.002	< 0.008	27.5	6.2	< 0.004	9.62	0.984	5.9	0.4	26.5	0.2	0.0778	< 0.002	0.025
S99-05019	6901877381	5.3	0.03	< 0.1	0.044	33.1	< 0.003	< 0.002	< 0.008	0.965	1.1	< 0.004	14.6	0.392	17.9	0.4	21.9	< 0.2	0.105	< 0.002	0.014
S99-05020	6901877547	47.3	0.04	< 0.1	0.11	23.4	< 0.003	< 0.002	< 0.008	2.73	1.6	< 0.004	8.87	0.317	51.1	0.9	15.5	0.2	0.169	< 0.002	0.019
S99-05021	6901834232	44.4	0.31	< 0.1	0.116	23.4	< 0.003	< 0.002	< 0.008	3.65	2.4	< 0.004	9.34	0.332	50.2	1.2	14.5	0.7	0.165	< 0.002	0.058
S99-05022	6901877530	29.9	0.04	< 0.1	0.102	40.6	< 0.003	< 0.002	< 0.008	13.8	2.7	< 0.004	18.6	0.545	10.1	1.9	32.7	0.3	0.166	< 0.002	0.074
S99-05023	6901877530	13.2	0.06	< 0.1	0.057	38.2	< 0.003	< 0.002	< 0.008	2.62	2.2	< 0.004	20.1	0.098	14.6	1.6	27.4	< 0.2	0.117	< 0.002	0.013
S99-05024	6901817596	57.4	0.03	< 0.1	0.129	19.3	< 0.003	< 0.002	< 0.008	2.45	2.2	< 0.004	8.81	0.132	51.5	0.8	10.4	< 0.2	0.119	< 0.002	0.03
S99-05025	6909210064	47.7	0.05	< 0.1	0.121	22.7	< 0.003	< 0.002	< 0.008	1.43	1.9	< 0.004	8.98	0.194	61.9	0.8	15.5	0.3	0.151	< 0.002	0.029
S99-05026	6909210064	1.3	0.03	< 0.1	0.071	43.2	< 0.003	< 0.002	< 0.008	0.251	0.9	< 0.004	18.5	0.453	59.5	0.1	16.7	< 0.2	0.249	0.004	0.017
S99-05027	6909284218	6.3	0.07	< 0.1	0.1	19	< 0.003	< 0.002	< 0.008	7.45	2.9	< 0.004	9.96	0.277	48.6	0.5	22.4	0.2	0.136	< 0.002	0.016
S99-05028	6909221308	6.9	0.12	< 0.1	0.187	57.2	< 0.003	< 0.002	< 0.008	2.61	3.7	< 0.004	23.5	0.975	100	0.3	9.19	0.3	0.375	< 0.002	0.026
S99-05029	6909221415	< 0.5	0.02	< 0.1	0.175	13.5	< 0.003	< 0.002	< 0.008	0.342	10.4	< 0.004	3.19	0.066	9.7	< 0.1	10.6	8.6	0.0512	< 0.002	0.018
S99-05030	6909263646	45	0.05	< 0.1	0.12	28.9	< 0.003	< 0.002	< 0.008	6.09	2.6	< 0.004	13.2	0.04	76.1	1	12.2	0.4	0.165	< 0.002	0.055

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05031	RIP5031	14/05/1999	25.1028	91.1161	1992	HTW	131.1	Mr Shamsuddin	Sylhet	Sunamganj	Tahirpur	S Sreepur	Patapna
S99-05032	RIP5032	14/05/1999	25.0937	91.1615	1998	HTW	112.8	Babar Ali	Sylhet	Sunamganj	Tahirpur	Taherpur	Bhati Taherpur
S99-05033	RIP5033	16/05/1999	24.8671	90.7244	1988	HTW	56.4	DPHE Thana office	Dhaka	Netrokona	Netrokona Sadar	Kailathi	Toynagar
S99-05034	RIP5034	16/05/1999	24.8412	90.7311	1997	HTW	68.6	Abdul Hamid	Dhaka	Netrokona	Netrokona Sadar	Kailathi	Baluakarda
S99-05035	RIP5035	16/05/1999	24.7803	90.7435	1992	HTW	61	Tofazzal Hossain Talukdar	Dhaka	Netrokona	Netrokona Sadar	Madanpur	Monang
S99-05036	RIP5036	16/05/1999	24.813	90.6962	1997	TARA	66.4	Deoan Ali	Dhaka	Netrokona	Netrokona Sadar	Daskin Bisiura	Sripurbali
S99-05037	RIP5037	16/05/1999	24.8943	90.6815	1998	TARA	64.9	Abdul Aziz	Dhaka	Netrokona	Netrokona Sadar	Ronha	Kumai
S99-05038	RIP5038	16/05/1999	24.9148	90.6924	1994	HTW	59.4	Emdadul Haque	Dhaka	Netrokona	Netrokona Sadar	Mongali	Kareharpur
S99-05039	RIP5039	16/05/1999	24.9409	90.7772	1997	TARA	68.6	F M Hossain Talukdar	Dhaka	Netrokona	Netrokona Sadar	Thakurakona	Lakshmirpur
S99-05040	RIP5040	19/05/1999	24.857	90.7601	1995	TARA	66.4	Saleha Aktar	Dhaka	Netrokona	Netrokona Sadar	Amtala	Ramkrishnapur
S99-05041	RIP5041	17/05/1999	24.9466	90.5976	1978	HTW	73.8	SAE office, DPHE	Dhaka	Netrokona	Purbadhala	Purbodhola	Purbodhola
S99-05042	RIP5042	17/05/1999	24.9505	90.5347	1995	TARA	70.1	Abu Siddiq Ahmed	Dhaka	Netrokona	Purbadhala	Agin	Ofnakanda
S99-05043	RIP5043	17/05/1999	25.0057	90.5184	1992	TARA	70.7	Jalal Uddin	Dhaka	Netrokona	Purbadhala	Hogla	Sehala
S99-05044	RIP5044	17/05/1999	24.9746	90.6259	1993	TARA	76.2	Abu Tohair	Dhaka	Netrokona	Purbadhala	Jhania	Barha
S99-05045	RIP5045	17/05/1999	24.9843	90.6893	1994	TARA	64	Amin Khan	Dhaka	Netrokona	Purbadhala	Dhalamulgaon	Jamdhala
S99-05046	RIP5046	17/05/1999	24.8453	90.6542	1989	HTW	66.1	Narayan Chandra Dash	Dhaka	Netrokona	Purbadhala	Guhalakanda	Jhalshuka
S99-05047	RIP5047	17/05/1999	24.8486	90.6292	1991	HTW	64	Moulana Abdul Hye	Dhaka	Netrokona	Purbadhala	Narandia	Narandia
S99-05048	RIP5048	18/05/1999	25.0723	90.8792	1999	HTW	143.3	DPHE Thana office	Dhaka	Netrokona	Kalmakanda	Kalmakanda	Naya para
S99-05049	RIP5049	18/05/1999	25.0579	90.9129	1987	HTW	78.3	Abdul Matin Master	Dhaka	Netrokona	Kalmakanda	Rangchah	Rangchah
S99-05050	RIP5050	18/05/1999	25.1117	90.8244	1972	HTW	69.2	Abdul Barek	Dhaka	Netrokona	Kalmakanda	Kharnar	Kachugara
S99-05051	RIP5051	18/05/1999	25.1537	90.7819	1987	HTW	41.1	Susil Banik	Dhaka	Netrokona	Kalmakanda	Lengura	Lengura
S99-05052	RIP5052	18/05/1999	25.0864	90.7932	1997	HTW	85.3	Abdul Kadir B.Sc	Dhaka	Netrokona	Kalmakanda	Nazirpur	Kandapara
S99-05053	RIP5053	18/05/1999	25.0736	90.8811	1998	HTW	90.5	Habibur Rahman	Dhaka	Netrokona	Kalmakanda	Kalmakanda	Kalmakanda
S99-05054	RIP5054	18/05/1999	25.0241	90.8584	1977	HTW	82.3	Pabai Pal P School	Dhaka	Netrokona	Kalmakanda	Pogla	Pabai
S99-05055	RIP5055	18/05/1999	25.0075	90.8097	1984	HTW	69.8	Md Abdul Mannan	Dhaka	Netrokona	Kalmakanda	Kailati	Kailati
S99-05056	RIP5056	19/05/1999	25.0324	90.9349	1991	HTW	81.7	Rabindra Chandra Dash	Dhaka	Netrokona	Kalmakanda	Baskapar	Barakhaparn
S99-05057	RIP5057	19/05/1999	25.0221	90.6468	1985	HTW	77.7	Asar Ali Fakir	Dhaka	Netrokona	Durgapur (N)	Kakorghora	Shukrapuri
S99-05058	RIP5058	19/05/1999	25.087	90.6621	1996	HTW	56.4	Abdul Hye	Dhaka	Netrokona	Durgapur (N)	Birishiri	Bhaligaon
S99-05059	RIP5059	19/05/1999	25.0655	90.6955	1994	HTW	46.6	Ahmed Ali	Dhaka	Netrokona	Durgapur (N)	Birishiri	Baodikondi
S99-05060	RIP5060	19/05/1999	25.1261	90.6767	1999	HTW	10.7	DPHE Thana office	Dhaka	Netrokona	Durgapur (N)	Durgapur	Durgapur
S99-05061	RIP5061	19/05/1999	25.125	90.7266	1997	HTW	18.3	Untu Daiya	Dhaka	Netrokona	Durgapur (N)	Chandigaoh	Baniapara
S99-05062	RIP5062	19/05/1999	25.1389	90.6406	1988	HTW	32	Md Rasul Uddin	Dhaka	Netrokona	Durgapur (N)	Kullogaon	Madhabpur
S99-05063	RIP5063	20/05/1999	24.8641	90.9687	1984	HTW	109.7	DPHE Thana office	Dhaka	Netrokona	Mohanganj	Pourashava	Tengapur
S99-05064	RIP5064	20/05/1999	24.8587	91.0181	1998	TARA	85.3	Abdul Motalab	Dhaka	Netrokona	Mohanganj	Battah Banihasi	Uttar Jagdishpur
S99-05065	RIP5065	20/05/1999	24.8459	91.0468	1991	HTW	97.5	Sufia Begum	Dhaka	Netrokona	Mohanganj	Tetulia	Tetulia
S99-05066	RIP5066	20/05/1999	24.8385	90.9815	1995	HTW	67.1	Mozammel Hossain	Dhaka	Netrokona	Mohanganj	Magan Shiadar	Magan
S99-05067	RIP5067	20/05/1999	24.8642	90.9687	1998	HTW	27.4	DPHE Thana office	Dhaka	Netrokona	Mohanganj	Pourashava	Tengapur
S99-05068	RIP5068	20/05/1999	24.8657	90.9455	1997	TARA	106.1	Golam Mostafa	Dhaka	Netrokona	Mohanganj	Borkashia Birampur	Birampur
S99-05069	RIP5069	20/05/1999	24.786	91.0677	1979	HTW	106.7	Prataf Chandra Kar	Dhaka	Netrokona	Mohanganj	Paglajar	Kachapur
S99-05070	RIP5070	20/05/1999	24.7929	91.0147	1984	HTW	101.2	Shaheed Smutri H. School	Dhaka	Netrokona	Mohanganj	Suair	Chechakali
S99-05071	RIP5071	20/05/1999	24.7928	90.9688	1998	TARA	71.6	Abdul Kuddus	Dhaka	Netrokona	Mohanganj	Samaj Shahido	Samaj Shildeo
S99-05072	RIP5072	20/05/1999	24.8955	91.0146	1997	HTW	114.3	Oalak Mia	Sylhet	Sunamganj	Dharmapasha	Dharmapasha	Dharmapasha
S99-05073	RIP5073	21/05/1999	24.9389	91.006	1998	HTW	103.9	Sayed Nazmul Haque	Sylhet	Sunamganj	Dharmapasha	Shellbrosh	Bir (south)
S99-05074	RIP5074	21/05/1999	24.9528	90.997	1996	HTW	100.6	Samad Ali	Sylhet	Sunamganj	Dharmapasha	Paikarah	Bowlam
S99-05075	RIP5075	21/05/1999	25.0111	90.9635	1998	HTW	144.8	Abdul Wadud	Sylhet	Sunamganj	Dharmapasha	Maddhya Nagar	Khalishakarda
S99-05076	RIP5076	21/05/1999	24.9458	91.0878	1977	HTW	146.3	Abul Hossain	Sylhet	Sunamganj	Dharmapasha	Joyashree	Baghaketa
S99-05077	RIP5077	21/05/1999	24.9681	91.1369	1994	HTW	134.1	Sukhair Govt P School	Sylhet	Sunamganj	Dharmapasha	Sukhair North	Sukhair
S99-05078	RIP5078	22/05/1999	24.8865	90.7329	1984	HTW	159.7	DPHE divisional office	Dhaka	Netrokona	Netrokona Sadar	Pouva Area	Ukil para

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05031	6909273726	20.5	0.03	0.1	0.154	20	< 0.003	< 0.002	< 0.008	6.5	3.1	< 0.004	9.04	0.08	37.9	1.3	27.1	0.2	0.119	< 0.002	0.093
S99-05032	6909284935	68	0.06	< 0.1	0.13	25.3	< 0.003	< 0.002	< 0.008	5.55	1.5	< 0.004	10.2	0.184	56.3	0.8	15.5	0.3	0.156	< 0.002	0.016
S99-05033	3727431589	0.5	0.06	< 0.1	0.014	36	< 0.003	< 0.002	< 0.008	0.064	0.7	< 0.004	12.2	0.017	43	0.2	19.2	0.5	0.178	0.003	0.018
S99-05034	3727431497	< 0.5	0.02	< 0.1	0.011	21.6	< 0.003	< 0.002	< 0.008	0.056	0.8	< 0.004	8.68	0.078	48.9	0.2	21	< 0.2	0.118	0.005	0.011
S99-05035	3727454634	< 0.5	0.05	< 0.1	0.026	30	< 0.003	< 0.002	< 0.008	0.103	0.5	< 0.004	10.9	0.124	41.6	0.2	18.7	0.6	0.142	0.005	0.015
S99-05036	3727423941	< 0.5	0.05	< 0.1	0.017	27.6	< 0.003	< 0.002	< 0.008	0.034	1.1	< 0.004	13	0.271	31.2	0.1	24.6	< 0.2	0.158	< 0.002	0.021
S99-05037	3727479581	< 0.5	0.04	< 0.1	0.032	23.5	< 0.003	< 0.002	0.011	0.047	1	< 0.004	11.1	0.407	38.8	0.1	24.2	0.3	0.123	< 0.002	0.054
S99-05038	3727463493	20.3	0.04	< 0.1	0.026	18.3	< 0.003	< 0.002	< 0.008	0.121	1.5	< 0.004	5.7	0.298	67.6	0.8	16.7	< 0.2	0.141	< 0.002	0.014
S99-05039	3727494906	< 0.5	0.04	< 0.1	0.015	19.6	< 0.003	< 0.002	< 0.008	0.023	0.9	< 0.004	6.17	1.42	57.2	0.2	22.8	< 0.2	0.122	0.005	0.023
S99-05040	3727407814	< 0.5	0.05	< 0.1	0.025	32.9	< 0.003	< 0.002	< 0.008	0.09	1	< 0.004	12.3	0.064	44.5	0.1	24.5	0.2	0.175	0.003	0.038
S99-05041	3728394851	0.6	0.04	< 0.1	0.016	21.2	< 0.003	< 0.002	< 0.008	0.097	1.1	< 0.004	8.36	0.653	51.7	0.4	22	0.2	0.132	0.004	0.017
S99-05042	3728307084	< 0.5	0.05	< 0.1	0.011	29.6	< 0.003	< 0.002	< 0.008	0.02	0.8	< 0.004	11.4	0.276	32.7	0.3	20	0.4	0.147	0.007	0.021
S99-05043	3728363927	3.5	0.03	< 0.1	0.032	32.7	< 0.003	< 0.002	< 0.008	0.139	1.3	< 0.004	13.1	0.493	37.5	0.4	22.8	< 0.2	0.175	< 0.002	0.033
S99-05044	3728371093	37.1	0.04	< 0.1	0.079	19	< 0.003	< 0.002	< 0.008	1.75	1.2	< 0.004	7.37	0.468	46.5	0.5	18.3	< 0.2	0.118	< 0.002	0.026
S99-05045	3728331469	44.6	0.02	< 0.1	0.088	7.4	< 0.003	< 0.002	< 0.008	3.75	1.1	< 0.004	3.44	0.172	52.8	0.2	11.6	< 0.2	0.0521	< 0.002	0.015
S99-05046	3728355461	< 0.5	0.04	< 0.1	0.023	27.8	< 0.003	< 0.002	< 0.008	0.03	< 0.5	< 0.004	10.4	0.097	35.8	0.2	21.3	0.2	0.141	0.004	0.024
S99-05047	3728387745	< 0.5	0.02	< 0.1	0.015	26.8	< 0.003	< 0.002	< 0.008	0.033	0.7	< 0.004	11.8	0.228	29.5	< 0.1	25.4	0.2	0.143	0.005	0.016
S99-05048	3724035733	262	0.02	< 0.1	0.096	13.3	< 0.003	< 0.002	< 0.008	2.86	2	< 0.004	5.65	0.073	94.5	1.4	11.7	0.3	0.0997	< 0.002	0.014
S99-05049	3724095867	15.6	< 0.01	< 0.1	0.086	5.9	< 0.003	< 0.002	< 0.008	14.4	1.4	< 0.004	1.27	0.148	19.3	0.5	14.6	0.5	0.0431	< 0.002	0.017
S99-05050	3724047550	87	0.01	< 0.1	0.058	8	< 0.003	< 0.002	< 0.008	7.65	1	< 0.004	3.05	0.058	53	0.5	10.6	< 0.2	0.0523	< 0.002	0.014
S99-05051	3724059667	60.1	0.01	< 0.1	0.036	4.8	< 0.003	0.003	< 0.008	12	2.8	< 0.004	1.98	0.04	15.8	0.5	9.23	< 0.2	0.0353	< 0.002	0.042
S99-05052	3724071983	47.3	0.03	< 0.1	0.078	11.5	< 0.003	< 0.002	< 0.008	9.22	1.2	< 0.004	4.04	0.227	35.4	0.8	20	< 0.2	0.0836	< 0.002	0.016
S99-05053	3724035578	134	0.02	< 0.1	0.071	14.8	< 0.003	< 0.002	< 0.008	1.99	1.6	< 0.004	6.34	0.109	73.9	1.1	9.19	0.2	0.0898	< 0.002	0.016
S99-05054	3724083750	54.4	0.03	< 0.1	0.155	24.9	< 0.003	< 0.002	< 0.008	6.46	1.6	0.005	9.34	0.828	56.6	1.1	20.3	< 0.2	0.176	< 0.002	0.022
S99-05055	3724023555	2.1	0.02	< 0.1	0.027	13.2	< 0.003	< 0.002	< 0.008	0.159	1.2	< 0.004	5.24	0.237	51.9	< 0.1	15.1	0.2	0.0829	< 0.002	0.02
S99-05056	3724011083	87.6	0.04	< 0.1	0.075	17.8	< 0.003	< 0.002	< 0.008	4.64	1.5	< 0.004	7.14	0.367	63.6	1.1	20.4	0.2	0.128	< 0.002	0.016
S99-05057	3721877480	37.6	0.04	< 0.1	0.047	18.3	< 0.003	< 0.002	< 0.008	0.624	1.4	< 0.004	7.37	0.558	47.9	0.9	21.1	< 0.2	0.11	< 0.002	0.014
S99-05058	3721817165	17.5	0.02	< 0.1	0.038	14	< 0.003	< 0.002	< 0.008	0.79	1	< 0.004	5.24	0.222	14.7	0.3	13.3	< 0.2	0.087	< 0.002	0.012
S99-05059	3721817124	176	0.01	< 0.1	0.085	14.2	< 0.003	< 0.002	< 0.008	5.5	1.6	< 0.004	6.44	0.048	33	0.7	8.42	0.3	0.121	< 0.002	0.013
S99-05060	3721851330	2	0.1	< 0.1	0.034	7.9	< 0.003	< 0.002	< 0.008	0.633	2.8	< 0.004	1.87	0.043	4.4	< 0.1	14	5.3	0.0418	< 0.002	0.019
S99-05061	3721825092	21.7	0.02	< 0.1	0.086	14.4	< 0.003	< 0.002	< 0.008	20.4	0.8	0.009	4	0.26	6.9	1	27.1	< 0.2	0.0792	< 0.002	0.019
S99-05062	3721886626	20.8	0.01	< 0.1	0.047	7.1	0.004	< 0.002	< 0.008	13.8	6.2	0.004	2.94	0.637	6	0.4	16.1	6.1	0.0369	< 0.002	0.02
S99-05063	3726301995	83	0.04	< 0.1	0.102	26.9	< 0.003	< 0.002	< 0.008	0.404	1.8	< 0.004	10.6	0.237	54.1	0.3	17.7	0.2	0.19	< 0.002	0.021
S99-05064	3726321994	0.9	0.06	< 0.1	0.16	72.9	< 0.003	< 0.002	< 0.008	0.034	1.8	0.008	28.3	0.361	144	0.1	16.9	8.9	0.462	0.003	0.045
S99-05065	3726384979	145	0.02	< 0.1	0.131	15.2	< 0.003	< 0.002	< 0.008	0.944	2	< 0.004	7.04	0.182	96	0.8	10.5	0.3	0.145	< 0.002	0.012
S99-05066	3726342637	0.9	0.05	< 0.1	0.081	55.5	< 0.003	< 0.002	< 0.008	0.225	2.3	0.006	22.8	2.2	137	0.1	23.3	17	0.396	0.003	0.019
S99-05067	3726301995	41.1	0.08	< 0.1	0.124	55.5	< 0.003	< 0.002	< 0.008	10.1	2.5	0.011	23.7	0.309	24.7	1.8	35.1	1.5	0.23	< 0.002	0.178
S99-05068	3726310255	52.3	0.03	< 0.1	0.1	23.6	< 0.003	< 0.002	< 0.008	1.27	1.7	< 0.004	9.27	0.203	54.1	0.5	21.6	< 0.2	0.144	< 0.002	0.024
S99-05069	3726331544	105	0.06	< 0.1	0.151	20.2	< 0.003	< 0.002	< 0.008	11.4	1.9	< 0.004	7.5	0.181	76.8	1.4	23.5	0.4	0.161	< 0.002	0.017
S99-05070	3726373202	31.7	0.06	< 0.1	0.112	53.2	< 0.003	< 0.002	< 0.008	5.76	4.9	0.008	19.7	0.302	103	0.9	16.8	0.5	0.374	< 0.002	0.049
S99-05071	3726363878	8.5	0.05	< 0.1	0.061	55.2	< 0.003	< 0.002	< 0.008	0.131	0.7	< 0.004	14.4	3.02	91.4	0.3	17.4	< 0.2	0.371	< 0.002	0.028
S99-05072	6903238314	79.4	0.03	< 0.1	0.075	20.3	< 0.003	< 0.002	< 0.008	0.806	1.7	< 0.004	7.95	0.159	76.3	1	18.9	0.4	0.137	< 0.002	0.014
S99-05073	6903276221	116	0.03	< 0.1	0.089	19.6	< 0.003	< 0.002	< 0.008	0.812	1.9	< 0.004	8.69	0.139	95.8	0.9	16.3	0.3	0.146	< 0.002	0.024
S99-05074	6903266187	145	0.02	< 0.1	0.113	19.7	< 0.003	< 0.002	< 0.008	0.947	2.1	< 0.004	9.54	0.1	91.1	1	15.7	0.3	0.143	< 0.002	0.022
S99-05075	6903247622	35.3	0.16	< 0.1	0.041	31.1	< 0.003	< 0.002	< 0.008	0.693	55.8	0.007	16	0.088	92.9	0.8	18.8	11.5	0.158	< 0.002	0.027
S99-05076	6903247076	101	0.03	< 0.1	0.091	14.7	< 0.003	< 0.002	< 0.008	0.573	1.6	< 0.004	7.09	0.03	107	1.5	14.2	0.3	0.104	< 0.002	0.039
S99-05077	6903281945	78	0.07	< 0.1	0.041	16.7	< 0.003	< 0.002	< 0.008	0.505	1.7	< 0.004	6.8	0.049	121	1.8	14.8	0.5	0.111	< 0.002	0.035
S99-05078	3727401959	18.8	0.08	< 0.1	0.073	29.6	< 0.003	< 0.002	< 0.008	0.59	1.9	< 0.004	9.06	0.091	56	0.4	15.4	0.3	0.206	< 0.002	0.061

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05079	RIP5079	23/05/1999	25.0356	90.0095	1974	HTW	37.2	Midha Bari Masjid	Dhaka	Sherpur	Sherpur Sadar	Pourashava-03	Nowhata (Uttar)
S99-05080	RIP5080	23/05/1999	25.0335	89.9486	1996	HTW	38.1	Makbul Hossain	Dhaka	Sherpur	Sherpur Sadar	Char Shapur	Satanipara/Char Sherpur
S99-05081	RIP5081	23/05/1999	25.0129	90.015	1988	WSDTW	152.4	Water supply pump No 2	Dhaka	Sherpur	Sherpur Sadar	Pourashava-08	Old Garur Hati/Narayar
S99-05082	RIP5082	23/05/1999	25.0129	90.0147	1997	HTW	38.1	Mosque	Dhaka	Sherpur	Sherpur Sadar	Pourashava-08	Old Garur Hati/Narayar
S99-05083	RIP5083	23/05/1999	24.9805	90.0752	1988	HTW	36.3	Rahamat Ullah	Dhaka	Sherpur	Sherpur Sadar	Bhatshala	Srirainpur
S99-05084	RIP5084	23/05/1999	24.9383	90.0698	1994	HTW	14	Bazar Masjid	Dhaka	Sherpur	Sherpur Sadar	Kamarla	Char Para Khunua
S99-05085	RIP5085	23/05/1999	25.0466	90.0696	1992	HTW	45.7	Barhtia W Para Masjid	Dhaka	Sherpur	Sherpur Sadar	Pakuora	Bartata
S99-05086	RIP5086	23/05/1999	25.0466	90.0696	1997	HTW	13.7	Abdul Jabbar	Dhaka	Sherpur	Sherpur Sadar	Pakuora	Bartata
S99-05087	RIP5087	24/05/1999	24.947	89.9977	1998	HTW	12.5	Md Selu Sheik	Dhaka	Sherpur	Sherpur Sadar	Balair Char	Assain Para (Chok Sahab
S99-05088	RIP5088	24/05/1999	24.9744	90.0153	1998	HTW	37.2	Khosh Mahmood	Dhaka	Sherpur	Sherpur Sadar	Lasmanpur	Lasmanpur
S99-05089	RIP5089	25/05/1999	24.9887	89.9563	1996	HTW	13.7	Suruz Zaman	Dhaka	Sherpur	Sherpur Sadar	Char Mocharia	Mokshedpur
S99-05090	RIP5090	25/05/1999	24.9494	89.9616	1999	HTW	37.2	Nurul Islam	Dhaka	Sherpur	Sherpur Sadar	Char Pakkiman	Dikpara
S99-05091	RIP5091	24/05/1999	25.0692	90.1308	1992	TARA	36.6	Yakub Ali	Dhaka	Sherpur	Nalitabari	Kalaspar	Balinghoda
S99-05092	RIP5092	24/05/1999	25.0877	90.1834	1997	TARA	44.2	Haji Mostafa	Dhaka	Sherpur	Nalitabari	Pourashava	Garkanda
S99-05093	RIP5093	24/05/1999	25.0877	90.1834	1995	HTW	12.5	Md Tofazzal Hossain	Dhaka	Sherpur	Nalitabari	Pourashava	Garkanda
S99-05094	RIP5094	24/05/1999	25.0476	90.1667	1997	TARA	22.9	Nur Mohammed	Dhaka	Sherpur	Nalitabari	Jogania	Baitkamari
S99-05095	RIP5095	24/05/1999	25.0595	90.2337	1992	HTW	19.8	Ramjan Ali	Dhaka	Sherpur	Nalitabari	Marichpuran	Guja Kura
S99-05096	RIP5096	24/05/1999	25.1376	90.1918	1997	TARA	48.8	Mosharraf Hossain	Dhaka	Sherpur	Nalitabari	Nayabil	Nayabil
S99-05097	RIP5097	24/05/1999	25.1376	90.1918	1998	HTW	25.9	Poresh Marak	Dhaka	Sherpur	Nalitabari	Nayabil	Nayabil
S99-05098	RIP5098	24/05/1999	25.1119	90.108	1997	TARA	29.3	Naljora Imtaj Ali H School	Dhaka	Sherpur	Nalitabari	Rajnagar	Rajnagar
S99-05099	RIP5099	24/05/1999	25.1601	90.1284	1998	TARA	41.1	Md Shafiuddin	Dhaka	Sherpur	Nalitabari	Nanni	Nanni
S99-05100	RIP5100	24/05/1999	25.1826	90.1624	1997	HTW	10.7	Abdur Rahman	Dhaka	Sherpur	Nalitabari	Poragaon	Dheklkura
S99-05102	RIP5102	25/05/1999	25.2125	89.9042	1988	HTW	31.4	Moulana Abul Alam	Dhaka	Sherpur	Sribardi	Kakilakura	Kakilakura
S99-05103	RIP5103	25/05/1999	25.2125	89.9042	1992	HTW	13.7	Abu Alam Monl	Dhaka	Sherpur	Sribardi	Kakilakura	Kakilakura
S99-05104	RIP5104	25/05/1999	25.2485	89.9298	1988	HTW	14.3	Akkas Ali	Dhaka	Sherpur	Sribardi	Singa Barura	Matphata
S99-05105	RIP5105	25/05/1999	25.1788	89.9479	1998	HTW	10.4	Shamsul Haque	Dhaka	Sherpur	Sribardi	Tathati	Bakchar
S99-05106	RIP5106	25/05/1999	25.2248	89.9629	1999	HTW	26.8	Abdul Gafur	Dhaka	Sherpur	Sribardi	Ranisimal	Bilbharat
S99-05107	RIP5107	25/05/1999	25.2248	89.9629	1998	HTW	13.7	Jamsed Ali	Dhaka	Sherpur	Sribardi	Ranisimal	Bilbharat
S99-05108	RIP5108	26/05/1999	24.8145	89.845	1995	HTW	17.7	Abdul Halim	Dhaka	Jamalpur	Sarishabari	Bhatara	Bhatara
S99-05109	RIP5109	26/05/1999	24.7817	89.8495	1998	HTW	80.8	Dudu Mia	Dhaka	Jamalpur	Sarishabari	Bhatara	Bangali
S99-05110	RIP5110	26/05/1999	24.7828	89.8506	1998	HTW	21.3	Abdus Sattar	Dhaka	Jamalpur	Sarishabari	Bhatara	Bangali
S99-05113	RIP5113	26/05/1999	24.7572	89.8647	1980	HTW	26.2	Abdis Sattar Tarafder	Dhaka	Jamalpur	Sarishabari	Nahadan	Sengua
S99-05114	RIP5114	26/05/1999	24.703	89.8219	1991	HTW	20.1	Tofazzal Hossain	Dhaka	Jamalpur	Sarishabari	Pogal Digha	Rudra Baira
S99-05115	RIP5115	26/05/1999	24.7017	89.8569	1986	HTW	16.8	Abdus Salam	Dhaka	Jamalpur	Sarishabari	Doail	Dolbhiti
S99-05116	RIP5116	26/05/1999	24.6476	89.8229	1989	HTW	21.3	Batikamari P School	Dhaka	Jamalpur	Sarishabari	Aona	Dayalpur
S99-05117	RIP5117	26/05/1999	24.8458	89.8375	1992	HTW	25.3	U P office	Dhaka	Jamalpur	Sarishabari	Pingna	Pigna
S99-05118	RIP5118	26/05/1999	24.9662	89.8107	1975	HTW	32.9	A Hye (Bacehumia)	Dhaka	Jamalpur	Melandah	Nangla	Deulabari
S99-05119	RIP5119	26/05/1999	24.9472	89.8348	1974	HTW	27.1	Osman Gani Chowdhury	Dhaka	Jamalpur	Melandah	Adra	Thuri
S99-05120	RIP5120	26/05/1999	24.909	89.82	1992	HTW	13.7	Abdus Salam	Dhaka	Jamalpur	Melandah	Pulkocha	Hazrabari
S99-05121	RIP5121	26/05/1999	24.8942	89.8643	1997	HTW	27.1	Bhonat Ali	Dhaka	Jamalpur	Melandah	Jhaugara	Jhaugara
S99-05122	RIP5122	26/05/1999	24.9246	89.8494	1987	HTW	13.7	Md Chan Mia	Dhaka	Jamalpur	Melandah	Charbanipakuri	Nahiramkul
S99-05123	RIP5123	27/05/1999	25.0847	89.7811	1976	HTW	35.7	Nagendra Chandra Richi	Dhaka	Jamalpur	Islampur	Palbandha	Palbandha
S99-05124	RIP5124	27/05/1999	25.1147	89.751	1995	HTW	22.3	Motiur Rahman	Dhaka	Jamalpur	Islampur	Patharbi	Mujata
S99-05125	RIP5125	27/05/1999	25.1268	89.7203	1995	HTW	18	Sri Mongol Das	Dhaka	Jamalpur	Islampur	Kulkandi	Kulkandi
S99-05126	RIP5126	28/05/1999	25.125	89.8367	1997	HTW	22.6		Dhaka	Jamalpur	Islampur	Goalerchar	Mahalgiri
S99-05127	RIP5127	28/05/1999	25.025	89.7333	1975	HTW	40.2	Mofazzal Hossain	Dhaka	Jamalpur	Islampur	Noapara	Noapara
S99-05129	RIP5129	29/05/1999	25.1935	89.7561	1997	HTW	18	Padri Bazar	Dhaka	Jamalpur	Dewanganj	Bahadurabad	Bahadurabad
S99-05130	RIP5130	29/05/1999	25.1453	89.7505	1997	HTW	22.6	Md Sadu Mia	Dhaka	Jamalpur	Dewanganj	Chukaibari	Chukaibari

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05079	3898803971	5.4	0.02	< 0.1	0.019	11.8	< 0.003	< 0.002	< 0.008	0.401	2.4	< 0.004	8.08	0.293	8.4	0.2	23.8	2.1	0.0423	< 0.002	0.007
S99-05080	3898840272	38.8	0.02	< 0.1	0.073	23.9	< 0.003	< 0.002	< 0.008	4.67	3.9	< 0.004	7.99	1.66	5.9	0.3	24.5	2.8	0.105	< 0.002	0.015
S99-05081	3898807734	5.1	0.03	< 0.1	0.074	27.9	< 0.003	< 0.002	< 0.008	0.888	2	0.005	11.9	0.404	11.6	0.1	28.5	3.1	0.146	< 0.002	0.014
S99-05082	3898807734	3.1	0.04	< 0.1	0.026	46.6	< 0.003	< 0.002	< 0.008	0.34	1.7	0.012	20.3	0.92	18.1	< 0.1	28.8	1.2	0.224	< 0.002	0.012
S99-05083	3898820131	0.7	0.03	< 0.1	0.046	35.8	< 0.003	< 0.002	< 0.008	0.395	1.1	< 0.004	15.7	0.305	20.8	< 0.1	27.5	4.8	0.189	< 0.002	0.011
S99-05084	3898867309	7.6	0.03	< 0.1	0.03	21.2	< 0.003	< 0.002	< 0.008	0.46	2.8	0.005	7.47	1.3	10.5	0.1	18.5	2	0.0885	< 0.002	0.011
S99-05085	3898881112	2.3	0.02	< 0.1	0.041	16.8	< 0.003	< 0.002	< 0.008	9.24	3.2	< 0.004	7.92	0.421	11.3	0.1	21.3	7.1	0.0834	< 0.002	0.015
S99-05086	3898881112	< 0.5	0.02	< 0.1	0.039	24.9	< 0.003	< 0.002	< 0.008	0.239	2.4	< 0.004	10.5	0.132	22.4	< 0.1	20.1	13.8	0.127	< 0.002	0.01
S99-05087	3898813187	< 0.5	0.02	< 0.1	0.048	24.9	< 0.003	< 0.002	< 0.008	0.069	3.9	0.007	16.5	1.1	22.1	< 0.1	17.2	8.1	0.056	< 0.002	0.011
S99-05088	3898874657	< 0.5	0.04	< 0.1	0.029	32.5	< 0.003	< 0.002	< 0.008	0.274	0.7	< 0.004	14.8	0.228	8.9	0.1	26.9	4.8	0.128	< 0.002	0.015
S99-05089	3898827732	115	0.04	< 0.1	0.074	37	< 0.003	< 0.002	< 0.008	8.21	4.5	< 0.004	13.1	1.54	14.4	1.7	19.3	0.2	0.144	< 0.002	0.016
S99-05090	3898833244	19.7	0.04	< 0.1	0.061	43.6	< 0.003	< 0.002	< 0.008	2.24	2.8	< 0.004	11.2	0.726	11.6	0.3	18	9.3	0.165	< 0.002	0.017
S99-05091	3897008071	12.3	0.02	< 0.1	0.098	24.2	< 0.003	< 0.002	< 0.008	10.5	1.9	0.005	11.5	1.82	13.3	0.2	27.1	19.2	0.0907	< 0.002	0.036
S99-05092	3897008360	5.3	0.02	< 0.1	0.029	18.2	< 0.003	< 0.002	< 0.008	0.492	1.2	0.008	6.64	0.39	10.1	< 0.1	31	4.6	0.0983	< 0.002	0.007
S99-05093	3897008360	17.3	0.02	< 0.1	0.133	17.2	< 0.003	< 0.002	< 0.008	29.2	8	< 0.004	9.19	7.83	31.7	0.1	15.9	27.4	0.109	< 0.002	0.051
S99-05094	3897034054	17.7	0.02	< 0.1	0.045	19.5	< 0.003	< 0.002	< 0.008	1.38	1.9	< 0.004	8.37	0.354	11.4	0.3	21.6	3	0.0621	< 0.002	0.033
S99-05095	3897094344	36.5	0.01	< 0.1	0.063	14	< 0.003	< 0.002	< 0.008	15.2	1	< 0.004	7.76	0.331	16.6	0.7	21	0.3	0.0713	< 0.002	0.031
S99-05096	3897086699	137	0.01	< 0.1	0.034	14	< 0.003	< 0.002	< 0.008	0.194	1.3	< 0.004	4.92	0.159	24.1	0.7	25.4	< 0.2	0.0902	< 0.002	0.051
S99-05097	3897086699	33.2	< 0.01	< 0.1	0.063	8.2	< 0.003	< 0.002	< 0.008	10.2	1.6	< 0.004	3.25	0.169	17.4	< 0.1	7.88	< 0.2	0.0561	< 0.002	0.026
S99-05098	3897077830	9.1	0.02	< 0.1	0.062	18.2	< 0.003	< 0.002	< 0.008	6.73	1.2	< 0.004	11	0.185	15.4	0.5	30.1	< 0.2	0.0677	< 0.002	0.056
S99-05099	3897069727	49.7	0.02	< 0.1	0.047	12.6	< 0.003	< 0.002	< 0.008	3.51	1.6	< 0.004	4.21	0.121	22.7	0.5	24.5	< 0.2	0.0894	< 0.002	0.04
S99-05100	3897069300	56.1	< 0.01	< 0.1	0.016	3.1	< 0.003	< 0.002	0.136	26.5	1.1	< 0.004	2.16	0.564	3.5	0.5	11.3	< 0.2	0.0242	< 0.002	0.119
S99-05102	3899047580	19.3	0.02	< 0.1	0.036	15.4	< 0.003	< 0.002	< 0.008	2.22	2.2	< 0.004	8.51	0.266	10.5	0.1	21.3	2.5	0.0559	< 0.002	0.02
S99-05103	3899047580	< 0.5	0.02	< 0.1	0.035	19.1	< 0.003	< 0.002	< 0.008	0.249	2.7	< 0.004	9.56	0.675	4.5	< 0.1	18.4	3.3	0.0738	< 0.002	0.02
S99-05104	3899079759	15.2	0.02	< 0.1	0.038	18.7	< 0.003	< 0.002	< 0.008	2.15	2.3	0.005	8.57	2.23	11.2	0.2	20	13.3	0.0751	< 0.002	0.02
S99-05105	3899094055	< 0.5	0.04	< 0.1	0.05	44.3	< 0.003	< 0.002	< 0.008	0.125	4	0.006	18.8	1.07	14.6	< 0.1	19.4	19.8	0.171	< 0.002	0.015
S99-05106	3899071178	14.8	0.01	0.1	0.077	11.9	< 0.003	< 0.002	< 0.008	41.8	2	0.009	4.67	1.48	6.2	0.4	22.7	0.3	0.0539	< 0.002	0.052
S99-05107	3899071178	3	0.01	< 0.1	0.043	9.3	0.004	< 0.002	< 0.008	7.74	8.4	< 0.004	4.74	1.5	9.1	0.3	22.8	5.6	0.0315	< 0.002	0.043
S99-05108	3398521117	0.9	0.05	< 0.1	0.119	56.2	< 0.003	< 0.002	< 0.008	0.384	4.5	0.009	22.4	1.06	26.6	0.1	20.8	17.5	0.172	< 0.002	0.02
S99-05109	3398521045	14.7	0.05	< 0.1	0.08	48.3	< 0.003	< 0.002	< 0.008	1.05	3.2	0.005	17.3	0.157	12.1	0.2	29.6	0.4	0.235	< 0.002	0.025
S99-05110	3398521045	230	0.04	< 0.1	0.088	37.5	< 0.003	< 0.002	< 0.008	11.4	2.4	< 0.004	16.9	0.687	8.3	0.8	23.3	0.2	0.124	< 0.002	0.017
S99-05113	3398552871	7.4	0.03	< 0.1	0.096	34.2	< 0.003	< 0.002	< 0.008	8.17	2.1	< 0.004	16.2	0.414	10	0.3	25.6	2.3	0.106	< 0.002	0.012
S99-05114	3398573818	5.5	0.03	< 0.1	0.06	29.5	< 0.003	< 0.002	< 0.008	3.97	2.1	0.005	14.8	0.385	14.5	0.1	20.4	2.9	0.1	< 0.002	0.011
S99-05115	3398531379	< 0.5	0.05	< 0.1	0.033	31.1	< 0.003	< 0.002	< 0.008	0.128	2.7	< 0.004	14.4	0.415	13.2	< 0.1	20.5	6.1	0.107	< 0.002	0.011
S99-05116	3398510320	3.3	0.02	< 0.1	0.127	23.7	< 0.003	< 0.002	< 0.008	18.1	1.9	< 0.004	9.68	0.441	12.4	0.8	22.9	3	0.0747	< 0.002	0.037
S99-05117	3398563752	30.5	0.05	< 0.1	0.113	59.6	< 0.003	< 0.002	< 0.008	9.41	3.7	< 0.004	20.3	0.277	15.5	1.9	26	0.2	0.212	< 0.002	0.014
S99-05118	3396185326	13.1	0.03	< 0.1	0.08	31.1	< 0.003	< 0.002	< 0.008	9.45	2.2	0.005	17.7	0.583	13.5	0.7	27	0.5	0.1	< 0.002	0.015
S99-05119	3396109973	25.9	0.02	< 0.1	0.086	20.4	< 0.003	< 0.002	< 0.008	11.9	1.9	< 0.004	9.39	0.51	9.8	1.1	26.1	< 0.2	0.0739	< 0.002	0.01
S99-05120	3396138490	< 0.5	0.04	< 0.1	0.036	22.8	< 0.003	< 0.002	< 0.008	0.399	1.8	< 0.004	10.7	0.26	5.2	< 0.1	19.6	3.6	0.081	< 0.002	0.013
S99-05121	3396157533	11.6	0.03	< 0.1	0.032	20.4	< 0.003	< 0.002	0.012	0.829	2.1	< 0.004	4.73	0.6	5	0.9	20.3	4.5	0.0488	< 0.002	0.021
S99-05122	3396119639	< 0.5	0.04	< 0.1	0.027	20.2	< 0.003	< 0.002	< 0.008	0.103	1.3	< 0.004	13.2	1.03	15.1	< 0.1	18.1	5	0.0713	< 0.002	0.009
S99-05123	3392979778	9.2	0.03	< 0.1	0.091	29.7	< 0.003	< 0.002	< 0.008	6.44	2.6	< 0.004	12.3	1.35	19	1.1	24.5	3.7	0.104	< 0.002	0.01
S99-05124	3392987724	4.4	0.07	< 0.1	0.122	49.2	< 0.003	< 0.002	< 0.008	11.8	2.6	0.008	23.2	0.749	23.9	1	22.8	6.7	0.179	< 0.002	0.015
S99-05125	3392963659	13.9	0.02	< 0.1	0.093	20.7	< 0.003	< 0.002	< 0.008	15.1	1.9	< 0.004	9.99	0.456	9.8	0.6	28.8	2	0.064	< 0.002	0.011
S99-05126	3392947681	0.5	0.05	< 0.1	0.076	57.9	< 0.003	< 0.002	< 0.008	0.085	4.3	0.007	26.7	1.17	23.8	< 0.1	14.7	25.6	0.224	< 0.002	0.035
S99-05127	3392971757	16.3	0.08	< 0.1	0.143	117	< 0.003	< 0.002	< 0.008	4.9	5	0.005	37.6	1.8	25	0.5	15	98.7	0.362	< 0.002	0.032
S99-05129	3391507093	1.6	0.05	< 0.1	0.055	63.1	< 0.003	< 0.002	< 0.008	0.131	4.2	0.006	21.9	1	5.6	< 0.1	19.4	11.5	0.191	< 0.002	0.016
S99-05130	3391543373	5.1	0.03	< 0.1	0.072	21.7	< 0.003	< 0.002	< 0.008	9.26	1.9	< 0.004	9.24	0.321	7.7	0.6	18.1	5.5	0.0686	< 0.002	0.02

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05131	RIP5131	29/05/1999	25.1453	89.7505	1995	HTW	7.9	Sadhu Sheikh	Dhaka	Jamalpur	Dewanganj	Chukaibari	Chukaibari
S99-05132	RIP5132	29/05/1999	25.1391	89.7678	1995	HTW	18.3	Bazar Committee	Dhaka	Jamalpur	Dewanganj	Dewanganj	Kharma
S99-05133	RIP5133	30/05/1999	24.8585	89.9048	1989	TARA	41.1	Mozammel Khan	Dhaka	Jamalpur	Jamalpur Sadar	Kendua	Kendua
S99-05134	RIP5134	30/05/1999	24.8515	89.8705	1994	HTW	22.9		Dhaka	Jamalpur	Jamalpur Sadar	Meshta	Birgaila
S99-05135	RIP5135	30/05/1999	24.7664	89.9316	1996	TARA	21.3	Khalilur Rahman	Dhaka	Jamalpur	Jamalpur Sadar	Digpaith	Santia
S99-05136	RIP5136	30/05/1999	24.8028	89.9345	1996	TARA	21.3	Abdul Mannan	Dhaka	Jamalpur	Jamalpur Sadar	Titpalla	Paschin Pardignli
S99-05137	RIP5137	30/05/1999	24.8146	90.1194	1996	HTW	32	Mahatab Uddin	Dhaka	Jamalpur	Jamalpur Sadar	Ghoradhap	Katarbari
S99-05139	RIP5139	01/06/1999	23.9836	90.9562	1975	HTW	22.9	Md Kanchan Mia	Dhaka	Narsingdi	Raipur (N)	Chandpur	Majher Char
S99-05140	RIP5140	01/06/1999	23.9535	90.8762	1987	HTW	21.3	Saydabad Madrassa	Dhaka	Narsingdi	Raipur (N)	Srinagar	Srinagar
S99-05141	RIP5141	01/06/1999	23.9061	90.9013	1997	HTW	21.3	Abdur Rahim	Dhaka	Narsingdi	Raipur (N)	Banshgari	Banshgari
S99-05142	RIP5142	01/06/1999	23.8861	90.8502	1989	HTW	17.7	Jamal Uddin	Dhaka	Narsingdi	Raipur (N)	Nilakshya	Nilakshya
S99-05143	RIP5143	01/06/1999	23.9312	90.7754	1994	HTW	26.8	Shawkat Ali	Dhaka	Narsingdi	Raipur (N)	Amirganj	Hasnabad
S99-05144	RIP5144	01/06/1999	24.0259	90.8631	1984	HTW	22.3	Abdus Sobhan	Dhaka	Narsingdi	Raipur (N)	UttarBakharnagar	Uttar Bakharnagar
S99-05145	RIP5145	31/05/1999	24.0899	90.6537	1991	HTW	21	Union parishad	Dhaka	Narsingdi	Manohardi	Daulatput	Daulatpur
S99-05146	RIP5146	31/05/1999	24.0957	90.6993	1985	HTW	28	Hatirdia Primary School	Dhaka	Narsingdi	Manohardi	Akduaria	Hatirdia
S99-05147	RIP5147	31/05/1999	24.1371	90.6981	1992	HTW	59.1	Kafil Uddin	Dhaka	Narsingdi	Manohardi	Shukundia	Manchardi
S99-05148	RIP5148	31/05/1999	24.1673	90.6923	1998	HTW	15.2	Torfazzal Hossain/Chowrasta Monluvi	Dhaka	Narsingdi	Manohardi	Chandanbari	Naluachak
S99-05149	RIP5149	31/05/1999	24.2332	90.6916	1998	HTW	31.7	Lal Mia	Dhaka	Narsingdi	Manohardi	Lebutala	Gangkul
S99-05150	RIP5150	31/05/1999	24.2289	90.7324	1985	HTW	14	Khidirpur High Street	Dhaka	Narsingdi	Manohardi	Khidirpur	Khidirpur
S99-05151	RIP5151	31/05/1999	24.1824	90.7718	1995	HTW	40.8	Abdul Baten	Dhaka	Narsingdi	Manohardi	Barachapa	Chanditala
S99-05152	RIP5152	31/05/1999	24.1528	90.7594	1991	TARA	47.5	Saiful Isalm	Dhaka	Narsingdi	Manohardi	Kanchikata	Katabaria
S99-05153	RIP5153	31/05/1999	24.0996	90.7686	1992	HTW	24.4	Abdus Sattar	Dhaka	Narsingdi	Manohardi	Gotasia	Chula
S99-05154	RIP5154	01/06/1999	23.9843	90.8707	1996	HTW	9.1	Mahader Chandra Shah	Dhaka	Narsingdi	Raipur (N)	Chanderkandi	Pacha Boalia
S99-05155	RIP5155	01/06/1999	23.9899	90.9034	1999	HTW	22.3	Dr Abdul Awal	Dhaka	Narsingdi	Raipur (N)	Raipura	Mamudpur
S99-05156	RIP5156	01/06/1999	24.0169	90.9367	1986	HTW	22.6	Idrish Ali	Dhaka	Narsingdi	Raipur (N)	Maheshpur	Sapmara
S99-05157	RIP5157	01/06/1999	23.9858	90.869	1986	HTW	21.3	Serajul Islam	Dhaka	Narsingdi	Raipur (N)	Chanderkandi	Pacha Boalia
S99-05158	RIP5158	01/06/1999	23.8101	90.7935	1990	HTW	22.3	Arafat Ali	Dhaka	Narsingdi	Raipur (N)	Adiabad	Adiabad
S99-05159	RIP5159	01/06/1999	24.0397	90.9166	1990	HTW	26.8	Lakshmipur Masjid (Uttar Para)	Dhaka	Narsingdi	Raipur (N)	Radhanagar	Chhota Lakshimpur
S99-05160	RIP5160	02/06/1999	23.9723	90.6549	1990	HTW	31.7	Thana Health Complex	Dhaka	Narsingdi	Palash	Jinardi	Gabtali
S99-05161	RIP5161	02/06/1999	23.9399	90.6748	1998	TARA	69.5	Md Kamal Hossain	Dhaka	Narsingdi	Palash	Jinardi	Kuraitali (Barar Char)
S99-05162	RIP5162	02/06/1999	23.9749	90.6798	1995	HTW	29	Nabi Newaz	Dhaka	Narsingdi	Palash	Gazaria	Ichhakali
S99-05163	RIP5163	02/06/1999	24.0086	90.6656	1982	HTW	42.7	Jahirul Huq	Dhaka	Narsingdi	Palash	Char Sindur	Gokulnagar
S99-05164	RIP5164	02/06/1999	24.0004	90.6521	1998	HTW	50	Md Nurul Islam	Dhaka	Narsingdi	Palash	Char Sindur	Kauadi
S99-05165	RIP5165	02/06/1999	23.9393	90.6141	1998	TARA	46.3	Union Parishad	Dhaka	Narsingdi	Palash	Ghorashal	Ghorashal
S99-05166	RIP5166	02/06/1999	23.8891	90.5895		HTW	0		Dhaka	Narsingdi	Palash	Danga	Hasanhata
S99-05167	RIP5167	06/06/1999	24.2402	89.6512	1978	HTW	22	Azahar Ali	Rajshahi	Sirajganj	Belkuchi	Dhukuriabera	Dhukuriabera
S99-05168	RIP5168	06/06/1999	24.2614	89.6775	1990	HTW	19	Fazlul Haque	Rajshahi	Sirajganj	Belkuchi	Daulatpur	Teasia
S99-05169	RIP5169	06/06/1999	24.2675	89.6974	1992	HTW	21.3	Jamal uddin	Rajshahi	Sirajganj	Belkuchi	Daulatpur	Meghulla
S99-05170	RIP5170	06/06/1999	24.2986	89.6901	1986	HTW	91.4	Upazilla Parishad	Rajshahi	Sirajganj	Belkuchi	Belkuchi	Chala
S99-05171	RIP5171	06/06/1999	24.2974	89.6894	1988	HTW	12.2	Aushit boron chowdhury	Rajshahi	Sirajganj	Belkuchi	Belkuchi	Chala
S99-05172	RIP5172	06/06/1999	24.3138	89.6984	1992	HTW	21.9	Jahangir Hossain	Rajshahi	Sirajganj	Belkuchi	Rajapur	Boirabari
S99-05173	RIP5173	06/06/1999	24.3309	89.6855	1978	HTW	23.5	Abdul Mozid	Rajshahi	Sirajganj	Belkuchi	Bhangabari	Tamai
S99-05174	RIP5174	06/06/1999	24.3575	89.6994	1996	HTW	21.9	Samaspur Bazar Mosque	Rajshahi	Sirajganj	Belkuchi	Rajapur	Samaspur
S99-05175	RIP5175	07/06/1999	24.3861	89.4004	1996	TARA	21	Md Rais uddin	Rajshahi	Sirajganj	Tarash	Naogaon	Bhait
S99-05176	RIP5176	07/06/1999	24.4489	89.3133	1995	TARA	21	Md Afsar Ali	Rajshahi	Sirajganj	Tarash	Baruhasa	Binodpur
S99-05177	RIP5177	07/06/1999	24.4679	89.3527	1993	TARA	21	Md Abdul Hye	Rajshahi	Sirajganj	Tarash	Baruhasa	Penguari
S99-05178	RIP5178	07/06/1999	24.5037	89.3525	1993	TARA	21.5	Sri Mongol Chandra	Rajshahi	Sirajganj	Tarash	Talom	Manikchapar
S99-05179	RIP5179	07/06/1999	24.4899	89.3753	1992	TARA	23	Mr Suresh chandra	Rajshahi	Sirajganj	Tarash	Deshigram	Kirsheen

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05131	3391543373	< 0.5	0.03	< 0.1	0.058	32.3	< 0.003	< 0.002	< 0.008	0.305	1.9	< 0.004	17.9	0.179	16.3	< 0.1	17.6	9.9	0.109	< 0.002	0.011
S99-05132	3391558684	45.8	0.03	< 0.1	0.071	34	< 0.003	< 0.002	< 0.008	7.23	2.4	< 0.004	12.1	2.06	7.4	0.5	17.2	8.2	0.113	< 0.002	0.017
S99-05133	3393635554	22.4	0.04	< 0.1	0.102	22.5	< 0.003	< 0.002	< 0.008	2.61	2.6	< 0.004	11.6	1.52	11.5	0.5	25.2	3.3	0.0863	< 0.002	0.01
S99-05134	3393647163	50.6	0.04	0.1	0.256	53.5	< 0.003	< 0.002	< 0.008	21.3	3.1	0.011	21.8	1.57	41.9	1.3	25	22	0.223	< 0.002	0.017
S99-05135	3393611871	8.2	0.02	< 0.1	0.055	18.8	< 0.003	< 0.002	< 0.008	10.6	2.1	< 0.004	9.27	0.635	7.7	0.3	23.7	0.2	0.0641	< 0.002	0.016
S99-05136	3393689757	< 0.5	0.04	< 0.1	0.05	15.9	< 0.003	< 0.002	< 0.008	0.118	15.3	0.005	10.5	0.134	8.4	< 0.1	24.8	3.1	0.0544	< 0.002	0.013
S99-05137	3393617550	2.8	0.06	< 0.1	0.091	67.1	0.004	< 0.002	< 0.008	0.713	2.3	0.021	25.4	1.42	12.8	< 0.1	25.8	0.6	0.368	< 0.002	0.018
S99-05139	3686427568	43.1	0.09	< 0.1	0.153	143	< 0.003	< 0.002	< 0.008	1.38	5.6	0.008	31.2	4.03	54.4	0.2	24.1	84.6	0.462	< 0.002	0.033
S99-05140	3686491939	206	0.08	< 0.1	0.102	88.2	< 0.003	< 0.002	< 0.008	5.35	3.1	< 0.004	18.6	2.76	14.8	1.7	23.8	10	0.299	< 0.002	0.048
S99-05141	3686416118	1.9	0.09	< 0.1	0.317	73.3	< 0.003	< 0.002	< 0.008	0.272	56.5	0.01	32.4	0.999	86.4	< 0.1	13	69.2	0.29	< 0.002	0.037
S99-05142	3686471718	153	0.06	< 0.1	0.082	73.4	< 0.003	< 0.002	< 0.008	3.8	4	< 0.004	16.1	1.72	19	1.2	22.3	24.9	0.238	< 0.002	0.017
S99-05143	3686410426	4	0.04	< 0.1	0.04	17.4	< 0.003	< 0.002	< 0.008	0.232	2.7	< 0.004	10	1.47	14.5	< 0.1	14.4	11.3	0.102	< 0.002	0.027
S99-05144	3686494979	1.4	0.08	< 0.1	0.118	55.6	< 0.003	< 0.002	< 0.008	0.047	4.3	0.009	31	1.64	57	< 0.1	15.5	28.9	0.185	< 0.002	0.036
S99-05145	3685247374	24.7	0.03	< 0.1	0.046	26.4	< 0.003	< 0.002	< 0.008	0.775	3	0.007	11.6	1.27	10.9	< 0.1	23.3	2.7	0.0903	< 0.002	0.01
S99-05146	3685254522	53.4	0.04	< 0.1	0.125	38.5	< 0.003	< 0.002	< 0.008	7.77	3	< 0.004	15.6	1.81	19.1	0.4	21.8	8.9	0.124	< 0.002	0.014
S99-05147	3685294718	< 0.5	0.02	< 0.1	0.026	19	< 0.003	< 0.002	< 0.008	0.054	3.5	0.005	22.1	0.448	8	0.1	23.2	2.1	0.23	< 0.002	0.008
S99-05148	3685233743	68.6	0.05	< 0.1	0.064	30	< 0.003	< 0.002	< 0.008	3.84	2.9	< 0.004	15	1.54	8.4	0.5	23.1	0.6	0.106	< 0.002	0.01
S99-05149	3685281436	36	0.04	< 0.1	0.034	15.3	< 0.003	< 0.002	< 0.008	0.22	2	< 0.004	7.73	1.61	7.4	0.1	22	1.6	0.0583	< 0.002	0.025
S99-05150	3685274614	4	0.05	< 0.1	0.048	24.4	< 0.003	< 0.002	< 0.008	1.07	2	< 0.004	11.3	1.64	5.8	0.1	20.3	2.3	0.0819	< 0.002	0.039
S99-05151	3685206214	1.1	0.03	< 0.1	0.036	10.3	< 0.003	< 0.002	< 0.008	0.347	1.1	< 0.004	3.76	0.215	14.1	< 0.1	27.3	14.2	0.0928	< 0.002	0.092
S99-05152	3685267589	< 0.5	0.02	< 0.1	0.043	14.7	< 0.003	0.005	< 0.008	0.146	1.6	0.005	3.96	0.047	17.6	0.2	34.8	0.2	0.102	0.003	0.028
S99-05153	3685261325	< 0.5	0.03	< 0.1	0.198	37	< 0.003	< 0.002	< 0.008	0.254	2.7	< 0.004	11.4	0.121	23.7	< 0.1	30.4	6.8	0.421	< 0.002	0.046
S99-05154	3686423726	1	0.06	< 0.1	0.101	38.4	< 0.003	< 0.002	< 0.008	0.922	4.5	< 0.004	16.4	0.234	54.3	< 0.1	16.6	23.4	0.137	< 0.002	0.019
S99-05155	3686484600	53.9	0.06	< 0.1	0.08	69	< 0.003	< 0.002	< 0.008	0.591	3.9	0.005	17.1	1.7	41.7	0.3	25.4	36.3	0.234	< 0.002	0.033
S99-05156	3686447900	194	0.04	< 0.1	0.12	53.4	< 0.003	< 0.002	< 0.008	13.4	6.1	< 0.004	19.1	1.66	11.3	0.7	20.6	0.4	0.197	< 0.002	0.02
S99-05157	3686423726	284	0.07	< 0.1	0.047	53.4	< 0.003	< 0.002	< 0.008	2.73	2.9	< 0.004	8.58	1.39	8.8	0.6	21.7	0.2	0.177	< 0.002	0.066
S99-05158	3686403015	89.4	0.05	< 0.1	0.039	27.4	< 0.003	< 0.002	< 0.008	1.63	2.8	< 0.004	6.65	1.7	7.1	0.7	22.1	2.5	0.105	< 0.002	0.015
S99-05159	3686481331	35.4	0.05	< 0.1	0.098	57	< 0.003	< 0.002	< 0.008	8.25	4.4	0.006	21.3	3.05	29.3	0.8	23.9	24.3	0.239	< 0.002	0.024
S99-05160	3686379347	1.6	0.04	< 0.1	0.079	20.4	< 0.003	< 0.002	< 0.008	0.108	1.5	< 0.004	7.46	0.502	16	0.2	30	0.3	0.173	0.003	0.017
S99-05161	3686379647	0.5	0.05	< 0.1	0.049	29.2	< 0.003	< 0.002	< 0.008	0.115	1.7	< 0.004	9.58	0.057	33.8	0.1	33.6	4.5	0.199	0.002	0.021
S99-05162	3686347473	21.2	0.07	< 0.1	0.055	45	< 0.003	< 0.002	< 0.008	0.472	2.9	< 0.004	16.3	1.35	11.4	0.2	22.6	4.6	0.148	< 0.002	0.018
S99-05163	3686315442	51.9	0.05	< 0.1	0.089	27.8	< 0.003	< 0.002	< 0.008	13.4	2.5	< 0.004	13.4	1.85	13.3	0.5	20.3	2.6	0.124	< 0.002	0.014
S99-05164	3686315568	3.9	0.04	< 0.1	0.072	18.8	< 0.003	< 0.002	< 0.008	2.05	1.9	< 0.004	8.34	0.232	32.3	0.4	25.5	0.7	0.105	< 0.002	0.022
S99-05165	3686363410	0.6	0.04	< 0.1	0.051	36.4	< 0.003	< 0.002	< 0.008	0.055	1.3	0.005	12	0.197	72.2	0.2	26.5	27.9	0.247	0.003	0.026
S99-05166	3686331458	< 0.5	0.04	< 0.1	0.08	22.4	< 0.003	< 0.002	< 0.008	0.064	2.1	< 0.004	24.1	0.919	55.9	0.2	21.6	21	0.191	0.005	0.009
S99-05167	5881167377	1	0.05	< 0.1	0.101	51.7	< 0.003	0.002	< 0.008	0.654	22.7	< 0.004	15.5	3.07	18.2	< 0.1	18	11.6	0.199	< 0.002	0.016
S99-05168	5881154994	10.5	0.06	< 0.1	0.091	38.1	< 0.003	< 0.002	< 0.008	5.8	3	< 0.004	16.4	1.04	16.2	0.6	18.4	2.5	0.148	< 0.002	0.021
S99-05169	5881154731	41.2	0.04	0.1	0.202	50	< 0.003	< 0.002	< 0.008	35.7	3.3	< 0.004	16.1	1.12	22.8	0.8	27.6	4.3	0.196	< 0.002	0.023
S99-05170	5881127240	16.6	0.02	< 0.1	0.033	19.2	< 0.003	< 0.002	< 0.008	0.942	2.6	< 0.004	7.61	0.259	3.7	0.8	21.5	1.8	0.0566	< 0.002	0.012
S99-05171	5881127240	0.6	0.06	< 0.1	0.051	43.4	< 0.003	< 0.002	< 0.008	0.078	2.8	< 0.004	11.6	1.11	15.4	< 0.1	16.4	10.3	0.14	< 0.002	0.012
S99-05172	5881181137	28.2	0.01	< 0.1	0.112	38.3	< 0.003	< 0.002	< 0.008	15.8	3.4	0.004	18.6	0.963	10.5	1.2	24.7	2.2	0.128	< 0.002	0.016
S99-05173	5881140972	25.5	0.02	0.1	0.07	45.7	< 0.003	< 0.002	< 0.008	8.86	2	0.007	20.2	0.32	10.8	1.2	22.9	2.2	0.12	< 0.002	0.021
S99-05174	5881181869	53.6	0.05	< 0.1	0.078	34.2	< 0.003	< 0.002	< 0.008	11.5	2.9	< 0.004	10.1	1.15	8.1	1.1	26.3	< 0.2	0.113	< 0.002	0.012
S99-05175	5888952117	0.8	0.01	< 0.1	0.027	30.3	< 0.003	< 0.002	< 0.008	0.036	1.1	0.005	12.7	2.04	21.2	0.1	28.3	6.3	0.133	< 0.002	0.017
S99-05176	5888910178	< 0.5	0.06	< 0.1	0.046	49.8	< 0.003	< 0.002	< 0.008	0.036	1.6	0.013	16.2	0.595	27.1	< 0.1	25.1	6.5	0.134	< 0.002	0.013
S99-05177	5888910799	10.8	0.07	< 0.1	0.026	43.2	< 0.003	< 0.002	< 0.008	0.058	1.1	0.005	12.3	3.31	17.1	< 0.1	30.5	2.5	0.375	< 0.002	0.015
S99-05178	5888973709	< 0.5	0.05	< 0.1	0.027	49.9	< 0.003	< 0.002	< 0.008	0.025	0.7	0.014	11.8	0.867	24.9	< 0.1	23.8	7.5	0.165	0.002	0.008
S99-05179	5888921592	< 0.5	0.01	< 0.1	0.015	32.2	< 0.003	< 0.002	< 0.008	< 0.005	1.7	0.015	11.7	0.016	22.5	< 0.1	22.9	2.1	0.185	< 0.002	0.012

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05180	RIP5180	07/06/1999	24.4246	89.3701	1984	DTW	76.2	T N O	Rajshahi	Sirajganj	Tarash	Tarash	Tarash
S99-05181	RIP5181	07/06/1999	24.4247	89.3729	1992	TARA	21.6	Govt. Quarters (uttara)	Rajshahi	Sirajganj	Tarash	Tarash	Tarash
S99-05182	RIP5182	07/06/1999	24.4312	89.3418	1995	TARA	21	Md Shontosh Ali	Rajshahi	Sirajganj	Tarash	Saguna	Saguna
S99-05183	RIP5183	07/06/1999	24.3951	89.3516	1993	TARA	21	Md Abdul Zalil	Rajshahi	Sirajganj	Tarash	Magurabinod	Magurabinod
S99-05184	RIP5184	07/06/1999	24.4226	89.4275	1994	TARA	21	Md Eshaque Ali	Rajshahi	Sirajganj	Tarash	Madhaninagar	Jhurjhuri
S99-05185	RIP5185	08/06/1999	24.3124	89.5623	1978	DTW	74.4	Director of Reshary	Rajshahi	Sirajganj	Ullahpara	Ullahpara	Bakua
S99-05186	RIP5186	08/06/1999	24.3364	89.5701	1995	TARA	23	Md. Anowar Hossain	Rajshahi	Sirajganj	Ullahpara	Panchakroshi	Kaliganj Tentulia
S99-05187	RIP5187	08/06/1999	24.3825	89.5396	1996	TARA	25.3	Md Akbar Ali Molla	Rajshahi	Sirajganj	Ullahpara	Hatikumrul	Patdhari
S99-05188	RIP5188	08/06/1999	24.2722	89.579	1997	TARA	23.8		Rajshahi	Sirajganj	Ullahpara	Durganagar	Parsantala
S99-05189	RIP5189	08/06/1999	24.2541	89.4999	1992	TARA	23	Md Sorhab Ali	Rajshahi	Sirajganj	Ullahpara	Mohanpur	Dakshin Mohanpur
S99-05190	RIP5190	08/06/1999	24.2697	89.4717	1994	TARA	25.3	Md Abbas Ali	Rajshahi	Sirajganj	Ullahpara	Barapangashi	Barapangashi
S99-05191	RIP5191	08/06/1999	24.2905	89.5189	1975	HTW	26.8	Md Idris Ali	Rajshahi	Sirajganj	Ullahpara	Durganagar	Bagholpur
S99-05192	RIP5192	08/06/1999	24.3369	89.5251	1996	TARA	25.3	Haran PK	Rajshahi	Sirajganj	Ullahpara	Purnimagati	Putea
S99-05193	RIP5193	08/06/1999	24.3548	89.4616	1995	TARA	25.3	Md Anisur Rahman	Rajshahi	Sirajganj	Ullahpara	Bangala	Majhipara
S99-05194	RIP5194	08/06/1999	24.3873	89.4581	1998	TARA	24.1	Md Amjad Hossin	Rajshahi	Sirajganj	Ullahpara	Ramkrisnapur	Badekusa
S99-05195	RIP5195	08/06/1999	24.3865	89.4569	1988	HTW	16.8	Md Nazrul Islam	Rajshahi	Sirajganj	Ullahpara	Ramkrisnapur	Badekusa
S99-05196	RIP5196	09/06/1999	24.2074	89.7147	1986	HTW	20.1	Md Eanoth Bapari	Rajshahi	Sirajganj	Chauhali	Sthal	Santosha
S99-05197	RIP5197	09/06/1999	24.2089	89.7153	1994	HTW	14	Abdul Mannaf	Rajshahi	Sirajganj	Chauhali	Sthal	Santosha
S99-05198	RIP5198	09/06/1999	24.1391	89.7771	1976	HTW	28	Md Makaddesh Ali Mai	Rajshahi	Sirajganj	Chauhali	Gorjane	Rahai Kawdia
S99-05199	RIP5199	09/06/1999	24.1499	89.7839	1986	HTW	22.3	DPHE office	Rajshahi	Sirajganj	Chauhali	Mirkutia	Khas Kaulia
S99-05200	RIP5200	09/06/1999	24.1341	89.7839	1998	HTW	13.7	Md Abul Kalam Azad	Rajshahi	Sirajganj	Chauhali	Mirkutia	Khas Kaulia
S99-05201	RIP5201	09/06/1999	24.0926	89.7917	1988	HTW	21.9	U P Office	Rajshahi	Sirajganj	Chauhali	Mirkutia	Khas Pukuria
S99-05202	RIP5202	09/06/1999	24.0463	89.7813	1999	HTW	18.3	Ainal Haque	Rajshahi	Sirajganj	Chauhali	Umarpur	Pathrail
S99-05203	RIP5203	09/06/1999	24.2246	89.6955	1997	HTW	15.2	Enayetpur buro Jame Mosque	Rajshahi	Sirajganj	Chauhali	Sadiachandpur	Enayetpur
S99-05204	RIP5204	09/06/1999	24.2388	89.6959	1996	HTW	17.1	Betil High School	Rajshahi	Sirajganj	Chauhali	Sadiachandpur	Betil
S99-05205	RIP5205	10/06/1999	24.4428	89.6689	1987	HTW	18	Md Golam Mostafa	Rajshahi	Sirajganj	Sirajganj Sadar	Sialkole	Bildhali
S99-05206	RIP5206	10/06/1999	24.4438	89.669	1987	HTW	12.5	Md Saiful Islam	Rajshahi	Sirajganj	Sirajganj Sadar	Sialkole	Bildhali
S99-05207	RIP5207	10/06/1999	24.4606	89.6651	1996	HTW	22.6	Md Zel Haque	Rajshahi	Sirajganj	Sirajganj Sadar	Bahuli	Bromokhola
S99-05208	RIP5208	10/06/1999	24.4975	89.6716	1996	HTW	24.1	Md Abdul Hakim	Rajshahi	Sirajganj	Sirajganj Sadar	Khokshabari	Shaluavita
S99-05209	RIP5209	10/06/1999	24.5156	89.6671	1998	HTW	20.7	Md Amir Hossain	Rajshahi	Sirajganj	Sirajganj Sadar	Chhangacha	Chhangacha
S99-05210	RIP5210	10/06/1999	24.5099	89.6469	1998	HTW	22.6		Rajshahi	Sirajganj	Sirajganj Sadar	Bagbati	Phulkocha
S99-05211	RIP5211	12/06/1999	25.3755	89.469	1997	HTW	17.8	Md Parjor Uddin	Rajshahi	Gaibandha	Sadullapur	Banagram	Habibullapur
S99-05212	RIP5212	12/06/1999	25.4382	89.4481	1983	HTW	13	Md Aiob Ali Khandokar	Rajshahi	Gaibandha	Sadullapur	Damodarpur	Bangamor
S99-05213	RIP5213	12/06/1999	25.4802	89.4667	1989	HTW	18.6	Md Mozaffor Hossain	Rajshahi	Gaibandha	Sadullapur	Naldanga	Dasila
S99-05214	RIP5214	12/06/1999	25.4303	89.4928	1999	HTW	13.4	Kazi Kudrat -E-Khoda	Rajshahi	Gaibandha	Sadullapur	Kumarpara	Kesalidangar
S99-05215	RIP5215	12/06/1999	25.4101	89.3978	1999	HTW	14.3	Md Nuruzzaman Mondol	Rajshahi	Gaibandha	Sadullapur	Jamalpur	Khorda Rasulpur
S99-05216	RIP5216	12/06/1999	25.4498	89.398	1994	HTW	17.7	Md Mojnu Mia	Rajshahi	Gaibandha	Sadullapur	Rasulpur	Taraf Kamal
S99-05217	RIP5217	12/06/1999	25.4217	89.3768	1999	HTW	13.4	Abdul Khaleque	Rajshahi	Gaibandha	Sadullapur	Faridpur	Mirpur
S99-05218	RIP5218	12/06/1999	25.3565	89.3723	1999	HTW	17.7	Md Amjad Hossain	Rajshahi	Gaibandha	Sadullapur	Dhaperhat	Sadipara
S99-05219	RIP5219	12/06/1999	25.3539	89.4183	1994	HTW	13.1	Abdul Mannan Sarker	Rajshahi	Gaibandha	Sadullapur	Bhatgram	Bhatgram
S99-05220	RIP5220	12/06/1999	25.3536	89.4176	1983	HTW	9.8	Md Mastafijur Rahman	Rajshahi	Gaibandha	Sadullapur	Bhatgram	Bhatgram
S99-05221	RIP5221	14/06/1999	25.1418	89.3586	1996	TARA	29.9	Abul Kalam Azad	Rajshahi	Gaibandha	Gobindaganj	Gumaniganj	Tarok Manu
S99-05222	RIP5222	14/06/1999	25.1813	89.3128	1978	TARA	28.3	A Samad	Rajshahi	Gaibandha	Gobindaganj	Katabari	Bogdaha
S99-05223	RIP5223	14/06/1999	25.2068	89.2102	1997	HTW	21.3	Kandia U P Office	Rajshahi	Gaibandha	Gobindaganj	Kandia	Kandia
S99-05224	RIP5224	14/06/1999	25.1236	89.2627	1994	TARA	29.9	Md Mofazzal Hossain	Rajshahi	Gaibandha	Gobindaganj	Rajahar	Hansawar
S99-05225	RIP5225	14/06/1999	25.1438	89.3521	1993	HTW	17.7	Mrs Rijia Khatun	Rajshahi	Gaibandha	Gobindaganj	Bapmara	Taraf Kamal
S99-05226	RIP5226	14/06/1999	25.1089	89.4131	1986	HTW	13.7	Md Suza Mia	Rajshahi	Gaibandha	Gobindaganj	Shibpur	Srimukh
S99-05227	RIP5227	14/06/1999	25.0993	89.4325	1991	HTW	18.3	Md Raja Mia	Rajshahi	Gaibandha	Gobindaganj	Kocharhahan	Arbishnapur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05180	5888984955	< 0.5	< 0.01	< 0.1	0.018	48.1	< 0.003	< 0.002	< 0.008	0.048	0.8	0.011	13.1	0.434	27.7	< 0.1	26.2	9.1	0.158	< 0.002	0.027
S99-05181	5888984955	< 0.5	< 0.01	< 0.1	0.028	37.9	< 0.003	< 0.002	< 0.008	< 0.005	1	0.013	11.9	< 0.002	20.9	< 0.1	18.7	< 0.2	0.12	0.011	0.005
S99-05182	5888963916	< 0.5	0.02	< 0.1	0.045	66.1	< 0.003	< 0.002	< 0.008	0.234	1.2	0.012	18.9	0.898	33	< 0.1	24.7	12.8	0.211	0.005	0.024
S99-05183	5888942659	< 0.5	0.02	< 0.1	0.016	21.9	< 0.003	< 0.002	< 0.008	0.031	1	0.005	10.2	0.772	16.8	< 0.1	30.7	5.2	0.0901	0.002	0.019
S99-05184	5888931469	< 0.5	0.01	0.1	0.105	38.6	< 0.003	< 0.002	< 0.008	15.3	2.6	0.008	19	0.989	13.7	0.6	27.2	0.5	0.147	< 0.002	0.027
S99-05185	5889494071	20.4	0.01	0.1	0.072	17.6	< 0.003	< 0.002	< 0.008	11	1.7	< 0.004	7.08	1.06	8.7	1.6	24.4	0.2	0.0802	< 0.002	0.017
S99-05186	5889451484	25.6	0.01	< 0.1	0.083	29.9	< 0.003	< 0.002	< 0.008	10.1	2.6	0.005	16.7	0.549	13.4	0.1	24.1	17.3	0.103	< 0.002	0.021
S99-05187	5889436733	2.7	< 0.01	< 0.1	0.064	25.9	< 0.003	< 0.002	< 0.008	8.31	1.4	0.005	15.7	0.48	12.3	1	24.6	< 0.2	0.0776	< 0.002	0.022
S99-05188	5889429696	12.5	0.03	< 0.1	0.177	67.8	0.003	< 0.002	0.013	2.79	12.7	0.005	38.7	0.835	36.6	< 0.1	20.7	83.7	0.181	< 0.002	0.028
S99-05189	5889443295	1.3	< 0.01	< 0.1	0.063	26.3	< 0.003	< 0.002	< 0.008	11.8	3.3	< 0.004	10.7	1.11	17.4	0.9	26.1	0.7	0.11	< 0.002	0.017
S99-05190	5889421121	26.4	0.02	0.1	0.097	29.5	< 0.003	< 0.002	< 0.008	13.4	2.7	< 0.004	8.47	1.01	14	0.7	21	9.1	0.102	< 0.002	0.018
S99-05191	5889429062	16.7	0.01	0.2	0.171	43.1	0.004	< 0.002	< 0.008	20.8	4.2	0.012	18.1	1.3	16.8	0.7	25	1.3	0.156	< 0.002	0.035
S99-05192	5889458794	15.9	0.02	0.1	0.095	23.7	< 0.003	< 0.002	< 0.008	8.3	2.1	0.005	14.1	0.483	16.5	1.2	23.6	6.2	0.0803	< 0.002	0.029
S99-05193	5889407586	28.4	0.02	0.1	0.1	24	< 0.003	< 0.002	< 0.008	12	3.2	0.004	9.61	0.949	14.5	0.8	22.6	< 0.2	0.0918	< 0.002	0.047
S99-05194	5889465056	37	0.02	< 0.1	0.136	36.1	< 0.003	< 0.002	< 0.008	3.87	4	< 0.004	18.3	2.03	11.3	0.9	26.5	1.7	0.131	< 0.002	0.026
S99-05195	5889465056	25.2	0.07	< 0.1	0.08	84.8	< 0.003	< 0.002	0.009	0.408	5	< 0.004	17	0.564	8.2	0.1	9.37	32.4	0.255	< 0.002	0.022
S99-05196	5882771836	1	0.02	< 0.1	0.051	58.6	< 0.003	< 0.002	< 0.008	0.152	4.3	< 0.004	12.4	0.388	5.3	< 0.1	9.43	10.3	0.174	< 0.002	0.063
S99-05197	5882771836	< 0.5	0.07	< 0.1	0.093	111	< 0.003	< 0.002	0.01	0.17	4.8	< 0.004	25.5	1.53	9.8	0.1	15.6	7.8	0.317	< 0.002	0.024
S99-05198	5882723742	0.6	0.08	< 0.1	0.09	111	< 0.003	< 0.002	0.01	0.1	4.1	0.004	27.7	1.64	13.1	0.2	19.4	12.5	0.324	< 0.002	0.024
S99-05199	5882730512	3.7	0.02	< 0.1	0.101	51.9	< 0.003	< 0.002	< 0.008	8.01	3.3	< 0.004	14.1	1.35	7.9	1.4	21.5	0.6	0.18	< 0.002	0.024
S99-05200	5882730512	2.2	0.06	< 0.1	0.076	72.5	< 0.003	< 0.002	< 0.008	4.81	4.2	< 0.004	17	1.77	14.3	0.3	14	14	0.216	< 0.002	0.022
S99-05201	5882730526	< 0.5	0.06	0.1	0.106	65.4	< 0.003	< 0.002	< 0.008	7.31	4.1	0.008	24.6	1.24	19.2	0.4	17.4	21.7	0.215	< 0.002	0.027
S99-05202	5882737684	1.1	0.07	< 0.1	0.086	67.4	< 0.003	< 0.002	< 0.008	6.84	4.1	< 0.004	18.5	1.34	9.4	0.7	18.4	19.9	0.234	< 0.002	0.035
S99-05203	5882747317	36	0.02	0.1	0.13	53.2	< 0.003	< 0.002	< 0.008	17.9	3.3	< 0.004	15.7	1.53	22.9	1	25.1	14.1	0.169	< 0.002	0.027
S99-05204	5882747072	12.6	0.01	< 0.1	0.069	24.1	< 0.003	< 0.002	< 0.008	10.6	3.3	< 0.004	10.4	0.998	12.9	0.6	23.7	5.5	0.0747	< 0.002	0.025
S99-05205	5887877181	65.9	0.02	< 0.1	0.051	31.5	< 0.003	< 0.002	< 0.008	5.99	2.8	0.005	15.3	1.74	13.9	0.5	23.2	8.8	0.103	< 0.002	0.029
S99-05206	5887877181	18.7	0.02	< 0.1	0.09	40.9	< 0.003	< 0.002	< 0.008	11.9	3.5	0.005	20	2.67	23.2	0.6	26	15.1	0.119	< 0.002	0.038
S99-05207	5887817200	52.4	0.02	< 0.1	0.059	36.9	< 0.003	< 0.002	< 0.008	4.88	3.4	< 0.004	11.6	1.62	8.7	0.6	23.6	4.5	0.112	< 0.002	0.019
S99-05208	5887843894	55.1	0.01	< 0.1	0.031	15.8	< 0.003	< 0.002	< 0.008	6.15	3.4	< 0.004	5.34	0.346	10.2	0.3	16.1	5.5	0.0448	< 0.002	0.05
S99-05209	5887894287	49.4	0.02	< 0.1	0.01	5.7	< 0.003	< 0.002	< 0.008	0.152	1.2	< 0.004	2.07	0.039	10.9	0.2	22.8	0.6	0.0389	0.002	0.379
S99-05210	5887809779	87.2	0.02	< 0.1	0.1	21.2	< 0.003	< 0.002	< 0.008	10.4	5.7	0.006	10.8	0.681	9.3	0.7	27.4	5.5	0.0792	< 0.002	0.054
S99-05211	5328208395	72.4	0.01	< 0.1	0.083	48.7	< 0.003	< 0.002	0.009	2.54	4.8	0.012	25.6	1.52	23	0.1	23.6	16.9	0.175	< 0.002	0.033
S99-05212	5328225095	84.1	< 0.01	0.1	0.043	12.5	0.003	< 0.002	< 0.008	9.98	3.1	< 0.004	4.09	0.878	7.5	1	20.1	< 0.2	0.0481	< 0.002	0.026
S99-05213	5328286311	4.1	< 0.01	< 0.1	0.009	8	< 0.003	0.005	< 0.008	0.06	0.8	< 0.004	2.96	0.05	10.1	0.1	23.6	< 0.2	0.0679	< 0.002	0.031
S99-05214	5328277527	< 0.5	0.04	< 0.1	0.024	27.9	< 0.003	< 0.002	< 0.008	0.37	1.2	0.009	12.8	0.778	16.8	< 0.1	30.2	10.5	0.174	< 0.002	0.025
S99-05215	5328268581	20	< 0.01	< 0.1	0.019	21.2	< 0.003	< 0.002	< 0.008	0.371	1.3	0.005	6.82	0.387	18	0.1	29.2	0.7	0.102	< 0.002	0.013
S99-05216	5328294947	0.6	0.01	0.2	0.082	40.2	0.006	< 0.002	< 0.008	21.7	9.2	< 0.004	15.9	1.2	27	0.7	18.7	15.8	0.159	< 0.002	0.025
S99-05217	5328243743	2	< 0.01	< 0.1	0.022	11.8	< 0.003	< 0.002	0.009	0.145	8.7	< 0.004	6.91	0.083	5.7	< 0.1	22.1	3.2	0.0439	< 0.002	0.052
S99-05218	5328234863	< 0.5	0.01	0.1	0.091	32	0.004	< 0.002	< 0.008	19.7	4	0.005	11.1	1.29	13.4	1	25.4	0.3	0.129	< 0.002	0.023
S99-05219	5328217101	8	0.05	< 0.1	0.026	14.6	< 0.003	< 0.002	< 0.008	0.146	2.2	< 0.004	6.56	0.209	5.1	< 0.1	17.3	2.1	0.0629	< 0.002	0.405
S99-05220	5328217101	< 0.5	0.01	< 0.1	0.042	17.3	< 0.003	< 0.002	< 0.008	0.074	40.8	< 0.004	7.24	0.131	8.8	< 0.1	18.3	6.1	0.133	< 0.002	0.136
S99-05221	5323016947	11.1	0.02	0.1	0.086	20.4	0.004	< 0.002	< 0.008	12.2	2.6	< 0.004	9.93	0.613	12.7	0.7	24.5	0.2	0.0737	< 0.002	0.13
S99-05222	5323039201	< 0.5	0.01	0.1	0.058	26.3	0.003	< 0.002	< 0.008	9.78	2.9	0.005	11.9	0.715	12.5	0.8	24.4	< 0.2	0.0921	< 0.002	0.116
S99-05223	5323033506	< 0.5	0.01	< 0.1	0.034	16	< 0.003	< 0.002	< 0.008	1.8	2.4	< 0.004	9.2	0.791	7.4	0.4	22.5	1.7	0.056	< 0.002	0.044
S99-05224	5323061079	0.9	0.01	< 0.1	0.055	20.6	< 0.003	< 0.002	< 0.008	7.41	6.2	< 0.004	8.18	0.538	8.2	0.4	18.3	6.4	0.0686	< 0.002	0.036
S99-05225	5323078944	9.4	0.02	< 0.1	0.038	22.6	< 0.003	< 0.002	< 0.008	1.54	3.4	< 0.004	12.7	0.301	10.6	< 0.1	22	17.5	0.0781	< 0.002	0.029
S99-05226	5323089906	< 0.5	0.01	< 0.1	0.03	16.3	< 0.003	< 0.002	< 0.008	2.28	2.2	< 0.004	8.97	0.364	9.4	0.5	22.1	1.3	0.0507	< 0.002	0.031
S99-05227	5323044079	45.2	< 0.01	< 0.1	0.031	15.6	< 0.003	< 0.002	< 0.008	0.69	2.8	< 0.004	10.1	0.193	7.7	0.1	17.2	5.1	0.0581	< 0.002	0.025

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05228	RIP5228	14/06/1999	25.1033	89.4611	1999	TARA	28.3	Md Amjad Hossain	Rajshahi	Gaibandha	Gobindaganj	Mahinaganj	Kumlra Danga
S99-05229	RIP5229	14/06/1999	25.1033	89.4615	1984	HTW	20.7	MD. Maizar Ali	Rajshahi	Gaibandha	Gobindaganj	Mahinaganj	Kumlra Danga
S99-05230	RIP5230	14/06/1999	25.0789	89.3626	1998	TARA	28.3	DUK	Rajshahi	Gaibandha	Gobindaganj	Kamardaha	Rasulpur
S99-05231	RIP5231	14/06/1999	25.1542	89.4155	1998	TARA	28.3	Kundarpur Mosque	Rajshahi	Gaibandha	Gobindaganj	Gobindagonj	Kundar Para
S99-05232	RIP5232	14/06/1999	25.1853	89.4502	1998	TARA	28.3	Baradaha Govt. primary school	Rajshahi	Gaibandha	Gobindaganj	Harirampur	Baradaha
S99-05233	RIP5233	14/06/1999	25.1903	89.3867	1995	HTW	10.7	Md Meud Ali	Rajshahi	Gaibandha	Gobindaganj	Taluk Kanupur	Somas Para
S99-05234	RIP5234	15/06/1999	25.1624	89.5226	1988	HTW	21	DPHE office	Rajshahi	Gaibandha	Saghatta	Bonarpara	Simultari
S99-05235	RIP5235	15/06/1999	25.1294	89.5231	1998	HTW	18	Mrs Pushpu Rani	Rajshahi	Gaibandha	Saghatta	Kachua	Burungi
S99-05236	RIP5236	15/06/1999	25.1092	89.5422	1998	HTW	20.1	Mr Mimol Babu	Rajshahi	Gaibandha	Saghatta	Ghuridaha	Baulia
S99-05237	RIP5237	15/06/1999	25.0901	89.5002	1977	HTW	29	Md Azharul Islam	Rajshahi	Gaibandha	Saghatta	Kamalerpara	Chakuli
S99-05238	RIP5238	15/06/1999	25.0766	89.5502	1998	HTW	17.1	Md Samsul Haque	Rajshahi	Gaibandha	Saghatta	Jummerbari	Badinarpara
S99-05239	RIP5239	15/06/1999	25.1296	89.5885	1988	HTW	13.4	Md Joynuddin	Rajshahi	Gaibandha	Saghatta	Sughatta	Sathalia
S99-05240	RIP5240	15/06/1999	25.1863	89.5767	1988	HTW	21	Nuruzzaman (Mosque)	Rajshahi	Gaibandha	Saghatta	Dharatkhali	Ulla
S99-05241	RIP5241	17/06/1999	25.7639	89.2005	1998	HTW	18	Md Asraf Hossain	Rajshahi	Rangpur	Rangpur Sadar	Rajendrapur	Binna Tarl
S99-05242	RIP5242	17/06/1999	25.796	89.1882	1978	HTW	27.1	Md Mofizur Rahman	Rajshahi	Rangpur	Rangpur Sadar	Uttam	Uttam
S99-05243	RIP5243	17/06/1999	25.8011	89.1434	1998	HTW	18	Md Zahidul Islam	Rajshahi	Rangpur	Rangpur Sadar	Haridebpur	Mahadevpur
S99-05244	RIP5244	17/06/1999	25.7335	89.1037	1998	HTW	35.7	Md Nosir Uddin	Rajshahi	Rangpur	Rangpur Sadar	Mominpur	Dakshin Mominpur
S99-05245	RIP5245	17/06/1999	25.7374	89.1405	1998	HTW	29.9	Asgor Ali	Rajshahi	Rangpur	Rangpur Sadar	Chndanpat	Sabajpur
S99-05246	RIP5246	17/06/1999	25.6806	89.1812	1998	HTW	18	Md Kaybor Ali	Rajshahi	Rangpur	Rangpur Sadar	Sadya Pushkarni	Keshabpur
S99-05247	RIP5247	17/06/1999	25.7191	89.2359	1998	HTW	18	Md Moned	Rajshahi	Rangpur	Rangpur Sadar	Darshana	Binodpur
S99-05248	RIP5248	17/06/1999	25.7093	89.2695	1998	HTW	13.4	Md Khalelur Rahman	Rajshahi	Rangpur	Rangpur Sadar	Tamphat	Kherda Tamphat
S99-05249	RIP5249	17/06/1999	25.7657	89.2794	1998	HTW	18	Sharat Chandra Debnath	Rajshahi	Rangpur	Rangpur Sadar	Tapodhan	Mahabatkhan
S99-05250	RIP5250	17/06/1999	25.7727	89.2418	1998	HTW	22.6	Tilok Chandra Borman	Rajshahi	Rangpur	Rangpur Sadar	Pourashava ward 01	Kellaband
S99-05251	RIP5251	17/06/1999	25.7471	89.2332	1985	HTW	7.9	Md Mozibur Rahman	Rajshahi	Rangpur	Rangpur Sadar	Pourashava Ward 01	Satgora
S99-05252	RIP5252	17/06/1999	25.7486	89.2311	1991	DTW	72.2	Keranipara pump No. 11	Rajshahi	Rangpur	Rangpur Sadar	Pourashava ward 01	Satgora
S99-05253	RIP5253	19/06/1999	25.5106	89.378	1993	TARA	30.5	Md Mozammel Montu	Rajshahi	Rangpur	Mithapukur	Emadpur	Emadpur
S99-05254	RIP5254	19/06/1999	25.5108	89.3783	1995	HTW	19.8	Md Mozammel Haque Minto	Rajshahi	Rangpur	Mithapukur	Emadpur	Emadpur
S99-05255	RIP5255	19/06/1999	25.53	89.3203		TARA	30.5	Nancorg Primary school	Rajshahi	Rangpur	Mithapukur	Bara Hazratpur	Tajurpara
S99-05256	RIP5256	19/06/1999	25.5365	89.2759	1998	TARA	28.7	14No Durgapur Union	Rajshahi	Rangpur	Mithapukur	Durgapur	Sathibari Haripur
S99-05257	RIP5257	19/06/1999	25.5299	89.2035	1992	TARA	28.7	Chawpati Bazar	Rajshahi	Rangpur	Mithapukur	Gopalpur	Salti Gopalpur
S99-05258	RIP5258	19/06/1999	25.5242	89.1625	1991	HTW	22.6	Md Nabim Uddin Shah	Rajshahi	Rangpur	Mithapukur	Balua Masimpur	Hamidpur
S99-05259	RIP5259	19/06/1999	25.4928	89.1491	1993	HTW	12.2	Md Shaheb Ali	Rajshahi	Rangpur	Mithapukur	Nilanpur	Makimpur
S99-05260	RIP5260	19/06/1999	25.5561	89.1927	1997	TARA	33.2	Md Abdul Matin	Rajshahi	Rangpur	Mithapukur	Chengmari	Abliripara
S99-05261	RIP5261	19/06/1999	25.5812	89.1888	1997	TARA	28.7	Abdul Aoual	Rajshahi	Rangpur	Mithapukur	Mayenpur	Generpur
S99-05262	RIP5262	19/06/1999	25.6347	89.2016	1997	TARA	28.7	Md. A. Rashid	Rajshahi	Rangpur	Mithapukur	Khoragachh	Rupal
S99-05263	RIP5263	19/06/1999	25.5943	89.2436	1993	HTW	22.6	Doluram	Rajshahi	Rangpur	Mithapukur	Latifpur	Batasan Latifpur
S99-05264	RIP5264	19/06/1999	25.5803	89.3186	1998	TARA	28.7	A. Mannan	Rajshahi	Rangpur	Mithapukur	Kaprikhal	Kismopalal
S99-05265	RIP5265	19/06/1999	25.59	89.3547	1998	TARA	28.7	Aminul Islam	Rajshahi	Rangpur	Mithapukur	Balarhat	Buruj Jahalia
S99-05266	RIP5266	19/06/1999	25.5905	89.354	1999	HTW	51.8	Aminul Islam	Rajshahi	Rangpur	Mithapukur	Balarhat	Buruj Jahalia
S99-05267	RIP5267	19/06/1999	25.6245	89.3564	1998	HTW	22.6	Bhangri U P office	Rajshahi	Rangpur	Mithapukur	Bhangni	Raypur
S99-05268	RIP5268	19/06/1999	25.6612	89.2788	1991	HTW	23.8	Pairabond Jame Mosque	Rajshahi	Rangpur	Mithapukur	Pairaband	Takia Koshabpur
S99-05269	RIP5269	20/06/1999	25.6903	89.0311	1991	TARA	34.1	Md Ansar Ali	Rajshahi	Rangpur	Badarganj	Damodarpur	Amrulbari
S99-05270	RIP5270	20/06/1999	25.7036	89.0002	1996	TARA	27.7	Md Emdadul Hoque	Rajshahi	Rangpur	Badarganj	Radhanagar	Mansinhapur
S99-05272	RIP5272	20/06/1999	25.6806	88.9909	1994	HTW	22.3	A Matin	Rajshahi	Rangpur	Badarganj	Ramnathpur	Uttar Ramnathpur
S99-05273	RIP5273	20/06/1999	25.6663	89.0431	1995	HTW	18.9	DPHE office	Rajshahi	Rangpur	Badarganj	Badarganj	Badarganj
S99-05274	RIP5274	20/06/1999	25.6105	89.0169	1980	HTW	23.5	Md Mosurul Islam	Rajshahi	Rangpur	Badarganj	Bishnupur	Dakshin Bishnupur
S99-05275	RIP5275	20/06/1999	25.6269	89.0966	1979	HTW	23.5	A Razzak	Rajshahi	Rangpur	Badarganj	Lohanipara	Kenchabari
S99-05276	RIP5276	20/06/1999	25.7313	89.0832	1992	HTW	25.6	A Razzaqe	Rajshahi	Rangpur	Badarganj	Madhupur	Santoshpur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05228	5323050589	1	< 0.01	0.1	0.085	15.4	0.003	< 0.002	< 0.008	16.5	2.8	< 0.004	6.99	0.748	12.2	0.8	22.6	< 0.2	0.0521	< 0.002	0.033
S99-05229	5323050589	< 0.5	0.02	< 0.1	0.092	53	< 0.003	< 0.002	0.01	0.074	7.8	0.009	26.1	2.82	20.7	0.1	17.2	35.3	0.164	< 0.002	0.063
S99-05230	5323027826	27.5	0.01	0.2	0.147	39.4	0.004	< 0.002	< 0.008	20.3	3.9	0.009	23.5	1.28	40.5	0.3	26.3	34.1	0.144	< 0.002	0.038
S99-05231	5323011593	54.4	0.02	< 0.1	0.057	36.7	0.004	< 0.002	0.009	0.375	3.5	0.01	20.3	1.74	17	0.2	23.5	10	0.131	< 0.002	0.035
S99-05232	5323022100	24.5	0.03	< 0.1	0.034	13.6	< 0.003	< 0.002	0.034	5.06	3.2	< 0.004	5.61	0.443	9.9	0.1	18.9	6.5	0.0542	< 0.002	0.081
S99-05233	5323094894	4	< 0.01	< 0.1	0.013	8.3	< 0.003	< 0.002	< 0.008	0.11	1.5	< 0.004	2.51	0.949	7.4	< 0.1	23.4	0.7	0.0414	< 0.002	0.018
S99-05234	5328819935	< 0.5	< 0.01	< 0.1	0.028	17.8	< 0.003	< 0.002	< 0.008	0.126	6.2	< 0.004	5.76	0.138	12.5	< 0.1	15.2	16.6	0.0653	< 0.002	0.053
S99-05235	5328857221	5.4	< 0.01	< 0.1	0.013	20.8	< 0.003	< 0.002	< 0.008	0.061	1.5	< 0.004	7.41	1.22	13.5	0.1	23	0.3	0.104	< 0.002	0.036
S99-05236	5328828127	5.6	< 0.01	< 0.1	0.013	8.6	< 0.003	< 0.002	< 0.008	1.46	2.5	< 0.004	3.09	0.148	8	0.1	21.1	6.8	0.0406	< 0.002	0.037
S99-05237	5328866238	15.5	< 0.01	< 0.1	0.037	7.5	< 0.003	< 0.002	< 0.008	7.49	3	< 0.004	3.56	0.329	6	0.4	14.3	2	0.0267	< 0.002	0.022
S99-05238	5328847042	< 0.5	< 0.01	< 0.1	0.041	25	< 0.003	< 0.002	< 0.008	0.082	5.1	< 0.004	10.7	1	9.2	< 0.1	10.4	13.7	0.0904	< 0.002	0.034
S99-05239	5328885892	4.3	0.02	< 0.1	0.014	7.8	< 0.003	< 0.002	< 0.008	0.178	3.5	0.005	2	0.038	7.4	< 0.1	9.83	1.3	0.0384	< 0.002	0.031
S99-05240	5328809986	13.3	0.01	< 0.1	0.044	13.4	< 0.003	< 0.002	< 0.008	6.81	4.4	< 0.004	4.61	0.835	8.3	0.2	18.7	10.6	0.0746	< 0.002	0.05
S99-05241	5854947186	3.7	< 0.01	< 0.1	0.025	12.4	0.004	< 0.002	< 0.008	6.5	3.9	< 0.004	3.83	0.874	9.6	0.4	23.4	3.2	0.0816	< 0.002	0.033
S99-05242	5854994988	1.4	0.02	< 0.1	0.055	31.6	< 0.003	< 0.002	< 0.008	0.138	20.3	< 0.004	11	0.33	53.3	0.1	16.4	27.8	0.115	< 0.002	0.035
S99-05243	5854923634	0.7	0.01	< 0.1	0.028	17.7	< 0.003	< 0.002	< 0.008	0.125	6.1	< 0.004	5.69	0.135	12.3	< 0.1	15	16.4	0.0639	< 0.002	0.052
S99-05244	5854931288	0.9	0.01	< 0.1	0.019	26.3	< 0.003	< 0.002	< 0.008	0.055	2.6	< 0.004	6.35	2.13	9.8	< 0.1	18.1	< 0.2	0.0895	< 0.002	0.042
S99-05245	5854907874	1.9	< 0.01	< 0.1	0.018	8.7	< 0.003	< 0.002	< 0.008	2.78	3.8	< 0.004	2.33	0.178	3.6	0.1	14.6	13.1	0.0308	< 0.002	0.048
S99-05246	5854963586	3.7	0.02	< 0.1	0.026	7.3	< 0.003	< 0.002	< 0.008	4.79	5.7	< 0.004	3.57	0.239	5.1	0.4	18.7	5.9	0.0248	< 0.002	0.038
S99-05247	5854915193	0.6	0.02	< 0.1	0.028	22.2	< 0.003	< 0.002	< 0.008	0.162	6.4	< 0.004	6.23	0.217	7.8	< 0.1	13	6.9	0.0978	< 0.002	0.044
S99-05248	5854979574	< 0.5	0.02	< 0.1	0.014	7.5	< 0.003	< 0.002	< 0.008	0.169	3.3	< 0.004	1.83	0.036	5.9	< 0.1	9.39	1.2	0.0362	< 0.002	0.03
S99-05249	5854987627	3.1	0.01	< 0.1	0.042	13	< 0.003	< 0.002	< 0.008	6.57	4.3	< 0.004	4.49	0.806	8	0.2	17.8	10.2	0.0718	< 0.002	0.048
S99-05250	5854901482	21.6	< 0.01	< 0.1	0.024	12.1	< 0.003	< 0.002	< 0.008	6.32	3.8	< 0.004	3.73	0.851	9.4	0.4	22.5	2.9	0.0783	< 0.002	0.032
S99-05251	5854901545	< 0.5	0.02	< 0.1	0.054	30.7	< 0.003	< 0.002	< 0.008	0.132	19	< 0.004	10.9	0.321	51.8	0.2	15.9	26.7	0.11	< 0.002	0.034
S99-05252	5854901545	< 0.5	0.03	< 0.1	0.018	20.7	< 0.003	< 0.002	< 0.008	0.149	1.6	< 0.004	9.73	0.631	14.3	< 0.1	26.4	10.8	0.138	< 0.002	0.032
S99-05253	5855844363	22.3	0.01	< 0.1	0.059	23.3	< 0.003	< 0.002	< 0.008	8.56	2.5	< 0.004	7.52	1.61	10.1	0.7	25.5	< 0.2	0.0946	< 0.002	0.025
S99-05254	5855844363	14.1	0.14	< 0.1	0.176	24.3	< 0.003	< 0.002	< 0.008	11.9	4.6	< 0.004	6.76	0.999	9.2	1	25.1	1.3	0.0874	< 0.002	0.028
S99-05255	5855816940	< 0.5	0.02	< 0.1	0.015	7.6	< 0.003	< 0.002	< 0.008	0.087	1	< 0.004	3.99	0.064	17.9	0.1	24.4	2.2	0.0557	0.002	0.016
S99-05256	5855839885	< 0.5	0.01	< 0.1	0.042	24.2	< 0.003	< 0.002	< 0.008	0.087	2.2	0.006	20	1.55	22.3	< 0.1	19.4	3.9	0.191	< 0.002	0.033
S99-05257	5855850856	< 0.5	< 0.01	< 0.1	0.008	9.8	< 0.003	< 0.002	< 0.008	0.032	0.9	0.005	4.15	0.057	18.7	0.1	24	0.8	0.0783	< 0.002	0.013
S99-05258	5855805115	< 0.5	0.01	< 0.1	0.011	8.3	< 0.003	< 0.002	< 0.008	0.12	< 0.5	< 0.004	3.74	0.041	16.6	0.1	23.2	< 0.2	0.0643	< 0.002	0.01
S99-05259	5855872615	< 0.5	< 0.01	< 0.1	0.016	11	< 0.003	< 0.002	< 0.008	0.049	2.7	< 0.004	3.8	0.092	13.5	< 0.1	18.3	3.3	0.0454	< 0.002	0.01
S99-05260	5855833012	< 0.5	< 0.01	< 0.1	0.004	3.7	< 0.003	< 0.002	< 0.008	0.034	0.8	0.005	1.81	0.052	7.8	0.1	28.3	< 0.2	0.0247	< 0.002	0.02
S99-05261	5855883209	< 0.5	< 0.01	< 0.1	0.005	6.1	< 0.003	< 0.002	< 0.008	0.028	0.9	0.004	2.55	0.043	11.7	0.2	25.6	< 0.2	0.0456	< 0.002	0.015
S99-05262	5855861824	< 0.5	< 0.01	< 0.1	0.015	18.1	< 0.003	< 0.002	< 0.008	0.137	1.1	< 0.004	9.54	1.18	9.2	0.2	26.1	1.1	0.137	< 0.002	0.032
S99-05263	5855867183	7.5	0.01	< 0.1	0.087	23.9	< 0.003	< 0.002	< 0.008	5.47	12.8	< 0.004	8.08	0.678	12.9	0.6	20.3	6.4	0.0908	< 0.002	0.019
S99-05264	5855855560	10.8	< 0.01	0.1	0.05	11.8	< 0.003	< 0.002	< 0.008	15.9	2.9	< 0.004	3.28	0.444	14.2	0.8	24.1	< 0.2	0.0638	< 0.002	0.033
S99-05265	5855822157	46.3	< 0.01	0.1	0.078	19.4	< 0.003	< 0.002	< 0.008	20.7	3.1	< 0.004	3.69	1.17	10.6	0.8	27.4	< 0.2	0.0822	< 0.002	0.095
S99-05266	5855822157	16.3	< 0.01	< 0.1	0.045	14.3	< 0.003	< 0.002	< 0.008	13.8	2.4	< 0.004	4.05	0.452	11.9	0.5	29.6	< 0.2	0.0697	< 0.002	0.042
S99-05267	5855827721	2.1	0.02	0.2	0.074	16.8	< 0.003	< 0.002	< 0.008	18.2	4.4	< 0.004	5.57	0.451	8.1	0.7	19.2	0.3	0.0527	< 0.002	0.051
S99-05268	5855889943	17	0.01	0.2	0.05	12.7	< 0.003	< 0.002	< 0.008	21.8	3.3	< 0.004	4.3	0.622	7.2	0.5	19.8	0.3	0.0455	< 0.002	0.026
S99-05269	5850325019	< 0.5	0.01	< 0.1	0.014	13.6	< 0.003	< 0.002	< 0.008	0.056	1	< 0.004	4.92	0.555	15.3	0.1	33.9	0.2	0.0752	0.003	0.017
S99-05270	5850382707	0.8	< 0.01	< 0.1	0.029	9.1	< 0.003	< 0.002	< 0.008	1.27	1.4	< 0.004	2.95	0.169	17.2	0.1	33.5	0.3	0.0588	< 0.002	0.019
S99-05272	5850388995	< 0.5	< 0.01	< 0.1	0.01	6.9	< 0.003	< 0.002	< 0.008	0.104	0.8	< 0.004	3.55	0.227	20.2	< 0.1	23.7	1.6	0.05	< 0.002	0.011
S99-05273	5850312057	< 0.5	0.01	< 0.1	0.014	5.7	< 0.003	< 0.002	< 0.008	0.241	1.6	0.006	2.13	0.036	6.2	< 0.1	12.1	0.5	0.0508	< 0.002	0.014
S99-05274	5850318210	< 0.5	< 0.01	< 0.1	0.011	6	< 0.003	< 0.002	< 0.008	0.445	1.2	< 0.004	2.52	0.053	10.9	0.2	30.1	0.4	0.0393	< 0.002	0.007
S99-05275	5850369468	< 0.5	0.02	< 0.1	0.013	8.8	< 0.003	0.002	< 0.008	0.152	0.9	< 0.004	3.42	1.28	13.1	< 0.1	16.3	1.1	0.0415	< 0.002	0.011
S99-05276	5850375899	< 0.5	< 0.01	< 0.1	0.035	6.6	< 0.003	< 0.002	< 0.008	0.059	0.7	< 0.004	4.13	0.072	19.2	< 0.1	18.9	2.8	0.0411	< 0.002	0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05277	RIP5277	20/06/1999	25.6981	89.1449	1992	HTW	14	Gopalpur U P	Rajshahi	Rangpur	Badarganj	Gopalpur	Kismat Basantapur
S99-05278	RIP5278	20/06/1999	25.725	89.2792	1997	HTW	67.4	A Waresh Talukder	Rajshahi	Rangpur	Rangpur Sadar	Pourashava ward 05	Alam Nagar
S99-05279	RIP5279	21/06/1999	25.8145	89.1079	1992	HTW	26.8	Md Ramjan Ali	Rajshahi	Rangpur	Taraganj	Ekarchali	Hazipur
S99-05280	RIP5280	21/06/1999	25.7787	89.0815	1996	HTW	23.8	Hariarkuti U P Office	Rajshahi	Rangpur	Taraganj	Hariarkuti	Kismat Menanagar
S99-05281	RIP5281	21/06/1999	25.7971	88.9569	1992	HTW	18.3	Fazilpur bazar (Kolir Uddin)	Rajshahi	Rangpur	Taraganj	Alampur	Fazilpur
S99-05282	RIP5282	21/06/1999	25.8108	89.0056	1984	HTW	17.7	Chawpathi Jame Mosque	Rajshahi	Rangpur	Taraganj	Kursha	Kursha
S99-05283	RIP5283	21/06/1999	25.8101	89.0227	1992	HTW	24.1	DPHE office	Rajshahi	Rangpur	Taraganj	Kursha	Kursha
S99-05284	RIP5284	21/06/1999	25.777	89.0129	1976	HTW	30.5	Md Jahangir Alam	Rajshahi	Rangpur	Taraganj	Sayar	Faridabad
S99-05285	RIP5285	22/06/1999	25.7768	88.5653	1998	HTW	19.5	Paresh Chandra	Rajshahi	Dinajpur	Kaharole	Taragaon	Hatiari
S99-05286	RIP5286	22/06/1999	25.8108	88.532	1998	TARA	26.8	Prem charon	Rajshahi	Dinajpur	Kaharole	Rasulpur	Malihata
S99-05287	RIP5287	22/06/1999	25.8551	88.539	1977	HTW	18.9	Tularam	Rajshahi	Dinajpur	Kaharole	Dabar	Teghra
S99-05288	RIP5288	22/06/1999	25.7792	88.6739	1992	HTW	22.6	Drenro Basaw	Rajshahi	Dinajpur	Kaharole	Sundarpur	Gar Mallikpur
S99-05289	RIP5289	22/06/1999	25.7724	88.6399	1972	HTW	36.6	Tarini Kumer Singh	Rajshahi	Dinajpur	Kaharole	Ramchandrapur	Parhmoshpur
S99-05290	RIP5290	22/06/1999	25.8055	88.6061	1991	HTW	19.5	Poresh Chandra	Rajshahi	Dinajpur	Kaharole	Mukundapur	Chak Maharan
S99-05291	RIP5291	23/06/1999	25.6915	88.6749	1995	TARA	32.9	Md Jamir Uddin	Rajshahi	Dinajpur	Dinajpur Sadar	Fazilpur	Maharajpur
S99-05292	RIP5292	23/06/1999	25.7417	88.7022	1998	TARA	32.9	Monmoth Rath Nay	Rajshahi	Dinajpur	Dinajpur Sadar	Sundarban	Kalikapur
S99-05293	RIP5293	23/06/1999	25.6386	88.6713	1992	TARA	32.6	Md Abed Ali	Rajshahi	Dinajpur	Dinajpur Sadar	Shekpura	Uttar Gopalpur
S99-05294	RIP5294	23/06/1999	25.5412	88.7124	1997	TARA	29.9	Shusul Chandra pal	Rajshahi	Dinajpur	Dinajpur Sadar	Shankarpur	Shankarpur
S99-05295	RIP5295	23/06/1999	25.5473	88.6751	1995	TARA	37.2	Md Mohasin Raja	Rajshahi	Dinajpur	Dinajpur Sadar	Uthrail	Muligaon
S99-05296	RIP5296	23/06/1999	25.571	88.623	1993	HTW	14	Charadangi High School	Rajshahi	Dinajpur	Dinajpur Sadar	Auliapur	Dakshin Faridpur
S99-05297	RIP5297	23/06/1999	25.5312	88.6187	1998	TARA	32.3	Kaim Uddin	Rajshahi	Dinajpur	Dinajpur Sadar	Askarpur	Jamalpur
S99-05298	RIP5298	23/06/1999	25.6307	88.6305	1988	HTW	39.6	V S Sheet Pourashava	Rajshahi	Dinajpur	Dinajpur Sadar	Pourashava ward 05	Chashipara
S99-05299	RIP5299	23/06/1999	25.6529	88.6428	1985	HTW	28	Upazila Jame Mosque	Rajshahi	Dinajpur	Dinajpur Sadar	Chehelgazi	Nayanpur
S99-05300	RIP5300	24/06/1999	25.9455	88.7222	1982	HTW	18.9	Md Yousuf Ali	Rajshahi	Dinajpur	Khansama	Alokjhari	Basuli
S99-05301	RIP5301	24/06/1999	25.9083	88.7267	1997	HTW	15.2	Md Jamal Bhokto	Rajshahi	Dinajpur	Khansama	Bherbheri	Shahajpur
S99-05302	RIP5302	24/06/1999	25.8576	88.7438	1984	HTW	18.9	Uadashi Ram	Rajshahi	Dinajpur	Khansama	Khamarpara	Duhashuha
S99-05303	RIP5303	24/06/1999	25.8448	88.7774	1995	HTW	21.3	Md Anowar Haque	Rajshahi	Dinajpur	Khansama	Angarpara	Pakerhat
S99-05304	RIP5304	24/06/1999	25.8232	88.7817	1989	HTW	18.3	Md Jamal Uddin	Rajshahi	Dinajpur	Khansama	Goaldihi	Goaldihi
S99-05305	RIP5305	24/06/1999	25.8008	88.7467	1998	HTW	18.3	Mr Altaf Hossain	Rajshahi	Dinajpur	Khansama	Bhubki	Agra
S99-05306	RIP5306	26/06/1999	25.6536	88.7864	1997	HTW	22.6	Abdulpur U P office	Rajshahi	Dinajpur	Chirirbandar	Abdulpur	Abdulpur
S99-05307	RIP5307	26/06/1999	25.6808	88.7689	1994	HTW	20.4	A Nurul Islam	Rajshahi	Dinajpur	Chirirbandar	Saintara	Jagannathpur
S99-05308	RIP5308	26/06/1999	25.7654	88.8125	1994	TARA	33.5	FateJangpur U P Office	Rajshahi	Dinajpur	Chirirbandar	Fatejangpur	Bara Hashinpur
S99-05309	RIP5309	26/06/1999	25.7712	88.7816	1994	HTW	32	A Zabbar	Rajshahi	Dinajpur	Chirirbandar	Nasratpur	Ranipur
S99-05310	RIP5310	26/06/1999	25.7063	88.8078	1997	HTW	18.9	Isabpur U P office	Rajshahi	Dinajpur	Chirirbandar	Isabpur	Binnakuri
S99-05311	RIP5311	26/06/1999	25.6289	88.7704	1994	HTW	19.2	Md Musa Meali	Rajshahi	Dinajpur	Chirirbandar	Amarpur	Amarpur
S99-05312	RIP5312	26/06/1999	25.6388	88.7175	1995	TARA	29.9	Basintapur Mosque	Rajshahi	Dinajpur	Chirirbandar	Auliapukur	Busantapur
S99-05313	RIP5313	26/06/1999	25.5469	88.7643	1997	TARA	25.9	Bangabari Jame Mosque	Rajshahi	Dinajpur	Chirirbandar	Bhiail	Rangabari
S99-05314	RIP5314	26/06/1999	25.5237	88.7601	1995	HTW	32	Mrs Lutfa Begum	Rajshahi	Dinajpur	Chirirbandar	Punatti	Saraswatipur
S99-05315	RIP5315	27/06/1999	25.394	89.0119	1998	TARA	28.3	Md Azmol Hossian	Rajshahi	Dinajpur	Birampur	Deor	Kanazgari
S99-05316	RIP5316	27/06/1999	25.4319	88.9685	1993	TARA	30.5	Md Mokbul Hossian	Rajshahi	Dinajpur	Birampur	Paliprayagpur	Chandipur
S99-05317	RIP5317	27/06/1999	25.4285	88.9801	1985	HTW	21.9	Md Lutfur Rahman	Rajshahi	Dinajpur	Birampur	Khanpur	Naupukur
S99-05318	RIP5318	27/06/1999	25.3261	88.9613	1988	HTW	22.6	Md Ketab Uddin	Rajshahi	Dinajpur	Birampur	Katla	Katla
S99-05319	RIP5319	27/06/1999	25.377	88.9682	1996	HTW	13.7	Md Fazor Uddin	Rajshahi	Dinajpur	Birampur	Birampur	Harekrishnapur
S99-05320	RIP5320	27/06/1999	25.3791	88.9949	1998	TARA	28.3	Md Mamuner Rashid	Rajshahi	Dinajpur	Birampur	Deor	Dosra Palashbari
S99-05321	RIP5321	28/06/1999	25.4091	89.0553	1996	TARA	26.8	Mrs Nurunnahar	Rajshahi	Dinajpur	Nawabganj (Di)	Golapganj	Sagunkhola
S99-05322	RIP5322	28/06/1999	25.428	89.0934	1993	TARA	25.3	Md Anwar Hossain	Rajshahi	Dinajpur	Nawabganj (Di)	Binodnagar	Kapaldanra
S99-05323	RIP5323	28/06/1999	25.3951	89.1088	1997	HTW	18.9	Mr Reazuddin	Rajshahi	Dinajpur	Nawabganj (Di)	Daudpur	Daudpur
S99-05324	RIP5324	28/06/1999	25.3589	89.1247	1986	TARA	25.3	Md Anser Ali	Rajshahi	Dinajpur	Nawabganj (Di)	Bhaduria	Nayani Jasira

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05277	5850331554	34.9	0.01	< 0.1	0.027	12.2	0.003	< 0.002	< 0.008	2.74	8	0.007	2.62	0.687	9.9	1.1	13.6	6.8	0.044	< 0.002	0.015
S99-05278	5854905045	< 0.5	0.03	< 0.1	0.014	18.4	< 0.003	< 0.002	< 0.008	0.128	1.1	< 0.004	9.57	2.11	16	0.1	21.5	1.3	0.109	< 0.002	0.012
S99-05279	5859247422	14.5	0.16	< 0.1	0.03	47	< 0.003	0.004	< 0.008	8.36	3	< 0.004	2.55	0.379	7.8	1.3	21	1.4	0.0954	< 0.002	0.146
S99-05280	5859263621	< 0.5	0.03	< 0.1	0.01	18.3	< 0.003	< 0.002	< 0.008	0.167	0.7	< 0.004	5.04	1.86	10.3	< 0.1	28.3	0.4	0.0883	< 0.002	0.029
S99-05281	5859215373	< 0.5	0.11	< 0.1	0.101	45.3	0.003	0.003	< 0.008	0.354	16.7	< 0.004	9.3	0.278	33.3	0.2	12.9	22.5	0.131	< 0.002	0.096
S99-05282	5859231671	< 0.5																			
S99-05283	5859231671	< 0.5	0.01	< 0.1	0.026	19.7	< 0.003	< 0.002	< 0.008	1.63	1.2	< 0.004	4.33	2.32	8.7	< 0.1	17	< 0.2	0.0867	< 0.002	0.023
S99-05284	5859279348	< 0.5	0.02	< 0.1	0.018	11.1	< 0.003	< 0.002	< 0.008	0.174	1.2	< 0.004	4.2	1.26	8.5	< 0.1	19.5	1.1	0.0646	< 0.002	0.015
S99-05285	5275694357	< 0.5	< 0.01	< 0.1	0.062	18.4	< 0.003	< 0.002	< 0.008	0.145	37.8	< 0.004	7.31	0.257	27.6	< 0.1	15.9	21.6	0.11	< 0.002	0.008
S99-05286	5275665578	3.1	< 0.01	< 0.1	0.018	12	< 0.003	< 0.002	< 0.008	1.87	1.5	< 0.004	3.45	0.429	10.7	0.1	26.1	< 0.2	0.0591	< 0.002	0.012
S99-05287	5275615955	5.4	< 0.01	< 0.1	0.025	17	< 0.003	< 0.002	< 0.008	4.21	1.6	< 0.004	3.91	0.605	15.2	0.3	27.3	< 0.2	0.0875	< 0.002	0.011
S99-05288	5275679305	11	0.13	< 0.1	0.025	14.2	< 0.003	0.002	0.018	0.367	2.7	< 0.004	3.93	0.822	14	0.5	31.8	0.3	0.0688	< 0.002	0.023
S99-05289	5275647695	2	< 0.01	< 0.1	0.025	13.8	< 0.003	< 0.002	< 0.008	1.21	1.6	< 0.004	4.9	0.305	18.2	0.1	31.3	< 0.2	0.0751	< 0.002	0.006
S99-05290	5275631169	< 0.5	0.02	< 0.1	0.016	13	< 0.003	< 0.002	< 0.008	0.229	1.1	< 0.004	5.94	1.15	8.5	< 0.1	28.1	3.7	0.0825	< 0.002	0.009
S99-05291	5276434497	3.1	< 0.01	< 0.1	0.055	25.7	< 0.003	< 0.002	< 0.008	2.06	2.2	< 0.004	7.22	0.337	16.8	0.2	31.5	4.2	0.147	< 0.002	0.015
S99-05292	5276486377	3.3	0.01	< 0.1	0.023	25.3	< 0.003	0.002	< 0.008	1.25	1.3	< 0.004	5.08	0.885	25.8	0.5	29.8	0.4	0.142	< 0.002	0.031
S99-05293	5276477967	5.6	0.02	< 0.1	0.06	27.3	< 0.003	< 0.002	< 0.008	0.246	1.9	0.005	8.11	0.431	27.6	0.2	28.4	5.8	0.153	< 0.002	0.01
S99-05294	5276460842	< 0.5	< 0.01	< 0.1	0.069	51.7	< 0.003	< 0.002	< 0.008	0.02	1.6	< 0.004	13.6	0.514	27.6	< 0.1	21.7	2.2	0.272	< 0.002	0.01
S99-05295	5276494529	1.8	< 0.01	< 0.1	0.07	23.7	< 0.003	< 0.002	< 0.008	0.224	1.5	< 0.004	5.84	0.331	21.5	0.1	29.4	1.5	0.129	< 0.002	0.011
S99-05296	5276417179	< 0.5	< 0.01	< 0.1	0.041	26.4	< 0.003	< 0.002	< 0.008	0.083	1	0.004	7.97	0.415	26	< 0.1	27.6	< 0.2	0.155	< 0.002	0.008
S99-05297	5276408340	2.1	< 0.01	< 0.1	0.039	37.5	< 0.003	< 0.002	< 0.008	0.274	1.3	< 0.004	9.94	0.265	28.7	0.1	24.7	0.2	0.202	< 0.002	0.015
S99-05298	5276405241	< 0.5	< 0.01	< 0.1	0.085	61.3	< 0.003	< 0.002	< 0.008	0.043	23.4	< 0.004	11.2	2.29	49.2	< 0.1	17	25.3	0.129	< 0.002	0.011
S99-05299	5276425626	< 0.5	< 0.01	< 0.1	0.037	10.5	< 0.003	< 0.002	< 0.008	0.066	2.8	< 0.004	4.84	0.054	8.1	< 0.1	26.7	1.4	0.0492	< 0.002	0.005
S99-05300	5276015139	3.5	< 0.01	< 0.1	0.042	17.6	< 0.003	< 0.002	< 0.008	9.68	2	0.005	5.1	0.571	18.4	0.2	29.9	2	0.138	< 0.002	0.012
S99-05301	5276063872	0.6	< 0.01	< 0.1	0.015	5.1	< 0.003	< 0.002	< 0.008	0.431	3.1	< 0.004	1.42	0.124	3.3	< 0.1	9.79	2	0.0259	< 0.002	0.007
S99-05302	5276094453	2.7	< 0.01	< 0.1	0.017	10.2	< 0.003	< 0.002	< 0.008	0.269	1.9	0.004	4.11	0.146	10.6	0.3	24	0.9	0.0483	< 0.002	0.006
S99-05303	5276031820	1	0.01	< 0.1	0.028	8.3	< 0.003	< 0.002	< 0.008	8.22	3.5	< 0.004	1.5	0.417	7	< 0.1	12.1	4.1	0.0331	< 0.002	0.022
S99-05304	5276079506	3.1	< 0.01	< 0.1	0.017	16.7	< 0.003	< 0.002	< 0.008	0.365	1.3	< 0.004	4.65	0.583	7.4	0.2	25.4	3.7	0.0975	< 0.002	0.039
S99-05305	5276047017	< 0.5	< 0.01	< 0.1	0.072	42.6	< 0.003	< 0.002	< 0.008	0.194	13.9	< 0.004	12	0.099	35.8	< 0.1	13.6	12.2	0.204	< 0.002	0.016
S99-05306	5273007006	2.5	< 0.01	< 0.1	0.035	28.8	< 0.003	< 0.002	< 0.008	2.6	1.4	< 0.004	6.67	0.494	19.1	0.1	30.8	6.1	0.15	< 0.002	0.029
S99-05307	5273079480	< 0.5	< 0.01	< 0.1	0.032	23.4	< 0.003	< 0.002	< 0.008	0.224	0.8	< 0.004	7.44	0.648	19.6	< 0.1	30.1	7.7	0.114	< 0.002	0.008
S99-05308	5273047082	1.5	< 0.01	< 0.1	0.022	13.8	< 0.003	< 0.002	< 0.008	0.604	1.2	< 0.004	4.45	0.133	17.5	0.1	32	1.3	0.0788	< 0.002	0.015
S99-05309	5273063844	13.4	0.06	< 0.1	0.156	72.4	< 0.003	0.004	< 0.008	3.04	3.2	< 0.004	14.7	3.57	29.2	0.2	29.4	129	0.449	< 0.002	0.163
S99-05310	5273055157	< 0.5	0.13	< 0.1	0.044	30.9	< 0.003	0.007	0.013	2.84	3.7	0.007	7.38	1.34	14	< 0.1	19.6	9.3	0.122	< 0.002	0.227
S99-05311	5273023020	0.5	< 0.01	< 0.1	0.035	31.4	< 0.003	< 0.002	< 0.008	0.131	1.3	< 0.004	6.79	0.047	26.1	< 0.1	22.6	8.2	0.192	< 0.002	0.005
S99-05312	5273031102	< 0.5	0.12	< 0.1	0.055	60.8	< 0.003	0.006	< 0.008	2.09	1	< 0.004	15.3	0.772	37.5	< 0.1	20.8	0.5	0.266	< 0.002	0.189
S99-05313	5273039061	< 0.5	< 0.01	< 0.1	0.115	51.3	< 0.003	< 0.002	< 0.008	0.163	1.4	< 0.004	18.4	0.658	45	< 0.1	18.9	0.3	0.275	< 0.002	0.017
S99-05314	5273071878	< 0.5	< 0.01	< 0.1	0.05	23.7	< 0.003	< 0.002	< 0.008	0.129	0.9	0.007	7.41	0.377	23.7	< 0.1	26.3	2.4	0.138	< 0.002	0.01
S99-05315	5271035529	0.6	< 0.01	< 0.1	0.021	13.4	< 0.003	< 0.002	< 0.008	1.66	1.5	0.004	6	0.177	14.3	< 0.1	36.2	< 0.2	0.0814	< 0.002	0.035
S99-05316	5271083238	< 0.5	< 0.01	< 0.1	0.006	6.7	< 0.003	0.003	< 0.008	0.071	1.5	< 0.004	3.08	0.019	12.4	0.2	33.2	1.3	0.0431	< 0.002	0.023
S99-05317	5271071704	2.2	< 0.01	< 0.1	0.015	12.7	< 0.003	< 0.002	< 0.008	0.794	1.1	< 0.004	3.48	0.068	13.7	< 0.1	28.5	< 0.2	0.0793	< 0.002	0.008
S99-05318	5271059558	8	< 0.01	< 0.1	0.037	17.3	< 0.003	< 0.002	< 0.008	5.58	1	< 0.004	5.78	1.01	19.8	0.1	32.5	2.3	0.1	< 0.002	0.012
S99-05319	5271023453	< 0.5	0.03	< 0.1	0.021	9.9	< 0.003	< 0.002	< 0.008	0.213	11.8	< 0.004	3.58	0.372	4.8	< 0.1	11.5	1.5	0.0546	< 0.002	0.008
S99-05320	5271035407	< 0.5	< 0.01	< 0.1	0.015	11.2	< 0.003	< 0.002	< 0.008	0.055	1.2	< 0.004	3.63	0.229	11	< 0.1	30.1	0.4	0.066	< 0.002	0.02
S99-05321	5276943874	< 0.5	< 0.01	< 0.1	0.005	4.2	< 0.003	0.003	< 0.008	0.021	0.8	< 0.004	0.91	0.002	7.4	0.2	21.4	< 0.2	0.0233	< 0.002	0.019
S99-05322	5276917534	31.6	< 0.01	< 0.1	0.11	12.9	< 0.003	< 0.002	< 0.008	7.99	2.9	< 0.004	2.97	0.622	12.3	0.3	20.8	2.5	0.088	< 0.002	0.032
S99-05323	5276925294	< 0.5	< 0.01	< 0.1	0.014	17.1	< 0.003	< 0.002	< 0.008	0.181	1.4	< 0.004	11.6	0.415	14.6	0.1	24.2	16.6	0.132	< 0.002	0.009
S99-05324	5276908720	< 0.5	< 0.01	< 0.1	0.006	6.9	< 0.003	< 0.002	< 0.008	0.034	0.8	< 0.004	3.55	0.2	12.7	< 0.1	28.5	< 0.2	0.0546	< 0.002	0.015

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05325	RIP5325	28/06/1999	25.3219	89.1594	1996	TARA	29.9	A Fattaj Ali	Rajshahi	Dinajpur	Nawabganj (Di)	Mahmudpur	Lakshmirpur
S99-05326	RIP5326	28/06/1999	25.3352	89.0453	1995	TARA	29.9	Mrs Suraia Begum	Rajshahi	Dinajpur	Nawabganj (Di)	Putimara	Dakshin Joydebpur
S99-05327	RIP5327	28/06/1999	25.5	89.0152	1990	HTW	18.9	Md Mirajuddin	Rajshahi	Dinajpur	Nawabganj (Di)	Joypur	Joypur
S99-05328	RIP5328	28/06/1999	25.5021	89.0617	1998	TARA	28.3	Md Deloer Hossian	Rajshahi	Dinajpur	Nawabganj (Di)	Kushdaha	Khalippur
S99-05329	RIP5329	29/06/1999	25.3382	89.0033		TARA	28.3	Md Mosfikur Rahman	Rajshahi	Dinajpur	Hakimpur	Khatta Madhabpara	Khatta
S99-05330	RIP5330	29/06/1999	25.2711	89.0068	1978	HTW	22.6	TNO quarters	Rajshahi	Dinajpur	Hakimpur	Hili Hakimpur	Basudebpur
S99-05331	RIP5331	30/06/1999	24.8099	88.9349	1995	DTW	30	Pump No. 5	Rajshahi	Naogaon	Naogaon Sadar	Pourashava ward 01	Chak Enayet
S99-05332	RIP5332	30/06/1999	24.8075	88.9375	1995	mini TAI	31.7	DPHE thana office	Rajshahi	Naogaon	Naogaon Sadar	Pourashava ward 01	Chak Dev
S99-05333	RIP5333	30/06/1999	24.8465	88.9229	1996	TARA	29.9	Md Tarikul Islam	Rajshahi	Naogaon	Naogaon Sadar	Baktiarpur	Barunkandi
S99-05334	RIP5334	30/06/1999	24.8871	88.9145	1997	HTW	31.7	Kirtipur Bazar	Rajshahi	Naogaon	Naogaon Sadar	Kirtipur	Kirtipur
S99-05335	RIP5335	30/06/1999	24.8987	88.8852	1992	TARA	34.4	A. Zabber	Rajshahi	Naogaon	Naogaon Sadar	Barshail	Barshail
S99-05336	RIP5336	30/06/1999	24.8144	88.8806	1996	TARA	39	Md Benizir Ahmed	Rajshahi	Naogaon	Naogaon Sadar	Dubalhati	Pirojpur
S99-05337	RIP5337	30/06/1999	24.8524	88.8825	1999	HTW	33.8	Md Asmat Ali	Rajshahi	Naogaon	Naogaon Sadar	Hapania	Ekdala
S99-05338	RIP5338	30/06/1999	24.8345	88.9451	1998	TARA	37.5	Md Nurul Islam	Rajshahi	Naogaon	Naogaon Sadar	Tilakpur	Kadoa
S99-05339	RIP5339	30/06/1999	24.7796	88.9536	1995	TARA	34.1	Mather Mollah Hat	Rajshahi	Naogaon	Naogaon Sadar	Chandipur	Simulia
S99-05340	RIP5340	30/06/1999	24.7994	88.9638	1997	TARA	25.3	Md Esmail Hossin	Rajshahi	Naogaon	Naogaon Sadar	Boalia	Dogachhia
S99-05341	RIP5341	01/07/1999	24.9227	88.9029	1976	HTW	29.9	Bwoti voshon	Rajshahi	Naogaon	Badalgachhi	Balubhara	Mirzapur
S99-05342	RIP5342	01/07/1999	24.9651	88.8986	1982	HTW	24.4	S.Mynosar Rahman	Rajshahi	Naogaon	Badalgachhi	Badalgachhi	Badalgachhi
S99-05343	RIP5343	01/07/1999	24.9651	88.9033	1992	TARA	27.4	Deb prashad	Rajshahi	Naogaon	Badalgachhi	Adhaipur	Senpara
S99-05344	RIP5344	01/07/1999	24.9734	88.966	1990	TARA	29	Md Sirajul Islam	Rajshahi	Naogaon	Badalgachhi	Kola	Adityapur
S99-05345	RIP5345	01/07/1999	24.9295	88.9672	1986	HTW	15.2	Shibpur Govt. Primary School	Rajshahi	Naogaon	Badalgachhi	Bilasbari	Halud Dihar
S99-05346	RIP5346	01/07/1999	24.9297	88.9679	1997	HTW	36.6	Shibpur High School	Rajshahi	Naogaon	Badalgachhi	Bilasbari	Halud Dihar
S99-05347	RIP5347	01/07/1999	25.0281	88.976	1996	TARA	29.9	Paharpur Museum	Rajshahi	Naogaon	Badalgachhi	Jagadishpur	Malancha
S99-05348	RIP5348	01/07/1999	24.9944	88.9697	1996	TARA	34.1	Mr Mahabub Alam	Rajshahi	Naogaon	Badalgachhi	Mithapur	Hakimpur
S99-05349	RIP5349	01/07/1999	24.991	88.9303	1989	TARA	29.9	Md. A. Gafur Ali	Rajshahi	Naogaon	Badalgachhi	Mathurapur	Faizabad
S99-05350	RIP5350	03/07/1999	24.9093	88.7466	1997	TARA	32	DPHE office	Rajshahi	Naogaon	Mahadebpur	Mahadevpur	Mahadevpur
S99-05351	RIP5351	03/07/1999	24.9124	88.7404	1994	HTW	27.1	Kamej Uddin	Rajshahi	Naogaon	Mahadebpur	Khajur	Kunjaban
S99-05352	RIP5352	03/07/1999	24.9219	88.7077	1999	HTW	32	Taj Uddin	Rajshahi	Naogaon	Mahadebpur	Khajur	Khajur
S99-05353	RIP5353	03/07/1999	24.9533	88.7178	1989	HTW	27.1	Maish Batan High School	Rajshahi	Naogaon	Mahadebpur	Hatur	Mahisbathan
S99-05354	RIP5354	03/07/1999	24.889	88.701	1999	TARA	28	Faiz Uddin	Rajshahi	Naogaon	Mahadebpur	Chandash	Bagdob
S99-05355	RIP5355	03/07/1999	24.9473	88.7424	1996	HTW	22.6	Zakaria	Rajshahi	Naogaon	Mahadebpur	Enayetpur	Enayetpur
S99-05356	RIP5356	03/07/1999	24.8876	88.738	1999	HTW	27.1	Shibganj Jame Mosque	Rajshahi	Naogaon	Mahadebpur	Uttargram	Dohali
S99-05357	RIP5357	03/07/1999	24.8492	88.7363	1998	TARA	28.3	Abdul Kaleque	Rajshahi	Naogaon	Mahadebpur	Safapur	Paharpur
S99-05358	RIP5358	03/07/1999	24.8629	88.8418	1996	HTW	21	N. Highway Police Fari	Rajshahi	Naogaon	Mahadebpur	Bhimpur	Bhimpur
S99-05359	RIP5359	04/07/1999	24.6017	88.932	1998	TARA	35.1	A. Aziz	Rajshahi	Naogaon	Atrai	Ahshanganj	Brojapur
S99-05360	RIP5360	04/07/1999	24.6241	88.9855	1997	TARA	34.4	Manik Chandra	Rajshahi	Naogaon	Atrai	Bonpara	Bhopara
S99-05361	RIP5361	04/07/1999	24.6253	89.0404	1998	TARA	35.1	Naoduli Bazar	Rajshahi	Naogaon	Atrai	Maniary	Naoduli
S99-05362	RIP5362	04/07/1999	24.6625	88.9017	1991	TARA	29.9	Md Munsur Ali	Rajshahi	Naogaon	Atrai	Kalikapur	Salua
S99-05363	RIP5363	04/07/1999	24.6638	88.9036	1993	HTW	19.8	Kalikapur V. S. Center	Rajshahi	Naogaon	Atrai	Kalikapur	Salua
S99-05364	RIP5364	04/07/1999	24.6758	88.8758	1996	TARA	34.7	Md Giash Uddin	Rajshahi	Naogaon	Atrai	Hatkalupara	Nandanali
S99-05365	RIP5365	04/07/1999	24.5888	89.0223	1993	TARA	34.4	Gaziur Rahman	Rajshahi	Naogaon	Atrai	Bisha	Islamgathi
S99-05366	RIP5366	04/07/1999	24.607	88.9771	1995	TARA	34.4	DPHE Thana office	Rajshahi	Naogaon	Atrai	Panchupur	Pathailjhala
S99-05367	RIP5367	04/07/1999	24.6379	88.9406	1996	HTW	31.7	Subid Chandra	Rajshahi	Naogaon	Atrai	Sahagola	Rasulpur
S99-05368	RIP5368	05/07/1999	24.8288	88.5688	1995	TARA	29.9	TNO office	Rajshahi	Naogaon	Niamatpur	Niamatpur	Balahair
S99-05369	RIP5369	05/07/1999	24.803	88.5315	1994	TARA	29.9	Md Joynal abedin	Rajshahi	Naogaon	Niamatpur	Srimantapur	Bhadfanda
S99-05370	RIP5370	05/07/1999	24.8053	88.5054	1987	TARA	34.4	Shiris Chandra	Rajshahi	Naogaon	Niamatpur	Parail	Jhinarpur
S99-05371	RIP5371	05/07/1999	24.8101	88.4695	1978	HTW	40.5	Hazi Md. Esrai	Rajshahi	Naogaon	Niamatpur	Rasulpur	Gangair
S99-05372	RIP5372	05/07/1999	24.8549	88.4394	1978	HTW	44.2	Md Riazuddin	Rajshahi	Naogaon	Niamatpur	Rasulpur	Chaura Samaspur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05325	5276977623	< 0.5	< 0.01	< 0.1	0.008	14.8	< 0.003	< 0.002	< 0.008	0.066	< 0.5	< 0.004	8.2	0.256	17	0.1	28.5	0.4	0.113	< 0.002	0.027
S99-05326	5276986259	< 0.5	< 0.01	< 0.1	0.007	8.3	< 0.003	< 0.002	< 0.008	0.026	0.8	0.005	3.72	0.112	12.2	< 0.1	26.8	0.3	0.0485	< 0.002	0.024
S99-05327	5276951468	< 0.5	0.07	< 0.1	0.022	7.6	< 0.003	< 0.002	< 0.008	0.021	1.3	< 0.004	2.91	0.019	11.3	< 0.1	20.7	< 0.2	0.0636	< 0.002	0.011
S99-05328	5276969561	< 0.5	< 0.01	< 0.1	0.007	7.2	< 0.003	< 0.002	< 0.008	0.012	1.4	< 0.004	3.53	0.014	12.7	0.1	29.6	0.7	0.0582	0.003	0.064
S99-05329	5274781583	0.5	< 0.01	< 0.1	0.018	10.7	< 0.003	< 0.002	< 0.008	1.36	1.2	< 0.004	4.32	0.183	14.4	< 0.1	31.9	0.2	0.0524	< 0.002	0.235
S99-05330	5274754115	< 0.5	< 0.01	< 0.1	0.004	8.9	< 0.003	< 0.002	< 0.008	0.036	0.8	0.004	5.2	0.007	15.2	< 0.1	26.4	< 0.2	0.0603	< 0.002	0.019
S99-05331	5646001232	< 0.5	< 0.01	< 0.1	0.045	40.7	< 0.003	< 0.002	< 0.008	0.927	2.2	0.005	17.5	0.714	36.3	< 0.1	29.3	3.5	0.191	< 0.002	0.065
S99-05332	5646001165	< 0.5	< 0.01	< 0.1	0.05	49.2	< 0.003	< 0.002	< 0.008	1.13	2.6	0.013	24.6	0.943	47.6	< 0.1	22.4	22.3	0.213	< 0.002	0.029
S99-05333	5646007080	3.7	< 0.01	< 0.1	0.044	15.9	< 0.003	< 0.002	< 0.008	8.27	1.8	0.007	5.62	0.461	21.6	0.2	32.1	< 0.2	0.0946	< 0.002	0.042
S99-05334	5646073615	< 0.5	< 0.01	< 0.1	0.012	13.2	< 0.003	< 0.002	< 0.008	0.232	1	0.01	7.69	1.43	18.3	< 0.1	28.5	4.2	0.0843	< 0.002	0.02
S99-05335	5646021139	1.4	< 0.01	< 0.1	0.043	69.3	< 0.003	< 0.002	< 0.008	0.131	2	0.014	22.8	1.42	40.3	0.2	29.7	24.6	0.303	< 0.002	0.021
S99-05336	5646051843	3.2	< 0.01	0.1	0.036	28.7	< 0.003	< 0.002	< 0.008	2.59	1.3	0.007	11	0.246	42.1	0.2	32	< 0.2	0.141	< 0.002	0.013
S99-05337	5646058375	< 0.5	< 0.01	< 0.1	0.018	27.6	< 0.003	< 0.002	< 0.008	0.103	0.8	0.01	14.7	1.61	25.3	< 0.1	25.7	4.9	0.189	< 0.002	0.145
S99-05338	5646094535	1.2	< 0.01	< 0.1	0.015	36.2	< 0.003	< 0.002	< 0.008	0.492	2.5	0.004	15.4	0.635	23	< 0.1	28.2	< 0.2	0.16	< 0.002	0.017
S99-05339	5646043948	< 0.5	< 0.01	< 0.1	0.049	42.3	< 0.003	< 0.002	< 0.008	2.12	2.4	0.007	16.5	0.256	33.3	< 0.1	32.7	22.5	0.157	< 0.002	0.019
S99-05340	5646029358	1	< 0.01	< 0.1	0.036	37.8	< 0.003	< 0.002	< 0.008	1.14	2.1	0.007	15.9	0.342	24.9	< 0.1	32.7	13.7	0.159	< 0.002	0.019
S99-05341	5640631665	< 0.5	< 0.01	< 0.1	0.015	34	< 0.003	< 0.002	< 0.008	0.088	1.1	0.008	16.5	1.26	25	0.1	27.4	8	0.152	< 0.002	0.011
S99-05342	5640621040	< 0.5	< 0.01	< 0.1	0.004	19.5	< 0.003	< 0.002	< 0.008	0.063	0.6	< 0.004	10.5	0.078	20.1	< 0.1	24.7	7.7	0.132	< 0.002	0.008
S99-05343	5640610902	14.9	< 0.01	< 0.1	0.107	21.2	< 0.003	< 0.002	< 0.008	3.99	2.1	0.011	8.41	0.745	11.1	< 0.1	29	5.8	0.13	< 0.002	0.025
S99-05344	5640663112	< 0.5	< 0.01	< 0.1	0.007	15	< 0.003	< 0.002	< 0.008	0.034	0.7	0.007	7.87	1.07	16.9	0.1	27.1	2	0.114	0.003	0.015
S99-05345	5640642377	< 0.5	< 0.01	< 0.1	0.005	20	< 0.003	< 0.002	< 0.008	0.217	< 0.5	< 0.004	9.46	0.493	24	0.1	25.4	0.7	0.0897	< 0.002	0.114
S99-05346	5640642377	< 0.5	< 0.01	< 0.1	0.018	18.2	< 0.003	< 0.002	< 0.008	0.13	1.2	0.009	10.4	0.74	20.9	< 0.1	31.1	1.5	0.112	< 0.002	0.018
S99-05347	5640652649	< 0.5	< 0.01	< 0.1	0.033	11.8	< 0.003	< 0.002	< 0.008	0.075	27.3	0.008	8.69	0.652	11	0.1	23.6	0.3	0.0414	< 0.002	0.024
S99-05348	5640684373	1.5	< 0.01	< 0.1	0.028	15.3	< 0.003	< 0.002	< 0.008	6.77	1.7	0.008	6.46	0.529	16.2	0.2	31	1	0.0856	< 0.002	0.023
S99-05349	5640673316	16.4	< 0.01	< 0.1	0.057	15.1	< 0.003	< 0.002	< 0.008	17.2	2.3	0.008	4.85	1.36	9.1	0.5	24.2	5.4	0.0838	< 0.002	0.037
S99-05350	5645066693	1.6	< 0.01	< 0.1	0.013	21.1	< 0.003	< 0.002	< 0.008	0.653	0.8	0.007	8.39	0.543	23.9	0.3	27.8	6.4	0.09	< 0.002	0.031
S99-05351	5645057615	6.6	< 0.01	< 0.1	0.031	21.5	< 0.003	< 0.002	< 0.008	1.38	1	0.006	8.59	0.86	13.3	0.2	29.7	< 0.2	0.118	< 0.002	0.013
S99-05352	5645057567	< 0.5	0.01	< 0.1	0.015	26.4	< 0.003	< 0.002	< 0.008	0.189	0.9	0.008	9.87	0.243	22.2	< 0.1	29.4	0.4	0.112	< 0.002	0.063
S99-05353	5645047654	0.9	< 0.01	< 0.1	0.03	35.9	< 0.003	< 0.002	< 0.008	1.73	1.4	0.009	11.8	0.788	19.3	< 0.1	32.4	0.4	0.144	< 0.002	0.029
S99-05354	5645019061	< 0.5	0.01	< 0.1	0.016	25.3	< 0.003	< 0.002	< 0.008	0.157	1	< 0.004	10.6	0.066	22.2	0.2	28.9	0.6	0.174	0.003	0.032
S99-05355	5645038382	< 0.5	< 0.01	< 0.1	0.009	19.3	< 0.003	< 0.002	< 0.008	0.123	0.6	0.005	9.67	1.16	22.7	< 0.1	20.9	10.4	0.115	< 0.002	0.016
S99-05356	5645095366	< 0.5	< 0.01	< 0.1	0.025	66	0.006	< 0.002	< 0.008	0.07	1.5	0.013	30.5	3.49	38.5	< 0.1	27.3	49.1	0.412	< 0.002	0.061
S99-05357	5645085764	< 0.5	< 0.01	< 0.1	0.038	39.5	< 0.003	< 0.002	< 0.008	0.624	1.2	0.013	15.8	0.776	25.6	< 0.1	28.9	16.1	0.167	< 0.002	0.09
S99-05358	5645009152	< 0.5	0.02	< 0.1	0.009	18.7	< 0.003	< 0.002	< 0.008	0.093	0.6	< 0.004	8.99	0.42	21.1	0.1	24.7	3.7	0.122	< 0.002	0.016
S99-05359	5640310224	1	< 0.01	< 0.1	0.047	71	< 0.003	< 0.002	< 0.008	0.477	1.8	0.005	14.7	0.45	18.8	< 0.1	21.2	8.2	0.211	< 0.002	0.029
S99-05360	5640321160	< 0.5	0.19	< 0.1	0.104	134	< 0.003	0.004	0.016	1.02	4.7	0.012	14.8	0.345	28.3	0.2	20.4	13	0.414	< 0.002	0.678
S99-05361	5640363718	3.2	0.13	< 0.1	0.043	76.4	< 0.003	0.003	0.009	1.7	2.7	0.007	12	0.582	16.6	0.2	25.3	12.7	0.206	< 0.002	0.318
S99-05362	5640352860	4.2	0.04	< 0.1	0.027	45.2	< 0.003	< 0.002	0.012	0.527	1.2	0.006	9.07	0.202	17.8	0.1	24.7	21.1	0.141	< 0.002	0.079
S99-05363	5640352860	< 0.5	< 0.01	< 0.1	0.022	56	< 0.003	< 0.002	< 0.008	0.12	0.5	0.007	12.7	0.184	23	< 0.1	22.6	12.1	0.129	0.002	0.052
S99-05364	5640342699	< 0.5	< 0.01	< 0.1	0.03	80.2	< 0.003	< 0.002	< 0.008	0.092	1.7	0.007	27.5	1.24	24.9	< 0.1	23.2	< 0.2	0.288	< 0.002	0.02
S99-05365	5640331442	< 0.5	0.03	< 0.1	0.015	16.5	< 0.003	< 0.002	< 0.008	0.063	2	0.004	4.25	0.122	10.4	< 0.1	18.2	4.8	0.0516	0.003	0.013
S99-05366	5640373776	< 0.5	< 0.01	< 0.1	0.114	125	< 0.003	< 0.002	< 0.008	0.034	7.6	0.016	21.3	0.223	51.3	< 0.1	11	46.4	0.502	< 0.002	0.055
S99-05367	5640384828	1.1	< 0.01	< 0.1	0.05	58.6	< 0.003	< 0.002	< 0.008	0.375	2.9	0.012	17.2	0.328	39.9	< 0.1	28.8	22.4	0.184	< 0.002	0.025
S99-05368	5646952071	< 0.5	< 0.01	< 0.1	0.063	79.3	< 0.003	< 0.002	< 0.008	0.166	1.5	0.01	20.7	0.158	38.4	< 0.1	24.9	0.3	0.366	< 0.002	0.016
S99-05369	5646984161	< 0.5	< 0.01	< 0.1	0.021	41.4	< 0.003	< 0.002	< 0.008	0.249	< 0.5	0.008	5.36	0.058	21.6	< 0.1	26.2	0.4	0.114	< 0.002	0.015
S99-05370	5646963483	< 0.5	< 0.01	< 0.1	0.043	37.1	< 0.003	< 0.002	< 0.008	1.12	1	0.005	7.78	0.329	21.7	< 0.1	34.3	7.1	0.202	< 0.002	0.024
S99-05371	5646973396	< 0.5	< 0.01	< 0.1	0.039	78.5	< 0.003	< 0.002	< 0.008	1.96	0.8	< 0.004	14	0.086	29.6	< 0.1	25.1	< 0.2	0.329	0.002	0.038
S99-05372	5646973241	< 0.5	< 0.01	< 0.1	0.075	109	< 0.003	< 0.002	< 0.008	0.513	1.4	0.011	38.8	0.056	83.5	< 0.1	21.2	0.8	0.564	0.002	0.029

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-05373	RIP5373	05/07/1999	24.8253	88.6138	1990	TARA	34.7	Md Soliaman	Rajshahi	Naogaon	Niamatpur	Bhabicha	Bhabanipur
S99-05374	RIP5374	05/07/1999	24.8652	88.6213	1996	TARA	29.9	Md Samser Ali	Rajshahi	Naogaon	Niamatpur	Bhabicha	Nakol
S99-05375	RIP5375	05/07/1999	24.8901	88.6353	1998	TARA	39	Md Moazzem Hossan	Rajshahi	Naogaon	Niamatpur	Chandannagar	Chhatra
S99-05376	RIP5376	05/07/1999	25.1429	88.5554	1991	HTW	42.7	Shiranti U P office	Rajshahi	Naogaon	Sapahar	Shiranti	Bhuil
S99-05377	RIP5377	05/07/1999	25.1258	88.5839	1978	HTW	59.4	TNO office	Rajshahi	Naogaon	Sapahar	Sapahar	Joypur
S99-05378	RIP5378	05/07/1999	25.0983	88.5299	1996	HTW	45.7	Janata Bank	Rajshahi	Naogaon	Sapahar	Goala	Nischintapur
S99-06001	RIP6001	09/05/1999	24.4874	90.9998	1978	HTW	73.8	Ashek Khan	Dhaka	Kishoreganj	Itna	Baribari	Simulbak
S99-06002	RIP6002	10/05/1999	24.6191	91.1199	1976	HTW	74.7	Azizur Rahman Chowdhury	Dhaka	Kishoreganj	Itna	Gazipur	Pachhat
S99-06003	RIP6003	10/05/1999	24.5582	91.1131	1978	HTW	68.6	Daroga Ali	Dhaka	Kishoreganj	Itna	Dhanpur	Jayanshahi Sahila
S99-06004	RIP6004	10/05/1999	24.5266	91.1008	1998	HTW	72.5	Thana Parishad Mosque	Dhaka	Kishoreganj	Itna	Itna	Itna
S99-06005	RIP6005	10/05/1999	24.5552	91.01	1985	HTW	65.5	Md Hafizur Rahman bhuyan	Dhaka	Kishoreganj	Itna	Badla	Thaneswar
S99-06006	RIP6006	10/05/1999	24.5834	90.9794	1994	HTW	65.5	Abdul Shahid Bhuyan	Dhaka	Kishoreganj	Itna	Raituti	Pachasia
S99-06008	RIP6008	10/05/1999	24.4969	91.0536	1998	HTW	73.2	Elongjuri Bazar	Dhaka	Kishoreganj	Itna	Elongjuri	Kaktengar
S99-06009	RIP6009	10/05/1999	24.4901	91.0689	1976	HTW	68.9	Rushmat Ali	Dhaka	Kishoreganj	Mithamain	Gopedishi	Aula
S99-06010	RIP6010	10/05/1999	24.4495	91.0812	1974	HTW	71.6	Ghiridhar Dash	Dhaka	Kishoreganj	Mithamain	Dhaki	Dhaki
S99-06011	RIP6011	10/05/1999	24.4002	91.0644	1986	HTW	73.2	Thana Parishad	Dhaka	Kishoreganj	Mithamain	Mithamoin	Mithamoin
S99-06012	RIP6012	10/05/1999	24.4122	91.1335	1996	HTW	73.2	Anayetul Haque	Dhaka	Kishoreganj	Mithamain	Keorjore	Telikhai
S99-06013	RIP6013	10/05/1999	24.3992	91.1168	1982	HTW	76.2	Ghagra Bazar	Dhaka	Kishoreganj	Mithamain	Ghagura	Ghagura
S99-06014	RIP6014	12/05/1999	24.1662	90.9259	1990	HTW	56.4	Md Ali Akbar	Dhaka	Kishoreganj	Kuliarchar	Kuliarchar	Kuliachar
S99-06015	RIP6015	12/05/1999	24.1586	90.9326	1986	DTW	115.8	Thana parishad	Dhaka	Kishoreganj	Kuliarchar	Kuliarchar	Kuliachar
S99-06016	RIP6016	12/05/1999	24.1883	90.9133	1998	HTW	81.7	Marfat Ali	Dhaka	Kishoreganj	Kuliarchar	Ramdi	Ramdi
S99-06017	RIP6017	12/05/1999	24.1689	90.8376	1996	HTW	72.5	Abdul Wadud Master	Dhaka	Kishoreganj	Kuliarchar	Gobaria Abdullahpur	Gobaria Abdullahpur
S99-06018	RIP6018	12/05/1999	24.1413	90.8733	1996	HTW	68	Siadur Rahman	Dhaka	Kishoreganj	Kuliarchar	Shalua	Domrakanda
S99-06019	RIP6019	12/05/1999	24.1227	90.919	1998	HTW	72.5	Hira Mia	Dhaka	Kishoreganj	Kuliarchar	Chhaysuti	Chhaysuti
S99-06020	RIP6020	12/05/1999	24.1599	90.9151	1998	TARA	80.8	Md Abdul Matin	Dhaka	Kishoreganj	Kuliarchar	Kuliarchar	Kutubpur
S99-06021	RIP6021	12/05/1999	24.1334	90.9304	1998	TARA	69.5	Dulal Chandra	Dhaka	Kishoreganj	Kuliarchar	Kuliarchar	Tatarkandi
S99-06022	RIP6022	13/05/1999	24.2784	90.8246	1974	HTW	54.9	Lal Hossian Masjid	Dhaka	Kishoreganj	Katiadi	Mumurdia	Mumurdia
S99-06023	RIP6023	13/05/1999	24.2509	90.7964	1986	DTW	103.6	Thana Parishad	Dhaka	Kishoreganj	Katiadi	Katiadi	Katiadi
S99-06024	RIP6024	13/05/1999	24.3265	90.8923	1974	HTW	46.3	Union health complex	Dhaka	Kishoreganj	Katiadi	Kargaon	Kargaon Konapora
S99-06025	RIP6025	13/05/1999	24.3392	90.8274	1990	HTW	80.2	Bangabandhu Hospital	Dhaka	Kishoreganj	Katiadi	Sahasram Dhuldia	Gachihata
S99-06026	RIP6026	13/05/1999	24.3403	90.8012	1993	HTW	59.4	Banagram A K High School	Dhaka	Kishoreganj	Katiadi	Banagram	Banagram
S99-06027	RIP6027	13/05/1999	24.2775	90.7822	1973	HTW	54.9	Union Parishad	Dhaka	Kishoreganj	Katiadi	Achmita	Achmita
S99-06028	RIP6028	13/05/1999	24.2508	90.7968	1992	HTW	21.9	TNO House	Dhaka	Kishoreganj	Katiadi	Katiadi	Katiadi
S99-06029	RIP6029	13/05/1999	24.3225	90.9305	1980	HTW	86.9	Twin Quarter	Dhaka	Kishoreganj	Nikli	Nikhli	Saitdhar
S99-06030	RIP6030	13/05/1999	24.3125	90.9145	1974	HTW	76.2	Rudarpudda Govt Prim school	Dhaka	Kishoreganj	Nikli	Jaraitala	Rudharpudda
S99-06031	RIP6031	13/05/1999	24.3685	90.9184	1980	HTW	76.2	Md Mukshad Ali	Dhaka	Kishoreganj	Nikli	Karpasha	Karpasha
S99-06032	RIP6032	13/05/1999	24.3743	90.9798	1975	HTW	68.6	Badal Mia	Dhaka	Kishoreganj	Nikli	Singpur	Tengaria
S99-06033	RIP6033	13/05/1999	24.2669	90.9492	1990	HTW	73.2	Md Mahram Ali	Dhaka	Kishoreganj	Nikli	Gurai	Gurai
S99-06034	RIP6034	16/05/1999	24.2868	91.0845	1983	HTW	70.7	Kastail Bazar	Dhaka	Kishoreganj	Austagram	Kastail	Kastail
S99-06035	RIP6035	16/05/1999	24.2706	91.0947	1998	HTW	73.2	Taher Uddin Pathan	Dhaka	Kishoreganj	Austagram	Deoghar	Sabhianagar
S99-06036	RIP6036	16/05/1999	24.2568	91.1082	1997	HTW	71.6	Md Akkas Mia	Dhaka	Kishoreganj	Austagram	Bangal Para	Ashtagram
S99-06037	RIP6037	16/05/1999	24.2751	91.1112	1993	HTW	73.2	Thana Parishad	Dhaka	Kishoreganj	Austagram	Ashtagram	Ashtagram
S99-06038	RIP6038	16/05/1999	24.2723	91.1043	1995	HTW	36.6	Md Muslim	Dhaka	Kishoreganj	Austagram	Ashtagram	Ashtagram
S99-06041	RIP6041	17/05/1999	24.4648	90.8734		DTW	100.6	Thana parishad	Dhaka	Kishoreganj	Karimganj	Karimganj	Karimganj
S99-06042	RIP6042	17/05/1999	24.464	90.8684	1974	HTW	71.9	Karimganj madrasha	Dhaka	Kishoreganj	Karimganj	Karimganj	Karimganj
S99-06043	RIP6043	17/05/1999	24.3692	90.8672	1992	HTW	57	Safir Uddin	Dhaka	Kishoreganj	Karimganj	Gujadia	Gujadia
S99-06044	RIP6044	17/05/1999	24.4798	90.9465	1997	HTW	77.4	Ashkar Ali	Dhaka	Kishoreganj	Karimganj	Sutarpara	Uttar Ganeshpur
S99-06045	RIP6045	17/05/1999	24.4752	90.9316	1996	HTW	71.9	Kamar Uddin	Dhaka	Kishoreganj	Karimganj	Niamatpur	Rauha

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-05373	5646921154	< 0.5	< 0.01	< 0.1	0.048	69.5	< 0.003	< 0.002	< 0.008	0.349	1.8	0.011	19.9	0.296	46.4	< 0.1	25.2	1.8	0.286	< 0.002	0.012
S99-05374	5646921734	< 0.5	< 0.01	< 0.1	0.106	82.4	< 0.003	< 0.002	< 0.008	0.479	3	0.013	17.3	0.268	44.9	< 0.1	24.8	0.4	0.291	< 0.002	0.018
S99-05375	5646931247	< 0.5	< 0.01	< 0.1	0.023	43.3	< 0.003	< 0.002	< 0.008	0.098	1.2	0.007	8.33	0.218	21.9	< 0.1	27	0.2	0.109	< 0.002	0.062
S99-05376	5648679178	< 0.5	< 0.01	< 0.1	0.043	44.4	< 0.003	< 0.002	< 0.008	0.029	0.7	< 0.004	12.7	0.111	24.4	< 0.1	21.3	< 0.2	0.19	< 0.002	0.018
S99-05377	5648671471	< 0.5	< 0.01	< 0.1	0.018	41.9	< 0.003	< 0.002	< 0.008	4.05	0.5	< 0.004	12.4	0.099	13.9	< 0.1	11.2	< 0.2	0.165	< 0.002	0.079
S99-05378	5648639725	< 0.5	< 0.01	< 0.1	0.047	50.6	< 0.003	< 0.002	< 0.008	0.421	0.5	< 0.004	13.9	0.047	24.5	< 0.1	19.9	< 0.2	0.201	< 0.002	0.015
S99-06001	3483325894	9.4	< 0.01	0.3	0.021	3	< 0.003	< 0.002	< 0.008	0.468	1.5	0.013	0.8	0.01	174	0.7	11.3	< 0.2	0.0284	< 0.002	0.009
S99-06002	3483327816	31.2	0.03	0.5	0.054	8.3	< 0.003	< 0.002	< 0.008	1.02	1.4	0.008	3.28	0.049	210	2.4	12.3	< 0.2	0.0603	< 0.002	0.006
S99-06003	3483343459	16.6	< 0.01	0.4	0.026	5.1	< 0.003	< 0.002	< 0.008	2.48	1.4	0.006	1.96	0.069	197	1.6	14.8	< 0.2	0.0354	0.003	0.007
S99-06004	3483351443	66.3	0.02	0.3	0.093	14.5	< 0.003	< 0.002	< 0.008	4.32	1.8	0.007	5.89	0.145	185	3.3	17.8	< 0.2	0.102	< 0.002	0.024
S99-06005	3483317961	81.4	< 0.01	0.4	0.005	4.7	< 0.003	< 0.002	< 0.008	0.086	1.8	0.005	2.79	< 0.002	198	2.7	15.2	0.3	0.0259	< 0.002	< 0.004
S99-06006	3483394752	29.6	0.1	0.4	0.032	2.8	< 0.003	< 0.002	< 0.008	1.69	1.3	0.005	0.94	0.034	227	4.5	12.3	0.3	0.0177	< 0.002	0.033
S99-06008	3483308501	5.4	0.02	0.3	0.02	4.7	< 0.003	< 0.002	< 0.008	0.479	1.4	0.005	0.8	0.018	181	0.6	11.1	0.3	0.0842	< 0.002	0.008
S99-06009	3485928014	27.4	0.01	0.3	0.047	7.8	< 0.003	< 0.002	< 0.008	1.92	1.2	0.004	2.67	0.099	193	4	16.6	0.3	0.0532	< 0.002	0.007
S99-06010	3485934326	86.8	< 0.01	0.3	0.067	15.4	< 0.003	< 0.002	< 0.008	2.69	1.4	< 0.004	6.95	0.143	169	2.3	14.3	< 0.2	0.105	< 0.002	0.01
S99-06011	3485966686	82.7	0.01	0.2	0.061	23.3	< 0.003	< 0.002	< 0.008	0.753	2.1	0.004	2.81	0.045	165	1	10.3	0.2	0.114	< 0.002	0.012
S99-06012	3485977953	0.7	< 0.01	0.2	0.033	17	< 0.003	< 0.002	< 0.008	0.06	1	0.007	5.83	0.355	132	0.1	11.8	0.2	0.116	< 0.002	0.018
S99-06013	3485919336	11.4	0.01	0.3	0.035	15.7	< 0.003	< 0.002	< 0.008	2.87	1.3	0.005	5.29	0.219	134	1.2	20.1	< 0.2	0.106	< 0.002	0.013
S99-06014	3485447605	217	0.02	0.4	0.076	23.1	< 0.003	< 0.002	< 0.008	3.52	14	0.01	41.3	0.061	216	5.2	27.7	0.7	0.299	< 0.002	0.012
S99-06015	3485447605	21	0.01	< 0.1	0.092	30.8	< 0.003	< 0.002	< 0.008	1.95	2.2	0.01	8	0.176	80	0.6	16.4	< 0.2	0.196	< 0.002	0.016
S99-06016	3485471886	31.6	0.02	< 0.1	0.084	22.5	< 0.003	< 0.002	< 0.008	4.04	1.7	0.005	5.57	0.157	67	1	16.5	< 0.2	0.161	< 0.002	0.013
S99-06017	3485435432	32.9	0.02	< 0.1	0.05	40.9	< 0.003	< 0.002	< 0.008	2.42	3.9	< 0.004	15.2	2.06	11.9	0.2	18.2	1.7	0.15	< 0.002	0.015
S99-06018	3485483346	49.6	0.02	< 0.1	0.012	14.5	< 0.003	< 0.002	< 0.008	7.39	4.6	< 0.004	19.7	0.161	39.2	1.3	26.3	< 0.2	0.168	< 0.002	0.013
S99-06019	3485411259	89.6	0.02	0.1	0.03	18.6	< 0.003	< 0.002	0.028	2.69	11.2	0.005	25.8	0.123	96.2	2.3	14.5	0.4	0.196	< 0.002	0.072
S99-06020	3485447648	5.4	0.03	0.1	0.056	17.3	< 0.003	< 0.002	< 0.008	2.03	1.9	0.012	7.27	0.097	71.1	0.2	27.8	< 0.2	0.117	< 0.002	0.012
S99-06021	3485447994	162	0.02	0.1	0.043	16.9	< 0.003	< 0.002	< 0.008	2.91	11.5	0.005	24.6	0.107	86.6	2.6	16	0.3	0.219	< 0.002	0.011
S99-06022	3484585704	< 0.5	0.02	< 0.1	0.034	44.7	< 0.003	< 0.002	< 0.008	0.06	2.1	0.01	17.3	0.168	82.2	0.1	26.5	0.5	0.259	0.006	0.015
S99-06023	3484557621	1	0.04	< 0.1	0.043	53.9	< 0.003	< 0.002	< 0.008	0.728	2.1	0.016	24.2	0.468	39	0.1	29	2.2	0.283	< 0.002	0.042
S99-06024	3484547611	32.9	0.02	< 0.1	0.065	23.4	< 0.003	< 0.002	< 0.008	0.883	1.7	0.004	6.39	0.079	126	1	13.6	0.2	0.152	< 0.002	0.013
S99-06025	3484595424	19	0.02	0.1	0.117	27.8	< 0.003	< 0.002	< 0.008	5.18	2.2	0.005	12.2	0.789	131	0.8	19	< 0.2	0.23	< 0.002	0.014
S99-06026	3484519114	< 0.5	0.02	< 0.1	0.033	30.7	< 0.003	< 0.002	< 0.008	0.256	1.9	0.004	13.1	0.241	33.8	0.1	28.5	< 0.2	0.183	0.002	0.015
S99-06027	3484509010	< 0.5	0.02	< 0.1	0.014	37.5	< 0.003	< 0.002	< 0.008	0.088	0.7	< 0.004	11.3	0.034	9.3	0.1	27.6	0.4	0.187	0.006	0.015
S99-06028	3484557621	< 0.5	0.03	< 0.1	0.05	75	< 0.003	< 0.002	< 0.008	0.086	2.1	0.01	33.5	0.571	14.2	0.1	28.8	0.2	0.371	0.002	0.021
S99-06029	3487676854	42.9	0.01	< 0.1	0.07	12.9	< 0.003	< 0.002	< 0.008	1.72	2	< 0.004	3.05	0.044	115	1.6	16.5	< 0.2	0.0765	< 0.002	0.014
S99-06030	3487647812	98.3	< 0.01	< 0.1	0.033	8.9	< 0.003	< 0.002	< 0.008	0.49	0.9	< 0.004	2.25	0.12	113	0.9	11.1	< 0.2	0.076	< 0.002	0.007
S99-06031	3487657532	94.8	0.04	0.2	0.049	13.2	< 0.003	< 0.002	< 0.008	1.26	1.8	< 0.004	5.28	0.371	163	1.3	11.3	< 0.2	0.0763	< 0.002	0.044
S99-06032	3487685966	23.6	0.04	0.2	0.023	5.1	< 0.003	< 0.002	< 0.008	1.18	1.4	0.009	1.17	0.064	176	2	11.6	< 0.2	0.0274	< 0.002	0.018
S99-06033	3487638378	11	0.02	< 0.1	0.024	9.5	< 0.003	< 0.002	< 0.008	0.341	0.9	0.005	1.62	0.069	106	0.4	13.8	< 0.2	0.0689	< 0.002	0.027
S99-06034	3480271623	77.5	< 0.01	< 0.1	0.187	15	0.003	< 0.002	< 0.008	12.2	1.6	< 0.004	5.15	0.283	75	1.1	17.6	< 0.2	0.138	< 0.002	0.015
S99-06035	3480247944	0.8	0.02	< 0.1	0.013	19.2	< 0.003	< 0.002	< 0.008	0.112	1	< 0.004	7.93	0.735	56.1	< 0.1	18.8	< 0.2	0.129	< 0.002	0.014
S99-06036	3480235843	< 0.5	0.01	< 0.1	0.028	24.4	< 0.003	< 0.002	< 0.008	0.319	1	< 0.004	9.15	1.05	51.9	< 0.1	18.1	< 0.2	0.152	< 0.002	0.019
S99-06037	3480223067	9.4	< 0.01	< 0.1	0.068	21.1	< 0.003	< 0.002	< 0.008	9.35	1	< 0.004	6.99	0.645	70.4	0.7	22.2	2.4	0.138	< 0.002	0.012
S99-06038	3480223067	11.3	< 0.01	< 0.1	0.029	17.3	< 0.003	< 0.002	< 0.008	6.04	1.5	< 0.004	6.02	0.566	56	0.5	25.4	< 0.2	0.122	< 0.002	0.011
S99-06041	3484269456	92	0.02	0.3	0.099	31.1	< 0.003	< 0.002	0.036	3.33	3.8	0.01	13.2	0.098	118	0.5	20.4	0.3	0.19	< 0.002	0.022
S99-06042	3484269456	54	0.01	0.3	0.128	26.6	< 0.003	< 0.002	< 0.008	4.7	2.5	0.007	9.59	0.108	129	1.1	16.9	< 0.2	0.189	< 0.002	0.075
S99-06043	3484234304	176	0.02	0.2	0.066	39	< 0.003	< 0.002	< 0.008	4.43	3.3	0.006	23.3	0.962	123	0.9	20.9	2.2	0.313	< 0.002	0.033
S99-06044	3484294983	21.6	0.01	0.3	0.022	2.9	< 0.003	< 0.002	< 0.008	1.05	1.1	0.005	1.02	0.035	195	3.3	11.6	< 0.2	0.0211	< 0.002	0.008
S99-06045	3484277807	26.8	0.01	0.4	0.038	4.5	< 0.003	< 0.002	< 0.008	1.7	1.5	0.005	1.66	0.045	205	2.9	12.9	< 0.2	0.0377	< 0.002	0.007

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-06046	RIP6046	18/05/1999	24.2824	90.6382	1996	HTW	50.3	Abdul Majid	Dhaka	Mymensingh	Gafargaon	Tengaba	Tengaba
S99-06047	RIP6047	18/05/1999	24.3371	90.6198	1992	TARA	82.3	Anisur Rahman	Dhaka	Mymensingh	Gafargaon	Datterbazar	Birai
S99-06048	RIP6048	18/05/1999	24.3866	90.5374	1998	HTW	54.9	Maskhali Hospital	Dhaka	Mymensingh	Gafargaon	Masakhali	Masakhali
S99-06049	RIP6049	18/05/1999	24.3874	90.551	1999	TARA	70.1	Falu Dapturi	Dhaka	Mymensingh	Gafargaon	Langair	Datter Monpara
S99-06050	RIP6050	18/05/1999	24.3934	90.5736	1998	TARA	73.2	Aktar Hossain	Dhaka	Mymensingh	Gafargaon	Longair	Maijbari
S99-06051	RIP6051	18/05/1999	24.4284	90.5665	1989	TARA	51.8	Falan	Dhaka	Mymensingh	Gafargaon	Gaffargaon	Uthari
S99-06052	RIP6052	18/05/1999	24.4284	90.5665	1974	DTW	140.2	Abdul Ali Fakir	Dhaka	Mymensingh	Gafargaon	Gaffargaon	Uthari
S99-06053	RIP6053	18/05/1999	24.4485	90.5595	1995	HTW	54.9	DPHE compound	Dhaka	Mymensingh	Gafargaon	Salti	Silani
S99-06054	RIP6054	18/05/1999	24.4517	90.5181	1999	HTW	59.1	Jalal Uddin	Dhaka	Mymensingh	Gafargaon	Jessora	Gandagram
S99-06055	RIP6055	19/05/1999	24.4471	90.3133	1998	TARA	55.8	Abdul Majid Master	Dhaka	Mymensingh	Bhaluka	Meduary	Lohabari
S99-06056	RIP6056	19/05/1999	24.4477	90.2792	1995	TARA	66.1	Md Shamsul Haque Chowdhury	Dhaka	Mymensingh	Bhaluka	Uthura	Narangi
S99-06057	RIP6057	19/05/1999	24.4144	90.3832	1991	TARA	57.3	Edris Ali	Dhaka	Mymensingh	Bhaluka	Mallikbari	Bhandabo
S99-06058	RIP6058	19/05/1999	24.3075	90.3178	1985	TARA	53.3	Kachina Bazar	Dhaka	Mymensingh	Bhaluka	Kachina	Kachina
S99-06059	RIP6059	19/05/1999	24.3273	90.3824	1998	TARA	65.2	S M Taher High School	Dhaka	Mymensingh	Bhaluka	Habirbari	Habirbari
S99-06060	RIP6060	19/05/1999	24.4351	90.4602	1994	TARA	61.6	Ansharul Haque	Dhaka	Mymensingh	Bhaluka	Dhitpur	Dhitpur
S99-06061	RIP6061	19/05/1999	24.4165	90.4463	1995	TARA	70.1	Uzzal Chandra Dab	Dhaka	Mymensingh	Bhaluka	Birunia	Goair
S99-06062	RIP6062	19/05/1999	24.4165	90.4463	1978	DTW	91.4	Bharat Chandra	Dhaka	Mymensingh	Bhaluka	Birunia	Goair
S99-06063	RIP6063	19/05/1999	24.4067	90.3918	1997	TARA	68.3	Ashraful Karim	Dhaka	Mymensingh	Bhaluka	Bhaluka	Bhaluka
S99-06064	RIP6064	20/05/1999	24.6451	90.3971	1998	TARA	57	Shamsur Rahman	Dhaka	Mymensingh	Trishal	Bailar	Bailar
S99-06065	RIP6065	20/05/1999	24.6259	90.4191	1990	TARA	57.9	Ibrahin Khalil	Dhaka	Mymensingh	Trishal	Kanthal	Kanthal
S99-06066	RIP6066	20/05/1999	24.5831	90.3913	1998	TARA	58.5	TNO House	Dhaka	Mymensingh	Trishal	Trishal	Trishal
S99-06067	RIP6067	20/05/1999	24.5852	90.3919	1990	DTW	94.5	Thana Parishad	Dhaka	Mymensingh	Trishal	Trishal	Trishal
S99-06068	RIP6068	20/05/1999	24.5426	90.3429	1998	TARA	57.9	Muqseddus Salim	Dhaka	Mymensingh	Trishal	Mathbari	Mathbari
S99-06069	RIP6069	20/05/1999	24.5617	90.5143	1995	TARA	63.4	Sukumar Pandit	Dhaka	Mymensingh	Trishal	Balipara	Beara
S99-06070	RIP6070	20/05/1999	24.611	90.498	1994	TARA	63.4	Sukuranjan Sarkar	Dhaka	Mymensingh	Trishal	Kanihari	Bear Ata
S99-06071	RIP6071	20/05/1999	24.4812	90.3522	1998	TARA	53.3	Saiful Islam	Dhaka	Mymensingh	Trishal	Mokshapur	Mokshapur
S99-06072	RIP6072	20/05/1999	24.3712	90.3992	1998	TARA	70.1	Abdul Aziz	Dhaka	Mymensingh	Trishal	Amirabari	Amirabari
S99-06073	RIP6073	22/05/1999	24.8416	90.559	1991	TARA	68.6	Abdul Qader	Dhaka	Mymensingh	Gouripur	Shidla	Manali
S99-06074	RIP6074	22/05/1999	24.8438	90.58	1988	HTW	61	Subal Chandra Roy	Dhaka	Mymensingh	Gouripur	Mailakanda	Mailakanda
S99-06075	RIP6075	22/05/1999	24.7361	90.5047	1998	TARA	54.9	Md Jaher Ali	Dhaka	Mymensingh	Gouripur	Dhakakohla	Chandapara
S99-06076	RIP6076	22/05/1999	24.7295	90.5499	1994	TARA	70.1	Aumullah Chaki	Dhaka	Mymensingh	Gouripur	Ramgopalpur	Ramgopalpur
S99-06077	RIP6077	22/05/1999	24.7561	90.5994	1996	HTW	17.1	Md Abdullah	Dhaka	Mymensingh	Gouripur	Bokainagar	Diupara
S99-06078	RIP6078	22/05/1999	24.759	90.6342	1967	HTW	39.6	Eaken Ali	Dhaka	Mymensingh	Gouripur	Achintapur	Bakarkona
S99-06079	RIP6079	22/05/1999	24.7652	90.6662	1976	HTW	51.8	Azizul Haque	Dhaka	Mymensingh	Gouripur	Maoha	Bhutiarkanda
S99-06080	RIP6080	22/05/1999	24.7528	90.5746	1989	HTW	67.1	Niva rani	Dhaka	Mymensingh	Gouripur	Paurashava ward 3	Kalipur Bazar
S99-06081	RIP6081	22/05/1999	24.7717	90.5702	1994	HTW	36.6	Thana Health Complex	Dhaka	Mymensingh	Gouripur	Gouripur	Gabhisimul
S99-06082	RIP6082	23/05/1999	24.5716	90.6886	1989	HTW	11	Thana Parishad	Dhaka	Mymensingh	Nandail	Nandail	Nandail
S99-06083	RIP6083	23/05/1999	24.5716	90.6886	1984	DTW	94.5	Thana Parishad	Dhaka	Mymensingh	Nandail	Nandail	Nandail
S99-06084	RIP6084	23/05/1999	24.584	90.7353	1996	TARA	91.4	Md Jasimuddin	Dhaka	Mymensingh	Nandail	Chandipasha	Basati
S99-06085	RIP6085	23/05/1999	24.5745	90.7964	1992	TARA	60.4	Md Saifuddin	Dhaka	Mymensingh	Nandail	Rajgati	Uluhati
S99-06086	RIP6086	23/05/1999	24.5799	90.7492	1996	TARA	78	Anamul Haque	Dhaka	Mymensingh	Nandail	Gangail	Pankerhati
S99-06087	RIP6087	23/05/1999	24.5368	90.7491	1997	TARA	68.6	Abdus Sobhan	Dhaka	Mymensingh	Nandail	Musuli	Musuli
S99-06088	RIP6088	23/05/1999	24.5311	90.704	1997	HTW	54.9	Atikur Rahman	Dhaka	Mymensingh	Nandail	Singrail	Udang Nadhyapur
S99-06089	RIP6089	23/05/1999	24.5757	90.6203	1997	TARA	73.2	Neyamat Ali	Dhaka	Mymensingh	Nandail	Moazzempur	Saidgaon
S99-06090	RIP6090	23/05/1999	24.5431	90.5609	1996	TARA	76.2	Md Giashuddin	Dhaka	Mymensingh	Nandail	Betagair	Bir Kamatkhali
S99-06091	RIP6091	24/05/1999	24.7482	90.3921	1993	TARA	52.7	Salma Begum	Dhaka	Mymensingh	Mymensingh Sadar	Akua	Akua
S99-06092	RIP6092	24/05/1999	24.7287	90.3698	1993	TARA	61.9	Md Sher Ali	Dhaka	Mymensingh	Mymensingh Sadar	Dapunia	Dapunia
S99-06093	RIP6093	24/05/1999	24.6845	90.3736	1996	TARA	57.3	Md Nayeb Ali	Dhaka	Mymensingh	Mymensingh Sadar	Ghagra	Parail

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-06046	3612288265	0.9	0.01	< 0.1	0.174	26.1	< 0.003	< 0.002	< 0.008	2.37	1.9	< 0.004	14	0.131	28.1	0.4	23.1	< 0.2	0.174	< 0.002	0.016
S99-06047	3612218226	< 0.5	0.02	< 0.1	0.085	26.8	< 0.003	0.003	< 0.008	0.041	2	0.004	12.6	0.455	25.8	0.2	31.6	1.2	0.16	0.004	0.017
S99-06048	3612244689	< 0.5	0.01	< 0.1	0.033	23.7	< 0.003	< 0.002	0.009	0.481	2.4	0.009	11.4	0.364	18.2	0.1	38.3	< 0.2	0.166	< 0.002	0.011
S99-06049	3612237354	2.4	0.01	< 0.1	0.044	24.6	< 0.003	< 0.002	< 0.008	1.23	1.7	0.005	10.2	0.148	29.6	0.2	32.6	< 0.2	0.144	< 0.002	0.123
S99-06050	3612237674	5.1	0.01	< 0.1	0.044	24.7	< 0.003	< 0.002	< 0.008	1.23	1.8	< 0.004	10.2	0.148	29.7	0.2	32.9	< 0.2	0.144	< 0.002	0.123
S99-06051	3612225985	< 0.5	0.02	< 0.1	0.044	24.5	< 0.003	< 0.002	< 0.008	0.224	1.8	0.009	5.59	0.062	72.9	0.2	21.6	2.3	0.17	< 0.002	0.109
S99-06052	3612225985	0.7	0.02	< 0.1	0.039	41.6	< 0.003	< 0.002	< 0.008	0.1	2.7	0.005	17.1	0.636	32	0.2	25	0.2	0.225	0.004	0.033
S99-06053	3612282935	< 0.5	0.02	< 0.1	0.021	33.7	< 0.003	< 0.002	< 0.008	0.117	1.3	< 0.004	9.47	0.021	28.7	0.3	24.2	0.3	0.259	0.004	0.048
S99-06054	3612231438	< 0.5	0.02	< 0.1	0.023	48.3	< 0.003	< 0.002	< 0.008	0.032	1.4	0.019	19.7	1.33	36.6	< 0.1	28.5	5.6	0.271	0.003	0.253
S99-06055	3611377606	< 0.5	0.01	< 0.1	0.091	24.3	< 0.003	< 0.002	< 0.008	0.508	1.2	< 0.004	9.57	0.158	21.5	< 0.1	34.5	0.4	0.126	< 0.002	0.049
S99-06056	3611394754	< 0.5	0.04	< 0.1	0.019	13.9	< 0.003	< 0.002	< 0.008	0.051	1	< 0.004	3.88	0.014	19.7	0.1	33.8	0.6	0.0933	0.004	0.026
S99-06057	3611369137	< 0.5	0.02	< 0.1	0.025	28.9	< 0.003	< 0.002	< 0.008	0.031	0.8	0.011	11	0.416	20.9	< 0.1	31.5	0.7	0.165	0.005	0.027
S99-06058	3611360468	< 0.5	0.02	< 0.1	0.022	38	< 0.003	< 0.002	< 0.008	0.115	0.9	< 0.004	12.8	0.115	29.9	0.1	24.1	0.4	0.203	0.006	0.021
S99-06059	3611351365	< 0.5	0.02	< 0.1	0.007	7.1	< 0.003	0.01	< 0.008	0.024	1.4	0.006	2.43	0.011	9.3	0.2	34.8	0.3	0.0607	0.003	0.087
S99-06060	3611343320	< 0.5	0.01	< 0.1	0.098	21.5	< 0.003	< 0.002	< 0.008	0.083	1.4	< 0.004	9.57	0.509	23.9	0.2	36.5	0.6	0.133	< 0.002	0.04
S99-06061	3611325354	< 0.5	0.01	0.1	0.022	17.5	< 0.003	< 0.002	< 0.008	2.24	1	0.008	7.52	0.167	26.3	< 0.1	29.3	0.4	0.0945	< 0.002	0.042
S99-06062	3611325354	< 0.5	0.03	< 0.1	0.028	23.3	< 0.003	< 0.002	< 0.008	1.28	1.4	0.006	8.18	0.187	26.9	< 0.1	30.4	0.5	0.126	< 0.002	0.031
S99-06063	3611308125	< 0.5	0.01	< 0.1	0.05	23.1	< 0.003	< 0.002	< 0.008	0.807	1.1	0.006	9.64	0.106	22.6	< 0.1	32.4	0.4	0.13	< 0.002	0.015
S99-06064	3619409122	< 0.5	0.02	< 0.1	0.024	32.6	< 0.003	< 0.002	< 0.008	0.076	1.7	0.004	15.9	1.11	25.6	< 0.1	25.4	0.5	0.165	< 0.002	0.047
S99-06065	3619457626	< 0.5	0.02	< 0.1	0.03	32.4	< 0.003	< 0.002	< 0.008	0.041	2.3	0.008	13.4	0.424	26.8	< 0.1	26.6	0.4	0.162	< 0.002	0.03
S99-06066	3619485994	< 0.5	0.05	< 0.1	0.033	33.6	< 0.003	< 0.002	< 0.008	0.066	2	0.007	14.2	0.39	26.4	< 0.1	29.4	0.6	0.17	0.003	0.096
S99-06067	3619485994	0.6	0.02	< 0.1	0.034	31.2	< 0.003	< 0.002	< 0.008	0.49	2.6	0.005	13.4	0.238	23.6	< 0.1	28.4	0.6	0.167	0.002	0.032
S99-06068	3619465682	< 0.5	0.02	< 0.1	0.017	28	< 0.003	< 0.002	< 0.008	0.036	1.4	< 0.004	12	0.028	26.8	0.1	31.4	0.3	0.157	0.003	0.11
S99-06069	3619419218	< 0.5	0.02	< 0.1	0.049	50	< 0.003	< 0.002	< 0.008	0.023	1.3	< 0.004	15.8	0.05	14.3	0.3	25.7	0.9	0.274	0.005	0.033
S99-06070	3619447231	< 0.5	0.02	< 0.1	0.021	28	< 0.003	< 0.002	< 0.008	0.109	1.7	< 0.004	13.5	0.88	23.1	0.1	28.7	0.3	0.15	< 0.002	0.022
S99-06071	3619471707	0.6	0.02	< 0.1	0.09	27.2	< 0.003	< 0.002	< 0.008	0.024	1.7	0.006	12.1	0.514	21.8	0.2	30.5	0.6	0.157	0.005	0.062
S99-06072	3619405032	< 0.5	0.02	< 0.1	0.014	22.7	< 0.003	< 0.002	< 0.008	0.024	2	0.006	10.2	0.387	22.7	0.1	36.4	0.8	0.164	0.003	0.052
S99-06073	3612385669	< 0.5	0.02	< 0.1	0.013	30	< 0.003	< 0.002	< 0.008	0.117	0.8	< 0.004	11.8	0.062	37	0.2	22.4	0.4	0.149	0.004	0.017
S99-06074	3612349591	< 0.5	0.01	< 0.1	0.025	28.2	< 0.003	< 0.002	< 0.008	0.119	1.3	< 0.004	11.7	0.036	28.4	0.2	25.1	< 0.2	0.126	0.006	0.015
S99-06075	3612327176	< 0.5	0.03	< 0.1	0.068	57.3	< 0.003	< 0.002	< 0.008	0.031	1.8	0.004	26.1	0.297	11.2	0.2	27.8	0.7	0.235	0.004	0.033
S99-06076	3612372792	< 0.5	0.03	< 0.1	0.011	41.8	< 0.003	< 0.002	< 0.008	0.038	2	< 0.004	14.1	0.584	10.4	0.2	28.1	0.2	0.227	0.005	0.023
S99-06077	3612322294	< 0.5	< 0.01	< 0.1	0.031	18.7	< 0.003	< 0.002	< 0.008	0.276	2.1	< 0.004	9.3	0.34	10.1	< 0.1	20.6	4.8	0.0781	< 0.002	0.022
S99-06078	3612304034	109	0.01	< 0.1	0.071	24.5	< 0.003	< 0.002	< 0.008	6.93	1.9	< 0.004	7.35	1.18	8.9	1.2	21.3	0.3	0.0961	< 0.002	0.023
S99-06079	3612358126	1.2	0.01	< 0.1	0.034	30.5	< 0.003	< 0.002	< 0.008	0.076	0.6	< 0.004	10.5	0.181	17.8	< 0.1	17.8	0.9	0.169	0.002	0.015
S99-06080	3612331424	< 0.5	0.01	< 0.1	0.009	23.4	< 0.003	< 0.002	< 0.008	0.042	0.9	< 0.004	7.81	2.59	9.3	0.2	28.6	< 0.2	0.131	0.004	0.016
S99-06081	3612331317	2.8	< 0.01	< 0.1	0.034	12.7	< 0.003	< 0.002	< 0.008	0.809	2.3	0.005	6.5	0.203	7.3	< 0.1	20.1	2.5	0.055	< 0.002	0.021
S99-06082	3617271720	< 0.5	0.02	< 0.1	0.059	41.6	< 0.003	< 0.002	< 0.008	0.11	3.2	0.007	18.3	0.091	28.3	< 0.1	16.1	19.2	0.149	< 0.002	0.02
S99-06083	3617271720	7.8	0.02	< 0.1	0.037	29.1	< 0.003	< 0.002	< 0.008	0.491	1.6	< 0.004	11.7	0.305	34.3	0.3	21.1	0.3	0.156	< 0.002	0.025
S99-06084	3617223122	29.1	0.02	< 0.1	0.106	34.7	< 0.003	< 0.002	< 0.008	0.891	2.2	0.005	13.6	0.18	41	0.3	21	< 0.2	0.212	< 0.002	0.027
S99-06085	3617279982	< 0.5	0.06	< 0.1	0.018	81.2	< 0.003	< 0.002	< 0.008	0.023	1.4	0.005	23.4	0.992	36	0.2	20.9	0.4	0.436	0.004	0.025
S99-06086	3617231781	24.5	0.02	< 0.1	0.079	32.8	< 0.003	< 0.002	< 0.008	1.29	2.1	0.005	13.2	0.074	34.7	0.4	22.8	< 0.2	0.178	< 0.002	0.016
S99-06087	3617263701	7.3	0.02	< 0.1	0.049	32.3	< 0.003	< 0.002	< 0.008	1.13	2.8	0.004	16.3	0.589	32.9	0.4	28.3	0.3	0.167	< 0.002	0.02
S99-06088	3617294976	60.8	0.03	< 0.1	0.121	33.6	< 0.003	< 0.002	< 0.008	1.3	2.6	0.005	18.4	0.172	44.8	0.6	19.8	0.3	0.232	< 0.002	0.021
S99-06089	3617255885	0.7	0.02	< 0.1	0.039	26.8	< 0.003	< 0.002	< 0.008	0.023	1.8	0.005	12.2	0.138	31.7	0.2	25.3	0.3	0.148	0.004	0.025
S99-06090	3617215170	< 0.5	0.02	< 0.1	0.067	29	< 0.003	< 0.002	< 0.008	0.027	2	< 0.004	13.1	0.844	30	0.1	22.3	0.5	0.177	< 0.002	0.019
S99-06091	3615210014	< 0.5	0.02	< 0.1	0.018	35.8	< 0.003	< 0.002	< 0.008	0.132	1.7	0.009	16.4	0.476	23.8	0.3	25.4	0.5	0.178	0.004	0.029
S99-06092	3615247366	< 0.5	0.02	< 0.1	0.015	32.3	< 0.003	< 0.002	< 0.008	0.12	1.3	0.01	13.9	0.449	32.1	< 0.1	30.2	3.6	0.174	0.003	0.02
S99-06093	3615254800	1.2	0.02	< 0.1	0.05	33.6	< 0.003	< 0.002	< 0.008	0.126	2.1	0.007	15.5	0.163	27.4	0.1	26.4	0.4	0.19	< 0.002	0.018

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-06094	RIP6094	24/05/1999	24.6845	90.4098	1995	TARA	71.6	Advocate Abdul Quddus	Dhaka	Mymensingh	Mymensingh Sadar	Bhabakhali	Chorkhai
S99-06095	RIP6095	24/05/1999	24.7269	90.4117	1992	TARA	64	Abdul Khaleque	Dhaka	Mymensingh	Mymensingh Sadar	Kewatkhali	Kewatkhali
S99-06096	RIP6096	24/05/1999	24.7676	90.4441	1997	HTW	59.4	Md Nekbar Ali	Dhaka	Mymensingh	Mymensingh Sadar	Char Nilakshia	Ragurampur
S99-06097	RIP6097	24/05/1999	24.7784	90.4361	1968	HTW	40.2	Union parishad office	Dhaka	Mymensingh	Mymensingh Sadar	Char Ishwardia	Char Haripur
S99-06098	RIP6098	24/05/1999	24.7935	90.4067	1994	HTW	48.8	Joy Bangla Mosque	Dhaka	Mymensingh	Mymensingh Sadar	Sirta	Gobindapur
S99-06099	RIP6099	24/05/1999	24.8369	90.3404	1997	TARA	48.2	Mirkandapara High School	Dhaka	Mymensingh	Mymensingh Sadar	Paranganj	Mirkandapur
S99-06100	RIP6100	24/05/1999	24.7709	90.388	1992	DTW	115.8	DPHE	Dhaka	Mymensingh	Mymensingh Sadar	Paurashava ward 1	Police line
S99-06101	RIP6101	25/05/1999	24.578	89.9731	1998	HTW	36	Sunil Chandra Rabidash	Dhaka	Tangail	Gopalpur	Dhopakandi	Sajanpur
S99-06102	RIP6102	25/05/1999	24.5708	89.8565	1997	HTW	36	Abdul Latif	Dhaka	Tangail	Gopalpur	Hemnagar	Banipara
S99-06103	RIP6103	25/05/1999	24.5885	89.864	1997	HTW	36	Abul Quasem	Dhaka	Tangail	Gopalpur	Jhaoail	Moail
S99-06104	RIP6104	25/05/1999	24.6017	89.8819	1990	HTW	27.4	Md Suraj Ali Khan	Dhaka	Tangail	Gopalpur	Nagdasimla	Chhota Hari
S99-06105	RIP6105	25/05/1999	24.6176	89.8903	1992	HTW	18.3	Chatutia Chowrasta	Dhaka	Tangail	Gopalpur	Hadira	Chatutia
S99-06106	RIP6106	25/05/1999	24.5482	89.9262	1984	DTW	76.2	Thana Parisad	Dhaka	Tangail	Gopalpur	Paurashava ward 03	Suti
S99-06107	RIP6107	25/05/1999	24.5404	89.8984	1996	HTW	32.6	Abdul Matalab	Dhaka	Tangail	Gopalpur	Alamnagar	Alamnagar
S99-06108	RIP6108	25/05/1999	24.5113	89.89	1999	HTW	36.3	Md Abdul Jalil	Dhaka	Tangail	Gopalpur	Mirzapur	Daulatpur
S99-06109	RIP6109	26/05/1999	24.3595	90.0447	1980	HTW	36.6	Alauddin Siddique college	Dhaka	Tangail	Kalihati	Birbasinda	Bhandeshwar
S99-06110	RIP6110	26/05/1999	24.3083	90.0311	1996	HTW	36.6	Rampur bazar mosque	Dhaka	Tangail	Kalihati	Balla	Rampur
S99-06111	RIP6111	26/05/1999	24.3873	89.991	1985	HTW	36.6	TNO house	Dhaka	Tangail	Kalihati	Kalihati	Kalihati
S99-06112	RIP6112	26/05/1999	24.389	89.9906	1995	DTW	106.7	Thana health complex	Dhaka	Tangail	Kalihati	Kalihati	Kalihati
S99-06113	RIP6113	26/05/1999	24.389	89.9906	1998	HTW	56.4	Abdul Latif Siddique (MP)	Dhaka	Tangail	Kalihati	Kalihati	Kalihati
S99-06114	RIP6114	26/05/1999	24.372	89.9611	1974	HTW	36.6	Bangra union parishad	Dhaka	Tangail	Kalihati	Bangra	Haldia
S99-06115	RIP6115	26/05/1999	24.4068	89.9116	1984	HTW	24.4	Narandia union Parishad	Dhaka	Tangail	Kalihati	Narandia	Daulatpur
S99-06116	RIP6116	26/05/1999	24.3833	89.8675	1982	HTW	36.6	Abdul Hamid Pradanic	Dhaka	Tangail	Kalihati	Salla	Salla
S99-06117	RIP6117	26/05/1999	24.3353	89.9191	1989	HTW	36.6	Elenga U P office	Dhaka	Tangail	Kalihati	Elenga	Elenga
S99-06118	RIP6118	27/05/1999	24.2403	89.9353	1999	HTW	35.7	Md Nadar Sekh	Dhaka	Tangail	Tangail Sadar	Karatia	Jalfai
S99-06119	RIP6119	27/05/1999	24.2827	89.9546	1980	HTW	31.4	Md Aminul Islam	Dhaka	Tangail	Tangail Sadar	Gharinda	Baruria
S99-06120	RIP6120	27/05/1999	24.2582	89.904	1994	HTW	21.3	Md Waheduzzaman (SAE)	Dhaka	Tangail	Tangail Sadar	Paurashava ward-05	Kagmara (Dakshin)
S99-06121	RIP6121	27/05/1999	24.204	89.8893	1999	HTW	35.7	Md Abdul Haque	Dhaka	Tangail	Tangail Sadar	Silimpur	Char Para
S99-06122	RIP6122	27/05/1999	24.2293	89.8663	1997	HTW	35.7	Auran Kumar Saha	Dhaka	Tangail	Tangail Sadar	Danya	Porabari
S99-06123	RIP6123	27/05/1999	24.2302	89.8498	1996	HTW	18.3	Md Abdul Mia	Dhaka	Tangail	Tangail Sadar	Katuli	Ghoanpara
S99-06124	RIP6124	27/05/1999	24.248	89.8688	1999	HTW	23.2	Abdur Razzaque	Dhaka	Tangail	Tangail Sadar	Danya	Bara Binyafair
S99-06125	RIP6125	27/05/1999	24.2593	89.8477	1998	HTW	40.5	Mirza Fazlul Haque	Dhaka	Tangail	Tangail Sadar	Hugra	Begantala
S99-06126	RIP6126	27/05/1999	24.3242	89.8861	1992	HTW	17.1	Md Matiur Rahman	Dhaka	Tangail	Tangail Sadar	Magra	Kuchbari
S99-06127	RIP6127	27/05/1999	24.2942	89.9195	1997	HTW	51.8	Balaram Shaha	Dhaka	Tangail	Tangail Sadar	Gala	Pachh Bikramhati
S99-06128	RIP6128	27/05/1999	24.2468	89.9359	1990	PW	24.4	Palli Biddut Shamiti	Dhaka	Tangail	Tangail Sadar	Paurashava-ward-01	Asekpur
S99-06129	RIP6129	28/05/1999	24.3191	90.1725	1997	HTW	37.2	TNO house	Dhaka	Tangail	Sakhipur	Gazaria	Sakhipur
S99-06130	RIP6130	28/05/1999	24.3168	90.1717	1989	DTW	76.2	Thana health complex	Dhaka	Tangail	Sakhipur	Gazaria	Sakhipur
S99-06131	RIP6131	28/05/1999	24.2109	90.1758	1998	TARA	54	UP office	Dhaka	Tangail	Sakhipur	Hatibandha	Taktar Chala
S99-06132	RIP6132	28/05/1999	24.2762	90.1654	1981	HTW	52.4	Md Siddiqur Rahman	Dhaka	Tangail	Sakhipur	Jadabpur	Boali
S99-06133	RIP6133	28/05/1999	24.3455	90.1572	1999	TARA	54.9	Forest bit office	Dhaka	Tangail	Sakhipur	Baheratail	Baheratail
S99-06134	RIP6134	28/05/1999	24.3523	90.2015	1993	TARA	51.8	Hazi Abdur Rauf	Dhaka	Tangail	Sakhipur	Kalia	Kachua
S99-06135	RIP6135	28/05/1999	24.3964	90.1916	1997	TARA	45.1	Md Abul Hossain	Dhaka	Tangail	Sakhipur	Kalia	Bara Chaona
S99-06136	RIP6136	29/05/1999	24.1526	89.9904	1997	HTW	22.9	Bathuli High School	Dhaka	Tangail	Delduar	Dubail	Dakshin Bathuli
S99-06137	RIP6137	29/05/1999	24.1751	89.952	1974	HTW	40.2	Dangalia madrassa	Dhaka	Tangail	Delduar	Delduar	Jangalia
S99-06138	RIP6138	29/05/1999	24.2051	89.9368	1976	HTW	40.5	Tara Prad Bashk	Dhaka	Tangail	Delduar	Pathrail	Pathrail
S99-06139	RIP6139	29/05/1999	24.1856	89.913	1982	HTW	34.1	Atia Mazar	Dhaka	Tangail	Delduar	Atia	Chala Atia
S99-06140	RIP6140	29/05/1999	24.1403	89.9007	1982	HTW	37.2	Elasin bazar mosque	Dhaka	Tangail	Delduar	Elasin	Panch Elasin
S99-06143	RIP6143	30/05/1999	24.0611	89.882	1998	HTW	22.9	Staff quarters	Dhaka	Tangail	Nagarpur	Nagarpur	Badnapara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-06094	3615220359	< 0.5	0.02	< 0.1	0.032	34	< 0.003	< 0.002	< 0.008	0.024	1.4	0.007	12.9	0.172	25.9	< 0.1	26	0.3	0.17	0.009	0.018
S99-06095	3615261598	0.6	0.02	< 0.1	0.038	40.3	< 0.003	< 0.002	< 0.008	1.24	1.7	0.009	16.3	0.31	31.9	< 0.1	25.5	0.5	0.2	< 0.002	0.022
S99-06096	3615240841	36.1	0.02	< 0.1	0.025	41.2	< 0.003	< 0.002	< 0.008	2.28	2.5	< 0.004	11	1.3	8.3	0.4	22.9	3.2	0.215	< 0.002	0.032
S99-06097	3615233269	59.4	< 0.01	< 0.1	< 0.002	< 0.1	< 0.003	< 0.002	< 0.008	< 0.005	< 0.5	< 0.004	< 0.04	< 0.002	1.6	< 0.1	< 0.03	< 0.2	< 0.0004	0.009	0.005
S99-06098	3615294448	45.7	0.06	< 0.1	0.048	18	< 0.003	< 0.002	< 0.008	2.59	1.7	< 0.004	4.83	0.435	4.6	1.4	21.2	0.2	0.0561	< 0.002	0.015
S99-06099	3615288710	0.7	0.38	< 0.1	0.036	33.7	< 0.003	< 0.002	< 0.008	0.408	1.2	< 0.004	12.4	0.191	13.7	0.1	23.2	2.1	0.126	0.005	0.102
S99-06100	3615263727	< 0.5	0.04	< 0.1	0.069	34.6	< 0.003	< 0.002	< 0.008	0.05	2	0.01	16.6	0.238	25.6	< 0.1	30.1	3.7	0.188	0.006	0.02
S99-06101	3933821887	39.9	0.02	0.1	0.107	25.6	< 0.003	< 0.002	< 0.008	7.22	4.3	< 0.004	13.5	1.86	10.6	0.5	28.6	0.4	0.0958	< 0.002	0.039
S99-06102	3933865094	11.8	0.02	< 0.1	0.11	37.2	< 0.003	< 0.002	< 0.008	8.42	3.6	< 0.004	12.7	0.442	9.3	0.7	21.9	19.5	0.119	< 0.002	0.043
S99-06103	3933873669	1.8	0.02	< 0.1	0.071	23.4	< 0.003	< 0.002	< 0.008	7.07	3.2	< 0.004	14.2	0.392	13.4	0.2	20.7	7.5	0.0702	< 0.002	0.034
S99-06104	3933894516	33.8	0.02	< 0.1	0.056	23.8	< 0.003	< 0.002	0.019	6.05	2.2	< 0.004	12.9	0.904	10.3	1.1	27.5	0.4	0.0776	< 0.002	0.039
S99-06105	3933858239	2.8	0.02	< 0.1	0.04	19.6	< 0.003	< 0.002	0.011	0.581	2.4	< 0.004	11.3	0.156	12.1	0.1	22.5	2.2	0.0558	< 0.002	0.019
S99-06106	3933803870	33.5	0.02	< 0.1	0.071	31.9	< 0.003	< 0.002	< 0.008	3.07	3.1	0.004	15.6	1.33	11.5	0.3	27	7.8	0.119	< 0.002	0.15
S99-06107	3933807012	6.6	0.02	< 0.1	0.084	20.4	< 0.003	< 0.002	< 0.008	5.17	2.6	< 0.004	12.2	0.252	16.6	0.3	25.3	1.7	0.0718	< 0.002	0.028
S99-06108	3933880302	4.1	0.02	< 0.1	0.127	27.6	< 0.003	< 0.002	< 0.008	10.9	3.4	< 0.004	16	0.574	9.1	1.2	27.2	7.6	0.0828	< 0.002	0.056
S99-06109	3934721161	39.3	0.02	< 0.1	0.114	34.1	< 0.003	< 0.002	< 0.008	5.28	1.8	< 0.004	12	1.35	19.1	0.5	32	0.5	0.175	< 0.002	0.025
S99-06110	3934707829	17.3	0.02	< 0.1	0.111	32.8	< 0.003	< 0.002	< 0.008	4.75	3.3	0.004	14.1	0.897	12.7	0.3	22.6	59.3	0.109	< 0.002	0.022
S99-06111	3934751510	14.1	0.02	< 0.1	0.092	27.3	< 0.003	< 0.002	0.019	3.56	3.5	0.008	17.1	1.11	20.8	0.3	25.1	10.8	0.0974	< 0.002	0.026
S99-06112	3934751510	9.7	0.02	< 0.1	0.076	43.6	0.008	< 0.002	< 0.008	2.22	3.4	0.009	18.2	3.5	13.5	0.1	30.5	6.9	0.242	< 0.002	0.088
S99-06113	3934751510	16.7	0.01	< 0.1	0.071	39.2	< 0.003	< 0.002	< 0.008	0.13	3.4	0.008	16.3	0.699	13.9	< 0.1	31.9	26.8	0.171	< 0.002	0.011
S99-06114	3934714409	45.5	0.03	< 0.1	0.117	30.5	< 0.003	< 0.002	< 0.008	17.6	2.1	< 0.004	10.3	0.7	10.7	0.9	27.1	0.4	0.107	< 0.002	0.05
S99-06115	3934773311	14.7	0.02	< 0.1	0.046	25.4	< 0.003	< 0.002	< 0.008	1.3	3.3	< 0.004	14.4	0.276	6.5	0.1	22.5	8.5	0.078	< 0.002	0.018
S99-06116	3934787874	7	0.04	< 0.1	0.165	83.1	< 0.003	< 0.002	< 0.008	3.6	6.3	0.004	46.7	1.53	27.6	0.3	9.58	72.3	0.349	< 0.002	0.029
S99-06117	3934736356	4	0.02	0.1	0.135	29	< 0.003	< 0.002	< 0.008	13.2	3.8	0.006	14.6	0.525	21.3	0.8	20.6	9.8	0.0921	< 0.002	0.02
S99-06118	3939559542	1.3	0.02	0.1	0.144	34.5	< 0.003	< 0.002	< 0.008	18.6	3.4	< 0.004	9.99	2.15	11.8	0.9	23.4	6.4	0.121	< 0.002	0.037
S99-06119	3939547133	21.5	0.02	< 0.1	0.14	35.1	< 0.003	< 0.002	< 0.008	10.1	4.5	< 0.004	19.4	1.98	19.6	0.7	23.6	28.5	0.157	< 0.002	0.023
S99-06120	3939505578	144	0.04	< 0.1	0.088	49.4	< 0.003	< 0.002	< 0.008	8.99	2.7	< 0.004	11	0.987	7.2	1.4	22.8	0.3	0.16	< 0.002	0.039
S99-06121	3939583316	17.4	0.02	0.2	0.121	32.3	< 0.003	< 0.002	< 0.008	17.5	3	0.005	9.81	1.1	12.4	1.2	24.6	8.6	0.101	< 0.002	0.036
S99-06122	3939517850	30.6	0.03	0.1	0.082	62.2	< 0.003	< 0.002	< 0.008	8.46	3.9	0.005	21.6	1.26	16	0.8	25.7	2.2	0.182	< 0.002	0.023
S99-06123	3939565471	0.6	0.08	< 0.1	0.096	104	< 0.003	< 0.002	< 0.008	0.119	5.3	< 0.004	25.5	1.74	4.7	0.1	14	1.4	0.333	< 0.002	0.024
S99-06124	3939517104	1.3	0.05	< 0.1	0.089	55.1	< 0.003	< 0.002	< 0.008	1.17	4.1	0.005	25.4	0.403	18.7	< 0.1	17.2	6.4	0.177	< 0.002	0.093
S99-06125	3939553149	83.6	0.03	< 0.1	0.093	69	< 0.003	< 0.002	< 0.008	9.63	4.1	0.004	26	1.89	7.1	0.9	25.6	19.2	0.233	< 0.002	0.027
S99-06126	3939577676	21.8	0.02	< 0.1	0.063	34.3	< 0.003	< 0.002	0.009	1.42	3.7	0.005	15.4	0.582	9.8	0.2	24.7	11.1	0.121	< 0.002	0.016
S99-06127	3939541804	40.4	0.02	< 0.1	0.045	35	< 0.003	< 0.002	< 0.008	1.45	3.1	0.006	13.4	1.34	8.2	0.3	23.7	10.4	0.119	< 0.002	0.019
S99-06128	3939501231	14.7	0.03	< 0.1	0.052	28.1	< 0.003	< 0.002	< 0.008	0.888	3.4	0.004	15.2	0.365	12.5	0.2	20	4.7	0.0825	< 0.002	0.064
S99-06129	3938527886	0.6	0.03	< 0.1	0.041	41.3	< 0.003	< 0.002	< 0.008	0.466	2	0.009	15.9	0.341	23.6	< 0.1	21.9	0.8	0.197	< 0.002	0.023
S99-06130	3938527886	< 0.5	0.02	< 0.1	0.04	33.9	< 0.003	< 0.002	0.023	0.215	1	0.005	12	0.893	24.9	< 0.1	31.3	0.9	0.191	0.003	0.036
S99-06131	3938540979	< 0.5	0.02	< 0.1	0.038	20.5	< 0.003	< 0.002	< 0.008	0.087	1	0.005	7.36	0.263	15.5	< 0.1	39.3	0.6	0.118	0.007	0.071
S99-06132	3938554264	< 0.5	0.04	< 0.1	0.026	24	< 0.003	< 0.002	< 0.008	0.563	0.8	0.012	9.4	0.998	21.9	< 0.1	32.9	0.4	0.141	0.003	0.147
S99-06133	3938513077	< 0.5	0.52	< 0.1	0.028	277	< 0.003	0.007	< 0.008	0.679	2.1	0.018	11.5	0.563	19.7	0.3	36.9	3.4	0.522	0.004	0.841
S99-06134	3938581575	< 0.5	0.02	< 0.1	0.02	32.7	< 0.003	< 0.002	< 0.008	0.06	1	< 0.004	10	0.309	23.9	< 0.1	30.3	0.4	0.197	0.004	0.024
S99-06135	3938581139	< 0.5	0.01	< 0.1	0.007	7.8	< 0.003	0.009	< 0.008	0.03	1.6	0.005	2.33	0.018	9.7	0.2	32.2	0.3	0.0674	0.003	0.041
S99-06136	3932323301	16.2	0.03	< 0.1	0.102	50	0.005	< 0.002	< 0.008	11.3	3.3	0.005	18.1	0.815	11.3	0.2	19.6	6.4	0.136	< 0.002	0.025
S99-06137	3932323505	38.9	0.02	< 0.1	0.079	31.3	< 0.003	< 0.002	< 0.008	10.2	3.2	0.007	14.5	1.53	11.2	0.6	26.2	7.7	0.103	< 0.002	0.022
S99-06138	3932371821	153	0.07	< 0.1	0.19	92.2	< 0.003	< 0.002	< 0.008	11.7	5.4	0.005	22	1.93	24.3	1.1	19.8	0.5	0.324	< 0.002	0.03
S99-06139	3932311293	73.7	0.02	< 0.1	0.081	37.9	< 0.003	< 0.002	< 0.008	6.73	4.9	< 0.004	12.9	0.84	7.2	1.4	23	0.3	0.112	< 0.002	0.023
S99-06140	3932347776	4.6	0.02	< 0.1	0.081	46.2	< 0.003	< 0.002	< 0.008	8.51	2.9	0.004	19.1	0.627	11	0.8	26.5	4.6	0.14	< 0.002	0.021
S99-06143	3937673069	149	0.03	< 0.1	0.08	54.2	< 0.003	< 0.002	< 0.008	8.54	2.5	< 0.004	14.6	0.983	5.4	1.2	25.4	< 0.2	0.149	< 0.002	0.14

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-06144	RIP6144	30/05/1999	24.0868	89.8785	1999	HTW	31.4	Sahabatpur bazar (rickshaw stand)	Dhaka	Tangail	Nagarpur	Sahabatpur	Sahabatpur
S99-06145	RIP6145	30/05/1999	24.2469	89.9108		DTW	0	DPHE supply well	Dhaka	Tangail	Tangail Sadar	Paurashava ward-03	Collegepara
S99-06146	RIP6146	01/06/1999	24.0922	90.5973	1997	TARA	52.7	Raonat Natun Bazar	Dhaka	Gazipur	Kapasia	Durgapur	Raonat
S99-06147	RIP6147	01/06/1999	24.0456	90.5739	1996	TARA	36.6	Chandpur Bazar	Dhaka	Gazipur	Kapasia	Chandpur	Chandpur
S99-06148	RIP6148	01/06/1999	24.1121	90.5726	1978	miniTAF	46.3	DPHE office	Dhaka	Gazipur	Kapasia	Kapasia	Saphaisri
S99-06149	RIP6149	02/06/1999	24.1117	90.6298	1980	HTW	53.3	Zahedul Haque	Dhaka	Gazipur	Kapasia	Karihata	Ekuria
S99-06150	RIP6150	02/06/1999	24.1879	90.657	1995	TARA	54.9	Afaz Uddin Sheik	Dhaka	Gazipur	Kapasia	Batrisab	Batrisab
S99-06151	RIP6151	02/06/1999	24.156	90.6298	1975	HTW	47.5	Beguni Bazar	Dhaka	Gazipur	Kapasia	Karihata	Merua
S99-06153	RIP6153	02/06/1999	24.1401	90.5795	1992	TARA	48.2	Nurul Islam	Dhaka	Gazipur	Kapasia	Targaon	Sonaura
S99-06155	RIP6155	02/06/1999	24.2234	90.5775	1997	HTW	46.3	Abdul Kadir	Dhaka	Gazipur	Kapasia	Singsree	Singsree
S99-06156	RIP6156	02/06/1999	24.1543	90.6705		HTW	29	Gagutia Chhana Bazar	Dhaka	Gazipur	Kapasia	Gagutia	Gagutia
S99-06157	RIP6157	02/06/1999	23.9936	90.4521	1998	TARA	57.3	Md Arman Sarker	Dhaka	Gazipur	Gazipur Sadar	Baria	Dari Baldha
S99-06158	RIP6158	02/06/1999	24.0007	90.4173	1998	DTW	138.7	DPHE DTW-3 Joydevpur bazar	Dhaka	Gazipur	Gazipur Sadar	Joydevpur	Paurashava ward01
S99-06159	RIP6159	02/06/1999	23.9834	90.4253	1994	TARA	62.2	Shambu Chandra Shell	Dhaka	Gazipur	Gazipur Sadar	Joydevpur	Bhora
S99-06160	RIP6160	02/06/1999	24.0268	90.3812	1997	TARA s,	55.2	Md Jasim Uddin	Dhaka	Gazipur	Gazipur Sadar	Kayaltia	Dakshin Salna
S99-06161	RIP6161	02/06/1999	24.0905	90.3452	1997	TARA	48.8	Professor Shampak	Dhaka	Gazipur	Gazipur Sadar	Mirzapur	Painsail
S99-06162	RIP6162	02/06/1999	23.9996	90.3996	1996	TARA	65.8	Md Shafiuddin	Dhaka	Gazipur	Gazipur Sadar	Basan	Telipara
S99-06163	RIP6163	02/06/1999	24.0115	90.3241	1998	TARA	54.9	Mizanur Rahman	Dhaka	Gazipur	Gazipur Sadar	Konabari	Mirpur
S99-06164	RIP6164	02/06/1999	23.9456	90.3827	1994	TARA	65.8	Gachha U P office	Dhaka	Gazipur	Gazipur Sadar	Gachha	Kalemeswar
S99-06165	RIP6165	02/06/1999	23.8937	90.402	1993	HTW	41.1	Masimpur Bastai (behind tongi Hospita	Dhaka	Gazipur	Gazipur Sadar	Tongi PSA ward -02	Machimpur
S99-06166	RIP6166	02/06/1999	23.8955	90.4003	1998	DTW	155.4	DPHE DTW Istama Field	Dhaka	Gazipur	Gazipur Sadar	Tongi PSA ward-02	Bhoram
S99-06167	RIP6167	03/06/1999	23.9829	90.6003	1998	TARA	64	Md Wahab Ali	Dhaka	Gazipur	Kaliganj (G)	Jamalpur	Jamalpur
S99-06168	RIP6168	03/06/1999	24.0111	90.5764	1996	TARA	57.9	Md Kafiluddin	Dhaka	Gazipur	Kaliganj (G)	Noktarpur	Potan
S99-06169	RIP6169	03/06/1999	24.0078	90.5421	1993	TARA	44.8	Jangalia Etimkhana	Dhaka	Gazipur	Kaliganj (G)	Jangalia	Jangalia
S99-06170	RIP6170	03/06/1999	23.9882	90.5453	1991	TARA	89.9	Md Maslah Uddin	Dhaka	Gazipur	Kaliganj (G)	Baktarpur	Kalun
S99-06171	RIP6171	03/06/1999	23.9778	90.5538	1996	HTW	24.4	Phuldi Mosque	Dhaka	Gazipur	Kaliganj (G)	Baktarpur	Phuldi
S99-06172	RIP6172	03/06/1999	23.9277	90.4474	1998	TARA	66.4	Md Alauddin	Dhaka	Gazipur	Gazipur Sadar	Pubail	Talatia
S99-06173	RIP6173	08/06/1999	24.882	89.4492	1992	HTW	14	Abdul Sayed	Rajshahi	Bogra	Gabtali	Gabtali	Gabtali
S99-06174	RIP6174	08/06/1999	24.9388	89.4081	1994	HTW	19.8	Abdul Sattar	Rajshahi	Bogra	Gabtali	Ramashwarpur	Satihara
S99-06175	RIP6175	08/06/1999	24.967	89.4357	1994	HTW	21.9	Abdul Bari	Rajshahi	Bogra	Gabtali	Sonarai	Khupi
S99-06176	RIP6176	08/06/1999	24.9051	89.5066	1996	HTW	21.9	Kadamtali High School	Rajshahi	Bogra	Gabtali	Nepaltali	Kadamtali
S99-06177	RIP6177	08/06/1999	24.8636	89.4956	1997	HTW	14	Md Shafiqul Islam	Rajshahi	Bogra	Gabtali	Durgahata	Hatibandha
S99-06178	RIP6178	08/06/1999	24.8796	89.4467	1993	TARA	32	DPHE Thana Compound	Rajshahi	Bogra	Gabtali	Gabtali	Gabtali
S99-06179	RIP6179	08/06/1999	24.8352	89.4611	1992	HTW	15.2	Abdur Razzaque	Rajshahi	Bogra	Gabtali	Mahishaban	Maria
S99-06180	RIP6180	08/06/1999	24.811	89.4849	1990	HTW	22.9	Kalakupa Bazar	Rajshahi	Bogra	Gabtali	Baliadighi	Baliadighi
S99-06181	RIP6181	08/06/1999	24.7839	89.4751	1998	HTW	22.9	Baghbari S U Senior Madrasha	Rajshahi	Bogra	Gabtali	Nasipur	Nasipur
S99-06182	RIP6182	09/06/1999	24.8214	89.0438	1978	HTW	18.9	DPHE thana compound	Rajshahi	Bogra	Adamdighi	Adamdighi	Adamdighi
S99-06183	RIP6183	09/06/1999	24.8217	89.0418	1984	DTW	0	Thana Parishad	Rajshahi	Bogra	Adamdighi	Adamdighi	Adamdighi
S99-06184	RIP6184	09/06/1999	24.8394	89.0222	1990	TARA	25.3	Md Nazir-uz-Zaman Takuldar	Rajshahi	Bogra	Adamdighi	Chhatiangram	Kaikuri
S99-06185	RIP6185	09/06/1999	24.7877	88.9936	1995	TARA	25.3	Hafiza Rahman (Sandira Dighirpar Mos	Rajshahi	Bogra	Adamdighi	Santahar	Sandira
S99-06186	RIP6186	09/06/1999	24.8312	89.0749	1992	TARA	25.3	Md Bahar Ali	Rajshahi	Bogra	Adamdighi	Nasratpur	Murail
S99-06187	RIP6187	09/06/1999	24.7612	89.1017	1994	TARA	25.3	Md Akram Hossain	Rajshahi	Bogra	Adamdighi	Champapur	Bihigram
S99-06188	RIP6188	09/06/1999	24.7973	89.134	1991	TARA	25.3	Joynul Abedin (Kundagram U P Office	Rajshahi	Bogra	Adamdighi	Kundagram	Kunagram
S99-06189	RIP6189	10/06/1999	24.7918	89.2755	1994	HTW	25.3	Malancha Bazar Mosque	Rajshahi	Bogra	Kahaloo	Malancha	Aghor
S99-06190	RIP6190	10/06/1999	24.7627	89.248	1992	HTW	18.9	Jamgaon Bazar	Rajshahi	Bogra	Kahaloo	Jamgaon	Jamgaon
S99-06191	RIP6191	10/06/1999	24.8216	89.209	1992	HTW	21.3	Md Abdul Khalaque Mollah	Rajshahi	Bogra	Kahaloo	Durgapur	Pratapur
S99-06192	RIP6192	10/06/1999	24.8369	89.2685	1976	HTW	18.9	DPHE Compound	Rajshahi	Bogra	Kahaloo	Kahaloo	Kahaloo
S99-06193	RIP6193	10/06/1999	24.867	89.2462	1993	TARA	25.3	Silkonar South Maktab	Rajshahi	Bogra	Kahaloo	Narahatta	Silkonar

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-06144	3937687864	30.3	< 0.01	< 0.1	0.21	82.8	< 0.003	< 0.002	< 0.008	9.03	3.8	0.004	29.7	1.48	26.1	1.3	26.6	5.6	0.294	< 0.002	0.021
S99-06145	3939503370	20.1	< 0.01	< 0.1	0.195	82.8	< 0.003	< 0.002	< 0.008	6.22	7.4	0.005	27.5	1.21	34.1	0.5	23	22.7	0.279	< 0.002	0.015
S99-06146	3333625820	0.8	< 0.01	< 0.1	0.021	26.1	< 0.003	< 0.002	< 0.008	0.065	1.3	< 0.004	7.65	0.042	24.7	0.2	34.2	1.3	0.166	0.008	0.009
S99-06147	3333617229	< 0.5	< 0.01	< 0.1	0.132	46.8	< 0.003	< 0.002	< 0.008	1.45	2.1	< 0.004	18.7	0.217	37.8	< 0.1	34	3.3	0.285	< 0.002	0.015
S99-06148	3333643874	< 0.5	< 0.01	< 0.1	0.045	26.9	< 0.003	< 0.002	< 0.008	0.044	1.7	0.004	11	0.025	26.7	0.4	33.6	1.2	0.161	0.009	0.025
S99-06149	3333651428	< 0.5	0.02	< 0.1	0.008	26.2	< 0.003	< 0.002	< 0.008	0.234	2.5	0.005	10.5	0.006	24.9	0.2	39.6	1.4	0.156	0.002	0.039
S99-06150	3333608138	< 0.5	0.08	< 0.1	0.025	13.5	< 0.003	0.006	< 0.008	0.68	2.6	< 0.004	3.64	0.009	14.5	0.2	36.3	2.4	0.132	< 0.002	0.08
S99-06151	3333651687	< 0.5	0.04	< 0.1	0.018	19.4	< 0.003	0.012	< 0.008	0.615	1.6	< 0.004	4.91	0.01	23.5	0.2	37.7	0.4	0.138	0.002	0.04
S99-06153	3333686916	< 0.5	< 0.01	< 0.1	0.013	27.3	< 0.003	< 0.002	< 0.008	0.03	1.1	0.008	8.4	0.042	25.9	< 0.1	36.3	0.4	0.168	0.003	0.032
S99-06155	3333677898	< 0.5	< 0.01	< 0.1	0.032	6.7	< 0.003	0.015	< 0.008	0.124	2.1	< 0.004	2.11	< 0.002	8.5	< 0.1	26	1.6	0.078	< 0.002	0.022
S99-06156	3333634440	< 0.5	< 0.01	< 0.1	0.051	4.8	< 0.003	0.005	< 0.008	0.112	2	< 0.004	1.43	0.002	4.9	< 0.1	17.4	0.3	0.0557	< 0.002	0.024
S99-06157	3333025368	< 0.5	0.01	< 0.1	0.035	19.9	< 0.003	< 0.002	< 0.008	0.172	< 0.5	0.018	9.32	0.781	27	< 0.1	36	0.2	0.123	0.004	0.018
S99-06158	3333060471	< 0.5	< 0.01	< 0.1	0.074	31.5	< 0.003	< 0.002	< 0.008	0.041	1.7	0.008	15	0.019	28.4	0.1	33.2	0.4	0.182	< 0.002	0.014
S99-06159	3333040163	< 0.5	< 0.01	< 0.1	0.106	34	< 0.003	< 0.002	< 0.008	0.041	1.2	0.006	14.8	0.368	33.6	0.2	29.7	2.3	0.207	< 0.002	0.018
S99-06160	3333054305	< 0.5	< 0.01	< 0.1	0.075	43.9	< 0.003	< 0.002	< 0.008	0.087	1.4	0.012	15	0.208	28.6	< 0.1	24.1	0.2	0.203	< 0.002	0.013
S99-06161	3333067791	< 0.5	< 0.01	< 0.1	0.017	9.9	< 0.003	0.012	< 0.008	0.031	1.9	< 0.004	3.02	0.011	11.1	0.2	33.2	0.3	0.0941	0.004	0.098
S99-06162	3333013978	< 0.5	0.02	< 0.1	0.144	76.4	< 0.003	< 0.002	< 0.008	0.083	1.5	0.015	24	0.271	71.1	< 0.1	20.2	0.6	0.425	< 0.002	0.018
S99-06163	3333060687	< 0.5	< 0.01	< 0.1	0.007	9.6	< 0.003	0.015	< 0.008	0.029	1.7	< 0.004	3.44	0.01	10.8	0.1	36	0.3	0.0795	0.003	0.048
S99-06164	3333031576	0.6	0.03	0.1	0.136	41.7	< 0.003	< 0.002	< 0.008	0.57	1.6	0.009	16.7	0.111	51.4	0.1	23.3	0.3	0.259	< 0.002	0.023
S99-06165	3333002680	< 0.5	0.02	< 0.1	0.061	20.8	< 0.003	< 0.002	< 0.008	0.175	0.8	< 0.004	12.4	0.171	38.9	0.1	24	0.7	0.154	< 0.002	0.015
S99-06166	3333002209	< 0.5	0.02	< 0.1	0.031	17.4	< 0.003	< 0.002	< 0.008	0.326	1.2	0.004	5.99	0.155	21.4	0.1	29.6	0.7	0.117	< 0.002	0.48
S99-06167	3333460491	2.1	0.01	< 0.1	0.089	22.2	< 0.003	< 0.002	< 0.008	0.14	1.2	< 0.004	9.38	0.024	24.1	0.2	22.8	< 0.2	0.154	0.003	0.042
S99-06168	3333494827	1.1	0.02	< 0.1	0.076	21.6	< 0.003	< 0.002	< 0.008	1.28	1	< 0.004	10.5	0.096	25.9	0.3	25	< 0.2	0.155	< 0.002	0.025
S99-06169	3333469508	< 0.5	0.03	< 0.1	0.123	72.5	< 0.003	< 0.002	< 0.008	0.434	2	0.008	22.1	0.323	46.2	0.1	23.3	0.7	0.327	< 0.002	0.035
S99-06170	3333417547	< 0.5	0.02	< 0.1	0.034	26.9	< 0.003	< 0.002	< 0.008	0.054	0.8	< 0.004	11.4	0.449	32	0.1	27.5	< 0.2	0.164	0.006	0.019
S99-06171	3333417816	< 0.5	0.03	< 0.1	0.09	28.4	< 0.003	< 0.002	< 0.008	0.54	0.9	< 0.004	11.2	0.585	15.1	0.2	27.8	7.5	0.246	< 0.002	0.027
S99-06172	3333081921	2.4	0.02	< 0.1	0.075	16.9	< 0.003	< 0.002	< 0.008	1.53	1	< 0.004	8.43	0.322	30.6	0.2	32.6	0.5	0.11	< 0.002	0.035
S99-06173	5104033299	< 0.5	0.02	< 0.1	0.08	54.1	< 0.003	< 0.002	< 0.008	0.09	2.9	0.005	32.5	0.006	26.2	0.1	17.2	150	0.256	< 0.002	0.021
S99-06174	5104081874	632	0.02	0.2	0.525	74.4	0.004	< 0.002	< 0.008	18	6.3	0.007	26.3	2.24	46.8	0.8	20.5	20.2	0.461	< 0.002	0.033
S99-06175	5104088500	20.1	0.01	< 0.1	0.071	34.8	< 0.003	< 0.002	< 0.008	0.442	3.2	0.005	17.4	0.484	17.2	0.1	29.5	0.5	0.128	< 0.002	0.02
S99-06176	5104074425	10.8	< 0.01	< 0.1	0.037	14.4	< 0.003	< 0.002	< 0.008	1.43	3.1	< 0.004	7.08	0.313	13.1	0.3	17.1	3.7	0.0549	< 0.002	0.01
S99-06177	5104027379	35.2	0.01	0.1	0.238	40.5	< 0.003	< 0.002	0.01	18.7	10.5	< 0.004	17	0.93	35.3	1.4	26.6	22	0.119	< 0.002	0.031
S99-06178	5104033299	19.4	0.01	< 0.1	0.137	34.5	0.006	< 0.002	< 0.008	9.11	3.3	< 0.004	16.6	0.662	16.7	1	27.6	2.1	0.157	< 0.002	0.024
S99-06179	5104054609	0.7	< 0.01	< 0.1	0.043	17.8	< 0.003	< 0.002	< 0.008	0.313	1.7	< 0.004	8.04	0.968	7.9	< 0.1	18.4	2.4	0.0849	< 0.002	0.012
S99-06180	5104006063	8.6	< 0.01	< 0.1	0.02	6.5	< 0.003	< 0.002	< 0.008	1.16	1.9	< 0.004	3.28	0.188	6.1	0.3	20.6	1.9	0.0274	< 0.002	0.01
S99-06181	5104067672	1.7	< 0.01	< 0.1	0.047	14.2	< 0.003	< 0.002	< 0.008	1.43	1.7	< 0.004	6.49	0.149	11.7	0.1	23.6	8.5	0.0648	< 0.002	0.011
S99-06182	5100613008	< 0.5	0.01	< 0.1	0.029	26.1	< 0.003	< 0.002	< 0.008	0.039	0.5	0.011	9.21	0.292	25.3	< 0.1	28.4	10.6	0.0954	0.002	0.012
S99-06183	5100613008	1.4	0.14	< 0.1	0.053	93.1	< 0.003	< 0.002	< 0.008	0.298	2.1	0.012	14.9	0.352	30.1	0.1	28.2	4.6	0.225	< 0.002	0.195
S99-06184	5100640444	1.2	0.01	< 0.1	0.04	41.7	< 0.003	< 0.002	< 0.008	0.837	2.3	0.01	14.7	0.428	22.9	< 0.1	29.7	6.8	0.15	< 0.002	0.024
S99-06185	5100681843	1	0.02	< 0.1	0.048	58	< 0.003	< 0.002	< 0.008	0.187	2.5	0.013	21	0.426	31.7	0.1	31.4	22.6	0.202	< 0.002	0.026
S99-06186	5100667692	1.4	0.02	< 0.1	0.058	60.1	< 0.003	< 0.002	< 0.008	0.577	2.5	0.01	15.5	0.41	23.6	0.1	26.8	3.8	0.184	< 0.002	0.222
S99-06187	5100627115	< 0.5	0.01	< 0.1	0.023	23.5	< 0.003	< 0.002	< 0.008	0.07	< 0.5	0.007	7.93	0.555	12.9	< 0.1	28.8	0.7	0.0666	< 0.002	0.046
S99-06188	5100654039	< 0.5	0.02	< 0.1	0.042	43.7	< 0.003	< 0.002	< 0.008	0.143	1.3	0.005	9.21	0.187	23.8	< 0.1	24.1	2.5	0.156	< 0.002	0.027
S99-06189	5105457023	2	0.02	< 0.1	0.046	44.7	< 0.003	< 0.002	< 0.008	0.555	2.7	0.008	14.1	0.682	19.1	< 0.1	28.3	4.8	0.141	< 0.002	0.02
S99-06190	5105428449	< 0.5	0.03	< 0.1	0.04	64.5	< 0.003	< 0.002	< 0.008	0.043	2.8	0.009	12	0.479	24	< 0.1	19.1	10.8	0.252	< 0.002	0.019
S99-06191	5105419863	< 0.5	0.06	< 0.1	0.068	92.7	< 0.003	< 0.002	< 0.008	0.048	2.9	0.013	18.8	0.711	43.9	< 0.1	23.8	9.7	0.355	< 0.002	0.066
S99-06192	5105438473	< 0.5	0.02	< 0.1	0.035	54.3	< 0.003	< 0.002	< 0.008	0.217	0.9	< 0.004	9.23	0.204	25.8	< 0.1	17.6	8.6	0.232	< 0.002	0.022
S99-06193	5105476947	< 0.5	< 0.01	< 0.1	0.02	24.9	< 0.003	< 0.002	< 0.008	0.705	1.2	< 0.004	7.91	0.366	22	< 0.1	25.8	2.1	0.0859	< 0.002	0.017

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-06194	RIP6194	10/06/1999	24.8696	89.2154	1990	HTW	18.9	Shekahar Bus Stand	Rajshahi	Bogra	Kahaloo	Birkedar	Sekahar Shyampur
S99-06195	RIP6195	10/06/1999	24.896	89.2212	1994	HTW	18.9	Kornipara Bazar	Rajshahi	Bogra	Kahaloo	Kalaimajpara	Kalai
S99-06196	RIP6196	10/06/1999	24.8909	89.2988	1996	HTW	14	Uchul Baria Bazar	Rajshahi	Bogra	Kahaloo	Paikar	Maligachha
S99-06197	RIP6197	10/06/1999	24.8583	89.2969	1985	HTW	18.9	Murail Bazar Mosque	Rajshahi	Bogra	Kahaloo	Murail	Murail
S99-06198	RIP6198	11/06/1999	25.0069	89.3176	1983	HTW	26.5	Md Azhar Ali	Rajshahi	Bogra	Shibganj (B)	Bihar	Banail
S99-06199	RIP6199	11/06/1999	24.981	89.2047	1996	TARA	25.3	Khairar Pukur Bazar	Rajshahi	Bogra	Shibganj (B)	Pirab	Palikanda
S99-06200	RIP6200	11/06/1999	24.9739	89.2582	1998	TARA	25.3	Jamtala Bazar	Rajshahi	Bogra	Shibganj (B)	Buriganj	Panchadah
S99-06201	RIP6201	11/06/1999	25.0165	89.2838	1998	HTW	36.6	Md Sah Alam	Rajshahi	Bogra	Shibganj (B)	Atmul	Betgari
S99-06202	RIP6202	11/06/1999	25.0544	89.2679	1998	TARA	36.6	Manjurul Islam	Rajshahi	Bogra	Shibganj (B)	Kichak	Chinal
S99-06203	RIP6203	11/06/1999	25.0693	89.3269	1999	TARA	25.3	Juria Anantapur Primary School	Rajshahi	Bogra	Shibganj (B)	Shibganj	Dhawagir
S99-06204	RIP6204	11/06/1999	25.0225	89.3323	1998	HTW	10.7	Azizul Haque	Rajshahi	Bogra	Shibganj (B)	Shibganj	Uthali
S99-06205	RIP6205	11/06/1999	25.019	89.4227	1995	HTW	16.8	Md Rezaul Paramank	Rajshahi	Bogra	Shibganj (B)	Saidpur	Khernapara
S99-06206	RIP6206	11/06/1999	25.0168	89.368	1998	TARA	36.6	Mokamtala Eidgah	Rajshahi	Bogra	Shibganj (B)	Mokamtala	Ganeshpur
S99-06207	RIP6207	11/06/1999	24.9492	89.3475	1998	TARA	25.3	Md Afzal Hossain	Rajshahi	Bogra	Shibganj (B)	Rainagar	Mahasthangar
S99-06208	RIP6208	12/06/1999	24.8733	89.64	1997	HTW	14	Md. Ranju kazi	Rajshahi	Bogra	Sariakandi	Karnibari	Chhanpacha
S99-06209	RIP6209	12/06/1999	24.9167	89.6167	1998	HTW	7.9	Md. Ishak Ali	Rajshahi	Bogra	Sariakandi	Kazla	Kazla
S99-06210	RIP6210	12/06/1999	24.7783	89.6	1980	HTW	18	Md. Nur Hassan khan	Rajshahi	Bogra	Sariakandi	Kamalpur	Rauhadaha
S99-06211	RIP6211	12/06/1999	24.9875	89.65	1996	HTW	9.1	Md. Shaheb Uddin sekh	Rajshahi	Bogra	Sariakandi	Chaluabari	Char Manikdair
S99-06212	RIP6212	12/06/1999	24.8929	89.5731	1984	DTW	146.3	Thana parishad	Rajshahi	Bogra	Sariakandi	Sariakandi	Dhap
S99-06213	RIP6213	12/06/1999	24.9334	89.5735	1998	HTW	22.6	Md Mosthafizur Rahman	Rajshahi	Bogra	Sariakandi	Hatsherpur	Khordbalali
S99-06214	RIP6214	12/06/1999	24.886	89.5631	1993	HTW	11	Mantu Dash	Rajshahi	Bogra	Sariakandi	Sarikandi	Hindukandi
S99-06215	RIP6215	12/06/1999	24.9102	89.5415	1991	TARA	25.3	Kaimul Islam	Rajshahi	Bogra	Sariakandi	Narchi	Narchi
S99-06216	RIP6216	12/06/1999	24.8172	89.5474	1998	HTW	22.6	Chhaihata High School	Rajshahi	Bogra	Sariakandi	Bhelabari	Chhaihata
S99-06217	RIP6217	12/06/1999	24.8655	89.5532	1981	HTW	16.2	Ramchandrapur High School	Rajshahi	Bogra	Sariakandi	Fulbari	Fulbari
S99-06218	RIP6218	12/06/1999	24.9102	89.5415	1998	HTW	14	Alhaz Matiur Rahman	Rajshahi	Bogra	Sariakandi	Narchi	Narchi
S99-06219	RIP6219	14/06/1999	24.9198	89.3242	1994	TARA	25.3	Ghora Dhap Bazar	Rajshahi	Bogra	Bogra Sadar	Noongola	Hazradighi
S99-06220	RIP6220	14/06/1999	24.948	89.2962	1997	TARA	25.3	Abdul Samad	Rajshahi	Bogra	Bogra Sadar	Namuja	Namuja
S99-06221	RIP6221	14/06/1999	24.9537	89.3673	1991	TARA	25.3	Md Chan Mia	Rajshahi	Bogra	Bogra Sadar	Lahisipara	Lahisipar
S99-06222	RIP6222	14/06/1999	24.9038	89.3762	1995	HTW	18.3	U. P. Parishad Office	Rajshahi	Bogra	Bogra Sadar	Shakharia	Banamalipara
S99-06223	RIP6223	14/06/1999	24.8809	89.3535	1981	HTW	18.9	Abdul Sattar	Rajshahi	Bogra	Bogra Sadar	Nishindara	Barakpur
S99-06224	RIP6224	14/06/1999	24.8453	89.3648	1985	HTW	20.1	DPHE compound	Rajshahi	Bogra	Bogra Sadar	Pourashava Ward-03	Sejgari
S99-06225	RIP6225	14/06/1999	24.8453	89.3648	1984	DTW	31.4	DPHE supply well, pump No. 09	Rajshahi	Bogra	Bogra Sadar	Pourashava Ward-03	Sejgari
S99-06226	RIP6226	15/06/1999	25.6649	89.617	1992	HTW	13.7	DPHE office	Rajshahi	Kurigram	Ulipur	Ulipur	Ulipur
S99-06227	RIP6227	15/06/1999	25.5969	89.6167	1984	DTW	54.9	Thana Parishad	Rajshahi	Kurigram	Ulipur	Ulipur	Ulipur
S99-06228	RIP6228	15/06/1999	25.759	89.7181	1996	HTW	12.5	Mohammed Ali	Rajshahi	Kurigram	Ulipur	Begumganj	Akel Mamud
S99-06229	RIP6229	15/06/1999	25.6751	89.6632	1995	HTW	13.4	Chawmohani	Rajshahi	Kurigram	Ulipur	Dhamsreni	Kaslagari Harlpur
S99-06230	RIP6230	15/06/1999	25.7278	89.6516	1996	HTW	16.5	Mandal Hat High School	Rajshahi	Kurigram	Ulipur	Buraburi	Sadi
S99-06231	RIP6231	15/06/1999	25.7369	89.6272	1996	HTW	13.7	U P Office	Rajshahi	Kurigram	Ulipur	Durgapur	Goral
S99-06232	RIP6232	15/06/1999	25.5847	89.5993	1991	HTW	13.7	U P Office	Rajshahi	Kurigram	Ulipur	Bazra	Bazra
S99-06233	RIP6233	15/06/1999	25.6716	89.5527	1998	TARA	27.4	Md Joynal Abedin	Rajshahi	Kurigram	Ulipur	Thetrai	Dari Kishopur
S99-06234	RIP6234	15/06/1999	25.7019	89.5534	1988	HTW	13.7	U P Office	Rajshahi	Kurigram	Ulipur	Daldalia	Uttar Daldalia
S99-06235	RIP6235	16/06/1999	26.0016	89.6528	1997	TARA	31.7	Md Samshul Haque	Rajshahi	Kurigram	Nageshwari	Santoshpur	Gopalpur
S99-06236	RIP6236	16/06/1999	26.036	89.641	1994	HTW	24.4	Nakharganj Bazar Mosque	Rajshahi	Kurigram	Nageshwari	Ramkhana	Dakshin Ramkhana
S99-06237	RIP6237	16/06/1999	26.0372	89.6818	1984	HTW	18	Raiganj Bazar Mosque	Rajshahi	Kurigram	Nageshwari	Raiganj .	Raiganj
S99-06238	RIP6238	16/06/1999	25.9687	89.6892	1984	HTW	29.9	Md Abdul Quader (B.Sc)	Rajshahi	Kurigram	Nageshwari	Nageshwari	Paschim Nageshwari
S99-06239	RIP6239	16/06/1999	25.9604	89.6939	1997	HTW	13.4	Abdur Rahman	Rajshahi	Kurigram	Nageshwari	Nageshwari	Paschim Nageshwari
S99-06240	RIP6240	16/06/1999	25.9182	89.7497	1992	TARA	29.9	Md Shishir Ali	Rajshahi	Kurigram	Nageshwari	Kaliganj	Salmara
S99-06241	RIP6241	16/06/1999	25.892	89.7088	1998	TARA	28.7	Hena Rani	Rajshahi	Kurigram	Nageshwari	Bhitarband	Bhabanipur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-06194	5105409923	< 0.5	0.09	< 0.1	0.023	66.1	< 0.003	< 0.002	< 0.008	0.078	1	0.006	9.84	0.233	23.5	0.1	21.9	2.4	0.176	< 0.002	0.12
S99-06195	5105447485	1.6	0.02	< 0.1	0.056	44.3	< 0.003	< 0.002	< 0.008	0.58	2.4	0.008	12.9	0.296	21.8	0.2	25.5	9.4	0.124	< 0.002	0.018
S99-06196	5105485703	0.6	0.04	< 0.1	0.042	50.5	< 0.003	< 0.002	< 0.008	0.741	1.5	< 0.004	11.8	0.204	22.8	0.1	22.8	2.9	0.147	< 0.002	0.046
S99-06197	5105466731	< 0.5	0.02	< 0.1	0.045	49.7	< 0.003	< 0.002	< 0.008	0.035	1.5	0.013	18.4	1.07	33	< 0.1	24.8	4.2	0.156	< 0.002	0.018
S99-06198	5109415109	88	< 0.01	< 0.1	0.069	29.2	< 0.003	< 0.002	< 0.008	10.4	3.2	0.005	6.51	0.199	8.7	1.1	22.2	< 0.2	0.0898	< 0.002	0.018
S99-06199	5109471707	2	0.02	< 0.1	0.052	35	< 0.003	< 0.002	< 0.008	0.579	1.4	0.006	11.2	0.395	21.7	< 0.1	27.6	2.5	0.124	< 0.002	0.018
S99-06200	5109423795	1.4	0.02	< 0.1	0.036	26.7	< 0.003	< 0.002	< 0.008	0.291	1.4	< 0.004	8.79	0.195	21.4	< 0.1	28.9	1	0.0974	< 0.002	0.014
S99-06201	5109407154	6.3	< 0.01	< 0.1	0.037	25.2	< 0.003	< 0.002	< 0.008	1.35	1.6	< 0.004	8.35	0.381	14.4	< 0.1	27.2	8.9	0.095	< 0.002	0.012
S99-06202	5109439296	1.9	0.01	< 0.1	0.057	24	< 0.003	< 0.002	< 0.008	0.867	1.8	0.004	7.96	0.311	18.6	0.1	30.3	0.7	0.0815	< 0.002	0.212
S99-06203	5109494353	91.7	0.01	< 0.1	0.094	28.2	< 0.003	< 0.002	< 0.008	14.9	2.5	< 0.004	8.17	1.26	13.1	0.6	22.1	0.3	0.106	< 0.002	0.095
S99-06204	5109494982	1.7	< 0.01	< 0.1	0.048	20.7	< 0.003	< 0.002	< 0.008	0.717	4.5	< 0.004	7.76	0.234	12.2	< 0.1	14.8	12.4	0.0731	< 0.002	0.041
S99-06205	5109487580	0.9	0.01	< 0.1	0.055	32.8	< 0.003	< 0.002	< 0.008	0.185	3.7	0.005	14.9	0.27	29	< 0.1	15.8	13.4	0.122	< 0.002	0.036
S99-06206	5109463377	41.5	0.01	< 0.1	0.049	27.2	< 0.003	< 0.002	< 0.008	0.299	2.3	0.004	12.8	0.963	13.9	0.6	27.4	0.4	0.0845	< 0.002	0.085
S99-06207	5109476642	2.1	< 0.01	< 0.1	0.021	9.3	< 0.003	< 0.002	< 0.008	0.04	35.6	0.005	5.38	1.18	7.9	5.2	43.5	3.3	0.0275	0.01	0.04
S99-06208	5108156293	< 0.5	0.1	< 0.1	0.115	141	< 0.003	< 0.002	< 0.008	0.73	7.6	< 0.004	31.1	0.546	5.9	0.2	11.4	73.5	0.424	< 0.002	0.037
S99-06209	5108155491	2.2	0.06	< 0.1	0.143	148	< 0.003	< 0.002	0.011	0.228	7.5	< 0.004	32.3	1.96	5.1	0.1	11.7	23.9	0.477	< 0.002	0.062
S99-06210	5108144841	< 0.5	0.03	< 0.1	0.043	27.3	< 0.003	< 0.002	< 0.008	1.08	3.9	0.004	13.6	0.614	14.3	0.1	15.4	7.7	0.0871	< 0.002	0.656
S99-06211	5108119220	< 0.5	0.06	< 0.1	0.15	146	0.003	< 0.002	0.009	0.435	7.2	0.004	30.4	1.23	5.9	0.1	11	24.5	0.519	< 0.002	0.033
S99-06212	5108188389	3	< 0.01	< 0.1	0.021	12.7	< 0.003	< 0.002	< 0.008	0.62	2.5	< 0.004	5.95	0.166	3.3	0.2	15.5	6	0.0496	< 0.002	0.062
S99-06213	5108137561	< 0.5	0.02	< 0.1	0.042	24.5	< 0.003	< 0.002	< 0.008	0.097	3.1	< 0.004	12.8	0.024	8	< 0.1	17.5	7.6	0.0886	< 0.002	0.037
S99-06214	5108188465	150	0.03	0.1	0.102	48.3	< 0.003	< 0.002	< 0.008	10.9	4.8	0.006	16	3.7	6.8	1.4	25.7	1	0.138	< 0.002	0.037
S99-06215	5108175702	37.3	< 0.01	0.2	0.099	28.4	0.004	< 0.002	< 0.008	23.6	2.9	< 0.004	12.2	1.48	10.7	0.8	21.9	< 0.2	0.0901	< 0.002	0.034
S99-06216	5108106287	0.9	0.01	< 0.1	0.032	21.7	< 0.003	< 0.002	< 0.008	0.077	2.2	< 0.004	10	1.14	12.1	< 0.1	21.1	6.3	0.074	< 0.002	0.025
S99-06217	5108131803	< 0.5	< 0.01	< 0.1	0.036	20.1	< 0.003	< 0.002	< 0.008	0.143	2.5	< 0.004	11.6	0.109	10.8	< 0.1	17.9	11.2	0.0694	< 0.002	0.032
S99-06218	5108175707	23.7	< 0.01	< 0.1	0.038	23.2	< 0.003	< 0.002	0.013	0.169	2.8	< 0.004	10.9	0.73	11.4	< 0.1	21.5	1.5	0.0684	< 0.002	0.016
S99-06219	5102069431	< 0.5	< 0.01	< 0.1	0.008	12.8	< 0.003	< 0.002	< 0.008	0.067	< 0.5	< 0.004	5.69	0.233	12.6	0.2	28.6	2.6	0.066	< 0.002	0.017
S99-06220	5102060699	1.3	0.01	< 0.1	0.055	39.5	< 0.003	< 0.002	< 0.008	0.244	2	0.014	15.1	0.338	26	< 0.1	34.6	8.1	0.147	< 0.002	0.03
S99-06221	5102047620	16.5	0.01	0.2	0.159	24.3	0.005	< 0.002	< 0.008	33.5	7	< 0.004	6.65	1.04	8	0.4	17.8	16.6	0.0862	< 0.002	0.036
S99-06222	5102082064	37.7	< 0.01	0.2	0.135	23.6	0.004	< 0.002	< 0.008	25.4	4	< 0.004	6.44	2.59	11.6	0.6	22	< 0.2	0.105	< 0.002	0.029
S99-06223	5102064087	< 0.5	< 0.01	< 0.1	0.014	18.4	< 0.003	< 0.002	< 0.008	0.1	< 0.5	0.004	8.93	0.817	19.7	0.1	29.6	< 0.2	0.106	< 0.002	0.012
S99-06224	5102003760	< 0.5	0.01	< 0.1	0.033	47	< 0.003	< 0.002	< 0.008	1.09	2	0.014	16.7	1.06	24	< 0.1	30.4	7.9	0.188	< 0.002	0.02
S99-06225	5102003760	< 0.5	0.02	< 0.1	0.048	59.7	< 0.003	< 0.002	0.009	0.797	2.2	0.015	23.3	0.834	47.2	< 0.1	28.5	24	0.296	0.002	0.028
S99-06226	5499489975	< 0.5	< 0.01	< 0.1	0.021	20.5	< 0.003	< 0.002	< 0.008	0.103	1.7	< 0.004	10.3	1.33	14.9	< 0.1	14.3	7.5	0.0854	< 0.002	0.01
S99-06227	5499489975	14.3	< 0.01	< 0.1	0.041	23.4	< 0.003	< 0.002	< 0.008	7.9	4	0.005	11.5	0.96	8.9	0.2	26.8	0.4	0.0979	< 0.002	0.054
S99-06228	5499405015	187	0.76	0.2	0.247	151	0.009	0.002	< 0.008	30	14	0.005	25.5	4.77	6.2	1.4	19.7	0.5	0.53	< 0.002	0.044
S99-06229	5499439435	3	< 0.01	< 0.1	0.04	18.6	0.003	< 0.002	< 0.008	5.03	2	< 0.004	10.6	0.444	10.7	0.2	21.7	1	0.0655	< 0.002	0.015
S99-06230	5499422840	6	< 0.01	0.2	0.09	13.8	0.006	< 0.002	< 0.008	25.7	4.4	0.004	6.02	0.598	4.7	0.7	20.8	0.5	0.0405	< 0.002	0.018
S99-06231	5499450310	24.4	0.02	0.1	0.087	29	0.006	< 0.002	< 0.008	18.5	3.3	< 0.004	11.6	1.35	9.3	1	25.6	< 0.2	0.099	< 0.002	0.018
S99-06232	5499416060	< 0.5	< 0.01	< 0.1	0.037	22.9	0.003	< 0.002	< 0.008	0.053	3.8	< 0.004	7.71	0.185	24.3	< 0.1	15.4	27.1	0.0783	< 0.002	0.014
S99-06233	5499483220	17.6	< 0.01	< 0.1	0.08	20.8	< 0.003	< 0.002	< 0.008	6.75	5.5	< 0.004	8.41	0.929	9.9	0.7	24.2	0.3	0.0874	< 0.002	0.034
S99-06234	5499433995	5.7	< 0.01	0.3	0.166	26.4	0.006	< 0.002	< 0.008	34.8	4.4	0.006	9.61	1.1	25.4	0.8	23.8	3.7	0.094	< 0.002	0.026
S99-06235	5496194453	4	< 0.01	< 0.1	0.064	11.9	< 0.003	0.002	< 0.008	6.45	6.6	< 0.004	5.29	0.889	4.2	1	16.6	< 0.2	0.0256	< 0.002	0.013
S99-06236	5496188302	1.4	< 0.01	< 0.1	0.068	22.7	< 0.003	< 0.002	< 0.008	5.06	2.9	< 0.004	11.5	0.815	7.5	0.3	15.7	4.8	0.0357	< 0.002	0.013
S99-06237	5496182881	1.1	0.02	< 0.1	0.075	37.8	< 0.003	0.005	< 0.008	7.61	4.3	< 0.004	11.8	0.979	8.6	0.3	16	4.9	0.0823	< 0.002	0.019
S99-06238	5496156793	0.5	< 0.01	< 0.1	0.04	12.4	< 0.003	0.003	< 0.008	6.4	2.2	< 0.004	5.36	0.162	6.5	< 0.1	16.6	6.3	0.0459	< 0.002	0.057
S99-06239	5496156793	< 0.5	< 0.01	< 0.1	0.027	14	< 0.003	< 0.002	< 0.008	0.503	2.3	< 0.004	7.88	0.485	9.1	< 0.1	20.1	1.8	0.0416	< 0.002	0.013
S99-06240	5496144894	11.1	< 0.01	0.1	0.079	28.3	< 0.003	< 0.002	< 0.008	17.9	2.4	< 0.004	9.71	1.08	5.4	0.7	20.3	< 0.2	0.0702	< 0.002	0.03
S99-06241	5496125176	< 0.5	< 0.01	< 0.1	0.039	23.6	< 0.003	< 0.002	< 0.008	1.48	3	< 0.004	12.4	0.452	4.2	0.1	16	1.1	0.0461	< 0.002	0.077

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-06242	RIP6242	16/06/1999	25.9756	89.7314	1995	TARA	29.9	Abdul Khaleque	Rajshahi	Kurigram	Nageshwari	Berubari	Tupamari
S99-06243	RIP6243	16/06/1999	25.9717	89.8069	1998	TARA	31.7	Md Khuzab Ali	Rajshahi	Kurigram	Nageshwari	Kachakata	Indragar
S99-06244	RIP6244	16/06/1999	25.9215	89.8235	1996	HTW	13.4	Md Eidrish Ali	Rajshahi	Kurigram	Nageshwari	Narayanpur	Chauddaghari
S99-06245	RIP6245	17/06/1999	25.9098	89.5733	1996	HTW	13.4	Gazibur Rahman	Rajshahi	Kurigram	Phulbari	Baravita	Ghogarkuthi
S99-06246	RIP6246	17/06/1999	25.9089	89.6235	1974	HTW	14	Dhirandha Nath	Rajshahi	Kurigram	Phulbari	Bhangamon	Bhangamon
S99-06247	RIP6247	17/06/1999	25.9781	89.6026	1969	HTW	14.6	Nabir Uddin	Rajshahi	Kurigram	Phulbari	Kashipur	Azoatarl
S99-06248	RIP6248	17/06/1999	25.9926	89.5202	1985	HTW	12.8	Md Sekandar Ali	Rajshahi	Kurigram	Phulbari	Naodanga	Phul Mati
S99-06249	RIP6249	17/06/1999	25.9717	89.5348	1998	HTW	13.4	Md Nasiruddin	Rajshahi	Kurigram	Phulbari	Shimulbari	Rowsun Shimulbari
S99-06250	RIP6250	17/06/1999	25.9489	89.5533	1993	HTW	14.9	DPHE office	Rajshahi	Kurigram	Phulbari	Phulbari	Chandrakana
S99-06251	RIP6251	19/06/1999	26.0879	89.6694	1995	HTW	13.7	Md Samir Uddin	Rajshahi	Kurigram	Bhurungamari	Joymanirhat	Chhoya Khatamari
S99-06252	RIP6252	19/06/1999	26.1111	89.6678	1985	HTW	14.3	DPHE office	Rajshahi	Kurigram	Bhurungamari	Bhurungamari	Dewan Khamar
S99-06253	RIP6253	19/06/1999	26.1111	89.6678	1984	DTW	59.4	Thana Parishad	Rajshahi	Kurigram	Bhurungamari	Bhurungamari	Dewan Khamar
S99-06254	RIP6254	19/06/1999	26.1556	89.7373	1997	HTW	10.7	Md Aminur Rahman	Rajshahi	Kurigram	Bhurungamari	Char Bhurungamari	Bhurungamari
S99-06255	RIP6255	19/06/1999	26.0674	89.7684	1990	HTW	24.7	Sahi Bazar	Rajshahi	Kurigram	Bhurungamari	Boldia	Uttar Baldia
S99-06256	RIP6256	19/06/1999	26.0961	89.7069	1974	HTW	14.3	Pateshwari Bazar	Rajshahi	Kurigram	Bhurungamari	Paikerchhara	Gachidanga
S99-06257	RIP6257	19/06/1999	26.0326	89.762	1997	TARA	29.9	Md Shamshul Haque	Rajshahi	Kurigram	Nageshwari	Kedar	Bishaupur
S99-06258	RIP6258	19/06/1999	26.1447	89.6222	1992	HTW	22.6	Phulkumar Mosque	Rajshahi	Kurigram	Bhurungamari	Pathardubi	Phul Kumar
S99-06259	RIP6259	19/06/1999	26.1786	89.6657	1994	HTW	13.4	Dhaldanga High School	Rajshahi	Kurigram	Bhurungamari	Shilkhuri	Dakshin Dhaldanga
S99-06260	RIP6260	20/06/1999	25.8762	89.679	1988	HTW	14	Madhya Kumarpur Bazar	Rajshahi	Kurigram	Kurigram Sadar	Bhogdanga	Madhya Kumarpur
S99-06261	RIP6261	20/06/1999	25.8471	89.699	1987	HTW	12.2	Intaz Ali	Rajshahi	Kurigram	Kurigram Sadar	Ghogadaha	Sobandaha
S99-06262	RIP6262	20/06/1999	25.8172	89.734	1998	HTW	13.4	Jatrapur Bazar Mosque	Rajshahi	Kurigram	Kurigram Sadar	Jatrapur	Ghananyampur
S99-06263	RIP6263	20/06/1999	25.8164	89.6937	1989	HTW	14	Shulkur Bazar Mosque	Rajshahi	Kurigram	Kurigram Sadar	Panchgachhi	Chatrapur
S99-06264	RIP6264	21/06/1999	25.9366	89.4645	1995	HTW	18	Hashem Ali	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Mogalhat	Bhatibari
S99-06265	RIP6265	21/06/1999	25.9267	89.496	1992	HTW	18	Md Abdul Majid	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Khulaghat	Khulaghat
S99-06266	RIP6266	21/06/1999	25.8602	89.505	1989	HTW	18	Md Ayub Ali	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Panchagram	Ramdash
S99-06267	RIP6267	21/06/1999	25.8339	89.4571	1996	HTW	18	Md Matiur Rahman	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Gokunda	Mostafi
S99-06268	RIP6268	21/06/1999	25.8696	89.441	1992	HTW	18	Deldar Ali	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Harati	Kazir Chara
S99-06269	RIP6269	21/06/1999	25.9053	89.4318	1995	HTW	18	Bitun Nur Mosque	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Mahendranagar	Haribhanga
S99-06270	RIP6270	21/06/1999	25.8436	89.4143	1989	HTW	24.4	Mariahat High School	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Rajpur	Rajpur
S99-06271	RIP6271	21/06/1999	25.8709	89.3804	1998	HTW	18	Md Hossian Ali	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Khuniagachi	Kalamati
S99-06272	RIP6272	21/06/1999	25.9124	89.434	1996	DTW	53.3	Paurashava water supply system(PWSS)	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Pourahava ward 03	Goshala Bazar
S99-06273	RIP6273	22/06/1999	25.9688	89.226	1996	HTW	19.5	Thana parishad rest house	Rajshahi	Lalmonirhat	Kaliganj (L)	Tushbhandar	Uttar Ghanasayam
S99-06274	RIP6274	22/06/1999	25.98	89.1872	1993	HTW	18	Md Abul Kaiyum	Rajshahi	Lalmonirhat	Kaliganj (L)	Bhotemari	Srutidhar
S99-06275	RIP6275	22/06/1999	26.0407	89.1981	1990	HTW	18	Union parishad	Rajshahi	Lalmonirhat	Kaliganj (L)	Madati	Sakhati
S99-06276	RIP6276	22/06/1999	25.9339	89.2547	1998	HTW	22.6	Md Nuruzzaman	Rajshahi	Lalmonirhat	Kaliganj (L)	Kakina	Kakina
S99-06277	RIP6277	22/06/1999	26.0193	89.331	1996	HTW	18	Nithak S. H. high school	Rajshahi	Lalmonirhat	Kaliganj (L)	Goral	Sebakdas Nithak
S99-06278	RIP6278	22/06/1999	26.0001	89.261	1995	HTW	13.4	Md Kazim Uddin	Rajshahi	Lalmonirhat	Kaliganj (L)	Chandrapur	Uttar Batris Hazari
S99-06279	RIP6279	22/06/1999	25.9916	89.2417	1996	HTW	31.7	Union parishad	Rajshahi	Lalmonirhat	Kaliganj (L)	Dalagram	Daksin Dalagram
S99-06280	RIP6280	22/06/1999	25.9806	89.3206	1998	HTW	18	Md Iman Ali	Rajshahi	Lalmonirhat	Kaliganj (L)	Chalabala	Nithak
S99-06281	RIP6281	23/06/1999	26.3462	89.0343	1984	HTW	14.3	Shohagpur Mosque	Rajshahi	Lalmonirhat	Patgram	Jagatber	Sohagpur
S99-06282	RIP6282	23/06/1999	26.3019	89.0834	1968	HTW	13.4	Union Parishad	Rajshahi	Lalmonirhat	Patgram	Jongra	Jongra
S99-06283	RIP6283	23/06/1999	26.2923	88.9721	1994	HTW	21	Md Minul Haque	Rajshahi	Lalmonirhat	Patgram	Kuchlibar	Dahagram
S99-06284	RIP6284	23/06/1999	26.252	89.0736	1998	HTW	13.4	Baura Bazar Mosque	Rajshahi	Lalmonirhat	Patgram	Baura	Nabinagar
S99-06285	RIP6285	24/06/1999	25.8958	88.8379	1994	HTW	27.1	Md Aynul Haque	Rajshahi	Nilphamari	Nilphamari Sadar	Kundapukur	Gurguri
S99-06286	RIP6286	24/06/1999	25.8387	88.8428	1992	HTW	27.1	Amudi Mamud	Rajshahi	Nilphamari	Nilphamari Sadar	Sonarai	Berakuthi
S99-06287	RIP6287	24/06/1999	25.8947	88.9231	1987	HTW	22.6	Munsur Ali	Rajshahi	Nilphamari	Nilphamari Sadar	Chapra Saramjani	Natib Chapra
S99-06288	RIP6288	24/06/1999	26.0317	88.8396	1978	HTW	22.6	Md Osman Gani	Rajshahi	Nilphamari	Nilphamari Sadar	Lakshmichap	Kachua
S99-06289	RIP6289	24/06/1999	25.9942	88.7463	1995	HTW	22.6	Bhobaniganj Bazar Mosque	Rajshahi	Nilphamari	Nilphamari Sadar	Goregram	Dhodadanga

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-06242	5496118982	3.3	< 0.01	< 0.1	0.05	13.5	< 0.003	< 0.002	< 0.008	11	2.3	< 0.004	4.81	0.897	7.5	0.4	21.1	< 0.2	0.0366	< 0.002	0.049
S99-06243	5496137503	62.9	0.11	0.1	0.135	151	0.004	0.003	0.018	18.8	6.7	< 0.004	28.8	5.23	6.2	1.9	17.4	22	0.325	< 0.002	0.065
S99-06244	5496163277	2.9	0.03	< 0.1	0.105	110	0.003	< 0.002	0.012	0.07	5.3	0.009	29.7	3.26	5.6	0.1	14.1	19.8	0.38	< 0.002	0.033
S99-06245	5491813298	< 0.5	0.01	< 0.1	0.023	21.9	< 0.003	< 0.002	< 0.008	0.129	1.8	< 0.004	7	0.609	11.4	0.6	21.3	0.3	0.0794	< 0.002	0.021
S99-06246	5491827171	< 0.5	0.02	< 0.1	0.029	31.3	< 0.003	0.003	< 0.008	0.054	3.8	0.005	11.9	1.23	5.7	0.4	19.9	0.9	0.119	< 0.002	0.019
S99-06247	5491854079	2.5	0.01	< 0.1	0.035	25.5	< 0.003	< 0.002	< 0.008	0.05	4.9	0.004	12.3	1.35	9.7	0.3	21.5	5.7	0.0867	< 0.002	0.018
S99-06248	5491867736	< 0.5	0.01	< 0.1	0.031	16.8	< 0.003	0.002	< 0.008	0.249	2.8	< 0.004	6.76	0.511	4.7	0.1	17.1	2.1	0.0429	< 0.002	0.016
S99-06249	5491881855	< 0.5	0.01	< 0.1	0.069	21	< 0.003	< 0.002	< 0.008	0.25	3.6	< 0.004	8.83	0.062	25.6	< 0.1	13.9	9	0.0465	< 0.002	0.045
S99-06250	5491840238	< 0.5	0.02	< 0.1	0.12	42.1	< 0.003	< 0.002	< 0.008	0.722	5	< 0.004	13.7	0.643	17.7	< 0.1	11.4	28.2	0.0911	< 0.002	0.031
S99-06251	5490657266	< 0.5	< 0.01	< 0.1	0.055	24.3	< 0.003	< 0.002	< 0.008	6.62	12.4	< 0.004	14.4	0.53	13.1	0.3	16.9	11.6	0.0522	< 0.002	0.023
S99-06252	5490619364	2.3	< 0.01	0.2	0.166	32.6	0.005	< 0.002	< 0.008	20.3	5.6	< 0.004	17.4	1.22	39.6	0.4	13.6	22.4	0.0695	< 0.002	0.029
S99-06253	5490619364	3.5	< 0.01	< 0.1	0.057	31.5	0.004	< 0.002	< 0.008	11.4	2.7	0.005	13.8	1.3	12.1	0.7	18.2	5.8	0.0528	< 0.002	0.04
S99-06254	5490647182	9.3	< 0.01	0.3	0.068	20.1	0.004	< 0.002	< 0.008	28.6	3.6	0.004	8.31	1.81	18.9	0.3	13.9	14.8	0.0407	< 0.002	0.034
S99-06255	5490628924	23.6	0.01	0.1	0.078	30.9	< 0.003	< 0.002	< 0.008	10.5	4.9	0.006	12.9	1.49	6.7	1.5	15.9	0.2	0.0714	< 0.002	0.021
S99-06256	5490666406	2.5	0.02	< 0.1	0.05	50.6	< 0.003	< 0.002	< 0.008	0.031	3.7	< 0.004	14.1	0.216	4.9	0.4	12.6	3.4	0.0756	< 0.002	0.019
S99-06257	5496150201	42.1	0.02	< 0.1	0.076	58.7	0.003	< 0.002	< 0.008	7.64	4.6	< 0.004	26	2.4	7.1	0.4	17.4	0.5	0.121	< 0.002	0.036
S99-06258	5490676798	10.3	0.01	< 0.1	0.065	43	< 0.003	< 0.002	0.019	2.8	1.8	< 0.004	20	0.705	10.7	0.1	7.39	3	0.0354	< 0.002	0.04
S99-06259	5490685322	< 0.5	0.01	< 0.1	0.041	42.1	< 0.003	< 0.002	0.008	0.126	3.3	< 0.004	16.5	3.69	9.1	0.2	13.6	4.7	0.0766	< 0.002	0.017
S99-06260	5495219650	1	0.02	< 0.1	0.099	37.1	< 0.003	< 0.002	0.04	4.22	5	< 0.004	22.3	0.363	30.3	0.1	14.3	17.1	0.0446	< 0.002	0.032
S99-06261	5495228943	2.3	< 0.01	< 0.1	0.06	25.7	< 0.003	< 0.002	< 0.008	10.6	2.1	< 0.004	10.5	1.07	9.4	0.4	22.6	2	0.0763	< 0.002	0.018
S99-06262	5495247318	< 0.5	0.01	< 0.1	0.03	34.8	< 0.003	< 0.002	< 0.008	0.112	2.4	< 0.004	13.8	0.057	7.9	0.1	13	6	0.102	< 0.002	0.033
S99-06263	5495285267	0.7	< 0.01	< 0.1	0.045	27.7	< 0.003	< 0.002	0.008	0.036	4.7	< 0.004	16	0.212	13.1	0.2	10	14.7	0.0375	0.003	0.014
S99-06264	5525565126	< 0.5	< 0.01	< 0.1	0.016	13.5	< 0.003	0.003	< 0.008	0.069	3.1	< 0.004	4.45	0.017	9.7	< 0.1	15.8	1.3	0.0507	< 0.002	0.009
S99-06265	5525551621	< 0.5	< 0.01	< 0.1	0.013	9.5	< 0.003	< 0.002	< 0.008	0.074	5.3	< 0.004	4.01	0.612	8.5	0.7	20.7	1.5	0.0381	< 0.002	0.007
S99-06266	5525563769	4.2	< 0.01	< 0.1	0.061	9.3	< 0.003	< 0.002	< 0.008	13.7	18.6	< 0.004	3.19	0.295	7.4	1.9	23.5	< 0.2	0.0409	< 0.002	0.017
S99-06267	5525527687	< 0.5	< 0.01	< 0.1	0.03	15.8	< 0.003	< 0.002	< 0.008	4.06	4.8	< 0.004	6.86	0.165	8.3	< 0.1	24.3	2.4	0.052	< 0.002	0.075
S99-06268	5525536467	< 0.5	< 0.01	< 0.1	0.009	10	< 0.003	< 0.002	< 0.008	0.087	3.4	< 0.004	2.83	0.024	5.9	< 0.1	14.7	3.3	0.0366	< 0.002	0.009
S99-06269	5525573368	< 0.5	< 0.01	< 0.1	0.006	10.2	< 0.003	< 0.002	< 0.008	0.035	3.8	< 0.004	2.93	0.014	6.1	< 0.1	15	2.2	0.0315	< 0.002	0.008
S99-06270	5525594824	4.5	< 0.01	< 0.1	0.045	11.7	< 0.003	< 0.002	< 0.008	2.91	2.8	< 0.004	3.83	0.768	15.3	0.2	26.3	3.2	0.0691	< 0.002	0.012
S99-06271	5525543434	< 0.5	< 0.01	< 0.1	0.014	14.7	< 0.003	< 0.002	< 0.008	0.133	3.9	< 0.004	4.33	1.34	7.4	0.2	18.1	3.6	0.065	< 0.002	0.063
S99-06272	5525503370	< 0.5	< 0.01	< 0.1	0.028	27.9	< 0.003	< 0.002	< 0.008	0.802	2.8	0.005	10.2	1.27	17.4	0.2	31	17.1	0.162	< 0.002	0.03
S99-06273	5523995986	0.6	< 0.01	< 0.1	0.025	20.1	< 0.003	< 0.002	< 0.008	1.36	6.1	< 0.004	5.16	0.31	7.4	0.1	18.1	3.3	0.0563	< 0.002	0.024
S99-06274	5523917856	1.3	< 0.01	< 0.1	0.052	19.5	< 0.003	< 0.002	< 0.008	13.3	16.7	< 0.004	7.11	0.396	16.6	0.8	17.2	8.5	0.0456	< 0.002	0.024
S99-06275	5523965774	1	< 0.01	< 0.1	0.012	7.8	< 0.003	< 0.002	< 0.008	3.53	3.7	< 0.004	2.5	0.131	6.1	0.2	18.1	1.3	0.0306	< 0.002	0.011
S99-06276	5523953407	< 0.5	< 0.01	< 0.1	0.005	6.3	< 0.003	< 0.002	0.01	0.051	4.5	< 0.004	2.05	0.022	4	< 0.1	14.5	3.1	0.0198	< 0.002	0.01
S99-06277	5523947831	< 0.5	0.01	< 0.1	0.01	5.5	< 0.003	< 0.002	< 0.008	0.932	3	< 0.004	1.69	0.033	4.1	< 0.1	15.1	1.5	0.0215	< 0.002	0.009
S99-06278	5523929970	< 0.5	0.02	< 0.1	0.01	8.3	< 0.003	< 0.002	< 0.008	0.183	5.8	< 0.004	1.78	0.04	8.2	< 0.1	10.7	8	0.0535	0.003	0.023
S99-06279	5523935244	9.2	< 0.01	< 0.1	0.032	10.9	< 0.003	< 0.002	< 0.008	10.1	3.3	< 0.004	2.06	1.17	8.6	< 0.1	24.8	3.3	0.0878	< 0.002	0.017
S99-06280	5523923693	< 0.5	0.02	< 0.1	0.006	8.2	< 0.003	< 0.002	< 0.008	0.308	3.1	< 0.004	1.72	0.044	4.6	< 0.1	9.82	1	0.0327	< 0.002	0.022
S99-06281	5527027965	< 0.5	0.02	< 0.1	0.015	7.6	< 0.003	0.002	< 0.008	0.252	6.9	< 0.004	2	0.039	7.4	< 0.1	12.1	7.1	0.0487	< 0.002	0.015
S99-06282	5527040596	< 0.5	< 0.01	< 0.1	0.015	6.6	< 0.003	0.002	< 0.008	1.08	3.5	< 0.004	1.88	0.124	5.2	< 0.1	13.6	1.8	0.028	< 0.002	0.016
S99-06283	5527054424	1.7	< 0.01	< 0.1	0.009	6.7	< 0.003	< 0.002	< 0.008	3.24	1.4	< 0.004	1.24	0.111	5.3	< 0.1	16	1.3	0.0267	< 0.002	0.016
S99-06284	5527013756	< 0.5	0.08	< 0.1	0.073	14.3	< 0.003	0.002	< 0.008	0.111	22.5	< 0.004	4.79	0.247	25.8	< 0.1	15.2	16.5	0.0512	< 0.002	0.022
S99-06285	5736450407	0.6	0.01	< 0.1	0.028	12.7	< 0.003	< 0.002	< 0.008	1.75	1.8	< 0.004	5.98	0.639	18.5	0.1	30.2	0.6	0.0839	< 0.002	0.015
S99-06286	5736488179	< 0.5	< 0.01	< 0.1	0.033	11.8	< 0.003	< 0.002	< 0.008	0.167	1.4	< 0.004	4.67	0.095	8.5	< 0.1	20.7	2.4	0.047	< 0.002	0.01
S99-06287	5736406696	< 0.5	< 0.01	< 0.1	0.007	8.7	< 0.003	< 0.002	< 0.008	0.122	3.2	< 0.004	4.19	0.163	5.7	< 0.1	19.6	0.9	0.0442	< 0.002	0.011
S99-06288	5736473432	1.2	< 0.01	< 0.1	0.011	10.8	< 0.003	< 0.002	< 0.008	3.56	2.9	< 0.004	3.19	0.543	7.8	0.1	23	1.2	0.0511	< 0.002	0.009
S99-06289	5736425318	1.6	< 0.01	< 0.1	0.021	26.6	< 0.003	< 0.002	< 0.008	2.49	3.4	< 0.004	7.88	1.22	11	< 0.1	25.1	3.4	0.172	< 0.002	0.014

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-06290	RIP6290	24/06/1999	25.9797	88.8067	1999	HTW	12.2	Abul Kalam	Rajshahi	Nilphamari	Nilphamari Sadar	Palashbari	Khalinapacha
S99-06291	RIP6291	24/06/1999	25.9445	88.9561	1995	HTW	23.5	Md Amzad Ali	Rajshahi	Nilphamari	Nilphamari Sadar	Kachukata	Kachukata
S99-06292	RIP6292	24/06/1999	25.9537	88.9135	1991	HTW	18	Tagar Pramanik Mosque	Rajshahi	Nilphamari	Nilphamari Sadar	Ramnagar	Ramnagar
S99-06293	RIP6293	24/06/1999	25.9343	88.8476	1989	HTW	39.6	Md Siaful Haque	Rajshahi	Nilphamari	Nilphamari Sadar	Pourashava ward 02	Nilphamari Town
S99-06294	RIP6294	27/06/1999	25.9363	88.853	1995	DTW	119.5	DPHE pump No.3	Rajshahi	Nilphamari	Nilphamari Sadar	Pourashava ward 02	Nilphamari Town
S99-06295	RIP6295	26/06/1999	26.0242	89.0051	1998	HTW	14.3	DPHE office	Rajshahi	Nilphamari	Jaldhaka	Jaldhaka	Mathabanga
S99-06296	RIP6296	26/06/1999	26.044	89.0193	1985	HTW	32.6	Md Taslim Uddin	Rajshahi	Nilphamari	Jaldhaka	Balagram	Paschim Balagram
S99-06297	RIP6297	26/06/1999	26.0849	89.0386	1989	HTW	14.3	Md Kamer Uddin	Rajshahi	Nilphamari	Jaldhaka	Daoabari	Paschim Golmunda
S99-06298	RIP6298	26/06/1999	26.0742	88.9553	1982	HTW	22.3	Kaliganj Bangabandhu Hat	Rajshahi	Nilphamari	Jaldhaka	Golna	Kaliganj
S99-06299	RIP6299	26/06/1999	26.114	88.8914	1987	HTW	29	Md Osman Ali	Rajshahi	Nilphamari	Jaldhaka	Dharmapal	Uttar Dharmapal
S99-06300	RIP6300	26/06/1999	26.035	88.9379	1985	HTW	7.9	Paschim Simulbari Mosque	Rajshahi	Nilphamari	Jaldhaka	Mirganj	Paschim Simulbari
S99-06301	RIP6301	26/06/1999	25.9726	88.9689	1999	HTW	34.4	Mashiur Rahman	Rajshahi	Nilphamari	Jaldhaka	Khutamara	Khalisa Khutamara
S99-06302	RIP6302	26/06/1999	25.9714	89.033	1978	HTW	7.9	Md Hakim Uddin (Mosque)	Rajshahi	Nilphamari	Jaldhaka	Kaimari	Chengnami
S99-06303	RIP6303	26/06/1999	26.0243	89.0048	1984	DTW	57.9	Thana parishad	Rajshahi	Nilphamari	Jaldhaka	Jaldhaka	Mathabanga
S99-06304	RIP6304	26/06/1999	26	89		HTW	0		Rajshahi	Nilphamari	Jaldhaka	data lost	
S99-06305	RIP6305	27/06/1999	25.8756	88.9917	1985	HTW	32.3	Momtaz Ali	Rajshahi	Nilphamari	Kishoreganj	Bahagili	Uttar Durakuthi
S99-06306	RIP6306	27/06/1999	25.9076	89.0116	1978	HTW	7.9	DPHE compound	Rajshahi	Nilphamari	Kishoreganj	Kishoreganj	Kesba
S99-06307	RIP6307	27/06/1999	25.8766	89.0944	1996	HTW	19.8	Magura bus stand mosque	Rajshahi	Nilphamari	Kishoreganj	Magura	Magura
S99-06308	RIP6308	27/06/1999	25.9022	89.0895	1975	HTW	14	Paschim Daliram mosque	Rajshahi	Nilphamari	Kishoreganj	Garagram	Poschim Daliram
S99-06309	RIP6309	27/06/1999	25.9224	89.0557	1990	HTW	21	Md Shirip Mia	Rajshahi	Nilphamari	Kishoreganj	Ranachandi	Sonakuri
S99-06310	RIP6310	27/06/1999	25.951	89.0272	1974	HTW	23.8	Barabhita Bazar mosque	Rajshahi	Nilphamari	Kishoreganj	Barabhita	Dakshin Barabhita
S99-06311	RIP6311	27/06/1999	25.9201	88.9945	1996	HTW	13.4	Dakshin Dangapara Madrasha	Rajshahi	Nilphamari	Kishoreganj	Putimari	Putimari
S99-06312	RIP6312	28/06/1999	26.2534	88.7444	1985	HTW	22.6	Union Parishad	Rajshahi	Panchagarh	Debiganj	Chilahati	Bhaulaganj
S99-06313	RIP6313	28/06/1999	26.1978	88.7296	1996	HTW	21.9	Union parishad	Rajshahi	Panchagarh	Debiganj	Tepriganj	Tepriganj
S99-06314	RIP6314	28/06/1999	26.054	88.7413	1995	HTW	22.3	Jagannathhat land office	Rajshahi	Panchagarh	Debiganj	Sonahar Mallikadaha	Sonahar
S99-06315	RIP6315	28/06/1999	26.1178	88.7623	1980	HTW	23.5	DPHE office	Rajshahi	Panchagarh	Debiganj	Debiganj	Debiganj
S99-06316	RIP6316	28/06/1999	26.1222	88.7341	1993	HTW	13.7	Union parishad	Rajshahi	Panchagarh	Debiganj	Debiganj	Khutamara
S99-06317	RIP6317	28/06/1999	26.0895	88.6997	1995	HTW	22.3	Mohammed Ali	Rajshahi	Panchagarh	Debiganj	Dandapal	Pradhanapad
S99-06318	RIP6318	28/06/1999	26.0475	88.6696	1975	HTW	31.7	Md Abdul Sattar	Rajshahi	Panchagarh	Debiganj	Chengti Hazhadanga	Hazradanga
S99-06319	RIP6319	28/06/1999	26.137	88.6998	1994	HTW	18.3	Shurandra Nath	Rajshahi	Panchagarh	Debiganj	Pamuli	Hedayetpur
S99-06320	RIP6320	29/06/1999	26.2636	88.3919	1985	HTW	16.2	Union Parishad	Rajshahi	Panchagarh	Atwari	Taria	Taria
S99-06321	RIP6321	29/06/1999	26.2067	88.3641	1998	HTW	19.8	Union Parishad	Rajshahi	Panchagarh	Atwari	Alowakhowa	Paltapara
S99-06322	RIP6322	29/06/1999	26.2347	88.4087	1989	HTW	19.8	DPHE office	Rajshahi	Panchagarh	Atwari	Radhanagar	Chhotadap
S99-06323	RIP6323	29/06/1999	26.2855	88.444	1990	HTW	17.7	Mirza Abul Quasem	Rajshahi	Panchagarh	Atwari	Mirzapur	Mirzapur
S99-06324	RIP6324	29/06/1999	26.3209	88.4559	1995	HTW	19.8	Md Nur Alam	Rajshahi	Panchagarh	Atwari	Dhamor	Jugikata
S99-06325	RIP6325	29/06/1999	26.1936	88.5511	1990	HTW	23.5	Satkhamar Fazil Madrasha	Rajshahi	Panchagarh	Atwari	Balarampur	Sutkhamar
S99-06326	RIP6326	30/06/1999	26.4936	88.3396	1995	HTW	16.8	DPHE compound	Rajshahi	Panchagarh	Tetulia	Tetulia	Tetulia
S99-06327	RIP6327	30/06/1999	26.5673	88.3841	1997	HTW	19.8	Trnaihat primary school	Rajshahi	Panchagarh	Tetulia	Tirnaihat	Tirnai
S99-06328	RIP6328	30/06/1999	26.6332	88.4156	1997	HTW	18	Md Ashim Uddin	Rajshahi	Panchagarh	Tetulia	Banglabanda	Banglabanda
S99-06329	RIP6329	01/07/1999	25.867	88.3585	1991	HTW	16.8	DPHE office	Rajshahi	Thakurgaon	Pirganj (T)	Pirganj	Jagtha
S99-06330	RIP6330	01/07/1999	25.7249	88.3939	1996	HTW	19.2	Shubal Chandra	Rajshahi	Thakurgaon	Pirganj (T)	Bairchuna	Bairchuna
S99-06331	RIP6331	01/07/1999	25.7745	88.3681	1997	HTW	20.7	Jabarhat high school headmaster	Rajshahi	Thakurgaon	Pirganj (T)	Jabarhat	Jabarhat
S99-06332	RIP6332	01/07/1999	25.8018	88.3375	1994	HTW	16.8	Land office	Rajshahi	Thakurgaon	Pirganj (T)	Sengaon	Sindurna
S99-06333	RIP6333	01/07/1999	25.8138	88.3443	1994	HTW	18.3	Union Parishad	Rajshahi	Thakurgaon	Pirganj (T)	Daulatpur	Joykur
S99-06334	RIP6334	01/07/1999	25.8669	88.3584	1984	DTW	32	Thana Parishad	Rajshahi	Thakurgaon	Pirganj (T)	Pirganj	Jagtha
S99-06335	RIP6335	01/07/1999	25.8645	88.3072	1998	HTW	14.3	Md Jarjis	Rajshahi	Thakurgaon	Pirganj (T)	Hajipur	Khidragargaon
S99-06336	RIP6336	01/07/1999	25.868	88.4548	1987	HTW	25.9	Krishna Kanta	Rajshahi	Thakurgaon	Pirganj (T)	Saidpur	Niamatpur
S99-06337	RIP6337	01/07/1999	25.9145	88.3592	1990	HTW	16.8	Khaddarpura mosque	Rajshahi	Thakurgaon	Pirganj (T)	Bhomradaha	Bhomradaha

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-06290	5736469517	1.5	0.02	< 0.1	0.017	17.6	< 0.003	< 0.002	< 0.008	4.03	5.2	< 0.004	4.26	0.372	6.4	0.3	15.2	0.6	0.0649	< 0.002	0.013
S99-06291	5736437467	22.8	< 0.01	< 0.1	0.02	11.5	< 0.003	< 0.002	< 0.008	13.7	4.2	< 0.004	2.9	0.448	7.6	1.4	21.2	< 0.2	0.0362	< 0.002	0.014
S99-06292	5736475805	3.4	< 0.01	< 0.1	0.016	9.7	< 0.003	< 0.002	< 0.008	10.4	2.9	< 0.004	2.21	0.315	7.2	0.5	21.9	0.7	0.0509	< 0.002	0.009
S99-06293	5736402995	14.5	< 0.01	< 0.1	0.12	16.4	< 0.003	< 0.002	< 0.008	15.4	2.1	< 0.004	4.29	0.617	11.5	0.3	27.5	< 0.2	0.0974	< 0.002	0.014
S99-06294	5736402995	< 0.5	< 0.01	< 0.1	0.057	18.7	< 0.003	< 0.002	< 0.008	0.229	2.1	< 0.004	5.76	0.631	13.8	< 0.1	36.2	1.2	0.134	< 0.002	0.161
S99-06295	5733643602	< 0.5	< 0.01	< 0.1	0.017	17.2	< 0.003	< 0.002	< 0.008	0.09	13.9	< 0.004	3.41	0.066	11.4	< 0.1	11.5	5.4	0.0934	< 0.002	0.109
S99-06296	5733607680	< 0.5	< 0.01	< 0.1	0.023	15.4	< 0.003	< 0.002	< 0.008	0.837	1.9	< 0.004	4.38	1.14	12	< 0.1	28.8	0.9	0.0825	< 0.002	0.01
S99-06297	5733614693	< 0.5	< 0.01	< 0.1	0.06	12.5	< 0.003	< 0.002	< 0.008	0.146	13.2	< 0.004	2.89	0.064	7.7	< 0.1	12.5	7.4	0.0725	< 0.002	0.116
S99-06298	5733636471	0.6	< 0.01	< 0.1	0.004	6	< 0.003	< 0.002	< 0.008	0.155	3.8	< 0.004	1.56	0.175	7.6	< 0.1	7.06	0.7	0.027	< 0.002	0.008
S99-06299	5733621994	3.3	< 0.01	< 0.1	0.013	6.1	< 0.003	< 0.002	< 0.008	11.7	4	< 0.004	1.68	0.325	5.2	0.2	15.6	0.3	0.0314	< 0.002	0.015
S99-06300	5733680733	2.1	< 0.01	< 0.1	0.041	12	< 0.003	< 0.002	< 0.008	0.567	22.2	< 0.004	4.15	0.575	22.6	< 0.1	11.1	18.4	0.049	< 0.002	0.013
S99-06301	5733665523	0.7	< 0.01	< 0.1	0.019	13.9	< 0.003	< 0.002	< 0.008	0.381	2.7	< 0.004	3.84	0.53	11.8	< 0.1	30	0.7	0.0825	< 0.002	0.048
S99-06302	5733651196	< 0.5	< 0.01	< 0.1	0.007	7.3	< 0.003	< 0.002	< 0.008	0.356	9	< 0.004	1.47	0.029	2.3	< 0.1	10.1	2.1	0.0427	< 0.002	0.008
S99-06303	5733643602	0.9	< 0.01	< 0.1	0.012	9.5	< 0.003	< 0.002	< 0.008	0.449	2.1	< 0.004	2.59	0.136	11.2	< 0.1	29.4	1	0.059	< 0.002	0.213
S99-06304	5733695300	< 0.5	0.06	< 0.1	0.006	12.9	< 0.003	0.003	< 0.008	4.55	5	< 0.004	3.08	0.096	10.3	< 0.1	14.8	13.6	0.0444	< 0.002	0.032
S99-06305	5734517966	4.9	< 0.01	< 0.1	0.021	7.1	< 0.003	< 0.002	< 0.008	3.41	2.3	< 0.004	1.8	0.306	6.7	0.3	25.1	1.1	0.0423	< 0.002	0.012
S99-06306	5734551397	< 0.5	< 0.01	< 0.1	0.008	6.6	< 0.003	< 0.002	< 0.008	0.094	1.6	< 0.004	0.75	0.033	4.3	< 0.1	11.1	3.7	0.034	< 0.002	0.016
S99-06307	5734560540	< 0.5	0.02	< 0.1	0.015	4.9	< 0.003	< 0.002	< 0.008	0.033	8.8	< 0.004	1.11	0.022	5.6	< 0.1	12.1	3.6	0.031	< 0.002	0.009
S99-06308	5734543724	1.7	< 0.01	< 0.1	0.07	16.4	< 0.003	< 0.002	< 0.008	8.74	11.1	< 0.004	4.18	0.196	10.6	0.2	16.5	7.5	0.0877	< 0.002	0.019
S99-06309	5734594895	< 0.5	< 0.01	< 0.1	0.023	10.2	< 0.003	< 0.002	< 0.008	0.132	27.8	< 0.004	3.58	0.043	10.6	< 0.1	15.9	11.4	0.0506	< 0.002	0.014
S99-06310	5734525213	< 0.5	< 0.01	< 0.1	0.029	16.8	< 0.003	< 0.002	< 0.008	0.099	12.7	< 0.004	4.42	0.016	20	< 0.1	12.8	7.2	0.105	< 0.002	0.017
S99-06311	5734586810	< 0.5	< 0.01	< 0.1	0.006	10.7	< 0.003	< 0.002	< 0.008	0.124	3.9	< 0.004	2.85	0.012	8	< 0.1	13.7	0.4	0.0535	< 0.002	0.012
S99-06312	5773419137	< 0.5	< 0.01	< 0.1	0.012	10.4	< 0.003	< 0.002	< 0.008	0.524	2.5	< 0.004	4.29	1.28	7.7	< 0.1	21.2	< 0.2	0.0513	< 0.002	0.013
S99-06313	5773495896	33.8	< 0.01	< 0.1	0.165	33.1	0.003	< 0.002	< 0.008	40.6	2.5	< 0.004	7.17	1.62	10.1	0.3	31.8	7.3	0.222	< 0.002	0.025
S99-06314	5773476866	< 0.5	< 0.01	< 0.1	0.016	9.8	< 0.003	< 0.002	< 0.008	0.401	2.1	< 0.004	3.87	2.5	12.1	< 0.1	24.2	2.3	0.089	< 0.002	0.012
S99-06315	5773447305	< 0.5	0.02	< 0.1	0.013	12.9	< 0.003	< 0.002	< 0.008	1.51	5	< 0.004	1.93	0.146	4.5	< 0.1	12.3	19.6	0.032	< 0.002	0.012
S99-06316	5773438581	0.5	< 0.01	< 0.1	0.021	8.8	< 0.003	< 0.002	< 0.008	2.82	2.2	< 0.004	2.07	0.25	5.3	0.1	21	3.3	0.0494	< 0.002	0.012
S99-06317	5773428738	< 0.5	< 0.01	< 0.1	0.002	3.8	< 0.003	< 0.002	< 0.008	0.045	1	< 0.004	1.81	0.017	6.3	< 0.1	19.1	0.3	0.0212	< 0.002	0.007
S99-06318	5773409433	1	< 0.01	< 0.1	0.02	7	< 0.003	< 0.002	< 0.008	3.44	2.3	< 0.004	2.26	0.172	10.2	0.1	25.9	0.7	0.0512	< 0.002	0.015
S99-06319	5773457443	< 0.5	0.03	< 0.1	0.023	7.6	< 0.003	< 0.002	< 0.008	2.54	5.6	< 0.004	2.86	0.125	9.3	0.1	16.7	6.2	0.058	< 0.002	0.012
S99-06320	5770481962	1.2	< 0.01	< 0.1	0.01	9.8	< 0.003	< 0.002	< 0.008	1.45	1.7	< 0.004	2.2	0.228	7.2	0.1	22.4	0.9	0.0496	< 0.002	0.009
S99-06321	5770413766	< 0.5	< 0.01	< 0.1	0.006	7.1	< 0.003	< 0.002	< 0.008	0.096	2.7	< 0.004	2.19	0.028	6.3	< 0.1	16.8	0.8	0.0313	< 0.002	0.009
S99-06322	5770467260	< 0.5	< 0.01	< 0.1	0.006	8.5	< 0.003	< 0.002	< 0.008	0.193	1.9	< 0.004	1.67	0.04	11.6	< 0.1	11.2	6.1	0.0251	< 0.002	0.01
S99-06323	5770454701	12.8	< 0.01	< 0.1	0.006	6.9	< 0.003	< 0.002	< 0.008	2.26	1.3	< 0.004	2.02	0.127	7	0.2	23.1	1.7	0.0251	< 0.002	0.009
S99-06324	5770440473	< 0.5	0.01	< 0.1	0.005	4.4	< 0.003	< 0.002	< 0.008	0.193	1	< 0.004	0.85	0.016	3.9	< 0.1	11.5	2.1	0.0151	< 0.002	0.007
S99-06325	5770427913	0.8	< 0.01	< 0.1	0.007	8.2	< 0.003	< 0.002	< 0.008	2.4	1.3	< 0.004	2.42	0.126	8.7	< 0.1	18	3.1	0.0371	< 0.002	0.012
S99-06326	5779081934	< 0.5	< 0.01	< 0.1	0.011	20.1	< 0.003	< 0.002	< 0.008	0.45	0.9	< 0.004	2.61	0.025	8.6	< 0.1	10.2	13.1	0.0914	< 0.002	0.012
S99-06327	5779094964	1.4	< 0.01	< 0.1	0.008	9.2	< 0.003	< 0.002	< 0.008	3.12	2	< 0.004	2.94	0.255	8.7	0.2	27.9	0.7	0.0404	< 0.002	0.01
S99-06328	5779013090	< 0.5	< 0.01	< 0.1	0.003	5.5	< 0.003	< 0.002	< 0.008	0.121	2.6	< 0.004	2.75	0.031	7.1	< 0.1	17.1	0.6	0.0329	< 0.002	0.018
S99-06329	5948277497	< 0.5	< 0.01	< 0.1	0.015	22.4	< 0.003	< 0.002	< 0.008	0.036	4.9	0.004	4.38	0.004	11.1	< 0.1	14.8	7.7	0.0578	< 0.002	0.011
S99-06330	5948208066	< 0.5	< 0.01	< 0.1	0.014	6.2	< 0.003	< 0.002	< 0.008	2.11	2.1	< 0.004	2.57	0.255	7.6	< 0.1	20.1	1.3	0.0294	< 0.002	0.009
S99-06331	5948251486	0.5	< 0.01	< 0.1	0.019	10.8	< 0.003	< 0.002	< 0.008	0.815	2.2	< 0.004	3.71	0.353	10.8	0.1	23.3	2.2	0.0695	< 0.002	0.009
S99-06332	5948294928	< 0.5	< 0.01	< 0.1	0.003	5.3	< 0.003	< 0.002	< 0.008	0.027	2.3	< 0.004	1.84	0.013	6	< 0.1	16.4	4.4	0.0225	< 0.002	0.006
S99-06333	5948234519	< 0.5	< 0.01	< 0.1	0.006	10.1	< 0.003	< 0.002	< 0.008	0.028	2.3	< 0.004	2.59	0.013	6.9	< 0.1	16.4	0.7	0.0248	< 0.002	0.009
S99-06334	5948202497	3.9	0.02	< 0.1	0.021	7.6	< 0.003	< 0.002	< 0.008	3.74	2	< 0.004	1.88	0.205	11.6	0.3	30.9	0.7	0.0414	< 0.002	0.127
S99-06335	5948243602	< 0.5	< 0.01	< 0.1	0.003	5.6	< 0.003	< 0.002	< 0.008	0.027	1.5	< 0.004	1.87	0.01	6.1	< 0.1	16	0.4	0.0261	< 0.002	0.007
S99-06336	5948286751	< 0.5	< 0.01	< 0.1	0.005	8.1	< 0.003	< 0.002	< 0.008	0.054	2.4	< 0.004	3.63	0.048	7.6	< 0.1	19.5	3.3	0.0365	< 0.002	0.09
S99-06337	5948225210	< 0.5	< 0.01	< 0.1	0.069	11.1	0.008	< 0.002	< 0.008	0.146	33.1	< 0.004	4.82	0.018	19.3	< 0.1	14.5	12.6	0.145	< 0.002	0.014

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-06339	RIP6339	01/07/1999	25.9332	88.3743	1994	HTW	18.9	Md Solamen Ali	Rajshahi	Thakurgaon	Pirganj (T)	Khangaon	Khangaon
S99-06340	RIP6340	03/07/1999	25.9043	88.2552	1995	HTW	16.5	DPHE office	Rajshahi	Thakurgaon	Ranisankail	Hossaingaon	Mahalbari
S99-06341	RIP6341	03/07/1999	25.862	88.2913	1975	HTW	22.6	Gogar Bazar Mosque	Rajshahi	Thakurgaon	Ranisankail	Lehemba	Gogar
S99-06342	RIP6342	03/07/1999	25.8929	88.2732	1978	HTW	20.7	Union parishad	Rajshahi	Thakurgaon	Ranisankail	Bachor	Dasla
S99-06343	RIP6343	03/07/1999	25.9411	88.3182	1993	HTW	22.3	Bangalgar Bazar	Rajshahi	Thakurgaon	Ranisankail	Rator/Nekmarad	Nargaon
S99-06344	RIP6344	03/07/1999	25.9797	88.2658	1984	HTW	21.9	Bhabanandapur Mosque	Rajshahi	Thakurgaon	Ranisankail	Rator/Nekmarad	Nargaon
S99-06345	RIP6345	03/07/1999	26.0006	88.2029	1992	HTW	17.7	Union parishad mosque	Rajshahi	Thakurgaon	Ranisankail	Dharmagarh	Chyangmari
S99-06346	RIP6346	03/07/1999	25.8717	88.2262	1984	HTW	18.9	Balidara Bazar	Rajshahi	Thakurgaon	Ranisankail	Hossaingaon	Balidara
S99-06347	RIP6347	04/07/1999	26.0385	88.454	1994	DTW	89.9	DPHE pump No 3	Rajshahi	Thakurgaon	Thakurgaon Sadar	Pourashava ward 03	College Para
S99-06348	RIP6348	04/07/1999	26.0694	88.4319	1977	HTW	18.9	Md Saifuddin	Rajshahi	Thakurgaon	Thakurgaon Sadar	Akcha	Dakshin Thakurgaon
S99-06349	RIP6349	04/07/1999	26.138	88.4231	1998	HTW	18.9	Sri Manta Kumar	Rajshahi	Thakurgaon	Thakurgaon Sadar	Rajagaon	Dharmapur
S99-06350	RIP6350	04/07/1999	26.1713	88.3953	1998	HTW	26.8	Jugul Chandra Shen	Rajshahi	Thakurgaon	Thakurgaon Sadar	Ruhea	Kashalgaon
S99-06351	RIP6351	04/07/1999	26.0592	88.3587	1998	HTW	22.3	Abdul Quader	Rajshahi	Thakurgaon	Thakurgaon Sadar	Chilarang	Bhelajan
S99-06352	RIP6352	04/07/1999	26.0151	88.3351	1993	HTW	21.9	Union Parishard	Rajshahi	Thakurgaon	Thakurgaon Sadar	Raipur	Padampur
S99-06353	RIP6353	04/07/1999	26.0367	88.4242	1999	HTW	18.9	Ashar Ali	Rajshahi	Thakurgaon	Thakurgaon Sadar	Mohammadpur	Harinarayanpur
S99-06354	RIP6354	05/07/1999	25.125	89.2019	1996	TARA	25.3	Md Ali Akbar	Rajshahi	Jaipurhat	Kalai	Matrai	Matrai
S99-06355	RIP6355	05/07/1999	25.1835	89.2191	1995	HTW	12.8	Md Edris Ali Kazi	Rajshahi	Jaipurhat	Kalai	Matrai	Sibsamudra
S99-06356	RIP6356	05/07/1999	25.0465	89.2071	1997	HTW	13.4	Md Jamat Ali	Rajshahi	Jaipurhat	Kalai	Punat	Radhanagar
S99-06357	RIP6357	05/07/1999	24.9996	89.1744	1996	TARA	25.3	Rafait Ullah	Rajshahi	Jaipurhat	Kalai	Zindarpur	Ghaturia
S99-06358	RIP6358	05/07/1999	25.0396	89.1751	1998	TARA	25.3	Mahfuza Rahman	Rajshahi	Jaipurhat	Kalai	Zindarpur	Begungaon
S99-06359	RIP6359	05/07/1999	25.1054	89.2333	1995	HTW	18.9	Muslimganj Bazar mosque	Rajshahi	Jaipurhat	Kalai	Udaypur	Mandai
S99-06360	RIP6360	05/07/1999	25.0509	89.1767	1997	TARA	25.3	Abdul Majid Akanda	Rajshahi	Jaipurhat	Kalai	Kalai	Kalai
S99-06361	RIP6361	05/07/1999	25.0638	89.1665	1984	DTW	64	Thana Parishad	Rajshahi	Jaipurhat	Kalai	Kalai	Kalai
S99-06362	RIP6362	06/07/1999	25.0337	89.0218	1998	TARA	25.3	Bishna Urau	Rajshahi	Jaipurhat	Akkelpur	Rukundipur	Rukundipur
S99-06363	RIP6363	06/07/1999	24.9949	89.0237	1998	TARA	25.3	Md Mozaffar Hossain	Rajshahi	Jaipurhat	Akkelpur	Rukundipur	Bhandaripara
S99-06364	RIP6364	06/07/1999	24.9626	89.0195	1997	TARA	25.3	Shahidul Islam	Rajshahi	Jaipurhat	Akkelpur	Sonamukhi	Hasta Basantapur
S99-06365	RIP6365	06/07/1999	24.9224	89.0187	1991	TARA	25.3	Afaz Uddin	Rajshahi	Jaipurhat	Akkelpur	Sonamukhi	Uttar Gantpur
S99-06366	RIP6366	06/07/1999	24.8843	89.0192	1995	TARA	25.3	Binjhahar Ahmedia Dhakil Madrasah	Rajshahi	Jaipurhat	Akkelpur	Tilakpur	Kanchapara
S99-06367	RIP6367	06/07/1999	24.8984	89.0509	1997	TARA	18.3	Abdul Gafur	Rajshahi	Jaipurhat	Akkelpur	Raikali	Sanatanpur
S99-06368	RIP6368	06/07/1999	24.9404	89.058	1995	TARA	25.3	Khairul Islam	Rajshahi	Jaipurhat	Akkelpur	Gopinathpur	Jogibhita
S99-06369	RIP6369	07/07/1999	25.1016	89.0237	1982	DTW	49.4	DPHE pump No 1	Rajshahi	Jaipurhat	Jaipurhat Sadar	Pourashava ward 02	Dakshin Purba Joypurha
S99-06370	RIP6370	07/07/1999	25.0895	89.0633	1995	TARA	25.3	Md Tofazzul Hossain	Rajshahi	Jaipurhat	Jaipurhat Sadar	Bambu	Hichmi
S99-06371	RIP6371	07/07/1999	25.1029	89.105	1994	TARA	25.3	Abdul Sattar	Rajshahi	Jaipurhat	Jaipurhat Sadar	Amdai	Mirgaon
S99-06372	RIP6372	07/07/1999	25.137	89.0315	1997	TARA	25.3	Puranapaid Bazar	Rajshahi	Jaipurhat	Jaipurhat Sadar	Puranapail	Puranapail
S99-06373	RIP6373	07/07/1999	25.047	89.0234	1998	TARA	25.3	Khaza Muddin	Rajshahi	Jaipurhat	Jaipurhat Sadar	Jamalpur	Madhabpara
S99-07001	RIP7001	10/05/1999	24.5484	91.3159	1998	HTW	27.1	Mr Mushahid	Sylhet	Habiganj	Ajmiriganj	Jalshuka	Nowagaon
S99-07002	RIP7002	10/05/1999	24.5645	91.2835	1988	HTW	60	Md Jakirul Islam	Sylhet	Habiganj	Ajmiriganj	Jalshuka	Jalshuka
S99-07003	RIP7003	10/05/1999	24.564	91.2797	1997	HTW	21.3	Brojolaldev	Sylhet	Habiganj	Ajmiriganj	Jalshuka	Atpara
S99-07004	RIP7004	10/05/1999	24.5564	91.2613	1995	HTW	64	Mukambari Mosque	Sylhet	Habiganj	Ajmiriganj	Ajmiriganj	Bashatia
S99-07005	RIP7005	15/05/1999	24.5968	91.2738	1990	HTW	67.1	Md Ahmmed	Sylhet	Habiganj	Ajmiriganj	Badalpur	Uttarhati Piluar Kondi
S99-07008	RIP7008	15/05/1999	24.5981	91.2786	1997	HTW	67.1	Md Idris Ali	Sylhet	Habiganj	Ajmiriganj	Badalpur	Pirojpur
S99-07009	RIP7009	16/05/1999	24.4893	91.1905	1994	HTW	67.1	Kakaichao Bazar	Sylhet	Habiganj	Ajmiriganj	Kakailseo	Mamudpur
S99-07010	RIP7010	12/05/1999	25.0698	91.4765	1988	HTW	79.2	Pijush Kranti Ray	Sylhet	Sunamganj	Dowarabazar	Mannargaon	Gopalpur/Ambari Bazaa
S99-07011	RIP7011	12/05/1999	25.0817	91.5135	1991	HTW	54.9	Mojor Ali member	Sylhet	Sunamganj	Dowarabazar	Laxmipur	U. nurpur
S99-07012	RIP7012	12/05/1999	25.0738	91.52	1975	HTW	22.9	Nurpur Jame Mosque	Sylhet	Sunamganj	Dowarabazar	Laxmirpur	Nurpur
S99-07013	RIP7013	12/05/1999	25.0502	91.5259	1975	HTW	39.6	Madris Ali	Sylhet	Sunamganj	Dowarabazar	Mannargaon	K. Bazar(Dumbond)
S99-07014	RIP7014	12/05/1999	25.047	91.5601	1992	HTW	53.3	T N O	Sylhet	Sunamganj	Dowarabazar	Dwarabazaar	Dwarabazar(Naingaon)
S99-07015	RIP7015	12/05/1999	25.0435	91.5682	1998	HTW	106.7	Thana health complex	Sylhet	Sunamganj	Dowarabazar	Dwarabazaar	Dwarabazar(Naingaon)

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-06339	5948260276	1.9	< 0.01		0.011	8.2	< 0.003	< 0.002	< 0.008	0.284	2.7	< 0.004	1.58	0.055	7.3	< 0.1	10.5	4.9	0.026	< 0.002	0.01
S99-06340	5948647674	< 0.5	< 0.01	< 0.1	0.005	8.8	< 0.003	< 0.002	< 0.008	0.046	2.4	< 0.004	2.94	0.007	6.6	< 0.1	17.1	0.6	0.0384	< 0.002	0.048
S99-06341	5948663481	< 0.5	< 0.01	< 0.1	0.023	27.3	< 0.003	< 0.002	< 0.008	0.033	2.4	< 0.004	7.08	0.007	35.9	< 0.1	13.3	12.9	0.133	< 0.002	0.015
S99-06342	5948615377	< 0.5	0.01	< 0.1	0.018	34	< 0.003	< 0.002	< 0.008	0.136	2	< 0.004	11.2	0.012	12.6	< 0.1	14.5	5	0.125	< 0.002	0.013
S99-06343	5948679738	< 0.5	< 0.01	< 0.1	0.003	4.6	< 0.003	< 0.002	< 0.008	0.024	1.4	< 0.004	2.17	0.063	5.8	< 0.1	19.9	< 0.2	0.0213	< 0.002	0.006
S99-06344	5948679200	< 0.5	< 0.01	< 0.1	0.017	10.2	< 0.003	< 0.002	< 0.008	0.058	4.2	0.008	5.81	0.119	12.6	< 0.1	24.2	4.7	0.0676	< 0.002	0.01
S99-06345	5948631353	< 0.5	< 0.01	< 0.1	0.007	10.9	< 0.003	0.002	< 0.008	0.031	2.5	< 0.004	3.44	0.007	10.5	< 0.1	15.6	1.3	0.0584	< 0.002	0.012
S99-06346	5948647136	< 0.5	< 0.01	< 0.1	0.008	6.4	< 0.003	< 0.002	< 0.008	0.046	3.5	< 0.004	4.63	0.005	5.7	0.1	26.5	1.1	0.0235	< 0.002	0.01
S99-06347	5949403213	4.9	0.01	< 0.1	0.027	9.7	< 0.003	< 0.002	< 0.008	0.825	2.4	< 0.004	1.97	0.174	28.4	0.4	31.6	< 0.2	0.0693	< 0.002	0.036
S99-06348	5949405336	6.5	< 0.01	< 0.1	0.03	8	< 0.003	< 0.002	< 0.008	4.09	1.5	< 0.004	1.46	0.178	21.5	0.6	31.4	< 0.2	0.0428	< 0.002	0.013
S99-06349	5949479373	< 0.5	< 0.01	< 0.1	0.016	5.9	< 0.003	< 0.002	< 0.008	0.135	13	< 0.004	2.14	0.014	16.2	< 0.1	14.4	4.5	0.0353	< 0.002	0.007
S99-06350	5949484563	< 0.5	0.04	< 0.1	0.039	29.4	< 0.003	< 0.002	< 0.008	0.082	12.1	< 0.004	10	1	23.9	< 0.1	16.5	12.1	0.327	< 0.002	0.019
S99-06351	5949431221	5.7	< 0.01	< 0.1	0.011	7.8	< 0.003	< 0.002	< 0.008	4.23	1.4	< 0.004	1.89	0.196	9.7	0.4	25.1	< 0.2	0.047	< 0.002	0.017
S99-06352	5949473789	1.4	0.02	< 0.1	0.016	8.9	< 0.003	< 0.002	< 0.008	6.46	5.1	< 0.004	3.31	0.146	11.3	0.6	21.1	0.7	0.0375	< 0.002	0.01
S99-06353	5949458473	< 0.5	< 0.01	< 0.1	0.025	13.7	< 0.003	< 0.002	< 0.008	2.32	3.4	< 0.004	4.33	0.082	9.1	< 0.1	17.2	6.5	0.0578	< 0.002	0.009
S99-06354	5385866661	3.1	0.01	< 0.1	0.027	23.1	< 0.003	< 0.002	< 0.008	0.561	1.4	0.008	7.21	0.178	22.7	< 0.1	29.1	0.8	0.0819	< 0.002	0.072
S99-06355	5385866899	< 0.5	0.18	< 0.1	0.054	43.7	< 0.003	< 0.002	< 0.008	1.57	0.7	0.016	14.2	0.696	22.8	< 0.1	30.2	9.8	0.18	< 0.002	0.017
S99-06356	5385876823	3.1	0.02	< 0.1	0.022	30.5	< 0.003	0.005	0.011	4.01	1.4	0.008	9.41	0.212	21	< 0.1	31	2	0.147	0.005	0.014
S99-06357	5385895378	0.8	< 0.01	< 0.1	0.026	22.2	< 0.003	< 0.002	< 0.008	0.603	1.2	0.01	7.57	0.251	18.5	< 0.1	27.7	0.5	0.0681	< 0.002	0.022
S99-06358	5385895156	< 0.5	< 0.01	< 0.1	0.04	29.7	< 0.003	< 0.002	< 0.008	0.648	1.5	0.011	11	0.327	20	< 0.1	27.4	3.8	0.0908	< 0.002	0.033
S99-06359	5385885646	< 0.5	< 0.01	< 0.1	0.013	30.2	< 0.003	< 0.002	< 0.008	0.035	< 0.5	0.007	10.1	0.191	24.2	< 0.1	29.2	3.8	0.0942	0.002	0.007
S99-06360	5385838500	7.7	< 0.01	< 0.1	0.026	21.6	< 0.003	< 0.002	< 0.008	0.575	1.4	0.007	8.14	0.266	15.3	< 0.1	32.9	0.8	0.0836	< 0.002	0.017
S99-06361	5385838500	0.9	< 0.01	< 0.1	0.034	23.4	< 0.003	< 0.002	< 0.008	0.171	1.5	0.007	7.58	0.172	15.6	< 0.1	31.9	0.8	0.095	< 0.002	0.016
S99-06362	5381347857	< 0.5	< 0.01	< 0.1	0.037	42.6	< 0.003	< 0.002	< 0.008	4.63	2.1	0.005	16.5	0.957	28.4	< 0.1	23.6	12.2	0.186	< 0.002	0.081
S99-06363	5381347162	< 0.5	< 0.01	< 0.1	0.031	48.5	< 0.003	< 0.002	< 0.008	1.92	1.9	0.014	20	2.97	24	0.2	28.6	13.2	0.266	< 0.002	0.074
S99-06364	5381363420	< 0.5	< 0.01	< 0.1	0.003	26.4	< 0.003	< 0.002	< 0.008	0.065	1	< 0.004	11.3	0.079	22	< 0.1	23.9	6.1	0.171	< 0.002	0.022
S99-06365	5381363994	< 0.5	< 0.01	< 0.1	0.016	17.8	< 0.003	< 0.002	< 0.008	0.576	0.9	0.007	8.67	0.815	11.6	< 0.1	28.1	1.3	0.126	< 0.002	0.019
S99-06366	5381379506	< 0.5	< 0.01	< 0.1	0.014	35.7	< 0.003	< 0.002	< 0.008	0.028	0.9	0.011	15	0.776	8.4	< 0.1	28.7	< 0.2	0.143	< 0.002	0.034
S99-06367	5381331866	< 0.5	< 0.01	< 0.1	0.01	15.9	< 0.003	< 0.002	< 0.008	0.098	0.6	0.01	7.74	0.114	18.2	< 0.1	30.3	2.2	0.0637	< 0.002	0.015
S99-06368	5381315480	0.7	< 0.01	< 0.1	0.025	33.8	< 0.003	< 0.002	< 0.008	0.276	1.3	0.006	11	0.237	22.6	< 0.1	30.6	2.2	0.122	< 0.002	0.021
S99-06369	5384702781	< 0.5	< 0.01	< 0.1	0.021	25.6	< 0.003	< 0.002	< 0.008	0.928	1.7	0.007	13.2	1.61	22.1	< 0.1	28	7.1	0.173	< 0.002	0.059
S99-06370	5384719465	1.6	0.01	< 0.1	0.024	18.2	< 0.003	< 0.002	< 0.008	1.15	1.8	0.004	7.81	0.399	17	0.1	33.8	2.6	0.0778	< 0.002	0.023
S99-06371	5384709719	0.9	< 0.01	< 0.1	0.046	47.3	< 0.003	< 0.002	< 0.008	1.61	2.3	0.004	19.3	0.499	25.3	< 0.1	30.5	14	0.201	< 0.002	0.033
S99-06372	5384785843	< 0.5	< 0.01	< 0.1	0.006	16.7	< 0.003	< 0.002	< 0.008	0.037	0.9	< 0.004	7.07	1.45	13.6	< 0.1	28.3	3.8	0.119	< 0.002	0.058
S99-06373	5384766665	< 0.5	< 0.01	< 0.1	0.025	22.5	< 0.003	< 0.002	< 0.008	0.53	1.3	0.005	7.73	0.491	22.2	< 0.1	31.5	10.5	0.0972	< 0.002	0.055
S99-07001	6360254587	136	< 0.01	0.3	0.056	56.9	0.003	< 0.002	< 0.008	5.29	9	0.008	40.7	0.099	169	3.6	32.3	1.7	0.412	< 0.002	0.033
S99-07002	6360254407	42.6	< 0.01	0.1	0.137	18.9	< 0.003	< 0.002	< 0.008	16.6	2.2	0.004	5.92	0.57	130	1.3	21	< 0.2	0.14	< 0.002	0.013
S99-07003	6360254060	72.6	< 0.01	< 0.1	0.019	36.9	< 0.003	< 0.002	< 0.008	3.46	5.7	< 0.004	23.5	0.084	12.2	1.6	32.1	0.7	0.217	< 0.002	0.012
S99-07004	6360213150	4.9	0.02	0.1	0.101	20.5	< 0.003	< 0.002	< 0.008	4.19	3.8	0.004	9.37	0.634	228	1.4	16.7	< 0.2	0.156	< 0.002	0.043
S99-07005	6360227226	18.9	0.05	< 0.1	0.136	21.2	< 0.003	< 0.002	< 0.008	14.6	1.5	< 0.004	7.2	0.971	97.7	1.4	27.8	1.2	0.134	< 0.002	0.049
S99-07008	6360227723	14.2	0.02	0.2	0.116	16	< 0.003	< 0.002	< 0.008	13.6	1.3	0.004	6.44	0.721	102	2.9	21.5	< 0.2	0.119	< 0.002	0.036
S99-07009	6360267542	16.4	0.03	0.4	0.057	14.1	< 0.003	< 0.002	< 0.008	2	1.7	< 0.004	5.02	0.103	192	1.7	15.7	1.5	0.106	< 0.002	0.117
S99-07010	6903367369	10	< 0.01	< 0.1	0.031	5.7	< 0.003	< 0.002	0.014	3.77	1.4	< 0.004	2.77	0.147	41.4	0.2	11.2	< 0.2	0.035	< 0.002	0.011
S99-07011	6903361980	15.7	< 0.01	< 0.1	0.059	2.5	< 0.003	< 0.002	< 0.008	5.99	3.6	< 0.004	3.76	0.067	5.3	0.2	7.04	< 0.2	0.0124	< 0.002	0.015
S99-07012	6903361980	8.1	< 0.01	0.1	0.008	1.9	< 0.003	< 0.002	< 0.008	0.248	1.8	< 0.004	0.41	0.021	209	0.8	9.93	< 0.2	0.0253	< 0.002	0.007
S99-07013	6903367312	< 0.5	< 0.01	< 0.1	0.006	3.3	< 0.003	< 0.002	< 0.008	0.053	1.4	0.005	0.5	0.016	142	0.1	14.5	< 0.2	0.0445	< 0.002	0.006
S99-07014	6903316646	204	< 0.01	0.2	0.035	1.6	< 0.003	< 0.002	< 0.008	0.807	4.9	< 0.004	2.24	0.014	142	5.8	7.7	0.2	0.0068	< 0.002	0.006
S99-07015	6903316646	53.4	0.04	0.1	0.043	2.4	< 0.003	< 0.002	< 0.008	4.24	2	< 0.004	1.86	0.116	58.7	0.1	7.12	1.3	0.0124	< 0.002	2.8

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07016	RIP7016	12/05/1999	25.0069	91.5629	1990	HTW	50.6	Mr Sirazuddin	Sylhet	Sunamganj	Dowarabazar	Duhalia	Duhalia Bazaar
S99-07019	RIP7019	13/05/1999	24.7925	91.3544	1985	HTW	132.3	Thana Parishad	Sylhet	Sunamganj	Derai	Derai Sarmangal	Derai
S99-07020	RIP7020	13/05/1999	24.7775	91.3811	1965	HTW	119.5	Abdul Magid Master	Sylhet	Sunamganj	Derai	Karimpur	Bhangadchor/E Candipι
S99-07021	RIP7021	13/05/1999	24.7428	91.3956	1988	HTW	137.2	Mutaleb Sarder	Sylhet	Sunamganj	Derai	Tarol	Tarol
S99-07022	RIP7022	13/05/1999	24.7431	91.4057	1974	HTW	146.3	Abdul Mannan	Sylhet	Sunamganj	Derai	Kulanj	Nagergoan
S99-07023	RIP7023	13/05/1999	24.7573	91.4126	1977	HTW	121.9	Radiker Ranjan Dev	Sylhet	Sunamganj	Derai	Jagdhal	Kaldhar
S99-07024	RIP7024	13/05/1999	24.8031	91.3338	1998	HTW	127.1	Md Aftab Mia	Sylhet	Sunamganj	Derai	Rajanagarr	Borargoan
S99-07025	RIP7025	14/05/1999	24.7018	91.3344	1967	HTW	114.3	Shahadev Dash	Sylhet	Sunamganj	Sulla	Habibpur	Sharaspur
S99-07026	RIP7026	14/05/1999	24.7173	91.3051	1974	HTW	114.3	Jamini Kranta	Sylhet	Sunamganj	Sulla	Habibpur	Noagoan
S99-07027	RIP7027	14/05/1999	24.7005	91.2761	1986	HTW	109.7	Giridhar High School	Sylhet	Sunamganj	Sulla	Bahara	Angaura (Doagoan)
S99-07028	RIP7028	14/05/1999	24.6499	91.2738	1986	HTW	109.7	Mr Bajlur Rahman	Sylhet	Sunamganj	Sulla	Sulla	Arabad
S99-07029	RIP7029	14/05/1999	24.672	91.2696		HTW	140.2	DPHE, Sulla Thana	Sylhet	Sunamganj	Sulla	Bhara	Thana HQ, Ghungiargoa
S99-07030	RIP7030	14/05/1999	24.7334	91.2086	1994	HTW	131.1	Md Surat Ali	Sylhet	Sunamganj	Sulla	Atgoan	Atgoan
S99-07031	RIP7031	16/05/1999	24.7338	90.7679	1992	HTW	64	Shuntu Mia	Dhaka	Netrokona	Kendua	Asujia	Singhergoan
S99-07032	RIP7032	16/05/1999	24.7255	90.8072	1995	TARA	59.4	Md Abdur Rahim	Dhaka	Netrokona	Kendua	Balaishimul	Balaishimul
S99-07033	RIP7033	16/05/1999	24.7012	90.7639	1995	HTW	65.5	Md Giasuddin Talukder	Dhaka	Netrokona	Kendua	Goraduba	Biddahballah
S99-07034	RIP7034	16/05/1999	24.6633	90.7674	1985	HTW	67.1	S K Bazar	Dhaka	Netrokona	Kendua	Sandikuna	Shandikuna Bazar
S99-07035	RIP7035	16/05/1999	24.6238	90.7876	1976	HTW	68.6	U P	Dhaka	Netrokona	Kendua	Roalbari	Roalbari
S99-07036	RIP7036	16/05/1999	24.6619	90.7863	1999	HTW	54.9	Belal Hossain	Dhaka	Netrokona	Kendua	Maska	Maska
S99-07037	RIP7037	16/05/1999	24.6595	90.8458	1999	HTW	21.3	Rofiqul Islam	Dhaka	Netrokona	Kendua	Kandiura	Kandiura
S99-07038	RIP7038	16/05/1999	24.6197	90.8597	1997	HTW	33.5	Chirang Bazar	Dhaka	Netrokona	Kendua	Chirang	Chirang
S99-07039	RIP7039	17/05/1999	24.7182	90.9442	1980	HTW	86.9	DPHE	Dhaka	Netrokona	Madan	Jahangirpur	Jahangirpur
S99-07040	RIP7040	17/05/1999	24.7232	90.9747		HTW	78	Abdu Maula	Dhaka	Netrokona	Madan	Madan	Kuliati
S99-07041	RIP7041	17/05/1999	24.7198	91.0127	1994	HTW	85.3	Abdul Mamin	Dhaka	Netrokona	Madan	Gobindasri	Gobindasri (W)
S99-07042	RIP7042	17/05/1999	24.6683	90.9613	1995	HTW	70.1	Raton Mia	Dhaka	Netrokona	Madan	Tiasri	Paharpur
S99-07043	RIP7043	17/05/1999	24.6317	90.9674	1996	HTW	74.7	Md Mogul Dash	Dhaka	Netrokona	Madan	Fatehpur	Hasimpur
S99-07044	RIP7044	17/05/1999	24.704	90.9279	1999	TARA	82.6	Dilhaque Mia	Dhaka	Netrokona	Madan	Jahangirpur	Ratnopur
S99-07045	RIP7045	17/05/1999	24.738	90.8827	1994	HTW	85.3	Bat Tala Bazar	Dhaka	Netrokona	Madan	Kaitail	Gobindapur
S99-07046	RIP7046	18/05/1999	24.735	90.9456	1997	HTW	105.2	Chanpor Ali	Dhaka	Netrokona	Atpara	Sukhari	Sukhari
S99-07047	RIP7047	18/05/1999	24.7979	90.806	1995	TARA	66.4	Avoypasa Bazar	Dhaka	Netrokona	Atpara	Sarmaisa	Avoypasa
S99-07048	RIP7048	18/05/1999	24.7641	90.8588	1983	HTW	64	Mr Bachu Mia	Dhaka	Netrokona	Atpara	Teligati	Bijoypur
S99-07049	RIP7049	18/05/1999	24.7701	90.8867	1989	HTW	64.6	Md Aftab Uddin	Dhaka	Netrokona	Atpara	Duqz	Robiargati
S99-07050	RIP7050	18/05/1999	24.8115	90.86	1997	TARA	64	TNO	Dhaka	Netrokona	Atpara	Baniangan	Atpara
S99-07051	RIP7051	18/05/1999	24.8277	90.8583	1997	TARA	65.5	Md Karimia	Dhaka	Netrokona	Atpara	Sonai	Salpasunai
S99-07052	RIP7052	18/05/1999	24.8079	90.8818	1998	TARA	67.1	Md badal mia	Dhaka	Netrokona	Atpara	Baniagan (east)	Mirjapur
S99-07053	RIP7053	19/05/1999	24.8961	90.8837	1996	TARA	72.2	DPHE	Dhaka	Netrokona	Barhatta	Barhatta	Brikalika
S99-07054	RIP7054	19/05/1999	24.8961	90.8837	1995	HTW	20.1	DPHE	Dhaka	Netrokona	Barhatta	Barhatta	Brikalika
S99-07055	RIP7055	19/05/1999	24.8748	90.8652	1998	TARA	69.8	Siddiqur Rahman	Dhaka	Netrokona	Barhatta	Sahata	Demura
S99-07056	RIP7056	19/05/1999	24.913	90.9017	1987	HTW	76.2	Raisuddin	Dhaka	Netrokona	Barhatta	Asma	Koilhati
S99-07057	RIP7057	19/05/1999	24.9148	90.9213	1989	TARA	80.2	Golam Mostafa	Dhaka	Netrokona	Barhatta	Singdha	Chandrapial Baza
S99-07058	RIP7058	19/05/1999	24.9277	90.9384	1992	HTW	88.1	Ajitendra Dash	Dhaka	Netrokona	Barhatta	Chhiram	Raimadhai
S99-07059	RIP7059	19/05/1999	24.9424	90.8357	1995	TARA	68.3	Md Abuni Mia	Dhaka	Netrokona	Barhatta	Bausi	Shusangdhar Para
S99-07060	RIP7060	19/05/1999	24.9834	90.8394		HTW	81.7	Md Suraz Ali Fakir	Dhaka	Netrokona	Barhatta	Raipur	Nichintapur
S99-07061	RIP7061	20/05/1999	24.7076	91.082	1998	HTW	77.1	Jaganathpur Bazar	Dhaka	Netrokona	Khaliajuri	Mendipur	Jaganathpur Bazar
S99-07062	RIP7062	20/05/1999	24.7509	91.0838	1988	HTW	78.6	Nuralipur Mosque	Dhaka	Netrokona	Khaliajuri	Chakua	Faridpur
S99-07063	RIP7063	20/05/1999	24.6911	91.1408	1988	HTW	118.3	TNO	Dhaka	Netrokona	Khaliajuri	Khaliajuri	Khaliajuri
S99-07064	RIP7064	20/05/1999	24.6997	91.1754		HTW	0.6		Dhaka	Netrokona	Khaliajuri	Krishnapur	Zaherpur
S99-07065	RIP7065	20/05/1999	24.671	91.1654	1996	HTW	109.1	Dhirendra chandra	Dhaka	Netrokona	Khaliajuri	Nagar	Udaipur

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-07016	6903332253	145	0.01	0.2	0.039	2.7	< 0.003	< 0.002	< 0.008	4.09	2.3	0.005	1.35	0.045	132	1.4	11.6	0.6	0.0222	< 0.002	0.137
S99-07019	6902928299	94.1	0.02	0.1	0.112	16.1	< 0.003	< 0.002	< 0.008	5.36	1.6	< 0.004	8.6	0.148	95.3	3.1	17	0.4	0.116	< 0.002	0.175
S99-07020	6902947078	59.1	0.01	0.1	0.06	9.5	< 0.003	< 0.002	< 0.008	2.13	1.1	< 0.004	4.54	0.098	105	6	16.4	0.4	0.0634	< 0.002	0.027
S99-07021	6902985936	57.5	0.03	< 0.1	0.087	14.5	< 0.003	< 0.002	< 0.008	4.41	1.2	< 0.004	6.79	0.166	71.5	2.7	18.9	0.3	0.106	< 0.002	0.019
S99-07022	6902957247	54.8	0.03	< 0.1	0.08	12.3	< 0.003	< 0.002	< 0.008	3.65	1.2	< 0.004	5.69	0.143	91.1	4.1	20.6	0.3	0.0902	< 0.002	0.025
S99-07023	6902938481	55.6	0.04	< 0.1	0.102	16.1	< 0.003	< 0.002	< 0.008	7.94	1.3	< 0.004	7.74	0.234	61.9	1.7	18.8	0.3	0.124	< 0.002	0.022
S99-07024	6902976149	78.2	0.03	< 0.1	0.075	14.1	< 0.003	< 0.002	< 0.008	2.32	1.8	< 0.004	7.38	0.108	118	5.5	16.7	0.4	0.0985	< 0.002	0.016
S99-07025	6908671905	57.2	0.02	0.2	0.075	13	< 0.003	< 0.002	< 0.008	2.7	1.2	0.004	6.18	0.115	98.6	3.6	17.8	0.4	0.0928	< 0.002	0.033
S99-07026	6908671712	70.6	0.02	0.2	0.095	15	< 0.003	< 0.002	0.01	3.95	1.2	< 0.004	7.46	0.126	90.3	2.7	17.7	0.4	0.113	< 0.002	0.054
S99-07027	6908647965	61	< 0.01	0.4	0.058	8.1	< 0.003	< 0.002	< 0.008	7.19	0.9	< 0.004	3.24	0.195	109	2.7	17.8	< 0.2	0.0603	< 0.002	0.019
S99-07028	6908695816	49.1	0.01	0.3	0.069	11.9	< 0.003	< 0.002	< 0.008	6.19	1.6	0.006	5.51	0.206	123	2.6	18.5	0.3	0.0855	< 0.002	0.018
S99-07029	6908647297	43	0.02	0.6	0.031	6.5	< 0.003	< 0.002	0.028	0.47	1.6	0.007	3.8	0.044	175	4.7	12.3	0.5	0.0527	< 0.002	0.014
S99-07030	6908623059	44.3	0.02	0.4	0.038	10.2	< 0.003	< 0.002	< 0.008	0.394	1.8	0.007	4.75	0.072	195	3.9	13.3	0.3	0.0732	< 0.002	0.014
S99-07031	3724706941	< 0.5	0.02	< 0.1	0.021	32.5	< 0.003	< 0.002	0.009	0.07	1.4	< 0.004	12.7	0.097	37.9	0.3	22	0.2	0.165	0.006	0.052
S99-07032	3724713081	< 0.5	0.02	< 0.1	0.059	48.8	< 0.003	< 0.002	0.011	0.046	1.4	< 0.004	17.5	0.157	52.3	< 0.1	17	1.4	0.272	0.004	0.028
S99-07033	3724733184	< 0.5	0.02	< 0.1	0.042	64.8	< 0.003	< 0.002	0.017	0.035	1.8	< 0.004	23.5	1.17	29.8	0.2	22.1	0.4	0.344	0.003	0.032
S99-07034	3724794909	0.5	0.01	< 0.1	0.013	26.2	< 0.003	< 0.002	< 0.008	0.099	1	< 0.004	7.92	0.322	9.5	0.2	28	0.8	0.135	0.005	0.018
S99-07035	3724788872	< 0.5	0.01	< 0.1	0.021	35.1	< 0.003	< 0.002	0.01	1.49	2.4	0.008	16.3	0.083	38.5	0.1	32.9	0.6	0.253	0.003	0.025
S99-07036	3724761642	0.5	0.03	< 0.1	0.032	43.4	< 0.003	< 0.002	0.01	0.188	1.7	< 0.004	14	0.152	26.5	0.3	22.3	0.5	0.265	0.006	0.041
S99-07037	3724747528	33.6	0.01	0.1	0.075	21.2	< 0.003	< 0.002	< 0.008	8.98	1.7	< 0.004	7.89	0.138	8	2	29	< 0.2	0.096	< 0.002	0.15
S99-07038	3724720278	79.5	0.01	0.6	0.092	13.4	< 0.003	< 0.002	< 0.008	3.61	2.7	0.008	5.77	0.076	223	2.4	22.8	0.2	0.119	< 0.002	0.017
S99-07039	3725631418	15.9	0.02	0.6	0.25	31.4	< 0.003	< 0.002	0.009	0.944	3.6	0.008	12.2	0.032	267	0.3	20.3	2.3	0.32	< 0.002	0.029
S99-07040	3725652576	154	0.02	0.3	0.109	16.9	< 0.003	< 0.002	< 0.008	6.38	2.4	0.006	7.77	0.057	183	2.2	18.1	0.4	0.132	< 0.002	0.021
S99-07041	3725621366	92.5	0.02	0.5	0.077	15.8	< 0.003	< 0.002	< 0.008	2.91	2.1	0.005	6.94	0.045	223	2.3	14.9	0.4	0.107	< 0.002	0.029
S99-07042	3725684251	105	0.02	0.5	0.136	20.5	< 0.003	< 0.002	< 0.008	5.88	2.7	0.005	8.22	0.067	191	2.8	18.2	0.4	0.163	< 0.002	0.02
S99-07043	3725610167	54.9	0.01	0.6	0.069	9.6	< 0.003	< 0.002	< 0.008	2.84	2	0.005	4.13	0.043	211	3.1	14.9	0.3	0.0751	< 0.002	0.026
S99-07044	3725631188	67.7	0.02	0.3	0.059	45.2	0.005	< 0.002	< 0.008	7.59	3.4	0.005	16.6	0.231	189	1.2	19.3	2.1	0.375	< 0.002	0.052
S99-07045	3725642356	1.6	0.06	< 0.1	0.053	76.2	< 0.003	< 0.002	0.017	0.103	2	0.008	25.6	0.578	66.1	0.2	21.4	0.4	0.465	0.006	0.029
S99-07046	3720459194	216	0.01	0.2	0.336	45.1	0.004	< 0.002	0.01	4.43	3.1	0.006	16.7	0.214	171	0.7	15.1	< 0.2	0.47	< 0.002	0.071
S99-07047	3720447007	7.7	0.02	< 0.1	0.139	44	0.006	< 0.002	0.01	8.14	2.5	0.007	21.5	5.07	43	0.6	26.5	1.2	0.234	< 0.002	0.051
S99-07048	3720483144	0.7	0.03	< 0.1	0.073	59.3	< 0.003	< 0.002	0.023	0.204	1.4	< 0.004	20.2	0.345	55.4	0.2	19.2	0.5	0.316	0.005	0.031
S99-07049	3720423764	< 0.5	0.02	< 0.1	0.021	72.9	< 0.003	< 0.002	0.024	0.121	1.7	< 0.004	27.6	0.168	88.4	0.1	18.5	0.8	0.455	0.003	0.075
S99-07050	3720411086	< 0.5	0.02	< 0.1	0.066	48.7	< 0.003	< 0.002	0.012	0.041	1.2	< 0.004	16.2	0.159	60.6	< 0.1	17.7	0.8	0.282	0.003	0.035
S99-07051	3720471958	< 0.5	0.01	< 0.1	0.023	35.8	< 0.003	< 0.002	0.009	0.054	1.1	< 0.004	13.1	0.189	59.9	0.1	19.4	0.3	0.183	0.004	0.024
S99-07052	3720411245	< 0.5	0.03	< 0.1	0.025	74.4	< 0.003	< 0.002	0.022	0.262	1.9	0.015	33.5	0.797	76	0.1	23.1	0.9	0.417	0.002	0.303
S99-07053	3720923230	< 0.5	0.03	< 0.1	0.056	71.2	0.004	< 0.002	0.026	0.054	2.5	< 0.004	35.7	1.6	90.3	0.2	20.9	1.1	0.467	0.004	0.056
S99-07054	3720923230	21.6	0.02	0.1	0.067	21.9	< 0.003	< 0.002	< 0.008	6.37	2.1	< 0.004	10.7	0.547	9.4	1	27	< 0.2	0.069	< 0.002	0.045
S99-07055	3720971331	< 0.5	0.02	< 0.1	0.015	28.6	< 0.003	< 0.002	0.009	0.056	1.2	< 0.004	11.9	0.284	51.9	0.2	22	< 0.2	0.139	0.005	0.042
S99-07056	3720911087	10.9	0.01	< 0.1	0.059	22.7	< 0.003	< 0.002	< 0.008	0.635	1	< 0.004	6.89	0.142	69.7	0.9	18.1	< 0.2	0.128	< 0.002	0.034
S99-07057	3720983243	3.6	0.01	< 0.1	0.024	29.4	< 0.003	< 0.002	0.011	0.072	1.2	< 0.004	14	1.12	37.9	0.2	21.2	< 0.2	0.222	< 0.002	0.028
S99-07058	3720947866	27.2	0.02	< 0.1	0.048	31.7	< 0.003	< 0.002	< 0.008	1.19	2.1	< 0.004	12.1	0.114	64.3	0.3	15.6	< 0.2	0.226	0.003	0.026
S99-07059	3720935947	29.8	< 0.01	< 0.1	0.053	8.2	< 0.003	< 0.002	< 0.008	2.01	1	< 0.004	3.46	0.191	76.8	0.6	14.4	< 0.2	0.0604	< 0.002	0.02
S99-07060	3720959250	12.6	0.02	< 0.1	0.09	31	< 0.003	< 0.002	< 0.008	4.68	1.8	< 0.004	12.5	0.419	59.1	0.7	19.5	< 0.2	0.187	< 0.002	0.03
S99-07061	3723867460	135	0.02	0.3	0.099	15.9	< 0.003	< 0.002	< 0.008	8.47	2.4	< 0.004	7.7	0.103	145	2.1	19	0.4	0.114	< 0.002	0.027
S99-07062	3723813638	125	0.02	0.2	0.114	18	< 0.003	< 0.002	< 0.008	6.45	2.7	< 0.004	8.05	0.062	132	1.7	14.1	0.3	0.136	< 0.002	0.023
S99-07063	3723840594	44.8	0.02	0.5	0.067	10.8	< 0.003	< 0.002	< 0.008	1.06	1.9	0.004	4.77	0.068	230	3.5	14.4	0.4	0.0794	< 0.002	0.018
S99-07064	3723854742	34.7	0.03	0.6	0.041	7.2	< 0.003	< 0.002	< 0.008	1.86	1.5	0.007	3	0.126	219	4.1	14.2	0.3	0.0516	< 0.002	0.023
S99-07065	3723881103	28.2	0.02	0.6	0.035	6.4	< 0.003	< 0.002	< 0.008	0.4	1.9	0.004	2.69	0.029	227	1.6	11.6	0.4	0.0504	< 0.002	0.021

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07066	RIP7066	20/05/1999	24.6572	91.0503	1992	HTW	83.8	Mamun Chowdhury	Dhaka	Netrokona	Khaliajuri	Gazipur	Gazipur
S99-07067	RIP7067	23/05/1999	24.9825	90.1307	1997	HTW	22.9	Chitholia Idd Ghamath	Dhaka	Sherpur	Nakla	Ganapaddi	Ganapaddi
S99-07068	RIP7068	23/05/1999	25.0051	90.1667	1983	HTW	22.9	Rofiz Uddin Rifaz	Dhaka	Sherpur	Nakla	Nakhla-2	Nakhla
S99-07069	RIP7069	23/05/1999	25.0055	90.2128	1962	HTW	26.2	U P Office	Dhaka	Sherpur	Nakla	Urpha	Ramishimul
S99-07070	RIP7070	23/05/1999	24.9694	90.1816	1995	HTW	26.2	Kursabadagari Govt.Primary School	Dhaka	Sherpur	Nakla	Kursabadagair	Kursabadagair
S99-07071	RIP7071	23/05/1999	24.9478	90.2192	1998	HTW	22.3	Md Iddrish Ali	Dhaka	Sherpur	Nakla	Talki	Bazidbari
S99-07072	RIP7072	23/05/1999	24.9182	90.2144	1995	TARA	22.6	Pathakata High School	Dhaka	Sherpur	Nakla	Pathakata	Pathakata
S99-07073	RIP7073	23/05/1999	24.9065	90.1859	1979	HTW	23.5	Md Ashraf Ali	Dhaka	Sherpur	Nakla	Char Ashtadhar	Char Nayabad
S99-07074	RIP7074	23/05/1999	24.9214	90.1356	1977	HTW	22.3	Izzat Ali	Dhaka	Sherpur	Nakla	Chandrakona	Basur Alga
S99-07075	RIP7075	23/05/1999	24.9531	90.1519	1997	HTW	22.3	Baneshwardi Govt.Primary School	Dhaka	Sherpur	Nakla	Baneshwardi	Baneshwardi
S99-07076	RIP7076	24/05/1999	25.1043	90.0416	1997	HTW	36	Mubarak Ali	Dhaka	Sherpur	Jhenaigati	Haligikanda	Jhulgaon
S99-07077	RIP7077	24/05/1999	25.1402	90.0442	1997	TARA	34.1	Md Khalilur Rahman	Dhaka	Sherpur	Jhenaigati	Jhenaigati	Surihara
S99-07078	RIP7078	24/05/1999	25.2006	90.0183	1996	TARA	38.1	Dhansail Bazar Mosque	Dhaka	Sherpur	Jhenaigati	Dhansail	Dhansail
S99-07079	RIP7079	24/05/1999	25.213	90.0091	1997	TARA	38.1		Dhaka	Sherpur	Jhenaigati	Khansha	Panbar
S99-07080	RIP7080	24/05/1999	25.1921	90.069		TARA	37.8	DPHE office	Dhaka	Sherpur	Jhenaigati	Jhenaigati	Jhenaigati
S99-07081	RIP7081	24/05/1999	25.192	90.0672	1993	HTW	10.7	Md Mahiuddin	Dhaka	Sherpur	Jhenaigati	Jhenaigati	Jhenaigati
S99-07082	RIP7082	24/05/1999	25.22	90.0349	1994	TARA	36.6	Md Shahidul Islam	Dhaka	Sherpur	Jhenaigati	Kangsha	Bakakura
S99-07083	RIP7083	24/05/1999	25.1896	90.1184	1997	TARA	36.3	Gofur Ali	Dhaka	Sherpur	Jhenaigati	Nalkira	Baibada
S99-07084	RIP7084	24/05/1999	25.1531	90.0887	1998	TARA	36.6	Md Akkas Ali	Dhaka	Sherpur	Jhenaigati	Gauripur	Bangoan
S99-07085	RIP7085	25/05/1999	25.1474	89.9353	1984	HTW	23.5	Thana Parished Mosque	Dhaka	Sherpur	Sribardi	Sribardi	Mathuradi
S99-07086	RIP7086	25/05/1999	25.106	89.9278	1974	HTW	23.5	Md Safiluddin	Dhaka	Sherpur	Sribardi	Bhelua	Shimulchara
S99-07087	RIP7087	25/05/1999	25.0878	89.9651	1962	HTW	34.1	Langarpara Primary School	Dhaka	Sherpur	Sribardi	Kharia Karirchar	Langarpara
S99-07088	RIP7088	25/05/1999	25.131	89.9829	1990	HTW	22.6	Abdul Khalek	Dhaka	Sherpur	Sribardi	Gasaipur	Bharara
S99-07089	RIP7089	25/05/1999	25.0832	90.0006	1992	HTW	34.1	Indelpur mosque	Dhaka	Sherpur	Sribardi	Kurikhania	Indelpur
S99-07090	RIP7090	26/05/1999	24.815	89.8228	1991	HTW	18	Akbar Ali	Dhaka	Jamalpur	Madarganj	Sidhli	Sadarbari
S99-07091	RIP7091	26/05/1999	24.8262	89.7993	1992	HTW	18	Shemganj Kallabari H School	Dhaka	Jamalpur	Madarganj	Sidhli	Mujahata
S99-07092	RIP7092	26/05/1999	24.8368	89.7539	1999	HTW	22.6	Md Abul Hossain	Dhaka	Jamalpur	Madarganj	Jorekhali	Dighalkandi
S99-07093	RIP7093	26/05/1999	24.8568	89.783	1997	HTW	22.3	Md Raisuddin	Dhaka	Jamalpur	Madarganj	Adarbhita	Bajiterpara
S99-07094	RIP7094	26/05/1999	24.8964	89.7576	1997	HTW	18	Abdur Razzak	Dhaka	Jamalpur	Madarganj	Gunaritala	Khorda Jonail
S99-07095	RIP7095	26/05/1999	24.8969	89.7303	1996	HTW	22.3	Dhines Chandra Gosh	Dhaka	Jamalpur	Madarganj	Balijuri	Baladbhara (Balijuri)
S99-07096	RIP7096	26/05/1999	24.8954	89.72	1994	HTW	7.6	Abdus Salam	Dhaka	Jamalpur	Madarganj	Balijuri	Baladbhara (Balijuri)
S99-07097	RIP7097	26/05/1999	24.9221	89.7138	1991	HTW	18	Tajul Islam	Dhaka	Jamalpur	Madarganj	Char Pakerdaha	Char Nagar
S99-07098	RIP7098	26/05/1999	24.9601	89.7407	1997	HTW	18	Md Nazrul Islam	Dhaka	Jamalpur	Madarganj	Karaichara	Nalchhia
S99-07099	RIP7099	26/05/1999	24.9964	89.7485	1999	HTW	18	U P office	Dhaka	Jamalpur	Melandah	Mahmudpur	Mahmudpur
S99-07100	RIP7100	26/05/1999	24.9811	89.8319	1983	HTW	23.8	Nurul Haque	Dhaka	Jamalpur	Melandah	Nayanagar	Adhipait
S99-07101	RIP7101	26/05/1999	25.0291	89.8226	1996	HTW	22.3	Tonki Bazar Mosque	Dhaka	Jamalpur	Melandah	Kulia	Tanki
S99-07102	RIP7102	26/05/1999	25.0371	89.8271	1981	HTW	31.7	Hosen Ali	Dhaka	Jamalpur	Melandah	Durmut	Durmut
S99-07103	RIP7103	26/05/1999	24.998	89.8453	1999	HTW	22.6	A Kuddus Khelifa	Dhaka	Jamalpur	Melandah	Sampur	Sampur
S99-07104	RIP7104	26/05/1999	24.9579	89.8534	1972	HTW	37.8	Gobindagarj Bazar Mosque	Dhaka	Jamalpur	Melandah	Nayanagar	Malancha
S99-07105	RIP7105	27/05/1999	25.0744	89.7733	1986	HTW	22.6	Harunur Rashid	Dhaka	Jamalpur	Islampur	Islampur	Bhengura
S99-07106	RIP7106	27/05/1999	25.0732	89.774	1996	HTW	12.2	Md Jobed Ali	Dhaka	Jamalpur	Islampur	Islampur	Bhengura
S99-07107	RIP7107	27/05/1999	25.059	89.7239	1993	HTW	22.6	U P office	Dhaka	Jamalpur	Islampur	Chinaduli	Chinaduli
S99-07108	RIP7108	27/05/1999	25.0381	89.8339		HTW	22.6	Md Hazrat Ali	Dhaka	Jamalpur	Islampur	Char Goalini	Goalinirchar
S99-07109	RIP7109	29/05/1999	25.1349	89.8822	1999	HTW	22.6	Md Motka Shek	Dhaka	Jamalpur	Bakshiganj	Nilakshmia	Nilakshmia
S99-07110	RIP7110	29/05/1999	25.1823	89.8712	1996	HTW	27.1	Mojammel Haque	Dhaka	Jamalpur	Bakshiganj	Bakshiganj	Char Kauria
S99-07111	RIP7111	29/05/1999	25.1903	89.828	1996	HTW	18.9	Md Anwar Hossain	Dhaka	Jamalpur	Bakshiganj	Kerurchar	Rabiarchar
S99-07112	RIP7112	29/05/1999	25.2262	89.8616	1997	HTW	18	Azim Uddin	Dhaka	Jamalpur	Bakshiganj	Bakshiganj	Surjyanagar
S99-07113	RIP7113	29/05/1999	25.2348	89.8859	1991	HTW	26.8	Md Abul Kashem	Dhaka	Jamalpur	Bakshiganj	Battarjore	Battarjore

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-07066	3723827341	127	0.01	0.6	0.05	11.2	< 0.003	< 0.002	< 0.008	1.83	2	0.006	5.1	0.045	185	2.2	17.2	0.4	0.0783	< 0.002	0.022
S99-07067	3896738508	3.3	0.02	< 0.1	0.061	24.8	< 0.003	< 0.002	0.011	4.48	3.4	0.004	15.4	0.83	9.4	0.1	23.4	3.2	0.0807	< 0.002	0.026
S99-07068	3896757734	< 0.5	< 0.01	< 0.1	0.031	17.4	< 0.003	< 0.002	0.008	0.154	2.1	< 0.004	9.61	0.191	8.3	< 0.1	18.9	5.2	0.0577	< 0.002	0.018
S99-07069	3896785893	1	< 0.01	< 0.1	0.049	10.9	< 0.003	< 0.002	< 0.008	4.9	2.2	< 0.004	6.16	0.185	9.8	< 0.1	16.7	6	0.0519	< 0.002	0.027
S99-07070	3896747633	< 0.5	0.02	< 0.1	0.033	16.6	< 0.003	0.004	0.01	0.129	2	< 0.004	8.97	0.182	10.2	< 0.1	21.8	3.2	0.0616	< 0.002	0.033
S99-07071	3896776135	< 0.5	< 0.01	< 0.1	0.038	18.3	< 0.003	< 0.002	0.009	0.16	2	< 0.004	8.95	0.032	10.5	< 0.1	20.1	7.2	0.0783	< 0.002	0.058
S99-07072	3896766802	17.2	< 0.01	< 0.1	0.036	19.1	< 0.003	< 0.002	0.01	0.34	2.4	< 0.004	9.82	1.89	8.3	0.2	24.9	1.2	0.0843	< 0.002	0.025
S99-07073	3896728373	1.6	0.01	< 0.1	0.021	14.3	< 0.003	< 0.002	< 0.008	0.084	2	< 0.004	4.81	0.773	5.2	0.1	19.2	2.2	0.0541	< 0.002	0.023
S99-07074	3896719101	5.2	0.02	< 0.1	0.025	15.4	< 0.003	< 0.002	< 0.008	0.176	2.3	0.006	5.97	0.894	7.6	< 0.1	17.8	3.4	0.0676	< 0.002	0.019
S99-07075	3896709045	54.4	0.02	< 0.1	0.054	27.1	< 0.003	< 0.002	< 0.008	4.66	2.5	< 0.004	9.17	1.59	7.2	0.6	23.9	0.4	0.108	< 0.002	0.042
S99-07076	3893717570	6.7	< 0.01	< 0.1	0.064	20.7	< 0.003	< 0.002	< 0.008	4.07	2	< 0.004	9.49	0.255	8	0.3	24.5	0.6	0.0696	< 0.002	0.022
S99-07077	3893725981	0.6	0.03	< 0.1	0.026	20.9	< 0.003	< 0.002	< 0.008	0.157	1.1	< 0.004	8.61	0.175	32	0.1	28.2	0.3	0.109	< 0.002	0.029
S99-07078	3893743291	5.8	0.01	< 0.1	0.083	21.9	< 0.003	< 0.002	< 0.008	4.69	1.7	< 0.004	10.4	0.261	16.1	0.4	33.1	0.4	0.132	< 0.002	0.032
S99-07079	3893743809	< 0.5	0.01	< 0.1	0.038	18.3	< 0.003	< 0.002	0.009	2.02	1.4	0.018	10.9	0.109	14.7	< 0.1	34.9	0.3	0.106	< 0.002	0.033
S99-07080	3893725557	36	< 0.01	< 0.1	0.071	19.6	< 0.003	< 0.002	< 0.008	2.12	1.4	< 0.004	7.7	0.298	19.6	0.6	27.6	< 0.2	0.129	< 0.002	0.03
S99-07081	3893725557	19.9	0.01	< 0.1	0.066	14.2	< 0.003	< 0.002	0.034	3.55	0.8	< 0.004	5.45	0.259	22.4	< 0.1	14.9	0.3	0.0848	< 0.002	0.039
S99-07082	3893743092	2.4	0.01	< 0.1	0.063	17.4	0.003	< 0.002	< 0.008	5.98	1.8	0.01	9.5	0.344	12.6	< 0.1	38.5	< 0.2	0.0944	< 0.002	0.031
S99-07083	3893760039	19	0.01	< 0.1	0.062	13.8	< 0.003	< 0.002	< 0.008	8.59	1.8	< 0.004	5.84	0.306	15.7	0.4	29.1	< 0.2	0.0845	< 0.002	0.069
S99-07084	3893760066	46.1	0.01	< 0.1	0.039	18.2	< 0.003	< 0.002	< 0.008	2.5	1.1	< 0.004	7.13	0.204	26.6	0.8	27	< 0.2	0.114	< 0.002	0.036
S99-07085	3899086737	11.4	0.01	< 0.1	0.037	21.8	< 0.003	< 0.002	< 0.008	0.867	2.6	< 0.004	12.7	1.18	8.4	0.2	19.5	4.1	0.0874	< 0.002	0.038
S99-07086	3899015893	99.5	0.02	< 0.1	0.03	21	< 0.003	< 0.002	< 0.008	0.625	2.3	< 0.004	6.65	1.06	7	0.7	22.8	< 0.2	0.0904	< 0.002	0.03
S99-07087	3899055681	168	0.02	0.1	0.065	33.3	< 0.003	< 0.002	0.019	11.8	3	< 0.004	12.4	1.13	6.8	0.8	21.1	2.3	0.15	< 0.002	0.046
S99-07088	3899039145	2.6	0.01	< 0.1	0.042	24.2	< 0.003	< 0.002	< 0.008	0.215	2.4	0.004	10.9	0.247	10.1	< 0.1	20	12.9	0.0986	< 0.002	0.028
S99-07089	3899063491	6.5	0.02	< 0.1	0.093	31.6	< 0.003	< 0.002	0.012	5.79	4.3	0.005	21.5	0.933	25.8	0.2	17.5	17.5	0.122	< 0.002	0.029
S99-07090	3395883907	0.9	0.01	< 0.1	0.075	52.8	0.003	< 0.002	0.015	0.031	4.3	0.004	23	0.885	9.6	0.2	12.7	14.4	0.158	< 0.002	0.022
S99-07091	3395883746	< 0.5	0.01	< 0.1	0.088	44.2	0.004	< 0.002	0.015	0.09	3.4	0.007	19.9	0.242	14.1	< 0.1	18.1	26.2	0.159	< 0.002	0.025
S99-07092	3395859409	8.2	0.02	< 0.1	0.052	22	< 0.003	< 0.002	< 0.008	3.76	2.9	< 0.004	8.44	0.238	6.1	0.7	21.2	2.6	0.0775	< 0.002	0.043
S99-07093	3395811043	13.3	0.01	< 0.1	0.141	40.3	< 0.003	< 0.002	< 0.008	9.33	3.8	0.007	18.9	0.793	9.8	0.3	24.4	1.2	0.151	< 0.002	0.026
S99-07094	3395847680	0.9	0.01	< 0.1	0.044	29	< 0.003	< 0.002	< 0.008	0.549	3.1	0.005	10.4	0.236	5.4	< 0.1	15.9	3.2	0.0703	< 0.002	0.025
S99-07095	3395823051	15.4	< 0.01	< 0.1	0.046	22.1	< 0.003	< 0.002	< 0.008	3.23	1.1	< 0.004	8.49	0.383	6.9	0.5	27.1	5.3	0.0469	< 0.002	0.016
S99-07096	3395823051	0.9	0.03	< 0.1	0.038	32.9	< 0.003	< 0.002	0.01	0.215	3.5	0.006	15.6	0.922	13.5	0.2	23.7	10	0.147	< 0.002	0.025
S99-07097	3395835299	< 0.5	0.02	< 0.1	0.075	60	< 0.003	< 0.002	0.022	0.039	3.8	0.005	32.4	0.4	20.7	0.1	11.6	15	0.157	0.003	0.02
S99-07098	3395871768	12.1	< 0.01	< 0.1	0.077	42.3	< 0.003	< 0.002	0.011	3.88	4.2	0.006	16	1.22	6	0.4	21.7	2.5	0.156	< 0.002	0.037
S99-07099	3396176646	< 0.5	0.16	< 0.1	0.044	25	< 0.003	< 0.002	0.021	0.05	2.7	< 0.004	14.9	0.023	18.7	< 0.1	13.9	10.3	0.0719	< 0.002	0.032
S99-07100	3396195007	8.2	0.04	< 0.1	0.059	19.1	< 0.003	< 0.002	< 0.008	5.91	2.6	< 0.004	9.87	0.448	7.9	0.5	20.7	5.3	0.0674	< 0.002	0.11
S99-07101	3396166938	0.8	0.03	< 0.1	0.053	31.7	< 0.003	< 0.002	0.014	1.08	2.1	0.006	14	0.034	20.4	< 0.1	17.6	9.4	0.124	< 0.002	0.032
S99-07102	3396128383	4.7	0.05	< 0.1	0.063	36.5	< 0.003	< 0.002	0.013	2.9	1.6	0.007	20.4	0.635	16.3	0.3	28	2.2	0.119	0.002	0.026
S99-07103	3396115465	4.4	0.02	< 0.1	0.036	17.2	< 0.003	< 0.002	< 0.008	2.6	2.5	< 0.004	8.16	0.45	6	0.3	14.3	5.9	0.0584	< 0.002	0.036
S99-07104	3396195653	12.8	0.02	0.1	0.074	32	< 0.003	< 0.002	0.008	10.2	2.4	0.007	17.5	0.748	17.3	0.5	24.5	2.8	0.115	< 0.002	0.029
S99-07105	3392955097	2.9	0.01	< 0.1	0.056	32.5	< 0.003	< 0.002	0.01	3.47	2	0.005	17.2	1.29	14.4	0.2	25.2	7.9	0.122	< 0.002	0.027
S99-07106	3392955097	1.3	0.01	< 0.1	0.079	49.6	< 0.003	< 0.002	0.017	3.3	3	0.005	26.6	0.968	25.9	0.1	20.7	19.1	0.187	0.003	0.038
S99-07107	3392931335	3.1	< 0.01	< 0.1	0.081	28.5	< 0.003	< 0.002	0.009	6.18	3.1	0.005	14	0.333	10.9	0.2	19.6	8.2	0.102	< 0.002	0.022
S99-07108	3392915465	9.4	< 0.01	< 0.1	0.051	34.9	< 0.003	< 0.002	0.013	0.228	4.1	0.004	16.8	1.43	16.2	0.3	18.2	21.3	0.127	0.002	0.019
S99-07109	3390780777	23.6	0.01	< 0.1	0.046	27.1	< 0.003	< 0.002	0.009	1.77	3.6	0.005	14.2	1.71	9.4	0.2	20.2	2.1	0.101	< 0.002	0.09
S99-07110	3390714295	11.4	0.01	< 0.1	0.102	35.6	< 0.003	< 0.002	0.013	7.55	4.4	0.009	23.9	2.38	40.6	0.2	23.1	16	0.129	< 0.002	0.034
S99-07111	3390773808	0.6	0.02	< 0.1	0.055	32.7	< 0.003	< 0.002	0.011	0.194	3.4	< 0.004	16.4	0.41	20.4	0.1	15.6	10.6	0.108	0.003	0.023
S99-07112	3390714932	< 0.5	0.01	< 0.1	0.228	61	< 0.003	< 0.002	0.02	0.091	30.1	0.012	28.4	1.04	76.5	0.1	12.9	34	0.244	0.003	0.033
S99-07113	3390707134	113	< 0.01	0.1	0.065	26	< 0.003	< 0.002	< 0.008	15	3.9	< 0.004	6.88	4.6	6.1	1.1	24.6	11	0.173	< 0.002	0.023

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07114	RIP7114	29/05/1999	25.2699	89.8703	1998	HTW	22.6	Abdul Jabbar B.Sc	Dhaka	Jamalpur	Bakshiganj	Dhanua	Gedra
S99-07115	RIP7115	29/05/1999	25.2904	89.8344	1989	HTW	22.6	Taibur Rahman	Dhaka	Jamalpur	Bakshiganj	Bagarchar	Ramrampur
S99-07116	RIP7116	29/05/1999	25.224	89.8321	1990	HTW	18	Jasijal Haque	Dhaka	Jamalpur	Bakshiganj	Sadhurpara	Sadhurpara
S99-07117	RIP7117	29/05/1999	25.2738	89.8318	1985	HTW	15.2	Md Emdadul Haque	Dhaka	Jamalpur	Bakshiganj	Bagarchar	Ramrampur
S99-07118	RIP7118	29/05/1999	25.2943	89.793	1998	HTW	13.7	Nur Mohammed	Dhaka	Jamalpur	Dewanganj	Par Ramrampur	Par Ramrampur
S99-07119	RIP7119	29/05/1999	25.2564	89.7845	1980	HTW	22.9	Md Abdul Wahed	Dhaka	Jamalpur	Dewanganj	Bahadurabad	Bahadurabad
S99-07120	RIP7120	30/05/1999	24.8418	89.9697	1997	TARA	43.3	U P Office	Dhaka	Jamalpur	Jamalpur Sadar	Sahabajpur	Sahabajpur
S99-07121	RIP7121	30/05/1999	24.8014	89.9856	1994	TARA	49.4	Keramat Ali	Dhaka	Jamalpur	Jamalpur Sadar	Sahabajpur	Kaidola
S99-07122	RIP7122	30/05/1999	24.9221	89.9445	1983	HTW	18.3	Md Abu Syed	Dhaka	Jamalpur	Jamalpur Sadar	Paurashava ward 2	Kachari para
S99-07123	RIP7123	30/05/1999	24.8651	89.982	1997	TARA	43.3	Md Bari Master	Dhaka	Jamalpur	Jamalpur Sadar	Sharifpur	Goda Simla
S99-07124	RIP7124	30/05/1999	24.8714	90.0247	1997	TARA	43.3	Md Syed Uddin	Dhaka	Jamalpur	Jamalpur Sadar	Sharifpur	Anantabari
S99-07125	RIP7125	30/05/1999	24.8365	90.0495	1995	TARA	42.7	Md Abdul Khalek	Dhaka	Jamalpur	Jamalpur Sadar	Ranagachha	Banarerpar
S99-07126	RIP7126	31/05/1999	23.9723	90.7251	1983	HTW	36.3	Syed Nagar Primary School	Dhaka	Narsingdi	Shibpur	Putia	Kamargaon
S99-07127	RIP7127	31/05/1999	24.0382	90.7176	1979	HTW	29	N Dattargaon Mosque	Dhaka	Narsingdi	Shibpur	Masimpur	Dattagaon
S99-07128	RIP7128	31/05/1999	24.038	90.7178	1989	HTW	12.8	Abdul Salam Sarker	Dhaka	Narsingdi	Shibpur	Masimpur	Dattagaon
S99-07129	RIP7129	31/05/1999	24.0206	90.6728	1991	HTW	24.4	Md Abdul Mannan	Dhaka	Narsingdi	Shibpur	Sadharchar	Khupi
S99-07130	RIP7130	31/05/1999	24.0711	90.6934	1979	HTW	53	Md Abdul Hakim	Dhaka	Narsingdi	Shibpur	Dulalpur	Nagarmahaswardi
S99-07131	RIP7131	31/05/1999	24.0725	90.7386	1999	TARA	51.2	Kurshed Alam	Dhaka	Narsingdi	Shibpur	Chakradha	Baraigaon
S99-07132	RIP7132	31/05/1999	24.0401	90.7374	1984	HTW	26.8	TNO	Dhaka	Narsingdi	Shibpur	Chakradha	Shibpur
S99-07133	RIP7133	31/05/1999	24.0309	90.7498	1992	TARA	40.2	Islam Uddin	Dhaka	Narsingdi	Shibpur	Baghaba	Baghaba
S99-07134	RIP7134	31/05/1999	24.0604	90.7937	1993	TARA	46	Md Shad Ali	Dhaka	Narsingdi	Shibpur	Joynagar	Pahar Joynagar
S99-07135	RIP7135	31/05/1999	24.0198	90.8095	1993	TARA	34.4	Md Abu Taleb	Dhaka	Narsingdi	Shibpur	Josar	Josar
S99-07136	RIP7136	01/06/1999	23.9334	90.7146	1976	DTW	79.2	DPHE	Dhaka	Narsingdi	Narsingdi Sadar	Ward 01	Bilashdi
S99-07137	RIP7137	01/06/1999	23.9309	90.7372	1997	HTW	40.5	Puranpara Govt. Primary School	Dhaka	Narsingdi	Narsingdi Sadar	Chinishpur	Puranpara
S99-07138	RIP7138	01/06/1999	23.9114	90.6579	1997	HTW	22.9	U P office	Dhaka	Narsingdi	Narsingdi Sadar	Panch Dona	Bhatpara
S99-07139	RIP7139	01/06/1999	23.8598	90.6192	1986	HTW	49.7	Md Akkas Ali	Dhaka	Narsingdi	Narsingdi Sadar	Amdia	Chherenda
S99-07140	RIP7140	01/06/1999	23.8403	90.6696	1997	HTW	10.7	Shafiuddin	Dhaka	Narsingdi	Narsingdi Sadar	Madhabdi	Manoharpur
S99-07141	RIP7141	01/06/1999	23.8136	90.6704	1989	HTW	22.3	Kafil Uddin	Dhaka	Narsingdi	Narsingdi Sadar	Kathalia	Kanthakia
S99-07142	RIP7142	01/06/1999	23.8757	90.6665	1985	HTW	38.7	U P Office	Dhaka	Narsingdi	Narsingdi Sadar	Meherpara	Paulanpur
S99-07143	RIP7143	01/06/1999	23.8212	90.734	1991	HTW	20.4	Adash Ali	Dhaka	Narsingdi	Narsingdi Sadar	Paikarchar	Uttar Char Bhasania
S99-07144	RIP7144	01/06/1999	23.8889	90.8016	1986	HTW	22.9	Md Sultan Miah	Dhaka	Narsingdi	Narsingdi Sadar	Alokbali	Alokbali
S99-07145	RIP7145	01/06/1999	23.9808	90.7279	1994	HTW	31.4	Md Kalam Hossain	Dhaka	Narsingdi	Narsingdi Sadar	Nazarpur	Dilarpur
S99-07146	RIP7146	02/06/1999	24.0658	90.8415	1997	TARA	45.4	Md Sirazul Islam	Dhaka	Narsingdi	Belabo	Amlaba	Amlaba
S99-07147	RIP7147	02/06/1999	24.1246	90.8287		HTW	46.3	Md Maznu Mia	Dhaka	Narsingdi	Belabo	Bajnaba	Birbhagber
S99-07148	RIP7148	02/06/1999	24.1292	90.8357	1998	HTW	29	Md ShariatUllah	Dhaka	Narsingdi	Belabo	Binyabaid	Char Bhagber
S99-07149	RIP7149	02/06/1999	24.1537	90.8097	1991	TARA	46.3	Md Jalal Uddin	Dhaka	Narsingdi	Belabo	Patuli	Chandipura
S99-07150	RIP7150	02/06/1999	24.1549	90.7731	1997	HTW	38.7	Shuturia Bazar	Dhaka	Narsingdi	Belabo	Patuli	Nagar Naluakot
S99-07151	RIP7151	02/06/1999	24.0912	90.8498	1975	HTW	50	Abdul Muttaleb	Dhaka	Narsingdi	Belabo	Belabo	Belabo
S99-07152	RIP7152	02/06/1999	24.0634	90.8805	1974	HTW	26.8	Md Fazlul Haque	Dhaka	Narsingdi	Belabo	Narayanpur	Joar Gobindapur
S99-07153	RIP7153	02/06/1999	24.0676	90.9223	1995	HTW	22.3	Md Emdadul Haque	Dhaka	Narsingdi	Belabo	Sallabad	Saralabad
S99-07154	RIP7154	05/06/1999	24.5046	89.144	1992	TARA	31.7	DPHE	Rajshahi	Natore	Singra	Singra	Khatapukuria
S99-07155	RIP7155	05/06/1999	24.486	89.0939	1995	TARA	31.7	Abdus Shukur	Rajshahi	Natore	Singra	Sherkole	Sherkole
S99-07156	RIP7156	05/06/1999	24.4557	89.0481	1998	HTW	25.9	Sahzahan Ali	Rajshahi	Natore	Singra	Lalor	Ataikula
S99-07157	RIP7157	05/06/1999	24.4418	89.0703	1998		33.8	Nitai Chandra	Rajshahi	Natore	Singra	Chhota Hatiandaha	Hatinadaha
S99-07158	RIP7158	05/06/1999	24.5329	89.1775	1987	HTW	23.6		Rajshahi	Natore	Singra	Chawgram	Chawgram
S99-07159	RIP7159	05/06/1999	24.5496	89.1974	1991		33.5	Paresh Chandra	Rajshahi	Natore	Singra	Italy	Pakuria
S99-07160	RIP7160	05/06/1999	24.5565	89.2342	1996	HTW	16.8	Bingram rani Bazar	Rajshahi	Natore	Singra	Ra-Khajuria	Bingram Bazar
S99-07161	RIP7161	05/06/1999	24.5591	89.2794	1999		33.5	Bamihal College	Rajshahi	Natore	Singra	Sukash	Bamihal

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-07114	3390723390	17.3	< 0.01	0.1	0.071	27.9	< 0.003	< 0.002	0.009	7.45	3	< 0.004	9.37	1.72	6.8	0.4	18.3	< 0.2	0.109	< 0.002	0.044
S99-07115	3390721855	98.7	0.01	< 0.1	0.059	33.9	< 0.003	< 0.002	< 0.008	7.49	2.1	< 0.004	10.1	0.853	7	1.1	18.5	< 0.2	0.129	< 0.002	0.037
S99-07116	3390794870	2.2	< 0.01	< 0.1	0.027	13	< 0.003	< 0.002	< 0.008	0.187	2.2	< 0.004	6.81	0.248	4.5	< 0.1	13.9	3.2	0.0519	< 0.002	0.021
S99-07117	3390721855	< 0.5	< 0.01	< 0.1	0.022	12.3	< 0.003	< 0.002	< 0.008	0.067	2.3	< 0.004	9	0.044	6.7	< 0.1	16.4	1.7	0.0373	< 0.002	0.017
S99-07118	3391587792	< 0.5	0.01	< 0.1	0.062	31.9	< 0.003	< 0.002	0.011	0.134	5.3	0.005	16.6	0.323	17.1	< 0.1	16.5	17.9	0.15	< 0.002	0.025
S99-07119	3391507093	6.5	< 0.01	< 0.1	0.041	26.3	< 0.003	< 0.002	0.01	0.633	3.7	0.005	16.7	0.861	9.8	< 0.1	17.8	14.5	0.0729	< 0.002	0.041
S99-07120	3393671858	< 0.5	0.01	< 0.1	0.017	23.5	< 0.003	< 0.002	< 0.008	0.068	0.9	< 0.004	10.3	0.045	9.8	0.1	31.6	0.4	0.136	0.003	0.081
S99-07121	3393671520	< 0.5	< 0.01	< 0.1	0.014	18.8	< 0.003	0.004	< 0.008	0.053	1.4	< 0.004	5.69	0.018	17.6	0.2	35.3	7.5	0.154	0.004	0.032
S99-07122	3393602528	< 0.5	< 0.01	< 0.1	0.011	10.2	< 0.003	< 0.002	< 0.008	0.109	< 0.5	< 0.004	3.97	0.014	15.6	0.1	29.5	0.7	0.0611	0.006	0.016
S99-07123	3393677407	0.6	0.02	< 0.1	0.02	22.6	< 0.003	< 0.002	0.022	0.851	1.3	0.009	11.4	0.274	14.6	< 0.1	33.1	1.9	0.115	< 0.002	0.046
S99-07124	3393677016	0.5	< 0.01	< 0.1	0.022	22.2	< 0.003	< 0.002	0.009	0.084	0.8	0.007	10.2	0.169	18.5	< 0.1	34.9	2.2	0.124	< 0.002	0.07
S99-07125	3393659060	< 0.5	0.01	< 0.1	0.015	22.6	< 0.003	< 0.002	0.013	0.023	< 0.5	0.004	11.1	0.994	19.2	< 0.1	31.3	1.1	0.134	0.004	0.021
S99-07126	3687684509	17	0.01	< 0.1	0.032	13.7	< 0.003	< 0.002	< 0.008	1.6	2.1	< 0.004	7.75	1.13	9.6	0.1	17.9	4.3	0.0588	< 0.002	0.027
S99-07127	3687673347	71.3	0.02	< 0.1	0.057	24.2	< 0.003	< 0.002	< 0.008	5.32	2.3	< 0.004	8.28	0.844	9.4	1.1	23.7	1.9	0.0874	< 0.002	0.06
S99-07128	3687673347	5.1	0.02	< 0.1	0.026	9.6	0.005	< 0.002	< 0.008	1.61	1.7	0.01	3.68	0.161	14.1	< 0.1	30.6	4.5	0.0344	0.004	0.038
S99-07129	3687694586	43.9	< 0.01	< 0.1	0.032	22	< 0.003	< 0.002	< 0.008	0.545	1.9	< 0.004	8.48	1.33	6.8	0.2	23.8	2	0.0688	< 0.002	0.02
S99-07130	3687642717	48	0.01	< 0.1	0.033	19.7	< 0.003	< 0.002	< 0.008	1.92	1.9	< 0.004	6.65	1.26	5.4	0.3	26.7	0.6	0.0728	< 0.002	0.022
S99-07131	3687631185	0.7	0.02	< 0.1	0.06	27.6	0.004	< 0.002	0.015	0.136	1.6	0.015	14.9	0.373	54.2	< 0.1	31.9	1.5	0.177	< 0.002	0.18
S99-07132	3687631910	42.2	0.01	< 0.1	0.039	31.7	< 0.003	< 0.002	< 0.008	0.566	2	< 0.004	7.82	0.694	9.5	0.3	24.4	1	0.106	< 0.002	0.048
S99-07133	3687621100	1.9	0.01	< 0.1	0.07	21.1	< 0.003	0.01	< 0.008	0.092	2	< 0.004	5.04	0.09	24.5	0.2	32.6	1.9	0.142	< 0.002	0.059
S99-07134	3687663711	0.9	< 0.01	< 0.1	0.028	17	< 0.003	0.004	< 0.008	0.053	1.2	0.004	6.35	0.033	16.7	0.1	34.1	0.3	0.118	0.004	0.035
S99-07135	3687652485	< 0.5	0.01	< 0.1	0.08	12.9	< 0.003	0.012	< 0.008	0.052	1.5	< 0.004	4.26	0.021	12.2	< 0.1	26.8	1.4	0.16	0.002	0.064
S99-07136	3686058236	< 0.5	0.01	< 0.1	0.031	28.8	< 0.003	< 0.002	0.011	0.069	1.2	< 0.004	9.23	0.031	29.5	0.2	27.6	5.5	0.202	0.005	0.055
S99-07137	3686023835	20.5	< 0.01	0.1	0.025	15.4	< 0.003	< 0.002	0.011	4.02	5	< 0.004	12.8	0.041	74.6	1.2	23.1	0.3	0.147	< 0.002	0.024
S99-07138	3686089207	< 0.5	0.01	< 0.1	0.094	31.4	< 0.003	< 0.002	0.014	0.116	1.9	0.005	12.8	0.643	24.7	0.3	33.2	7.2	0.272	0.006	0.026
S99-07139	3686011337	< 0.5	0.02	< 0.1	0.024	48.2	< 0.003	< 0.002	0.02	0.126	1.5	0.012	25.4	1.49	23.4	< 0.1	24.5	0.9	0.267	0.004	0.026
S99-07140	3686053704	< 0.5	0.02	< 0.1	0.194	77.6	0.004	< 0.002	0.025	0.253	15	0.007	36.3	0.285	126	< 0.1	12.5	31.3	0.309	0.002	0.036
S99-07141	3686047592	84.6	< 0.01	< 0.1	0.116	32.7	< 0.003	< 0.002	0.01	7.12	8.1	0.004	15.3	2.22	31.3	0.3	23.7	12.1	0.141	< 0.002	0.03
S99-07142	3686065823	1.3	0.01	< 0.1	0.031	31	< 0.003	< 0.002	0.013	0.053	1.1	< 0.004	12.3	0.122	28.8	0.1	31.4	0.4	0.181	0.005	0.024
S99-07143	3686083965	192	0.03	< 0.1	0.072	63.8	< 0.003	< 0.002	0.011	4.85	4	< 0.004	14	0.72	13	3.6	20.7	9.9	0.193	< 0.002	0.036
S99-07144	3686005023	45.9	0.07	< 0.1	0.145	141	0.004	< 0.002	0.027	0.544	8.4	0.008	37	1.65	34.3	0.3	24.6	38.2	0.415	< 0.002	0.23
S99-07145	3686077450	52.4	0.12	< 0.1	0.048	45.6	< 0.003	< 0.002	0.02	0.73	5.1	< 0.004	13.9	0.604	17	0.5	18.5	27.4	0.146	< 0.002	0.083
S99-07146	3680711047	1.3	< 0.01	< 0.1	0.057	11.2	< 0.003	0.015	< 0.008	0.151	2.3	< 0.004	2.74	0.009	12.5	0.1	32.1	0.4	0.126	0.002	0.016
S99-07147	3680713116	6.3	< 0.01	< 0.1	0.06	16.9	< 0.003	< 0.002	0.008	0.953	1.4	< 0.004	8.48	0.215	21.7	0.4	28.5	0.3	0.133	< 0.002	0.022
S99-07148	3680725227	120	0.01	< 0.1	0.056	42.4	0.009	0.005	0.017	3.83	1.9	< 0.004	13.2	2.72	21.8	0.8	27.1	2.3	0.27	0.003	0.044
S99-07149	3680771208	5.8	0.01	< 0.1	0.012	9.4	< 0.003	0.009	< 0.008	0.374	1.5	< 0.004	3.25	0.093	11.3	0.2	32	1.7	0.0828	0.003	0.02
S99-07150	3680771737	2.7	0.01	< 0.1	0.084	4.8	< 0.003	0.004	< 0.008	0.419	2.9	< 0.004	1.52	0.062	7	< 0.1	16	0.6	0.0618	< 0.002	0.028
S99-07151	3680720150	1.9	< 0.01	< 0.1	0.022	18	< 0.003	< 0.002	0.008	0.236	0.7	< 0.004	6.86	0.211	13	0.1	29	2.8	0.134	0.005	0.034
S99-07152	3680759458	48.5	0.01	< 0.1	0.032	20.4	< 0.003	< 0.002	< 0.008	1	2.1	< 0.004	6.28	1.39	7.8	0.3	22.3	0.9	0.0842	< 0.002	0.031
S99-07153	3680783908	163	< 0.01	0.2	0.068	13.6	< 0.003	< 0.002	0.013	1.87	10.7	0.004	19.8	0.227	161	2.7	10.9	1.7	0.131	< 0.002	0.022
S99-07154	5699187894	2.8	0.06	< 0.1	0.068	72.2	< 0.003	< 0.002	0.012	0.073	3.7	0.02	17.5	0.418	28.6	< 0.1	27.3	21.3	0.217	< 0.002	0.032
S99-07155	5699179883	0.6	0.04	< 0.1	0.047	79.4	< 0.003	< 0.002	0.018	0.358	1.6	0.01	21.9	0.804	33.5	0.1	22.1	21	0.278	0.003	0.04
S99-07156	5699163024	1	0.04	< 0.1	0.114	163	< 0.003	< 0.002	0.019	1.22	3.8	0.011	35.4	0.866	13	0.2	17.7	18.4	0.286	< 0.002	0.028
S99-07157	5699139233	< 0.5	0.04	< 0.1	0.047	84.1	< 0.003	< 0.002	0.014	0.025	2.1	0.009	18.6	0.769	18.4	< 0.1	21.4	15	0.213	< 0.002	0.042
S99-07158	5699123200	< 0.5	0.04	< 0.1	0.058	76.7	< 0.003	< 0.002	0.015	0.101	3.1	0.012	16.4	0.585	25.1	< 0.1	21.5	22.1	0.239	< 0.002	0.02
S99-07159	5699147698	< 0.5	0.02	< 0.1	0.047	63.5	< 0.003	< 0.002	< 0.008	0.098	2.8	0.01	12	0.633	19.4	0.1	22.4	2.3	0.238	< 0.002	0.022
S99-07160	5699195300	< 0.5	< 0.01	< 0.1	0.025	43.4	< 0.003	< 0.002	< 0.008	0.065	0.8	< 0.004	8.07	0.201	16.4	< 0.1	17.6	5.4	0.24	< 0.002	0.017
S99-07161	5699194053	< 0.5	0.05	< 0.1	0.051	86.3	< 0.003	< 0.002	< 0.008	0.042	3	0.012	11.5	0.439	24.5	0.1	17.2	9.2	0.319	< 0.002	0.026

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07162	RIP7162	06/06/1999	24.373	89.6363	1989	HTW	23.5	Mohiruddin Sarkar	Rajshahi	Sirajganj	Kamarkhanda	Jamtail	Kura
S99-07163	RIP7163	06/06/1999	24.3217	89.6498	1998		17.1	Sakendar Ali Mia	Rajshahi	Sirajganj	Kamarkhanda	Ray Daulatpur	Chaubaria
S99-07164	RIP7164	06/06/1999	24.3484	89.6606	1997		21.9	S M Samsul Haque	Rajshahi	Sirajganj	Kamarkhanda	Ray Daulatpur	Dhaleshwar
S99-07165	RIP7165	06/06/1999	24.3713	89.6885	1998		22.6	Md Ali Ajhar Talukdar	Rajshahi	Sirajganj	Kamarkhanda	Jamatail	Nandina Madhu
S99-07166	RIP7166	06/06/1999	24.4005	89.6536	1978	HTW	22.6	Md Abdul Mannan	Rajshahi	Sirajganj	Kamarkhanda	Jhawail	Parihaul Bagbari
S99-07167	RIP7167	06/06/1999	24.4397	89.6168	1995	HTW	22.6	Samsul Alam	Rajshahi	Sirajganj	Kamarkhanda	Bhadraghat	Bhadraghat
S99-07168	RIP7168	06/06/1999	24.399	89.6034	1994	HTW	22.6	Haider Ali Khan	Rajshahi	Sirajganj	Kamarkhanda	Bhadraghat	Saidgati
S99-07169	RIP7169	06/06/1999	24.3629	89.6585	1992	DTW	72.8	T N O	Rajshahi	Sirajganj	Kamarkhanda	Jamtail	Jamtail
S99-07170	RIP7170	07/06/1999	24.5132	89.5964	1993	TARA	20.7	Habibur Rahman	Rajshahi	Sirajganj	Raiganj	Brahmagacha	Kutharganti
S99-07171	RIP7171	07/06/1999	24.465	89.5967	1992	TARA	23.8	Abu Bakker	Rajshahi	Sirajganj	Raiganj	Pangashi	Krishnadia
S99-07172	RIP7172	07/06/1999	24.5102	89.5233	1999	TARA	21	R. M. Chawdhury	Rajshahi	Sirajganj	Raiganj	Dhangara	Raiganj
S99-07173	RIP7173	01/06/1999	24.2542	90.3413	1980	HTW/d	59.4	Alhaz Ismail Hossain	Dhaka	Gazipur	Sripur	Gazipur	Gazipur
S99-07174	RIP7174	07/06/1999	24.5491	89.5055	1997	TARA	30.2	Sirajul Haque	Rajshahi	Sirajganj	Raiganj	Chandaikona	Chandaikona
S99-07175	RIP7175	07/06/1999	24.4814	89.4628	1995	TARA	21	Abdus Subhan	Rajshahi	Sirajganj	Raiganj	Sonakhara	Bansail
S99-07176	RIP7176	07/06/1999	24.5277	89.4339	1997	HTW	20.1	Ajgar Ali	Rajshahi	Sirajganj	Raiganj	Dhamainagar	Chander Paikara
S99-07177	RIP7177	07/06/1999	24.4481	89.4834	1992	TARA	20.1	Tumsher Ali	Rajshahi	Sirajganj	Raiganj	Dhubil	Malatinagar
S99-07178	RIP7178	07/06/1999	24.4143	89.5096	1991	TARA	21	Abu Syed Mullah	Rajshahi	Sirajganj	Raiganj	Ghurka	Bharmohini
S99-07179	RIP7179	07/06/1999	24.4512	89.5452	1995	TARA	21	Dadpur mosque	Rajshahi	Sirajganj	Raiganj	Nalka	Dadpur
S99-07180	RIP7180	08/06/1999	24.15	89.588	1998	TARA	25.9	Maiharul Islam	Rajshahi	Sirajganj	Shahjadpur	Potajra	Potajra
S99-07181	RIP7181	08/06/1999	24.134	89.5928	1991	DTW	119.8	Baghabari Power Plant	Rajshahi	Sirajganj	Shahjadpur	Rupbati	Selachapri
S99-07182	RIP7182	08/06/1999	24.0887	89.639	1996	TARA	25.9	Abdur Rahman	Rajshahi	Sirajganj	Shahjadpur	Gala	Barnia
S99-07183	RIP7183	08/06/1999	24.1799	89.5915	1996	HTW	12.8	Md Abu Daud	Rajshahi	Sirajganj	Shahjadpur	Shahjadpur	Dwariapur
S99-07184	RIP7184	08/06/1999	24.1996	89.5608	1998	TARA	22.9	Pathar Ali	Rajshahi	Sirajganj	Shahjadpur	Kayempur	Kayempur
S99-07185	RIP7185	08/06/1999	24.2257	89.5768	1997	TARA	22.9	Surendranath Karnaker	Rajshahi	Sirajganj	Shahjadpur	Garadha	Makorkuta
S99-07186	RIP7186	08/06/1999	24.2201	89.5931	1998	TARA	22.9	Iman Ali	Rajshahi	Sirajganj	Shahjadpur	Narnia	Narnia
S99-07187	RIP7187	08/06/1999	24.222	89.6206	1997	TARA	23.5	Mukleshur Rahman	Rajshahi	Sirajganj	Shahjadpur	Beltail	Shatbaria
S99-07188	RIP7188	08/06/1999	24.1661	89.6232	1994	TARA	24.4	Azad Rahman	Rajshahi	Sirajganj	Shahjadpur	Shahjadpur	Daya
S99-07189	RIP7189	09/06/1999	24.5936	89.6644	1993	HTW	17.7	U P Board office	Rajshahi	Sirajganj	Kazipur	Subhagachha	Subhagachha
S99-07190	RIP7190	09/06/1999	24.6141	89.6176	1995	HTW	23.8	Abul Hossain	Rajshahi	Sirajganj	Kazipur	Gandiail	Kalikapur
S99-07191	RIP7191	09/06/1999	24.6491	89.642	1990	HTW	17.1	TN O - Mufazzal Hossain	Rajshahi	Sirajganj	Kazipur	Gandiail	Alampur
S99-07192	RIP7192	09/06/1999	24.6495	89.6417	1990	HTW	18.3	BRDB Quarters	Rajshahi	Sirajganj	Kazipur	Gandiail	Alampur
S99-07193	RIP7193	09/06/1999	24.6569	89.6445	1990	HTW	14	Babar Ali	Rajshahi	Sirajganj	Kazipur	Kazipur	Meghai
S99-07194	RIP7194	09/06/1999	24.6896	89.6275	1994	HTW	23.5	Md Jahangir Alam	Rajshahi	Sirajganj	Kazipur	Maizbari	Maizbari
S99-07195	RIP7195	09/06/1999	24.6588	89.5496	1994	HTW	18.9	Akber Hossain	Rajshahi	Sirajganj	Kazipur	Sonamhukhi	Paikpara
S99-07196	RIP7196	09/06/1999	24.7153	89.6943	1994	HTW	20.1	Md Siddique Hossain	Rajshahi	Sirajganj	Kazipur	Khas Rajbari	Khas Rajkand
S99-07197	RIP7197	09/06/1999	24.6917	89.7034	1996	HTW	20.4	Nur Islam Sarkar	Rajshahi	Sirajganj	Kazipur	Natuapara	Rehai Suriber
S99-07198	RIP7198	09/06/1999	24.6435	89.7212	1995	HTW	17.7	Abdus Satter	Rajshahi	Sirajganj	Kazipur	Tekani	Parkhuksha
S99-07199	RIP7199	09/06/1999	24.6882	89.7813	1992	HTW	14	Mohir Uddin Chairman	Rajshahi	Sirajganj	Kazipur	Chargrish	Raghunathpur
S99-07200	RIP7200	10/06/1999	24.5665	89.6371	1998	HTW	22.6	Delwar Hossain	Rajshahi	Sirajganj	Sirajganj Sadar	Ratankandi	Saratail
S99-07201	RIP7201	10/06/1999	24.5904	89.6436	1995	HTW	14	Kazimuddin Mondal	Rajshahi	Sirajganj	Sirajganj Sadar	Ratankandi	Chuk Bahuka
S99-07202	RIP7202	10/06/1999	24.4577	89.7058	1994	HTW	15.2	Fani Karmoker	Rajshahi	Sirajganj	Sirajganj Sadar	Pourashava ward 02	M M Ullah Road
S99-07203	RIP7203	10/06/1999	24.4457	89.7149	1997	DTW	82.3	Pauroshava	Rajshahi	Sirajganj	Sirajganj Sadar	Pourashava Ward 07	Dhanbandi
S99-07204	RIP7204	10/06/1999	24.4861	89.7039	1994	HTW	18	Abdus Salam Master	Rajshahi	Sirajganj	Sirajganj Sadar	Kawakola	Chittulia
S99-07205	RIP7205	10/06/1999	24.5264	89.6875	1998	HTW	22.6	Rezaul Karim	Rajshahi	Sirajganj	Sirajganj Sadar	Sengacha	Vatpairi
S99-07206	RIP7206	10/06/1999	24.4282	89.7053	1998	HTW	18	U P office	Rajshahi	Sirajganj	Sirajganj Sadar	Kaliaharipur	Bonbaria
S99-07207	RIP7207	10/06/1999	24.3892	89.715	1998	HTW	22.6	Mashud Rana	Rajshahi	Sirajganj	Sirajganj Sadar	Saidabad	Saidabad
S99-07208	RIP7208	12/06/1999	25.3319	89.5479	1992	HTW	13.1	D. C.(Gaibanda)	Rajshahi	Gaibandha	Gaibandha Sadar	Pourashava ward 01	Devt Companipara
S99-07209	RIP7209	12/06/1999	25.3892	89.5261	1995	HTW	18.9	Sirazul Haque	Rajshahi	Gaibandha	Gaibandha Sadar	Kuptala	Kuptala

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-07162	5884438633	55.8	0.01	0.2	0.134	69.1	0.004	< 0.002	< 0.008	22.6	5.7	0.006	21	2.81	13.6	0.8	21.3	0.4	0.232	< 0.002	0.032
S99-07163	5884476217	3.2	< 0.01	< 0.1	0.058	42.5	< 0.003	< 0.002	0.013	0.484	14.3	0.007	21.1	0.854	19.4	0.3	21	29.7	0.0833	< 0.002	0.017
S99-07164	5884476307	4.4	< 0.01	0.1	0.05	21.7	< 0.003	< 0.002	< 0.008	7.64	1.9	< 0.004	11.8	0.546	8	0.5	21.1	< 0.2	0.0662	< 0.002	0.018
S99-07165	5884438741	62.2	0.01	0.1	0.097	50.7	0.004	< 0.002	< 0.008	13.9	5.7	< 0.004	15.2	1.86	12.5	0.7	21.6	10.5	0.17	< 0.002	0.032
S99-07166	5884457832	92.5	< 0.01	< 0.1	0.07	41.3	0.003	< 0.002	< 0.008	7.92	2.8	< 0.004	12.3	1.65	7.8	1.4	26.1	2	0.178	< 0.002	0.018
S99-07167	5884419108	12.8	0.01	< 0.1	0.073	33.8	0.003	< 0.002	0.011	9.23	2.3	< 0.004	11.2	1.03	10.1	1	24.2	< 0.2	0.103	< 0.002	0.023
S99-07168	5884419886	3.1	0.02	< 0.1	0.037	17.7	< 0.003	< 0.002	< 0.008	4.43	2.4	< 0.004	8.53	0.268	8.3	0.3	20.4	< 0.2	0.0496	< 0.002	0.018
S99-07169	5884438416	51.9	0.03	0.1	0.08	32	0.004	< 0.002	< 0.008	12.2	2.9	< 0.004	9.93	1.52	9.2	1.3	23.3	2.5	0.106	< 0.002	0.045
S99-07170	5886109786	2.5	< 0.01	< 0.1	0.058	27	< 0.003	< 0.002	0.01	2.84	2.4	0.004	16.6	0.673	11	0.3	20.4	3.7	0.0994	< 0.002	0.021
S99-07171	5886176582	46.8	< 0.01	< 0.1	0.068	24.7	0.003	< 0.002	< 0.008	8	2.4	< 0.004	13.1	0.307	13.3	1.8	26.7	0.3	0.0919	< 0.002	0.018
S99-07172	5886138840	28.7	0.01	< 0.1	0.071	30.6	< 0.003	< 0.002	< 0.008	10.4	1.9	< 0.004	13	0.617	12.6	0.9	28	0.4	0.0981	< 0.002	0.045
S99-07173	3338619352	8.5	0.05	< 0.1	0.066	38.2	< 0.003	< 0.002	< 0.008	1.34	2.9	< 0.004	15.7	0.698	17.5	< 0.1	25.3	4	0.157	< 0.002	0.018
S99-07174	5886119226	< 0.5	0.06	< 0.1	0.028	58.8	< 0.003	< 0.002	< 0.008	0.026	1.3	< 0.004	23.3	1.38	14.5	0.2	22.8	3.6	0.336	0.003	0.028
S99-07175	5886185067	13.1	0.03	< 0.1	0.148	21	< 0.003	< 0.002	< 0.008	48.2	4	0.006	6.26	0.964	14.4	0.7	22.3	< 0.2	0.1	< 0.002	0.03
S99-07176	5886128231	< 0.5	0.06	< 0.1	0.033	51.7	< 0.003	< 0.002	< 0.008	0.239	0.6	0.011	12.7	0.835	32.3	< 0.1	25.6	8	0.222	< 0.002	0.012
S99-07177	5886147659	< 0.5	0.04	< 0.1	0.026	28.8	< 0.003	< 0.002	< 0.008	0.086	2.2	0.005	10.8	1.43	11.5	< 0.1	21.5	13.7	0.112	< 0.002	0.021
S99-07178	5886157644	50.1	0.06	< 0.1	0.092	34.1	< 0.003	< 0.002	< 0.008	4.06	3	< 0.004	13.7	1.22	12.9	0.7	25.8	0.5	0.121	< 0.002	0.02
S99-07179	5886160257	14.2	0.04	< 0.1	0.075	28.8	< 0.003	< 0.002	< 0.008	11.1	2.1	< 0.004	14.6	0.472	19.2	0.8	22.6	< 0.2	0.0848	< 0.002	0.012
S99-07180	5886773783	81.8	0.07	< 0.1	0.123	68.6	< 0.003	< 0.002	< 0.008	15.5	4.3	< 0.004	17.3	1.35	12.8	0.6	22.7	< 0.2	0.237	< 0.002	0.035
S99-07181	5886780928	61.7	0.06	< 0.1	0.067	52.7	< 0.003	< 0.002	< 0.008	3.37	3.7	0.006	22.7	0.087	12.6	0.4	27.1	< 0.2	0.209	< 0.002	0.058
S99-07182	5886714100	187	0.08	< 0.1	0.139	94	< 0.003	< 0.002	< 0.008	14.7	4	< 0.004	23.6	0.926	8.3	0.6	19.9	< 0.2	0.323	< 0.002	0.018
S99-07183	5886787400	39.9	0.04	< 0.1	0.064	35.1	< 0.003	< 0.002	< 0.008	12.1	2.7	< 0.004	12.5	2.83	14	1.5	26.7	4.8	0.126	< 0.002	0.02
S99-07184	5886743566	26.8	0.05	< 0.1	0.127	35.3	< 0.003	< 0.002	< 0.008	19.7	4.1	0.006	14	2.14	10.7	1	21.9	4.7	0.122	< 0.002	0.018
S99-07185	5886721633	50.1	0.05	< 0.1	0.14	35.4	< 0.003	< 0.002	< 0.008	22.7	4	< 0.004	16	0.779	19.2	0.7	22.3	1.3	0.126	< 0.002	0.076
S99-07186	5886758705	195	0.05	< 0.1	0.109	44.8	< 0.003	< 0.002	< 0.008	22.8	3.3	< 0.004	14.8	3.04	8.8	0.7	23.9	9.1	0.192	< 0.002	0.119
S99-07187	5886707922	51.5	0.07	< 0.1	0.073	74.2	< 0.003	< 0.002	< 0.008	1.58	3.7	< 0.004	20.7	3.77	9	1.1	18.6	1	0.233	< 0.002	0.033
S99-07188	5886787355	80.6	0.05	< 0.1	0.068	38.1	< 0.003	< 0.002	< 0.008	17.5	2.6	< 0.004	15.3	1.45	7.3	0.8	20.5	< 0.2	0.1	< 0.002	0.02
S99-07189	5885086965	1.2	0.05	< 0.1	0.038	39.9	< 0.003	< 0.002	< 0.008	0.132	2.8	< 0.004	11.9	0.725	12.7	< 0.1	17.2	13.7	0.113	< 0.002	0.01
S99-07190	5885025502	< 0.5	0.05	< 0.1	0.04	46.8	< 0.003	< 0.002	< 0.008	0.07	3.1	< 0.004	18.3	0.275	13.6	< 0.1	17.5	15.2	0.117	< 0.002	0.009
S99-07191	5885025019	52.6	0.05	< 0.1	0.066	43.3	< 0.003	< 0.002	< 0.008	3.18	4.7	< 0.004	17.8	2.24	11.3	1.1	23.7	3.5	0.17	< 0.002	0.011
S99-07192	5885025019	63.6	0.05	< 0.1	0.064	41.4	< 0.003	< 0.002	< 0.008	1.55	5.1	< 0.004	17.4	2.28	11.8	1.1	24.4	4.8	0.164	< 0.002	0.014
S99-07193	5885034689	384	0.07	< 0.1	0.069	59.3	< 0.003	< 0.002	< 0.008	1.51	3	< 0.004	23.3	2.74	10.8	1.1	24.3	0.6	0.169	< 0.002	0.016
S99-07194	5885051650	4.4	0.04	< 0.1	0.028	26	< 0.003	< 0.002	< 0.008	0.081	3.6	0.007	12.1	0.235	14.2	0.2	20.3	20.4	0.0558	0.002	0.008
S99-07195	5885077738	11.9	0.05	< 0.1	0.072	29.3	< 0.003	< 0.002	< 0.008	5.87	2.8	< 0.004	12.4	0.856	14.6	0.4	22.1	5.9	0.104	< 0.002	0.019
S99-07196	5885043600	0.7	0.11	< 0.1	0.106	118	< 0.003	< 0.002	< 0.008	0.067	6.3	< 0.004	27.9	1.34	6.8	< 0.1	11.4	29.8	0.328	< 0.002	0.012
S99-07197	5885060896	< 0.5	0.08	< 0.1	0.061	68.7	< 0.003	< 0.002	< 0.008	0.066	5.6	< 0.004	15.8	0.876	3.2	< 0.1	12.5	6.5	0.192	< 0.002	0.025
S99-07198	5885094758	< 0.5	0.06	< 0.1	0.065	59.5	< 0.003	< 0.002	< 0.008	0.025	5.6	< 0.004	16.7	0.846	4.9	< 0.1	10	10.2	0.188	< 0.002	0.018
S99-07199	5885008852	1.3	0.1	< 0.1	0.132	138	< 0.003	< 0.002	< 0.008	0.041	6.5	< 0.004	32.3	2.46	7.7	< 0.1	15.1	17.9	0.425	< 0.002	0.014
S99-07200	5887860904	39.4	0.05	< 0.1	0.119	43.9	< 0.003	< 0.002	< 0.008	11.5	3.9	< 0.004	19.9	1.8	10.8	1.1	18	31	0.127	< 0.002	0.021
S99-07201	5887860220	118	0.06	< 0.1	0.057	58	< 0.003	< 0.002	< 0.008	9.49	3.2	< 0.004	16	1.61	7.6	1.5	24.2	< 0.2	0.155	< 0.002	0.018
S99-07202	5887887791	2.1	0.07	0.1	0.069	63.8	< 0.003	< 0.002	< 0.008	0.066	5.2	< 0.004	23.1	1.39	46.5	< 0.1	13.9	27.4	0.205	< 0.002	0.008
S99-07203	5887887293	23.1	0.06	< 0.1	0.209	60.3	< 0.003	< 0.002	< 0.008	10.5	6.6	0.005	23.9	1.59	31.2	0.7	20.2	25.5	0.23	< 0.002	0.014
S99-07204	5887834156	12.1	0.08	< 0.1	0.07	56.5	< 0.003	0.002	< 0.008	0.738	4.9	< 0.004	14.7	3.02	7.2	1.1	19.6	1.7	0.153	< 0.002	0.02
S99-07205	5887894157	2.4	0.04	< 0.1	0.103	27.7	< 0.003	< 0.002	< 0.008	19.8	3.3	< 0.004	12.1	0.911	9.9	0.5	20	2.5	0.0997	< 0.002	0.033
S99-07206	5887825071	4.5	0.04	< 0.1	0.038	29.6	< 0.003	< 0.002	< 0.008	0.375	3	< 0.004	10.6	0.436	8	0.1	13.9	3.6	0.0827	< 0.002	0.016
S99-07207	5887869884	10.4	0.06	< 0.1	0.183	58.8	< 0.003	< 0.002	< 0.008	21.8	3.6	< 0.004	27	2.53	16.4	0.8	23.4	16.4	0.223	< 0.002	0.049
S99-07208	5322488186	< 0.5	0.05	< 0.1	0.05	33.8	< 0.003	< 0.002	< 0.008	0.407	3.3	0.011	25.2	1.01	41.1	< 0.1	19.8	11.8	0.12	< 0.002	0.05
S99-07209	5322465599	< 0.5	0.04	< 0.1	0.026	25.6	< 0.003	< 0.002	< 0.008	0.29	4.2	< 0.004	13.2	0.464	17.1	< 0.1	22.5	5.8	0.0793	< 0.002	0.019

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07210	RIP7210	12/06/1999	25.4116	89.5325	1999	TARA	28.3	Nurul Islam Master	Rajshahi	Gaibandha	Gaibandha Sadar	Lakshmirpur	Gobindapur
S99-07211	RIP7211	12/06/1999	25.3941	89.5714	1984	HTW	19.2	Iddris Ali Sarker	Rajshahi	Gaibandha	Gaibandha Sadar	Malibari	Kismat Malibari
S99-07212	RIP7212	12/06/1999	25.3759	89.5538	1987	TARA	29.9	Yasin Ali Master	Rajshahi	Gaibandha	Gaibandha Sadar	Kholahati	Kholahati
S99-07213	RIP7213	12/06/1999	25.3272	89.5899	1986	HTW	18.3	Anisur Rahman	Rajshahi	Gaibandha	Gaibandha Sadar	Gidari	Kismat Falia
S99-07214	RIP7214	12/06/1999	25.2494	89.5546	1999	HTW	21	Sarwar Hossain	Rajshahi	Gaibandha	Gaibandha Sadar	Badiakhali	Rifaitpur
S99-07215	RIP7215	12/06/1999	25.3063	89.5525	1987	HTW	18	Md Chan Mia	Rajshahi	Gaibandha	Gaibandha Sadar	Boali	Thansinpur
S99-07216	RIP7216	12/06/1999	25.3248	89.5486	1986	DTW	106.7	Pourashava	Rajshahi	Gaibandha	Gaibandha Sadar	Pourashava Ward 02	Masterpara
S99-07217	RIP7217	12/06/1999	25.2984	89.4949	1994	HTW	21	Mahatab Uddin	Rajshahi	Gaibandha	Gaibandha Sadar	Ramchandrapur	Bhagabanpur
S99-07218	RIP7218	12/06/1999	25.3302	89.4708	1999	HTW	21	Md Dulal Mia	Rajshahi	Gaibandha	Gaibandha Sadar	Sahapara	Kamar Pirgachha
S99-07219	RIP7219	12/06/1999	25.3348	89.5338	1986	DTW	109.7	Pourashava	Rajshahi	Gaibandha	Gaibandha Sadar	Pourashava Ward 03	Barobaripara
S99-07220	RIP7220	12/06/1999	25.3307	89.5409	1992	HTW	21	DPHE Gaibanda	Rajshahi	Gaibandha	Gaibandha Sadar	Pourashava ward 01	Muhuripara
S99-07221	RIP7221	14/06/1999	25.2719	89.3025	1995	TARA	32	Md Yusuf Ali	Rajshahi	Gaibandha	Palashbari	Kishoregari	Beradanga
S99-07222	RIP7222	14/06/1999	25.244	89.3111		HTW	33.5	Md Hidar Ali	Rajshahi	Gaibandha	Palashbari	Hossainpur	Sisudaha
S99-07223	RIP7223	14/06/1999	25.2478	89.372	1998	HTW	30.5	Md Lal Mia	Rajshahi	Gaibandha	Palashbari	Barisal	Bhabanipur
S99-07224	RIP7224	14/06/1999	25.2823	89.3547	1995	TARA	30.5	TNO	Rajshahi	Gaibandha	Palashbari	Palashbari	Jamalpur
S99-07225	RIP7225	14/06/1999	25.287	89.389	1995	HTW	15.2	Mahadipur High School	Rajshahi	Gaibandha	Palashbari	Mahadipur	Mahadipur
S99-07226	RIP7226	14/06/1999	25.3135	89.4341	1996	TARA	29.9	Gaziur Rahman	Rajshahi	Gaibandha	Palashbari	Betkapa	Mustafapur
S99-07227	RIP7227	14/06/1999	25.2539	89.4918	1996	HTW	15.2	Union Health Complex	Rajshahi	Gaibandha	Palashbari	Manoharpur	Manoharpur
S99-07228	RIP7228	14/06/1999	25.2409	89.5037	1992	HTW	15.2	Anisur Rahman Chowdhury	Rajshahi	Gaibandha	Palashbari	Harinathpur	Taluk Jamira
S99-07229	RIP7229	14/06/1999	25.2551	89.4482	1995	HTW	30.5	Md Saiful Islam	Rajshahi	Gaibandha	Palashbari	Pabnapur	Parbamania
S99-07230	RIP7230	14/06/1999	25.2829	89.356	1984	DTW	106.7	TNO	Rajshahi	Gaibandha	Palashbari	Palashbari	Jamalpur
S99-07231	RIP7231	15/06/1999	25.1291	89.6257	1997	HTW	12.2	Md Surman Ali	Rajshahi	Gaibandha	Fulchhari	Phulchhari	Bagabari
S99-07232	RIP7232	15/06/1999	25.184	89.6248	1992	HTW	21	Nayeb Ali	Rajshahi	Gaibandha	Fulchhari	Phulchhari	Pipalia
S99-07233	RIP7233	15/06/1999	25.2063	89.6503	1980	HTW	18	Abul Kashem	Rajshahi	Gaibandha	Fulchhari	Fazlupur	Khatlamari
S99-07234	RIP7234	15/06/1999	25.1904	89.5901	1992	HTW	13.1	TNO Office	Rajshahi	Gaibandha	Fulchhari	Gazaria	Gajaria
S99-07235	RIP7235	15/06/1999	25.1903	89.5903	1998	TARA	29.9	Md Babu Mia	Rajshahi	Gaibandha	Fulchhari	Gazaria	Gajaria
S99-07236	RIP7236	15/06/1999	25.2559	89.5775	1997	HTW	22.6	Md Kafiluddin	Rajshahi	Gaibandha	Fulchhari	Udakhali	Udakhali
S99-07237	RIP7237	15/06/1999	25.2953	89.5892	1993	HTW	18	Md Safiqul Islam	Rajshahi	Gaibandha	Fulchhari	Udakhali	Haripur
S99-07238	RIP7238	15/06/1999	25.3178	89.601	1997	HTW	18	Abdul Majid Sarkar	Rajshahi	Gaibandha	Fulchhari	Kanchipara	Kanchipara
S99-07239	RIP7239	16/06/1999	25.5659	89.526	1998	HTW	13.7	Thana staff quarters	Rajshahi	Gaibandha	Sundarganj	Dahabanda	Sundarganj
S99-07240	RIP7240	16/06/1999	25.5659	89.526	1997	STW	18	TNO	Rajshahi	Gaibandha	Sundarganj	Dahabanda	Sundarganj
S99-07241	RIP7241	16/06/1999	25.5365	89.5545	1999	HTW	22.6	Md Suja Mia	Rajshahi	Gaibandha	Sundarganj	Belka	Belka
S99-07242	RIP7242	16/06/1999	25.4985	89.5957	1996	HTW	21.9	Kanchibari Mosque	Rajshahi	Gaibandha	Sundarganj	Kanchibari	Satirjan
S99-07243	RIP7243	16/06/1999	25.4581	89.5959	1994	HTW	21.9	Aminul Islam	Rajshahi	Gaibandha	Sundarganj	Sripur	Boalia
S99-07244	RIP7244	16/06/1999	25.4801	89.5568	1993	HTW	22.9	Abul Hossain	Rajshahi	Gaibandha	Sundarganj	Chhaparhati	Dakshin Haruadaha
S99-07245	RIP7245	16/06/1999	25.5141	89.5168	1984	HTW	18.9	Ramjiban U P office	Rajshahi	Gaibandha	Sundarganj	Ramjiban	Nijpara
S99-07246	RIP7246	16/06/1999	25.5141	89.4846	1984	HTW	18.9	Mansur Ali	Rajshahi	Gaibandha	Sundarganj	Sarbanandar	Taluk Bajit
S99-07247	RIP7247	16/06/1999	25.5962	89.4541	1997	HTW	19.8	Kubbash Ali	Rajshahi	Gaibandha	Sundarganj	Bamandanga	Phalagachha
S99-07248	RIP7248	16/06/1999	25.5818	89.5172	1997	HTW	19.8	Mirganj Primary School	Rajshahi	Gaibandha	Sundarganj	Tarapur	Chachia Nirganj
S99-07249	RIP7249	17/06/1999	25.7674	89.4235	1980	HTW	19.2	Abdul Latif	Rajshahi	Rangpur	Kaunia	Kaunia Balapara	Ganga Narayan
S99-07250	RIP7250	17/06/1999	25.7748	89.4453	1992	HTW	18.9	Abdur Rashid	Rajshahi	Rangpur	Kaunia	Kaunia Balapara	Taluksahabaz
S99-07251	RIP7251	17/06/1999	25.7596	89.4491	1995	HTW	11	Md Faker Uddin	Rajshahi	Rangpur	Kaunia	Tepa Madhupur	Ganai
S99-07252	RIP7252	17/06/1999	25.7368	89.4399	1962	HTW	29.3	Hazrat Ali	Rajshahi	Rangpur	Kaunia	Tepa Madhupur	Rajib
S99-07253	RIP7253	17/06/1999	25.7156	89.4715	1992	HTW	13.4	Bhyar Hat	Rajshahi	Rangpur	Kaunia	Tepa Madhupur	Sadra Taluk
S99-07254	RIP7254	17/06/1999	25.7711	89.3946	1997	HTW	14	Sabdi D. S. Senior Madrasha	Rajshahi	Rangpur	Kaunia	Shahidbagh	Sadbi
S99-07255	RIP7255	17/06/1999	25.7603	89.372	1998	HTW	14	Jitendra Bhat	Rajshahi	Rangpur	Kaunia	Kursha	Sibukanthiram
S99-07256	RIP7256	17/06/1999	25.7651	89.3468	1991	HTW	17.1	Altaf Hossain	Rajshahi	Rangpur	Kaunia	Kursha	Chandipur
S99-07257	RIP7257	17/06/1999	25.8067	89.3412	1996	HTW	22.9	Md Kurban Ali	Rajshahi	Rangpur	Kaunia	Baragach	Thakurdas

SAMPLE ID	GEOCODE	As	Al	B	Ba	Ca	Co	Cr	Cu	Fe	K	Li	Mg	Mn	Na	P	Si	SO_4	Sr	V	Zn
		ug/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	mg/L	mg/L	mg/L	mg/L	mg/L
S99-07210	5322473292	5.5	0.03	< 0.1	0.061	18.2	< 0.003	< 0.002	< 0.008	5.51	3.5	0.006	7.18	0.814	8.6	0.2	22.7	1.5	0.0649	< 0.002	0.043
S99-07211	5322480556	< 0.5	0.03	< 0.1	0.02	15.9	< 0.003	< 0.002	< 0.008	0.319	1.3	0.005	9.33	0.453	8.2	< 0.1	16.9	3.9	0.0598	< 0.002	0.008
S99-07212	5322458512	3.9	0.03	< 0.1	0.078	24.6	< 0.003	< 0.002	< 0.008	9.21	2.8	0.005	12	0.468	8.1	0.2	27.1	0.2	0.0889	< 0.002	0.021
S99-07213	5322443541	11.7	0.02	< 0.1	0.062	12.1	< 0.003	< 0.002	< 0.008	9.52	8.7	< 0.004	6.3	0.338	7.5	1.4	22	< 0.2	0.0455	< 0.002	0.013
S99-07214	5322407863	12	0.04	< 0.1	0.059	26.1	< 0.003	< 0.002	< 0.008	1.75	3.4	0.005	17.3	0.867	18	0.2	28.4	8.7	0.0893	< 0.002	0.034
S99-07215	5322421958	1.5	0.05	< 0.1	0.055	39.5	< 0.003	< 0.002	< 0.008	0.963	5.6	0.005	15.9	0.906	14.2	< 0.1	23.4	16.3	0.162	< 0.002	0.053
S99-07216	5322488497	23.4	0.04	< 0.1	0.058	30.2	< 0.003	< 0.002	< 0.008	6.92	3.5	< 0.004	13	0.603	10.7	0.5	26.2	0.6	0.122	< 0.002	0.012
S99-07217	5322487124	11.2	0.04	< 0.1	0.134	30.4	< 0.003	< 0.002	< 0.008	12.7	3.7	< 0.004	16.6	0.847	22.9	0.5	25.2	6.6	0.107	< 0.002	0.015
S99-07218	5322494475	5.9	0.04	< 0.1	0.092	28.2	< 0.003	< 0.002	< 0.008	18.1	6.5	< 0.004	13.7	0.822	24.7	0.9	21.8	10.1	0.0873	< 0.002	0.018
S99-07219	5322488962	22	0.04	< 0.1	0.048	31.2	< 0.003	< 0.002	< 0.008	5.52	3	0.005	12.7	0.611	10.9	0.4	26.3	1.7	0.137	< 0.002	0.052
S99-07220	5322488621	< 0.5	0.06	< 0.1	0.08	60.8	< 0.003	< 0.002	< 0.008	0.198	2.9	< 0.004	36.1	0.696	62.4	< 0.1	16.1	37.8	0.248	< 0.002	0.015
S99-07221	5326747124	3.8	0.03	< 0.1	0.027	16.8	< 0.003	< 0.002	< 0.008	4.51	1	0.007	8.46	0.798	18.6	0.3	32.6	1.4	0.109	< 0.002	0.058
S99-07222	5326738932	10	0.03	< 0.1	0.093	19.1	< 0.003	< 0.002	< 0.008	6.3	1	< 0.004	7.85	0.762	15.7	0.8	25.5	< 0.2	0.129	< 0.002	0.028
S99-07223	5326709136	12.9	0.04	< 0.1	0.042	24.4	< 0.003	< 0.002	< 0.008	1.21	2.5	< 0.004	12.3	0.305	12	0.1	23.8	1.8	0.0912	< 0.002	0.101
S99-07224	5326785441	7.9	0.04	< 0.1	0.186	27.9	< 0.003	< 0.002	< 0.008	36.2	5.3	0.006	7.12	1.23	23.9	0.5	19.8	1.7	0.101	< 0.002	0.066
S99-07225	5326757596	30.7	0.04	< 0.1	0.059	29.5	< 0.003	< 0.002	< 0.008	3.08	3.5	< 0.004	13.3	1.3	13.2	0.4	26.4	4.2	0.0956	< 0.002	0.027
S99-07226	5326719646	84	0.03	< 0.1	0.059	24.3	< 0.003	< 0.002	< 0.008	2.66	2.3	0.006	9.32	1.9	9.1	0.6	29.4	0.4	0.0888	< 0.002	0.055
S99-07227	5326766634	6.5	0.03	< 0.1	0.038	19.9	< 0.003	< 0.002	< 0.008	1.84	2.7	0.004	12.2	0.62	7.6	0.1	25.6	4	0.067	< 0.002	0.014
S99-07228	5326728988	15.6	0.03	< 0.1	0.058	22.5	< 0.003	< 0.002	< 0.008	10.9	3.1	< 0.004	11.1	0.55	10.2	0.9	27.2	0.5	0.0713	< 0.002	0.017
S99-07229	5326776708	< 0.5	0.02	< 0.1	0.011	9.4	< 0.003	< 0.002	< 0.008	0.082	1.5	< 0.004	3.69	0.061	7.4	< 0.1	18.7	1.8	0.0384	< 0.002	0.012
S99-07230	5326785441	18	0.05	< 0.1	0.112	28.5	< 0.003	< 0.002	< 0.008	26.7	5	0.005	7.23	1.77	22	0.6	23.2	1.4	0.144	< 0.002	0.051
S99-07231	5322135037	< 0.5	0.07	< 0.1	0.065	66.8	< 0.003	< 0.002	< 0.008	0.127	5.5	< 0.004	16.3	1.44	4.7	< 0.1	9.31	31.5	0.207	< 0.002	0.016
S99-07232	5322135833	0.9	0.06	< 0.1	0.065	62.3	< 0.003	< 0.002	< 0.008	0.068	5.3	< 0.004	16.2	1.33	8.4	< 0.1	12.1	5.6	0.186	< 0.002	0.009
S99-07233	5322123659	2.2	0.11	< 0.1	0.184	158	< 0.003	< 0.002	0.126	0.107	11.7	< 0.004	35.9	4.59	32.8	< 0.1	18.8	22.5	0.452	< 0.002	0.093
S99-07234	5322147335	< 0.5	0.03	< 0.1	0.024	22.4	< 0.003	< 0.002	< 0.008	0.072	2.4	0.008	8.92	0.079	21.6	< 0.1	18.9	11.9	0.0898	< 0.002	0.008
S99-07235	5322147335	26.6	0.04	< 0.1	0.073	29.7	< 0.003	< 0.002	< 0.008	9.06	2.5	0.005	7.43	0.615	5.4	0.3	23.4	0.5	0.117	< 0.002	0.018
S99-07236	5322171970	3	0.03	< 0.1	0.057	20.2	< 0.003	< 0.002	< 0.008	8.7	2	< 0.004	10.8	0.633	13.4	0.3	15.6	5.9	0.0616	< 0.002	0.013
S99-07237	5322171435	< 0.5	0.05	< 0.1	0.114	38.8	< 0.003	< 0.002	< 0.008	0.177	19.6	0.01	22.3	1.55	26	< 0.1	22.5	22.5	0.145	< 0.002	0.022
S99-07238	5322159584	3.5	0.04	< 0.1	0.101	32.1	< 0.003	< 0.002	< 0.008	10.2	3.9	< 0.004	19.7	0.605	15.5	0.5	23	2.4	0.101	< 0.002	0.025
S99-07239	5329131877	0.6	0.04	< 0.1	0.031	30.3	< 0.003	< 0.002	< 0.008	0.105	4.5	< 0.004	12.1	0.392	22.2	0.2	18.7	8	0.0897	0.002	0.01
S99-07240	5329131877	7.2	0.04	< 0.1	0.023	26.6	< 0.003	< 0.002	< 0.008	2.27	3.7	< 0.004	10.9	0.83	14.5	0.3	24.8	2.3	0.0837	< 0.002	0.027
S99-07241	5329112099	3.4	0.02	< 0.1	0.058	16.1	< 0.003	< 0.002	< 0.008	8.12	2.4	0.005	9.42	0.207	4.5	0.3	16.7	1.8	0.0532	< 0.002	0.027
S99-07242	5329150832	8.8	0.02	< 0.1	0.07	16.3	< 0.003	< 0.002	< 0.008	19.7	2.5	0.005	11.2	0.678	7.7	0.7	23.7	1	0.0613	< 0.002	0.016
S99-07243	5329188171	2.2	0.03	< 0.1	0.038	19.6	< 0.003	< 0.002	< 0.008	0.789	2.5	0.005	12.2	0.336	10	< 0.1	22.3	5.5	0.0703	< 0.002	0.01
S99-07244	5329125262	8.8	0.03	< 0.1	0.033	16.9	< 0.003	< 0.002	< 0.008	2.64	2.6	0.009	7.39	0.293	3.8	< 0.1	21	2.3	0.06	< 0.002	0.009
S99-07245	5329163651	< 0.5	0.03	< 0.1	0.034	19.8	< 0.003	< 0.002	< 0.008	0.134	5.3	< 0.004	6.85	0.038	17.1	< 0.1	13.3	9.5	0.111	< 0.002	0.009
S99-07246	5329175886	33.6	0.04	< 0.1	0.068	31.1	< 0.003	< 0.002	< 0.008	8.42	19	< 0.004	14.2	0.864	12.9	1.5	24.7	4.4	0.1	< 0.002	0.013
S99-07247	5329106741	708	0.08	< 0.1	0.092	63.6	< 0.003	< 0.002	< 0.008	11.2	2.6	< 0.004	28	1.18	13.9	2	24.8	0.2	0.195	< 0.002	0.013
S99-07248	5329194109	18	0.03	< 0.1	0.031	20.4	< 0.003	< 0.002	< 0.008	2.03	8.2	< 0.004	8.07	0.322	78.5	1	18	19.5	0.0583	< 0.002	0.01
S99-07249	5854227385	2	0.02	< 0.1	0.024	17.1	< 0.003	< 0.002	< 0.008	0.195	3.8	< 0.004	6.99	0.499	12.9	< 0.1	19	5.8	0.0624	< 0.002	0.007
S99-07250	5854227970	5.8	0.02	< 0.1	0.032	17.1	< 0.003	< 0.002	< 0.008	10.6	2.2	< 0.004	6.38	0.638	12	1	23.8	0.3	0.0614	< 0.002	0.011
S99-07251	5854281373	9.5	0.03	< 0.1	0.038	19.4	< 0.003	< 0.002	< 0.008	7.82	2.3	< 0.004	6.85	0.503	14.5	0.9	27.9	< 0.2	0.0568	< 0.002	0.012
S99-07252	5854281711	4.6	0.02	< 0.1	0.055	13.9	< 0.003	< 0.002	< 0.008	9.24	3.4	< 0.004	4.02	0.622	5.7	0.3	20.8	0.4	0.0551	< 0.002	0.014
S99-07253	5854281845	5.9	0.03	< 0.1	0.054	19.6	< 0.003	< 0.002	< 0.008	14.1	2.8	< 0.004	8.23	0.751	10.9	0.6	24.2	< 0.2	0.0645	< 0.002	0.018
S99-07254	5854267820	2.1	0.02	< 0.1	0.073	13.7	< 0.003	< 0.002	< 0.008	7.8	5.8	< 0.004	5.07	0.353	9.2	0.3	19.6	1.6	0.0501	< 0.002	0.013
S99-07255	5854240920	5.7	0.02	< 0.1	0.039	13.8	< 0.003	< 0.002	< 0.008	9.68	3.4	< 0.004	4.3	0.266	9.1	0.3	21.2	2.5	0.0427	< 0.002	0.074
S99-07256	5854240261	< 0.5	0.01	< 0.1	0.024	11	< 0.003	< 0.002	< 0.008	0.256	1.1	< 0.004	11.5	2.12	13.7	< 0.1	6.91	1.3	0.0334	< 0.002	0.008
S99-07257	5854213982	< 0.5	0.02	< 0.1	0.009	10.4	< 0.003	< 0.002	< 0.008	0.232	1.9	< 0.004	3.99	1.12	7.1	0.1	22.1	3.3	0.0404	< 0.002	0.008

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07258	RIP7258	17/06/1999	25.7624	89.313	1979	HTW	19.8	Mafizul Alam	Rajshahi	Rangpur	Kaunia	Sarai	Madamudan
S99-07259	RIP7259	18/06/1999	25.8321	89.254	1998	HTW	31.7	Mahbubur Rahman	Rajshahi	Rangpur	Gangachara	Gajaghanta	Taluk Habu
S99-07260	RIP7260	18/06/1999	25.8001	89.3091	1998	HTW	31.7	Anwarul Islam	Rajshahi	Rangpur	Gangachara	Marania	Baksa
S99-07261	RIP7261	18/06/1999	25.8588	89.2518	1991	HTW	22.6	Mahubar Rahman	Rajshahi	Rangpur	Gangachara	Lakshmitari	Mahipur
S99-07262	RIP7262	18/06/1999	25.8546	89.2195	1999	HTW	8.8	TNO	Rajshahi	Rangpur	Gangachara	Gangachara	Gangachara
S99-07263	RIP7263	18/06/1999	25.885	89.2001	1991	HTW	22.6	Ekramul Hossain	Rajshahi	Rangpur	Gangachara	Kolkanda	Dakshin Kolkanda
S99-07264	RIP7264	18/06/1999	25.8789	89.1596	1997	HTW	12.2	Bakshiganj Bazr	Rajshahi	Rangpur	Gangachara	Barabil	Barabil
S99-07265	RIP7265	18/06/1999	25.9182	89.1606	1998	HTW	22.9	Md Ekramul Islam	Rajshahi	Rangpur	Gangachara	Alambiditar	Paikan
S99-07266	RIP7266	18/06/1999	25.9461	89.132	1997	HTW	32	UP Office	Rajshahi	Rangpur	Gangachara	Nohali	Purba Kuchua
S99-07267	RIP7267	18/06/1999	25.8665	89.1008	1997	HTW	16.8	Shashi Babu	Rajshahi	Rangpur	Gangachara	Betgari	Khaprikhal
S99-07268	RIP7268	18/06/1999	25.8267	89.1145	1993	HTW	10.7	K Kanchipur High School	Rajshahi	Rangpur	Gangachara	Khaleya	Dakshin Khaleya
S99-07269	RIP7269	19/06/1999	25.4159	89.3064	1997	TARA	30.5	Taleb Hossain	Rajshahi	Rangpur	Pirganj (R)	Pirganj	Prajapara
S99-07270	RIP7270	19/06/1999	25.3491	89.3369	1992	HTW	26.2	Md Sabu Hossain	Rajshahi	Rangpur	Pirganj (R)	Ramnathpur	Jamdani
S99-07271	RIP7271	20/06/1999	25.6918	88.972	1995	TARA	29.9	Md Akheruzzaman	Rajshahi	Rangpur	Badarganj	Gopinathpur	Khiarpara
S99-07272	RIP7272	19/06/1999	25.4789	89.364	1998	HTW	45.4	Abdur Razzak	Rajshahi	Rangpur	Pirganj (R)	Panchgachhi	Jahangirabad
S99-07273	RIP7273	19/06/1999	25.4789	89.364	1994	HTW	19.8	Khairul Islam	Rajshahi	Rangpur	Pirganj (R)	Panchgachhi	Jahangirabad
S99-07274	RIP7274	19/06/1999	25.484	89.3173	1980	HTW	16.8	K. A. Ahmed	Rajshahi	Rangpur	Pirganj (R)	Shanerhat	Kholahati
S99-07275	RIP7275	19/06/1999	25.4973	89.2002	1992	HTW	15.2	Dhika Ram	Rajshahi	Rangpur	Pirganj (R)	Bhendabari	Bhendabari
S99-07276	RIP7276	19/06/1999	25.4744	89.2203	1996	TARA	29.9	Md Taimur Hossain	Rajshahi	Rangpur	Pirganj (R)	Kumedpur	Palashbari
S99-07277	RIP7277	19/06/1999	25.4307	89.2325	1997	TARA	29.9	Riajul Haque	Rajshahi	Rangpur	Pirganj (R)	Madankhali	Kapti Khal
S99-07278	RIP7278	19/06/1999	25.3339	89.2775	1980	HTW	18.3	Md Zalil M P	Rajshahi	Rangpur	Pirganj (R)	Chatra	Chatra
S99-07279	RIP7279	19/06/1999	25.4088	89.3278	1989	HTW	26.2	Md Khaja Najimuddin	Rajshahi	Rangpur	Pirganj (R)	Ramnathpur	Uzirpur
S99-07280	RIP7280	20/06/1999	25.6568	89.4143	1996	HTW	18	Thana complex	Rajshahi	Rangpur	Pirgachha	Pirgachha	Anantaram
S99-07281	RIP7281	20/06/1999	25.6581	89.4133	1985	DTW	53.3	Thana complex	Rajshahi	Rangpur	Pirgachha	Pirgachha	Anantaram
S99-07282	RIP7282	20/06/1999	25.6124	89.4135	1996	HTW	22.6	Abed Ali	Rajshahi	Rangpur	Pirgachha	Kaikuri	Ramchandara
S99-07283	RIP7283	20/06/1999	25.6163	89.4343	1976	HTW	14	Delwar Hossain	Rajshahi	Rangpur	Pirgachha	Kandi	Dadan
S99-07284	RIP7284	20/06/1999	25.5972	89.4826	1998	HTW	19.8	Joynal Abedin	Rajshahi	Rangpur	Pirgachha	Kandi	Teani Maniram
S99-07285	RIP7285	20/06/1999	25.6433	89.4919	1994	HTW	18	Tambulpur G. P. School	Rajshahi	Rangpur	Pirgachha	Tambulpur	Tambulpur
S99-07286	RIP7286	20/06/1999	25.6719	89.5032	1979	HTW	19.5	Sri Prafullah Kumar	Rajshahi	Rangpur	Pirgachha	Chhaola	Sibdeb
S99-07287	RIP7287	20/06/1999	25.7018	89.4812	1998	HTW	18	Abdul Majid	Rajshahi	Rangpur	Pirgachha	Chhaola	Jigabari
S99-07288	RIP7288	20/06/1999	25.6995	89.4409	1979	HTW	19.2	Shakhayat Ullah	Rajshahi	Rangpur	Pirgachha	Annadanagar	Protap Jaysen
S99-07289	RIP7289	20/06/1999	25.6992	89.3882	1992	HTW	18	B. H. Khan mosque	Rajshahi	Rangpur	Pirgachha	Itakumari	Bara Hayat Khan
S99-07290	RIP7290	20/06/1999	25.7049	89.3449	1992	HTW	28.7	Jafar Ali	Rajshahi	Rangpur	Pirgachha	Kalyani	Pakira
S99-07291	RIP7291	20/06/1999	25.6651	89.3567	1994	HTW	18	U P office	Rajshahi	Rangpur	Pirgachha	Parul	Saidpur
S99-07292	RIP7292	22/06/1999	25.7599	88.4887	1994	HTW	27.1	Tiren Chandra	Rajshahi	Dinajpur	Bochaganj	Atgaon	Alampur
S99-07293	RIP7293	22/06/1999	25.7253	88.4647	1975	HTW	16.2	Bhaduri Primary School	Rajshahi	Dinajpur	Bochaganj	Chhatail	Bhaduari
S99-07294	RIP7294	22/06/1999	25.7885	88.4534	1990	HTW	14.3	Ratan Chandra	Rajshahi	Dinajpur	Bochaganj	Mushidhat	Mushidhat
S99-07295	RIP7295	22/06/1999	25.7895	88.4225	1988	HTW	32.6	Md Jalal Uddin	Rajshahi	Dinajpur	Bochaganj	Rangaon	Kanua
S99-07296	RIP7296	22/06/1999	25.8389	88.4553	1994	HTW	22.6	Md Lutfar Rahman	Rajshahi	Dinajpur	Bochaganj	Napanagar	Sultanpur
S99-07297	RIP7297	22/06/1999	25.8383	88.4719	1998	HTW	22.6	Md Sultan Mia	Rajshahi	Dinajpur	Bochaganj	Ishania	Muraripur
S99-07298	RIP7298	23/06/1999	25.6566	88.6025	1997	TARA	36	Md Aftab Uddin	Rajshahi	Dinajpur	Biral	Farakkabad	Farakkabad
S99-07299	RIP7299	23/06/1999	25.734	88.5974	1996	TARA	46.3	Dr Alauddin Ahmed	Rajshahi	Dinajpur	Biral	Azimpur	Rajuria
S99-07300	RIP7300	23/06/1999	25.6941	88.5639	1997	TARA	33.5	Samsul Haque Chawdhury	Rajshahi	Dinajpur	Biral	Dhamair	Gobindapur
S99-07301	RIP7301	23/06/1999	25.717	88.5406	1997	TARA	25.3	Sri Gali Chand	Rajshahi	Dinajpur	Biral	Mangalpur	Mostafabad
S99-07302	RIP7302	23/06/1999	25.6952	88.4874	1997	HTW	29.9	Md Samsul Haque	Rajshahi	Dinajpur	Biral	Sahargram	Gaganpur
S99-07303	RIP7303	23/06/1999	25.626	88.521	1995	HTW	25.3	Md Elius Ali	Rajshahi	Dinajpur	Biral	Ranipukur	Kasipara
S99-07304	RIP7304	23/06/1999	25.5643	88.537	1992	HTW	26.2	U P Office	Rajshahi	Dinajpur	Biral	Dharmapur	Gopinathpur
S99-07305	RIP7305	23/06/1999	25.6308	88.5471	1998	TARA	39.6	DPHE office	Rajshahi	Dinajpur	Biral	Biral	Biral

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-07258	5854254621	< 0.5	0.01	< 0.1	0.016	10.3	< 0.003	< 0.002	< 0.008	0.132	0.6	< 0.004	5.07	0.718	7.8	< 0.1	19.4	1.8	0.0667	< 0.002	0.007
S99-07259	5852742926	< 0.5	0.04	< 0.1	0.034	30.8	< 0.003	< 0.002	< 0.008	0.16	5.7	< 0.004	9.22	1.01	21.6	0.2	19	11.8	0.0957	< 0.002	0.008
S99-07260	5852784109	5.9	0.02	< 0.1	0.03	13.5	< 0.003	< 0.002	< 0.008	6.68	1.3	< 0.004	5.17	1.04	9.6	0.4	22.5	0.3	0.076	< 0.002	0.009
S99-07261	5852773626	4.7	0.02	< 0.1	0.033	17.8	< 0.003	< 0.002	0.019	6.51	3.7	< 0.004	5.22	0.287	12.2	0.1	19.6	8.8	0.0561	< 0.002	0.024
S99-07262	5852731395	< 0.5	0.05	< 0.1	0.025	39.9	< 0.003	< 0.002	< 0.008	0.181	5.9	< 0.004	1.85	0.076	9	< 0.1	6.94	6	0.189	< 0.002	0.053
S99-07263	5852763313	1.2	0.02	< 0.1	0.006	13.3	< 0.003	< 0.002	< 0.008	0.662	1.4	< 0.004	4.24	0.63	10.3	0.2	23.5	2.5	0.0613	< 0.002	0.009
S99-07264	5852710136	< 0.5	0.02	< 0.1	0.018	10.1	< 0.003	< 0.002	< 0.008	0.067	7.5	< 0.004	2.4	0.144	7.3	< 0.1	14.2	7.9	0.0464	< 0.002	0.063
S99-07265	5852708696	7.8	0.03	< 0.1	0.022	12.5	< 0.003	< 0.002	< 0.008	0.213	3.8	< 0.004	2.58	4.96	3	< 0.1	8.32	6.7	0.07	< 0.002	0.013
S99-07266	5852777781	0.5	0.02	< 0.1	0.015	7.6	< 0.003	< 0.002	< 0.008	0.975	7.3	< 0.004	2.05	0.217	5.3	< 0.1	15.2	2.3	0.0362	< 0.002	0.009
S99-07267	5852721517	0.6	0.02	< 0.1	0.008	9.5	< 0.003	< 0.002	< 0.008	0.683	5.5	< 0.004	2.54	0.176	4.2	< 0.1	14.7	9.5	0.0355	< 0.002	0.006
S99-07268	5852752299	0.6	0.03	< 0.1	0.039	24.4	< 0.003	< 0.002	< 0.008	0.047	17.2	< 0.004	5.97	0.085	29.5	< 0.1	12.1	11	0.117	< 0.002	0.01
S99-07269	5857669817	< 0.5	0.04	< 0.1	0.015	20.7	< 0.003	< 0.002	< 0.008	0.099	1.7	< 0.004	8.01	0.132	12.6	< 0.1	25.7	0.4	0.194	< 0.002	0.055
S99-07270	5857682588	< 0.5	0.01	< 0.1	< 0.002	5.1	< 0.003	< 0.002	< 0.008	0.049	0.9	< 0.004	2.38	0.067	8.1	0.2	26.8	0.6	0.0276	0.003	0.007
S99-07271	5850337526	< 0.5	0.02	< 0.1	0.054	13.6	< 0.003	< 0.002	< 0.008	0.084	1.1	< 0.004	5.26	0.07	17.3	< 0.1	22.9	0.6	0.115	< 0.002	0.011
S99-07272	5857663487	36	0.04	< 0.1	0.077	25.8	< 0.003	< 0.002	< 0.008	7.95	4.3	< 0.004	8.34	0.862	16	0.2	27.3	< 0.2	0.114	< 0.002	0.234
S99-07273	5857663487	7.7	0.03	< 0.1	0.075	20.3	< 0.003	< 0.002	< 0.008	18.9	4.5	< 0.004	7.74	0.577	12.3	0.6	24.4	< 0.2	0.0689	< 0.002	0.025
S99-07274	5857688613	< 0.5	0.03	< 0.1	0.022	20.6	< 0.003	< 0.002	< 0.008	0.226	0.9	0.006	11	0.057	12.6	< 0.1	22.5	5.6	0.165	< 0.002	0.009
S99-07275	5857618164	< 0.5	0.03	< 0.1	0.035	15.2	< 0.003	< 0.002	< 0.008	0.441	1.5	0.006	7.03	0.236	20.4	< 0.1	27.2	7	0.105	< 0.002	0.009
S99-07276	5857644760	1.4	0.02	< 0.1	0.013	9.3	< 0.003	< 0.002	< 0.008	1.28	1.7	0.004	4.27	0.308	14.4	< 0.1	32.7	1.3	0.053	< 0.002	0.017
S99-07277	5857650542	< 0.5	0.02	< 0.1	0.012	8.8	< 0.003	0.003	< 0.008	0.044	1.6	< 0.004	3.44	0.025	12.3	< 0.1	23.5	0.2	0.0722	< 0.002	0.014
S99-07278	5857631235	< 0.5	0.02	< 0.1	0.028	9.2	< 0.003	0.006	< 0.008	0.077	1	< 0.004	4.01	0.025	11.6	< 0.1	20.6	0.4	0.0741	< 0.002	0.015
S99-07279	5857682991	< 0.5	0.04	< 0.1	0.087	25.4	< 0.003	< 0.002	< 0.008	0.183	1.4	< 0.004	10.2	0.051	27.4	0.1	23.6	1.3	0.17	0.002	0.014
S99-07280	5857376034	0.8	0.06	< 0.1	0.059	47.3	< 0.003	< 0.002	< 0.008	0.663	7.1	< 0.004	12.8	0.281	28.2	< 0.1	10.5	20.3	0.158	< 0.002	0.014
S99-07281	5857376034	3.5	0.03	< 0.1	0.079	18.7	< 0.003	< 0.002	< 0.008	18.8	5.9	0.005	5.13	0.676	9.7	0.5	22.3	1.2	0.0759	< 0.002	0.019
S99-07282	5857338791	24.5	0.04	< 0.1	0.044	19.9	< 0.003	< 0.002	< 0.008	11.3	2.7	< 0.004	7.62	0.999	10.3	1.3	24.8	< 0.2	0.0592	< 0.002	0.017
S99-07283	5857357215	298	0.05	< 0.1	0.078	38.8	< 0.003	< 0.002	< 0.008	22.4	3.6	< 0.004	12.1	1.33	12.3	0.5	26.4	< 0.2	0.17	< 0.002	0.023
S99-07284	5857357977	15.6	0.04	< 0.1	0.035	25.7	< 0.003	< 0.002	< 0.008	12.4	3.3	< 0.004	8.1	0.509	10.5	1.2	23.3	< 0.2	0.0711	< 0.002	0.024
S99-07285	5857385971	14.2	0.04	< 0.1	0.038	29.1	< 0.003	< 0.002	< 0.008	8.52	2.6	< 0.004	10.9	0.569	13.4	1	27.3	< 0.2	0.123	< 0.002	0.012
S99-07286	5857319861	1.7	0.03	< 0.1	0.046	13.3	< 0.003	< 0.002	< 0.008	7.72	5.9	< 0.004	4.09	0.287	7.6	< 0.1	16.1	9.4	0.0483	< 0.002	0.019
S99-07287	5857319407	6.9	0.02	< 0.1	0.043	13.9	< 0.003	< 0.002	< 0.008	13.2	2.3	< 0.004	5.98	0.807	10.8	0.5	26.5	0.2	0.0489	< 0.002	0.038
S99-07288	5857309727	2.2	0.03	< 0.1	0.047	12.2	< 0.003	< 0.002	< 0.008	7.69	5.8	< 0.004	3.64	0.308	7.4	0.2	16	2.6	0.0515	< 0.002	0.011
S99-07289	5857328116	0.7	0.02	< 0.1	0.022	10.8	< 0.003	< 0.002	< 0.008	0.976	3.7	< 0.004	4.98	0.21	7.1	< 0.1	20.7	1.8	0.0357	< 0.002	0.012
S99-07290	5857347267	< 0.5	0.02	< 0.1	0.012	11.5	< 0.003	< 0.002	< 0.008	0.158	< 0.5	< 0.004	7.05	2.48	9.1	< 0.1	25.5	0.7	0.0647	< 0.002	0.009
S99-07291	5857366826	< 0.5	0.03	< 0.1	0.022	15.4	< 0.003	< 0.002	< 0.008	0.11	7	< 0.004	7.28	0.179	6.6	< 0.1	17	7.7	0.0632	< 0.002	0.011
S99-07292	5272113027	< 0.5	0.03	< 0.1	0.014	11.7	< 0.003	< 0.002	< 0.008	0.074	1.5	< 0.004	3.61	0.188	21.5	0.2	29.2	0.5	0.0572	< 0.002	0.009
S99-07293	5272127172	< 0.5	0.02	< 0.1	0.011	9.8	< 0.003	< 0.002	< 0.008	0.262	1	< 0.004	3.43	0.197	13.1	0.1	31	0.2	0.0529	< 0.002	0.006
S99-07294	5272154704	< 0.5	0.04	< 0.1	0.011	7.9	< 0.003	0.003	< 0.008	0.095	1.9	0.005	3.64	0.031	7.7	< 0.1	18.4	2.8	0.0304	< 0.002	0.008
S99-07295	5272181490	1.2	0.05	< 0.1	0.024	13.7	< 0.003	< 0.002	0.009	0.278	1.4	0.005	3.8	0.384	16.9	0.2	31.6	2.1	0.068	< 0.002	0.021
S99-07296	5272167946	< 0.5	0.03	< 0.1	0.051	17.7	< 0.003	< 0.002	< 0.008	1.83	4.3	< 0.004	8	0.204	18.7	< 0.1	15.3	10.2	0.0765	< 0.002	0.019
S99-07297	5272140697	2.4	0.03	< 0.1	0.022	8.8	< 0.003	< 0.002	< 0.008	3.08	1.8	< 0.004	2.75	0.244	10	0.2	25.1	< 0.2	0.0423	< 0.002	0.037
S99-07298	5271766412	< 0.5	0.05	< 0.1	0.032	23.2	< 0.003	< 0.002	< 0.008	0.142	0.6	< 0.004	7.48	0.49	31	0.1	25.6	0.2	0.112	< 0.002	0.024
S99-07299	5271709825	< 0.5	0.02	< 0.1	0.016	10.7	< 0.003	< 0.002	< 0.008	0.037	1.3	< 0.004	3.44	0.184	17.8	0.1	28	< 0.2	0.063	< 0.002	0.016
S99-07300	5271747470	< 0.5	0.04	< 0.1	0.069	23.7	< 0.003	< 0.002	< 0.008	0.057	1.9	< 0.004	6.71	0.505	17	0.2	30.9	0.9	0.129	< 0.002	0.025
S99-07301	5271776660	3.9	0.02	< 0.1	0.046	14	< 0.003	< 0.002	< 0.008	0.871	1.5	< 0.004	3.14	0.9	12.5	0.3	26.5	< 0.2	0.0792	< 0.002	0.014
S99-07302	5271794437	9.2	0.03	< 0.1	0.022	7.7	< 0.003	< 0.002	< 0.008	1.93	1.1	< 0.004	2	0.263	14	0.6	28.3	0.5	0.043	< 0.002	0.016
S99-07303	5271785569	0.9	0.02	< 0.1	0.016	4.7	< 0.003	< 0.002	< 0.008	3.19	2	< 0.004	1.43	0.174	7.5	0.2	19.8	1.9	0.023	< 0.002	0.093
S99-07304	5271757478	< 0.5	0.02	< 0.1	0.013	10	< 0.003	< 0.002	< 0.008	0.053	4.4	0.006	8.3	0.057	13.3	< 0.1	16	2.1	0.0481	< 0.002	0.009
S99-07305	5271728185	< 0.5	0.03	< 0.1	0.035	15.7	< 0.003	< 0.002	< 0.008	0.023	0.6	< 0.004	5.58	0.303	17.3	< 0.1	25.2	5.3	0.0782	< 0.002	0.067

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07306	RIP7306	24/06/1999	25.9068	88.5924	1998	TARA	28.3	Khoka Krishna	Rajshahi	Dinajpur	Birganj	Bhognagar	Bhognagar
S99-07307	RIP7307	24/06/1999	25.9238	88.5546	1984	HTW	18.9	Abdus Salam	Rajshahi	Dinajpur	Birganj	Satair	Prannagar
S99-07308	RIP7308	24/06/1999	25.9122	88.5345	1979	HTW	23.5	U P office	Rajshahi	Dinajpur	Birganj	Mohammadpur	Mohanpur
S99-07309	RIP7309	24/06/1999	25.9438	88.64	1995	TARA	29.9	Md Jahangir Hossain	Rajshahi	Dinajpur	Birganj	Maricha	Mahatabpur
S99-07310	RIP7310	24/06/1999	26.0203	88.6286	1984	HTW	23.5	Sri Jagindra Nath	Rajshahi	Dinajpur	Birganj	Palashbari	Bairbari
S99-07311	RIP7311	24/06/1999	25.9989	88.6915	1988	HTW	18.9	Jharbari High School	Rajshahi	Dinajpur	Birganj	Shatagram	Prasadpara
S99-07312	RIP7312	24/06/1999	25.9197	88.7208	1994	HTW	35.1	Abbas Ali	Rajshahi	Dinajpur	Birganj	Mohanpur	Kasipur
S99-07313	RIP7313	24/06/1999	25.8964	88.6947	1993	HTW	25	Kalyani Primary School	Rajshahi	Dinajpur	Birganj	Nijpara	Saidpur Kalyani
S99-07314	RIP7314	24/06/1999	25.856	88.6497	1993	HTW	12.2	Md Mukhlesur Rahman	Rajshahi	Dinajpur	Birganj	Sujalpur	Sujalpur
S99-07315	RIP7315	26/06/1999	25.5753	88.9407	1995	TARA	25.3	Jaher Uddin Primary school	Rajshahi	Dinajpur	Parbatipur	Habra	Serpur
S99-07316	RIP7316	26/06/1999	25.5433	88.9526	1998	HTW	28.3	Barapukuria Coal Mine	Rajshahi	Dinajpur	Parbatipur	Hamidpur	Chauhati
S99-07317	RIP7317	26/06/1999	25.5866	88.967	1995	TARA	25.3	Md Abdul Khaleque	Rajshahi	Dinajpur	Parbatipur	Palashbari	Kalikapur
S99-07318	RIP7318	26/06/1999	25.6107	88.9777	1994	HTW	18.9	Sri Bhaben Chandra	Rajshahi	Dinajpur	Parbatipur	Harirampur	Purba Hossainpur
S99-07319	RIP7319	26/06/1999	25.6943	88.9098	1998	TARA	25.3	Afsher Uddin	Rajshahi	Dinajpur	Parbatipur	Belaichandi	Jagannathpur
S99-07320	RIP7320	26/06/1999	25.6689	88.9183	1989	HTW	23.8	DPHE office	Rajshahi	Dinajpur	Parbatipur	Rampur	Rampur
S99-07321	RIP7321	26/06/1999	25.6631	88.8843		HTW	28	Rajabasam G. P. school	Rajshahi	Dinajpur	Parbatipur	Manmathapur	Rajabazar
S99-07322	RIP7322	26/06/1999	25.6602	88.8418	1999	HTW	28	Ideal College office	Rajshahi	Dinajpur	Parbatipur	Mominpur	Haibatpur
S99-07323	RIP7323	27/06/1999	25.5315	88.9489	1997	TARA	30.2	Mizanur Rahman	Rajshahi	Dinajpur	Fulbari	Shibnagar	Baghra
S99-07324	RIP7324	27/06/1999	25.4418	88.9734	1997	TARA	30.2	Sri Banto Rae	Rajshahi	Dinajpur	Fulbari	Daulatpur	Jayanagar
S99-07325	RIP7325	27/06/1999	25.4588	88.9691	1998	TARA	29.9	Siddiqur Rahman	Rajshahi	Dinajpur	Fulbari	Khayerbari	Uttar Lakshmipur
S99-07326	RIP7326	27/06/1999	25.5079	88.8236	1992	TARA	20.1	BDR camp	Rajshahi	Dinajpur	Fulbari	Eluary	Panikata
S99-07327	RIP7327	27/06/1999	25.5001	88.9501	1995	HTW	29.9	Bus satnd Mosque	Rajshahi	Dinajpur	Fulbari	Pourashava ward 01	Sujapur
S99-07328	RIP7328	27/06/1999	25.4235	88.8995	1998	TARA	20.1	Md Yanus Ali	Rajshahi	Dinajpur	Fulbari	Betdighi	Khanduakhai
S99-07329	RIP7329	27/06/1999	25.4622	88.9286	1998	TARA	29.9	Mukhlesur Rahman	Rajshahi	Dinajpur	Fulbari	Aladipur	Basudevpur
S99-07330	RIP7330	28/06/1999	25.2559	89.2425	1992	TARA	25.3	DPHE office	Rajshahi	Dinajpur	Ghoraghat	Ghoraghat	C B Bishwanathpur
S99-07331	RIP7331	28/06/1999	25.2748	89.24	1998	TARA	28	Md Tashir Uddin	Rajshahi	Dinajpur	Ghoraghat	Singha	Abirerpara
S99-07332	RIP7332	28/06/1999	25.2971	89.2149	1998	TARA	28	Panna Lal Malai	Rajshahi	Dinajpur	Ghoraghat	Singra	Singra
S99-07333	RIP7333	28/06/1999	25.322	89.1927	1998	TARA	28.7	Md Marjan Ali	Rajshahi	Dinajpur	Ghoraghat	Bulakipur	Haripara
S99-07334	RIP7334	28/06/1999	25.2614	89.1877	1994	TARA	28.7	Balahar High school	Rajshahi	Dinajpur	Ghoraghat	Palsa	Balahar
S99-07335	RIP7335	28/06/1999	25.2451	89.2843	1992	HTW	25	Ghoraghat Bazar	Rajshahi	Dinajpur	Ghoraghat	Ghoraghat	Dakshin Joydevpur
S99-07336	RIP7336	29/06/1999	25.3048	89.0091	1978	HTW	18.9	Akim Uddin	Rajshahi	Dinajpur	Hakimpur	Boaldar	Raybhog
S99-07337	RIP7337	29/06/1999	25.2766	89.0131	1994	HTW	18.9	Abdul Hai	Rajshahi	Dinajpur	Hakimpur	Hili Hakimpur	Basudevpur
S99-07338	RIP7338	29/06/1999	25.2793	89.1275	1994	TARA	29	Abdul Khaleque	Rajshahi	Dinajpur	Hakimpur	Alihat	Baona
S99-07339	RIP7339	29/06/1999	25.2802	89.0664	1998	HTW	22.9	Carmatha Bazar	Rajshahi	Dinajpur	Hakimpur	Hili Hakimpur	Chhatni
S99-07340	RIP7340	30/06/1999	25.0546	88.7627	1994	HTW	24.4	TNO office	Rajshahi	Naogaon	Patnitala	Nizapur	Nizapur
S99-07341	RIP7341	30/06/1999	25.0806	88.792	1992	HTW	24.4	Ambati Bazar mosque	Rajshahi	Naogaon	Patnitala	Patichara	Ambati
S99-07342	RIP7342	30/06/1999	25.0144	88.8027	1998	HTW	25.9	Khirshin S. K. High school	Rajshahi	Naogaon	Patnitala	Ghoshnagar	Koch Kirshin
S99-07343	RIP7343	30/06/1999	25.0503	88.7465	1999	HTW	29	M. A. Gafur	Rajshahi	Naogaon	Patnitala	Patnitala	Mamudpur
S99-07344	RIP7344	30/06/1999	25.0201	88.6885	1989	TARA	35.1	Md. Halim	Rajshahi	Naogaon	Patnitala	Matindhar	Sidua
S99-07345	RIP7345	30/06/1999	25.0626	88.7328	1999	HTW	34.4	Patnitala High School	Rajshahi	Naogaon	Patnitala	Patnitala	Patnitala
S99-07346	RIP7346	30/06/1999	25.0832	88.6853	1996	TARA	34.4	Madhuil Battali Bazar	Rajshahi	Naogaon	Patnitala	Ekbarpur	Madhail
S99-07347	RIP7347	30/06/1999	25.0974	88.6924	1997	HTW	34.4	Krishnapur College	Rajshahi	Naogaon	Patnitala	Krishnapur	Krishnapur
S99-07348	RIP7348	30/06/1999	25.1063	88.6311	1994	Super T/	81.4	Anisur Rahman	Rajshahi	Naogaon	Patnitala	Dibar	Bakrail
S99-07349	RIP7349	01/07/1999	25.1615	88.7711	1993	TARA	34.4	Bhadur Muddy	Rajshahi	Naogaon	Dhamoirhat	Alampur	Bastabar
S99-07350	RIP7350	01/07/1999	25.174	88.7508	1998	HTW	21	Shimultali BDR camp	Rajshahi	Naogaon	Dhamoirhat	Agradigun	Monoharpur
S99-07351	RIP7351	01/07/1999	25.1208	88.7641	1996	HTW	18.3	Abul Kalam Azad	Rajshahi	Naogaon	Dhamoirhat	Khelna	Bhagabanpur
S99-07352	RIP7352	01/07/1999	25.1305	88.783	1996	TARA	31.7	Abdul Gaffar Sarkar	Rajshahi	Naogaon	Dhamoirhat	Alampur	Bheram
S99-07353	RIP7353	01/07/1999	25.1529	88.8292	1995	TARA	34.4	Md Abdul Latif	Rajshahi	Naogaon	Dhamoirhat	Omar	Farsipara

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-07306	5271208154	< 0.5	0.02	< 0.1	0.005	6.2	< 0.003	< 0.002	< 0.008	0.052	1.3	< 0.004	3.23	0.1	6.8	< 0.1	19.9	0.5	0.0287	< 0.002	0.064
S99-07307	5271277808	< 0.5	0.02	< 0.1	0.006	5.3	< 0.003	< 0.002	< 0.008	0.116	0.9	0.005	2.84	0.076	5.3	< 0.1	22.8	0.3	0.0346	< 0.002	0.011
S99-07308	5271225659	50.9	0.05	< 0.1	0.054	38.5	< 0.003	< 0.002	< 0.008	15.1	1.3	< 0.004	10.1	0.488	21.3	0.4	21.1	0.4	0.22	< 0.002	0.023
S99-07309	5271217665	6.1	0.03	< 0.1	0.034	14.9	< 0.003	< 0.002	< 0.008	11.1	1.7	< 0.004	4.41	0.589	12.2	0.7	29.3	4	0.0774	< 0.002	0.035
S99-07310	5271251058	54.2	0.03	< 0.1	0.031	14.5	< 0.003	< 0.002	< 0.008	9.72	1.4	< 0.004	5.44	0.274	15.8	0.5	24.2	< 0.2	0.107	< 0.002	0.017
S99-07311	5271269814	< 0.5	< 0.01	< 0.1	0.034	17.1	< 0.003	< 0.002	< 0.008	0.379	23.1	< 0.004	5.4	0.052	17.9	< 0.1	13.6	15.2	0.111	< 0.002	0.015
S99-07312	5271234532	6	0.03	< 0.1	0.026	12.4	< 0.003	< 0.002	< 0.008	4.25	2.2	< 0.004	3.08	0.432	13.9	0.5	31.1	< 0.2	0.0735	< 0.002	0.019
S99-07313	5271243872	< 0.5	< 0.01	< 0.1	0.007	7.2	< 0.003	< 0.002	< 0.008	0.133	2	< 0.004	3	0.035	6.1	< 0.1	13.8	3.3	0.035	< 0.002	0.013
S99-07314	5271294957	< 0.5	< 0.01	< 0.1	0.013	9.9	< 0.003	< 0.002	< 0.008	0.09	1.9	< 0.004	3.85	0.043	10	< 0.1	19.8	4.6	0.0714	< 0.002	0.018
S99-07315	5277725907	< 0.5	< 0.01	< 0.1	0.011	10.8	< 0.003	< 0.002	< 0.008	0.399	0.8	0.005	4.94	0.158	19.6	< 0.1	30	0.7	0.0628	< 0.002	0.03
S99-07316	5277734201	< 0.5	< 0.01	< 0.1	0.021	10.9	< 0.003	< 0.002	< 0.008	0.06	1.2	0.01	5.65	0.334	20.9	< 0.1	27.4	1.1	0.0816	< 0.002	0.126
S99-07317	5277777478	< 0.5	0.09	< 0.1	0.021	12.8	< 0.003	0.002	< 0.008	0.661	1.8	0.006	4.98	0.222	23.5	< 0.1	32.5	4.9	0.0915	< 0.002	0.096
S99-07318	5277743782	< 0.5	0.05	< 0.1	0.046	16.5	< 0.003	< 0.002	< 0.008	0.41	4.1	< 0.004	4.83	0.055	10.9	< 0.1	12.3	8.5	0.0453	< 0.002	0.053
S99-07319	5277708440	< 0.5	0.03	< 0.1	0.037	25.4	< 0.003	< 0.002	< 0.008	1.34	1.6	< 0.004	8.41	0.173	24.3	< 0.1	30.6	4.6	0.149	< 0.002	0.063
S99-07320	5277786853	1.5	< 0.01	< 0.1	0.068	30.2	< 0.003	< 0.002	< 0.008	3.21	1.5	< 0.004	9.09	0.584	26.6	0.1	33.2	1.9	0.216	< 0.002	0.02
S99-07321	5277751831	< 0.5	< 0.01	< 0.1	0.009	15.3	< 0.003	< 0.002	< 0.008	0.879	6.8	0.01	7.39	0.251	18	< 0.1	23.2	0.5	0.0629	< 0.002	0.141
S99-07322	5277760391	< 0.5	< 0.01	< 0.1	0.018	12	< 0.003	< 0.002	< 0.008	0.082	1.1	< 0.004	4.61	0.445	16	< 0.1	28.7	1.2	0.0671	< 0.002	0.162
S99-07323	5273894048	0.8	< 0.01	< 0.1	0.013	12.1	< 0.003	< 0.002	< 0.008	0.159	1	0.005	3.93	0.071	17.3	0.1	31.4	0.3	0.0859	< 0.002	0.041
S99-07324	5273838389	< 0.5	0.02	< 0.1	0.011	8.5	< 0.003	0.002	< 0.008	0.062	2.3	< 0.004	3.23	0.028	11.3	< 0.1	19.9	< 0.2	0.0793	< 0.002	0.106
S99-07325	5273876981	< 0.5	0.05	< 0.1	0.006	6.1	< 0.003	< 0.002	< 0.008	0.11	1.4	< 0.004	2.04	0.027	12.7	0.1	30.1	< 0.2	0.0411	0.003	0.084
S99-07326	5273847719	< 0.5	< 0.01	< 0.1	0.03	17.4	< 0.003	< 0.002	< 0.008	1.58	1.3	< 0.004	4.71	0.192	21	< 0.1	26	2.5	0.107	< 0.002	0.027
S99-07327	5273801917	4.7	< 0.01	< 0.1	0.05	23.3	< 0.003	< 0.002	< 0.008	6.01	3	< 0.004	6.79	0.875	18.4	0.1	19.6	18.3	0.156	< 0.002	0.035
S99-07328	5273828499	< 0.5	< 0.01	< 0.1	0.018	17.9	< 0.003	< 0.002	< 0.008	0.404	1.2	0.004	5.55	0.139	20.3	< 0.1	34.7	1.4	0.114	< 0.002	0.016
S99-07329	5273809096	< 0.5	< 0.01	< 0.1	0.005	5.3	< 0.003	< 0.002	< 0.008	0.015	1.4	< 0.004	2.28	0.157	8.2	< 0.1	22.8	1.3	0.0474	< 0.002	0.057
S99-07330	5274338242	< 0.5	< 0.01	< 0.1	0.008	9.6	< 0.003	0.003	< 0.008	0.091	0.8	< 0.004	3.92	0.031	8.2	< 0.1	20.6	< 0.2	0.0799	< 0.002	0.029
S99-07331	5274376017	< 0.5	< 0.01	< 0.1	0.005	11	< 0.003	< 0.002	< 0.008	0.054	1.2	< 0.004	3.2	0.024	8.8	0.2	29.5	1	0.062	0.003	0.106
S99-07332	5274376934	< 0.5	< 0.01	< 0.1	0.002	4.3	< 0.003	< 0.002	< 0.008	0.062	0.9	< 0.004	1.78	0.014	12.1	0.2	22.2	0.6	0.0335	0.005	0.053
S99-07333	5274319495	< 0.5	< 0.01	< 0.1	0.006	8.4	< 0.003	0.003	< 0.008	0.022	1.8	< 0.004	3.38	0.016	6	< 0.1	14	< 0.2	0.0797	< 0.002	0.085
S99-07334	5274357077	< 0.5	< 0.01	< 0.1	0.024	27.3	< 0.003	< 0.002	< 0.008	0.979	1	0.008	8.09	3.41	19.4	< 0.1	27.2	5.1	0.233	< 0.002	0.043
S99-07335	5274338372	< 0.5	< 0.01	< 0.1	0.008	12	< 0.003	0.007	< 0.008	0.051	1.1	0.005	4.82	0.112	9.9	< 0.1	28.1	1	0.1	< 0.002	0.04
S99-07336	5274740912	< 0.5	< 0.01	< 0.1	0.008	5.8	< 0.003	< 0.002	< 0.008	0.454	1.1	< 0.004	2.71	0.128	11.6	< 0.1	27.6	2.2	0.0338	< 0.002	0.037
S99-07337	5274754115	< 0.5	< 0.01	< 0.1	0.015	13.9	< 0.003	< 0.002	< 0.008	0.135	0.7	0.005	6.1	0.019	18.4	< 0.1	20.3	1.5	0.121	< 0.002	0.05
S99-07338	5274713090	1.3	< 0.01	< 0.1	0.023	17	< 0.003	< 0.002	< 0.008	0.515	1.5	0.005	6.18	0.227	18.4	< 0.1	30.6	0.6	0.097	< 0.002	0.017
S99-07339	5274754279	1	< 0.01	< 0.1	0.021	13.1	< 0.003	< 0.002	< 0.008	0.88	1.3	0.005	4.88	0.169	14.5	< 0.1	29.3	< 0.2	0.0647	< 0.002	0.013
S99-07340	5647560740	6.6	< 0.01	< 0.1	0.026	22.5	< 0.003	< 0.002	< 0.008	0.67	1.2	0.004	3.1	0.14	12.1	0.1	25.7	0.3	0.053	< 0.002	0.011
S99-07341	5647577023	< 0.5	< 0.01	< 0.1	0.023	17.3	< 0.003	< 0.002	< 0.008	0.516	1.3	0.007	6.32	0.216	14.5	< 0.1	27.3	1.5	0.0504	< 0.002	0.034
S99-07342	5647534592	< 0.5	< 0.01	< 0.1	0.02	17.5	< 0.003	< 0.002	< 0.008	0.856	1.2	< 0.004	5.13	0.193	15.4	< 0.1	25.1	< 0.2	0.0414	< 0.002	0.016
S99-07343	5647586676	< 0.5	0.11	< 0.1	0.191	18.2	< 0.003	< 0.002	0.013	10.5	4.4	0.006	4.82	1.08	4.2	< 0.1	15.7	5.3	0.091	< 0.002	0.61
S99-07344	5647551911	< 0.5	< 0.01	< 0.1	0.017	19	< 0.003	< 0.002	< 0.008	1.03	1.3	0.006	7.03	0.234	12.7	< 0.1	29.2	< 0.2	0.069	< 0.002	0.019
S99-07345	5647586807	3.2	< 0.01	< 0.1	0.028	28.5	< 0.003	< 0.002	< 0.008	1.49	1.7	0.007	11	0.534	21.3	< 0.1	33.6	4.8	0.109	< 0.002	0.048
S99-07346	5647508639	1.3	< 0.01	< 0.1	0.041	24.8	< 0.003	< 0.002	< 0.008	0.992	1.3	< 0.004	6.16	0.156	14.3	< 0.1	29.3	0.3	0.106	< 0.002	0.02
S99-07347	5647543606	< 0.5	< 0.01	< 0.1	0.01	15	< 0.003	< 0.002	< 0.008	0.05	0.8	0.007	4.88	0.156	10.3	< 0.1	31.1	0.6	0.0624	< 0.002	0.051
S99-07348	5647525100	< 0.5	< 0.01	< 0.1	0.067	65.2	< 0.003	< 0.002	< 0.008	0.239	3.9	< 0.004	19.8	0.05	19.4	< 0.1	10.5	0.3	0.276	< 0.002	0.03
S99-07349	5642821134	< 0.5	< 0.01	< 0.1	0.006	19.6	< 0.003	< 0.002	< 0.008	0.043	0.8	< 0.004	6.89	0.457	13.4	< 0.1	23.2	0.4	0.0893	< 0.002	0.016
S99-07350	5642810782	< 0.5	< 0.01	< 0.1	0.005	15.8	< 0.003	< 0.002	< 0.008	0.158	0.8	< 0.004	6.3	0.067	19.1	< 0.1	26.6	1.7	0.101	< 0.002	0.012
S99-07351	5642837166	< 0.5	< 0.01	< 0.1	0.01	10.8	< 0.003	< 0.002	< 0.008	0.153	0.7	0.009	4.52	0.178	10.9	< 0.1	18.2	2	0.0722	< 0.002	0.012
S99-07352	5642821161	< 0.5	< 0.01	< 0.1	0.027	16.7	< 0.003	< 0.002	< 0.008	1.18	1.3	0.005	7.17	0.172	22.7	< 0.1	27.1	0.7	0.0698	< 0.002	0.015
S99-07353	5642884481	< 0.5	< 0.01	< 0.1	0.032	16.9	< 0.003	< 0.002	< 0.008	0.125	1.2	0.005	5.3	0.19	13	0.1	30.9	0.3	0.0645	< 0.002	0.028

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-07354	RIP7354	01/07/1999	25.0786	88.9325	1995	TARA	34.1	Tamij Uddin Mandal	Rajshahi	Naogaon	Dhamoirhat	Isabpur	Poranagar
S99-07355	RIP7355	01/07/1999	25.1208	88.927	1995	TARA	34.4	Akber Ali	Rajshahi	Naogaon	Dhamoirhat	Jahanpur	Jahanpur
S99-07356	RIP7356	01/07/1999	25.1394	88.8846	1990	TARA	34.4	Golap Hossain	Rajshahi	Naogaon	Dhamoirhat	Dhamoirhat	Mahabbatpur
S99-07357	RIP7357	01/07/1999	25.0584	88.8211	1992	TARA	34.4	Prachandra	Rajshahi	Naogaon	Dhamoirhat	Aranagar	DakshinSyampur
S99-07358	RIP7358	03/07/1999	25.025	88.42	1994	TARA	39.6	DPHE office	Rajshahi	Naogaon	Porsha	Nithpur	Nitpur
S99-07359	RIP7359	03/07/1999	25.0306	88.5066	1985	HTW	43.9	Gulam Rahman	Rajshahi	Naogaon	Porsha	Ganguria	Amda
S99-07360	RIP7360	03/07/1999	25.0048	88.4993		DTW	74.1	Akter Hossain	Rajshahi	Naogaon	Porsha	Tetulia	Purail
S99-07361	RIP7361	03/07/1999	24.9509	88.4857	1998	TARA st	56.1	U P office	Rajshahi	Naogaon	Porsha	Chhaor	Char Kirttali
S99-07362	RIP7362	03/07/1999	25.0202	88.579	1985	DSHP	64.9	Md Sahar Uddin	Rajshahi	Naogaon	Porsha	Ghatnagar	Ghatnagar
S99-07363	RIP7363	03/07/1999	25.0256	88.5944	1992	TARA	41.1	Meda Mosque	Rajshahi	Naogaon	Porsha	Masidpur	Meda
S99-07364	RIP7364	04/07/1999	24.7031	88.9273	1992	TARA	29	Jarip Uddin Mandal	Rajshahi	Naogaon	Raninagar	Gona	Durgapur
S99-07365	RIP7365	04/07/1999	24.6765	88.9317	1990	TARA	29	Moin Khan	Rajshahi	Naogaon	Raninagar	Gona	Nandabari
S99-07366	RIP7366	04/07/1999	24.7117	88.9184	1999	TARA	27.1	Ataikula high school	Rajshahi	Naogaon	Raninagar	Mirat	Ataikola
S99-07367	RIP7367	04/07/1999	24.7305	88.9369	1986	TARA	26.8	Eanyetpur Mosque	Rajshahi	Naogaon	Raninagar	Kashimpur	Eanyetpur
S99-07368	RIP7368	04/07/1999	24.7064	89.1043	1997	HTW	19.8	Md Maij Uddin	Rajshahi	Naogaon	Raninagar	Ekdala	Jatrapur
S99-07369	RIP7369	04/07/1999	24.7161	89.0865	1993	TARA	27.4	Abadpukur Bazar	Rajshahi	Naogaon	Raninagar	Kaligram	Kaligaon
S99-07370	RIP7370	04/07/1999	24.7728	89.052	1993	HTW	29	Parail G. P. Schhol	Rajshahi	Naogaon	Raninagar	Parail	Parail
S99-07371	RIP7371	04/07/1999	24.7388	88.9604	1990	TARA	25.3	Thana Complex	Rajshahi	Naogaon	Raninagar	Raninagar	Balubhara
S99-07372	RIP7372	05/07/1999	24.7425	88.6811	1995	TARA	42.1	Md Hadek Ali	Rajshahi	Naogaon	Manda	Kusumba	Hazigobindapur
S99-07373	RIP7373	05/07/1999	24.7042	88.65	1998	HTW	34.4	UP office	Rajshahi	Naogaon	Manda	Bharso	Bharso
S99-07374	RIP7374	05/07/1999	24.6833	88.68	1992	TARA	34.4	Alhaj Jahir Uddin	Rajshahi	Naogaon	Manda	Kalikapur	Chhota Mulluk
S99-07375	RIP7375	05/07/1999	24.6992	88.7117	1996	TARA	34.4	Mati Pramanic	Rajshahi	Naogaon	Manda	Nurullabad	Ramnagar
S99-07376	RIP7376	05/07/1999	24.7692	88.7083	1996	HTW	34.4	Mansur Rahman	Rajshahi	Naogaon	Manda	Manda	Kamarkuri
S99-07377	RIP7377	05/07/1999	24.76	88.7167	1999	TARA	34.4	Gabindha Mandir	Rajshahi	Naogaon	Manda	Prasadpur	Prasadpur
S99-07378	RIP7378	05/07/1999	24.8117	88.7683	1998	TARA	33.5	Al Haj Shamir Uddin	Rajshahi	Naogaon	Manda	Mainani	Durgapur
S99-07379	RIP7379	05/07/1999	24.7733	88.8	1998	TARA	33.5	Osman Ali	Rajshahi	Naogaon	Manda	Kansopara	Ilsagari
S99-07380	RIP7380	05/07/1999	24.7183	88.775	1992	TARA	34.4	Ismail Hossain	Rajshahi	Naogaon	Manda	Kashab	Panjar Bhanga
S99-07381	RIP7381	05/07/1999	25.1039	88.5713	1987	HTW	59.4	Md Ali Master	Rajshahi	Naogaon	Sapahar	Sapahar	Nurpur
S99-07382	RIP7382	05/07/1999	25.0296	88.6054	1994	TARA	42.7	Md Fazlu	Rajshahi	Naogaon	Sapahar	Tilna	Doas
S99-07383	RIP7383	05/07/1999	25.0492	88.5857	1988	TARA	43		Rajshahi	Naogaon	Sapahar	Tilna	Chachahar

SAMPLE ID	GEOCODE	As ug/l	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-07354	5642852842	< 0.5	< 0.01	< 0.1	0.006	11.2	< 0.003	< 0.002	< 0.008	0.046	1	< 0.004	4.01	0.083	6.7	< 0.1	23.3	1.2	0.0575	< 0.002	0.026
S99-07355	5642863555	5.5	0.06	< 0.1	0.052	31.5	< 0.003	0.002	< 0.008	0.174	2	< 0.004	9.41	0.175	19.2	0.2	24.9	2.5	0.121	< 0.002	0.031
S99-07356	5642842721	< 0.5	0.03	< 0.1	0.007	10	< 0.003	< 0.002	< 0.008	0.073	1.1	0.005	4.01	0.016	11.1	< 0.1	32	0.7	0.0699	< 0.002	0.019
S99-07357	5642831425	< 0.5	< 0.01	< 0.1	0.019	18.9	< 0.003	< 0.002	< 0.008	1.6	1	< 0.004	5.93	0.26	15.7	< 0.1	28.6	< 0.2	0.0551	< 0.002	0.015
S99-07358	5647955731	< 0.5	< 0.01	< 0.1	0.019	24.2	< 0.003	< 0.002	< 0.008	0.099	< 0.5	0.006	6.17	0.052	18.9	< 0.1	27.4	< 0.2	0.115	< 0.002	0.041
S99-07359	5647923032	< 0.5	< 0.01	< 0.1	0.025	32.4	< 0.003	< 0.002	< 0.008	0.584	0.8	< 0.004	9.45	0.021	15.3	< 0.1	18.8	< 0.2	0.141	< 0.002	0.017
S99-07360	5647987799	< 0.5	< 0.01	< 0.1	0.02	60.8	< 0.003	< 0.002	< 0.008	0.464	1.4	< 0.004	14.5	0.019	13.9	< 0.1	9.35	< 0.2	0.205	< 0.002	0.135
S99-07361	5647915276	< 0.5	< 0.01	0.1	0.035	90	< 0.003	< 0.002	< 0.008	0.043	1.6	0.007	35.9	0.012	60.2	< 0.1	17.7	0.2	0.433	< 0.002	0.036
S99-07362	5647931393	< 0.5	0.01	< 0.1	0.05	93.9	< 0.003	< 0.002	< 0.008	0.24	2.2	< 0.004	31.8	0.012	39.2	< 0.1	11	< 0.2	0.395	< 0.002	0.034
S99-07363	5647947692	< 0.5	< 0.01	< 0.1	0.019	19.1	< 0.003	< 0.002	< 0.008	0.769	1	0.006	5.57	0.237	34.6	< 0.1	26.6	0.3	0.0794	< 0.002	0.015
S99-07364	5648531361	< 0.5	< 0.01	< 0.1	0.013	28.9	< 0.003	< 0.002	< 0.008	0.054	0.9	0.012	11.2	0.362	40.3	< 0.1	27.3	6.7	0.111	< 0.002	0.018
S99-07365	5648531754	0.6	< 0.01	< 0.1	0.026	33.6	< 0.003	< 0.002	< 0.008	0.215	1.2	0.009	9.21	0.242	21.8	< 0.1	26.2	11.4	0.106	< 0.002	0.014
S99-07366	5648563047	0.6	< 0.01	< 0.1	0.045	51.6	< 0.003	< 0.002	< 0.008	0.625	2.5	0.004	22	0.186	49.8	< 0.1	26.4	5.5	0.212	< 0.002	0.04
S99-07367	5648552371	< 0.5	< 0.01	< 0.1	0.021	26.3	< 0.003	< 0.002	< 0.008	0.028	0.9	0.007	12.7	0.569	27.1	< 0.1	25.2	0.8	0.123	< 0.002	0.016
S99-07368	5648521481	1.1	< 0.01	< 0.1	0.039	60.8	< 0.003	< 0.002	< 0.008	2.45	2.8	0.011	19.4	0.978	18.8	< 0.1	31.6	26.8	0.17	< 0.002	0.04
S99-07369	5648542528	< 0.5	0.03	< 0.1	0.03	41.8	< 0.003	< 0.002	< 0.008	1.33	1.9	0.012	12.7	0.242	8.1	< 0.1	28.7	3.3	0.12	< 0.002	0.042
S99-07370	5648573801	< 0.5	< 0.01	< 0.1	0.05	57.8	< 0.003	< 0.002	< 0.008	2.2	2.7	< 0.004	16.9	0.488	25.2	< 0.1	27	4.3	0.187	< 0.002	0.017
S99-07371	5648584078	< 0.5	< 0.01	< 0.1	0.009	29.8	< 0.003	< 0.002	< 0.008	0.034	0.6	0.009	13.7	0.897	29.6	0.1	23.2	1.5	0.152	< 0.002	0.023
S99-07372	5644754512	< 0.5	< 0.01	< 0.1	0.009	41.4	< 0.003	< 0.002	< 0.008	0.092	1.3	< 0.004	17.8	1.33	39.1	0.1	24.3	4	0.205	0.002	0.017
S99-07373	5644713139	9.1	< 0.01	0.1	0.056	38.1	< 0.003	< 0.002	< 0.008	1.25	1.5	0.005	10.1	0.21	36.3	0.2	29.5	< 0.2	0.117	< 0.002	0.023
S99-07374	5644733209	2.2	< 0.01	0.1	0.065	66.6	< 0.003	< 0.002	< 0.008	2.3	2	0.019	15.6	0.38	52.4	0.1	26.6	0.7	0.184	< 0.002	0.016
S99-07375	5644774858	244	< 0.01	0.2	0.45	90.1	< 0.003	< 0.002	< 0.008	6.06	3	0.005	26	1	71.7	0.8	21.4	2.9	0.341	< 0.002	0.018
S99-07376	5644767602	164	< 0.01	0.1	0.078	30.8	< 0.003	< 0.002	< 0.008	1.36	1.9	0.008	10.7	0.732	57	0.6	20.2	1.5	0.118	< 0.002	0.036
S99-07377	5644788838	2.4	< 0.01	< 0.1	0.055	68.5	0.005	0.002	< 0.008	0.101	4	0.012	16.6	5.45	43.2	< 0.1	16.1	43.5	0.318	< 0.002	0.051
S99-07378	5644761432	14.2	< 0.01	< 0.1	0.039	39.6	< 0.003	< 0.002	0.013	1.9	1.1	0.004	13.3	0.26	30.9	0.4	32.1	0.3	0.176	< 0.002	0.044
S99-07379	5644740522	0.9	0.02	< 0.1	0.016	25.2	< 0.003	< 0.002	< 0.008	0.058	0.5	0.01	12.6	1.01	30.4	< 0.1	26.5	2.4	0.153	< 0.002	0.038
S99-07380	5644747795	4.7	< 0.01	1.2	0.112	72.7	< 0.003	< 0.002	< 0.008	1.76	3.3	0.022	18.6	0.346	237	0.2	24.7	< 0.2	0.263	< 0.002	0.016
S99-07381	5648671738	< 0.5	< 0.01	< 0.1	0.032	33.1	< 0.003	< 0.002	< 0.008	0.584	0.8	0.005	11.2	0.125	17.4	< 0.1	15.7	0.6	0.17	< 0.002	0.032
S99-07382	5648694357	0.7	< 0.01	< 0.1	0.042	40	< 0.003	< 0.002	< 0.008	1.15	1.9	0.005	9.28	0.234	28	< 0.1	29.6	0.5	0.163	< 0.002	0.017
S99-07383	5648694247	< 0.5	< 0.01	< 0.1	0.029	26.2	< 0.003	< 0.002	< 0.008	11	0.9	0.006	7.23	0.464	20.9	< 0.1	22.4	< 0.2	0.101	< 0.002	0.533

B National Hydrochemical Survey (extended suite)

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-02454	RIP0020	03-Dec-98	23.688	90.522	1990	STW	66	Z Hossain	Dhaka	Narayanganj	Shiddirganj	Shiddirganj	Shiddirganj
S98-02509	RIP1334	21-Apr-98	23.769	89.256	1989	STW	39	Md. Abdul Jalil	Khulna	Kushtia	Khoksa	Khoksa	Bhabanipur
S98-02614	RIP3246	17-May-98	23.039	91.52	1988	DTW	244	DPHE Office	Chittagong	Feni	Chhagalnaiya	Chhagalnaiya	Pa.chhagalnaiya
S98-02727	RIP0006	03-Sep-98	23.754	90.582	1995	STW	25	A Awal	Dhaka	Narayanganj	Sonargaon	Jampur	Singlaba
S98-02750	RIP0038	15-Mar-98	23.88	90.071	1996	STW	34	Md. Afaz Uddin	Dhaka	Manikganj	Manikganj Sadar	Krishnapur	Bora kafigram hi
S98-02752	RIP0040	15-Mar-98	23.802	90.02	1983	STW	18	Kalu Sarkar	Dhaka	Manikganj	Manikganj Sadar	Putail	Mid putail
S98-02789	RIP0090	21-Apr-98	23.92	90.139	1996	Tara	57	Riazuddin Master	Dhaka	Dhaka	Dhamrai	Sutipara	Sutipara
S98-02799	RIP0103	22-Apr-98	23.73	90.339	1996	STW	44	Md Babul	Dhaka	Dhaka	Keraniganj	Sakta	Ati
S98-02800	RIP0104	22-Apr-98	23.73	90.317	1997	STW	76	Mr Yakub Ali	Dhaka	Dhaka	Keraniganj	Taranagar	Baramandharia
S98-03040	RIP0627	06-Sep-98	23.545	90.499	1994	STW	53	Mohiuddin Dalal	Dhaka	Munshiganj	Munshiganj Sadar	Rampal	Gobindapur
S98-03114	RIP1063	23-Mar-98	22.862	89.556	1995	STW	56	Gobinda Chandra Sil	Khulna	Khulna	Dighalia	Senhati	Chandani mohal
S98-03249	RIP1220	04-Apr-98	23.401	89.6	1997	STW	72	Mohammadpur Bazar	Khulna	Magura	Mohammadpur (M)	Mohammadpur	Mohammadpur
S98-03308	RIP1289	04-Jan-98	22.469	89.605	1995	STW	13	Hosneara Begum	Khulna	Bagerhat	Mongla	Paurashava w03	Char salabunia
S98-03311	RIP1292	04-Feb-98	23.269	89.498	1997	STW	21	Nanda Dulal	Khulna	Narail	Narail Sadar	Habakhali	Harighara
S98-03312	RIP1295	04-Apr-98	23.581	89.444	1977	STW	49	Md. Yunus Ali	Khulna	Magura	Sreepur (M)	Sabdalpur	Naohata
S98-03416	RIP1425	04-Dec-98	23.24	89.097	1993	Tara	47	Md Abdur Rashid	Khulna	Jessore	Chaugachha	Phulsara	Atra
S98-03440	RIP1452	16-Apr-98	23.794	88.905	1997	STW	45	Mansur Ali	Khulna	Chuadanga	Alamdanga	Hardi	Hardi
S98-03620	RIP1660	05-Dec-98	23.099	90.483	1991	STW	30	Kodalpur Bazar	Dhaka	Shariatpur	Gosairhat	Kodalpur	Uttar Kodalpur
S99-01545	RIP7501	15-Dec-99	23.7497	90.3888		DTW	200	Well S170A	Dhaka	Dhaka	Dhaka		
S99-01546	RIP7502	15-Dec-99	23.726	90.3852		DTW	200	Azimpur colony (pump 7)	Dhaka	Dhaka	Dhaka		
S99-01547	RIP7503	15-Dec-99	23.7606	90.3637		DTW	200	Muhammadpur (pump 8)	Dhaka	Dhaka	Dhaka		
S99-01548	RIP7504	15-Dec-99	23.8017	90.3597		DTW	200	Inside BIBM compound	Dhaka	Dhaka	Dhaka		Mirpur
S99-01549	RIP7505	15-Dec-99	23.7985	90.4066		DTW	200	Banani Pump (pump 5)	Dhaka	Dhaka	Dhaka		
S99-01550	RIP7506	15-Dec-99	23.7405	90.4072		DTW	200	Circuit House	Dhaka	Dhaka	Dhaka		
S99-01551	RIP7507	15-Dec-99	23.7149	90.4287		DTW	200	Bay Edabad	Dhaka	Dhaka	Dhaka		

SAMPLE ID	GEOCODE	Al ug/L	Be ug/L	Cd ug/L	Ce ug/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	Dy ug/L	Er ug/L	Eu ug/L	Gd ug/L	Ho ug/L	La ug/L	Li ug/L	Lu ug/L	Mo ug/L	Nd ug/L	Ni ug/L
S98-02454	3678063773	15	< 0.05	< 0.02	0.027	7.2	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.021	2.3	< 0.005	0.8	0.02	5.9
S98-02509	4506347138	8	< 0.05	0.05	0.008	34.6		< 0.05	7	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.006	5.1	< 0.005	9.4	< 0.01	
S98-02614	2301428699	13	< 0.05	< 0.02	0.009	1.72		< 0.05	6	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.008	2.2	< 0.005	4.3	< 0.01	132
S98-02727	3670434921	4	< 0.05	0.51	0.078	5.89	< 0.5	< 0.05	1	0.01	0.02	< 0.006	< 0.01	< 0.005	0.022	6	< 0.005	< 0.1	< 0.01	23.6
S98-02750	3564671113	25	< 0.05	0.02	0.019	0.55	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.011	2.5	< 0.005	2.4	< 0.01	2.4
S98-02752	3564694646	11	< 0.05	0.03	0.024	0.4	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.011	2.4	< 0.005	1.6	0.02	2.4
S98-02789	3261494939	4	< 0.05	0.04	0.055	0.73	< 0.5	< 0.05	< 1	0.01	< 0.01	< 0.006	0.02	< 0.005	0.031	25	< 0.005	0.6	0.03	2.9
S98-02799	3263860057	12	< 0.05	0.04	0.031	4.59	< 0.5	< 0.05	2	< 0.01	0.01	< 0.006	< 0.01	< 0.005	0.007	2.2	< 0.005	1.1	< 0.01	5.9
S98-02800	3263877131	14	< 0.05	< 0.02	0.032	3.13	< 0.5	< 0.05	5	0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.016	2.4	< 0.005	2.8	0.01	10.4
S98-03040	3595685483		< 0.05	0.12	0.144	9.3	0.6	< 0.05	8	< 0.01	< 0.01	< 0.006	0.01	< 0.005	0.085	22.3	< 0.005	0.4	0.08	11.4
S98-03114	4474085236	8	< 0.05	0.08	0.017	1.02	< 0.5	< 0.05	< 1	< 0.01	0.01	< 0.006	< 0.01	< 0.005	0.006	23.8	< 0.005	0.4	< 0.01	2.4
S98-03249	4556652615	6	< 0.05	0.03	< 0.005	1.14	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	< 0.005	10.4	< 0.005	2.4	< 0.01	3.6
S98-03308	4015864408		< 0.05	< 0.02	0.587	2.76	1.4	0.19	2	0.05	0.05	< 0.006	0.07	0.013	0.261	9.4	0.007	1	0.27	7.6
S98-03311	4657640475	4	< 0.05	< 0.02	0.01	1.19	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	< 0.005	3.1	< 0.005	1.8	< 0.01	3.3
S98-03312	4559563683	4	< 0.05	0.07	0.018	1.41	< 0.5	< 0.05	5	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.009	2.3	< 0.005	2.3	< 0.01	2.5
S98-03416	4411177007	7	< 0.05	< 0.02	0.007	1.23	< 0.5	< 0.05	1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.006	2	< 0.005	2.7	< 0.01	2.5
S98-03440	4180747447	27	< 0.05	0.06	0.04	0.95	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.02	2.4	< 0.005	2	0.03	3.1
S98-03620	3863647994	6	< 0.05	0.04	< 0.005	1	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	< 0.01	< 0.005	0.007	3.5	< 0.005	3.8	< 0.01	5.1
S99-01545	3260	3	0.02	0.09	0.015	1.53	< 0.5	0.005	1	< 0.02	< 0.01	< 0.005	< 0.01	< 0.005	0.006	15.3	< 0.005	< 0.2	< 0.03	2.3
S99-01546	3260	5	< 0.01	0.04	0.022	0.3	2.4	< 0.005	1	< 0.02	< 0.01	< 0.005	< 0.01	< 0.005	0.012	6	< 0.005	< 0.2	< 0.03	2.1
S99-01547	3260	23	0.01	0.06	0.02	0.17	0.7	< 0.005	< 1	< 0.02	< 0.01	< 0.005	< 0.01	< 0.005	0.013	5.8	< 0.005	< 0.2	< 0.03	0.9
S99-01548	3260	5	0.05	0.03	0.007	0.2	8.6	0.005	2	< 0.02	< 0.01	< 0.005	< 0.01	< 0.005	< 0.005	9.9	< 0.005	< 0.2	< 0.03	1.1
S99-01549	3260	4	0.01	0.03	0.023	0.09	3.1	< 0.005	2	< 0.02	< 0.01	< 0.005	< 0.01	< 0.005	0.015	8.4	< 0.005	< 0.2	< 0.03	0.6
S99-01550	3260	4	0.03	0.02	0.008	0.21	3.2	< 0.005	1	< 0.02	< 0.01	< 0.005	< 0.01	< 0.005	0.006	9.4	< 0.005	< 0.2	< 0.03	1
S99-01551	3260	3	0.02	0.04	0.009	0.65	1	< 0.005	11	< 0.02	< 0.01	< 0.005	< 0.01	< 0.005	0.007	9.5	< 0.005	< 0.2	< 0.03	1.8

SAMPLE ID	Pb ug/L	Pr ug/L	Rb ug/L	Sb ug/L	Sm ug/L	Sn ug/L	Tb ug/L	Th ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-02454	0.15	< 0.005	0.4	< 0.02	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	4.25	0.3	0.023	< 0.008	8
S98-02509	0.76	< 0.005	0.6	0.07	< 0.01	0.3	< 0.005		< 0.01	< 0.005	5.59	< 0.2	0.059	< 0.008	94
S98-02614	0.16	< 0.005	1.9	0.04	< 0.01	0.1	< 0.005		< 0.01	< 0.005	0.05	< 0.2	0.017	< 0.008	62
S98-02727	0.12	< 0.005	0.1	0.02	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	0.03	1.6	0.227	< 0.008	9
S98-02750	0.11	< 0.005	0.9	< 0.02	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	7.12	< 0.2	0.027	< 0.008	4
S98-02752	0.1	< 0.005	0.5	0.02	0.01	0.6	< 0.005		< 0.01	< 0.005	6.61	< 0.2	0.04	< 0.008	4
S98-02789	0.27	0.006	0.2	< 0.02	0.01	< 0.1	< 0.005		< 0.01	< 0.005	1.97	0.7	0.123	0.012	10
S98-02799	0.09	< 0.005	0.4	< 0.02	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	1.11	1.6	0.055	0.01	10
S98-02800	0.33	< 0.005	2.3	0.03	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	1.44	4.2	0.073	0.016	16
S98-03040	10.8	0.017	1	0.13	0.02	0.3	< 0.005		< 0.01	< 0.005	5.44	1.3	0.18	0.015	30
S98-03114	0.77	< 0.005	< 0.1	0.02	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	11.6	2.1	0.116	0.01	3
S98-03249	0.47	< 0.005	0.2	0.06	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	0.29	0.5	0.044	< 0.008	4
S98-03308	0.64	0.068	10.2	0.16	0.05	< 0.1	0.01		< 0.01	< 0.005	2.63	2.1	0.32	0.029	83
S98-03311	0.1	< 0.005	0.4	< 0.02	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	2.1	2.4	0.086	< 0.008	9
S98-03312	0.48	< 0.005	0.4	0.03	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	0.7	2.4	0.065	< 0.008	6
S98-03416	0.45	< 0.005	0.4	0.07	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	0.34	2.4	0.037	< 0.008	40
S98-03440	0.58	< 0.005	1	0.03	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	4.03	2.2	0.089	0.009	16
S98-03620	0.1	< 0.005	2	0.03	< 0.01	< 0.1	< 0.005		< 0.01	< 0.005	3.68	< 0.2	0.018	< 0.008	4
S99-01545	0.21	< 0.005	0.4	< 0.01	< 0.01	0.2	< 0.005	< 0.01	< 0.01	< 0.005	0.3	1.8	0.03	< 0.02	13
S99-01546	0.28	< 0.005	0.7	0.01	< 0.01	< 0.1	< 0.005	< 0.01	< 0.01	< 0.005	0.42	1.2	0.07	< 0.02	20
S99-01547	0.37	< 0.005	0.5	0.02	< 0.01	< 0.1	< 0.005	< 0.01	< 0.01	< 0.005	0.16	1.5	0.02	< 0.02	5
S99-01548	0.23	< 0.005	0.6	0.06	< 0.01	< 0.1	< 0.005	< 0.01	< 0.01	< 0.005	0.02	1.1	0.01	< 0.02	97
S99-01549	0.2	< 0.005	0.5	< 0.01	< 0.01	< 0.1	< 0.005	< 0.01	< 0.01	< 0.005	0.03	1.5	< 0.01	< 0.02	13
S99-01550	0.17	< 0.005	0.5	0.01	< 0.01	0.3	< 0.005	< 0.01	< 0.01	< 0.005	0.04	1.3	< 0.01	< 0.02	6
S99-01551	0.42	< 0.005	0.7	0.02	< 0.01	0.2	< 0.005	< 0.01	< 0.01	< 0.005	0.97	1.2	0.03	< 0.02	6

C BWDB Water-Quality Monitoring Network survey

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	WELL TYPE	DEPTH m	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-01785	SAT-1	23/07/1998	26.479	88.514	HTW	9	Rajshahi	Panchagarh	Tetulia	Satmara	Satmara
S98-01786	130DA-2		25.7	88.5	HTW	15	Rajshahi	Panchagarh	Boda	Boda	Boda
S98-01787	TA-2/B	20/07/1998	24.088	90.17	HTW	37	Dhaka	Tangail	Mirzapur	Gurai	Gurai
S98-01788	BALI-3	23/07/1998	26.083	88.279	HTW	18	Rajshahi	Thakurgaon	Baliadangi	Baliadanga	Baliadanga
S98-01789	SALN-4	23/07/1998	26.054	88.533	HTW	37	Rajshahi	Thakurgaon	Thakurgaon Sadar	Salander	Salander
S98-01790	JA-4/B	19/07/1998	24.91	89.946	HTW	26	Dhaka	Jamalpur	Jamalpur Sadar	Jamalpur	Fulbaria
S98-01791	KABIR-5	24/07/1998	25.903	88.6	HTW	30	Rajshahi	Dinajpur	Birganj	Birgong	Kbirashat
S98-01792	RANI-6	23/07/1998	25.901	88.254	HTW	30	Rajshahi	Thakurgaon	Ranisankail	Ranisanwail	Ranisanwail
S98-01793	SIBRM-7	24/07/1998	25.665	88.652	HTW	18	Rajshahi	Dinajpur	Dinajpur Sadar	Sibrampur	Sibrampur
S98-01794	PARBT-8	24/07/1998	25.653	88.915	HTW	20	Rajshahi	Dinajpur	Parbatipur	Parbatipur	Parbatipur
S98-01795	HAKM-9	22/07/1998	25.288	89.021	HTW	21	Rajshahi	Dinajpur	Hakimpur	Hakimpur	Hakimpur
S98-01796	CHIL-10	25/07/1998	26.1	88.8	HTW	24	Rajshahi	Nilphamari	Domar	Chilahati	Chilahati
S98-01797	NIL-11	24/07/1998	25.9	88.8	HTW	18	Rajshahi	Nilphamari	Nilphamari Sadar	Nilphamari	Nilphamari
S98-01798	BRUT-12	25/07/1998	26.203	89.11	HTW		Rajshahi	Lalmonirhat	Hatibandha	Barakhta	Barakhta
S98-01799	JAL-13	25/07/1998	25.931	88.838	HTW	27	Rajshahi	Nilphamari	Jaldhaka	Jaldhaka	Jaldhaka
S98-01800	RANG-14	26/07/1998	25.752	89.253	HTW	18	Rajshahi	Rangpur	Rangpur Sadar	Rangipur	Rangipur
S98-01801	LALM-15	25/07/1998	25.913	89.436	HTW	14	Rajshahi	Lalmonirhat	Lalmonirhat Sadar	Lalmonihat	Lalmonihat
S98-01802	NAGUR-16	26/07/1998	25.965	89.671	HTW	18	Rajshahi	Kurigram	Nageshwari	Nagieshwari	Nagieshwari
S98-01803	ULI-17	26/07/1998	25.653	89.623	HTW	18	Rajshahi	Kurigram	Ulipur	Ulipur	Ulipur
S98-01804	BAMAN	26/07/1998	25.532	89.446		18	Rajshahi	Gaibandha	Sundarganj	Bamandaga	Bamandaga
S98-01805	BOA-19	27/07/1998	25.318	89.55	HTW	18	Rajshahi	Gaibandha	Gaibandha Sadar	Boalia	Boalia
S98-01806	GABIN-20	27/07/1998	25.134	89.387		12	Rajshahi	Gaibandha	Gobindaganj	Gabindagons	Gabindagons
S98-01807	MADR-21	22/07/1998	25.109	89.036	HTW	15	Rajshahi	Jaipurhat	Jaipurhat Sadar	Madergonj	Madergonj
S98-01808	SANTA-22	22/07/1998	24.804	88.969	HTW	18	Rajshahi	Bogra	Adamdighi	Santahar	Santahar
S98-01809	GIOKU-23	27/07/1998	24.933	89.348	HTW	18	Rajshahi	Bogra	Bogra Sadar	Giokul	Giokul
S98-01810	PATNI-29	22/07/1998	25.05	88.75	HTW	15	Rajshahi	Naogaon	Patnitala	Patnitala	Patnitala
S98-01811	MAND-25	22/07/1998	24.793	88.701	HTW	30	Rajshahi	Naogaon	Manda	Manda	Manda
S98-01812	PIR-25	27/07/1998	22.365	89.933			Barisal	Pirojpur	Mathbaria		Burirchar
S98-01813	RAHAN-26	21/07/1998	24.8	88.2	HTW	30	Rajshahi	Nawabganj	Gomastapur	Rahandur	Rahandur
S98-01814	PIR-26	27/07/1998	22.365	89.933	HTW	37	Barisal	Pirojpur	Mathbaria		Burirchar
S98-01815	SHIB-27	21/07/1998	24.684	88.157	Piez	61	Rajshahi	Nawabganj	Shibganj (N)	Shibgong	Shibgong
S98-01816	PIR-27	27/07/1998	22.365	89.933	HTW	27	Barisal	Pirojpur	Mathbaria		Burirchar
S98-01817	GIODA-28	21/07/1998	24.461	88.328	HTW	30	Rajshahi	Rajshahi	Godagari	Giodagari	Giodagari
S98-01818	SAPU-29	21/07/1998	24.374	88.558	HTW	37	Rajshahi	Rajshahi	Rajpara	Sapura	Sapura
S98-01819	CHAR-30	20/07/1998	24.304	88.738	HTW	18	Rajshahi	Rajshahi	Charghat	Charghat	Charghat
S98-01820	NAT-31	20/07/1998	24.414	89.988	HTW	27	Rajshahi	Natore	Natore Sadar	Natore	Natore
S98-01821	SING-32	20/07/1998	24.506	89.143	TARA	18	Rajshahi	Natore	Singra	Singra	Singra
S98-01822	LAL-33	20/07/1998	24.179	88.966	HTW	27	Rajshahi	Natore	Lalpur	Lalpur	Lalpur
S98-01823	ROYG-34	27/07/1998	24.507	89.526	HTW	15	Rajshahi	Sirajganj	Raiganj	Roygong	Roygong
S98-01824	SIRA-35	28/07/1998	24.463	89.708	HTW	18	Rajshahi	Sirajganj	Sirajganj Sadar	Sirjgong	Sirjgong
S98-01825	CHAT-36	20/07/1998	24.15	89.261	HTW	18	Rajshahi	Pabna	Chatmohar	Chatmohur	Chatmohur
S98-01826	PAB-37	19/07/1998	24.006	89.235	HTW	30	Rajshahi	Pabna	Pabna Sadar	Pabna	Pabna
S98-01827	SUJA-38	19/07/1998	23.94	89.408	HTW	18	Rajshahi	Pabna	Sujanagar	Sujanager	Sujanager
S98-01828	NAGIR-39	28/07/1998	23.951	89.65	HTW	20	Rajshahi	Pabna	Bera	Nagierbari	Nagierbari
S98-01829	JA-40	19/07/1998	25.156	89.751	HTW	27	Dhaka	Jamalpur	Dewanganj	Chukaibari	Batheshasaria
S98-01830	PRAG-40	19/07/1998	24.005	88.765	TARA	113	Khulna	Kushtia	Daulatpur (Ku)	Pragpur	Pragpur
S98-01831	HYM-41	18/07/1998	25.117	90.335		27	Dhaka	Mymensingh	Haluaghat	Haluagher	Haluaghatthana Compn
S98-01832	VHAR-41	19/07/1998	24.019	88.992	HTW		Khulna	Kushtia	Bheramara	Vharamara	Vharamara

SAMPLE ID	GEOCODE	As ug/L	Al ug/L	B mg/L	Ba mg/L	Be ug/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	Dy ug/L	Er ug/L	Eu ug/L	F mg/L
S98-01785	57790	1	7	< 0.01	0.031	0.05	13.6	0.28	0.013	30.6	0.18	< 0.5	0.6	1	0.01	< 0.01	< 0.006	0.07
S98-01786	57725	2.2	2	< 0.01	0.017	< 0.05	12.8	0.19	0.006	10	0.32	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.1
S98-01787	39366	1.1	14	< 0.01	0.031	< 0.05	28.8	< 0.02	0.031	2.5	0.56	< 0.5	< 0.05	3	< 0.01	< 0.01	< 0.006	0.34
S98-01788	59408	1.1	4	< 0.01	0.018	< 0.05	15.8	0.27	0.009	14.5	0.1	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.08
S98-01789	59494	< 0.5	4	< 0.01	0.016	< 0.05	9.24	0.12	0.007	14.2	0.18	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.03
S98-01790	33936	1.7	7	< 0.01	0.046	< 0.05	20.6	< 0.02	0.016	14.5	0.14	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.14
S98-01791	52712	< 0.5	2	< 0.01	0.015	< 0.05	13.7	0.12	0.007	16.7	0.28	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.06
S98-01792	59486	0.8	4	< 0.01	0.017	< 0.05	22.3	0.66	0.007	20.9	0.15	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.06
S98-01793	52764	< 0.5	8	< 0.01	0.007	< 0.05	4.55	0.16	0.01	6.6	< 0.05	0.7	< 0.05	4	< 0.01	< 0.01	< 0.006	0.08
S98-01794	52777	0.8	4	< 0.01	0.048	< 0.05	23.8	0.14	0.009	32.3	0.62	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.2
S98-01795	52747	0.9	3	0.02	0.016	< 0.05	21.9	0.08	0.007	21.2	0.58	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.07
S98-01796	57315	< 0.5	4	< 0.01	0.015	< 0.05	15.5	0.06	0.02	13.4	0.56	< 0.5	< 0.05	< 1	< 0.01	0.02	< 0.006	0.16
S98-01797	57364	1.9	3	< 0.01	0.022	< 0.05	13.8	0.02	0.005	32.9	0.53	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.007	0.19
S98-01798	55233	< 0.5	16	0.02	0.062	< 0.05	16.4	0.39	0.017	33.4	0.19	2.6	0.51	1	< 0.01	0.01	< 0.006	0.1
S98-01799	57336	< 0.5	3	< 0.01	0.006	< 0.05	8.09	0.06	0.005	3.1	0.09	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.07
S98-01800	58549	< 0.5	4	0.01	0.024	< 0.05	13.3	0.15	0.011	3.5	0.32	< 0.5	< 0.05	1	< 0.01	0.01	< 0.006	0.12
S98-01801	55255	4	4	< 0.01	0.034	< 0.05	9.19	0.09	0.038	8.1	0.13	0.6	0.08	1	0.02	0.02	0.007	0.12
S98-01802	54961	< 0.5	4	0.03	0.073	< 0.05	41.6	0.2	0.053	52.4	1.19	< 0.5	< 0.05	1	0.03	0.03	0.018	0.2
S98-01803	54994	0.6	5	< 0.01	0.024	< 0.05	19.7	0.08	0.011	7.7	0.52	< 0.5	< 0.05	< 1	< 0.01	0.01	< 0.006	0.2
S98-01804	53291	< 0.5	6	< 0.01	0.058	< 0.05	36.2	0.07	0.013	97	0.36	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.19
S98-01805	53224	< 0.5	3	< 0.01	0.044	< 0.05	28.9	< 0.02	0.005	26.5	0.13	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.33
S98-01806	53230	< 0.5	4	0.03	0.05	< 0.05	25.9	0.05	< 0.005	36.8	0.21	< 0.5	< 0.05	2	< 0.01	< 0.01	0.01	0.34
S98-01807	53847	< 0.5	2	< 0.01	0.023	< 0.05	21.8	0.16	0.005	8.5	0.33	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.3
S98-01808	51006	< 0.5	3	0.02	0.038	< 0.05	62.6	0.11	0.01	97.2	1.2	< 0.5	< 0.05	1	< 0.01	< 0.01	< 0.006	0.3
S98-01809	51020	< 0.5	15	0.01	0.006	< 0.05	11	0.08	0.014	4.9	0.42	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.32
S98-01810	56475	0.5	3	< 0.01	0.002	< 0.05	6.42	< 0.02	< 0.005	2.8	0.09	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.43
S98-01811	56447	0.5	4	< 0.01	0.008	< 0.05	10.7	0.05	0.006	3.4	0.38	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.21
S98-01812	17958	5.6		1.95	1.03	< 0.05	35	< 0.02	0.049	7140	0.21	1.2	0.15	3	0.02	0.03	< 0.006	< 0.01
S98-01813	57037	1	3	0.04	0.04	< 0.05	56.4	< 0.02	< 0.005	3.9	0.29	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.35
S98-01814	17958	1.4	13	0.83	0.625	< 0.05	105	0.09	0.037	9140	0.48	1.2	0.27	4	0.03	0.04	0.11	< 0.01
S98-01815	57088	0.6	4	0.03	0.115	< 0.05	137	0.03	0.01	9.1	1.18	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.31
S98-01816	17958	14.6		0.35	0.025	< 0.05	17.3	0.05	0.457	242	0.44	1.6	0.06	5	0.05	0.02	0.016	0.17
S98-01817	58134	0.5	3	0.01	0.027	< 0.05	37.3	< 0.02	0.006	6.9	0.15	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.006	0.44
S98-01818	58185	1.7	4	0.02	0.063	< 0.05	148	< 0.02	0.008	78	1.28	< 0.5	< 0.05	1	< 0.01	< 0.01	0.013	0.62
S98-01819	58125	< 0.5	4	0.02	0.098	< 0.05	138	0.02	0.01	2.9	0.51	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.011	0.23
S98-01820	56963	5.5	4	0.02	0.142	< 0.05	177	0.03	< 0.005	120	0.6	< 0.5	< 0.05	1	< 0.01	< 0.01	0.022	0.46
S98-01821	56991	< 0.5	3	0.02	0.09	< 0.05	159	0.03	0.008	126	0.89	< 0.5	< 0.05	1	< 0.01	< 0.01	0.015	0.15
S98-01822	56944	0.9	5	0.02	0.039	< 0.05	109	0.11	0.014	22.2	0.78	< 0.5	< 0.05	< 1	< 0.01	0.01	< 0.006	0.48
S98-01823	58861	12.3	4	0.01	0.026	< 0.05	22.6	0.06	0.009	4	0.13	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.73
S98-01824	58878	15.4	4	0.01	0.031	< 0.05	21.6	0.06	0.006	3.1	0.19	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.15
S98-01825	57622	3.5	3	0.03	0.061	< 0.05	108	0.03	0.01	7.5	0.59	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.01	0.4
S98-01826	57655	1.9	4	0.03	0.079	< 0.05	114	0.02	0.005	5	1.56	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.008	0.5
S98-01827	57683	1.1	5	0.03	0.056	< 0.05	91.5	0.07	0.014	7.9	1.45	< 0.5	< 0.05	< 1	0.01	0.01	< 0.006	0.39
S98-01828	57616	28.7	4	0.02	0.123	< 0.05	127	0.09	0.009	56.9	0.39	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.02	0.26
S98-01829	33915	82.5	12	0.02	0.14	< 0.05	37	< 0.02	0.017	26.6	0.21	< 0.5	0.16	< 1	< 0.01	< 0.01	0.017	0.3
S98-01830	45039	8.4	3	0.04	0.211	< 0.05	118	< 0.02	0.006	27.1	0.33	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.34
S98-01831	36124	34.9	4	< 0.01	0.059	< 0.05	19	< 0.02	0.008	2.3	0.12	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.5
S98-01832	45015	0.8	4	0.02	0.13	< 0.05	125	0.04	0.006	9.8	0.59	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.017	0.3

SAMPLE ID	Fe mg/L	Gd ug/L	HCO_3 mg/L	Ho ug/L	I mg/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S98-01785	0.06	< 0.01	34	< 0.005	0.0013	10.9	0.009	0.8	< 0.005	3.97	0.05	0.2	21.3	< 0.01	< 0.02	1.1	0.008	7.6
S98-01786	6.21	< 0.01	68	< 0.005	0.0021	2.2	< 0.005	0.7	< 0.005	4.09	0.323	0.2	7.1	< 0.01	< 0.02	1	0.004	< 0.2
S98-01787	1.48	< 0.01	215	< 0.005	0.0078	0.8	0.017	4.8	< 0.005	11	0.63	0.2	25.1	0.01	< 0.02	11.6	< 0.004	< 0.2
S98-01788	0.24	< 0.01	57	< 0.005	0.0012	2.6	0.011	0.7	< 0.005	4.22	0.032	< 0.1	11.7	< 0.01	< 0.02	1.4	0.018	3
S98-01789	1.38	< 0.01	17	< 0.005	0.0013	4.2	< 0.005	3.1	< 0.005	2.42	0.085	< 0.1	7.2	< 0.01	< 0.02	0.8	0.079	3.9
S98-01790	0.26	< 0.01	127	< 0.005	0.0028	0.9	0.011	1	< 0.005	7.25	0.102	< 0.1	19.5	< 0.01	< 0.02	2.4	< 0.004	< 0.2
S98-01791	0.17	< 0.01	56	< 0.005	0.001	1.6	< 0.005	2.2	< 0.005	6.57	0.142	< 0.1	9.9	< 0.01	< 0.02	1	0.008	3.3
S98-01792	0.293	< 0.01	37	< 0.005	0.006	3.4	< 0.005	3	< 0.005	7.49	0.029	< 0.1	10.1	< 0.01	< 0.02	1.7	0.028	12.5
S98-01793	0.027	< 0.01	60	< 0.005	0.008	2.6	0.009	0.3	< 0.005	2.07	0.008	< 0.1	23	< 0.01	< 0.02	0.9	< 0.004	2.8
S98-01794	1.65	< 0.01	120	< 0.005	0.0046	2.5	< 0.005	2	< 0.005	10.2	0.647	0.1	23.8	< 0.01	< 0.02	1.3	< 0.004	< 0.2
S98-01795	0.224	< 0.01	106	< 0.005	0.003	1.6	< 0.005	2.4	< 0.005	9.01	0.469	< 0.1	14.5	< 0.01	< 0.02	3.3	< 0.004	1.4
S98-01796	0.356	< 0.01	95	< 0.005	0.016	2.8	0.012	0.8	< 0.005	3.74	6.2	< 0.1	12.1	< 0.01	< 0.02	0.7	< 0.004	< 0.2
S98-01797	0.837	< 0.01	46	< 0.005	0.0051	2.7	< 0.005	3	< 0.005	4.31	1.48	0.4	25.4	< 0.01	0.37	0.8	0.004	< 0.2
S98-01798	0.271	< 0.01	37	< 0.005	0.0024	13.6	0.009	0.3	< 0.005	2.67	0.212	0.5	14	0.01	< 0.02	1.2	0.015	8.3
S98-01799	0.018	< 0.01	44	< 0.005	< 0.0008	2.4	< 0.005	0.2	< 0.005	1.01	0.222	< 0.1	6.2	< 0.01	< 0.02	0.5	< 0.004	< 0.2
S98-01800	0.988	< 0.01	31	< 0.005	0.0013	7	0.02	0.6	< 0.005	2.24	0.133	0.3	10.1	0.02	< 0.02	2.4	0.023	3.3
S98-01801	9.07	< 0.01	46	< 0.005	0.0021	4	0.019	0.7	< 0.005	2.27	0.691	0.6	7.3	0.03	< 0.02	1.3	< 0.004	< 0.2
S98-01802	0.182	0.03	187	0.01	0.0057	9.3	0.05	1.6	< 0.005	14	1.96	< 0.1	33.3	0.06	< 0.02	3	0.015	2.9
S98-01803	2.13	< 0.01	122	< 0.005	0.0038	2.3	0.008	3	< 0.005	9.61	0.242	0.2	12.1	< 0.01	< 0.02	2	0.012	0.3
S98-01804	0.084	< 0.01	145	< 0.005	< 0.0008	14.4	0.01	0.5	< 0.005	12.2	0.179	1.4	56.5	0.01	< 0.02	1.5	0.012	0.6
S98-01805	0.054	< 0.01	182	< 0.005	< 0.0008	2	< 0.005	3.4	< 0.005	17.1	0.478	0.4	18.5	< 0.01	< 0.02	1.1	0.044	< 0.2
S98-01806	0.016	0.01	140	< 0.005	0.0017	16.7	< 0.005	0.9	< 0.005	9.42	0.067	1.9	26.5	< 0.01	< 0.02	1.5	< 0.004	1.5
S98-01807	0.976	< 0.01	146	< 0.005	0.0034	1.3	< 0.005	6.9	< 0.005	11.8	0.566	< 0.1	12.6	< 0.01	< 0.02	1.6	< 0.004	< 0.2
S98-01808	0.04	< 0.01	251	< 0.005	0.0195	0.9	0.008	12.4	< 0.005	24.7	0.435	< 0.1	68.1	< 0.01	< 0.02	7.5	0.009	3.2
S98-01809	0.023	< 0.01	100	< 0.005	0.0028	0.7	< 0.005	1.4	< 0.005	6.48	1.53	< 0.1	15.2	< 0.01	< 0.02	1.1	< 0.004	< 0.2
S98-01810	0.08	< 0.01	65	< 0.005	0.0028	0.4	< 0.005	1	< 0.005	3.35	0.131	< 0.1	13.4	< 0.01	< 0.02	2.1	< 0.004	< 0.2
S98-01811	0.354	< 0.01	97	< 0.005	0.0426	0.5	< 0.005	2.4	< 0.005	5.1	0.381	< 0.1	16.4	< 0.01	< 0.02	8	< 0.004	< 0.2
S98-01812	0.078	0.02	165	< 0.005	5.84	33.2	0.034	24.8	< 0.005	1.83	0.006	0.6	4970	0.02	7.2	1.5	0.007	< 0.2
S98-01813	1.24	< 0.01	347	< 0.005	0.0878	0.9	< 0.005	6.9	< 0.005	13.7	0.072	0.2	44.2	< 0.01	< 0.02	2.1	< 0.004	< 0.2
S98-01814	0.086	0.02	96	0.016	2.72	126	0.046	28.8	0.012	283	0.044	0.8	5450	0.04	28.7	4	0.561	0.5
S98-01815	0.03	< 0.01	512	< 0.005	0.0189	2.4	0.006	16.6	< 0.005	42.2	0.662	0.6	63.7	< 0.01	< 0.02	3.4	< 0.004	< 0.2
S98-01816	0.426	0.03	569	0.007	0.061	6.8	0.204	3.3	< 0.005	17.9	0.131	3.8	317	0.19	< 0.02	2.2	< 0.004	0.8
S98-01817	0.174	< 0.01	242	< 0.005	0.0113	0.6	< 0.005	5	< 0.005	9.71	0.103	0.2	33.9	< 0.01	< 0.02	1.5	< 0.004	< 0.2
S98-01818	0.014	< 0.01	396	< 0.005	0.0225	1.7	< 0.005	4.5	< 0.005	36.2	2.54	1.6	40.7	< 0.01	< 0.02	4.5	< 0.004	< 0.2
S98-01819	0.03	< 0.01	399	< 0.005	0.0298	2	0.006	10.8	< 0.005	30.5	1.28	0.9	26.8	< 0.01	< 0.02	3.5	< 0.004	< 0.2
S98-01820	0.032	< 0.01	392	< 0.005	0.0473	3.4	0.006	8	< 0.005	42.6	0.766	0.5	38.5	< 0.01	< 0.02	5.5	< 0.004	< 0.2
S98-01821	0.037	< 0.01	361	< 0.005	0.0316	1	0.005	10.7	< 0.005	40.8	0.846	0.2	55	< 0.01	< 0.02	4.7	< 0.004	< 0.2
S98-01822	0.036	< 0.01	410	< 0.005	0.0179	1.3	0.006	8.9	< 0.005	30.2	0.492	0.8	22.9	< 0.01	< 0.02	3.9	< 0.004	< 0.2
S98-01823	3.99	< 0.01	143	< 0.005	0.0013	1	0.007	2.7	< 0.005	10.7	0.648	0.7	10.3	< 0.01	0.15	1	0.014	< 0.2
S98-01824	0.397	< 0.01	135	< 0.005	0.0024	3.1	< 0.005	1.9	< 0.005	11.5	0.626	0.8	4.6	< 0.01	< 0.02	1	< 0.004	< 0.2
S98-01825	0.044	0.01	626	< 0.005	0.0505	1.6	0.006	11.3	< 0.005	38	0.602	0.5	40.8	< 0.01	< 0.02	3.1	< 0.004	< 0.2
S98-01826	0.151	< 0.01	399	< 0.005	0.0512	2.8	< 0.005	15.4	< 0.005	25.6	0.493	0.6	38.1	< 0.01	< 0.02	8.9	< 0.004	< 0.2
S98-01827	0.061	< 0.01	475	< 0.005	0.197	1.2	0.005	3.4	< 0.005	35	1.5	0.4	39.8	< 0.01	< 0.02	3	< 0.004	< 0.2
S98-01828	3.75	< 0.01	409	< 0.005	0.0277	2.3	< 0.005	4	< 0.005	32.5	2.21	1.8	17	< 0.01	< 0.02	3.5	0.094	0.7
S98-01829	15.8	0.01	164	< 0.005	0.0017	2.4	0.013	4.6	< 0.005	12.5	0.322	0.8	8.7	0.01	2.51	1.7	< 0.004	< 0.2
S98-01830	0.015	< 0.01	417	< 0.005	0.0515	4.6	< 0.005	2.6	< 0.005	36.4	0.414	0.2	22.6	< 0.01	< 0.02	3.3	< 0.004	< 0.2
S98-01831	0.791	< 0.01	177	< 0.005	0.0153	1.3	0.009	3.8	< 0.005	8.28	0.526	1.7	27.9	< 0.01	< 0.02	0.8	< 0.004	< 0.2
S98-01832	0.017	< 0.01	379	< 0.005	0.031	1.9	0.007	10.1	< 0.005	31.5	0.614	1.5	18.6	< 0.01	< 0.02	3.5	< 0.004	< 0.2

SAMPLE ID	P mg/L	Pb ug/L	Pr ug/L	Rb ug/L	Sb ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	Tb ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-01785	< 0.2	2.58	< 0.005	32	0.05	12.3	< 0.01	1	9.7	0.0786	< 0.005	0.06	< 0.005	0.16	< 0.2	0.03	< 0.008	10
S98-01786	< 0.2	0.5	< 0.005	5.7	< 0.02	22	< 0.01	0.8	2.4	0.071	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.006	< 0.008	22
S98-01787	< 0.2	0.43	0.006	0.7	0.03	25.1	< 0.01	1.9	1.1	0.18	< 0.005	< 0.01	< 0.005	0.48	3	0.029	< 0.008	20
S98-01788	< 0.2	2.84	< 0.005	1	< 0.02	11.5	< 0.01	1.3	6.3	0.0545	< 0.005	< 0.01	< 0.005	0.07	< 0.2	0.068	< 0.008	58
S98-01789	< 0.2	0.78	< 0.005	1.7	< 0.02	15.5	< 0.01	0.8	4.4	0.0477	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.028	< 0.008	14
S98-01790	0.2	2.95	< 0.005	0.3	0.04	26.6	< 0.01	1	1.9	0.18	< 0.005	< 0.01	< 0.005	< 0.01	3.1	0.009	< 0.008	66
S98-01791	< 0.2	0.65	< 0.005	0.3	< 0.02	15.1	< 0.01	1.2	1.6	0.078	< 0.005	< 0.01	< 0.005	0.05	< 0.2	0.01	< 0.008	17
S98-01792	< 0.2	1.23	< 0.005	0.3	< 0.02	15.1	< 0.01	0.7	4.8	0.0951	< 0.005	< 0.01	< 0.005	0.15	< 0.2	0.022	< 0.008	
S98-01793	< 0.2	2.37	< 0.005	0.9	< 0.02	8.05	< 0.01	1.3	4.5	0.0199	< 0.005	< 0.01	< 0.005	0.03	0.6	0.042	< 0.008	14
S98-01794	< 0.2	0.97	< 0.005	8.2	< 0.02	22	< 0.01	1.3	15.4	0.157	< 0.005	0.02	< 0.005	0.05	< 0.2	0.01	< 0.008	23
S98-01795	< 0.2	0.16	< 0.005	0.2	< 0.02	12.7	< 0.01	1	7.3	0.188	< 0.005	< 0.01	< 0.005	0.02	0.6	0.042	< 0.008	21
S98-01796	< 0.2	0.24	< 0.005	0.2	< 0.02	12.9	0.01	1.5	< 0.2	0.115	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.204	0.012	13
S98-01797	< 0.2	0.33	< 0.005	2.7	0.03	15.8	< 0.01	1.3	4.3	0.0652	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.011	0.014	3
S98-01798	< 0.2	7.58	< 0.005	38.2	0.11	8.12	< 0.01	1.3	6.9	0.0693	< 0.005	0.11	< 0.005	0.27	0.8	0.039	0.01	12
S98-01799	< 0.2	0.35	< 0.005	3.5	0.03	9.56	< 0.01	0.8	1.6	0.0356	< 0.005	0.03	< 0.005	0.17	0.8	0.008	< 0.008	11
S98-01800	< 0.2	0.71	< 0.005	5.4	0.27	11.5	< 0.01	1.4	27.6	0.0248	< 0.005	0.01	< 0.005	0.07	< 0.2	0.103	0.013	96
S98-01801	0.5	1.31	0.005	14.3	0.03	11.7	0.01	1.5	3.1	0.0463	< 0.005	0.05	< 0.005	0.01	0.3	0.109	0.008	20
S98-01802	< 0.2	0.8	0.011	0.2	0.05	14.2	< 0.01	1.1	13.7	0.201	< 0.005	< 0.01	< 0.005	0.41	0.4	0.296	0.026	17
S98-01803	< 0.2	0.96	< 0.005	0.6	0.04	16.8	< 0.01	1.1	6.5	0.0806	< 0.005	< 0.01	< 0.005	0.12	0.7	0.02	< 0.008	10
S98-01804	< 0.2	1.06	< 0.005	0.2	0.05	9.53	< 0.01	0.9	21.1	0.114	< 0.005	< 0.01	< 0.005	3.13	0.6	0.049	< 0.008	
S98-01805	< 0.2	0.34	< 0.005	2.3	0.02	17.5	< 0.01	1.7	2.2	0.098	< 0.005	< 0.01	< 0.005	0.1	< 0.2	0.007	< 0.008	7
S98-01806	< 0.2	0.48	< 0.005	0.5	0.03	12.6	< 0.01	1.1	11.5	0.0787	< 0.005	< 0.01	< 0.005	0.68	1	0.024	0.016	7
S98-01807	< 0.2	0.23	< 0.005	4.4	< 0.02	25.4	< 0.01	3.3	2.7	0.114	< 0.005	0.01	< 0.005	0.02	< 0.2	0.006	< 0.008	91
S98-01808	< 0.2	0.39	< 0.005	0.2	0.03	20.4	0.01	0.9	48.8	0.266	< 0.005	< 0.01	< 0.005	0.34	1.3	0.083	< 0.008	42
S98-01809	< 0.2	0.58	< 0.005	< 0.1	< 0.02	20.1	< 0.01	1.3	3.2	0.0872	< 0.005	< 0.01	< 0.005	0.02	1.5	0.022	< 0.008	19
S98-01810	< 0.2	0.2	< 0.005	< 0.1	0.02	17.5	< 0.01	1.1	2.2	0.0289	< 0.005	< 0.01	< 0.005	0.01	1.5	0.008	< 0.008	14
S98-01811	0.2	0.34	< 0.005	< 0.1	< 0.02	20.7	< 0.01	1.7	0.7	0.0723	< 0.005	< 0.01	< 0.005	0.03	1.1	0.017	< 0.008	50
S98-01812	5.3	1.5	0.008	19.4	0.23	0.19	0.02	0.5	0.6	4.01	< 0.005	0.3	0.006	0.02	0.6	0.066	0.011	
S98-01813	0.2	0.27	< 0.005	0.3	< 0.02	19.2	< 0.01	2.4	6.2	0.243	< 0.005	< 0.01	< 0.005	1.11	< 0.2	0.008	< 0.008	78
S98-01814	1.1	0.65	0.017	11.1	0.17	0.08	0.05	0.7	< 0.2	2.39	0.016	8.76	0.011	0.03	< 0.2	0.056	0.014	71
S98-01815	0.2	0.23	< 0.005	0.4	0.03	15.8	< 0.01	1.4	46.4	0.461	< 0.005	< 0.01	< 0.005	6	1.4	0.062	< 0.008	11
S98-01816	7.9	1.49	0.053	3.1	0.13	19.7	0.06	0.8	12.3	0.146	0.007	0.14	< 0.005	0.18	3.2	0.193	0.021	58
S98-01817	< 0.2	0.19	< 0.005	0.2	< 0.02	19.7	< 0.01	1.2	5.2	0.173	< 0.005	< 0.01	< 0.005	0.29	3.4	0.007	< 0.008	7
S98-01818	< 0.2	0.26	< 0.005	0.2	< 0.02	16.1	< 0.01	0.9	14.9	0.476	< 0.005	< 0.01	< 0.005	6.84	2.1	0.109	0.009	20
S98-01819	< 0.2	0.2	< 0.005	7.1	< 0.02	17.9	< 0.01	1.2	1.8	0.371	< 0.005	0.02	< 0.005	3.63	< 0.2	0.088	< 0.008	13
S98-01820	< 0.2	0.21	< 0.005	1.2	0.04	17	0.02	0.8	11.9	0.831	< 0.005	< 0.01	< 0.005	7.16	0.3	0.035	< 0.008	
S98-01821	< 0.2	0.16	< 0.005	0.2	0.03	18	< 0.01	1.1	31	0.361	< 0.005	< 0.01	< 0.005	7.27	0.9	0.079	< 0.008	19
S98-01822	< 0.2	0.72	< 0.005	< 0.1	0.04	15.7	< 0.01	0.9	2.4	0.291	< 0.005	< 0.01	< 0.005	0.59	2.3	0.104	< 0.008	30
S98-01823	< 0.2	0.39	< 0.005	2.6	< 0.02	21.6	< 0.01	1.2	1	0.0687	< 0.005	< 0.01	< 0.005	< 0.01	< 0.2	0.006	< 0.008	
S98-01824	< 0.2	0.88	< 0.005	1.7	< 0.02	15.5	< 0.01	1.5	0.2	0.0781	< 0.005	< 0.01	< 0.005	0.01	< 0.2	0.008	< 0.008	8
S98-01825	< 0.2	0.17	< 0.005	< 0.1	< 0.02	19.4	< 0.01	1.4	4.7	0.526	< 0.005	< 0.01	< 0.005	7.93	1.7	0.14	0.015	
S98-01826	< 0.2	0.17	< 0.005	0.1	0.31	16.8	0.01	1.4	0.6	0.447	< 0.005	< 0.01	< 0.005	8.38	2.6	0.038	< 0.008	6
S98-01827	0.3	0.19	< 0.005	0.1	< 0.02	20.3	< 0.01	1.3	< 0.2	0.391	< 0.005	< 0.01	< 0.005	5.27	2.6	0.12	0.008	23
S98-01828	< 0.2	0.71	< 0.005	3.1	0.03	18.6	< 0.01	1.1	0.7	0.338	< 0.005	< 0.01	< 0.005	0.04	< 0.2	0.014	< 0.008	15
S98-01829	1.6	0.38	< 0.005	2.9	< 0.02	26.5	0.01	2.5	< 0.2	0.169	< 0.005	< 0.01	< 0.005	< 0.01	< 0.2	0.017	< 0.008	
S98-01830	< 0.2	0.21	< 0.005	1.1	< 0.02	11.1	< 0.01	1.1	13.8	0.364	< 0.005	< 0.01	< 0.005	8.12	< 0.2	0.011	< 0.008	15
S98-01831	0.4	0.48	< 0.005	2.2	0.03	18.4	< 0.01	1.3	< 0.2	0.114	< 0.005	< 0.01	< 0.005	0.01	< 0.2	0.009	< 0.008	21
S98-01832	< 0.2	0.18	< 0.005	0.3	0.03	18.4	< 0.01	1.1	14.6	0.338	< 0.005	< 0.01	< 0.005	0.51	< 0.2	0.072	< 0.008	9

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	WELL TYPE	DEPTH m	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-01833	KUST-42	19/07/1998	23.909	89.128	HTW	49	Khulna	Kushtia	Kushtia Sadar	Kushtia	Kushtia
S98-01834	SHER-42/A	18/07/1998	25.018	90.012	HTW	36	Rajshahi	Bogra	Sherpur	Sherpur	
S98-01835	MEHER-43	19/07/1998	23.761	88.632	HTW	27	Khulna	Meherpur	Meherpur Sadar	Meherpur	Meherpur
S98-01836	JAM-43	20/07/1998	24.758	89.835	HTW	20	Dhaka	Jamalpur	Sarishabari	Sharishabari	Sharishabari
S98-01837	DAR-44	19/07/1998	23.529	88.81	HTW	18	Khulna	Chuadanga	Chuadanga Sadar	Darsana	Darsana
S98-01838	MYM-44	17/07/1998	24.748	90.406	DTW	107	Dhaka	Mymensingh	Mymensingh Sadar	Sadar	Bagmera
S98-01839	JHIN-45	18/07/1998	23.547	89.165		122	Khulna	Jhenaidah	Jhenaidah Sadar	Jhinaidha	Jhinaidha
S98-01840	NET-45	17/07/1998	24.866	90.722	HTW	65	Dhaka	Netrokona	Netrokona Sadar	Sadar	Netrokona
S98-01841	MAGU-46	15/07/1998	23.488	89.429	HTW	21	Khulna	Magura	Magura Sadar	Magura	Magura
S98-01842	KISH-46	18/07/1998	24.444	90.773	DTW	118	Dhaka	Kishoreganj	Kishoreganj Sadar	Goital	Kishorgorj
S98-01843	JES-47	18/07/1998	23.167	89.219	DTW	133	Khulna	Jessore	Jessore Sadar	Jessore	Jessore
S98-01844	MYM-47	17/07/1998	24.454	90.54	HTW		Dhaka	Mymensingh	Gafargaon	Saltia	Sulhasia
S98-01845	NAR-48	18/07/1998	23.173	89.513	HTW	24	Khulna	Narail	Narail Sadar	Narail	Narail
S98-01846	KISH-48	18/07/1998	24.047	90.973	HTW	20	Dhaka	Kishoreganj	Bhairab	Bhairab	Bhairab Rly St
S98-01847	GODKHA-49	15/07/1998	23.059	89.077	HTW	24	Khulna	Jessore	Jhikargachha	Godkhali	Godkhali
S98-01848	TA-49	20/07/1998	24.605	90.024	HTW	34	Dhaka	Tangail	Madhupur	Madhupur	Madhupur
S98-01849	KHUL-50	15/07/1998	22.812	89.561	DTW	274	Khulna	Khulna	Khulna Sadar	Khulna	Khulna
S98-01850	TA-50	20/07/1998	24.24	89.909	HTW	27	Dhaka	Tangail	Tangail Sadar	Sadar	Bepari Para
S98-01851	SATKHR-51	17/07/1998	22.718	89.07	DTW	183	Khulna	Satkhira	Satkhira Sadar	Satkhira	Satkhira
S98-01852	TA-51	20/07/1998	24.108	90.076	HTW	27	Dhaka	Tangail	Mirzapur	Baithgram	Gurail
S98-01853	CHAL-52	18/07/1998	22.586	89.504	HTW	18	Khulna	Bagerhat	Bagerhat Sadar	Chalna	Chalna
S98-01854	GA-52	17/07/1998	24.197	90.474	HTW	29	Dhaka	Gazipur	Sripur	Sreepur	Sreepur
S98-01855	BAGIER-53	15/07/1998	22.663	89.763		38	Khulna	Bagerhat	Bagerhat Sadar	Bagierhat	Bagierhat
S98-01856	NAR-53	18/07/1998	23.926	90.718	HTW		Dhaka	Narsingdi	Narsingdi Sadar	Narshingdi	Norshindi Dak Hangloo
S98-01857	KHALIS-54	18/07/1998	22.548	89.538	DTW	274	Khulna	Khulna	Khulna Sadar	Khalishpur	Khalishpur
S98-01858	DA-54	16/07/1998	23.734	90.418	DTW	137	Dhaka	Dhaka	Motijheel	Motijheel	Pwd Colony
S98-01859	RJB-69	22/07/1998	23.765	89.476	HTW	22	Dhaka	Rajbari	Pangsha		Kalukhau
S98-01860	RJB-70	22/07/1998	23.754	89.645	DTW	127	Dhaka	Rajbari	Rajbari Sadar		Municipality
S98-01861	FAR-71	23/07/1998	23.599	89.835	DTW	84	Dhaka	Faridpur	Faridpur Sadar		Municipal
S98-01862	GOP-72	23/07/1998	23.21	89.693	HTW	20	Dhaka	Gopalganj	Kashiani		Bhatiapara
S98-01863	GOP-73	23/07/1998	23.005	89.823	HTW	20	Dhaka	Gopalganj	Gopalganj Sadar	Municipality	Gopalganj
S98-01864	MAD-74	23/07/1998	23.167	90.195	DTW	238	Dhaka	Madaripur	Madaripur Sadar	Municipality	Madaripur
S98-01865	BAR-75	25/07/1998	22.7	90.369	DTW	610	Barisal	Barisal	Barisal Sadar		Barisal
S98-01866	PAT-77	25/07/1998	22.355	90.345	DTW	274	Barisal	Patuakhali	Patuakhali Sadar	Municipality	Patuakhali
S98-01867	DA-101	21/07/1998	23.51	90.217	HTW	26	Dhaka	Munshiganj	Munshiganj Sadar	Bhaishakul	Bhaishakul T Inst
S98-01868	DA-102	16/07/1998	23.769	90.364	DTW	53	Dhaka	Dhaka	Mohammadpur (D)	Mohammedpur	Mohammedpur
S98-04510	GOHI-44	29/07/1998	22.1467	91.8231	Piez	265	Chittagong	Chittagong	Anowara	Gohira	UC Office
S98-04511	RUST-45	29/07/1998	22.1924	91.8562	HTW	146	Chittagong	Chittagong	Anowara	Battali	Battali
S98-04512	GOHI-46	29/07/1998	22.1467	91.8231	Piez	68	Chittagong	Chittagong	Anowara	Gohira	UC Office
S98-04513	COM-84	28/07/1998	23.4453	91.1722	HTW	32	Chittagong	Comilla	Comilla Sadar	Shaktala	Shaktala
S98-04514	DAUD-85	28/07/1998	23.536	90.7104	HTW	32	Chittagong	Comilla	Daudkandi	Daudkandi	Daudkandi Bazar
S98-04515	LAKS-86	28/07/1998	23.2499	91.115	HTW	23	Chittagong	Comilla	Laksam	Nabaratpur	Nabaratpur
S98-04516	HAJ-87	31/07/1998	23.2484	90.8696	DTW	107	Chittagong	Chandpur	Hajiganj	Aligonj	Aligonj H complex
S98-04517	CHAN-88	31/07/1998	23.2342	90.6673	HTW	168	Chittagong	Chandpur	Chandpur Sadar	Shologhar	Shologhar
S98-04518	NOA-89	28/07/1998	22.8334	91.0955	HTW	11	Chittagong	Noakhali	Noakhali Sadar	Sonapur	Sonapur
S98-04519	FENI-90	28/07/1998	23.0053	91.3866	HTW	13	Chittagong	Feni	Feni Sadar	Pachgadria	Feni Rest House
S98-04520	MIR-91	28/07/1998	22.7761	91.5656	HTW	25	Chittagong	Chittagong	Mirsharai	PS	Miraswarai
S98-04521	CTG-92	29/07/1998	22.4735	91.7891	DTW	110	Chittagong	Chittagong	Hathazari	Hathajani	University

SAMPLE ID	GEOCODE	As ug/L	Al ug/L	B mg/L	Ba mg/L	Be ug/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	Dy ug/L	Er ug/L	Eu ug/L	F mg/L
S98-01833	45079	< 0.5	4	0.02	0.046	< 0.05	102	0.07	0.008	2.6	0.64	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.009	0.29
S98-01834	51088	27.8	4	0.02	0.127	< 0.05	41	< 0.02	0.014	45.9	0.38	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.015	0.24
S98-01835	45787	17.7	3	0.04	0.126	< 0.05	106	< 0.02	< 0.005	22.6	0.31	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.011	0.13
S98-01836	33985	1.4	6	0.02	0.051	< 0.05	36.1	0.03	0.024	41.3	0.61	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.007	0.22
S98-01837	41823	5.7	7	0.1	0.363	< 0.05	183	0.04	0.029	202	0.53	< 0.5	< 0.05	2	< 0.01	< 0.01	< 0.006	0.03
S98-01838	36152	4.2	3	< 0.01	0.063	< 0.05	28.4	< 0.02	0.007	1.5	0.16	< 0.5	< 0.05	1	< 0.01	< 0.01	< 0.006	0.42
S98-01839	44419	35.6	29	0.02	0.106	< 0.05	69.5	0.04	0.017	4	0.29	0.5	< 0.05	2	< 0.01	< 0.01	< 0.006	0.27
S98-01840	37274	1.8	3	< 0.01	0.012	< 0.05	37.8	< 0.02	0.009	39.8	0.15	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.38
S98-01841	45557	17	4	0.03	0.192	< 0.05	132	0.02	0.01	27.3	0.59	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.33
S98-01842	34849	13.6	5	0.02	0.056	< 0.05	22.9	< 0.02	0.009	2.4	0.28	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.3
S98-01843	44147	40.8	4	0.03	0.128	< 0.05	113	< 0.02	0.013	77.3	0.38	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.24
S98-01844	36122	2.7	3	< 0.01	0.025	< 0.05	33.4	< 0.02	0.012	2.7	0.11	< 0.5	< 0.05	< 1	< 0.01	< 0.01	0.007	0.44
S98-01845	46576	3.4	5	0.12	0.056	< 0.05	63.6	< 0.02	0.007	260	0.55	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.54
S98-01846	34811	120	5	0.02	0.075	< 0.05	69.8	< 0.02	0.009	2.7	0.4	< 0.5	< 0.05	< 1	< 0.01	< 0.01	< 0.006	0.19
S98-01847	44123	32.5	3	0.01	0.143	< 0.05	95.2	0.04	< 0.005	16.1	0.31	< 0.5	< 0.05	1	< 0.01	< 0.01	0.03	0.15
S98-01848	39357	7.5	11	< 0.01	0.011	< 0.05	16.6	< 0.02	0.031	1.3	0.43	< 0.5	< 0.05	2	< 0.01	< 0.01	< 0.006	0.23
S98-01849	44751	< 0.5	6	0.16	0.137	< 0.05	44.6	< 0.02	0.02	168	0.13	< 0.5	0.1	1	< 0.01	< 0.01	< 0.006	0.14
S98-01850	39395	77.6	11	0.02	0.102	< 0.05	48.1	< 0.02	0.027	20	0.25	< 0.5	< 0.05	1	0.01	< 0.01	0.012	0.27
S98-01851	48782	11.8	2	0.05	0.597	< 0.05	166	< 0.02	< 0.005	311	0.55	< 0.5	0.07	1	< 0.01	< 0.01	0.093	0.08
S98-01852	39366	16.8	15	0.03	0.09	< 0.05	32.3	< 0.02	0.025	5.8	0.14	< 0.5	0.06	2	< 0.01	< 0.01	< 0.006	0.4
S98-01853	40108	1.4	5	0.72	0.061	< 0.05	31.1	< 0.02	0.008	1160	0.25	< 0.5	0.14	< 1	< 0.01	< 0.01	< 0.006	0.21
S98-01854	33386	7.7	13	0.02	0.032	< 0.05	19.8	0.03	0.079	3.8	0.14	0.5	< 0.05	2	0.01	< 0.01	< 0.006	0.37
S98-01855	40108	8.1	14	0.09	0.145	< 0.05	128	< 0.02	0.019	134	0.33	< 0.5	< 0.05	2	< 0.01	< 0.01	< 0.006	0.08
S98-01856	36860	70.6	23	0.03	0.238	< 0.05	57.1	< 0.02	0.018	64.2	0.3	< 0.5	< 0.05	< 1	0.01	< 0.01	< 0.006	0.62
S98-01857	44751	0.7	5	0.24	0.128	< 0.05	45.2	< 0.02	0.008	206	0.17	0.5	< 0.05	1	< 0.01	< 0.01	< 0.006	0.16
S98-01858	32654	7.5	10	< 0.01	0.026	< 0.05	26.2	0.03	0.016	30	0.17	< 0.5	< 0.05	5	< 0.01	< 0.01	< 0.006	0.22
S98-01859	38273	29	11	0.01	0.127	< 0.05	79.2	< 0.02	0.02	6	0.23	< 0.5	< 0.05	1	< 0.01	< 0.01	< 0.006	0.16
S98-01860	38276	61.8	9	0.03	0.146	< 0.05	97.7	< 0.02	0.019	10.6	0.43	< 0.5	< 0.05	2	< 0.01	< 0.01	< 0.006	0.14
S98-01861	32947	215	8	0.04	0.172	< 0.05	106	< 0.02	0.018	14	0.42	< 0.5	0.13	1	< 0.01	< 0.01	< 0.006	0.15
S98-01862	33543	200	8	0.04	0.294	< 0.05	150	< 0.02	0.021	27.3	0.72	< 0.5	< 0.05	2	< 0.01	< 0.01	< 0.006	0.02
S98-01863	33532	144	8	0.06	0.223	< 0.05	108	< 0.02	0.015	28.4	0.42	< 0.5	< 0.05	2	< 0.01	< 0.01	0.012	0.24
S98-01864	35454	3.1	16	0.25	0.241	< 0.05	80.4	< 0.02	0.03	411	0.23	< 0.5	< 0.05	4	< 0.01	< 0.01	< 0.006	0.28
S98-01865	10651	3.4	15	0.22	0.019	< 0.05	7.59	< 0.02	0.017	58.2	0.06	< 0.5	< 0.05	4	< 0.01	< 0.01	< 0.006	0.14
S98-01866	17895	10	28	0.35	0.025	< 0.05	6.11	< 0.02	0.096	297	0.21	< 0.5	< 0.05	3	< 0.01	< 0.01	< 0.006	0.16
S98-01867	35956	401	12	0.16	0.271	< 0.05	65	0.03	0.028	93.8	1.07	< 0.5	< 0.05	2	< 0.01	< 0.01	< 0.006	0.31
S98-01868	32650	7.5	6	< 0.01	0.022	< 0.05	29	< 0.02	0.014	15.9	0.14	1.6	< 0.05	9	< 0.01	< 0.01	< 0.006	0.19
S98-04510	21504	1.2	21	0.19	0.078	< 0.05	46.8	0.03	0.055	812	0.53	0.6	< 0.05	2	< 0.01	< 0.01	0.016	0.09
S98-04511	21504	4.2	15	0.02	0.039	< 0.05	19.3	< 0.02	0.092	7.5	0.97	0.5	< 0.05	5	< 0.01	< 0.01	< 0.006	0.15
S98-04512	21504	0.7	15	0.03	0.072	< 0.05	25.8	< 0.02	0.027	143	0.25	0.6	< 0.05	2	< 0.01	< 0.01	0.012	0.12
S98-04513	21967	3.7	12	0.04	0.064	< 0.05	22.3	< 0.02	0.021	2.4	1.13	< 0.5	< 0.05	17	< 0.01	< 0.01	0.014	0.35
S98-04514	21936	444	14	0.07	0.129	< 0.05	84.6	< 0.02	0.02	77	0.77	< 0.5	< 0.05	2	< 0.01	< 0.01	0.018	0.19
S98-04515	21972	107	12	0.04	0.03	< 0.05	33.6	< 0.02	0.022	81	0.18	0.7	< 0.05	1	< 0.01	< 0.01	< 0.006	0.21
S98-04516	21349	2.5	24	0.03	0.099	< 0.05	41.8	0.03	0.045	150	0.31	0.6	< 0.05	19	< 0.01	< 0.01	0.01	0.23
S98-04517	21322	234	16	< 0.01	0.112	< 0.05	57.3	0.03	0.043	33.4	0.32	0.5	0.05	4	< 0.01	< 0.01	0.023	0.24
S98-04518	27587	100	12	0.32	0.032	< 0.05	33.4	< 0.02	0.028	196	0.35	< 0.5	< 0.05	1	< 0.01	< 0.01	0.008	0.25
S98-04519	23029	111	18	0.02	0.019	< 0.05	26	< 0.02	0.034	21.7	0.17	0.5	< 0.05	2	< 0.01	0.01	< 0.006	0.32
S98-04520	21553	275	39	0.2	0.02	< 0.05	20	< 0.02	0.063	35.1	0.25	1.1	< 0.05	3	< 0.01	< 0.01	< 0.006	0.38
S98-04521	21537	4.4	12	< 0.01	0.042	0.12	2.93	< 0.02	0.034	2.8	0.31	3.9	< 0.05	8	< 0.01	< 0.01	0.008	0.04

SAMPLE ID	Fe mg/L	Gd ug/L	HCO_3 mg/L	Ho ug/L	I mg/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S98-01833	0.953	< 0.01	342	< 0.005	0.0082	1.3	< 0.005	10	< 0.005	21.3	0.625	1.8	17.4	< 0.01	0.19	3.4	0.044	< 0.2
S98-01834	19.6	< 0.01	242	< 0.005	0.0152	2.3	0.009	2.8	< 0.005	22.6	2.27	0.7	29.8	0.01	0.62	2.2	< 0.004	< 0.2
S98-01835	0.007	< 0.01	371	< 0.005	0.0027	3.6	< 0.005	3.2	< 0.005	20.7	0.232	0.6	39.9	< 0.01	< 0.02	3	< 0.004	< 0.2
S98-01836	0.316	< 0.01	178	< 0.005	0.04	2.3	0.015	2.3	< 0.005	17.2	0.383	< 0.1	30.1	< 0.01	< 0.02	2.1	< 0.004	2.6
S98-01837	0.02	< 0.01	531	< 0.005	0.0521	74.4	0.024	10.4	< 0.005	39.4	0.042	7.8	110	0.02	< 0.02	4.9	< 0.004	41
S98-01838	0.074	< 0.01	219	< 0.005	0.0636	1.4	0.006	6.6	< 0.005	12.3	0.148	0.1	27.4	< 0.01	< 0.02	1.1	< 0.004	< 0.2
S98-01839	0.914	< 0.01	296	< 0.005	0.0034	2.3	0.009	5.1	< 0.005	14.3	0.428	1	7.7	0.01	< 0.02	2.5	< 0.004	< 0.2
S98-01840	0.697	< 0.01	222	< 0.005	0.26	1.1	0.007	1	< 0.005	13.5	0.03	0.7	41.3	< 0.01	< 0.02	1.5	< 0.004	< 0.2
S98-01841	0.494	< 0.01	457	< 0.005	0.0013	3.1	0.009	6.5	< 0.005	40.2	0.214	1.5	26.1	< 0.01	0.64	3.9	< 0.004	< 0.2
S98-01842	0.749	< 0.01	214	< 0.005	0.0008	1.8	0.007	3.5	< 0.005	11.1	0.243	0.6	32.7	< 0.01	< 0.02	1	< 0.004	< 0.2
S98-01843	0.403	< 0.01	392	< 0.005	0.014	3.4	0.01	16	< 0.005	30.6	0.408	0.7	71.4	< 0.01	0.87	3.2	0.004	< 0.2
S98-01844	0.192	< 0.01	234	< 0.005	0.063	1.1	0.006	0.6	< 0.005	11.9	0.036	< 0.1	28.6	0.02	< 0.02	1.5	< 0.004	< 0.2
S98-01845	0.02	0.01	783	< 0.005	0.13	1.7	< 0.005	15.2	< 0.005	28.4	0.665	1.5	342	< 0.01	< 0.02	4	< 0.004	< 0.2
S98-01846	2.61	< 0.01	284	< 0.005	0.008	4	0.007	2.3	< 0.005	16.7	1.24	2.5	14.5	< 0.01	< 0.02	2.2	< 0.004	< 0.2
S98-01847	1.13	< 0.01	370	< 0.005	0.0009	3.5	< 0.005	1.3	< 0.005	19.9	0.332	0.5	7.7	< 0.01	< 0.02	3.2	< 0.004	< 0.2
S98-01848	2.84	< 0.01	118	< 0.005	0.0019	1.3	0.01	2.9	< 0.005	4.8	0.372	< 0.1	16.3	0.01	< 0.02	1.3	< 0.004	< 0.2
S98-01849	0.028	< 0.01	417	< 0.005	0.082	5.4	0.017	6.9	< 0.005	27.6	0.025	0.3	162	< 0.01	< 0.02	1.3	< 0.004	0.6
S98-01850	7.33	0.01	192	< 0.005	0.015	3	0.016	1.9	< 0.005	12.2	1.64	1.8	9.1	0.01	< 0.02	1.9	0.007	< 0.2
S98-01851	0.019	< 0.01	408	< 0.005	0.0041	13.8	0.013	8.7	< 0.005	46.2	0.103	1	142	< 0.01	< 0.02	4.9	< 0.004	1.1
S98-01852	4.43	< 0.01	178	< 0.005	0.0037	2.4	0.017	4.9	< 0.005	15.1	0.874	0.5	12.6	0.01	< 0.02	3.5	< 0.004	< 0.2
S98-01853	0.094	< 0.01	642	< 0.005	0.084	15.4	0.009	17.3	< 0.005	35.9	0.035	1.2	893	< 0.01	3.37	0.9	1.35	1.1
S98-01854	1.62	0.02	134	< 0.005	0.021	0.7	0.053	2.8	< 0.005	6.77	0.044	0.2	17.9	0.07	< 0.02	2	< 0.004	< 0.2
S98-01855	0.086	< 0.01	281	< 0.005	0.0073	2.8	0.012	2.4	< 0.005	25.4	0.102	0.8	52.2	0.01	0.1	3.9	0.011	< 0.2
S98-01856	5.16	< 0.01	290	< 0.005	0.0031	3.1	0.016	0.7	< 0.005	33.8	0.17	1.2	17.9	< 0.01	0.95	2.3	0.004	< 0.2
S98-01857	0.022	< 0.01	501	< 0.005	0.017	3.9	< 0.005	7.2	< 0.005	23.4	0.028	0.5	218	< 0.01	< 0.02	1.3	< 0.004	0.5
S98-01858	0.071	< 0.01	120	< 0.005	0.0096	1.4	0.009	9.8	< 0.005	10.1	0.041	< 0.1	21.1	0.01	0.15	2.4	< 0.004	2.3
S98-01859	2.26	< 0.01	398	< 0.005	0.0059	2.8	0.019	1.3	< 0.005	15	0.333	0.8	9.9	0.01	< 0.02	2.2	< 0.004	2.5
S98-01860	4.43	< 0.01	481	< 0.005	0.018	5.6	0.012	8.4	< 0.005	36.1	0.722	1.1	24.3	< 0.01	< 0.02	3.1	< 0.004	0.7
S98-01861	5.67	< 0.01	552	< 0.005	0.017	4.5	0.014	6.8	< 0.005	37.2	0.204	1.9	29.5	< 0.01	< 0.02	3	< 0.004	2.4
S98-01862	10.6	< 0.01	567	< 0.005	0.014	4.7	0.013	3.6	< 0.005	45.1	0.305	0.9	26.9	0.01	< 0.02	4.1	< 0.004	1.4
S98-01863	6.92	< 0.01	527	< 0.005	0.0056	4.1	0.017	4	< 0.005	23.4	0.127	1.4	45	< 0.01	< 0.02	2.9	< 0.004	2.2
S98-01864	1.17	0.01	354	< 0.005	0.18	4.4	0.019	13.5	< 0.005	34	0.04	0.3	231	0.01	< 0.02	2.6	< 0.004	< 0.2
S98-01865	0.156	< 0.01	373	< 0.005	0.051	2.2	0.013	3.8	< 0.005	3.93	0.033	0.3	152	0.02	< 0.02	< 0.4	< 0.004	< 0.2
S98-01866	0.112	< 0.01	524	< 0.005	0.24	2.4	0.096	4	< 0.005	3.52	0.015	0.6	189	0.05	< 0.02	< 0.4	< 0.004	1.6
S98-01867	4.43	< 0.01	579	< 0.005	0.75	5.3	0.019	7.1	< 0.005	31.3	0.151	3.6	133	0.01	< 0.02	4.1	< 0.004	3.8
S98-01868	0.096	< 0.01	170	< 0.005	0.0089	2	0.008	5.9	< 0.005	10.8	0.027	< 0.1	22.6	< 0.01	< 0.02	5	< 0.004	0.8
S98-04510	33.6	< 0.01	34	< 0.005	0.0122	8.6	0.029	68.3	< 0.005	50.7	2.45	< 0.1	497	0.03	0.25	2.7	0.006	< 0.2
S98-04511	0.211	< 0.01	181	< 0.005	0.0032	2.6	0.027	4.1	< 0.005	11.2	0.147	0.2	26.9	0.02	< 0.02	1.7	< 0.003	< 0.2
S98-04512	12.4	< 0.01	117	< 0.005	0.0097	3.5	0.018	20	< 0.005	22	1.14	< 0.1	52.9	0.03	0.02	1.4	< 0.003	0.4
S98-04513	1.66	< 0.01	135	< 0.005	0.0052	1.9	0.017	2.7	< 0.005	9.75	0.403	0.5	22.5	< 0.01	0.03	1.9	< 0.003	< 0.2
S98-04514	10.1	< 0.01	387	< 0.005	0.123	7.4	0.016	2.9	< 0.005	31	0.268	2.3	42.3	< 0.01	< 0.02	3.8	0.012	7.1
S98-04515	2.78	< 0.01	319	< 0.005	0.0099	16	0.011	2.3	< 0.005	56.6	0.413	0.7	27.5	0.01	0.09	1.6	< 0.003	1.5
S98-04516	4.02	< 0.01	115	< 0.005	0.098	3.4	0.034	7.3	< 0.005	19.6	0.335	< 0.1	55.8	0.02	0.2	3.1	< 0.003	< 0.2
S98-04517	7.06	< 0.01	286	< 0.005	0.0186	3.7	0.028	2	< 0.005	18.1	0.252	2.4	15.4	0.01	4.1	2.2	< 0.003	0.7
S98-04518	0.665	< 0.01	678	< 0.005	0.131	13.4	0.017	4.2	< 0.005	45.2	0.374	5.6	244	0.02	< 0.02	1.7	< 0.003	1.2
S98-04519	0.49	< 0.01	361	< 0.005	0.0292	12.4	0.023	3.7	< 0.005	46	0.674	1.7	28.2	0.02	< 0.02	1.1	< 0.003	1.3
S98-04520	1.32	0.02	384	< 0.005	0.13	16	0.036	2.9	< 0.005	37	0.247	4	60.4	0.02	< 0.02	1.5	2.62	2.6
S98-04521	0.033	< 0.01	34	< 0.005	0.0013	3	0.025	4.2	< 0.005	1.73	0.029	< 0.1	4.8	0.02	< 0.02	5.5	0.006	0.6

SAMPLE ID	P mg/L	Pb ug/L	Pr ug/L	Rb ug/L	Sb ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	Tb ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-01833	< 0.2	0.19	< 0.005	< 0.1	0.03	18.6	< 0.01	3.2	< 0.2	0.255	< 0.005	< 0.01	< 0.005	0.28	0.5	0.021	< 0.008	
S98-01834	1.4	0.47	< 0.005	1.8	0.03	23.2	0.02	0.7	0.5	0.181	< 0.005	< 0.01	< 0.005	0.01	< 0.2	0.045	< 0.008	16
S98-01835	< 0.2	0.14	< 0.005	1	0.02	10.8	< 0.01	1.9	19.3	0.302	< 0.005	< 0.01	< 0.005	0.75	< 0.2	0.013	< 0.008	
S98-01836	< 0.2	0.59	< 0.005	0.4	0.03	13.4	< 0.01	0.7	11.5	0.139	< 0.005	< 0.01	< 0.005	0.59	0.4	0.039	< 0.008	40
S98-01837	0.4	1.18	< 0.005	9.2	0.16	15.5	< 0.01	1	47.6	0.456	< 0.005	< 0.01	< 0.005	3.35	7.2	0.014	< 0.008	8
S98-01838	< 0.2	0.25	< 0.005	1.8	< 0.02	23.4	< 0.01	1.4	1.8	0.154	< 0.005	< 0.01	< 0.005	0.66	< 0.2	0.013	< 0.008	3
S98-01839	0.5	0.7	< 0.005	1.5	0.06	15.5	0.01	1.3	< 0.2	0.18	< 0.005	< 0.01	< 0.005	0.09	< 0.2	0.02	< 0.008	13
S98-01840	0.3	0.29	< 0.005	0.2	0.06	16.4	< 0.01	0.6	< 0.2	0.195	< 0.005	< 0.01	< 0.005	0.97	2.1	0.01	< 0.008	34
S98-01841	< 0.2	0.25	< 0.005	6.9	0.16	15.8	< 0.01	1.4	< 0.2	0.551	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.007	< 0.008	
S98-01842	0.3	0.55	< 0.005	1.5	0.02	20.9	0.02	1.1	< 0.2	0.15	< 0.005	< 0.01	< 0.005	0.05	< 0.2	0.007	< 0.008	59
S98-01843	< 0.2	0.21	< 0.005	4.2	0.03	17.6	< 0.01	0.6	< 0.2	0.398	< 0.005	< 0.01	< 0.005	1.6	< 0.2	0.012	< 0.008	4
S98-01844	0.3	0.39	< 0.005	0.2	0.02	22	< 0.01	1.1	3.3	0.2	< 0.005	< 0.01	< 0.005	0.4	5.7	0.016	< 0.008	9
S98-01845	0.2	0.34	< 0.005	0.1	0.15	15.1	< 0.01	1.6	< 0.2	0.34	< 0.005	< 0.01	< 0.005.	7.89	0.4	0.019	< 0.008	
S98-01846	0.6	0.5	< 0.005	1.2	0.03	16.8	< 0.01	0.7	2.7	0.253	< 0.005	< 0.01	< 0.005	0.43	< 0.2	0.012	< 0.008	28
S98-01847	0.3	0.24	< 0.005	1.3	0.03	11.2	< 0.01	2	2.5	0.295	< 0.005	< 0.01	< 0.005	< 0.01	< 0.2	0.007	< 0.008	9
S98-01848	0.2	1	< 0.005	0.2	< 0.02	28.4	< 0.01	1	0.8	0.131	< 0.005	< 0.01	< 0.005	0.03	1.2	0.066	< 0.008	50
S98-01849	< 0.2	0.18	< 0.005	3.5	< 0.02	12.1	< 0.01	0.7	< 0.2	0.417	< 0.005	< 0.01	< 0.005	0.01	< 0.2	0.012	< 0.008	3
S98-01850	1.5	0.52	< 0.005	3.7	0.04	19.1	< 0.01	1.9	< 0.2	0.175	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.015	< 0.008	28
S98-01851	< 0.2	0.09	< 0.005	5.9	< 0.02	15.4	< 0.01	0.7	10.1	0.52	< 0.005	< 0.01	< 0.005	< 0.01	< 0.2	0.01	< 0.008	3
S98-01852	0.6	0.48	< 0.005	3	0.02	20.3	< 0.01	2.1	12.8	0.123	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.019	< 0.008	26
S98-01853	0.4	0.19	< 0.005	4.2	< 0.02	8.22	< 0.01	0.4	< 0.2	0.373	< 0.005	< 0.01	< 0.005	< 0.01	0.2	0.008	0.01	6
S98-01854	0.4	1.44	0.016	0.4	0.04	27.3	0.01	1	0.7	0.119	< 0.005	< 0.01	< 0.005	0.05	1.8	0.057	< 0.008	44
S98-01855	< 0.2	0.34	< 0.005	2.3	< 0.02	9.01	< 0.01	0.8	20.4	0.358	< 0.005	< 0.01	< 0.005	0.01	< 0.2	0.013	< 0.008	5
S98-01856	0.3	0.35	< 0.005	1.4	0.03	16.2	0.02	0.5	< 0.2	0.347	< 0.005	< 0.01	< 0.005	0.03	< 0.2	0.013	< 0.008	11
S98-01857	< 0.2	2	< 0.005	3.2	< 0.02	11.5	< 0.01	0.5	< 0.2	0.364	< 0.005	< 0.01	< 0.005	< 0.01	< 0.2	0.009	< 0.008	4
S98-01858	< 0.2	0.88	< 0.005	0.8	0.03	32.2	< 0.01	1.2	4.3	0.17	< 0.005	0.01	< 0.005	0.06	0.7	0.015	< 0.008	28
S98-01859	0.5	0.42	< 0.005	0.8	0.02	10.9	< 0.01	1	< 0.2	0.233	< 0.005	< 0.01	< 0.005	0.03	< 0.2	0.008	< 0.008	33
S98-01860	0.5	0.41	< 0.005	3.5	0.04	19.1	< 0.01	1	0.7	0.434	< 0.005	0.01	< 0.005	0.39	< 0.2	0.011	< 0.008	40
S98-01861	0.8	0.32	< 0.005	5.6	0.04	17.4	< 0.01	0.9	< 0.2	0.432	< 0.005	< 0.01	< 0.005	0.03	< 0.2	0.012	< 0.008	7
S98-01862	0.7	0.39	< 0.005	3.2	0.04	16.8	< 0.01	0.8	< 0.2	0.739	< 0.005	< 0.01	< 0.005	< 0.01	< 0.2	0.02	< 0.008	12
S98-01863	0.5	0.43	< 0.005	3.4	0.04	11.7	< 0.01	1	< 0.2	0.39	< 0.005	< 0.01	< 0.005	0.01	< 0.2	0.011	< 0.008	
S98-01864	0.3	0.7	< 0.005	5	0.05	17.9	0.01	0.5	< 0.2	0.453	< 0.005	< 0.01	< 0.005	0.02	< 0.2	0.015	< 0.008	22
S98-01865	0.3	0.69	< 0.005	2	0.03	9.57	< 0.01	2.2	0.2	0.108	< 0.005	0.03	< 0.005	< 0.01	< 0.2	0.011	< 0.008	16
S98-01866	0.8	0.79	0.018	1.7	0.03	9.13	0.01	3.1	0.4	0.0905	< 0.005	0.02	< 0.005	< 0.01	0.5	0.03	< 0.008	53
S98-01867	1.1	0.54	< 0.005	3.8	0.15	12.6	< 0.01	0.9	0.3	0.439	< 0.005	< 0.01	< 0.005	0.08	0.3	0.02	< 0.008	
S98-01868	< 0.2	0.53	< 0.005	1.2	0.05	30.4	< 0.01	1.4	4.9	0.222	< 0.005	< 0.01	< 0.005	0.14	1.8	0.024	0.008	14
S98-04510	0.3	1.81	0.007	5.1	0.07	24.6	0.02	< 0.1	261	0.564	< 0.005	0.05	< 0.005	< 0.01	< 0.2	0.034	< 0.008	
S98-04511	< 0.2	0.65	< 0.005	3.8	0.06	13.2	< 0.01	2.5	0.8	0.194	< 0.005	0.07	< 0.005	0.01	0.2	0.037	< 0.008	
S98-04512	0.4	0.41	< 0.005	2.8	0.05	28.1	< 0.01	0.3	0.4	0.297	< 0.005	0.02	< 0.005	< 0.01	< 0.2	0.025	< 0.008	47
S98-04513	< 0.2	0.31	0.005	1.3	0.05	20.6	< 0.01	1.1	0.7	0.298	< 0.005	0.13	< 0.005	0.05	0.4	0.014	< 0.008	74
S98-04514	1.2	0.32	< 0.005	5.3	0.04	16.2	0.02	0.4	< 0.2	0.492	< 0.005	0.08	< 0.005	< 0.01	0.2	0.022	< 0.008	30
S98-04515	0.8	0.38	< 0.005	5.9	0.02	14	< 0.01	0.6	4.4	0.333	< 0.005	0.05	< 0.005	< 0.01	< 0.2	0.014	< 0.008	18
S98-04516	< 0.2	2.2	0.006	5.5	0.11	28.3	< 0.01	0.2	< 0.2	0.303	< 0.005	0.01	< 0.005	0.02	< 0.2	0.032	< 0.008	52
S98-04517	1.7	2.19	< 0.005	4	0.06	18.7	< 0.01	0.9	< 0.2	0.26	< 0.005	0.01	< 0.005	< 0.01	< 0.2	0.032	< 0.008	
S98-04518	1	1.2	0.006	3.1	0.06	16	< 0.01	0.2	4.3	0.32	< 0.005	0.07	< 0.005	0.19	0.3	0.021	< 0.008	12
S98-04519	0.6	0.46	< 0.005	5.6	0.05	15.4	< 0.01	0.7	10.6	0.241	< 0.005	0.03	< 0.005	0.27	< 0.2	0.028	< 0.008	13
S98-04520	1.7	8.17	0.008	6.8	0.12	11	< 0.01	0.7	0.8	0.266	< 0.005	0.03	< 0.005	0.02	0.4	0.026	< 0.008	13
S98-04521	< 0.2	3.07	0.005	9.7	0.04	12	< 0.01	1.3	1.3	0.0352	< 0.005	0.03	< 0.005	< 0.01	< 0.2	0.029	< 0.008	24

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	WELL TYPE	DEPTH m	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-04522	CTG-93	29/07/1998	22.3704	91.8442	DTW	146	Chittagong	Chittagong	Chandgaon	Chandgown	Chandgown
S98-04523	ANWA-94	29/07/1998	22.2234	91.898	HTW	43	Chittagong	Chittagong	Anowara	Anwara	Thana Parishad Office
S98-04524	SAT-95	29/07/1998	22.0721	92.0479	HTW	31	Chittagong	Chittagong	Satkania	Satkania	Satkania
S98-04525	COX-99	30/07/1998	21.4349	91.9656	HTW	10	Chittagong	Cox's Bazar	Cox's Bazar Sadar		BWDB rest house
S98-04526	UKHI-100	30/07/1998	21.2432	92.1325	DTW	52	Chittagong	Cox's Bazar	Ukhia	Ukhia	Ukhia Bazar
S99-00796	SAN-43(CS)	04/06/1999	22.4815	91.4285	Piez	56.96	Chittagong	Chittagong	Sandwip	Rahamatpur	Rahamatpur
S99-00797	SAN-42(CMD)	04/06/1999	22.4815	91.4285	Piez	160.92	Chittagong	Chittagong	Sandwip	Rahamatpur	Rahamatpur
S99-00798	SAN-41(CD)	04/06/1999	22.4815	91.4285	Piez	261.94	Chittagong	Chittagong	Sandwip	Rahamatpur	Rahamatpur
S99-00799	MOH-98	28/05/1999	21.517	91.9584	Piez	7.32	Chittagong	Cox's Bazar	Maheshkhali	Gorukghata	Gorukghata
S99-00800	KUT-97	30/05/1999	21.8128	91.8449	Piez	542.68	Chittagong	Cox's Bazar	Kutubdia	Baraghope	Baraghope
S99-00801	SAND-9	03/06/1999	22.4817	91.4332	Piez	329.26	Chittagong	Chittagong	Sandwip	BWDB Guest house	BWDB Guest house
S99-00802	AKHA-82	24/05/1999	23.8659	91.201	HTW	18.3	Chittagong	Brahamanbaria	Akhaura	Railway station	Railway station
S99-00803	MUR-83	24/05/1999	23.7627	90.9899	HTW	26.22	Chittagong	Comilla	Muradnagar	Kasimpur	Kasimpur
S99-00804	CHU-81	25/05/1999	24.1945	91.5138	HTW	30.5	Sylhet	Habiganj	Chunarughat	Chunarughat Bazar	Chunarughat Bazar
S99-00805	HABI-80	25/05/1999	24.3776	91.4083	HTW	36.59	Sylhet	Habiganj	Habiganj Sadar	Rajanagar	Rajanagar
S99-00806	MVI-79	25/05/1999	24.4696	91.7603	HTW	30.5	Sylhet	Maulvibazar	Maulvi Bazar Sadar	Sultanpur	Sultanpur
S99-00807	SYL-78	25/05/1998	24.8795	91.8605	HTW	30.5	Sylhet	Sylhet	Sylhet Sadar	Railway station	Railway station

SAMPLE ID	GEOCODE	As ug/L	Al ug/L	B. mg/L	Ba mg/L	Be ug/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	Dy ug/L	Er ug/L	Eu ug/L	F mg/L
S98-04522	21519	3.4	24	< 0.01	0.055	< 0.05	6.28	< 0.02	0.067	7	1.7	0.7	< 0.05	3	0.01	0.01	0.015	0.21
S98-04523	21504	2	11	1.28	0.033	< 0.05	26.7	< 0.02	0.03	334	0.5	< 0.5	0.07	1	< 0.01	< 0.01	< 0.006	0.05
S98-04524	21582	4.6	15	0.53	0.023	< 0.05	3.74	< 0.02	0.031	217	0.21	0.8	< 0.05	2	< 0.01	< 0.01	< 0.006	0.65
S98-04525	22224	2	13	0.02	0.024	< 0.05	79.1	< 0.02	0.035	91	0.47	< 0.5	< 0.05	3	< 0.01	0.01	< 0.006	0.1
S98-04526	22294	1.2	13	< 0.01	0.022	< 0.05	4.44	< 0.02	0.03	2.7	0.11	2.1	0.06	2	< 0.01	< 0.01	0.006	0.06
S99-00796	21578	0.9		0.1	0.082		37.7			187								0.09
S99-00797	21578	0.6		0.1	0.087		35.5			158								0.12
S99-00798	21578	1.1		0.1	0.154		106			980								0.05
S99-00799	22249	8.7		0.4	0.034		29.1			770								0.64
S99-00800	22245	1.1		< 0.1	0.081		22.8			1.9								0.14
S99-00801	21578	1.1		0.1	0.133		125			940								0.07
S99-00802	21202	11.3		< 0.1	0.012		17.7			10.1								0.2
S99-00803	21981	261		0.2	0.017		41.1			85								0.23
S99-00804	63626	3.4		< 0.1	0.026		9.5			7.5								0.12
S99-00805	63644	5.2		< 0.1	0.036		16.7			8.2								0.19
S99-00806	65874	2.3		< 0.1	0.033		9.3			2.1								0.24
S99-00807	69162	11.2		< 0.1	0.027		3.5			2.2								0.24

SAMPLE ID	Fe mg/L	Gd ug/L	HCO_3 mg/L	Ho ug/L	I mg/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S98-04522	0.202	0.01	121	< 0.005	0.0042	2.7	0.031	4.9	< 0.005	6.65	0.578	0.1	29	0.03	< 0.02	1.7	< 0.003	< 0.2
S98-04523	0.365	< 0.01	451	< 0.005	0.198	65.2	0.016	7.4	< 0.005	75.5	0.236	< 0.1	253	0.02	0.03	1	0.003	< 0.2
S98-04524	0.527	< 0.01	442	< 0.005	0.0428	11.3	0.021	9.4	< 0.005	7.1	0.053	0.9	277	0.02	0.03	< 0.4	< 0.003	37.2
S98-04525	0.128	< 0.01	366	< 0.005	0.0057	26.5	0.017	16.1	< 0.005	57.6	1.96	1	55.2	< 0.01	0.04	2.7	< 0.003	31.3
S98-04526	0.307	< 0.01	43	< 0.005	0.0016	5	0.029	4.8	< 0.005	4.13	0.037	< 0.1	10.7	0.04	0.02	1.8	< 0.003	0.4
S99-00796	0.139		352		0.0038	6.1				24.3	0.007		136		0.03		< 0.003	3.1
S99-00797	0.065		264		0.0286	6.2				24.1	0.008		138		0.05		0.015	23
S99-00798	0.047		292		0.127	9.7				93.1	0.012		410		0.02		0.037	8.5
S99-00799	0.088		424		0.134	24				45.6	0.039		510		0.03		0.022	0.2
S99-00800	0.29		179		0.001	2.9				3.13	0.124		47		0.01		< 0.003	0.2
S99-00801	0.089		332		0.124	10.3				104	0.019		454		0.03		0.005	3.9
S99-00802	0.249		113		0.0177	2.5				8.87	0.18		22.6		0.04		< 0.003	0.2
S99-00803	0.134		396		0.14	11.3				44.2	0.021		60.5		0.03		0.013	11.3
S99-00804	0.161		60.4		0.0152	2.5				4.37	1.44		8		< 0.01		0.005	1.2
S99-00805	0.211		202		0.0064	2.6				7.56	0.094		34.4		0.01		< 0.003	0.9
S99-00806	0.197		108		0.092	2.2				4.48	0.275		14.4		4.22		< 0.003	< 0.02
S99-00807	2.26		172		0.0212	1.6				3.44	0.037		63		0.02		< 0.003	3.7

SAMPLE ID	P mg/L	Pb ug/L	Pr ug/L	Rb ug/L	Sb ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	Tb ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-04522	< 0.2	1.93	0.008	1.5	0.06	21.1	< 0.01	1.2	0.5	0.0764	< 0.005	0.02	< 0.005	0.02	0.5	0.092	0.012	24
S98-04523	6.4	0.39	< 0.005	13.4	0.07	27.7	< 0.01	0.1	0.7	0.453	< 0.005	0.07	< 0.005	0.01	0.4	0.014	< 0.008	12
S98-04524	2.4	0.41	0.006	3.5	0.05	12.2	< 0.01	0.3	0.4	0.0547	< 0.005	< 0.01	< 0.005	< 0.01	0.7	0.017	< 0.008	18
S98-04525	< 0.2	0.64	< 0.005	11.7	0.17	7.9	< 0.01	0.3	47.6	0.566	< 0.005	0.03	< 0.005	1.16	1.5	0.041	< 0.008	12
S98-04526	< 0.2	0.44	0.01	8.2	0.03	13.9	< 0.01	1.1	3.7	0.047	< 0.005	0.02	< 0.005	0.03	< 0.2	0.035	< 0.008	11
S99-00796	0.2					16.9			1.2	0.334								
S99-00797	0.2					16.6			2.2	0.309								
S99-00798	0.3					15.4			59.4	1.09								
S99-00799	2.9					9.86			144	0.3								
S99-00800	< 0.1					12			2.7	0.34								
S99-00801	0.3					15.8			68.4	1.24								
S99-00802	0.2					33.9			4.4	0.114								
S99-00803	1.3					26.2			1.5	0.332								
S99-00804	< 0.1					16.9			< 0.2	0.0635								
S99-00805	0.2					27.4			0.7	0.115								
S99-00806	< 0.1					15.9			< 0.2	0.0734								
S99-00807	0.4					10.7			0.5	0.0228								

D Special Study Areas

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST.	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S97-00331	BTS001	20/02/1997	24.569	88.2715		HTW	27.2	Miapara	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Rajarampur
S97-00332	BTS002	20/02/1997	24.569	88.2715		dug well	8.4	Miapara	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Rajarampur
S97-00333	BTS003	20/02/1997	24.5693	88.2732		HTW	28.6	Monjur Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Rajarampur
S97-00334	BTS004	20/02/1997	24.5681	88.2734		HTW	36	Mr Aminul Islam	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Rajarampur
S97-00335	BTS005	20/02/1997	24.5688	88.2741		HTW	21	Mr Mahfuzul Haque	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Rajarampur
S97-00336	BTS006	20/02/1997	24.5929	88.2766		HTW		Municipal supply, Pathanpara	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Nababganj
S97-00337	BTS007	20/02/1997	24.5929	88.2673		HTW		Municipal office pumphouse	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Nababganj
S97-00338	BTS008	21/02/1997	24.5949	88.2615		HTW	27	Mr Md Giausuddin	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Rehaichar
S97-00339	BTS009	21/02/1997	24.5882	88.2668		HTW		Primary teachers inst., Master Para	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Chauat Pratap
S97-00340	BTS010	21/02/1997	24.5833	88.2628		HTW	26	adj house of Soiwab Ahmed	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Char Nayansukh
S97-00341	BTS011	21/02/1997	24.5797	88.2769		HTW		Mr Md Abdul Rashid	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Sakerbati
S97-00342	BTS012	21/02/1997	24.5823	88.2773		HTW	23	Mr Zalal Uddin	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Baligan
S97-00343	BTS013	21/02/1997	24.583	88.2734		HTW		Mr Nuhumondol	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Jat Pralap
S97-00344	BTS014	22/02/1997	24.8733	88.4394		HTW	49	Purba Fargilpur	Rajshahi	Nawabganj	Gomastapur	Parisad Parbatipur	
S97-00345	BTS015	23/02/1997	24.5972	88.2516		HTW	29	Mr Md Aftab Uddin	Rajshahi	Nawabganj	Nawabganj Sadar	Barogharia	Ranihati
S97-00346	BTS016	23/02/1997	24.5971	88.2517		HTW	32	Mr Md Katu Mandal	Rajshahi	Nawabganj	Nawabganj Sadar	Barogharia	Ranihati
S97-00347	BTS017	23/02/1997	24.5979	88.2496		HTW	20	Mr Abdul Majid	Rajshahi	Nawabganj	Nawabganj Sadar	Barogharia	Ranihati
S97-00348	BTS018	23/02/1997	24.5996	88.2412		HTW	34.4	Mr Md Kalu Dafader, Chaktola	Rajshahi	Nawabganj	Nawabganj Sadar	Maharajpur	Ranihati
S97-00349	BTS019	23/02/1997	24.6032	88.2265		HTW	34.5	Mr Md Sakander Ali, Miapara	Rajshahi	Nawabganj	Nawabganj Sadar	Maharajpur	Ranihati
S97-00350	BTS020	23/02/1997	24.6109	88.2193		HTW	27.4	Mr Ishrafil Haque, Nachudume	Rajshahi	Nawabganj	Nawabganj Sadar	Maharajpur	Ranihati
S97-00351	BTS021	23/02/1997	24.5921	88.2812		HTW		George Court,	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Chauat Pratap
S97-00352	BTS022	24/02/1997	24.5885	88.2594		HTW	39.6	Mr Mukul Biswas, Chandlai	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Chauat Pratap
S97-00353	BTS023	24/02/1997	24.5858	88.2597		HTW	22.9	Mr Md Hussain Ali, Chandlai	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Chauat Pratap
S97-00354	BTS024	24/02/1997	24.5846	88.2607		dug well	9.3	Chandlai, dug well	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Chauat Pratap
S97-00355	BTS025	24/02/1997	24.5829	88.2886		HTW	24.4	Mr Hagid Md Ali	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Sarupnagar
S97-00356	BTS026	24/02/1997	24.5705	88.2998		HTW	13.7	Mr Habibur Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	Haripur
S97-00357	BTS027	24/02/1997	24.5916	88.2887		HTW	15.8	front of mosque, Ali Nagar	Rajshahi	Nawabganj	Nawabganj Sadar	Maharajpur	Ranihati
S97-00358	BTS028	24/02/1997	24.6144	88.3249		Tara	38.8	Mr Md Bazlar Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Atohar
S97-00359	BTS029	24/02/1997	24.5972	88.2804		Tara	34.4	DPHE campus	Rajshahi	Nawabganj	Nawabganj Sadar	Pourashava	
S98-00701	BTS101	06/03/1998	22.8731	90.7844	1992	Shallow H	10.7	near sluicegate	Chittagong	Lakshmipur	Lakshmipur Sadar	Shakchar	Char Ramani Mohan
S98-00702	BTS102	06/03/1998	22.8686	90.7858	1992	Deep HP	182.9	near sluicegate	Chittagong	Lakshmipur	Lakshmipur Sadar	Shakchar	Char Ramani Mohan
S98-00703	BTS103	06/03/1998	22.895	90.755	1992	Shallow H	9.1	Mosque, Karatir Hat	Chittagong	Lakshmipur	Lakshmipur Sadar	Shakchar	Char Ramani Mohan
S98-00704	BTS104	06/03/1998	22.9083	90.7986	1988	DPHE HF	228.6	Mr Hazi Nayed Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Shakchar	Shakchar
S98-00705	BTS105	06/03/1998	22.93	90.8133	1995	DPHE HF	10.7	Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Shakchar	Old Tum Char
S98-00706	BTS106	07/03/1998	22.9458	90.8086	1996	Private HF	17.1	Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Dalal Bazar	Lakshmipur
S98-00707	BTS107	07/03/1998	22.9794	90.7669	1992	Private HF	14	Mr Ali Akbar	Chittagong	Lakshmipur	Lakshmipur Sadar	Dalal Bazar	Khidirpur
S98-00709	BTS109	07/03/1998	22.9806	90.8042	1990	Shallow H	9.1	West Nandanpur Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Dakshin Hamchadi	Dakshin (S) Hamchadi
S98-00710	BTS110	07/03/1998	22.9806	90.8042	1994	Deep HP	219.5	West Nandanpur Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Dakshin Hamchadi	Dakshin (S) Hamchadi
S98-00711	BTS111	07/03/1998	23.0167	90.8194	1989	Private HF	14	Mr Hazi Hossain Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Uttar Hamchadi	Uttar (N) Hamchadi
S98-00713	BTS113	07/03/1998	23.0006	90.8378	1973	Shallow H	11	Bijoynagar High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Uttar Hamchadi	Bijoynagar
S98-00714	BTS114	07/03/1998	22.9603	90.8372	1986	Private HF	9.8	Mr Mohd Rafiq Ulla	Chittagong	Lakshmipur	Lakshmipur Sadar	Parbatinagar	Matlabpur
S98-00715	BTS115	08/03/1998	23.0422	90.7717	1998	Deep pum	375	DANIDA Obs b/h OTW/P/R-1	Chittagong	Lakshmipur	Raipur (L)	Raipur	Deyanatpur
S98-00716	BTS116	08/03/1998	22.9544	90.8761	1997	Shallow H	9.1	Darbani Edgah Madrasha	Chittagong	Lakshmipur	Lakshmipur Sadar	Bangakhan	Alipur
S98-00717	BTS117	08/03/1998	22.9828	90.8783	1973	Private HF	7.9	Mr Syed Ahmed Bhuyan	Chittagong	Lakshmipur	Lakshmipur Sadar	Parbatinagar	Dilshadpur
S98-00718	BTS118	08/03/1998	23.0194	90.8786	1971	Shallow H	12.2	Nandigram High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Baksipur	Nandigram
S98-00719	BTS119	09/03/1998	23.0128	90.9153	1986	DPHE HF	9.1	Mr Mohd. Nurannab	Chittagong	Lakshmipur	Lakshmipur Sadar	Baksipur	Khodawandapur
S98-00720	BTS120	09/03/1998	22.9817	90.9306	1997	Private HF	225.6	Mr Shaidulla Chowdhury	Chittagong	Lakshmipur	Lakshmipur Sadar	Dattapara	Dattapara
S98-00721	BTS121	09/03/1998	22.9772	90.9069	1998	Private HF	12.2	Totarkhil Ayeshe High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Dattapara	Totarkhil

SAMPLE ID	GEOCODE	Al ug/L	AsIII ug/L	AsTot ug/L	B mg/L	Ba mg/L	Be ug/L	Br mg/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	^{34}S ‰	diss O2 mg/L	DOC mg/L	Dy ug/L
S97-00331	5706696	5.4	2540	2400	0.04	0.102	< 0.01	0.041	109	0.06	0.01	6.2	0.42	< 0.6	0.011	0.81	-15.4	-5.1	-34			2.2	< 0.02
S97-00332	5706696	7.2	8	< 6	0.08	0.146	0.02	0.128	141	< 0.06	< 0.01	116	0.45	1.1	0.111	2.59	-17.3	-6.2	-41	4.55	3.7	2.6	< 0.02
S97-00333	5706696	5.6	561	904	0.03	0.155	< 0.01	0.058	105	< 0.06	< 0.01	14.8	0.63	< 0.6	0.03	0.95	-11.8	-3.6	-25		1.9	4.7	< 0.02
S97-00334	5706696	1.7	214	321	0.08	0.267	0.02		129	< 0.06	< 0.01	35.9	0.68	< 0.6	0.022	19.3	-13.4				0.1	2.6	< 0.02
S97-00335	5706696	1.4	831	1280	0.02	0.116	< 0.01	0.047	125	< 0.06	< 0.01	18.9	0.58	< 0.6	< 0.009	0.47	-13.6				0.5	3.8	< 0.02
S97-00336	5706696	2.3	109	151	< 0.01	0.164	< 0.01	0.02	98	< 0.06	< 0.01	7.8	0.35	< 0.6	0.01	0.13	-12.9	-6	-38		< 0.1	1.2	< 0.02
S97-00337	5706696	1.9	90	141	0.03	0.25	< 0.01	0.063	129	< 0.06	< 0.01	56.3	0.46	< 0.6	0.014	0.15	-12.5	-5.5	-37		< 0.1	2.9	< 0.02
S97-00338	5706696852	1.3	383	1050	0.03	0.203	< 0.01	0.047	140	< 0.06	< 0.01	16	0.59	< 0.6	0.011	1.68	-16.6	-6	-38		0.7	2.7	< 0.02
S97-00339	5706696	1.3	354	511	0.05	0.211	< 0.01	0.048	131	< 0.06	< 0.01	40.4	0.48	< 0.6	0.011	0.1	-14.9	-4.7	-35		0.3	1.7	< 0.02
S97-00340	5706696267	1.6	280	688	0.03	0.357	< 0.01	0.054	134	0.19	< 0.01	29.3	0.87	< 0.6	0.013	0.18	-14.9	-5.3	-39		< 0.1	1.6	< 0.02
S97-00341	5706696959	1.5	48	81	0.03	0.177	< 0.01	0.061	131	< 0.06	< 0.01	31.3	0.6	< 0.6	0.019	0.06	-13.3	-5.7	-37	16	0.2	3.2	< 0.02
S97-00342	5706696	1.2	<4	8	0.02	0.149	< 0.01	0.03	103	< 0.06	< 0.01	36.9	0.34	< 0.6	< 0.009	0.18	-25.4	-6.1	-35		0.1	1.2	< 0.02
S97-00343	5706696	1.3	12	37	0.02	0.131	< 0.01	0.041	106	< 0.06	< 0.01	20.3	0.32	< 0.6	0.015	0.08	-22.8	-5.9	-45		0.2	2.6	< 0.02
S97-00344	57037	1.6	<4	< 6	0.04	0.017	0.07	0.014	26.5	< 0.06	< 0.01	1.3	0.41	< 0.6	< 0.009	0.28					0.2	<1	< 0.02
S97-00345	5706613838	2.8	8	22	0.01	0.174	< 0.01	0.042	106	< 0.06	< 0.01	22.3	0.32	< 0.6	0.012	0.07	-24.2	-6.2	-43	24.5	0.1	2.5	< 0.02
S97-00346	5706613838	1.9	20	43	0.01	0.219	< 0.01	0.048	116	< 0.06	< 0.01	22.1	0.39	< 0.6	< 0.009	0.06					< 0.1	<1	< 0.02
S97-00347	5706613838	1.5	16	39	0.01	0.194	< 0.01	0.027	109	< 0.06	< 0.01	25.8	0.38	< 0.6	< 0.009	0.06					0.1	2.6	< 0.02
S97-00348	5706655844	3.7	80	92	0.05	0.303	< 0.01	0.035	138	< 0.06	< 0.01	16.2	0.44	< 0.6	0.023	0.13	-20.7	-5.6	-29		0.2	5.5	< 0.02
S97-00349	5706655844	2.4	115	253	0.04	0.22	< 0.01	0.029	115	< 0.06	< 0.01	6.6	0.45	< 0.6	0.013	0.03					< 0.1	2.5	< 0.02
S97-00350	5706655844	2.4	114	200	0.01	0.142	< 0.01	0.012	101	< 0.06	< 0.01	1.2	0.46	< 0.6	< 0.009	0.07					< 0.1	2.5	< 0.02
S97-00351	5706696	2	153	255	< 0.01	0.163	< 0.01	0.018	101	< 0.06	< 0.01	2	0.33	< 0.6	0.02	0.04					< 0.1	3	< 0.02
S97-00352	5706696	2.9	759	1150	0.02	0.204	< 0.01	0.062	143	< 0.06	< 0.01	16.4	0.61	< 0.6	< 0.009	0.08	-25.6	-6.1	-42		0.5	5.4	< 0.02
S97-00353	5706696	2.3	467	1180	0.02	0.19	< 0.01	0.044	130	< 0.06	< 0.01	16.6	0.97	< 0.6	< 0.009	0.04					0.1	3.6	< 0.02
S97-00354	5706696	1.5	<4	9	0.01	0.129	< 0.01	0.06	150	< 0.06	< 0.01	55.5	0.51	< 0.6	0.038	0.37	-21.9	-6.2	-42	3.9	1.5	1.6	< 0.02
S97-00355	5706696869	4		107	< 0.01	0.138	< 0.01	0.016	92.6	< 0.06	< 0.01	7.2	0.33	< 0.6	0.011	0.05					0.4	<1	< 0.02
S97-00356	5706696432	1.7	<4	< 6	< 0.01	0.106	< 0.01	0.018	86.1	< 0.06	0.02	12.9	0.31	< 0.6	< 0.009	0.13					0.2	<1	< 0.02
S97-00357	5706655844	1.6	84	149	0.01	0.07	< 0.01	0.023	66.5	< 0.06	< 0.01	8.7	0.31	< 0.6	< 0.009	0.06					< 0.1	4.5	< 0.02
S97-00358	5706644062	7.6	<4	< 6	0.04	0.032	< 0.01	0.016	70.5	< 0.06	< 0.01	4.4	0.24	< 0.6	< 0.009	0.15					< 0.1	<1	< 0.02
S97-00359	5706696	3.3	25	46	< 0.01	0.174	< 0.01	0.062	116	< 0.06	0.01	70.6	0.38	< 0.6	< 0.009	0.1					0.4	<1	< 0.02
S98-00701	2514385190	5	< 6	13	0.27	0.096	< 0.05	0.64	49.6	0.03	< 0.005	148	0.39	< 0.5	< 0.05	< 1	-16.74	-5.3	-38		1.3	0	< 0.01
S98-00702	2514385190	3	< 6	< 6	0.05	0.129	< 0.05	0.19	32.9	< 0.02	< 0.005	44.1	0.1	< 0.5	< 0.05	< 1	-13.47	-3.2	-14		< 0.1	6.2	< 0.01
S98-00703	2514385190	6	77	150	0.09	0.031	< 0.05	0.14	58.6	< 0.02	0.009	43.2	0.88	< 0.5	< 0.05	< 1	-14.41	-2.2	-20		0.1	13	< 0.01
S98-00704	2514385891	1	< 6	< 6	0.04	0.121	< 0.05	0.184	26.9	< 0.02	< 0.005	37.1	0.08	< 0.5	< 0.05	< 1	-17.48	-3.2	-14		< 0.1	5.2	< 0.01
S98-00705	2514385705	3	110	189	0.06	0.033	< 0.05	0.05	70.9	0.03	0.008	5.7	0.33	< 0.5	< 0.05	< 1		-3.2	-20		< 0.1	2	< 0.01
S98-00706	2514335571	4	88	364	0.65	0.16	< 0.05	1.79	58.6	0.03	0.011	360	0.77	< 0.5	< 0.05	< 1	-18.28	-4.8	-23		< 0.1	10	< 0.01
S98-00707	2514335532	13	< 6	42	0.05	0.042	< 0.05	0.071	32.3	< 0.02	0.018	17.6	0.28	< 0.5	< 0.05	< 1	-7.12	-4.5	-31		< 0.1	1.5	< 0.01
S98-00709	2514390237	6	289	390	0.13	0.079	< 0.05	0.118	101	0.03	0.012	67.7	0.8	< 0.5	< 0.05	< 1	-15.22	-4.5	-32		< 0.1	14	< 0.01
S98-00710	2514390237	4	< 6	< 6	0.05	0.079	< 0.05	0.046	25.3	< 0.02	< 0.005	6.7	0.11	< 0.5	< 0.05	< 1	-15.92	-2.6	-14		2.1	2.8	< 0.01
S98-00711	2514375977	36	64	270	0.13	0.272	< 0.05	1.67	186	0.03	0.022	390	1.28	< 0.5	< 0.05	1	-14.72	-9.6	-64		< 0.1	14	0.01
S98-00713	2514375108	7	153	248	0.14	0.034	< 0.05	0.092	55.2	0.03	0.005	9.6	0.35	< 0.5	< 0.05	< 1	-17.86	-3.9	-19		< 0.1	8.8	< 0.01
S98-00714	2514380622	41	127	139	0.33	0.022	< 0.05	0.266	45.8	< 0.02	0.01	59.2	0.63	< 0.5	< 0.05	< 1	-21.2	-4.6	-27		< 0.1	8.7	< 0.01
S98-00715	2515871385	5	< 6	< 6	0.04	0.086	< 0.05	0.024	23.8	< 0.02	0.04	3.5	1.44	< 0.5	0.06	< 1	-14.53	-2.6	-9		0.3	1.5	< 0.01
S98-00716	251435030	6	61	82	0.23	0.026	< 0.05	0.71	54.8	< 0.02	0.045	239	0.34	< 0.5	< 0.05	< 1	-18.1	-2.8	-18		< 0.1	3.1	< 0.01
S98-00717	2514380302	8	< 6	82	0.54	0.01	< 0.05	0.355	19.1	0.03	0.01	63.8	1.18	< 0.5	< 0.05	< 1	-15.23	-2.8	-23		< 0.1	5	< 0.01
S98-00718	2514310666	2	94	256	0.04	0.01	< 0.05	0.043	56.9	< 0.02	0.009	5.4	0.52	< 0.5	< 0.05	< 1	-17.94	-2.1	-15		0.1	4.5	< 0.01
S98-00719	2514310536	4	78	165	0.06	0.005	< 0.05	0.47	27.4	< 0.02	0.005	5.4	0.37	< 0.5	< 0.05	< 1	-18.28	-2.4	-20		< 0.1	5.8	< 0.01
S98-00720	2514340272	< 1	< 6	< 6	0.04	0.08	< 0.05	0.2	27.4	< 0.02	< 0.005	47.3	0.13	< 0.5	< 0.05	< 1	-14.19	-3.1	-14		< 0.1	1.9	< 0.01
S98-00721	2514340951	4	< 6	180	0.4	0.184	0.09	5.3	124	< 0.02	0.061	1240	1.01	< 0.5	0.09	< 1	-10.51	-5.4	-35		< 0.1	8.5	0.01

SAMPLE ID	Eh mV	Er ug/L	Eu ug/L	F mg/L	Fe mg/L	Ga ug/L	Gd ug/L	Ge ug/L	HCO_3 mg/L	Ho ug/L	I ug/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S97-00331		< 0.009	< 0.006	0.37	0.24	0.14	< 0.02	0.03	508	< 0.002	9.5	4.6	0.015	1.31	< 0.004	24.7	1.04	10.5	16.4	< 0.01	1.17	5.2	0.135	0.48
S97-00332	336	< 0.009	< 0.006	0.25	< 0.006	0.05	< 0.02	0.08	585	< 0.002	1	22.2	< 0.008	4.9	< 0.004	41.5	0.004	0.6	115	< 0.01	< 0.02	6.6	0.151	23
S97-00333	106	< 0.009	< 0.006	0.3	6.33	0.19	< 0.02	< 0.02	491	< 0.002	10.2	5	< 0.008	1.54	< 0.004	23.2	1.26	7.9	13.7	< 0.01	2.67	5.2	0.026	0.14
S97-00334	72	< 0.009	< 0.006	0.18	7.69	0.17	< 0.02	0.05	578	< 0.002	9.6	4.9	0.01	1.62	< 0.004	30.4	1.16	4.1	22	< 0.01	1.55	5.9	< 0.003	< 0.01
S97-00335	175	< 0.009	< 0.006	0.31	0.158	0.09	< 0.02	< 0.02	511	< 0.002	17	3.7	0.012	1.71	< 0.004	23.2	0.695	13.5	13.8	< 0.01	0.97	6.1	< 0.003	< 0.01
S97-00336	44	< 0.009	< 0.006	0.18	3.54	0.16	< 0.02	0.03	434	< 0.002	2.1	3.6	0.011	1.47	< 0.004	20.1	0.965	1.3	14.1	< 0.01	0.74	4.9	0.004	0.22
S97-00337	84	< 0.009	< 0.006	0.13	1.79	0.13	< 0.02	0.03	547	< 0.002	5.8	6	0.013	2.95	< 0.004	29.2	0.885	1.6	38.5	< 0.01	0.69	6	0.009	0.44
S97-00338	167	< 0.009	< 0.006	0.22	0.401	0.28	< 0.02	< 0.02	614	< 0.002	18.8	5	0.011	2.46	< 0.004	33.6	1.87	4.8	16.9	< 0.01	1.33	7.2	0.029	0.64
S97-00339	45	< 0.009	< 0.006	0.13	4.38	0.35	< 0.02	< 0.02	528	< 0.002	13.2	4.9	< 0.008	1.63	< 0.004	25.3	2.07	2.7	19.3	< 0.01	0.63	6.7	0.009	0.02
S97-00340	26	< 0.009	< 0.006	0.21	10.3	0.2	< 0.02	0.04	605	< 0.002	12.7	5.3	0.016	1.77	< 0.004	32.4	1.26	4.8	18.1	< 0.01	3.2	6.4	< 0.003	< 0.01
S97-00341	100	< 0.009	< 0.006	0.15	1.38	0.15	< 0.02	< 0.02	506	< 0.002	6.9	5.2	0.011	2.24	< 0.004	28.6	1.06	1.9	17.7	< 0.01	0.93	6.1	0.047	0.34
S97-00342	124	< 0.009	< 0.006	0.14	0.439	0.06	< 0.02	< 0.02	408	< 0.002	2	6.1	< 0.008	1.56	< 0.004	25.2	0.37	0.4	17	< 0.01	< 0.02	4.4	< 0.003	< 0.01
S97-00343	79	< 0.009	< 0.006	0.14	2.47	0.11	< 0.02	< 0.02	419	< 0.002	3.3	4.3	< 0.008	1.68	< 0.004	22.4	0.592	1	19.7	< 0.01	0.52	4.6	< 0.003	0.02
S97-00344	225	< 0.009	< 0.006	0.24	6.3	< 0.02	< 0.02	0.1	169	< 0.002	5.5	0.6	< 0.008	3.29	< 0.004	6.34	0.036	0.3	18.4	< 0.01	< 0.02	2.7	< 0.003	< 0.01
S97-00345	29	< 0.009	< 0.006	0.15	2.04	0.13	< 0.02	< 0.02	388	< 0.002	3.3	4.3	0.009	1.19	< 0.004	19.6	0.651	0.8	18.2	< 0.01	< 0.02	4.8	< 0.003	< 0.01
S97-00346	34	< 0.009	< 0.006	0.15	3.33	0.13	< 0.02	0.05	483	< 0.002	4.6	4.6	0.01	1.13	< 0.004	23.5	0.84	1.6	15.3	< 0.01	0.54	5.6	< 0.003	< 0.01
S97-00347	78	< 0.009	< 0.006	0.13	1.43	0.12	< 0.02	< 0.02	444	< 0.002	1.4	5.2	0.009	1.87	< 0.004	27.7	0.81	1	18.8	< 0.01	0.04	5.2	0.041	0.13
S97-00348	45	< 0.009	< 0.006	0.11	5.56	0.15	< 0.02	< 0.02	630	< 0.002	12.6	4.9	0.011	2.14	< 0.004	32.6	1.09	2.1	25.5	< 0.01	1.09	6.1	0.052	0.41
S97-00349	38	< 0.009	< 0.006	0.15	8.6	0.18	< 0.02	< 0.02	555	< 0.002	7.5	4.3	< 0.008	1.74	< 0.004	29.2	1.03	2.9	14	< 0.01	1.53	5.9	0.013	0.64
S97-00350	145	< 0.009	< 0.006	0.1	1.28	0.15	< 0.02	< 0.02	488	< 0.002	1.5	3.7	0.01	2.24	< 0.004	29.5	0.858	1.4	8.3	< 0.01	0.71	5.3	0.004	0.1
S97-00351	49	< 0.009	< 0.006	0.17	3.72	0.13	< 0.02	< 0.02	472	< 0.002	3	3.4	0.012	1.19	< 0.004	20.8	0.759	2.2	15.5	< 0.01	0.93	4.9	< 0.003	1.02
S97-00352	136	< 0.009	< 0.006	0.19	0.552	0.16	< 0.02	< 0.02	641	< 0.002	14.4	4.6	0.009	1.89	< 0.004	34	1.23	6.4	14	< 0.01	2.18	7.1	< 0.003	< 0.01
S97-00353	33	< 0.009	< 0.006	0.26	8.25	0.16	< 0.02	0.04	593	< 0.002	16.1	4.6	< 0.008	1.49	< 0.004	27.9	1.15	8.4	14.1	< 0.01	2.61	6	< 0.003	< 0.01
S97-00354	248	< 0.009	< 0.006	0.21	0.05	0.1	< 0.02	< 0.02	549	< 0.002	3.2	6.3	< 0.008	2.18	< 0.004	32	0.658	2.2	29.8	< 0.01	0.15	6.9	0.092	8.38
S97-00355	160	< 0.009	< 0.006	0.22	0.159	0.14	< 0.02	< 0.02	413	< 0.002	1.2	2.8	0.012	1.76	< 0.004	19.1	0.791	0.8	15.7	< 0.01	0.19	4.3	0.004	0.03
S97-00356	182	< 0.009	< 0.006	0.3	0.106	0.04	< 0.02	< 0.02	313	< 0.002	1.8	2.9	0.016	2.31	< 0.004	14.3	0.264	3.5	13	< 0.01	0.13	4	0.023	0.26
S97-00357	58	< 0.009	< 0.006	0.24	1.01	0.07	< 0.02	< 0.02	291	< 0.002	6.6	2	< 0.008	1.82	< 0.004	14.9	0.489	1.6	6.7	< 0.01	0.55	3	0.004	0.12
S97-00358	290	0.01	< 0.006	0.55	0.01	< 0.02	< 0.02	0.05	432	0.003	30	0.8	< 0.008	10.6	< 0.004	22.2	0.13	0.4	41.7	< 0.01	0.03	2.9	< 0.003	0.05
S97-00359	138	< 0.009	< 0.006	0.18	0.659	0.14	< 0.02	< 0.02	486	< 0.002	1.3	5.6	0.015	2.63	< 0.004	27.1	0.829	0.8	54.1	< 0.01	0.46	4.9	< 0.003	< 0.01
S98-00701	119	< 0.01	< 0.006	0.25	1.17		< 0.01		629	< 0.005	154	11.1	< 0.005	3	< 0.005	32.7	0.624	5.6	211	< 0.01	1.98	1.7	0.005	< 0.3
S98-00702	59	< 0.01	< 0.006	0.17	0.837		< 0.01		285	< 0.005	6.8	5.6	< 0.005	2.5	< 0.005	20.8	0.066	< 0.1	55.7	< 0.01	< 0.02	1	0.161	< 0.3
S98-00703	86	< 0.01	< 0.006	0.21	0.74		< 0.01		497	< 0.005	29	19.1	0.006	2.8	< 0.005	46.4	0.79	2.4	37.5	< 0.01	< 0.02	2	6.21	3.6
S98-00704	78	< 0.01	0.006	0.17	2.36		< 0.01		251	< 0.005	6.1	4.1	< 0.005	3.2	< 0.005	18.7	0.123	< 0.1	46.1	< 0.01	0.34	0.9	0.003	< 0.3
S98-00705	57	< 0.01	< 0.006	0.18	3.32		< 0.01		432	< 0.005	51.7	4.5	< 0.005	2.3	< 0.005	33.9	0.538	2.5	15.8	< 0.01	1.58	2.1	0.005	< 0.3
S98-00706	25	0.01	< 0.006	0.27	6.78		< 0.01		1110	< 0.005	1240	14	0.01	2.4	< 0.005	58.2	0.21	20	453	< 0.01	7.41	1.9	< 0.002	< 0.3
S98-00707	94	< 0.01	< 0.006	0.15	5.22		< 0.01		271	< 0.005	24.5	3.4	0.011	2.6	< 0.005	25	0.535	0.7	20.1	< 0.01	0.09	1	< 0.002	< 0.3
S98-00709	48	< 0.01	0.009	0.18	7.62		< 0.01		612	< 0.005	210	7	0.01	2.5	< 0.005	40.9	1.09	7.2	64.6	< 0.01	4.52	2.7	< 0.002	< 0.3
S98-00710	156	0.01	< 0.006	0.2	0.97		< 0.01		266	< 0.005	4.9	4.6	< 0.005	4.6	< 0.005	17.3	0.084	0.2	40.9	< 0.01	0.16	1	< 0.002	< 0.3
S98-00711	41	0.01	0.009	0.14	24.8		< 0.01		785	< 0.005	756	10.1	0.016	3.4	< 0.005	62.6	0.979	4.1	183	< 0.01	6.93	5	< 0.002	< 0.3
S98-00713	91	< 0.01	< 0.006	0.31	3.47		< 0.01		466	< 0.005	70.6	8.3	0.006	2.1	< 0.005	38.9	0.746	8.9	27	< 0.01	2.18	1.6	3.84	0.3
S98-00714	82	< 0.01	< 0.006	0.26	3.79		< 0.01		641	< 0.005	134	8.8	0.01	3.1	< 0.005	32.3	0.654	9.5	158	< 0.01	3.28	2.8	< 0.002	< 0.3
S98-00715	129	< 0.01	< 0.006	0.2	0.527		< 0.01		254	< 0.005	3.4	4.4	0.02	6.1	< 0.005	16.9	0.106	0.6	33.2	0.02	< 0.02	4	< 0.002	< 0.3
S98-00716	119	< 0.01	< 0.006	0.28	0.765		< 0.01		514	< 0.005	283	11.8	0.029	4.7	< 0.005	32.7	0.435	5.2	231	0.03	2.43	1.7	< 0.002	29.4
S98-00717	85	< 0.01	< 0.006	0.37	1.48		< 0.01		768	< 0.005	225	11.5	< 0.005	3.6	< 0.005	22.4	0.184	14.1	259	< 0.01	2.26	1.6	< 0.002	< 0.3
S98-00718	54	< 0.01	< 0.006	0.16	1.74		< 0.01		368	< 0.005	30.7	6.9	< 0.005	1.7	< 0.005	29.9	0.447	2.7	7.9	< 0.01	2.43	1.7	< 0.002	< 0.3
S98-00719	72	< 0.01	< 0.006	0.21	0.709		< 0.01		278	< 0.005	45.1	6.1	< 0.005	1.8	< 0.005	27.4	0.483	5	16	< 0.01	2.01	0.9	< 0.002	< 0.3
S98-00720	120	< 0.01	< 0.006	0.23	3.61		< 0.01		195	< 0.005	5	3.7	< 0.005	6.8	< 0.005	19.4	0.094	< 0.1	28.1	< 0.01	0.09	0.9	< 0.002	< 0.3
S98-00721	37	0.01	0.01	0.23	11.3		< 0.01		719	0.007	1150	22.3	0.031	4.8	< 0.005	105	0.316	6.4	725	0.02	17.8	3	< 0.002	< 0.3

SAMPLE ID	Ptot mg/L	Pb ug/L	pH	Pr ug/L	Rb ug/L	Sb ug/L	SEC uS/cm	Se ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	T °C	Tb ug/L	Th ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S97-00331	0.2	0.07	7.32	< 0.006	0.459	< 0.1	812		11.3	< 0.005		1.5	0.496	25.5	< 0.004	< 0.02	< 0.005	< 0.004	0.354		0.047	0.011	40.8
S97-00332	< 0.2	0.07	7.26	< 0.006	5.67	< 0.1	1562		11.3	< 0.005		70.9	0.614	24.9	< 0.004	< 0.02	0.016	< 0.004	13.2		0.032	0.006	24.1
S97-00333	0.7	0.33	7.21	< 0.006	3.27	< 0.1	780		10.9	< 0.005		0.6	0.393	24.2	< 0.004	< 0.02	< 0.005	< 0.004	< 0.007		0.011	0.002	301
S97-00334	1	< 0.05	7.17	< 0.006	3.74	0.4	940		12.1	< 0.005		0.6	0.423	26	< 0.004	< 0.02	< 0.005	< 0.004	0.009		0.017	0.006	21.8
S97-00335	0.3	0.05	7.25	< 0.006	0.977	< 0.1	843		13.4	< 0.005		0.6	0.358	26	< 0.004	< 0.02	< 0.005	< 0.004	0.472		0.038	0.002	15
S97-00336	0.7	0.1	7.1	< 0.006	1.92	< 0.1	674		13.1	0.007		1.5	0.27	27.9	< 0.004	< 0.02	< 0.005	< 0.004	0.011		0.012	0.004	10.3
S97-00337	0.3	< 0.05	6.98	< 0.006	2.59	< 0.1	977		13	< 0.005		14.5	0.386	27.6	< 0.004	< 0.02	< 0.005	< 0.004	0.664		0.022	0.005	10.7
S97-00338	< 0.2	0.39	6.96	< 0.006	1.55	< 0.1	932		13.1	< 0.005		0.6	0.569	26.9	< 0.004	< 0.02	< 0.005	< 0.004	0.465		0.044	0.005	17.6
S97-00339	0.8	< 0.05	7.27	< 0.006	2.35	< 0.1	872		9.35	< 0.005		0.5	0.391	27.5	< 0.004	< 0.02	< 0.005	< 0.004	0.017		0.02	0.003	2.5
S97-00340	0.8	< 0.05	7.15	< 0.006	3	< 0.1	948		11.7	< 0.005		0.6	0.567	26.9	< 0.004	< 0.02	< 0.005	< 0.004	< 0.007		0.012	< 0.002	8.2
S97-00341	< 0.2	< 0.05	7.1	< 0.006	1.59	< 0.1	886		14.8	< 0.005		11.1	0.349	27.3	< 0.004	< 0.02	< 0.005	< 0.004	0.433		0.039	0.007	4
S97-00342	< 0.2	0.05	7.34	< 0.006	1.56	< 0.1	773		6.15	< 0.005		14.5	0.309	25.2	< 0.004	< 0.02	< 0.005	< 0.004	15.2		0.009	0.003	19
S97-00343	< 0.2	< 0.05	7.21	< 0.006	1.83	< 0.1	742		14.2	< 0.005		11.4	0.291	25.9	< 0.004	< 0.02	< 0.005	< 0.004	0.429		0.028	0.003	51.5
S97-00344	< 0.2	< 0.05	6.29	< 0.006	0.514	< 0.1	285		24.6	< 0.005		0.3	0.151	26.4	< 0.004	0.02	< 0.005	< 0.004	0.042		0.011	< 0.002	102
S97-00345	0.3	< 0.05	7.28	< 0.006	1.06	< 0.1	752		10.8	< 0.005		16	0.232	25.9	< 0.004	< 0.02	< 0.005	< 0.004	0.023		0.017	< 0.002	4
S97-00346	0.7	< 0.05	7.23	< 0.006	1.57	< 0.1	830		11.7	< 0.005		4.9	0.375	25.3	< 0.004	< 0.02	< 0.005	< 0.004	0.014		0.031	0.004	10.7
S97-00347	0.6	0.12	7.2	< 0.006	1.16	< 0.1	813		11.4	0.012		14.7	0.34	26.3	< 0.004	< 0.02	< 0.005	< 0.004	0.114		0.012	< 0.002	4.4
S97-00348	0.6	< 0.05	7.02	< 0.006	3.05	< 0.1	1004		13	< 0.005		7.9	0.506	26.8	< 0.004	< 0.02	< 0.005	< 0.004	0.017		0.024	< 0.002	4.4
S97-00349	0.5	0.22	7.05	< 0.006	3.24	< 0.1	853		12.6	0.014		0.5	0.439	26	< 0.004	< 0.02	< 0.005	< 0.004	< 0.007		0.01	< 0.002	12
S97-00350	< 0.2	0.09	7.1	< 0.006	1.39	< 0.1	761		14.3	0.01		2.1	0.414	25	< 0.004	< 0.02	< 0.005	< 0.004	0.183		0.029	0.002	4.3
S97-00351	0.5	0.05	7.16	< 0.006	1.26	< 0.1	747		13.3	0.013		0.3	0.28	26.7	< 0.004	< 0.02	< 0.005	< 0.004	0.009		0.009	0.003	80.1
S97-00352	0.3	< 0.05	7.23	< 0.006	1.54	< 0.1	952		13	< 0.005		0.5	0.573	25.4	< 0.004	< 0.02	< 0.005	< 0.004	0.18		0.024	0.006	3.4
S97-00353	0.7	< 0.05	7.14	< 0.006	1.15	< 0.1	934		11.5	< 0.005		0.5	0.496	25.4	< 0.004	< 0.02	< 0.005	< 0.004	0.032		0.009	< 0.002	2.1
S97-00354	< 0.2	< 0.05	7.04	< 0.006	2.78	< 0.1	1109		11.8	0.01		13.5	0.527	24.6	< 0.004	< 0.02	< 0.005	< 0.004	1.24		0.013	< 0.002	35.7
S97-00355	0.5	< 0.05	7.2	< 0.006	1.17	< 0.1	704		11.9	< 0.005		2.9	0.192	25.5	< 0.004	< 0.02	< 0.005	< 0.004	0.138		0.018	< 0.002	1.7
S97-00356	< 0.2	0.21	7.14	< 0.006	0.801	< 0.1	604		10.6	< 0.005		28.6	0.241	26	< 0.004	< 0.02	< 0.005	< 0.004	1.37		0.043	0.002	12.6
S97-00357	< 0.2	< 0.05	7.2	< 0.006	0.406	< 0.1	475		14.2	< 0.005		1.1	0.2	24.8	< 0.004	< 0.02	< 0.005	< 0.004	0.05		0.014	< 0.002	7.1
S97-00358	< 0.2	0.12	6.92	< 0.006	0.163	< 0.1	654		15	0.006		1.3	0.346	27.3	< 0.004	< 0.02	< 0.005	< 0.004	1.94		0.171	0.019	17.4
S97-00359	< 0.2	0.24	7.07	< 0.006	1.78	< 0.1	988		14.2	0.019		28.4	0.274	27.5	< 0.004	< 0.02	< 0.005	< 0.004	0.973		0.048	0.003	5.8
S98-00701	0.7	0.27	7.2	< 0.005	1	0.05	1440		12.2	< 0.01	< 0.1	1.2	0.304	27.4	< 0.005		< 0.01	< 0.005	0.93	< 0.2	0.023	< 0.008	48
S98-00702	0.3	0.07	7.22	< 0.005	3.4	< 0.02	577		20.4	< 0.01	< 0.1	< 0.2	0.288	28.7	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.008	< 0.008	6
S98-00703	0.5	0.06	7.17	< 0.005	2.2	0.03	830		11	< 0.01	< 0.1	0.6	0.352	26.9	< 0.005		< 0.01	< 0.005	2.51	< 0.2	0.047	< 0.008	4
S98-00704	0.3	0.05	6.92	< 0.005	3.1	< 0.02	490		24	< 0.01	< 0.1	< 0.2	0.248	25.7	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	< 0.005	< 0.008	5
S98-00705	2	0.2	7.05	< 0.005	2.2	0.38	652		15.5	< 0.01	< 0.1	< 0.2	0.263	26.9	< 0.005		< 0.01	< 0.005	0.04	< 0.2	0.019	< 0.008	5
S98-00706	3.4	0.17	7.28	< 0.005	4.7	0.04	2490		10.8	< 0.01	< 0.1	0.5	0.444	24.9	< 0.005		< 0.01	< 0.005	< 0.01	0.5	0.088	0.01	3
S98-00707	0.9	0.37	6.78	< 0.005	3.3	< 0.02	441		14.2	< 0.01	0.5	8.4	0.128	24.6	< 0.005		< 0.01	< 0.005	0.08	< 0.2	0.016	< 0.008	17
S98-00709	1.8	0.24	7.06	< 0.005	3	0.05	1060		13.4	< 0.01	0.2	0.2	0.419	25.3	< 0.005		< 0.01	< 0.005	0.13	< 0.2	0.049	< 0.008	66
S98-00710	0.4	0.07	6.92	< 0.005	3.1	0.02	416	< 0.2	24.3	< 0.01	< 0.1	0.3	0.219	25.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	< 0.005	< 0.008	41
S98-00711	2.8	0.51	6.86	< 0.005	5	0.03	2090		15.3	< 0.01	0.3	0.4	0.749	24.6	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.087	< 0.008	
S98-00713	2.2	0.28	7.18	< 0.005	2.3	0.04	666	< 0.2	14.5	< 0.01	0.2	0.2	0.289	25.3	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.029	< 0.008	16
S98-00714	1.8	0.14	7.19	< 0.005	2.8	0.17	1060		14.4	< 0.01	< 0.1	0.3	0.274	24.7	< 0.005		< 0.01	< 0.005	0.15	0.4	0.027	< 0.008	6
S98-00715	< 0.2	0.13	6.99	< 0.005	6	0.16	395		27.3	< 0.01	< 0.1	0.6	0.212	31	< 0.005		< 0.01	< 0.005	0.21	1.3	0.032	< 0.008	12
S98-00716	0.9	0.11	7.12	< 0.005	2.4	< 0.02	1510		14.7	< 0.01	< 0.1	32.4	0.301	25.9	< 0.005		< 0.01	< 0.005	0.42	< 0.2	0.044	< 0.008	18
S98-00717	1.4	0.39	7.33	< 0.005	1.7	0.09	1230		14.5	< 0.01	0.4	0.4	0.175	24.3	< 0.005		< 0.01	< 0.005	0.27	0.6	0.041	0.01	25
S98-00718	1.2	0.45	7.23	< 0.005	1.4	< 0.02	539		13.9	< 0.01	< 0.1	< 0.2	0.246	25	< 0.005		< 0.01	< 0.005	0.08	< 0.2	0.02	< 0.008	32
S98-00719	0.6	0.62	7.37	< 0.005	2.1	0.03	417		12.1	< 0.01	0.2	< 0.2	0.171	24.5	< 0.005		< 0.01	< 0.005	0.05	< 0.2	0.015	< 0.008	46
S98-00720	0.3	0.23	6.68	< 0.005	3.2	< 0.02	436		27.6	< 0.01	< 0.1	< 0.2	0.211	26.8	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.005	< 0.008	17
S98-00721	2.7	0.1	7.15	0.007	9.5	0.05	4330		12.3	0.01	< 0.1	0.4	1.06	25.1	< 0.005		< 0.01	< 0.005	0.02	0.3	0.082	0.01	55

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST.	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-00722	BTS122	09/03/1998	22.9569	90.9375	1983	Private HF	7.9	Mr Abdul Mannan	Chittagong	Lakshmipur	Lakshmipur Sadar	Hajirpara	Uttar (N) Kalidasbag
S98-00723	BTS123	10/03/1998	22.985	90.9597	1987	Pumped Ir	182.9	Kansa Narayanpur	Chittagong	Lakshmipur	Lakshmipur Sadar	Uttar Joypur	Uttar (N) Joypur
S98-00724	BTS124	10/03/1998	22.965	90.9597	1995	Private HF	12.2	Mr Nurunnabi	Chittagong	Lakshmipur	Lakshmipur Sadar	Uttar Joypur	Chandra Prabhabag
S98-00725	BTS125	10/03/1998	22.9458	90.9919	1986	Private HF	9.1	Pratabganj Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Chandraganj	Deopara
S98-00726	BTS126	10/03/1998	22.9778	90.9911	1986	Private HF	10.4	Mr Faybul Hoque	Chittagong	Lakshmipur	Lakshmipur Sadar	Chandraganj	Amani Lakshmipur
S98-00727	BTS127	10/03/1998	22.9253	90.9744	1997	Private HF	262.1	Kamarchat Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Chandraganj	Ganipur
S98-00728	BTS128	10/03/1998	22.8889	90.9722	1993	Private HF	11	Mr Toraf Muah	Chittagong	Lakshmipur	Lakshmipur Sadar	Charsai	Titarkandi
S98-00729	BTS129	11/03/1998	22.9417	90.9592	1993	Private HF	7.9	Hajirpara Hamidi High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Hajirpara	Dakshin (S) Latibpur
S98-00730	BTS130	11/03/1998	22.905	90.9275	1996	Private HF	243.8	Mr Arun Chandra Kuri	Chittagong	Lakshmipur	Lakshmipur Sadar	Dighali	Dighali
S98-00732	BTS132	11/03/1998	22.8814	90.9453	1998	Private HF	12.2	Mr Mofizur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Charsai	Jagannathpur
S98-00733	BTS133	11/03/1998	22.8653	90.9372	1993	Private HF	7.9	Madha Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Kushakhali	Madna
S98-00734	BTS134	11/03/1998	22.8525	90.9058	1990	Village HP	182.9	Farashganj Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Kushakhali	Farasganj
S98-00735	BTS135	11/03/1998	22.8239	90.9064	1997	DPHE HI	243.8	Mr Arif Patwari	Chittagong	Lakshmipur	Lakshmipur Sadar	Kushakhali	Jhaudagi
S98-00736	BTS136	11/03/1998	22.8567	90.8642	1991	Unicef/DI	7.9	Miarbari Hydar Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Bhabaniganj	Char Monasa
S98-00737	BTS137	11/03/1998	22.9133	90.8369	1992	Private HF	12.2	Mr Fakhrul Alam	Chittagong	Lakshmipur	Lakshmipur Sadar	Laharkandi	Abirnagar
S98-00738	BTS138	12/03/1998	22.885	90.8581	1993	Private HF	12.2	Bhabaniganj High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Bhabaniganj	Bhabaniganj
S98-00739	BTS139	12/03/1998	22.8933	90.8894	1990	Village HP	259.1	Old Piaziganj Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Bhabaniganj	Binod Dharmapur
S98-00740	BTS140	12/03/1998	22.9144	90.9006	1998	Private HF	7.9	Mr A Matin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	Mandari
S98-00742	BTS142	12/03/1998	22.9439	90.9111	1991	Private HF	11	Mandari High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	Ratanpur
S98-00743	BTS143	12/03/1998	22.9128	90.8728	1997	Private HP TW		Chankhali High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Laharkandi	Chandkhali
S98-00744	BTS144	13/03/1998	22.96	90.9731	1989	Pumped Ir	176.8	Panchpara High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Chandraganj	Panchpara
S98-00745	BTS145	13/03/1998	22.9878	90.9303	1986	Pumped Ir	170.7	Dattapara KSS	Chittagong	Lakshmipur	Lakshmipur Sadar	Dattapara	Dattapara
S98-00746	BTS146	13/03/1998	22.9261	90.9289	1971	Private HF	14	Mr Saleh Ahmed Molla	Chittagong	Lakshmipur	Lakshmipur Sadar	Dighali	Purba (E) Jamirtali
S98-00747	BTS147	13/03/1998	22.8903	90.9142	1995	Private HF	7.9	Mr Shah Alam Kushaliuq	Chittagong	Lakshmipur	Lakshmipur Sadar	Kushakhali	Chiladi
S98-00748	BTS148	13/03/1998	22.9422	90.8828	1976	Private HF	7.9	Mr Abul Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	Jadia
S98-00749	BTS149	14/03/1998	22.9322	90.7767	1994	Private HF	7.9	Mr Munir Ahmed Bhuiyan	Chittagong	Lakshmipur	Lakshmipur Sadar	Char Ruhita	Char Ruhita
S98-00750	BTS150	14/03/1998	22.9664	90.7786	1986	Private HF	7.9	Mr Foyez Box Patwari	Chittagong	Lakshmipur	Lakshmipur Sadar	Char Ruhita	Char Mondal
S98-00751	BTS151	14/03/1998	22.9875	90.8644	1983	Private HF	7.9	Sonapur High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Parbatinagar	Sonapur
S98-00752	BTS152	14/03/1998	22.9347	90.8294	1992	Urban sup	318	DANIDA No. 1 Urban Supply	Chittagong	Lakshmipur	Lakshmipur Sadar	Lakshmipur Paurashava	
S98-00753	BTS153	14/03/1998	22.9336	90.8203	1992	Urban sup	305	DANIDA No. 2 Urban Supply	Chittagong	Lakshmipur	Lakshmipur Sadar	Lakshmipur Paurashava	
S98-00754	BTS154	14/03/1998	22.9836	90.8561	1991	Private HF	228.6	Mr Sekandar Master	Chittagong	Lakshmipur	Lakshmipur Sadar	Parbatinagar	Sonapur
S98-00755	BTS155	15/03/1998	22.9242	90.8583	1993	Private HF	7.9	Mr Hassan Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Laharkandi	Laharkandi
S98-00756	BTS156	15/03/1998	22.9414	90.8644	1991	Private HF	14	Mr Rofique	Chittagong	Lakshmipur	Lakshmipur Sadar	Laharkandi	Athiatali
S98-00758	BTS158	15/03/1998	22.9694	90.8092	1980	Unicef/DI	14	Dalal Bazar High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Dalal Bazar	Lakshmipur
S98-00759	BTS159	15/03/1998	22.9694	90.8092	1995	Private HF	243.8	Dalal Bazar High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Dalal Bazar	Lakshmipur
S98-00760	BTS160	15/03/1998	23.035	90.8306	1986	Private HF	11	Mr Saedul Hoq	Chittagong	Lakshmipur	Lakshmipur Sadar	Uttar Hamchadi	Shyamganj
S98-00761	BTS161	15/03/1998	23.0758	90.8319	1994	Private HF	14	Mr Abul Bashar	Chittagong	Lakshmipur	Ramganj	Chandipur	Chandipur
S98-00762	BTS162	15/03/1998	23.0778	90.8353	1997	Private HF	195.1		Chittagong	Lakshmipur	Ramganj	Chandipur	Chandipur
S98-00763	BTS163	15/03/1998	23.0778	90.8353	1984	Private HF	11		Chittagong	Lakshmipur	Ramganj	Chandipur	Chandipur
S98-00764	BTS164	16/03/1998	22.9239	90.9439	1992	Private HF	9.1	Bhuyian Bazar	Chittagong	Lakshmipur	Lakshmipur Sadar	Dighali	Fatehpur
S98-00765	BTS165	16/03/1998	22.9431	90.9406	1973	Private HF	7.9	Mrs Ozifa Chowdhury	Chittagong	Lakshmipur	Lakshmipur Sadar	Hajirpara	Char Chamita
S98-00766	BTS201	06/03/1998	23.6147	89.8553	1983	Private HF	24.4	Tepokhola	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	Tepokhola
S98-00767	BTS202	06/03/1998	23.6075	89.8633	1997	Private HF	27.4	Mr Md Mubarak Mattaber	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	Dakshin (S) Tepokhola
S98-00768	BTS203	06/03/1998	23.6031	89.8272	1980	Private HF	36.6	Goalchaot Wireless para	Dhaka	Faridpur	Faridpur Sadar	Ambikapur	Alipur
S98-00769	BTS204	06/03/1998	23.6064	89.8444	1996	Private HF	18.9	DCs residence	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	Tepokhola
S98-00770	BTS205	06/03/1998	23.5689	89.8536	1983	Private HF	45.7	Mr Solimuddin Mollik	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Bil Mamudpur
S98-00771	BTS206	07/03/1998	23.5792	89.8014	1986	Private HF	54.3	Mr Akisuddin Mollah	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Domrakandi
S98-00772	BTS207	07/03/1998	23.5622	89.7992	1997	Private HF	65.5	Mr Md Aziz Mollah	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Muraridaha

SAMPLE ID	GEOCODE	Al ug/L	AsIII ug/L	AsTot ug/L	B mg/L	Ba mg/L	Be ug/L	Br mg/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	^{34}S ‰	diss O2 mg/L	DOC mg/L	Dy ug/L
S98-00722	2514350683	2	9	86	0.04	0.021	< 0.05	0.076	48.5	< 0.02	< 0.005	72	0.3	< 0.5	< 0.05	< 1	-19.03	-3.8	-22		< 0.1	3.2	< 0.01
S98-00723	2514395986	< 1	< 6	< 6	0.06	0.254	< 0.05	1.21	66	< 0.02	< 0.005	295	0.24	< 0.5	< 0.05	< 1	-12.95	-3.1	-16		< 0.1	4.7	< 0.01
S98-00724	2514395147	2	31	38	0.26	0.013	< 0.05	0.7	16.6	< 0.02	0.012	157	0.29	< 0.5	< 0.05	< 1	-17.86	-3.6	-27		< 0.1	4.9	< 0.01
S98-00725	2514320289	1	206	262	0.26	0.01	< 0.05	0.235	20	< 0.02	< 0.005	72.1	0.18	< 0.5	< 0.05	< 1	-19.57	-2.3	-11		< 0.1	3	< 0.01
S98-00726	2514320038	< 1	141	404	0.08	0.014	< 0.05	0.087	40.2	< 0.02	0.014	23.6	1.01	< 0.5	< 0.05	< 1	-15.67	-1.5	-20		< 0.1	4.4	< 0.01
S98-00727	2514320346	3	< 6	8	0.03	0.383	< 0.05	2.98	111	< 0.02	< 0.005	637	0.32	< 0.5	0.08	< 1	-13.69	-4	-23		< 0.1	4.2	< 0.01
S98-00728	2514325947	2	76	85	0.27	0.017	< 0.05	0.6	55.6	< 0.02	0.009	133	0.57	< 0.5	< 0.05	< 1	-16.5	-3.4	-26		< 0.1	4.5	< 0.01
S98-00729	2514350250	5	50	98	0.2	0.01	< 0.05	0.071	30.9	0.04	0.013	15.6	0.22	< 0.5	< 0.05	2	-17.3	-2.4	-16		< 0.1	2.9	< 0.01
S98-00730	2514345298	2	< 6	< 6	0.04	0.102	< 0.05	0.309	35.2	< 0.02	< 0.005	68	0.11	< 0.5	< 0.05	< 1	-15.76	-3.1	-17		< 0.1	3.4	< 0.01
S98-00732	2514325445	2	< 6	22	0.54	0.055	< 0.05	5	128	0.03	0.058	1090	0.66	< 0.5	< 0.05	< 1		-6.6	-47		< 0.1	3.6	0.02
S98-00733	2514355579	8	< 6	< 6	0.82	0.073	< 0.05	4.9	81	0.03	0.037	1290	0.63	< 0.5	< 0.05	< 1	-14.21	-2.4	-18	13.8	< 0.1	3.8	0.01
S98-00734	2514355315	11	< 6	< 6	0.05	0.069	< 0.05	0.099	27.9	< 0.02	0.011	24.7	0.08	< 0.5	< 0.05	< 1	-12.77	-1.8	-16		< 0.1	2.5	< 0.01
S98-00735	2514355471	2	< 6	< 6	0.05	0.121	< 0.05	0.325	38	< 0.02	< 0.005	74.6	0.1	< 0.5	< 0.05	< 1	-12.48	-2	-16		< 0.1	1.4	< 0.01
S98-00736	2514315181	4	8	15	0.25	0.014	< 0.05	0.34	28.3	< 0.02	0.014	115	0.41	< 0.5	< 0.05	< 1	-11.07	-2.7	-22		< 0.1	4.2	< 0.01
S98-00737	2514360012	1	50	103	0.05	0.012	< 0.05	0.063	58.8	< 0.02	< 0.005	72.1	0.25	< 0.5	< 0.05	< 1	-17.3	-4.4	-26		0.1	3.4	< 0.01
S98-00738	2514315121	4	52	86	0.26	0.013	< 0.05	0.26	38.6	< 0.02	0.009	96	0.22	< 0.5	< 0.05	< 1	-17.56	-3.4	-19		< 0.1	4.3	< 0.01
S98-00739	2514315125	12	< 6	< 6	0.05	0.219	< 0.05	1.29	80.4	0.04	0.009	324	0.23	< 0.5	0.08	1	-16.07	-3	-17		< 0.1	1	< 0.01
S98-00740	2514370609	4	27	46	0.1	0.01	< 0.05	0.5	27.3	< 0.02	0.033	155	0.22	< 0.5	< 0.05	< 1	-22.06	-2.8	-15		< 0.1	3.7	< 0.01
S98-00742	2514370865	3	50	62	0.16	0.01	< 0.05	0.255	34.8	< 0.02	0.012	64.3	0.43	< 0.5	< 0.05	< 1	-15.86	-4.3	-24		< 0.1	2.9	< 0.01
S98-00743	2514360138	1	37	43	0.06	0.005	< 0.05	0.34	27.6	0.02	0.012	89	0.45	< 0.5	< 0.05	< 1	-15.74	-4	-26		< 0.1	6.5	< 0.01
S98-00744	2514320713	1	< 6	< 6	0.04	0.167	< 0.05	1.03	61.2	< 0.02	< 0.005	310	0.16	< 0.5	< 0.05	< 1	-15.41	-4.2	-20	39.5	< 0.1	1.6	< 0.01
S98-00745	2514340272	3	< 6	< 6	0.05	0.33	< 0.05	1.22	66.3	< 0.02	< 0.005	310	0.21	< 0.5	< 0.05	< 1	-17.37	-3.5	-18		< 0.1	1.5	< 0.01
S98-00746	2514345791	5	26	55	0.05	0.042	< 0.05	0.08	57.8	< 0.02	0.02	23.9	0.43	< 0.5	< 0.05	< 1	-20.64	-4	-25		< 0.1	3.1	< 0.01
S98-00747	2514355216	4	< 6	< 6	0.52	0.062	< 0.05	5.6	104	0.05	0.027	1550	0.66	< 0.5	< 0.05	< 1	-16.63	-4	-31	19.9	0.2	1.5	0.01
S98-00748	2514370441	9	71	107	0.05	0.012	< 0.05	0.176	31.8	< 0.02	0.011	61.3	0.26	< 0.5	< 0.05	3	-16.41	-2.5	-18		< 0.1	1.8	< 0.01
S98-00749	2514330194	4	31	65	0.16	0.052	< 0.05	0.109	81.1	< 0.02	0.019	69.5	0.48	< 0.5	< 0.05	< 1	-19.43	-4.2	-31		< 0.1	2.6	0.01
S98-00750	2514330186	2	188	276	0.15	0.076	< 0.05	0.365	72.8	< 0.02	0.007	82.5	1.11	< 0.5	< 0.05	< 1		-4.8	-35		< 0.1	5.7	< 0.01
S98-00751	2514380925	< 1	54	114	0.07	0.017	< 0.05	0.074	42	< 0.02	0.005	11.1	1.5	< 0.5	< 0.05	< 1	-9.08	-2.6	-15		< 0.1	3	< 0.01
S98-00752	2514357	3	< 6	< 6	0.04	0.068	< 0.05	0.035	24	< 0.02	< 0.005	3.7	0.07	< 0.5	< 0.05	< 1		-2.3	-8			1.8	< 0.01
S98-00753	2514357	4	< 6	< 6	0.04	0.076	< 0.05	0.032	24.6	< 0.02	0.006	2.7	0.08	< 0.5	< 0.05	< 1	-13.22	-2.1	-8		0.7	0.7	< 0.01
S98-00754	2514380925	< 1	< 6	< 6	0.05	0.262	< 0.05	0.87	59.5	< 0.02	< 0.005	238	3.18	< 0.5	< 0.05	< 1	-12.29	-2.9	-16		< 0.1	1.2	< 0.01
S98-00755	2514360562	11	51	65	0.34	0.02	< 0.05	1.02	33.3	< 0.02	0.013	254	0.41	< 0.5	< 0.05	< 1	-15.4	-4.3	-30		< 0.1	3.8	< 0.01
S98-00756	2514360056	4	51	142	0.08	0.011	< 0.05	0.087	22	0.13	0.011	27.1	2.27	< 0.5	< 0.05	< 1	-16.53	-3.5	-21		< 0.1	2.4	< 0.01
S98-00758	2514335571	2	50	194	0.06	0.058	< 0.05	0.021	74.1	< 0.02	< 0.005	6.2	0.64	< 0.5	< 0.05	< 1	-16.6	-2.9	-20		< 0.1	2.5	< 0.01
S98-00759	2514335571	2	< 6	< 6	0.05	0.136	< 0.05	0.51	35.3	< 0.02	0.005	129	0.22	< 0.5	< 0.05	< 1	-13.03	-2.1	-13		0.2	0.3	< 0.01
S98-00760	2514375934	25	38	54	0.08	0.015	< 0.05	0.061	28.9	0.05	0.021	14.9	0.4	0.5	< 0.05	2	-17.71	-3.2	-26		< 0.1	1.6	< 0.01
S98-00761	2516523192	2	455	702	0.21	0.055	< 0.05	1.53	69.4	0.11	0.007	414	1.41	< 0.5	0.07	< 1	-7.92	-4.5	-26		< 0.1	9.8	< 0.01
S98-00762	2516523192	3	< 6	< 6	0.05	0.111	< 0.05	0.37	36.7	< 0.02	0.034	74	0.23	< 0.5	< 0.05	< 1	-9.12	-1.9	-12		< 0.1	3.1	< 0.01
S98-00763	2516523192	7	501	986	0.15	0.014	< 0.05	0.043	37.3	0.02	< 0.005	6.3	0.34	< 0.5	< 0.05	< 1	-21.31	-4	-26		< 0.1	3.2	< 0.01
S98-00764	2514345324	2	92	153	0.21	0.025	< 0.05	0.16	39.3	< 0.02	0.125	34.8	0.55	< 0.5	< 0.05	< 1	-19.96	-3.4	-20		0.1	5.9	< 0.01
S98-00765	2514350164	1	55	84	0.04	0.011	< 0.05	0.04	27.2	< 0.02	< 0.005	7.1	0.3	< 0.5	< 0.05	< 1	-20.42	-2.3	-14			1.3	< 0.01
S98-00766	3294719	2	7	16	0.02	0.163	< 0.05	0.05	127	< 0.02	0.016	27.6	0.39	< 0.5	< 0.05	< 1	-15.73	-4.4	-30		< 0.1	0.8	< 0.01
S98-00767	3294719	3	990	1460	0.05	0.13	< 0.05	0.07	142	0.03	< 0.005	9.3	0.71	< 0.5	< 0.05	< 1	-10.07	-3.2	-18		< 0.1	2.5	< 0.01
S98-00768	3294715025	5	27	306	0.03	0.251	< 0.05	0.03	116	< 0.02	< 0.005	33.9	0.67	< 0.5	< 0.05	< 1	-15.52	-3.4	-23		< 0.1	1.9	< 0.01
S98-00769	3294719	4	< 6	49	0.03	0.175	< 0.05	0.04	116	< 0.02	0.017	16.5	0.38	< 0.5	< 0.05	< 1	-13.57	-4.1	-26		< 0.1	1.7	< 0.01
S98-00770	329477164	4	< 6	36	0.06	0.077	< 0.05	0.13	88.4	< 0.02	< 0.005	13.5	0.59	< 0.5	0.13	< 1		-4.2	-27		< 0.1	6.6	< 0.01
S98-00771	3294755361	1	39	106	0.07	0.303	< 0.05	0.09	65.7	< 0.02	< 0.005	7.2	1.75	< 0.5	0.21	< 1	-8.64	-3.7	-28		< 0.1	3.6	< 0.01
S98-00772	3294755728	3	< 6	< 6	0.05	0.258	< 0.05	0.09	104	< 0.02	0.007	3.4	0.45	< 0.5	0.09	< 1	-12.93	-4.8	-25		< 0.1	2.4	< 0.01

SAMPLE ID	Eh mV	Er ug/L	Eu ug/L	F mg/L	Fe mg/L	Ga ug/L	Gd ug/L	Ge ug/L	HCO_3 mg/L	Ho ug/L	I ug/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S98-00722	100	< 0.01	< 0.006	0.24	1.87		< 0.01		397	< 0.005	24.7	10.7	< 0.005	3.1	< 0.005	60.5	1.72	1.1	27.1	< 0.01	0.86	1.6	< 0.002	< 0.3
S98-00723	115	< 0.01	0.023	0.17	10.9		< 0.01		205	< 0.005	14.7	6.8	0.005	10.5	< 0.005	47.7	0.399	< 0.1	84.6	< 0.01	1.02	2.1	< 0.002	< 0.3
S98-00724	96	< 0.01	< 0.006	0.3	0.317		< 0.01		410	< 0.005	104	7.1	0.011	3	< 0.005	15.7	0.231	3.4	205	< 0.01	1.18	0.8	< 0.002	< 0.3
S98-00725	28	< 0.01	< 0.006	0.45	0.767		< 0.01		519	< 0.005	89.4	11.5	< 0.005	2.1	< 0.005	27.7	0.199	3.5	153	< 0.01	3.97	0.8	< 0.002	< 0.3
S98-00726	27	< 0.01	< 0.006	0.25	5.43		0.01		393	< 0.005	49.2	10	< 0.005	2.1	< 0.005	45.8	0.772	3.7	17.9	< 0.01	3.05	1.3	< 0.002	< 0.3
S98-00727	128	< 0.01	0.014	0.18	9.46		< 0.01		125	< 0.005	59.2	6.9	0.011	18.7	< 0.005	75.8	0.294	< 0.1	201	< 0.01	0.34	6.6	< 0.002	< 0.3
S98-00728	78	< 0.01	< 0.006	0.28	2.21		< 0.01		566	< 0.005	151	11.8	0.006	3.7	< 0.005	46.8	0.893	4.4	144	< 0.01	2.51	1.6	< 0.002	< 0.3
S98-00729	66	< 0.01	< 0.006	0.36	0.629		< 0.01		393	< 0.005	86.5	8.6	< 0.005	2.6	< 0.005	21.1	0.272	12.9	69.2	< 0.01	4.72	1.2	< 0.002	< 0.3
S98-00730	99	< 0.01	< 0.006	0.26	2.97		< 0.01		188	< 0.005	5.1	3.8	< 0.005	6.5	< 0.005	20.1	0.098	< 0.1	33.2	< 0.01	< 0.02	1.4	< 0.002	< 0.3
S98-00732	114	0.01	< 0.006	0.08	1.6		0.02		797	< 0.005	560	23.4	0.03	10	< 0.005	119	1.55	1.1	679	0.02	1.87	3.5	< 0.002	< 0.3
S98-00733	150	0.03	< 0.006	0.11	0.59		0.01		1140	< 0.005	161	30.2	0.026	10.1	< 0.005	124	1.17	1.7	1090	0.02	2.05	2.9	< 0.002	< 0.3
S98-00734	81	< 0.01	< 0.006	0.17	0.716		< 0.01		271	< 0.005	5	6	0.01	5.2	< 0.005	16.9	0.051	< 0.1	43.8	< 0.01	< 0.02	0.8	< 0.002	< 0.3
S98-00735	74	< 0.01	< 0.006	0.17	1.07		< 0.01		261	< 0.005	14.8	8.3	0.005	5.6	< 0.005	24.4	0.089	< 0.1	55.2	< 0.01	0.29	1.4	< 0.002	< 0.3
S98-00736	125	< 0.01	0.007	0.29	0.154		< 0.01		570	< 0.005	50.3	12.4	0.01	2.8	< 0.005	22.4	0.295	3.5	203	< 0.01	0.79	1.2	< 0.002	< 0.3
S98-00737	81	< 0.01	< 0.006	0.23	6.25		< 0.01		385	< 0.005	34.6	6.2	0.006	2.8	< 0.005	46.6	0.534	1.3	24.8	< 0.01	1.09	1.7	< 0.004	< 0.3
S98-00738	75	< 0.01	< 0.006	0.35	1.54		< 0.01		568	< 0.005	79.8	18.1	0.009	4.4	< 0.005	58.1	0.445	4.7	113	< 0.01	3.33	1.2	0.004	< 0.3
S98-00739	120	< 0.01	< 0.006	0.21	5.64		< 0.01		188	< 0.005	19.2	7.6	0.012	12.3	< 0.005	51.6	0.198	< 0.1	81.6	< 0.01	0.61	2.5	< 0.004	< 0.3
S98-00740	85	< 0.01	< 0.006	0.38	0.823		< 0.01		317	< 0.005	16.3	6.7	0.015	3.7	< 0.005	27.5	0.504	7.4	130	0.01	1	0.9	< 0.004	< 0.3
S98-00742	81	< 0.01	< 0.006	0.24	0.621		< 0.01		463	< 0.005	94.7	11.7	0.005	4	< 0.005	38.7	0.442	4.6	97.9	< 0.01	3.37	1.2	< 0.004	< 0.3
S98-00743	140	< 0.01	< 0.006	0.15	2.44		< 0.01		266	< 0.005	28.5	3.1	0.006	6.4	< 0.005	26.6	1.19	0.2	82.9	< 0.01	< 0.02	0.9	< 0.004	< 0.3
S98-00744	98	< 0.01	0.01	0.25	5.65		< 0.01		171	< 0.005	26.5	3.8	< 0.005	9.5	< 0.005	31	0.355	< 0.1	128	0.01	0.32	1.9	< 0.004	< 0.3
S98-00745	127	< 0.01	0.009	0.16	12		< 0.01		149	< 0.005	23.6	7.2	0.006	10.9	< 0.005	50.5	0.319	< 0.1	83.9	< 0.01	1.3	2.1	< 0.004	< 0.3
S98-00746	105	< 0.01	< 0.006	0.14	1.07		< 0.01		429	< 0.005	15	10.4	0.014	3.3	< 0.005	46.1	0.854	0.7	17.8	< 0.01	1.84	2.2	< 0.004	< 0.3
S98-00747	160	0.01	0.006	0.14	0.351		< 0.01		497	< 0.005	158	37.3	0.014	10.1	< 0.005	145	1.09	1	934	0.03	1.27	3.3	< 0.004	< 0.3
S98-00748	109	< 0.01	< 0.006	0.19	2.63		< 0.01		273	< 0.005	26.1	9.7	0.007	3.7	< 0.005	39.1	1.2	1.6	22.2	< 0.01	< 0.02	1.2	< 0.004	1.6
S98-00749	89	< 0.01	< 0.006	0.13	3.12		< 0.01		641	< 0.005	34.7	11.9	0.015	3.5	< 0.005	67.2	1.79	1.2	60.7	0.02	0.8	2.4	< 0.004	< 0.3
S98-00750	35	< 0.01	0.009	0.18	6.84		< 0.01		546	< 0.005	243	7.3	< 0.005	2.3	< 0.005	41.8	0.577	3.5	79.2	< 0.01	6.99	2.1	< 0.004	< 0.3
S98-00751	67	< 0.01	< 0.006	0.22	1.26		< 0.01		275	< 0.005	38.6	4.6	< 0.005	1.7	< 0.005	23.1	0.435	3.6	17	< 0.01	1.67	< 0.4	0.006	< 0.3
S98-00752	94	< 0.01	0.008	0.19	1.19		< 0.01		246	< 0.005	3.3	3.7	< 0.005	5.3	< 0.005	16.9	0.076	< 0.1	32.3	< 0.01	0.07	0.8	< 0.004	< 0.3
S98-00753	158	< 0.01	< 0.006	0.2	1.54		< 0.01		215	< 0.005	2.4	3.5	0.006	4.8	< 0.005	16.4	0.089	< 0.1	31.7	< 0.01	0.2	1	< 0.004	< 0.3
S98-00754	90	< 0.01	< 0.006	0.15	4.53		< 0.01		190	< 0.005	12.9	6	< 0.005	6.9	< 0.005	43.3	0.165	0.2	64	< 0.01	0.93	< 0.4	< 0.004	< 0.3
S98-00755	111	< 0.01	< 0.006	0.3	0.634		< 0.01		688	< 0.005	178	14.9	0.006	5.3	< 0.005	46.6	0.629	7.9	281	< 0.01	2.51	2.1	< 0.004	< 0.3
S98-00756	115	< 0.01	< 0.006	0.21	3.92		< 0.01		271	< 0.005	27.3	4.6	0.007	4.8	< 0.005	18.6	1.29	2.4	48.6	< 0.01	0.88	6.8	< 0.004	< 0.3
S98-00758	57	< 0.01	< 0.006	0.16	7.03		< 0.01		422	< 0.005	57.4	5	0.006	1.8	< 0.005	30.2	1.28	2.2	18.1	< 0.01	1.93	3.5	< 0.004	< 0.3
S98-00759	108	< 0.01	< 0.006	0.17	3.74		< 0.01		217	< 0.005	8.4	4.2	0.005	5.8	< 0.005	24.1	0.093	< 0.1	68	< 0.01	1.05	2	< 0.004	< 0.3
S98-00760	156	< 0.01	< 0.006	0.29	0.833		< 0.01		278	< 0.005	35.4	6.2	0.013	2.7	< 0.005	29.7	0.543	3	22.4	< 0.01	< 0.02	2.4	< 0.004	1.2
S98-00761	36	< 0.01	< 0.006	0.29	10		< 0.01		597	< 0.005	410	10.7	< 0.005	4.2	< 0.005	43.5	0.253	6.1	277	< 0.01	14.7	5.1	4.47	< 0.3
S98-00762	97	< 0.01	< 0.006	0.24	2.58		< 0.01		268	< 0.005	14.8	3.7	0.017	5.6	< 0.005	22.7	0.173	< 0.1	70.5	< 0.01	0.36	2.1	< 0.004	< 0.3
S98-00763	18	< 0.01	< 0.006	0.45	1.84		< 0.01		324	< 0.005	20.1	5.2	< 0.005	2	< 0.005	13.9	0.495	12.8	40.1	< 0.01	3.83	1.6	< 0.004	< 0.3
S98-00764	83	< 0.01	< 0.006	0.36	1.71		< 0.01		405	< 0.005	48.8	7.3	0.1	2.4	< 0.005	34.8	0.555	5.9	53	0.02	2.35	2	< 0.004	< 0.3
S98-00765	113	< 0.01	< 0.006	0.21	0.782		< 0.01		266	< 0.005	15.2	5.5	< 0.005	3.3	< 0.005	31.3	0.824	1.2	12.2	< 0.01	< 0.02	1.6	< 0.004	1
S98-00766	-6	< 0.01	< 0.006	0.2	0.447		0.01		471	< 0.005	8.2	4.5	0.012	2.5	< 0.005	27.8	1.47	0.9	22.5	< 0.01	0.11	3.6	< 0.004	< 0.3
S98-00767	-28	< 0.01	< 0.006	0.4	4.24		< 0.01		580	< 0.005	34.4	3.9	< 0.005	1.2	< 0.005	29.6	1.13	20.5	25	< 0.01	1.36	3.9	< 0.004	< 0.3
S98-00768	-1	< 0.01	0.007	0.2	9.6		< 0.01		529	< 0.005	10.1	3.9	0.007	2.2	< 0.005	32.5	1.13	2.9	19	< 0.01	1.76	3.3	0.004	< 0.3
S98-00769	19	< 0.01	< 0.006	0.1	0.944		< 0.01		568	< 0.005	8.2	6.2	0.011	3	< 0.005	30.6	0.999	1.4	30.9	< 0.01	< 0.02	2.9	< 0.004	< 0.3
S98-00770	-20	< 0.01	< 0.006	0.24	7.68		< 0.01		561	< 0.005	44.2	5	< 0.005	4.3	< 0.005	40	0.08	1.4	36.6	< 0.01	< 0.02	2.4	< 0.004	4.7
S98-00771	80	< 0.01	< 0.006	0.18	16.1		< 0.01		563	< 0.005	37.1	7	0.006	8.5	< 0.005	40	0.082	1.9	40.2	< 0.01	10.2	3.6	< 0.004	< 0.3
S98-00772	86	< 0.01	< 0.006	0.12	11.3		< 0.01		590	< 0.005	70.8	4.1	0.006	5.6	< 0.005	38.6	0.103	1.7	24.7	< 0.01	4.89	2.3	< 0.004	< 0.3

SAMPLE ID	Ptot mg/L	Pb ug/L	pH	Pr ug/L	Rb ug/L	Sb ug/L	SEC uS/cm	Se ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	T °C	Tb ug/L	Th ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-00722	0.5	0.06	7.04	< 0.005	1.8	< 0.02	808		17.1	< 0.01	< 0.1	26.8	0.338	24.6	< 0.005		< 0.01	< 0.005	0.57	< 0.2	0.024	< 0.008	10
S98-00723	0.4	0.41	6.54	< 0.005	4.8	< 0.02	1160		24.3	< 0.01	< 0.1	< 0.2	0.522	26.4	< 0.005		< 0.01	< 0.005	0.02	< 0.2	0.012	< 0.008	5
S98-00724	0.6	0.24	7.35	< 0.005	1.3	0.02	1020		13.8	< 0.01	< 0.1	1.5	0.108	26.2	< 0.005		< 0.01	< 0.005	0.26	< 0.2	0.022	< 0.008	21
S98-00725	1.7	0.09	7.55	< 0.005	2	0.02	894		8.37	< 0.01	< 0.1	< 0.2	0.177	26	< 0.005		< 0.01	< 0.005	0.55	< 0.2	0.024	< 0.008	6
S98-00726	1.3	0.09	7.23	< 0.005	3.3	0.03	611		11.8	< 0.01	0.1	0.3	0.337	25.5	< 0.005		< 0.01	< 0.005	0.02	< 0.2	0.035	< 0.008	7
S98-00727	0.3	0.06	6.53	< 0.005	7.4	0.03	2000	< 0.2	27.2	0.01	< 0.1	4.9	0.873	26.3	< 0.005		< 0.01	< 0.005	< 0.01	0.2	0.014	< 0.008	63
S98-00728	0.7	0.11	7.23	< 0.005	2.6	0.02	1160		13.8	< 0.01	< 0.1	0.2	0.312	25	< 0.005		< 0.01	< 0.005	0.76	< 0.2	0.047	< 0.008	26
S98-00729	0.8	0.49	7.39	< 0.005	2	0.03	608	< 0.2	12.1	< 0.01	< 0.1	0.9	0.195	26.7	< 0.005		< 0.01	< 0.005	0.38	< 0.2	0.023	< 0.008	67
S98-00730	0.2	0.1	6.71	< 0.005	4.8	< 0.02	502		27.8	< 0.01	< 0.1	< 0.2	0.248	27.1	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.007	< 0.008	6
S98-00732	1.1	0.72	7.02	0.008	6.6	0.1	3600		11.2	< 0.01	< 0.1	85.6	0.93	27.1	< 0.005		< 0.01	0.005	8.8	< 0.2	0.108	0.011	56
S98-00733	0.5	0.14	7.03	< 0.005	4.9	0.06	4640		10.3	< 0.01	< 0.1	265	0.797	26.6	< 0.005		< 0.01	< 0.005	17.3	< 0.2	0.13	0.013	41
S98-00734	0.2	0.2	7.13	< 0.005	5	< 0.02	424		21.4	< 0.01	< 0.1	< 0.2	0.216	27.7	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.011	< 0.008	3
S98-00735	< 0.2	0.11	7.09	< 0.005	5.6	0.08	584		22.1	< 0.01	0.2	< 0.2	0.3	27.6	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.009	< 0.008	2
S98-00736	0.3	0.25	7.36	< 0.005	1	0.05	1050		10.5	< 0.01	0.1	6.9	0.176	26.3	< 0.005		< 0.01	< 0.005	1.72	< 0.2	0.049	0.01	13
S98-00737	1.2	0.12	6.99	< 0.005	3.1	< 0.02	723		16	< 0.01	< 0.1	10.8	0.266	24.7	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.029	< 0.008	6
S98-00738	1.1	0.35	7.25	< 0.005	3	0.03	1050		13.7	< 0.01	< 0.1	0.4	0.367	25.8	< 0.005		< 0.01	< 0.005	0.87	< 0.2	0.035	0.011	51
S98-00739	0.3	0.35	6.67	< 0.005	9.5	0.05	1180		26.8	< 0.01	< 0.1	< 0.2	0.594	27.3	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.018	< 0.008	10
S98-00740	0.4	0.13	7.26	< 0.005	3	< 0.02	886		14.3	< 0.01	< 0.1	0.8	0.174	26.6	< 0.005		< 0.01	< 0.005	0.48	< 0.2	0.039	< 0.008	13
S98-00742	0.6	0.47	7.2	< 0.005	2.8	0.03	883	< 0.2	13.8	< 0.01	0.2	6.3	0.251	26.3	< 0.005		< 0.01	< 0.005	0.36	< 0.2	0.037	< 0.008	23
S98-00743	< 0.2	0.2	6.72	< 0.005	1.7	< 0.02	650		12.8	< 0.01	< 0.1	17.7	0.111	26	< 0.005		< 0.01	< 0.005	0.09	< 0.2	0.022	< 0.008	3
S98-00744	< 0.2	0.31	6.59	< 0.005	4.2	0.34	1170		26.8	< 0.01	< 0.1	3	0.423	26.5	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.015	< 0.008	6
S98-00745	0.3	0.1	6.55	< 0.005	5.1	0.1	1130		23.3	< 0.01	< 0.1	1.1	0.545	26.9	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.013	< 0.008	6
S98-00746	0.3	0.12	6.99	< 0.005	2.2	0.28	638		18.1	< 0.01	< 0.1	12.1	0.33	25.3	< 0.005		< 0.01	< 0.005	1.18	0.2	0.041	< 0.008	19
S98-00747	0.3	0.55	7.59	< 0.005	7.1	0.12	4190		8.85	< 0.01	< 0.1	217	0.956	26	< 0.005		< 0.01	< 0.005	7.17	< 0.2	0.074	0.009	57
S98-00748	0.7	0.81	6.86	< 0.005	2	0.08	549		19.2	< 0.01	< 0.1	0.3	0.242	25.1	< 0.005		< 0.01	< 0.005	0.05	< 0.2	0.035	< 0.008	82
S98-00749	0.5	0.43	7.02	< 0.005	2.6	0.08	1010		11.6	< 0.01	0.2	17.9	0.444	24.6	< 0.005		< 0.01	< 0.005	3.23	< 0.2	0.088	0.008	4
S98-00750	2.9	0.09	7.04	< 0.005	2.5	0.04	958		16.2	< 0.01	< 0.1	< 0.2	0.379	25.1	< 0.005		< 0.01	< 0.005	< 0.01	0.2	0.022	< 0.008	27
S98-00751	1.6	0.09	7.09	< 0.005	1.1	0.09	442		16.5	< 0.01	< 0.1	< 0.2	0.172	25.9	< 0.005		< 0.01	< 0.005	0.06	2.3	0.017	< 0.008	14
S98-00752	0.3	0.3	7	< 0.005	4	< 0.02	433		27.2	< 0.01	< 0.1	< 0.2	0.209	31.1	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	< 0.005	< 0.008	7
S98-00753	0.3	0.18	7.01	< 0.005	3.7	0.03	420		24.8	< 0.01	< 0.1	< 0.2	0.225	29.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.006	< 0.008	12
S98-00754	0.3	0.16	6.75	< 0.005	5	0.17	933		22	< 0.01	< 0.1	< 0.2	0.506	25.3	< 0.005		< 0.01	< 0.005	< 0.01	2.2	0.01	< 0.008	23
S98-00755	1	0.15	7.18	< 0.005	4.3	0.1	1540		14.1	< 0.01	< 0.1	6.5	0.293	25.9	< 0.005		< 0.01	< 0.005	1.82	< 0.2	0.056	< 0.008	20
S98-00756	0.4	0.79	6.66	< 0.005	2.3	1.18	449		15.5	< 0.01	0.3	0.8	0.13	25.7	< 0.005		< 0.01	< 0.005	0.04	0.2	0.031	< 0.008	
S98-00758	2.8	0.1	6.86	< 0.005	2.7	0.04	597		18.6	< 0.01	< 0.1	0.4	0.296	26.6	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.022	< 0.008	20
S98-00759	0.3	0.06	6.75	< 0.005	3.6	0.02	612		22.6	< 0.01	< 0.1	2.9	0.285	26.7	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.009	< 0.008	11
S98-00760	0.4	0.7	7.09	0.005	1.7	0.06	429		16.5	< 0.01	0.1	0.5	0.173	24.6	< 0.005		< 0.01	< 0.005	0.27	0.4	0.028	< 0.008	67
S98-00761	1.6	0.13	7.21	< 0.005	5.6	0.23	1630		10.3	0.01	< 0.1	0.4	0.464	25.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.04	< 0.008	5
S98-00762	0.3	0.09	6.89	0.005	3.3	< 0.02	510		23.8	< 0.01	0.1	0.5	0.293	25.6	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.019	< 0.008	3
S98-00763	1.5	0.11	7.42	< 0.005	3.5	0.1	438	< 0.2	7.02	< 0.01	< 0.1	< 0.2	0.2	24.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.022	< 0.008	4
S98-00764	1	0.05	7.14	0.008	1.7	0.04	596	< 0.2	15.1	< 0.01	0.2	0.7	0.24	27.3	< 0.005		< 0.01	< 0.005	0.09	< 0.2	0.024	< 0.008	5
S98-00765	0.2	0.09	6.9	< 0.005	2.2	0.07	384		18.2	< 0.01	0.3	4.2	0.157	25.1	< 0.005		< 0.01	< 0.005	0.22	< 0.2	0.018	< 0.008	12
S98-00766	< 0.2	0.12	6.84	< 0.005	0.6	< 0.02	837		15	< 0.01	0.1	13.5	0.459	25.8	< 0.005		< 0.01	< 0.005	2.51	< 0.2	0.082	< 0.008	20
S98-00767	1.2	0.07	7.17	< 0.005	0.9	0.15	909	< 0.2	11.5	< 0.01	< 0.1	0.2	0.55	25.7	< 0.005		< 0.01	< 0.005	0.16	< 0.2	0.013	< 0.008	12
S98-00768	0.6	0.07	6.99	< 0.005	4	0.04	874		12.9	< 0.01	< 0.1	8.2	0.516	26.3	< 0.005		< 0.01	< 0.005	0.04	< 0.2	0.017	< 0.008	
S98-00769	0.4	0.15	6.82	< 0.005	0.6	0.02	863		16.3	< 0.01	< 0.1	3.9	0.448	26.6	< 0.005		< 0.01	< 0.005	1.36	< 0.2	0.048	< 0.008	19
S98-00770	1.8	0.02	6.82	< 0.005	6.7	< 0.02	849		18.4	< 0.01	< 0.1	0.5	0.321	26.2	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.019	< 0.008	7
S98-00771	2.8	0.06	6.61	< 0.005	6	0.05	795		24	< 0.01	< 0.1	< 0.2	0.342	25.8	< 0.005		0.01	< 0.005	< 0.01	< 0.2	0.019	< 0.008	10
S98-00772	2	0.05	6.77	< 0.005	3.1	< 0.02	808		20.1	< 0.01	< 0.1	< 0.2	0.448	26	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.018	< 0.008	3

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST.	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-00774	BTS208	07/03/1998	23.5553	89.8125	1978	Private HF	53.3	Mr Abdus Satter	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Tulagram
S98-00775	BTS209	07/03/1998	23.5092	89.8197	1993	Private HF	49.7	Mr Md Khalil Huwlader	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Ichail
S98-00776	BTS210	07/03/1998	23.5094	89.8103	1993	Private HF	25.9	Mr Abdus Salam	Dhaka	Faridpur	Faridpur Sadar	Kanaipur	Fursa
S98-00777	BTS211	07/03/1998	23.5331	89.79	1994	Private HF	26.2	Mr Md Akkas Shek	Dhaka	Faridpur	Faridpur Sadar	Kanaipur	Solakunda
S98-00778	BTS212	07/03/1998	23.4958	89.7861	1997	Private HF	40.5	Mr Kazi Atahar	Dhaka	Faridpur	Faridpur Sadar	Kanaipur	Rankali
S98-00779	BTS213	08/03/1998	23.5158	89.8397	1975	Private HF	53.3	Mr Md Hatem Mollah	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Morgalkot
S98-00780	BTS214	08/03/1998	23.5311	89.8531	1993	Private HF	50.3	Mr Md Shahjahan Khan	Dhaka	Faridpur	Faridpur Sadar	Greda	Bakhunda
S98-00781	BTS215	08/03/1998	23.5347	89.8675	1995	Private HF	32	Mr Abdur Rahman Bhuyan	Dhaka	Faridpur	Faridpur Sadar	Greda	Jayar
S98-00782	BTS216	08/03/1998	23.5747	89.8825	1990	Private HF	40.5	Mr Abdur Rashid Shek	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Chauhatta
S98-00783	BTS217	08/03/1998	23.5586	89.9025	1995	Private HF	41.1	Mr Md Nuruddin Mollah	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Aliabad
S98-00784	BTS218	08/03/1998	23.5969	89.8769	1968	Private HF	20.1	Mr Kazi Mikter Hossain	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Bhajandanga
S98-00785	BTS219	09/03/1998	23.6869	89.7972	1982	Unicef/DI	24.4	Mr Md Chan Mia	Dhaka	Faridpur	Faridpur Sadar	Char Madhabdia	Goalertila
S98-00786	BTS220	09/03/1998	23.6964	89.8067	1991	Private HF	22.3	Mr Md Korban Khan	Dhaka	Faridpur	Faridpur Sadar	Uttar Channel	Uttar Decreechar Madhabdi
S98-00788	BTS221	09/03/1998	23.6714	89.8083	1993	Private HF	18.3	Mr Hafez Abul Kashem	Dhaka	Faridpur	Faridpur Sadar	Char Madhabdia	Char Baludhum
S98-00789	BTS222	09/03/1998	23.6292	89.8278	1995	Private HF	32	Md Pur Bazar	Dhaka	Faridpur	Faridpur Sadar	Ambikapur	Adampur
S98-00790	BTS223	09/03/1998	23.67	89.7253	1997	Private HF	29	Mr Md Habibur Rahmah	Dhaka	Faridpur	Faridpur Sadar	Ishan Gopalpur	Decree Char Barakhada
S98-00791	BTS224	09/03/1998	23.6603	89.7639	1978	Private HF	28	Mr Md Jalal Uddin Shek	Dhaka	Faridpur	Faridpur Sadar	Ishan Gopalpur	Durgapur
S98-00792	BTS225	09/03/1998	23.6436	89.7828	1976	Private HF	38.7	Mr Sk Abdul Aziz	Dhaka	Faridpur	Faridpur Sadar	Ishan Gopalpur	Char Nashipur
S98-00793	BTS226	10/03/1998	23.6014	89.8378	1990	Urban sup	79	Jiltuli Sonali Bank ww No 10	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	
S98-00794	BTS227	10/03/1998	23.5825	89.8403	1990	Campus su	164.6	River Research Institute	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Habeli Rajapur
S98-00796	BTS228	10/03/1998	23.5825	89.8403	1990	Campus H	137.2	River Research Institute	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Habeli Rajapur
S98-00797	BTS229	10/03/1998	23.5872	89.8133	1988	Pumped su	204	Technical Training Centre	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	
S98-00798	BTS230	10/03/1998	23.5872	89.8133	1988	HP TW	213.4	Technical Training Centre	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	
S98-00799	BTS231	10/03/1998	23.6372	89.7383	1995	Pumped su	14	Mr Paran Kumar Chandra Das	Dhaka	Faridpur	Faridpur Sadar	Majchar	Shibrampur
S98-00800	BTS232	10/03/1998	23.6117	89.7758	1993	Private HF	35.1	Mr Md Nazrul Islam	Dhaka	Faridpur	Faridpur Sadar	Majchar	Majchar Kanarpur
S98-00801	BTS233	11/03/1998	23.5794	89.7678	1991	Private HF	28.3	Mr Md. Motaleb Mollah	Dhaka	Faridpur	Faridpur Sadar	Krishnanagar	Gobindapur
S98-00802	BTS234	11/03/1998	23.5411	89.7336	1993	Private HF	27.4	Mr Md Hatem Ali Shek	Dhaka	Faridpur	Faridpur Sadar	Krishnanagar	Ujan Mallikpur
S98-00803	BTS235	11/03/1998	23.5639	89.6975	1977	Private HF	28	Mr Abul Hossain Mollah	Dhaka	Faridpur	Faridpur Sadar	Krishnanagar	Parmanandapur
S98-00804	BTS236	11/03/1998	23.5853	89.705	1995	HP TW	30.5	Sadardi Bazar	Dhaka	Faridpur	Faridpur Sadar	Krishnanagar	Sadardi
S98-00805	BTS237	11/03/1998	23.5697	89.7406	1997	Private HF	22.9	Mr Sk Shahid	Dhaka	Faridpur	Faridpur Sadar	Krishnanagar	Batikamaribil
S98-00806	BTS238	11/03/1998	23.5972	89.79	1988	HP TW	20.1	Karmapur High School	Dhaka	Faridpur	Faridpur Sadar	Ambikapur	Karmapur
S98-00807	BTS239	12/03/1998	23.5436	89.7678	1992	Private HF	46.3	Mr Delwar Hossain Mollah	Dhaka	Faridpur	Faridpur Sadar	Kanaipur	Hoglakandi
S98-00808	BTS240	12/03/1998	23.5264	89.7678	1992	Private HF	26.8	Mr Sunil Kumar Shil	Dhaka	Faridpur	Faridpur Sadar	Kanaipur	Raikali Khaskandi
S98-00809	BTS241	12/03/1998	23.5414	89.8044	1988	Pumped Ir	87.8	Mr Md. Sharif	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Betbaria
S98-00810	BTS242	12/03/1998	23.5397	89.8381	1991	HP TW	54.3	Mosque	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Akain
S98-00811	BTS243	12/03/1998	23.5703	89.8411	1988	Private HF	57.3	Mosque, Chairman's House	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Kaijuri
S98-00813	BTS244	12/03/1998	23.5567	89.8686	1988	Private HF	45.7	Mr Sk Ahamed Ali	Dhaka	Faridpur	Faridpur Sadar	Greda	Ikri
S98-00814	BTS245	12/03/1998	23.5783	89.8942	1983	Private HF	48.8	Mr Md Chandullah Mollah	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Gadadhordangi
S98-00815	BTS246	13/03/1998	23.6058	89.8828	1997	Private HF	22.3	Mr Md Khairul Alam	Dhaka	Faridpur	Faridpur Sadar	Decreer Char	Char Madhya Tepakhola
S98-00816	BTS247	13/03/1998	23.6233	89.8878	1992	Private HF	26.8	Mr Md Rokon Uddin Hazi	Dhaka	Faridpur	Faridpur Sadar	Decreer Char	Decreer Char
S98-00817	BTS248	13/03/1998	23.6406	89.8556	1997	Private HF	26.8	Mr Ski Afsar	Dhaka	Faridpur	Faridpur Sadar	Decreer Char	Char Tepurakandi
S98-00818	BTS249	13/03/1998	23.6669	89.8369	1987	Private HF	21.9	Mr Abdul Khaleque	Dhaka	Faridpur	Faridpur Sadar	Char Madhabdia	Dakshin (S) Char Madabdia
S98-00819	BTS250	13/03/1998	23.6517	89.8169	1991	Private HF	26.8	Mr Akher Ali Saodagar	Dhaka	Faridpur	Faridpur Sadar	Char Madhabdia	Dakshin (S) Char Madhabdi
S98-00820	BTS251	13/03/1998	23.6761	89.7847	1992	Private HF	22.9	Mr Md Jamal Mirda	Dhaka	Faridpur	Faridpur Sadar	Ishan Gopalpur	Durgapur
S98-00821	BTS252	14/03/1998	23.5753	89.7178	1997	Private HF	18.3	Mr Kazi Abdul Mazed	Dhaka	Faridpur	Faridpur Sadar	Krishnanagar	Bhabukdia
S98-00823	BTS253	14/03/1998	23.6119	89.7442	1994	Private HF	32	Mr Sree Angon	Dhaka	Faridpur	Faridpur Sadar	Majchar	Bagchar
S98-00824	BTS254	14/03/1998	23.6139	89.7936	1995	Private HF	15.8	Mr Sk Shorab	Dhaka	Faridpur	Faridpur Sadar	Majchar	Dayarampur
S98-00825	BTS255	14/03/1998	23.6439	89.875	1995	Private HF	13.7	Mr Abdus Samad Mirda	Dhaka	Faridpur	Faridpur Sadar	Uttar Channel	Uttar (N) Channel

SAMPLE ID	GEOCODE	Al ug/L	AsIII ug/L	AsTot ug/L	B mg/L	Ba mg/L	Be ug/L	Br mg/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	^{34}S ‰	diss O2 mg/L	DOC mg/L	Dy ug/L
S98-00774	3294755975	3	< 6	41	0.1	0.439	< 0.05	0.67	98.9	< 0.02	< 0.005	127	1.57	< 0.5	0.15	< 1	0.62	-5.4	-25		< 0.1	13	< 0.01
S98-00775	3294755133	3	42	84	0.04	0.196	< 0.05	0.07	115	< 0.02	< 0.005	16.2	0.7	< 0.5	0.06	< 1	-13.19	-4.2	-34		< 0.1	3.8	< 0.01
S98-00776	3294763386	3	192	278	0.04	0.159	< 0.05	0.058	123	< 0.02	< 0.005	3.6	0.42	< 0.5	< 0.05	< 1	-5.82	-3.3	-24		< 0.1	2.9	< 0.01
S98-00777	3294763931	9	< 6	41	0.02	0.155	< 0.05	0.014	115	< 0.02	0.007	1.8	0.3	< 0.5	< 0.05	< 1	-8.26	-3	-16		< 0.1	4.2	< 0.01
S98-00778	3294763868	2	99	123	0.04	0.234	< 0.05	0.06	87.4	< 0.02	0.008	10.4	0.39	< 0.5	0.07	< 1	-10.53	-5.2	-33		< 0.1	3.5	< 0.01
S98-00779	3294755716	3	125	186	0.1	0.154	< 0.05	0.28	57.1	< 0.02	< 0.005	56.7	0.95	< 0.5	< 0.05	< 1	-5.91	-4.7	-35		< 0.1	8.8	< 0.01
S98-00780	3294739050	6	46	80	0.1	0.074	< 0.05	0.39	43.9	< 0.02	< 0.005	86	0.6	< 0.5	0.07	< 1	-10.1	-5.3	-38		< 0.1	6.5	< 0.01
S98-00781	3294739532	2	40	162	0.05	0.081	< 0.05	0.026	49.2	< 0.02	< 0.005	2	0.21	< 0.5	< 0.05	2	-13.76	-4.1	-25		< 0.1	1	< 0.01
S98-00782	329477291	8	200	398	0.06	0.152	< 0.05	0.07	95.7	< 0.02	0.005	7.6	0.56	< 0.5	< 0.05	< 1	-14.77	-2.7	-14		< 0.1	2.4	< 0.01
S98-00783	32947719	22	< 6	39	0.05	0.242	< 0.05	0.01	167	0.05	0.026	5.5	2.1	< 0.5	< 0.05	2	-15.3	-2.6	-23		< 0.1	3.2	< 0.01
S98-00784	329477120	3	17	57	0.02	0.136	< 0.05	0.022	129	< 0.02	0.014	3.8	0.63	< 0.5	< 0.05	< 1	-13.52	-4.9	-34		< 0.1	0.3	< 0.01
S98-00785	3294723424	93	< 6	< 6	0.02	0.078	< 0.05	< 0.02	78.6	< 0.02	0.059	18.6	0.34	< 0.5	< 0.05	< 1	-14.64	-4.6	-28		< 0.1	1	< 0.01
S98-00786	3294787994	4	< 6	< 6	0.03	0.17	< 0.05	0.083	156	< 0.02	0.04	2.6	0.65	< 0.5	< 0.05	< 1	-16.51	-5.1	-35		< 0.1	0.4	< 0.01
S98-00788	3294723057	4	< 6	< 6	0.02	0.176	< 0.05	0.05	150	< 0.02	0.042	51.9	0.69	< 0.5	< 0.05	< 1	-6.77	-4.7	-30		< 0.1		< 0.01
S98-00789	3294715006	4	< 6	18	0.02	0.119	< 0.05	0.03	101	< 0.02	0.013	16	0.37	< 0.5	< 0.05	< 1	-15.95	-4.4	-26		< 0.1	0.3	< 0.01
S98-00790	3294747322	3	62	129	0.03	0.166	< 0.05	0.013	94.5	0.16	0.005	1.8	0.72	< 0.5	< 0.05	< 1	-9.89	-4	-23		< 0.1	1.1	< 0.01
S98-00791	3294747367	3	99	245	0.03	0.168	< 0.05	0.041	125	< 0.02	0.008	3	0.59	< 0.5	< 0.05	< 1	-11.04	-5.1	-33		< 0.1	2.4	< 0.01
S98-00792	3294747259	2	49	148	0.03	0.201	< 0.05	0.05	97.4	< 0.02	< 0.005	11.5	0.39	< 0.5	0.07	< 1	-12.24	-5.5	-31		< 0.1	2.1	< 0.01
S98-00793	3294719	5	< 6	28	0.05	0.262	< 0.05	0.11	116	< 0.02	< 0.005	38.7	0.6	< 0.5	0.11	< 1	-12.65	-4.9	-31		< 0.1	1.7	< 0.01
S98-00794	3294755475	4	< 6	20	0.08	0.269	< 0.05	0.37	77.3	< 0.02	0.006	79.8	0.65	< 0.5	0.19	< 1	-11.42	-5.6	-39		< 0.1	5.4	< 0.01
S98-00796	3294755475	4	< 6	< 6	0.1	0.123	< 0.05	0.45	67.2	< 0.02	0.099	93	1.17	< 0.5	< 0.05	< 1	-14.08	-6.2	-40		< 0.1	1.4	0.02
S98-00797	3294719	3	< 6	52	0.08	0.2	< 0.05	0.76	120	< 0.02	0.015	195	0.94	< 0.5	0.38	< 1	-14.43	-6.6	-41		< 0.1	2.8	< 0.01
S98-00798	3294719	34	6	< 6	0.05	0.229	< 0.05	0.45	125	0.1	0.026	115	0.45	< 0.5	0.24	< 1	-9.94	-5.3	-32		< 0.1	1.5	< 0.01
S98-00799	3294779918	3	< 6	6	< 0.01	0.102	< 0.05	< 0.02	81.4	< 0.02	0.007	15.8	0.25	< 0.5	< 0.05	< 1	-18.31	-4.5	-24		< 0.1		< 0.01
S98-00800	3294779697	2	< 6	< 6	0.02	0.119	< 0.05	0.019	102	< 0.02	0.017	4.2	0.3	< 0.5	< 0.05	< 1	-16.51	-4	-22		< 0.1	2	< 0.01
S98-00801	3294771345	3	< 6	15	< 0.01	0.097	< 0.05	0.017	89.3	< 0.02	0.015	4	0.26	< 0.5	< 0.05	< 1	-15.78	-3.7	-20		< 0.1		< 0.01
S98-00802	3294771982	16	10	73	0.02	0.15	< 0.05	0.012	99.1	< 0.02	< 0.005	2.6	0.26	< 0.5	< 0.05	< 1	-10.15	-3.4	-17		< 0.1	1.9	< 0.01
S98-00803	3294771773	5	108	30	0.04	0.193	< 0.05	0.03	117	< 0.02	0.006	8.2	0.45	< 0.5	< 0.05	< 1	-12.45	-4.4	-27		< 0.1	0.5	< 0.01
S98-00804	3294771880	11	< 6	< 6	0.03	0.137	< 0.05	0.027	101	< 0.02	0.015	2.6	0.33	< 0.5	< 0.05	< 1	-12.75	-4	-23		< 0.1	0.8	< 0.01
S98-00805	3294771082	2	< 6	128	0.03	0.189	< 0.05	0.13	124	< 0.02	0.015	14.7	0.31	< 0.5	< 0.05	< 1	-14.63	-3.9	-24		< 0.1		< 0.01
S98-00806	3294715646	12	17	45	0.01	0.098	< 0.05	< 0.02	89.2	< 0.02	0.015	8.7	0.29	< 0.5	< 0.05	< 1	-15.26	-4.1	-32		< 0.1	1.3	< 0.01
S98-00807	3294763481	3	119	343	0.03	0.169	< 0.05	0.06	99.2	< 0.02	< 0.005	7.2	0.24	< 0.5	0.07	1	-12.56	-3.7	-27		< 0.1	1.7	< 0.01
S98-00808	3294763849	3	9	109	0.02	0.121	< 0.05	0.025	74.9	< 0.02	< 0.005	5.1	0.26	< 0.5	0.06	< 1		-4.3	-22		< 0.1	0.6	< 0.01
S98-00809	3294755101	4	82	191	0.04	0.183	< 0.05	0.031	99.4	< 0.02	0.009	3.8	0.32	< 0.5	0.12	< 1	-7.87	-4.6	-28		< 0.1		< 0.01
S98-00810	3294755012	3	104	160	0.08	0.156	< 0.05	0.21	64.3	< 0.02	< 0.005	36.6	0.76	< 0.5	0.06	< 1		-6	-41		< 0.1	4.6	< 0.01
S98-00811	3294755583	9	16	51	0.04	0.165	< 0.05	0.04	51.9	< 0.02	0.014	11.3	0.44	< 0.5	0.22	< 1	-6.21	-4.3	-25		< 0.1	2	< 0.01
S98-00813	3294739507	3	18	35	0.09	0.236	< 0.05	0.14	56.4	< 0.02	< 0.005	16.4	0.73	< 0.5	< 0.05	< 1		-4.1	-28		< 0.1	4.6	< 0.01
S98-00814	329477392	15	< 6	8	0.04	0.255	< 0.05	0.11	138	< 0.02	0.01	17.7	0.52	< 0.5	0.1	< 1	-13.18	-4.2	-27		< 0.1	1.1	< 0.01
S98-00815	3294731253	6	< 6	11	0.02	0.204	< 0.05	0.11	161	< 0.02	0.05	11	0.84	< 0.5	< 0.05	< 1	-15.32	-5.7	-34		0.3		0.02
S98-00816	3294731329	2	< 6	15	0.03	0.168	< 0.05	0.118	158	< 0.02	0.025	4.8	0.57	< 0.5	< 0.05	< 1	-13.21	-5.6	-41		0.7	1.2	< 0.01
S98-00817	3294731285	3	53	< 6	0.03	0.265	< 0.05	0.07	134	< 0.02	0.018	11.3	0.95	< 0.5	< 0.05	< 1	-14.13	-6.1	-40		1.4	0.2	< 0.01
S98-00818	3294723310	3	< 6	< 6	0.03	0.125	< 0.05	0.03	115	< 0.02	0.02	13.8	0.39	< 0.5	< 0.05	< 1	-16.1	-5.3	-36		< 0.1		< 0.01
S98-00819	3294723304	9	< 6	< 6	0.03	0.141	< 0.05	0.02	117	< 0.02	0.022	10.5	0.44	< 0.5	< 0.05	< 1	-14.99	-4.7	-31		< 0.1		0.02
S98-00820	3294747367	2	< 6	< 6	0.02	0.049	< 0.05	0.013	49.1	< 0.02	0.014	2.2	0.14	< 0.5	< 0.05	< 1	-14.32	-7.5	-52		< 0.1	1.1	< 0.01
S98-00821	3294771114	9	41	132	0.03	0.151	< 0.05	0.03	122	< 0.02	0.012	7.5	0.42	< 0.5	< 0.05	7	-11.8	-2.8	-18		< 0.1	0.1	< 0.01
S98-00823	3294779038	8	22	8	0.02	0.199	< 0.05	0.07	180	< 0.02	0.034	87	0.68	< 0.5	< 0.05	< 1	-13.83	-4	-21		< 0.1	0.9	0.01
S98-00824	3294779316	4	< 6	10	0.02	0.094	< 0.05	< 0.02	92.1	< 0.02	0.027	17.1	0.34	< 0.5	< 0.05	< 1	-15.51	-3.7	-21		< 0.1	0.2	< 0.01
S98-00825	3294787760	4	< 6	< 6	0.03	0.269	< 0.05	0.03	188	< 0.02	0.101	9.6	0.78	< 0.5	< 0.05	< 1	-13.83	-4.1	-29	-0.9	< 0.1	1	0.01

SAMPLE ID	Eh mV	Er ug/L	Eu ug/L	F mg/L	Fe mg/L	Ga ug/L	Gd ug/L	Ge ug/L	HCO_3 mg/L	Ho ug/L	I ug/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S98-00774	98	< 0.01	< 0.006	0.1	18.7		< 0.01		848	< 0.005	103	6.6	0.01	8.6	< 0.005	40.6	0.183	0.8	175	< 0.01	17.6	4	0.004	< 0.3
S98-00775	97	< 0.01	0.011	0.1	6.76		< 0.01		563	< 0.005	21	5.4	0.005	4.4	< 0.005	29.9	0.17	1.1	28.9	< 0.01	1.85	3.5	0.004	< 0.3
S98-00776	98	< 0.01	< 0.006	0.12	9.34		< 0.01		607	< 0.005	17.2	4.8	< 0.005	1.7	< 0.005	28	0.21	2.5	28	< 0.01	< 0.02	2.8	3.42	3.7
S98-00777	100	0.01	0.011	0.14	5.69		< 0.01		502	< 0.005	4.2	3.9	0.01	1.8	< 0.005	23.2	0.754	1.2	13.1	< 0.01	0.16	2.9	< 0.004	< 0.3
S98-00778	104	0.01	0.007	0.11	12.1		< 0.01		536	< 0.005	38.7	5.6	0.007	3.6	< 0.005	25.3	0.593	1.6	50.7	< 0.01	3.08	2.2	0.004	< 0.3
S98-00779	77	< 0.01	< 0.006	0.19	4.84		< 0.01		614	< 0.005	57.6	5.1	0.005	4.6	< 0.005	26.3	0.08	2.4	144	< 0.01	6.28	2.4	0.004	< 0.3
S98-00780	79	< 0.01	< 0.006	0.18	6.11		< 0.01		502	< 0.005	53.7	8.6	< 0.005	5.4	< 0.005	41.9	0.081	0.6	105	< 0.01	5.81	1.2	0.006	< 0.3
S98-00781	71	< 0.01	< 0.006	0.09	3.37		< 0.01		410	< 0.005	6.7	6.1	< 0.005	2.6	< 0.005	37	0.041	1.7	14	< 0.01	2.88	1.5	0.004	< 0.3
S98-00782	75	< 0.01	< 0.006	0.11	8.83		< 0.01		566	< 0.005	47	5.1	0.007	3.7	< 0.005	39.6	0.127	6.1	25	< 0.01	3.92	2.9	< 0.004	< 0.3
S98-00783	99	< 0.01	< 0.006	0.14	1.1		< 0.01		714	< 0.005	71.4	4.4	0.022	2.5	< 0.005	34.3	0.7	2.9	16.4	0.02	0.94	18.8	0.071	< 0.3
S98-00784	76	< 0.01	< 0.006	0.1	2.21		< 0.01		553	< 0.005	9.7	3.9	0.008	2.3	< 0.005	25.9	1.26	1.5	9.6	< 0.01	0.83	5.6	< 0.004	< 0.3
S98-00785	138	< 0.01	< 0.006	0.1	0.224		< 0.01		300	< 0.005	6.6	3.5	0.033	1.8	< 0.005	14.5	0.478	0.7	13.8	0.03	0.21	2.4	< 0.004	< 0.3
S98-00786	202	< 0.01	< 0.006	0.03	0.144		0.01		688	< 0.005	27	5.4	0.024	3.1	< 0.005	34.7	1.28	0.2	13.8	0.02	< 0.02	5	0.33	0.4
S98-00788	86	0.01	< 0.006	0.04	0.471		< 0.01		566	< 0.005	2.5	6.2	0.029	3.6	< 0.005	42.6	1.13	0.3	24.3	0.02	< 0.02	5.2	< 0.004	< 0.3
S98-00789	121	< 0.01	< 0.006	0.06	0.827		< 0.01		402	< 0.005	12.4	4.4	0.008	2.1	< 0.005	18.8	0.919	0.5	11.2	< 0.01	0.46	2.7	< 0.004	< 0.3
S98-00790	149	< 0.01	0.01	0.12	5.53		< 0.01		534	< 0.005	4.8	4.6	0.005	1.9	< 0.005	37	0.994	1.9	12.1	< 0.01	1.72	3	< 0.004	< 0.3
S98-00791	186	< 0.01	< 0.006	0.04	5.97		< 0.01		580	< 0.005	30.6	5.2	0.007	1.5	< 0.005	28.4	2.86	3.7	14.4	< 0.01	< 0.02	3.7	< 0.004	2.6
S98-00792	187	< 0.01	< 0.006	0.08	9.92		< 0.01		497	< 0.005	24.5	4.3	< 0.005	2.6	< 0.005	26.7	0.383	1.8	24.7	< 0.01	2.38	2.3	< 0.004	< 0.3
S98-00793	47	< 0.01	< 0.006	0.16	7.54		< 0.01		614	< 0.005	30.2	4.8	< 0.005	7.4	< 0.005	36.3	0.297	2.2	46.7	< 0.01	2.5	3.2	< 0.004	< 0.3
S98-00794	39	< 0.01	< 0.006	0.15	8.47		< 0.01		607	< 0.005	79.4	7.1	0.006	8.3	< 0.005	43.5	0.243	2.1	100	< 0.01	3.84	2.1	< 0.004	< 0.3
S98-00796	143	0.02	0.008	0.14	1.73		0.01		610	< 0.005	71.4	3.4	0.039	8.5	< 0.005	28.4	0.371	0.3	148	0.03	0.07	3	< 0.004	< 0.3
S98-00797	95	< 0.01	< 0.006	0.16	1.85		< 0.01		653	< 0.005	100	5.4	0.012	11.2	< 0.005	46.8	0.101	2.1	139	< 0.01	0.33	3.6	0.004	< 0.3
S98-00798	22	< 0.01	< 0.006	0.1	5.74		< 0.01		612	< 0.005	51.7	5.1	0.016	9.2	< 0.005	49.1	0.133	1.5	67.3	0.01	2.65	3.1	< 0.004	< 0.3
S98-00799	170	< 0.01	< 0.006	0.09	0.143		< 0.01		305	< 0.005	2.3	4.7	0.006	2.3	< 0.005	13.3	0.092	0.6	9.8	< 0.01	< 0.02	2.2	0.004	< 0.3
S98-00800	127	< 0.01	< 0.006	0.06	0.776		< 0.01		439	< 0.005	2.6	3.6	0.007	2	< 0.005	21.9	0.854	0.4	12.2	< 0.01	0.38	2.2	< 0.004	< 0.3
S98-00801	109	< 0.01	< 0.006	0.11	0.479		< 0.01		371	< 0.005	5.4	3.7	0.011	1.4	< 0.005	19.7	0.611	0.6	5.1	< 0.01	< 0.02	2.1	< 0.004	< 0.3
S98-00802	39	< 0.01	0.011	0.13	8.2		< 0.01		456	< 0.005	2.4	2.8	< 0.005	1.7	< 0.005	23.8	0.354	1.4	15.5	< 0.01	< 0.02	2.4	0.004	1.1
S98-00803	34	< 0.01	< 0.006	0.12	11.5		< 0.01		668	< 0.005	4.9	4.4	0.007	2.6	< 0.005	33.2	0.503	1.3	47.3	< 0.01	1.92	3	0.007	< 0.3
S98-00804	49	< 0.01	< 0.006	0.13	9.08		< 0.01		463	< 0.005	12.7	2.6	0.008	2.2	< 0.005	22.9	0.213	1.3	13	< 0.01	1.02	2.7	< 0.004	< 0.3
S98-00805	54	< 0.01	< 0.006	0.1	8.59		< 0.01		556	< 0.005	8.2	4.3	0.011	2.1	< 0.005	27.3	0.862	1.9	17.3	< 0.01	0.8	2.9	< 0.004	< 0.3
S98-00806	145	< 0.01	< 0.006	0.09	0.483		< 0.01		380	< 0.005	5.1	3.1	0.009	2	< 0.005	22.3	0.983	1.3	7.4	< 0.01	0.21	2.7	0.004	< 0.3
S98-00807	42	< 0.01	< 0.006	0.11	5.48		< 0.01		478	< 0.005	8.1	4.3	< 0.005	2.7	< 0.005	27.3	0.32	1.9	14.7	< 0.01	2.35	2.2	0.007	< 0.3
S98-00808	49	< 0.01	< 0.006	0.12	7.71		< 0.01		422	< 0.005	4.7	4	< 0.005	2.3	< 0.005	25.9	0.395	1.6	14.4	< 0.01	2.42	1.9	< 0.004	< 0.3
S98-00809	52	< 0.01	< 0.006	0.14	6.99		< 0.01		556	< 0.005	17.5	4.3	0.008	5.6	< 0.005	37.3	0.2	1.8	21.5	< 0.01	2.71	2.5	0.007	< 0.3
S98-00810	62	< 0.01	< 0.006	0.2	4.96		< 0.01		541	< 0.005	40.6	6.3	< 0.005	4.4	< 0.005	39	0.092	1.4	71.6	< 0.01	4.83	2.1	0.006	< 0.3
S98-00811	77	< 0.01	< 0.006	0.13	19.6		< 0.01		488	< 0.005	31.3	7.9	0.009	6.6	< 0.005	47.9	0.162	0.2	18.6	< 0.01	6.46	1.4	< 0.004	< 0.3
S98-00813	100	< 0.01	< 0.006	0.2	7.68		< 0.01		556	< 0.005	52	6.8	< 0.005	7.9	< 0.005	32	0.111	< 0.1	65.7	< 0.01	16.2	2.4	0.004	< 0.3
S98-00814	73	< 0.01	< 0.006	0.08	10.1		< 0.01		773	< 0.005	96.5	6.8	0.005	4.9	< 0.005	59.5	0.121	1.1	21.8	< 0.01	< 0.02	3.6	4.8	4.9
S98-00815	149	< 0.01	< 0.006	0.04	0.8		< 0.01		675	< 0.005	118	6.2	0.028	4	< 0.005	38.4	1.29	0.6	18.4	0.03	0.49	6.5	< 0.004	< 0.3
S98-00816	138	< 0.01	< 0.006	0.02	1.04		< 0.01		670	< 0.005	122	5.3	0.02	2.6	< 0.005	33.2	1.64	0.5	20.7	0.01	0.48	4.2	< 0.004	< 0.3
S98-00817	84	< 0.01	0.015	0.08	6.94		< 0.01		617	< 0.005	49.5	4.4	0.017	2.5	< 0.005	32.2	4.23	1.5	22.6	< 0.01	1.29	3.3	< 0.004	< 0.3
S98-00818	109	< 0.01	0.008	0.06	0.119		< 0.01		444	< 0.005	28.1	5.3	0.015	2.3	< 0.005	24.3	0.884	0.3	12.9	0.02	0.12	3.3	< 0.004	< 0.3
S98-00819	51	0.01	0.01	0.08	3.12		< 0.01		483	< 0.005	10.9	4.9	0.015	2.4	< 0.005	24.5	1.47	0.5	12.2	0.01	0.52	3.2	< 0.004	< 0.3
S98-00820	52	< 0.01	< 0.006	0.1	0.052		< 0.01		200	< 0.005	3	3.4	0.009	1.5	< 0.005	8.92	0.256	0.6	6.1	< 0.01	< 0.02	1.1	< 0.004	< 0.3
S98-00821	47	< 0.01	< 0.006	0.08	5.57		< 0.01		534	< 0.005	14.6	3.3	0.01	1.7	< 0.005	27.5	0.651	2.5	17.6	< 0.01	0.61	2.7	< 0.004	< 0.3
S98-00823	166	< 0.01	0.011	0.12	0.705		< 0.01		622	< 0.005	7.2	4.9	0.019	3.5	< 0.005	43.6	1.2	1.3	32.8	0.02	0.61	5.3	< 0.004	< 0.3
S98-00824	85	< 0.01	< 0.006	0.13	0.604		< 0.01		378	< 0.005	7.9	3.5	0.013	2.2	< 0.005	22.2	0.557	0.3	13.3	< 0.01	0.23	2.3	< 0.004	< 0.3
S98-00825	68	< 0.01	0.012	0.04	0.185		0.02		775	< 0.005	20	8.4	0.053	4	< 0.005	52.4	1.65	0.2	6.9	0.05	0.28	5.1	< 0.004	< 0.3

SAMPLE ID	Ptot mg/L	Pb ug/L	pH	Pr ug/L	Rb ug/L	Sb ug/L	SEC uS/cm	Se ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	T °C	Tb ug/L	Th ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-00774	3.5	0.04	6.61	< 0.005	5.6	< 0.02	1400		23.7	< 0.01	< 0.1	0.8	0.504	25.6	< 0.005		< 0.01	< 0.005	< 0.01	0.3	0.025	< 0.008	7
S98-00775	2	0.14	6.67	< 0.005	4.2	< 0.02	749		21.3	< 0.01	< 0.1	0.3	0.353	25.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.014	< 0.008	6
S98-00776	2.1	0.18	6.86	< 0.005	6.1	< 0.02	764		16.9	< 0.01	< 0.1	0.2	0.443	26.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.011	< 0.008	8
S98-00777	1.4	0.05	7.01	< 0.005	3	0.03	626	< 0.2	14.1	0.01	0.1	< 0.2	0.293	26.3	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.03	< 0.008	9
S98-00778	1.9	0.08	6.7	< 0.005	5.7	< 0.02	683		19.4	< 0.01	< 0.1	< 0.2	0.36	26.5	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.031	< 0.008	4
S98-00779	2.7	0.1	6.81	< 0.005	4.5	0.02	1070		17.4	< 0.01	< 0.1	0.6	0.287	25.7	< 0.005		< 0.01	< 0.005	< 0.01	0.2	0.012	< 0.008	3
S98-00780	2.8	0.06	6.57	< 0.005	7.4	< 0.02	953		25	< 0.01	< 0.1	0.6	0.298	25.8	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.021	< 0.008	2
S98-00781	2.1	0.21	7.04	< 0.005	5	< 0.02	542		17.1	< 0.01	< 0.1	< 0.2	0.26	25.9	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.014	< 0.008	3
S98-00782	2.1	0.1	6.99	< 0.005	6.3	< 0.02	754		15.7	< 0.01	< 0.1	< 0.2	0.371	25.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.026	< 0.008	4
S98-00783	0.3	0.12	7.1	0.006	1	0.37	897		16.2	< 0.01	< 0.1	0.5	0.559	25.8	< 0.005		< 0.01	< 0.005	4.27	1.8	0.096	< 0.008	58
S98-00784	0.3	0.03	7.03	< 0.005	1	0.14	721		14.1	< 0.01	< 0.1	0.4	0.428	25.7	< 0.005		< 0.01	< 0.005	1.69	0.2	0.057	< 0.008	5
S98-00785	< 0.2	0.39	7.23	0.006	1	0.08	519		11.6	< 0.01	< 0.1	11	0.252	26.4	< 0.005		< 0.01	< 0.005	4.95	< 0.2	0.038	< 0.008	9
S98-00786	< 0.2	0.12	6.88	0.006	1.7	< 0.02	889		12.8	0.01	< 0.1	0.3	0.547	26.2	< 0.005		0.01	< 0.005	14.8	< 0.2	0.104	< 0.008	7
S98-00788	< 0.2	0.08	6.84	< 0.005	1	0.06	979		12	< 0.01	< 0.1	63.5	0.468	26.7	< 0.005		< 0.01	< 0.005	12.1	0.2	0.092	< 0.008	7
S98-00789	< 0.2	0.06	7.01	< 0.005	1.7	< 0.02	625		13.9	< 0.01	< 0.1	10.8	0.344	26.4	< 0.005		< 0.01	< 0.005	1.96	< 0.2	0.049	< 0.008	3
S98-00790	1.5	0.18	7	< 0.005	1.3	0.22	698		16	< 0.01	< 0.1	< 0.2	0.396	26.4	< 0.005		< 0.01	< 0.005	0.07	0.2	0.02	< 0.008	25
S98-00791	0.6	0.11	7.09	< 0.005	1.8	0.04	770		11.8	< 0.01	< 0.1	< 0.2	0.45	25.6	< 0.005		< 0.01	< 0.005	1.44	< 0.2	0.055	< 0.008	9
S98-00792	1.6	0.09	6.9	< 0.005	4.8	< 0.02	697		17.9	< 0.01	< 0.1	< 0.2	0.39	25.8	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.028	< 0.008	7
S98-00793	1.6	0.08	7	< 0.005	6.7	< 0.02	881	< 0.2	16.1	< 0.01	< 0.1	1.2	0.48	27.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.027	< 0.008	16
S98-00794	1.8	0.08	6.98	< 0.005	7.2	< 0.02	990		16.4	< 0.01	< 0.1	0.2	0.44	25.5	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.02	< 0.008	10
S98-00796	0.3	0.06	6.75	0.008	0.3	0.04	1030		19.6	0.02	< 0.1	< 0.2	0.353	27.2	< 0.005		< 0.01	< 0.005	0.82	0.3	0.098	0.018	7
S98-00797	0.5	0.13	6.93	< 0.005	10.6	0.04	1220		17.3	< 0.01	< 0.1	0.4	0.617	28.1	< 0.005		0.02	< 0.005	0.18	< 0.2	0.028	< 0.008	
S98-00798	< 0.2	0.48	7.22	< 0.005	9.6	< 0.02	1760		10.2	< 0.01	< 0.1	0.2	0.58	26.9	< 0.005		0.06	< 0.005	< 0.01	< 0.2	0.033	< 0.008	
S98-00799	< 0.2	0.23	7.2	< 0.005	0.4	0.03	481	< 0.2	6.32	< 0.01	< 0.1	4.7	0.195	25.4	< 0.005		< 0.01	< 0.005	1.47	0.4	0.025	< 0.008	41
S98-00800	< 0.2	0.15	7.01	< 0.005	0.3	0.03	588		15.1	< 0.01	< 0.1	3.3	0.362	25.9	< 0.005		< 0.01	< 0.005	2.34	< 0.2	0.036	< 0.008	35
S98-00801	0.2	0.07	7.22	< 0.005	0.8	0.04	526	< 0.2	13.3	< 0.01	< 0.1	2.8	0.329	27.1	< 0.005		< 0.01	< 0.005	1.75	< 0.2	0.041	< 0.008	19
S98-00802	1.5	0.16	7.01	< 0.005	1.8	< 0.02	619		14.2	< 0.01	0.2	< 0.2	0.329	26.1	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.021	< 0.008	10
S98-00803	1.5	0.08	6.96	< 0.005	4.6	< 0.02	817		14.6	< 0.01	< 0.1	< 0.2	0.491	26.4	< 0.005		< 0.01	< 0.005	0.03	< 0.2	0.018	< 0.008	10
S98-00804	1.8	0.16	6.96	< 0.005	4.3	< 0.02	589		19	< 0.01	< 0.1	< 0.2	0.368	27.3	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.022	< 0.008	7
S98-00805	1.2	0.15	6.98	< 0.005	2.5	< 0.02	689		15.8	< 0.01	< 0.1	< 0.2	0.383	26.3	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.033	< 0.008	5
S98-00806	< 0.2	0.06	7	< 0.005	0.5	< 0.02	512		15.9	< 0.01	< 0.1	0.6	0.335	26.7	< 0.005		< 0.01	< 0.005	0.32	< 0.2	0.049	< 0.008	4
S98-00807	1.5	0.11	7.06	< 0.005	5.8	< 0.02	618		15	< 0.01	< 0.1	< 0.2	0.377	26.5	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.013	< 0.008	4
S98-00808	1.8	0.07	6.97	< 0.005	7	< 0.02	535		18.4	< 0.01	< 0.1	< 0.2	0.265	26	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.013	< 0.008	8
S98-00809	1.7	0.07	6.95	< 0.005	5.8	< 0.02	653		16.9	< 0.01	< 0.1	< 0.2	0.408	27	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.022	< 0.008	3
S98-00810	2	0.09	7	< 0.005	4.5	< 0.02	741		18.9	< 0.01	< 0.1	0.5	0.346	26.6	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.013	< 0.008	9
S98-00811	2.5	0.3	6.59	< 0.005	10.6	< 0.02	612		33.8	< 0.01	< 0.1	0.4	0.333	26.1	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.042	< 0.008	6
S98-00813	5	0.12	6.57	< 0.005	3.7	< 0.02	731		33.1	< 0.01	< 0.1	0.5	0.272	26.1	< 0.005		< 0.01	< 0.005	< 0.01	0.4	0.015	< 0.008	4
S98-00814	1.9	0.05	6.79	< 0.005	6.3	< 0.02	804		20.4	< 0.01	< 0.1	< 0.2	0.634	26.1	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.034	< 0.008	6
S98-00815	0.3	0.21	6.83	0.005	4.5	0.03	1020		14	0.02	< 0.1	22	0.561	26.5	< 0.005		0.02	< 0.005	11	< 0.2	0.137	< 0.008	27
S98-00816	0.4	0.1	6.88	< 0.005	1.2	< 0.02	988		14.6	0.01	< 0.1	0.3	0.532	26.4	< 0.005		< 0.01	< 0.005	6.23	< 0.2	0.091	< 0.008	9
S98-00817	0.6	0.3	6.83	< 0.005	1.4	0.04	920		14.1	< 0.01	< 0.1	2	0.499	27	< 0.005		< 0.01	< 0.005	3.69	< 0.2	0.075	0.009	5
S98-00818	< 0.2	0.18	7.03	< 0.005	2.1	< 0.02	758		10.9	< 0.01	< 0.1	21.7	0.415	26.9	< 0.005		< 0.01	< 0.005	12.6	< 0.2	0.055	< 0.008	5
S98-00819	0.3	0.15	6.94	< 0.005	1.9	0.02	760		14.3	< 0.01	< 0.1	2.1	0.396	26.7	< 0.005		< 0.01	< 0.005	4.04	< 0.2	0.057	0.008	7
S98-00820	< 0.2	0.28	7.35	< 0.005	1	0.04	344		10.3	< 0.01	< 0.1	7	0.148	28.1	< 0.005		< 0.01	< 0.005	1.85	0.5	0.019	< 0.008	4
S98-00821	1.1	0.29	7.01	< 0.005	1.5	0.03	785		14.4	< 0.01	0.3	< 0.2	0.357	26.6	< 0.005		< 0.01	< 0.005	0.06	< 0.2	0.032	< 0.008	7
S98-00823	< 0.2	0.09	6.88	0.005	0.7	0.05	1140		16.9	< 0.01	< 0.1	49.8	0.651	25.8	< 0.005		< 0.01	< 0.005	2.84	0.3	0.107	0.013	8
S98-00824	< 0.2	0.4	7.02	< 0.005	0.7	< 0.02	628		15.4	< 0.01	< 0.1	13.5	0.35	25.8	< 0.005		< 0.01	< 0.005	1.51	< 0.2	0.048	< 0.008	4
S98-00825	< 0.2	0.17	6.7	0.012	2.6	0.04	1100		10.9	0.02	< 0.1	21.6	0.746	27.3	< 0.005		< 0.01	< 0.005	23.8	0.7	0.132	0.012	5

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST.	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-00826	BTS256	14/03/1998	23.6303	89.8867	1995	Private HF	14	Mr Altaf Tasilder (Mosque)	Dhaka	Faridpur	Faridpur Sadar	Decreer Char	Decreer Char
S98-00827	BTS257	15/03/1998	23.5842	89.8611	1997	Private HF	49.7	Mr Sk Mir Ali	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Bil Mahmudpur
S98-00828	BTS258	15/03/1998	23.5767	89.8156	1989	Private HF	27.4	Mr Sk Abdul Ohab	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Kabirpur
S98-00829	BTS259	15/03/1998	23.5819	89.835	1994	Private HF	36.6	Mr Md Aminuddin Sardar	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Habeli Rajapur
S98-00830	BTS260	15/03/1998	23.5789	89.8411	1994	Private HF	32	Mr Abdul Hakim Khan	Dhaka	Faridpur	Faridpur Sadar	Kaijuri	Mahmudpur
S98-00831	BTS261	16/03/1998	23.6339	89.7581	1996	Private HF	16.8	Mr Md Hashem Sk	Dhaka	Faridpur	Faridpur Sadar	Majchar	Shibrampur
S98-00832	BTS262	16/03/1998	23.5897	89.8128	1993	Private HF	50	Mr Anil Kumar Shaha	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	Brahmankanda
S98-00833	BTS263	16/03/1998	23.6033	89.8408	1993	Test HP T	185	Old water works compound	Dhaka	Faridpur	Faridpur Sadar	Faridpur Paurashava	
S98-00834	BTS264	16/03/1998	23.5919	89.8417	1995	Private HF	50	Mr Abdul Aziz Khan	Dhaka	Faridpur	Faridpur Sadar	Aliabad	Kamalpur
S98-00854	BTS301	21/03/1998	24.6017	88.2767	1990	Tara pump	34	DPHE Campus	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Paurashava
S98-00855	BTS302	21/03/1998	24.5992	88.2581	1988	Private HF	28	Mr Gagisuddin	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Rahaichar
S98-00856	BTS303	21/03/1998	24.5769	88.2547	1981	Private HF	32	Mr Sree Dhrain	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Sakerbati
S98-00857	BTS304	22/03/1998	24.6186	88.4019	1966	Private HF	46.3	Mr Shams Uddin Miah	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Amura
S98-00858	BTS305	22/03/1998	24.6403	88.3783	1995	Private HF	42.7	Mr Gopal Hasda, Natunpara	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Jalahar
S98-00859	BTS306	22/03/1998	24.6156	88.3656	1984	Private HF	46.3	Mr M Shahjahan	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Belgachi
S98-00860	BTS307	22/03/1998	24.6306	88.295	1986	Private HF	27.4	Mr Alauddin	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Taherpur
S98-00861	BTS350	28/03/1998	24.6039	88.3889	1978	Private HF	35.1	Kendol Primary School	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Kandol
S98-00862	BTS308	22/03/1998	24.6183	88.3194	1992	PrivateTar	35.1	Mr Bazlur	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Atohar
S98-00863	BTS309	22/03/1998	24.6108	88.3192	1990	Irrigation \	34.1	Andanidanga Irrigation Project	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Sadihat
S98-00864	BTS310	22/03/1998	24.5983	88.3228	1988	PrivateTar	27.4	Mr Ramzan Ali	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Hosendanga
S98-00865	BTS311	23/03/1998	24.6017	88.2369	1973	Private HF	35.1	Moharajpur Chaktala Mosque	Rajshahi	Nawabganj	Nawabganj Sadar	Maharajpur	Ranihati
S98-00866	BTS312	23/03/1998	24.6025	88.2081	1993	Private HF	19.8	Mr Enamul Hoq	Rajshahi	Nawabganj	Nawabganj Sadar	Ranihati	Ramchandrapur
S98-00867	BTS313	23/03/1998	24.6239	88.195	1987	Private HF	21.3	Mr Kachucoubi	Rajshahi	Nawabganj	Nawabganj Sadar	Ranihati	Ranihati
S98-00868	BTS314	23/03/1998	24.625	88.2628	1997	PrivateTar	35.1	Mr Naimul Islam	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Piarapur
S98-00869	BTS315	23/03/1998	24.6231	88.2778	1972	Private HF	27.4	Mr Shalim Uddin	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Simultala
S98-00870	BTS316	23/03/1998	24.6544	88.2825	1990	PrivateTar	29	Mr Abdul Maleque	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Krishnapur
S98-00871	BTS317	23/03/1998	24.6372	88.2381	1990	Private HF	29	Mr Bhulu Mondol	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Arazi Simultala
S98-00872	BTS318	23/03/1998	24.5839	88.2522	1991	Private HF	29	Mr Sayed Serajul Islam	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Char Nayansukh
S98-00873	BTS319	24/03/1998	24.6433	88.2806	1987	Private Ta	35.1	Mr Ekramul Hoq	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Srirampur
S98-00875	BTS320	24/03/1998	24.665	88.2983	1995	Private HF	19.8	Mr A Ahsan	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Mohespur
S98-00876	BTS321	24/03/1998	24.6889	88.295	1997	Private Ta	33.5	Master Abdul Azizi	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Harirampur
S98-00877	BTS322	24/03/1998	24.6883	88.2633	1987	Private HF	29	Mr Famzlur Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Arunbari
S98-00878	BTS323	24/03/1998	24.7072	88.2739	1995	Private HF	29	Mr Sadequl Islam	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Sarjan
S98-00879	BTS324	24/03/1998	24.68	88.3189	1994	Private HF	29	Nadhaikrishnapur Primary School	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Nadhaikrishnapur
S98-00880	BTS325	24/03/1998	24.6706	88.3358	1993	Private Ta	38.1	Mr Bazun Murma	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Agna
S98-00881	BTS326	24/03/1998	24.6525	88.3139	1993	Private Ta	38.1	Mr Doyal Roy	Rajshahi	Nawabganj	Nawabganj Sadar	Gobratala	Amarak
S98-00883	BTS327	25/03/1998	24.5736	88.2067	1988	Private Ta	33.5	Kalinagar Primary School	Rajshahi	Nawabganj	Nawabganj Sadar	Sundorpur	Kalinagar
S98-00884	BTS328	25/03/1998	24.5586	88.1844	1991	Irrigation \	33.5	Mr Abdul Hossain	Rajshahi	Nawabganj	Nawabganj Sadar	Sundorpur	Biswanathpur
S98-00885	BTS329	25/03/1998	24.5592	88.1836	1971	Private HF	19.2	Mr Abdul Hossain	Rajshahi	Nawabganj	Nawabganj Sadar	Sundorpur	Biswanathpur
S98-00886	BTS330	25/03/1998	24.5797	88.1642	1991	Private Ta	29	Mr Samsad Reiswas?	Rajshahi	Nawabganj	Nawabganj Sadar	Narayandpur	Jayandipur
S98-00887	BTS331	25/03/1998	24.5386	88.1811	1971	Private HF	29	Maharajpur Mosque	Rajshahi	Nawabganj	Nawabganj Sadar	Sundorpur	Ran Krishnapur
S98-00888	BTS332	25/03/1998	24.5406	88.2325	1963	Private HF	19.8	Mr Arshad Ali	Rajshahi	Nawabganj	Nawabganj Sadar	Islampur	Bara rasin
S98-00889	BTS307	22/03/1998	24.6306	88.295	1986	Private HF	27.4	Mr Alauddin	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Taherpur
S98-00890	BTS334	25/03/1998	24.5228	88.2683	1998	Private HF	19.8	Mr Dhideuli Hal	Rajshahi	Nawabganj	Nawabganj Sadar	Debinagar	Debinagar
S98-00891	BTS335	26/03/1998	24.5022	88.1817	1994	Private HF	21.3	Mal Bagadanga Primary School	Rajshahi	Nawabganj	Nawabganj Sadar	Char Bagadanga	Mal Bagadanga
S98-00892	BTS336	26/03/1998	24.5125	88.2483	1988	Private HF	21.3	Mr Sultan	Rajshahi	Nawabganj	Nawabganj Sadar	Char Bagadanga	Suknapara
S98-00893	BTS337	26/03/1998	24.4956	88.2175	1997	Private HF	21.3	Mr Asad Mondol	Rajshahi	Nawabganj	Nawabganj Sadar	Shajahanpur	Sekalipur
S98-00894	BTS338	26/03/1998	24.4844	88.245	1988	Private HF	21.3	Mr Golam Hossain	Rajshahi	Nawabganj	Nawabganj Sadar	Alatuli	Roninagar

SAMPLE ID	GEOCODE	Al ug/L	AsIII ug/L	AsTot ug/L	B mg/L	Ba mg/L	Be ug/L	Br mg/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	^{34}S ‰	diss O2 mg/L	DOC mg/L	Dy ug/L
S98-00826	3294731329	4	< 6	< 6	0.03	0.276	< 0.05	0.107	190	< 0.02	0.095	2	0.85	< 0.5	< 0.05	< 1	-17.09	-4.6	-28		< 0.1	1.1	< 0.01
S98-00827	329477164	3	92	195	0.05	0.094	< 0.05	0.032	34.8	< 0.02	0.006	4	0.41	< 0.5	0.14	< 1	-7.9	-4.9	-38		< 0.1	3.9	< 0.01
S98-00828	3294755562	5	< 6	27	0.1	0.248	< 0.05	0.36	87.1	< 0.02	0.005	67.8	1.06	< 0.5	0.12	< 1	-5.7	-5.8	-38		< 0.1	8.4	< 0.01
S98-00829	3294755475	3	< 6	< 6	0.03	0.078	< 0.05	0.062	67	< 0.02	0.006	4.8	0.86	< 0.5	0.09	< 1	-4.7	-3.8	-31		< 0.1	4.7	< 0.01
S98-00830	3294755709	40	16	24	0.05	0.12	< 0.05	0.13	67.9	< 0.02	0.046	12.7	1.51	0.9	0.1	2	-9.26	-2.8	-17		< 0.1	7.9	< 0.01
S98-00831	3294779918	3	< 6	12	0.03	0.141	< 0.05	0.021	103	< 0.02	0.032	4.8	0.5	< 0.5	< 0.05	< 1	-11.79	-3.1	-16		< 0.1		< 0.01
S98-00832	3294719	5	74	161	0.06	0.149	< 0.05	0.05	76.4	< 0.02	0.01	7.5	0.47	< 0.5	0.26	< 1	-9.17	-4	-28		< 0.1		< 0.01
S98-00833	3294719	15	< 6	9	0.07	0.191	< 0.05	0.35	106	0.07	< 0.005	78.2	1.27	< 0.5	0.11	< 1	-13.21	-5.3	-42		< 0.1		< 0.01
S98-00834	329477600	1	90	171	0.05	0.118	< 0.05	0.045	54.6	< 0.02	0.007	4.8	0.38	< 0.5	0.08	< 1	-10.44	-4.1	-27		< 0.1		< 0.01
S98-00854	5706696	23	< 6	35	0.01	0.152	< 0.05	0.04	110	< 0.02	0.007	42.5	0.33	< 0.5	< 0.05	< 1	-13.83	-5.1	-37		0.5	1.5	< 0.01
S98-00855	5706696852	4	< 6	742	0.03	0.199	< 0.05	0.04	140	< 0.02	0.019	14.9	0.57	< 0.5	< 0.05	< 1	-14.26	-5.7	-38		< 0.1	1.9	< 0.01
S98-00856	5706696959	10	< 6	51	0.02	0.119	< 0.05	< 0.02	90.5	< 0.02	0.013	18.2	0.44	< 0.5	< 0.05	< 1	-12.15	-4	-27		< 0.1	2.2	< 0.01
S98-00857	5706644005	8	< 6	< 6	0.05	0.065	< 0.05	0.11	73.2	< 0.02	< 0.005	8.7	0.33	< 0.5	< 0.05	< 1	-11.11	-4.1	-20		< 0.1	2	< 0.01
S98-00858	5706644471	2	< 6	< 6	0.04	0.062	< 0.05	0.04	75.4	< 0.02	0.009	8.8	0.26	< 0.5	< 0.05	< 1	-11.46	-3.4	-21		< 0.1	1.7	< 0.01
S98-00859	5706644108	4	< 6	< 6	0.04	0.064	< 0.05	0.5	259	0.07	0.007	328	0.91	< 0.5	< 0.05	4	-12.52	-3.8	-27		1.5	4	0.02
S98-00860	5706611949	2	< 6	< 6	< 0.01	0.028	< 0.05	0.013	36.7	< 0.02	< 0.005	3.2	0.2	< 0.5	< 0.05	< 1	-12.86	-4.6	-28		0.9	1.1	< 0.01
S98-00861	5706644579	2	< 6	< 6	0.05	0.091	< 0.05	0.029	84.3	< 0.02	< 0.005	7	0.4	< 0.5	< 0.05	2					< 0.1	1.2	< 0.01
S98-00862	5706644062	2	< 6	< 6	0.04	0.03	0.14	0.016	67.4	< 0.02	0.009	3.2	0.2	< 0.5	< 0.05	< 1	-14.46	-4.7	-26		0.6	0.8	< 0.01
S98-00863	5706644858	2	< 6	< 6	0.02	0.03	< 0.05	0.05	71.9	0.02	0.011	19.1	0.25	0.6	< 0.05	< 1		-4	-23	6.6	< 0.1	1.6	< 0.01
S98-00864	5706644473	5	< 6	< 6	0.03	0.05	< 0.05	0.04	70.4	< 0.02	0.014	13.4	0.9	< 0.5	< 0.05	< 1	-10.54	-4.7	-27		1.9	0.5	< 0.01
S98-00865	5706655844	6	< 6	6	0.04	0.246	< 0.05	0.03	142	< 0.02	0.007	13.6	0.45	< 0.5	< 0.05	< 1	-8.61	-5.4	-37		< 0.1	1	< 0.01
S98-00866	5706683807	6	< 6	20	0.02	0.135	< 0.05	0.03	104	< 0.02	0.02	6.8	0.34	< 0.5	< 0.05	< 1	-14.28	-6.3	-43	11.2	< 0.1	1.5	< 0.01
S98-00867	5706683841	2	6	212	0.03	0.145	< 0.05	0.03	114	< 0.02	0.011	28.5	0.41	< 0.5	< 0.05	< 1	-12.17	-5.1	-35		< 0.1	1.5	< 0.01
S98-00868	5706611079	4	< 6	< 6	0.01	0.079	< 0.05	0.009	96.9	< 0.02	0.031	1.4	0.43	< 0.5	< 0.05	< 1	-9.31	-5	-34		< 0.1	1.3	0.01
S98-00869	5706611921	17	< 6	< 6	< 0.01	0.05	< 0.05	0.011	83.7	< 0.02	0.02	1.2	0.31	< 0.5	< 0.05	2	-12.9	-5.5	-36		< 0.1	0.9	< 0.01
S98-00870	5706611568	6	< 6	< 6	0.01	0.112	< 0.05	0.023	104	< 0.02	0.011	6.9	0.26	< 0.5	< 0.05	< 1	-10.95	-4.7	-27		0.2	1.2	< 0.01
S98-00871	5706611051	27	< 6	< 6	< 0.01	0.064	< 0.05	0.01	86.4	< 0.02	0.009	3.2	0.28	< 0.5	< 0.05	< 1	-12.74	-5.4	-35		< 0.1	1.8	< 0.01
S98-00872	5706696267	2	< 6	40	0.01	0.177	< 0.05	0.1	122	< 0.02	< 0.005	70.4	0.45	< 0.5	< 0.05	< 1	-15.3	-6.7	-42		< 0.1	2.4	< 0.01
S98-00873	5706611926	36	< 6	10	0.02	0.076	< 0.05	0.021	85.6	< 0.02	0.006	3.4	0.42	< 0.5	< 0.05	< 1	-10.67	-4.2	-35		< 0.1	0.6	< 0.01
S98-00875	5706633659	12	< 6	< 6	< 0.01	0.047	< 0.05	0.035	69.7	< 0.02	0.01	6.7	0.24	< 0.5	< 0.05	< 1	-13.39	-2.8	-18		< 0.1	0.8	< 0.01
S98-00876	5706633415	5	< 6	< 6	0.1	0.039	< 0.05	0.09	87.9	< 0.02	0.01	22.7	0.84	< 0.5	< 0.05	< 1	-13.36	-5.1	-33		< 0.1	1	< 0.01
S98-00877	5706633056	18	< 6	< 6	0.02	0.142	< 0.05	0.18	178	< 0.02	0.016	67.3	0.88	< 0.5	< 0.05	< 1	-15.42	-5.8	-40		< 0.1	1.9	< 0.01
S98-00878	5706633994	6	< 6	< 6	0.02	0.114	< 0.05	< 0.02	83.9	< 0.02	< 0.005	8	0.25	< 0.5	< 0.05	< 1	-11.75	-5.3	-34		< 0.1	1.5	< 0.01
S98-00879	5706633687	2	< 6	< 6	0.02	0.055	< 0.05	0.06	54	< 0.02	< 0.005	25.1	0.3	< 0.5	< 0.05	< 1	-12.7	-4	-28		< 0.1	0.8	< 0.01
S98-00880	5706633011	3	< 6	< 6	0.08	0.048	< 0.05	0.04	86.9	< 0.02	0.008	8.6	0.24	< 0.5	< 0.05	< 1	-11.21	-4.2	-31		0.2	0.8	0.01
S98-00881	5706633022	4	< 6	< 6	0.02	0.039	< 0.05	0.022	47.2	< 0.02	0.007	2.4	0.13	< 0.5	< 0.05	< 1	-13.42	-4.2	-29		0.2	3.9	< 0.01
S98-00883	5706694494	8	< 6	8	0.02	0.093	< 0.05	0.021	81	< 0.02	0.01	4.4	0.3	< 0.5	< 0.05	< 1	-14.9	-7.7	-47		0.4	0.8	< 0.01
S98-00884	5706694164	3	< 6	67	0.03	0.156	< 0.05	0.019	98.5	< 0.02	0.012	5.4	0.37	< 0.5	< 0.05	< 1	-15.68	-7.4	-49		< 0.1	2.1	< 0.01
S98-00885	5706694164	4	22	21	0.03	0.134	< 0.05	0.1	118	< 0.02	0.034	11.5	0.51	< 0.5	< 0.05	< 1	-15.26	-6.6	-48		< 0.1	0.7	< 0.01
S98-00886	5706667483	5	< 6	17	0.01	0.134	< 0.05	0.018	82.1	< 0.02	0.009	4.6	0.22	< 0.5	< 0.05	< 1	-14.63	-6.7	-45		0.1	1.8	< 0.01
S98-00887	5706694818	98	< 6	< 6	0.07	0.292	< 0.05	0.05	148	0.02	0.028	34.5	0.5	< 0.5	< 0.05	< 1	-16.76	-6.7	-51	1.2	< 0.1	0.6	< 0.01
S98-00888	5706639096	< 1	< 6	< 6	0.01	0.159	< 0.05	< 0.02	86.8	< 0.02	< 0.005	13.9	0.09	< 0.5	< 0.05	< 1		-6	-39		< 0.1	1.5	< 0.01
S98-00889	5706611949	5	< 6	< 6	< 0.01	0.028	< 0.05	0.013	36.6	< 0.02	< 0.005	2.6	0.23	< 0.5	< 0.05	< 1	-12.01	-4.3	-23		0.9	1.2	< 0.01
S98-00890	5706627295	5	< 6	< 6	0.02	0.115	< 0.05	< 0.02	102	< 0.02	0.02	16.9	0.39	< 0.5	< 0.05	< 1	-15.68	-6.5	-40		< 0.1	1.5	< 0.01
S98-00891	5706622614	5	< 6	14	< 0.01	0.075	< 0.05	< 0.001	72.7	< 0.02	0.021	4	0.27	< 0.5	< 0.05	< 1	-12.75	-6.3	-48		< 0.1	0.6	< 0.01
S98-00892	5706622233	16	< 6	< 6	0.01	0.098	< 0.05	0.02	87.1	< 0.02	0.027	16.5	0.31	< 0.5	< 0.05	< 1	-13.16	-7.1	-52	-0.1	< 0.1	2.9	< 0.01
S98-00893	5706689898	2	< 6	< 6	0.05	0.442	< 0.05	0.11	218	0.04	0.065	51.5	1.19	< 0.5	< 0.05	2	-16.82	-5.3	-35		< 0.1	9.4	0.01
S98-00894	570665830	7	< 6	< 6	0.01	0.089	< 0.05	< 0.02	79.5	< 0.02	0.016	13.2	0.22	< 0.5	< 0.05	< 1	-13.68	-6.9	-48		< 0.1	1.1	< 0.01

SAMPLE ID	Eh mV	Er ug/L	Eu ug/L	F mg/L	Fe mg/L	Ga ug/L	Gd ug/L	Ge ug/L	HCO_3 mg/L	Ho ug/L	I ug/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S98-00826	77	< 0.01	< 0.006	0.02	0.294		0.02		841	0.006	130	7.6	0.048	4	< 0.005	51	1.71	0.1	14.4	0.05	0.45	4.7	< 0.004	< 0.3
S98-00827	39	< 0.01	0.017	0.16	3.37		< 0.01		249	< 0.005	7.8	3.8	< 0.005	3.1	< 0.005	17.2	0.149	2.9	21.7	< 0.01	3.46	1.5	0.004	< 0.3
S98-00828	35	< 0.01	0.015	0.2	10.4		< 0.01		700	< 0.005	108	6.8	0.008	5.4	< 0.005	35.8	0.098	2.2	128	< 0.01	8.95	3.1	0.004	< 0.3
S98-00829	64	< 0.01	0.006	0.13	11		< 0.01		490	< 0.005	30.6	4	0.006	6.2	< 0.005	46.9	0.088	0.1	17	< 0.01	5.05	2.3	< 0.004	< 0.3
S98-00830	91	< 0.01	0.009	0.14	18.4		< 0.01		485	< 0.005	97.6	4.2	0.022	8.8	< 0.005	44	0.246	0.2	18.6	0.03	3.63	5	< 0.004	< 0.3
S98-00831	166	0.02	< 0.006	0.08	0.879		< 0.01		485	< 0.005	3.1	3.2	0.019	2.8	< 0.005	29.8	0.822	0.2	9.7	0.01	1.16	3.4	< 0.004	< 0.3
S98-00832	38	< 0.01	< 0.006	0.2	8.27		< 0.01		536	< 0.005	25.1	4.8	0.008	5.4	< 0.005	36.3	0.078	2.2	39	< 0.01	5.79	2	< 0.004	< 0.3
S98-00833	101	< 0.01	0.006	0.15	3.53		< 0.01		668	< 0.005	75.3	4.6	0.006	14.1	< 0.005	41.1	0.581	1.5	108	< 0.01	0.36	3.7	0.39	< 0.3
S98-00834	57	< 0.01	0.011	0.16	6.27		< 0.01		432	< 0.005	15	6.1	< 0.005	4.7	< 0.005	31	0.136	1.3	32.2	< 0.01	4.53	1.7	< 0.004	< 0.3
S98-00854	319	< 0.01	< 0.006	0.13	0.627		< 0.01		430	< 0.005	2.1	5.6	0.006	2.7	< 0.005	26.6	0.764	0.8	28.6	< 0.01	0.26	3	0.208	< 0.3
S98-00855	81	< 0.01	0.02	0.2	0.696		0.01		622	< 0.005	20.1	5.3	0.011	2.8	< 0.005	34.2	2.1	3.9	17.4	< 0.01	2.03	4	0.005	< 0.3
S98-00856	155	< 0.01	0.009	0.15	0.242		< 0.01		377	< 0.005	8.2	5	0.008	2.5	< 0.005	16.5	0.755	2.4	18.4	< 0.01	0.54	2.7	0.91	< 0.3
S98-00857	95	< 0.01	0.009	0.41	0.587		< 0.01		433	< 0.005	42	0.8	0.006	4.8	< 0.005	26.6	0.038	0.2	36.1	< 0.01	< 0.02	2.2	< 0.004	< 0.3
S98-00858	91	0.01	< 0.006	0.5	0.045		< 0.01		463	< 0.005	56.7	0.8	0.009	8.3	< 0.005	24.7	0.035	0.3	54.5	< 0.01	< 0.02	2.2	< 0.004	< 0.3
S98-00859	121	0.01	< 0.006	0.51	0.184		0.01		497	0.006	69.2	1.1	0.032	9.7	< 0.005	97	0.031	0.6	98.5	0.03	< 0.02	8.7	0.019	68
S98-00860	138	< 0.01	< 0.006	0.41	0.255		< 0.01		199	< 0.005	14.3	0.5	< 0.005	7	< 0.005	10.2	0.02	0.1	19.7	< 0.01	< 0.02	1.4	0.004	0.6
S98-00861	139	< 0.01	< 0.006	0.53	0.992		< 0.01		462	< 0.005	27.5	3.2	0.006	4.2	< 0.005	25	0.025	0.6	39.2	< 0.01	< 0.02	3.1	< 0.004	< 0.3
S98-00862	100	0.02	< 0.006	0.45	0.014		< 0.01		395	< 0.005	32.6	1	0.006	12.5	< 0.005	21.9	0.082	0.3	44.1	< 0.01	< 0.02	2	< 0.004	< 0.3
S98-00863	53	0.01	< 0.006	0.48	0.015		< 0.01		378	< 0.005	35.3	0.8	0.007	11.3	< 0.005	22.7	0.068	0.2	39.7	< 0.01	< 0.02	2.1	0.055	< 0.3
S98-00864	122	< 0.01	0.008	0.43	0.294		< 0.01		419	< 0.005	37.7	1	0.006	9.2	< 0.005	18.8	0.477	0.5	57.2	< 0.01	< 0.02	2.3	0.004	< 0.3
S98-00865	-4	< 0.01	0.009	0.14	5.29		< 0.01		630	< 0.005	9.5	4.9	0.007	2.2	< 0.005	34.9	1.26	2	18.1	< 0.01	0.35	4.1	0.005	< 0.3
S98-00866	7	< 0.01	< 0.006	0.07	1.78		< 0.01		447	< 0.005	2.3	4.4	0.007	2.1	< 0.005	24.6	0.733	0.4	11.2	< 0.01	0.38	2.9	0.004	< 0.3
S98-00867	-3	< 0.01	< 0.006	0.12	1.8		< 0.01		457	< 0.005	8.3	4	0.007	2.3	< 0.005	28.1	1.44	2.7	12	0.01	1.45	3.1	< 0.004	< 0.3
S98-00868	36	< 0.01	< 0.006	0.49	0.042		< 0.01		528	< 0.005	8.3	1.8	0.01	8	< 0.005	30.3	0.454	0.8	44.8	< 0.01	< 0.02	2.6	< 0.004	< 0.3
S98-00869	57	< 0.01	< 0.006	0.27	0.216		< 0.01		379	< 0.005	2.4	1.9	0.009	6.6	< 0.005	18.9	0.163	2.3	13.3	< 0.01	0.06	2.4	< 0.004	< 0.3
S98-00870	66	< 0.01	< 0.006	0.43	2.09		< 0.01		524	< 0.005	14.5	2	< 0.005	4.3	< 0.005	28.5	0.75	0.5	37.7	< 0.01	< 0.02	2.3	< 0.004	< 0.3
S98-00871	11	< 0.01	< 0.006	0.36	1.52		< 0.01		349	< 0.005	< 0.8	1.3	0.005	2.9	< 0.005	13.5	0.389	1.2	17.2	< 0.01	< 0.02	2.5	< 0.004	< 0.3
S98-00872	30	< 0.01	0.012	1.28	3.01		< 0.01		379	< 0.005	4.1	4.4	0.007	2.4	< 0.005	28	1.22	0.9	18.2	< 0.01	0.99	3.2	< 0.004	< 0.3
S98-00873	48	< 0.01	< 0.006	0.41	1.65		< 0.01		428	< 0.005	18.6	0.9	0.005	6.8	< 0.005	21.9	0.869	0.8	29.2	< 0.01	< 0.02	2.5	< 0.004	< 0.3
S98-00875	46	< 0.01	< 0.006	0.38	0.25		< 0.01		312	< 0.005	32.4	0.6	< 0.005	3.3	< 0.005	13	0.079	0.2	26.4	< 0.01	< 0.02	2.3	< 0.004	< 0.3
S98-00876	48	< 0.01	< 0.006	0.31	0.036		< 0.01		447	< 0.005	75.9	0.7	0.006	16.4	< 0.005	17.6	0.723	0.3	58.8	< 0.01	< 0.02	2.8	< 0.004	< 0.3
S98-00877	6	< 0.01	< 0.006	0.16	1.02		< 0.01		573	< 0.005	2.8	4.7	0.009	3.7	< 0.005	35.2	1.65	0.5	39.2	< 0.01	< 0.02	4.2	< 0.004	< 0.3
S98-00878	2	< 0.01	< 0.006	0.45	3.31		< 0.01		401	< 0.005	4.3	2.4	< 0.005	1.3	< 0.005	24.2	0.337	0.4	12.6	< 0.01	< 0.02	2.2	< 0.004	< 0.3
S98-00879	60	< 0.01	< 0.006	0.37	5.46		< 0.01		302	< 0.005	72.9	0.8	< 0.005	3.6	< 0.005	10.5	0.082	0.2	52.9	< 0.01	< 0.02	2	0.007	< 0.3
S98-00880	109	0.01	< 0.006	0.33	0.022		< 0.01		530	0.005	53.4	1.8	0.011	12.5	< 0.005	26.4	0.036	0.4	61	< 0.01	< 0.02	2.4	< 0.004	< 0.3
S98-00881	106	< 0.01	< 0.006	0.34	0.022		< 0.01		241	< 0.005	17.2	0.7	0.008	8.3	< 0.005	12.4	0.02	0.1	22.4	< 0.01	< 0.02	1.5	< 0.004	0.4
S98-00883	56	< 0.01	0.007	0.13	0.461		< 0.01		349	< 0.005	3.8	4.5	0.008	2.4	< 0.005	17.8	0.57	0.8	8.7	< 0.01	0.54	2.2	< 0.004	< 0.3
S98-00884	1	< 0.01	0.007	0.11	2.45		< 0.01		444	< 0.005	59.5	4.2	0.009	2	< 0.005	23.4	0.807	1.2	13.5	< 0.01	0.68	2.6	0.566	< 0.3
S98-00885	41	< 0.01	< 0.006	0.07	0.723		< 0.01		546	< 0.005	99.6	5.3	0.031	2.6	< 0.005	30.8	1.07	1.1	18.4	0.02	0.76	2.7	0.004	< 0.3
S98-00886	166	< 0.01	< 0.006	0.1	1.99		< 0.01		360	< 0.005	3	5	< 0.005	1.5	< 0.005	18	0.657	0.7	6.2	< 0.01	< 0.02	2.1	< 0.004	< 0.3
S98-00887	123	< 0.01	< 0.006	0.04	0.055		< 0.01		662	< 0.005	7.8	6.9	0.018	6.2	< 0.005	46.3	0.963	0.4	32.3	0.03	< 0.02	3.3	< 0.004	< 0.3
S98-00888	98	< 0.01	0.008	0.09	0.079		< 0.01		360	< 0.005	1.2	9.9	< 0.005	3.8	< 0.005	20.6	0.33	0.5	12.4	< 0.01	< 0.02	1	0.007	1.4
S98-00889	138	< 0.01	< 0.006	0.44	0.27		< 0.01		199	< 0.005	14.4	0.5	< 0.005	7.2	< 0.005	10.3	0.022	0.1	19.6	< 0.01	< 0.02	1.5	< 0.004	0.5
S98-00890	97	< 0.01	0.006	0.08	0.298		< 0.01		408	< 0.005	2.9	5.6	0.008	2.5	< 0.005	23.8	0.435	0.4	11.2	< 0.01	< 0.02	3.2	< 0.004	< 0.3
S98-00891	30	< 0.01	< 0.006	0.12	0.171		< 0.01		302	< 0.005	2.5	4	0.01	1.6	< 0.005	15.1	0.607	1.1	5.2	< 0.01	0.07	2.1	< 0.004	< 0.3
S98-00892	28	< 0.01	0.007	0.1	0.184		< 0.01		323	< 0.005	5.8	4.7	0.014	2	< 0.005	17.6	0.51	0.7	13.1	< 0.01	< 0.02	2.5	< 0.004	0.4
S98-00893	29	0.01	0.037	0.04	0.043		0.01		695	< 0.005	25.9	18.7	0.04	6.1	< 0.005	43.4	1.19	0.2	17.5	0.03	< 0.02	6.7	0.138	12.6
S98-00894	-8	< 0.01	< 0.006	0.11	0.047		< 0.01		283	< 0.005	1	4.8	0.009	2.1	< 0.005	14.3	0.419	0.9	12.9	0.01	0.02	1.8	0.042	2

SAMPLE ID	Ptot mg/L	Pb ug/L	pH	Pr ug/L	Rb ug/L	Sb ug/L	SEC uS/cm	Se ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	T °C	Tb ug/L	Th ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-00826	0.3	0.12	6.73	0.008	2.8	0.05	1100	< 0.2	11.3	0.02	< 0.1	2.1	0.769	26.9	< 0.005		< 0.01	< 0.005	29.6	0.3	0.155	0.01	4
S98-00827	2.4	0.06	7.09	< 0.005	5.1	0.03	388		16.8	< 0.01	< 0.1	< 0.2	0.207	26	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.019	< 0.008	8
S98-00828	2.3	0.12	6.81	< 0.005	6.2	0.02	1010		18.7	< 0.01	< 0.1	0.3	0.43	26.2	< 0.005		< 0.01	< 0.005	< 0.01	0.2	0.034	0.008	3
S98-00829	3.2	0.16	6.54	< 0.005	4.9	0.09	637		38	< 0.01	0.1	0.3	0.363	26.8	< 0.005		< 0.01	< 0.005	< 0.01	0.3	0.021	< 0.008	4
S98-00830	2.7	0.94	6.38	< 0.005	4.4	0.24	622		41.9	< 0.01	0.2	0.5	0.333	26	< 0.005		< 0.01	< 0.005	0.01	1.2	0.053	0.009	28
S98-00831	0.2	0.16	6.83	< 0.005	0.5	0.04	620		16.9	< 0.01	< 0.1	< 0.2	0.465	25.9	< 0.005		< 0.01	< 0.005	1.14	< 0.2	0.076	< 0.008	18
S98-00832	2	0.16	6.85	< 0.005	8.8	< 0.02	681		19.4	< 0.01	< 0.1	< 0.2	0.335	26.2	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.02	< 0.008	5
S98-00833	0.4	28.6	6.88	< 0.005	7.4	< 0.02	951		19.7	< 0.01	< 0.1	< 0.2	0.494	27.2	< 0.005		0.01	< 0.005	0.09	< 0.2	0.016	0.008	
S98-00834	2	0.25	6.88	< 0.005	8	< 0.02	557		21.2	< 0.01	< 0.1	< 0.2	0.291	25.6	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.018	< 0.008	19
S98-00854	0.2	1.19	7.09	< 0.005	1.7	0.02	707		14.5	< 0.01	< 0.1	18.7	0.254	27.4	< 0.005		< 0.01	< 0.005	1.23	< 0.2	0.032	< 0.008	9
S98-00855	< 0.2	0.13	6.98	< 0.005	1.4	0.03	771		13.4	< 0.01	< 0.1	< 0.2	0.576	27.2	< 0.005		< 0.01	< 0.005	0.68	< 0.2	0.052	< 0.008	11
S98-00856	< 0.2	0.09	7.01	< 0.005	0.8	0.03	575		14	< 0.01	< 0.1	< 0.2	0.319	27.2	< 0.005		< 0.01	< 0.005	0.31	< 0.2	0.032	< 0.008	2
S98-00857	< 0.2	0.03	6.8	< 0.005	0.3	0.02	580		18.5	< 0.01	< 0.1	1.3	0.382	27.6	< 0.005		< 0.01	< 0.005	2.13	1.4	0.029	< 0.008	56
S98-00858	0.2	0.13	6.84	< 0.005	0.1	< 0.02	633		18	< 0.01	< 0.1	3.9	0.391	26.8	< 0.005		< 0.01	< 0.005	4.04	2.2	0.15	< 0.008	6
S98-00859	0.2	0.08	6.77	0.007	0.3	0.08	1590		15	< 0.01	< 0.1	109	1.4	27.1	< 0.005		< 0.01	< 0.005	32.4	1.3	0.233	0.01	62
S98-00860	< 0.2	< 0.01	6.69	< 0.005	< 0.1	0.05	331		20.4	< 0.01	< 0.1	0.9	0.175	26.8	< 0.005		< 0.01	< 0.005	0.44	1.8	0.042	< 0.008	3
S98-00861	< 0.2	0.11	0	< 0.005	0.4	0.03	712		16.8	< 0.01	0.5	1.6	0.418	27.5	< 0.005		< 0.01	< 0.005	2.97	0.9	0.015	< 0.008	38
S98-00862	< 0.2	0.3	0	< 0.005	0.3	< 0.02	588		16	< 0.01	< 0.1	0.5	0.348	27.5	< 0.005		< 0.01	< 0.005	1.76	1.8	0.129	0.028	11
S98-00863	< 0.2	< 0.01	0	< 0.005	0.3	< 0.02	605		17.3	< 0.01	< 0.1	10.9	0.382	27.6	< 0.005		< 0.01	< 0.005	1.98	1.6	0.108	0.009	7
S98-00864	< 0.2	0.77	0	< 0.005	0.4	0.03	633		15.6	< 0.01	< 0.1	5.5	0.302	27.8	< 0.005		< 0.01	< 0.005	3.54	1	0.082	0.01	23
S98-00865	0.6	0.16	7.05	< 0.005	2.3	< 0.02	907		12.7	< 0.01	< 0.1	1	0.542	26.3	< 0.005		< 0.01	< 0.005	0.03	< 0.2	0.037	< 0.008	6
S98-00866	< 0.2	0.01	7	< 0.005	2.1	< 0.02	689	< 0.2	13.7	< 0.01	< 0.1	9.7	0.397	26.2	< 0.005		< 0.01	< 0.005	1.56	< 0.2	0.043	< 0.008	10
S98-00867	< 0.2	< 0.01	6.91	< 0.005	1.9	0.02	783		13.2	< 0.01	< 0.1	10.4	0.417	26.4	< 0.005		< 0.01	< 0.005	0.45	< 0.2	0.062	< 0.008	7
S98-00868	< 0.2	0.22	6.83	< 0.005	0.1	< 0.02	763		14	< 0.01	< 0.1	13.9	0.297	26.9	< 0.005		< 0.01	< 0.005	3.79	1.7	0.04	< 0.008	69
S98-00869	< 0.2	0.28	6.93	< 0.005	< 0.1	0.02	583		15.2	< 0.01	< 0.1	< 0.2	0.271	28.3	< 0.005		< 0.01	< 0.005	1.78	2.6	0.023	< 0.008	8
S98-00870	0.2	0.19	6.86	< 0.005	4.1	< 0.02	825		16.1	< 0.01	< 0.1	18.9	0.285	27.9	< 0.005		< 0.01	< 0.005	0.34	< 0.2	0.048	< 0.008	12
S98-00871	< 0.2	0.14	7.03	< 0.005	4.6	0.03	554		8.44	< 0.01	< 0.1	6.8	0.281	26.6	< 0.005		< 0.01	< 0.005	0.07	< 0.2	0.043	0.008	5
S98-00872	0.3	0.02	7.01	< 0.005	1.9	0.06	891		14.8	< 0.01	< 0.1	44.8	0.433	26.6	< 0.005		< 0.01	< 0.005	0.23	< 0.2	0.027	0.008	6
S98-00873	0.3	0.2	6.74	< 0.005	0.3	0.02	642		14.4	< 0.01	< 0.1	4.8	0.25	27.8	< 0.005		< 0.01	< 0.005	0.12	0.7	0.029	< 0.008	21
S98-00875	< 0.2	< 0.01	6.74	< 0.005	0.3	< 0.02	495		11.2	< 0.01	< 0.1	8.1	0.15	27	< 0.005		< 0.01	< 0.005	1.23	0.8	0.033	< 0.008	5
S98-00876	0.2	0.34	6.69	< 0.005	< 0.1	< 0.02	713		17.3	< 0.01	< 0.1	12.1	0.278	26.5	< 0.005		< 0.01	< 0.005	3.29	0.9	0.071	< 0.008	
S98-00877	< 0.2	0.16	6.92	< 0.005	0.1	0.03	1140		12.3	< 0.01	< 0.1	99.2	0.396	27	< 0.005		< 0.01	< 0.005	2.05	1.1	0.107	0.011	10
S98-00878	0.5	< 0.01	6.87	< 0.005	3.3	< 0.02	589		15.6	< 0.01	< 0.1	1.3	0.181	27	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.018	< 0.008	5
S98-00879	< 0.2	0.06	6.61	< 0.005	0.2	0.03	535		20.8	< 0.01	< 0.1	9.7	0.192	26.7	< 0.005		< 0.01	< 0.005	0.91	0.4	0.012	< 0.008	32
S98-00880	< 0.2	0.27	6.9	< 0.005	0.2	< 0.02	758	< 0.2	15.6	< 0.01	< 0.1	0.6	0.555	26.6	< 0.005		< 0.01	< 0.005	2.73	1.2	0.174	0.02	8
S98-00881	< 0.2	0.31	6.55	< 0.005	0.2	< 0.02	374		20.3	< 0.01	0.1	< 0.2	0.22	26.1	< 0.005		< 0.01	< 0.005	0.48	1.4	0.088	< 0.008	23
S98-00883	< 0.2	0.55	6.99	< 0.005	1.9	< 0.02	518		13.1	< 0.01	< 0.1	< 0.2	0.305	27	< 0.005		< 0.01	< 0.005	0.6	< 0.2	0.035	0.014	45
S98-00884	0.4	0.03	7.1	< 0.005	2.1	0.03	654		13.4	< 0.01	< 0.1	3.6	0.364	27.8	< 0.005		< 0.01	< 0.005	0.93	< 0.2	0.034	< 0.008	5
S98-00885	0.3	0.26	6.92	< 0.005	2.7	0.03	775		13.4	< 0.01	0.1	1.6	0.439	26.3	< 0.005		0.01	< 0.005	5.62	< 0.2	0.086	< 0.008	11
S98-00886	0.2	0.1	7.16	< 0.005	1.6	< 0.02	522		11.7	< 0.01	< 0.1	4.1	0.288	27.7	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.021	< 0.008	4
S98-00887	< 0.2	0.1	6.89	< 0.005	1.6	0.1	1040	< 0.2	10	< 0.01	< 0.1	27	0.659	27.2	< 0.005		< 0.01	< 0.005	17.2	2.2	0.084	< 0.008	8
S98-00888	< 0.2	< 0.01	7.14	< 0.005	0.4	0.06	591		9.47	< 0.01	0.4	11.6	0.315	27.2	< 0.005		< 0.01	< 0.005	5.3	1.6	< 0.005	< 0.008	1
S98-00889	< 0.2	< 0.01	6.69	< 0.005	0.1	0.06	331		20.2	< 0.01	< 0.1	0.7	0.183	26.8	< 0.005		< 0.01	< 0.005	0.44	1.9	0.048	< 0.008	3
S98-00890	< 0.2	< 0.01	7.09	< 0.005	0.7	< 0.02	650		9.33	< 0.01	< 0.1	9.8	0.326	27.1	< 0.005		< 0.01	< 0.005	6.97	0.2	0.039	< 0.008	3
S98-00891	< 0.2	< 0.01	7.1	< 0.005	0.8	0.04	482		10.5	< 0.01	0.6	2.2	0.255	26.9	< 0.005		< 0.01	< 0.005	0.97	0.4	0.03	< 0.008	2
S98-00892	< 0.2	0.09	7.16	< 0.005	1.7	0.03	598		9.71	< 0.01	0.3	17.9	0.309	26.3	< 0.005		< 0.01	< 0.005	7.62	0.8	0.041	< 0.008	38
S98-00893	< 0.2	0.02	6.75	< 0.005	0.5	0.05	1370		10.6	0.01	0.3	62	0.666	27	< 0.005		< 0.01	< 0.005	13.7	1.2	0.128	< 0.008	7
S98-00894	< 0.2	0.15	7.32	< 0.005	1.2	0.1	549		8.49	< 0.01	< 0.1	13	0.264	27.4	< 0.005		< 0.01	< 0.005	6.98	1.3	0.032	< 0.008	34

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST.	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S98-00895	BTS339	26/03/1998	24.5	88.2289	1998	Private HF	16.8	Mr Abul Quashem	Rajshahi	Nawabganj	Nawabganj Sadar	Shajahanpur	Durlabhpur
S98-00896	BTS340	27/03/1998	24.5958	88.2739	1980	Productior	41.1	New Market No:4, DPHE	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Paurashava
S98-00897	BTS341	27/03/1998	24.5942	88.2819	1998	Productior	45	Court Area No:10, DPHE	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Milki
S98-00898	BTS342	27/03/1998	24.5939	88.2822	1997	Private HF	15.2	Mr Fazlur Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Milki
S98-00899	BTS343	27/03/1998	24.5997	88.2806	1980	Productior	41.1	Tank Corner No:1, DPHE	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Paurashava
S98-00900	BTS344	27/03/1998	24.5992	88.2708	1982	Private HF	39.6	Mr Alauddin	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Goalpara
S98-00901	BTS345	27/03/1998	24.6053	88.2897	1994	Private HF	25.9	Mr Sahabuddin	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Kalyanpur
S98-00902	BTS346	27/03/1998	24.5742	88.2689	1990	Private HF	21.3	Mr Anisur Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Rajarampur
S98-00903	BTS347	27/03/1998	24.5742	88.2689	1997	Private rin;	7.9	Mr Anisur Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Rajarampur
S98-00904	BTS348	27/03/1998	24.5689	88.3033	1991	Private HF	33.5	Mr Baffiqul Islam	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Daripur
S98-00905	BTS349	28/03/1998	24.6414	88.4044	1993	Private HF	42.7	Mr Asnir Ali	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Jhilim
S98-00906	BTS350	28/03/1998	24.6039	88.3889	1978	Private HF	35.1	Kandol Primary School	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Kendol
S98-00907	BTS333	25/03/1998	24.5406	88.2325	1963	Private HF	19.8	Mr Arshad Ali	Rajshahi	Nawabganj	Nawabganj Sadar	Islampur	Bara rasin
S98-00908	BTS351	28/03/1998	24.6544	88.3489	1982	Private HF	25.9	Mr Soheleral	Rajshahi	Nawabganj	Nachole	Nirzampur	Basugram
S98-00909	BTS352	28/03/1998	24.6267	88.3217	1991	Private Ta	38.1	Mr Kalim Vadin	Rajshahi	Nawabganj	Nawabganj Sadar	Baliadanga	Koholapara
S98-00910	BTS353	28/03/1998	24.6114	88.3478	1986	Private Ta	41.1	Mr Ruhul Amin	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Pustampur
S98-00911	BTS354	28/03/1998	24.5794	88.3231	1995	Private Ta	32	Mr Mahboob Hossain	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Thakur Palsa
S98-00912	BTS355	29/03/1998	24.5761	88.2903	1956	Private rin;	8.5	Mr Daud Mondol	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj Paurashava	Haripur
S98-00913	BTS356	29/03/1998	24.5133	88.3064	1978	DPHE HF	22.9	DPHE, Mr Nurul Islam Khan	Rajshahi	Nawabganj	Nawabganj Sadar	Char Anupnagar	Anupnagar
S98-00914	BTS357	29/03/1998	24.5139	88.3061	1952	Private rin;	3.8	Mr Tofaggal	Rajshahi	Nawabganj	Nawabganj Sadar	Char Anupnagar	Anupnagar
S98-00915	BTS358	29/03/1998	24.5347	88.3061	1990	Private Ta	29	Mr Brojendra	Rajshahi	Nawabganj	Nawabganj Sadar	Char Anupnagar	Anupnagar
S98-00916	BTS359	29/03/1998	24.5792	88.2308	1987	Private HF	15.2	Mr Monsoor Rahman	Rajshahi	Nawabganj	Nawabganj Sadar	Sundorpur	Mohanpur
S99-00360	BTS405	17/03/1999	24.618	88.375	1987	Irrigation '	52.4	Munimul Haque	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Khitta
S99-00361	BTS406	17/03/1999	24.6162	88.3862	1991	Tara Pumr	39.6	Bhabuk	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Bhabuk
S99-00362	BTS407	17/03/1999	24.61	88.3787	1999	Tara Pumr	42.7	Hasimpur	Rajshahi	Nawabganj	Nawabganj Sadar	Jhilim	Hasimpur
S99-00363	BTS408	18/03/1999	24.7495	88.0722	1983	No 6 Handpump T/\		BDR Campsite	Rajshahi	Nawabganj	Shibganj (N)	Binodpur	Kiranganj
S99-00364	BTS409	18/03/1999	24.7495	88.0738	1984	No 6 Hanc	34.1	BDR Campsite	Rajshahi	Nawabganj	Shibganj (N)	Shabazpur	Telkupi
S99-00365	BTS410	18/03/1999	24.7063	88.0982	1991	No 6 Hanc	38.7	Mankasa	Rajshahi	Nawabganj	Shibganj (N)	Mankasa	Mankasa
S99-00366	BTS411	18/03/1999	24.6892	88.1572	1988	No 6 Hanc	35.1	DPHE campus site	Rajshahi	Nawabganj	Shibganj (N)		Parashava
S99-00367	BTS412	19/03/1999	24.7493	88.1243	1975	No 6 Hanc	34.4	Hadinagar	Rajshahi	Nawabganj	Shibganj (N)	Shyampur	Hadinagar
S99-00368	BTS413	19/03/1999	24.7372	88.154	1985	No 6 Hanc	28.3	Bajipur	Rajshahi	Nawabganj	Shibganj (N)	Shyampur	Bajipur
S99-00369	BTS414	19/03/1999	24.7262	88.1603	1989	No 6 Hanc	35.1	Sadasipur	Rajshahi	Nawabganj	Shibganj (N)	Shyampur	Ajgobi
S99-00370	BTS415	19/03/1999	24.727	88.1607	1993	No 6 Hanc	14.6	Sadasipur	Rajshahi	Nawabganj	Shibganj (N)	Shyampur	Ajgobi
S99-00371	BTS416	19/03/1999	24.6842	88.1488	1989	No 6 Hanc	36.9	Kalupur	Rajshahi	Nawabganj	Shibganj (N)	Durlabpur	Durlabpur
S99-00372	BTS417	19/03/1999	24.6823	88.102	1993	No 6 Hanc	35.1	Jaganthpur Govt. primary school	Rajshahi	Nawabganj	Shibganj (N)	Kansat	Jagathpur
S99-00373	BTS418	19/03/1999	24.6508	88.178	1995	No 6 Hanc	34.4	Salrajitpur	Rajshahi	Nawabganj	Shibganj (N)	Salrajitpur	Salrajitpur
S99-00374	BTS419	20/03/1999	24.721	88.2015	1979	No 6 Hanc	37.5	Balurchar	Rajshahi	Nawabganj	Shibganj (N)	Kansat	Biswanathpur
S99-00375	BTS420	20/03/1999	24.7177	88.1888	1994	No 6 Hanc	35.7	Shibnagar	Rajshahi	Nawabganj	Shibganj (N)	Kansat	Shibnagar
S99-00376	BTS421	20/03/1999	24.7103	88.1715	1998	No 6 Hanc	34.1	Bilbari	Rajshahi	Nawabganj	Shibganj (N)	Kansat	Mohonbag
S99-00377	BTS422	20/03/1999	24.7282	88.1777	1989	No 6 Hanc	32.6	Bag Durgapur	Rajshahi	Nawabganj	Shibganj (N)	Kansat	Bag Durgapur
S99-00378	BTS423	20/03/1999	24.7347	88.1692	1979	No 6 Hanc	38.7	Kalaban	Rajshahi	Nawabganj	Shibganj (N)	Mabarakbur	Kalaban
S99-00379	BTS424	20/03/1999	24.719	88.2192	1989	No 6 Hanc	34.4	Chalk Haripur	Rajshahi	Nawabganj	Shibganj (N)	Kansat	
S99-00380	BTS425	20/03/1999	24.6595	88.1883	1989	Ring Well	6	Mithupur	Rajshahi	Nawabganj	Shibganj (N)	Shibganj	
S99-00381	BTS426	20/03/1999	24.6577	88.191	1989	Concrete &	19.8	Mithupur	Rajshahi	Nawabganj	Shibganj (N)	Shibganj	
S99-00382	BTS427	21/03/1999	24.6577	88.191	1994	No 6 Hanc	19.8	Mithurpur	Rajshahi	Nawabganj	Shibganj (N)	Shibganj	
S99-00383	BTS428	21/03/1999	24.6803	88.248	1956	Concrete r	9.2	Bamungaon	Rajshahi	Nawabganj	Shibganj (N)	Dhainagar	Chatanpur?
S99-00384	BTS429	21/03/1999	24.6797	88.2535	1995	No 6 Hanc	33.5	Bamungaon	Rajshahi	Nawabganj	Shibganj (N)	Dhainagar	Chaintapur?
S99-00385	BTS430	21/03/1999	24.6347	88.1967	1994	No 6 Hanc	35.1	Sabek Nayanobhanga	Rajshahi	Nawabganj	Shibganj (N)	Nayanobhanga	Nayanobhanga

SAMPLE ID	GEOCODE	Al ug/L	AsIII ug/L	AsTot ug/L	B mg/L	Ba mg/L	Be ug/L	Br mg/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	^{34}S ‰	diss O2 mg/L	DOC mg/L	Dy ug/L
S98-00895	5706689358	2	< 6	< 6	0.01	0.095	< 0.05	0.016	85.5	< 0.02	0.023	4.1	0.27	< 0.5	< 0.05	< 1	-11.03	-6	-41		< 0.1	1.5	0.01
S98-00896	5706696	1	23	137	0.01	0.182	< 0.05	0.01	102	< 0.02	< 0.005	3.9	0.43	< 0.5	< 0.05	< 1	-12.4	-5.5	-42		0.2	7.5	< 0.01
S98-00897	5706696636	2	27	136	< 0.01	0.084	< 0.05	0.019	63.2	< 0.02	< 0.005	6.2	0.2	< 0.5	< 0.05	< 1	-12.55	-5	-38		< 0.1	1.2	< 0.01
S98-00898	5706696636	2	< 6	12	< 0.01	0.072	< 0.05	0.016	51.6	< 0.02	< 0.005	7.2	0.19	< 0.5	< 0.05	< 1	-11.41	-3.4	-29		< 0.1	1.8	< 0.01
S98-00899	5706696	2	< 6	27	0.02	0.153	< 0.05	0.04	121	< 0.02	0.011	59.6	0.34	< 0.5	< 0.05	< 1	-14.54	-4.4	-33		< 0.1	2	< 0.01
S98-00900	5706696852	< 1	53	234	0.01	0.147	< 0.05	0.017	119	< 0.02	< 0.005	3.4	0.13	< 0.5	< 0.05	< 1	-11.86	-5.2	-31		0.5	1.7	< 0.01
S98-00901	5706696506	1	< 6	< 6	0.02	0.062	< 0.05	0.015	100	< 0.02	0.019	3	0.79	< 0.5	< 0.05	< 1	-8.56	-4.5	-30		0.1	1.5	< 0.01
S98-00902	5706696	1	< 6	1520	0.04	0.101	< 0.05	0.025	111	0.03	0.007	4.3	0.4	< 0.5	< 0.05	< 1					< 0.1	1.8	< 0.01
S98-00903	5706696	16	< 6	13	0.07	0.182	< 0.05	0.11	155	< 0.02	< 0.005	105	0.62	< 0.5	< 0.05	< 1	-6.33	-5.8	-36		4.1	1.4	< 0.01
S98-00904	5706696285	11	< 6	9	0.07	0.064	< 0.05	0.04	78.4	< 0.02	0.024	12.9	0.47	< 0.5	< 0.05	< 1	-9.85	-4.5	-31		< 0.1	1.2	0.01
S98-00905	5706644466	2	< 6	< 6	0.06	0.053	< 0.05	0.027	66.8	< 0.02	0.005	4.7	0.21	< 0.5	< 0.05	< 1	-12.25	-3.5	-24		0.9	1.3	< 0.01
S98-00906	5706644579	4	< 6	< 6	0.05	0.092	< 0.05	< 0.02	84.6	< 0.02	< 0.005	7.2	0.39	< 0.5	< 0.05	< 1	-9.94	-4.2	-29		< 0.1		< 0.01
S98-00907	5706639096	6	< 6	< 6	0.02	0.158	< 0.05	< 0.02	87.1	< 0.02	0.012	13.7	0.29	< 0.5	< 0.05	< 1	-14.64	-5.8	-40		< 0.1	1.5	< 0.01
S98-00908	57056	4	< 6	< 6	0.04	0.06	< 0.05	0.03	90.5	< 0.02	0.013	10.6	0.76	< 0.5	< 0.05	< 1		-3.1	-24		< 0.1	1.4	< 0.01
S98-00909	5706611	5	< 6	< 6	0.04	0.042	< 0.05	0.017	74.7	< 0.02	0.011	2.8	0.22	< 0.5	< 0.05	< 1		-3.4	-25		0.8	0.5	< 0.01
S98-00910	5706644790	2	< 6	< 6	0.04	0.092	< 0.05	0.14	86.7	< 0.02	0.01	30.7	0.31	< 0.5	< 0.05	< 1		-2.2	-21		0.4	1.6	< 0.01
S98-00911	5706644966	4	< 6	< 6	0.08	0.06	< 0.05	0.05	77.8	0.02	0.011	11.9	0.45	< 0.5	< 0.05	< 1		-3.5	-29		0.6	0.3	< 0.01
S98-00912	5706696432	5	< 6	14	0.02	0.127	< 0.05	0.06	115	< 0.02	< 0.005	51.1	0.45	< 0.5	< 0.05	< 1	-16.57	-6.3	-47		1.5	2.2	< 0.01
S98-00913	5706616037	4	< 6	< 6	< 0.01	0.129	< 0.05	< 0.02	64.9	< 0.02	0.016		0.31	< 0.5	< 0.05	< 1					< 0.1	1.8	< 0.01
S98-00914	5706616037	44	< 6	8	0.03	0.226	< 0.05	0.12	163	< 0.02	0.043	64.3	0.63	< 0.5	< 0.05	1					0.7	1.3	< 0.01
S98-00915	5706616037	10	< 6	< 6	0.04	0.143	< 0.05	0.04	103	< 0.02	0.026	11.6	0.42	< 0.5	< 0.05	< 1					0.8	1.9	< 0.01
S98-00916	5706694653	3	< 6	88	< 0.01	0.154	< 0.05	0.016	121	< 0.02	0.015	5	0.59	< 0.5	< 0.05	< 1					< 0.1	0.3	< 0.01
S99-00360	5706644534	5	< 0.5	< 0.5	< 0.1	0.064	< 0.05	0.013	78.2	< 0.02	0.015	2.9	0.18	< 0.5	< 0.05	< 1	-7.8	-4.2	-30		0.2	0.4	< 0.01
S99-00361	5706644534	5	< 0.5	< 0.5	< 0.1	0.067	< 0.05	0.012	74.7	< 0.02	0.011	5.1	0.14	< 0.5	< 0.05	< 1	-7.2	-2.9	-22		0.7	0.9	< 0.01
S99-00362	5706644426	11	< 0.5	< 0.5	< 0.1	0.083	< 0.05	0.011	80.8	< 0.02	0.005	3.1	0.13	1.3	< 0.05	< 1	-5.4	-2.9	-24		1.4	0.7	< 0.01
S99-00363	570885497	1	12.9	18.6	< 0.1	0.207	< 0.05	0.04	151	< 0.02	0.038	14.2	0.68	< 0.5	< 0.05	< 1	-10.3	-5.3	-37		< 0.1	0.8	< 0.01
S99-00364	5708877939	2	3.3	5.5	< 0.1	0.177	< 0.05	0.026	148	< 0.02	0.026	1.4	0.52	< 0.5	< 0.05	< 1	-12.1	-5.5	-40		< 0.1	1.4	0.01
S99-00365	5708853130	2	44.4	61.2	< 0.1	0.189	< 0.05	0.09	153	< 0.02	0.014	43.4	0.42	< 0.5	< 0.05	< 1	-14.8	-5.9	-40		< 0.1	0.8	< 0.01
S99-00366	5708883889	3	< 0.5	< 0.5	< 0.1	0.12	< 0.05	0.082	120	0.04	0.097	18.1	1.3	< 0.5	< 0.05	< 1	-8.5	-5.1	-42		< 0.1	2.3	0.02
S99-00367	5708889381	12	76.3	103	< 0.1	0.119	< 0.05	0.018	89.5	< 0.02	0.008	1	0.28	< 0.5	< 0.05	< 1	-12.7	-4.3	-28		< 0.1	0.5	< 0.01
S99-00368	5708889055	2	< 0.5	1.5	< 0.1	0.064	< 0.05	0.016	63.5	< 0.02	0.009	4.4	0.14	< 0.5	< 0.05	< 1	-11.9	-7.6	-51		< 0.1	<0.1	< 0.01
S99-00369	5708889824	61	7.6	10.7	< 0.1	0.099	< 0.05	0.019	89.1	< 0.02	0.032	3.1	0.27	< 0.5	< 0.05	< 1	-11.2	-5.7	-45		< 0.1	0.3	0.01
S99-00370	5708889824	3	109	313	< 0.1	0.125	< 0.05	0.021	85.8	< 0.02	0.011	1.7	0.64	< 0.5	< 0.05	< 1	-14.3	-3.9	-33		< 0.1	0.4	< 0.01
S99-00371	5708829296	2	< 0.5	< 0.5	< 0.1	0.086	< 0.05	0.057	106	0.03	0.049	5.1	0.75	< 0.5	< 0.05	< 1	-10	-7	-48		< 0.1	0.6	< 0.01
S99-00372	5708829412	6	141	131	< 0.1	0.166	< 0.05	0.09	140	< 0.02	0.042	27.5	0.49	< 0.5	< 0.05	< 1	-18.1	-5.6	-42		< 0.1	1	0.01
S99-00373	5708871879	2	104	157	< 0.1	0.215	< 0.05	0.026	115	< 0.02	< 0.005	3.1	0.24	< 0.5	< 0.05	< 1	-9.3	-4.8	-41		< 0.1	0.6	< 0.01
S99-00374	5708841105	1	4.7	8.9	< 0.1	0.225	< 0.05	0.068	140	< 0.02	0.005	2.7	0.24	< 0.5	< 0.05	< 1	-9.1	-1.9	-24		< 0.1	1.3	< 0.01
S99-00375	5708841894	11	2.5	3.9	< 0.1	0.145	< 0.05	0.084	136	< 0.02	0.007	4.8	0.29	< 0.5	0.1	< 1	-9.6	-3.2	-30		< 0.1	0.6	< 0.01
S99-00376	5708841075	2	< 0.5	< 0.5	< 0.1	0.116	< 0.05	0.1	159	0.13	0.012	33.1	1.88	< 0.5	< 0.05	< 1	-11.3	-3.3	-39		< 0.1	0.7	< 0.01
S99-00377	5708841045	3	< 0.5	< 0.5	< 0.1	0.083	< 0.05	0.065	125	< 0.02	0.026	3.4	0.86	< 0.5	< 0.05	< 1	-8.6	-2.2	-27		< 0.1	0.5	< 0.01
S99-00378	5708847057	12	< 0.5	< 0.5	< 0.1	0.103	< 0.05	0.06	119	0.02	0.026	3.8	0.69	< 0.5	< 0.05	< 1	-10.5	-3.8	-31		< 0.1	1.3	0.01
S99-00379	5708841713	9	< 0.5	12.1	< 0.1	0.257	< 0.05	0.067	183	< 0.02	0.013	3.8	0.39	< 0.5	0.08	< 1	-10	-4.8	-37		0.1	0.3	< 0.01
S99-00380	5708883173	5	< 0.5	< 0.5	< 0.1	0.089	< 0.05	0.016	114	0.02	0.036	8.2	0.37	< 0.5	< 0.05	< 1	-6.8	-4.4	-38		0.7	0.2	< 0.01
S99-00381	5708883173	3	5.3	109	< 0.1	0.19	< 0.05	0.061	141	< 0.02	< 0.005	12.2	0.41	< 0.5	< 0.05	< 1	-11	-6.1	-44		< 0.1	1.7	< 0.01
S99-00382	5708883173	38	< 0.5	< 0.5	< 0.1	0.073	< 0.05	0.021	106	< 0.02	0.193	2.4	0.98	< 0.5	< 0.05	2	-7.4	-5.3	-46		< 0.1	0.6	0.04
S99-00383	5708823140	17	< 0.5	< 0.5	< 0.1	0.112	< 0.05	0.19	213	0.02	0.023	223	0.46	< 0.5	< 0.05	1	-12	-4	-37		1.9	1.4	< 0.01
S99-00384	5708823140	10	2.4	2.7	< 0.1	0.088	< 0.05	0.06	113	0.02	0.012	4.4	0.51	< 0.5	< 0.05	< 1	-6.8	-3.5	-35		< 0.1	0.5	< 0.01
S99-00385	57088	5	< 0.5	< 0.5	< 0.1	0.143	< 0.05	0.028	103	< 0.02	0.014	13.3	0.31	< 0.5	< 0.05	< 1	-15	-4.2	-37		< 0.1	2.1	< 0.01

SAMPLE ID	Eh mV	Er ug/L	Eu ug/L	F mg/L	Fe mg/L	Ga ug/L	Gd ug/L	Ge ug/L	HCO_3 mg/L	Ho ug/L	I ug/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S98-00895	-3	< 0.01	< 0.006	0.05	0.162		< 0.01		364	< 0.005	1	5.1	0.013	1.9	< 0.005	23	0.26	0.4	8.5	< 0.01	< 0.02	2.1	< 0.004	< 0.3
S98-00896	30	< 0.01	0.011	0.15	4.76		< 0.01		448	< 0.005	2.1	3.9	0.005	2.2	< 0.005	21.6	0.919	1.5	13.6	< 0.01	0.86	2.8	0.004	< 0.3
S98-00897	-11	< 0.01	< 0.006	0.16	1.52		< 0.01		278	< 0.005	3.4	2.8	0.007	1.1	< 0.005	13.5	0.591	0.8	7.4	< 0.01	0.16	1.5	< 0.004	< 0.3
S98-00898	-5	< 0.01	< 0.006	0.14	2.15		< 0.01		202	< 0.005	4.9	2.3	< 0.005	0.8	< 0.005	10.7	0.506	0.2	5.7	< 0.01	< 0.02	1.4	< 0.004	< 0.3
S98-00899	41	< 0.01	0.012	0.18	1.04		0.01		444	< 0.005	5.2	4	0.009	2.6	< 0.005	27.8	0.805	0.7	32.6	< 0.01	0.12	3.1	0.004	< 0.3
S98-00900	59	< 0.01	< 0.006	0.12	0.678		< 0.01		507	< 0.005	5.2	5.1	< 0.005	2.4	< 0.005	24.2	1.17	2.3	14.7	< 0.01	0.67	1.2	< 0.004	< 0.3
S98-00901	95	< 0.01	0.01	0.42	0.455		< 0.01		505	< 0.005	26.5	0.8	0.006	5.7	< 0.005	22.7	0.979	0.4	46.9	< 0.01	< 0.02	3	< 0.004	< 0.3
S98-00902	50	< 0.01	< 0.006	0.35	0.185		< 0.01		477	< 0.005	5.7	4.7	0.005	1.8	< 0.005	24.8	0.99	10.5	14.8	< 0.01	0.9	3.1	0.004	< 0.3
S98-00903	76	< 0.01	0.011	0.18	0.007		< 0.01		603	< 0.005	< 0.8	12.4	< 0.005	7.1	< 0.005	45.5	0.384	0.8	82.1	< 0.01	0.02	4.8	0.184	9.5
S98-00904	32	0.01	0.009	0.46	0.073		< 0.01		469	< 0.005	58.2	0.6	0.01	17.3	< 0.005	20	0.532	0.3	63.8	< 0.01	< 0.02	2.3	< 0.004	< 0.3
S98-00905	34	< 0.01	< 0.006	0.69	0.135		< 0.01		489	< 0.005	65.4	0.7	0.005	6.4	< 0.005	23.9	0.018	0.3	70.6	< 0.01	< 0.02	1.9	< 0.004	< 0.3
S98-00906	139	< 0.01	0.007	0.62	1.02		< 0.01		462	< 0.005	26	3.2	< 0.005	4.2	< 0.005	25.2	0.024	0.6	38.8	< 0.01	< 0.02	2.8	0.014	< 0.3
S98-00907	98	< 0.01	< 0.006	0.08	0.07		< 0.01		360	< 0.005	1.1	9.8	0.011	4.1	< 0.005	20.4	0.331	0.5	12.4	< 0.01	< 0.02	2.5	0.011	1.5
S98-00908	22	< 0.01	< 0.006	0.48	1.52		< 0.01		458	< 0.005	82.2	0.8	0.006	10.2	< 0.005	19.6	0.407	0.6	44.9	< 0.01	< 0.02	3.3	< 0.004	< 0.3
S98-00909	56	< 0.01	< 0.006	0.51	0.058		< 0.01		440	0.005	36.7	1.1	0.011	12	< 0.005	24.7	0.014	0.4	39.6	0.01	< 0.02	2.1	0.005	< 0.3
S98-00910	76	0.01	0.017	0.48	0.016		< 0.01		490	< 0.005	59.6	1.1	0.011	13.3	< 0.005	34.1	0.135	0.3	57.8	0.01	< 0.02	2.4	< 0.004	1.7
S98-00911	91	0.01	< 0.006	0.46	0.019		< 0.01		469	0.005	54	1.2	0.006	11.1	< 0.005	23.4	0.425	0.5	59.3	< 0.01	< 0.02	2	< 0.004	< 0.3
S98-00912	182	< 0.01	< 0.006	0.22	0.041		< 0.01		648	< 0.005	1.1	9.6	< 0.005	4.5	< 0.005	32.1	1.06	1.2	104	< 0.01	0.11	3.5	< 0.004	1.7
S98-00913	85	< 0.01	< 0.006	0.11	0.18		< 0.01		257	< 0.005	3.5	11.3	0.01	3	< 0.005	9.04	0.305	1.2	8.1	0.02	< 0.02	2.2	< 0.004	< 0.3
S98-00914	90	< 0.01	< 0.006	0.09	0.341		0.01		614	< 0.005	16.5	6.7	0.022	4.2	< 0.005	42	1.68	0.4	24	0.02	0.3	4.7	0.016	< 0.3
S98-00915	90	< 0.01	0.009	0.07	0.336		< 0.01		564	< 0.005	41.2	3.9	0.012	3.7	< 0.005	30.6	1.02	0.9	49.3	< 0.01	0.15	2.9	< 0.004	< 0.3
S98-00916	94	< 0.01	0.009	0.11	1.73		< 0.01		502	< 0.005	7.9	5.6	0.01	2.6	< 0.005	24	2.13	1.8	9.9	< 0.01	1.54	3.3	0.004	< 0.3
S99-00360	278	< 0.01	< 0.006	0.48	0.049		< 0.01		448	< 0.005	34.4	1.4	0.01	8.5	< 0.005	24.5	0.091	0.3	42.7	< 0.01	< 0.01	1.5	0.012	0.9
S99-00361	273	< 0.01	< 0.006	0.47	0.047		< 0.01		430	< 0.005	21.2	1.2	< 0.005	6.4	< 0.005	22.4	0.007	0.2	48.4	< 0.01	< 0.01	1.4	0.037	1.8
S99-00362	255	< 0.01	< 0.006	0.56	0.051		< 0.01		380	< 0.005	17	1.1	< 0.005	4.6	< 0.005	21.7	< 0.002	0.3	27.1	< 0.01	< 0.01	1.5	0.007	< 0.5
S99-00363	341	< 0.01	< 0.006	0.1	0.275		0.01		626	< 0.005	14.3	6.5	0.024	3.3	< 0.005	34.1	1.21	0.4	26.4	0.03	0.37	3.3	< 0.004	< 0.5
S99-00364	287	< 0.01	< 0.006	0.07	1.57		< 0.01		637	< 0.005	11.4	6.4	0.019	3.3	< 0.005	33.9	1.04	0.3	17.5	0.01	0.58	3.1	0.004	< 0.5
S99-00365	212	< 0.01	< 0.006	0.17	2		< 0.01		576	< 0.005	11.7	5.5	0.01	2.4	< 0.005	39.8	1.23	1.2	27.6	< 0.01	0.68	3.2	< 0.004	< 0.5
S99-00366	227	0.01	< 0.006	0.51	0.039		0.02		680	0.006	142	2.1	0.038	12.7	< 0.005	31.8	1.57	1.3	73	0.03	< 0.01	2.5	< 0.004	< 0.5
S99-00367	-18	< 0.01	< 0.006	0.12	2.4		< 0.01		427	< 0.005	6.7	4.3	0.01	1.9	< 0.005	20.8	0.933	1.1	8.8	< 0.01	0.45	2	< 0.004	< 0.5
S99-00368	-18	< 0.01	< 0.006	0.16	0.036		< 0.01		263	< 0.005	1.9	3.7	< 0.005	1.6	< 0.005	9.72	0.432	1.1	7.4	< 0.01	< 0.01	1.3	< 0.004	< 0.5
S99-00369	-15	< 0.01	< 0.006	0.12	0.175		< 0.01		412	< 0.005	7	4	0.02	2.4	< 0.005	19.8	0.803	0.6	11.3	< 0.01	0.55	2	< 0.004	< 0.5
S99-00370	-22	0.01	< 0.006	0.25	7.66		< 0.01		430	< 0.005	7.6	4.7	0.005	1.6	< 0.005	21.5	1.37	4.6	9.8	< 0.01	1.39	1.9	< 0.004	< 0.5
S99-00371	6	< 0.01	< 0.006	0.63	0.052		< 0.01		558	< 0.005	73.2	1.9	0.015	10.5	< 0.005	30.5	1.21	1.4	34.3	< 0.01	< 0.01	2.4	< 0.004	< 0.5
S99-00372	-9	< 0.01	< 0.006	0.18	0.441		< 0.01		607	< 0.005	44.3	5.6	0.02	2.4	< 0.005	36.8	1.49	4.7	24.1	< 0.01	1.35	2.8	< 0.004	< 0.5
S99-00373	100	< 0.01	< 0.006	0.25	3.72		< 0.01		517	< 0.005	17.9	3.8	< 0.005	1.1	< 0.005	28	0.638	2.1	16.5	< 0.01	0.89	2	0.005	< 0.5
S99-00374	37	< 0.01	< 0.006	0.31	4.09		< 0.01		694	< 0.005	270	2.5	< 0.005	9.1	< 0.005	49.2	0.294	0.6	68.3	< 0.01	< 0.01	2.6	< 0.004	< 0.5
S99-00375	-63	< 0.01	< 0.006	0.47	1.43		< 0.01		739	< 0.005	214	3.7	0.005	2.8	< 0.005	42.4	1.35	2	85.6	< 0.01	0.1	2.5	< 0.004	< 0.5
S99-00376	-12	0.01	< 0.006	0.39	0.027		< 0.01		658	< 0.005	103	1.8	0.006	13.7	< 0.005	37.9	4.36	0.6	50.9	< 0.01	< 0.01	3.4	< 0.004	< 0.5
S99-00377	-34	< 0.01	< 0.006	0.36	0.066		< 0.01		620	< 0.005	200	2.5	0.006	17.8	< 0.005	43.3	1.45	0.2	48.8	< 0.01	< 0.01	2.7	< 0.004	< 0.5
S99-00378	-65	< 0.01	< 0.006	0.3	0.082		< 0.01		618	< 0.005	145	2.2	0.01	17.3	< 0.005	39.2	0.888	0.2	46.9	< 0.01	< 0.01	2.3	< 0.004	< 0.5
S99-00379	81	0.01	< 0.006	0.34	5.36		< 0.01		826	< 0.005	181	3.7	0.009	0.9	< 0.005	37.8	0.904	1.4	95.1	< 0.01	< 0.01	3.5	< 0.004	< 0.5
S99-00380	89	< 0.01	< 0.006	0.56	0.021		< 0.01		491	< 0.005	27.4	2.7	0.017	2.1	< 0.005	30	0.704	0.7	25.6	0.02	0.99	2.4	< 0.004	< 0.5
S99-00381	-102	< 0.01	< 0.006	0.48	9.79		< 0.01		708	< 0.005	65.7	2.6	0.006	1	< 0.005	39.3	0.516	3.3	41.9	< 0.01	0.81	3	< 0.004	< 0.5
S99-00382	-74	0.03	< 0.006	0.65	0.196		0.03		606	0.009	34	1.8	0.125	11.5	0.005	29.5	0.853	1.7	88.7	0.12	< 0.01	2.2	< 0.004	< 0.5
S99-00383	122	0.02	< 0.006	0.66	0.039		< 0.01		640	< 0.005	6.8	2.9	0.02	7.8	< 0.005	102	0.218	0.6	138	0.02	0.01	4.7	< 0.004	6
S99-00384	-13	< 0.01	< 0.006	0.45	1.55		< 0.01		614	< 0.005	47.4	2.3	0.011	11	< 0.005	33	1.3	1	88	< 0.01	< 0.01	2.1	< 0.004	< 0.5
S99-00385	23	< 0.01	< 0.006	0.13	0.026		< 0.01		423	< 0.005	6.4	7.3	0.01	4.4	< 0.005	23.8	0.483	1.1	20	0.01	< 0.01	1.9	< 0.004	< 0.5

SAMPLE ID	Ptot mg/L	Pb ug/L	pH	Pr ug/L	Rb ug/L	Sb ug/L	SEC uS/cm	Se ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	T °C	Tb ug/L	Th ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S98-00895	< 0.2	< 0.01	7.21	< 0.005	0.5	0.04	586		9.68	< 0.01	< 0.1	7.4	0.364	27	< 0.005		< 0.01	< 0.005	8.3	0.6	0.04	< 0.008	3
S98-00896	1	< 0.01	7.06	< 0.005	2.2	0.02	702		13.9	< 0.01	< 0.1	< 0.2	0.31	28.8	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.008	< 0.008	3
S98-00897	0.9	< 0.01	7.22	< 0.005	1	< 0.02	442	< 0.2	13.4	< 0.01	0.6	1.1	0.188	28.3	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.014	< 0.008	6
S98-00898	1	< 0.01	7.17	< 0.005	1.2	< 0.02	345		10.5	< 0.01	< 0.1	< 0.2	0.0968	26	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.009	< 0.008	2
S98-00899	< 0.2	0.06	7.03	< 0.005	1.9	< 0.02	891		15.1	< 0.01	0.2	19.9	0.324	28.1	< 0.005		0.01	< 0.005	1.34	< 0.2	0.044	< 0.008	3
S98-00900	0.2	< 0.01	7.02	< 0.005	1	0.02	752		15	< 0.01	0.7	< 0.2	0.363	27.9	< 0.005		< 0.01	< 0.005	0.19	< 0.2	< 0.005	< 0.008	< 1
S98-00901	< 0.2	< 0.01	6.79	< 0.005	0.1	0.04	734		14.9	< 0.01	0.4	4.1	0.25	26.2	< 0.005		< 0.01	< 0.005	6.44	1.9	0.145	0.018	6
S98-00902	0.2	0.05	7.2	< 0.005	0.5	0.03	702	< 0.2	12.6	< 0.01	0.2	< 0.2	0.488	26.3	< 0.005		< 0.01	< 0.005	0.45	< 0.2	0.045	0.01	30
S98-00903	< 0.2	0.03	7.25	< 0.005	3.2	0.09	1270		11.2	< 0.01	< 0.1	74.5	0.617	25.3	< 0.005		< 0.01	< 0.005	20.4	2.4	0.032	< 0.008	6
S98-00904	< 0.2	0.04	6.8	< 0.005	0.1	0.15	702		16.6	< 0.01	< 0.1	1.7	0.338	26.4	< 0.005		< 0.01	< 0.005	3.87	1.9	0.127	0.01	5
S98-00905	< 0.2	0.09	7	< 0.005	0.3	< 0.02	713		16.2	< 0.01	0.5	1.4	0.366	27.1	< 0.005		< 0.01	< 0.005	3.3	1.5	0.038	< 0.008	4
S98-00906	< 0.2	< 0.01		< 0.005	0.4	0.03	712		16.8	< 0.01	0.6	1.4	0.417	27.5	< 0.005		< 0.01	< 0.005	2.79	0.9	0.014	< 0.008	39
S98-00907	< 0.2	0.11	7.14	< 0.005	0.4	0.07	591		9.5	< 0.01	< 0.1	11.6	0.315	27.2	< 0.005		< 0.01	< 0.005	5.92	1.9	0.041	< 0.008	6
S98-00908	< 0.2	0.5		< 0.005	0.2	0.03	701		16.2	< 0.01	0.4	1.3	0.326	27.6	< 0.005		< 0.01	< 0.005	3.55	1.2	0.099	0.009	
S98-00909	< 0.2	0.79		< 0.005	0.3	< 0.02	634		15.5	< 0.01	0.2	0.7	0.371	26.4	< 0.005		< 0.01	< 0.005	2.61	2.1	0.181	0.009	37
S98-00910	< 0.2	0.36		< 0.005	0.2	< 0.02	828		15.1	< 0.01	0.4	9.6	0.533	27.1	< 0.005		< 0.01	< 0.005	3.7	2.5	0.098	0.013	17
S98-00911	< 0.2	0.28		< 0.005	0.2	< 0.02	721		16.2	< 0.01	< 0.1	1.4	0.34	26.8	< 0.005		< 0.01	< 0.005	3.42	1.1	0.146	0.013	39
S98-00912	0.3	< 0.01		< 0.005	2.6	0.09	1080		13	< 0.01	0.2	18.7	0.405	25.5	< 0.005		0.01	< 0.005	4.22	5.7	0.016	< 0.008	14
S98-00913	< 0.2	0.03		< 0.005	0.3	0.11	423		7.35	< 0.01	.0.5	3.9	0.148	26.6	< 0.005		< 0.01	< 0.005	2.69	1.2	0.026	< 0.008	24
S98-00914	< 0.2	0.03		0.005	3.3	0.31	1060	< 0.2	12.8	< 0.01	0.3	26.3	0.578	25.4	< 0.005		< 0.01	< 0.005	7.83	0.4	0.041	< 0.008	8
S98-00915	< 0.2	0.24		< 0.005	1.3	< 0.02	825		14.5	< 0.01	0.3	8.6	0.41	27.3	< 0.005		< 0.01	< 0.005	2.7	< 0.2	0.06	< 0.008	9
S98-00916	< 0.2	< 0.01		< 0.005	1.3	< 0.02	726		16.1	< 0.01	0.5	1.1	0.376	26.6	< 0.005		< 0.01	< 0.005	1.02	< 0.2	0.051	< 0.008	41
S99-00360	< 0.1	0.09	6.92	< 0.005	0.7	< 0.02	647		19.9	< 0.01	< 0.1	0.7	0.351	27.8	< 0.005		< 0.01	< 0.005	2.3	2	0.067	< 0.008	10
S99-00361	< 0.1	5.82	6.96	< 0.005	0.2	< 0.02	610		21.7	< 0.01	< 0.1	0.7	0.326	27.2	< 0.005		< 0.01	< 0.005	1.81	2.9	0.043	< 0.008	20
S99-00362	< 0.1	0.94	7.04	< 0.005	0.1	< 0.02	567		20.4	< 0.01	< 0.1	0.5	0.293	27.2	< 0.005		< 0.01	< 0.005	1.79	2.3	0.026	< 0.008	48
S99-00363	< 0.1	0.17	6.87	0.006	2.2	< 0.02	902		18.5	< 0.01	< 0.1	8.5	0.595	27.1	< 0.005		< 0.01	< 0.005	6.44	< 0.2	0.09	0.009	6
S99-00364	< 0.1	0.11	6.92	< 0.005	1	0.02	878		17.7	< 0.01	< 0.1	0.7	0.55	27	< 0.005		< 0.01	< 0.005	4.73	< 0.2	0.092	0.009	6
S99-00365	0.2	0.09	7.04	< 0.005	1.4	0.02	974		17.4	< 0.01	< 0.1	22.5	0.623	26.5	< 0.005		< 0.01	< 0.005	1.66	< 0.2	0.069	0.008	4
S99-00366	< 0.1	0.07	6.71	0.006	0.1	0.02	1042		17.5	< 0.01	< 0.1	29	0.408	27	< 0.005		< 0.01	< 0.005	5.45	2.2	0.261	0.02	3
S99-00367	0.2	0.06	7.08	< 0.005	1.5	< 0.02	605		15.8	< 0.01	< 0.1	1.4	0.317	26.9	< 0.005		< 0.01	< 0.005	0.26	< 0.2	0.031	< 0.008	3
S99-00368	< 0.1	0.02	6.99	< 0.005	1.4	0.02	408		13.1	< 0.01	< 0.1	6.2	0.213	27.2	< 0.005		0.01	< 0.005	1.91	< 0.2	0.025	< 0.008	1
S99-00369	< 0.1	0.04	7.02	< 0.005	1.3	0.04	596		16.6	< 0.01	< 0.1	0.8	0.321	27	< 0.005		< 0.01	< 0.005	1.4	< 0.2	0.06	< 0.008	3
S99-00370	0.5	0.15	7.13	< 0.005	1.2	0.06	591		14.2	< 0.01	< 0.1	< 0.2	0.368	26.2	< 0.005		< 0.01	< 0.005	0.19	< 0.2	0.029	< 0.008	28
S99-00371	< 0.1	0.04	6.77	< 0.005	0.2	0.02	784		18.2	< 0.01	< 0.1	6.9	0.398	26.7	< 0.005		< 0.01	< 0.005	1.98	2.1	0.113	< 0.008	4
S99-00372	< 0.1	0.11	7.01	< 0.005	1.9	0.04	894		17.1	< 0.01	< 0.1	< 0.2	0.651	26.8	< 0.005		0.01	< 0.005	2.35	< 0.2	0.088	0.009	2
S99-00373	0.7	0.06	7.02	< 0.005	3.1	< 0.02	709		17.6	< 0.01	< 0.1	< 0.2	0.387	26.7	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.029	< 0.008	2
S99-00374	0.2	0.03	6.76	< 0.005	2.1	< 0.02	1090		20	< 0.01	< 0.1	73.3	0.435	27	< 0.005		< 0.01	< 0.005	0.18	< 0.2	0.047	< 0.008	3
S99-00375	0.3	0.06	6.8	< 0.005	8.1	< 0.02	1128		22.3	< 0.01	< 0.1	66.2	0.468	27.3	< 0.005		< 0.01	< 0.005	0.86	< 0.2	0.071	0.008	4
S99-00376	0.1	0.03	6.7	< 0.005	0.3	< 0.02	1075		19.6	< 0.01	< 0.1	48.3	0.45	26.7	< 0.005		< 0.01	< 0.005	6.33	0.8	0.226	0.014	4
S99-00377	< 0.1	< 0.01	6.74	< 0.005	0.4	< 0.02	946		20.6	< 0.01	< 0.1	38.7	0.412	26.7	< 0.005		< 0.01	< 0.005	5.37	1.8	0.044	< 0.008	2
S99-00378	< 0.1	0.07	6.76	< 0.005	0.1	< 0.02	906		20.7	< 0.01	< 0.1	9.2	0.366	27.1	< 0.005		< 0.01	< 0.005	4.57	1.5	0.078	0.009	2
S99-00379	1	0.09	6.84	< 0.005	5.3	< 0.02	1261		20.5	< 0.01	< 0.1	115	0.436	26.4	< 0.005		< 0.01	< 0.005	0.45	< 0.2	0.096	0.009	5
S99-00380	< 0.1	0.32	6.99	0.007	0.8	0.03	734		11.3	< 0.01	< 0.1	19.7	0.39	25.7	< 0.005		< 0.01	< 0.005	13.1	0.8	0.056	< 0.008	11
S99-00381	1.2	0.04	6.81	< 0.005	1.8	0.02	974		19.3	< 0.01	< 0.1	0.4	0.475	26.8	< 0.005		< 0.01	< 0.005	0.1	< 0.2	0.041	< 0.008	6
S99-00382	< 0.1	0.25	5.9	0.03	0.4	0.03	886		19	0.04	< 0.1	45.3	0.375	26.8	0.007		< 0.01	< 0.005	31.7	2.1	0.447	0.037	3
S99-00383	< 0.1	0.09	7.06	< 0.005	4.4	0.06	1744		14.9	< 0.01	< 0.1	335	0.793	24	< 0.005		< 0.01	< 0.005	47.1	3.9	0.09	< 0.008	41
S99-00384	0.1	0.07	6.82	< 0.005	0.9	0.07	920		19.5	< 0.01	< 0.1	61.9	0.393	26.8	< 0.005		< 0.01	< 0.005	2.88	0.2	0.042	< 0.008	7
S99-00385	< 0.1	0.03	7.06	< 0.005	0.5	0.04	639		15.7	< 0.01	< 0.1	7.7	0.297	25.9	< 0.005		< 0.01	< 0.005	4.99	1	0.045	< 0.008	2

SAMPLE ID	SAMPLE FIELD_ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST.	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	MOUZA
S99-00386	BTS431	21/03/1999	24.6562	88.1127	1995	No 6 Han	22.9	Lakhipur	Rajshahi	Nawabganj	Shibganj (N)	Panka	
S99-00387	BTS432	21/03/1999	24.6233	88.1503	1990	Concrete	19.2	Radhakantapur	Rajshahi	Nawabganj	Shibganj (N)	Uzirpur	Radhakantapur
S99-00388	BTS433	22/03/1999	24.6017	88.284	1996	Electric pump		Paurashava	Rajshahi	Nawabganj	Nawabganj Sadar	Nawabganj	Nawabganj
S99-00389	BTS436	22/03/1999	24.5993	88.2537		River sample		Mahananda River	Rajshahi	Nawabganj	Nawabganj Sadar		
S99-00390	BTS437	22/03/1999	24.5712	88.268	1984	No 6 Han	21	Rajarampur	Rajshahi	Nawabganj	Nawabganj Sadar	Ch Nawabganj	Ch Nawabganj
S99-00391	BTS438	22/03/1999	24.5743	88.2677	1972	Ring Well	8.9	Rajarampur	Rajshahi	Nawabganj	Nawabganj Sadar	Ch Nawabganj	Ch Nawabganj
S99-00392	BTS439	22/03/1999	24.5908	88.271	1983	No 6 Han	36.6	New Market No 4 DPHE	Rajshahi	Nawabganj	Nawabganj Sadar	Ch Nawabganj	Ch Nawabganj
S99-00393	BTS448	23/03/1999	24.6285	88.3897	1995	Tara Pum	42.7	Dhinagar	Rajshahi	Nawabganj	Nawabganj Sadar	Dhinagar	Dhinagar
S99-00394	BTS449	23/03/1999	24.6215	88.358	1991	Tara T/W	38.1	Belgachhi	Rajshahi	Nawabganj	Nawabganj Sadar		
S99-00395	BTS501	31/03/1999	23.0608	90.9685	1994	Handpum	12.2	DPHE Office shallow	Chittagong	Noakhali	Chatkhil	Chatkil	Chatkil
S99-00396	BTS502	31/03/1999	23.0608	90.9685		Handpum	262.1	DPHE Office deep	Chittagong	Noakhali	Chatkhil	Chatkil	Chatkil
S99-00397	BTS503	31/03/1999	23.0593	90.9855	1997	Handpum	15.2	Bhimpur	Chittagong	Noakhali	Chatkhil	Dighirpar	Halimar
S99-00398	BTS504	31/03/1999	23.0727	90.9792	1994	Handpum	11	Abutorabnagar	Chittagong	Noakhali	Chatkhil	Pachgaon	
S99-00399	BTS505	31/03/1999	23.0752	90.9753	1979	Handpum	11	Primary School	Chittagong	Noakhali	Chatkhil	Pachgaon	Mirzapur
S99-00400	BTS506	31/03/1999	23.0745	90.9742	1992	Handpum	295.7	Mirzapur	Chittagong	Noakhali	Chatkhil	Pachgaon	Mirzapur
S99-00401	BTS507	31/03/1999	23.0653	90.9645	1991	Handpum	9.1	Govt. Primary School	Chittagong	Noakhali	Chatkhil	Pachgaon	Sundarpur
S99-00402	BTS508	31/03/1999	23.0706	90.9874	1997	Handpum	13.7	Bahor Alipur	Chittagong	Noakhali	Chatkhil	Pachgaon	Bahor Alipur
S99-00403	BTS509	01/04/1999	22.9483	90.9895	1991	Handpum	10.7	Girls High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Chandraganj	West Latifpur
S99-00404	BTS510	01/04/1999	22.9518	90.9917			253	Haji, Majibal Huq	Chittagong	Lakshmipur	Lakshmipur Sadar	Chandraganj	
S99-00405	BTS511	01/04/1999	22.963	90.9923			3.6	Abdul Mannan Kazi	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00406	BTS512	01/04/1999	22.9725	90.8545			36	Md- Fakrul Alam	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00407	BTS513	01/04/1999	22.9667	90.98			12.8	Motraddin, Union council	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00408	BTS514	01/04/1999	22.9475	90.9827			8.8	Deopara	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00409	BTS525	02/04/1999	22.9075	90.965			7.9	Fakhrul Alam	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00410	BTS526	02/04/1999	22.9028	90.8553			7.9	Moulari Nazibullah	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00411	BTS527	03/04/1999	22.8173	90.8883			7.6	Govt. primary school, Chan Ubak	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00412	BTS528	03/04/1999	22.8927	90.8893			30	Ghandharbbapur	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00413	BTS529	03/04/1999	22.8533	90.8313			7.3	Md. Shakabuddin	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00415	BTS531	04/04/1999	22.9092	90.7823			26	Char Balammara	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00416	BTS532	04/04/1999	22.889	90.8113			224	Jagatbar	Chittagong	Lakshmipur	Lakshmipur Sadar		
S99-00417	BTS533	04/04/1999	22.8878	90.811			11	Jagatpur	Chittagong	Lakshmipur	Lakshmipur Sadar		

SAMPLE ID	GEOCODE	Al ug/L	AsIII ug/L	AsTot ug/L	B mg/L	Ba mg/L	Be ug/L	Br mg/L	Ca mg/L	Cd ug/L	Ce ug/L	Cl mg/L	Co ug/L	Cr ug/L	Cs ug/L	Cu ug/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	^{34}S ‰	diss O2 mg/L	DOC mg/L	Dy ug/L
S99-00386	5708865643	6	< 0.5	< 0.5	< 0.1	0.183	< 0.05	0.026	138	< 0.02	0.054	1.9	0.53	< 0.5	< 0.05	< 1	-12	-5.7	-45		< 0.1	0.9	< 0.01
S99-00387	5708865648	3	< 0.5	< 0.5	< 0.1	0.196	< 0.05	0.03	113	0.03	0.017	20	0.32	< 0.5	< 0.05	< 1	-16.4	-6.2	-47		< 0.1	4.3	< 0.01
S99-00388	57066	8	13.3	16.8	< 0.1	0.165	< 0.05	0.045	115	< 0.02	0.017	16.1	0.31	< 0.5	< 0.05	< 1	-11.4	-3.8	-39		< 0.1	2.6	< 0.01
S99-00389	57066	14	22.9	29	< 0.1	0.041	< 0.05	0.029	55.7	< 0.02	0.036	9.6	0.16	< 0.5	< 0.05	1	-10	-3	-25		6.8	1.4	< 0.01
S99-00390	57066	4	2210	2340	< 0.1	0.113	< 0.05	0.035	122	< 0.02	0.014	8.9	0.32	< 0.5	< 0.05	< 1	-15.7	-5	-38		0.5	1.5	< 0.01
S99-00391	57066	2	2	3.8	0.1	0.205	< 0.05	0.13	205	0.03	0.01	95.1	0.38	< 0.5	< 0.05	1	-15.4	-6.2	-45		3.5	0.6	< 0.01
S99-00392	57066	2	80.2	108	< 0.1	0.174	< 0.05	0.012	109	< 0.02	< 0.005	2.4	0.3	< 0.5	< 0.05	< 1	-10.5	-5.7	-43		0.1	0.3	< 0.01
S99-00393	5706644301	1	< 0.5	6.8	< 0.1	0.046	< 0.05	0.019	67.2	0.03	0.005	3.4	0.14	< 0.5	< 0.05	< 1	-9.4	-3.8	-30		< 0.1	0.6	< 0.01
S99-00394	5706644108	2	< 0.5	< 0.5	< 0.1	0.075	< 0.05	0.013	75.3	< 0.02	< 0.005	5.1	0.15	< 0.5	< 0.05	< 1	-7.3	-3.6	-23		0.4	1.6	< 0.01
S99-00395	2751019171	4	57.1	61.4	< 0.1	0.015	< 0.05	0.06	34.1	< 0.02	0.013	20.2	0.13	< 0.5	< 0.05	< 1	-19.2	-0.7	-11		< 0.1	0.8	< 0.01
S99-00396	2751019171	3	< 0.5	< 0.5	< 0.1	0.028	< 0.05	0.018	20.2	< 0.02	< 0.005	1.7	0.47	< 0.5	< 0.05	< 1	-11.2	-2.9	-14		< 0.1	2.3	< 0.01
S99-00397	2751057137	3	490	670	0.2	0.008	< 0.05	0.099	33.6	< 0.02	< 0.005	17.5	< 0.05	< 0.5	< 0.05	< 1	-13.1	-1.7	-19		< 0.1	2.2	< 0.01
S99-00398	2751038008	5	243	287	0.1	0.006	< 0.05	0.52	34.7	< 0.02	< 0.005	140	0.58	< 0.5	< 0.05	< 1	-19.2	-1.9	-17		< 0.1	4.4	< 0.01
S99-00399	2751057566	2	390	409	0.5	0.011	< 0.05	1.56	34.9	< 0.02	0.005	426	0.43	< 0.5	0.05	< 1	-23.6	-3	-21		< 0.1	5.3	< 0.01
S99-00400	2751057566	4	< 0.5	1.2	< 0.1	0.033	< 0.05	0.021	22	< 0.02	< 0.005	1.8	0.05	< 0.5	< 0.05	< 1	-13	-2.6	-14		0.6	0.2	< 0.01
S99-00401	2751057969	3	106	125	0.1	0.013	< 0.05	0.089	34	< 0.02	0.007	16.6	0.35	< 0.5	< 0.05	< 1	-17.9	-1.7	-15		1.4	1.6	< 0.01
S99-00402	2751057120	3	165	202	0.1	0.007	< 0.05	0.102	22	0.02	0.009	7.7	0.74	1.3	< 0.05	1	-16.1	-2.1	-21		< 0.1	1.7	< 0.01
S99-00403	2514320739	2	28	30.3	0.3	0.008	< 0.05	0.19	21	< 0.02	0.008	39.8	0.18	< 0.5	< 0.05	< 1	-17.7	-1.5	-14		< 0.1	1.3	< 0.01
S99-00404	25143	< 1	< 0.5	< 0.5	< 0.1	0.657	< 0.05	3.97	153	< 0.02	< 0.005	1050	0.32	< 0.5	0.06	< 1	-12.9	-3	-17		< 0.1	0.9	< 0.01
S99-00405	25143	2	45.8	52.3	0.5	0.035	< 0.05	1.32	47.9	< 0.02	0.015	342	0.6	< 0.5	< 0.05	< 1	-18.6	-3.4	-29		< 0.1	1.7	< 0.01
S99-00406	25143	2	91.9	109	0.6	0.053	< 0.05	4.47	111	< 0.02	0.017	1360	0.75	< 0.5	< 0.05	< 1	-19.9	-4.1	-25		< 0.1	2.1	0.01
S99-00407	25143	3	68.4	80.7	< 0.1	0.012	< 0.05	0.068	26.8	< 0.02	0.04	5	0.76	< 0.5	< 0.05	< 1	-18.7	-1.6	-20		< 0.1	3.4	< 0.01
S99-00408	25143	11	59.1	75.6	0.1	0.009	< 0.05	0.061	41.4	< 0.02	0.016	4.9	0.26	< 0.5	< 0.05	< 1	-20.6	-3.7	-29		< 0.1	1.3	< 0.01
S99-00409	25143	93	61.2	72.9	< 0.1	0.047	< 0.05	0.8	67.6	0.09	0.102	195	0.68	1.3	0.05	2	-18.1	-1.2	-13		< 0.1	0.4	0.02
S99-00410	25143	3	61.5	64.5	0.2	0.058	< 0.05	3.24	144	< 0.02	0.012	892	0.92	< 0.5	< 0.05	< 1	-20.6	-3.5	-31		< 0.1	1.6	< 0.01
S99-00411	25143	3	27.4	36.4	0.3	0.034	< 0.05	0.25	63.2	< 0.02	0.026	65.7	0.29	< 0.5	< 0.05	< 1	-15.7	-2	-15		< 0.1	0.7	< 0.01
S99-00412	25143	3	24.1	34.5	0.1	0.034	< 0.05	0.2	57.2	0.02	0.018	99.5	0.65	1	< 0.05	< 1	-15.3	-3.4	-29		< 0.1	1.4	< 0.01
S99-00413	25143	2	71.8	88.6	0.2	0.015	< 0.05	0.42	81.8	< 0.02	0.019		0.58	< 0.5	< 0.05	< 1	-14	-4	-32		< 0.1	2.5	< 0.01
S99-00415	25143	4	7.2	9.4	0.2	0.04	< 0.05	0.098	79.6	< 0.02	0.022	18	0.35	< 0.5	< 0.05	< 1	-14.2	-3.9	-26		< 0.1	<0.1	< 0.01
S99-00416	25143	7	1	2.1	< 0.1	0.098	< 0.05	0.103	25	< 0.02	0.02	17.6	0.09	< 0.5	0.06	< 1	-15.6	-3.3	-21		< 0.1	<0.1	< 0.01
S99-00417	25143	3	< 0.5	94.8	0.5	0.025	< 0.05	2.59	51.2	< 0.02	0.008	736	0.23	< 0.5	< 0.05	< 1	-12.3	-4.7	-33		< 0.1	0.6	< 0.01

SAMPLE ID	Eh mV	Er ug/L	Eu ug/L	F mg/L	Fe mg/L	Ga ug/L	Gd ug/L	Ge ug/L	HCO_3 mg/L	Ho ug/L	I ug/L	K mg/L	La ug/L	Li ug/L	Lu ug/L	Mg mg/L	Mn mg/L	Mo ug/L	Na mg/L	Nd ug/L	NH_4-N mg/L	Ni ug/L	NO_2-N mg/L	NO_3-N mg/L
S99-00386		< 0.01	< 0.006	0.06	0.237		< 0.01		492	< 0.005	11.9	6.1	0.028	2.6	< 0.005	26	1.13	0.4	12.6	0.02	0.09	2.6	< 0.004	< 0.5
S99-00387	154	< 0.01	< 0.006	0.08	0.109		< 0.01		480	< 0.005	0.9	6.6	0.013	4.2	< 0.005	31.7	0.646	0.8	21.7	0.02	0.03	2.2	< 0.004	< 0.5
S99-00388	112	< 0.01	0.009	0.14	0.673		< 0.01		464	< 0.005	12.1	5	0.011	3.3	< 0.005	24.4	0.602	0.8	24.6	0.01	0.11	2.6	< 0.004	< 0.5
S99-00389	304	< 0.01	< 0.006	0.24	0.039		0.01		260	< 0.005	5.6	4	0.016	0.8	< 0.005	14.9	0.151	0.9	19.3	0.02	0.09	1.3	0.011	< 0.5
S99-00390	167	< 0.01	< 0.006	0.31	0.167		< 0.01		506	< 0.005	7.8	5.1	0.008	1.8	< 0.005	26.7	1.04	9.8	15.9	< 0.01	1.05	2.4	< 0.004	< 0.5
S99-00391	315	< 0.01	< 0.006	0.01	0.084		< 0.01		695	< 0.005	0.5	6.7	0.011	2.9	< 0.005	40.3	0.184	0.5	132	< 0.01	< 0.01	3.9	0.018	28.1
S99-00392	89	< 0.01	< 0.006	0.11	3.03		< 0.01		468	< 0.005	2.3	4.6	< 0.005	3.5	< 0.005	22.9	0.187	1.4	16	< 0.01	0.77	2.1	< 0.004	< 0.5
S99-00393	243	< 0.01	< 0.006	0.59	0.039		< 0.01		380	< 0.005	19.2	1.1	< 0.005	6.2	< 0.005	23.9	0.024	0.3	37.7	< 0.01	< 0.01	1.6	< 0.004	< 0.5
S99-00394	139	< 0.01	0.007	0.62	0.05		< 0.01		386	< 0.005	19.3	1.3	0.008	8.1	< 0.005	25.5	0.006	0.3	30.7	< 0.01	0.02	1.7	0.011	2.2
S99-00395	68	< 0.01	< 0.006	0.25	0.525		< 0.01		348	< 0.005	30	13	0.007	3.3	< 0.005	46.1	0.865	2	23.9	< 0.01	< 0.01	0.8	1.71	1.8
S99-00396	18	< 0.01	< 0.006	0.32	1.99		< 0.01		171.8	< 0.005	1.2	2.2	< 0.005	2.5	< 0.005	12.9	0.095	2.9	20.4	< 0.01	< 0.01	1	< 0.004	< 0.5
S99-00397	-14	< 0.01	0.007	0.24	4.79		< 0.01		366	< 0.005	77.7	8.2	< 0.005	5.4	< 0.005	42.9	0.314	< 0.1	29.5	< 0.01	< 0.01	< 0.4	0.91	3.3
S99-00398	44	< 0.01	< 0.006	0.21	2.17		< 0.01		414	< 0.005	111	14.3	< 0.005	3.1	< 0.005	62	0.289	2.2	104	< 0.01	< 0.01	1.2	3.54	4.4
S99-00399	12	< 0.01	< 0.006	0.32	2.73		< 0.01		644	< 0.005	290	19.7	< 0.005	3.5	< 0.005	79.9	0.39	7.2	333	< 0.01	0.02	1.1	4.16	6.6
S99-00400	115	< 0.01	< 0.006	0.3	2.19		< 0.01		174.4	< 0.005	1.6	2.6	< 0.005	6.4	< 0.005	12	0.088	< 0.1	23.5	< 0.01	< 0.01	0.6	< 0.004	< 0.5
S99-00401	-105	< 0.01	< 0.006	0.29	1.29		< 0.01		342	< 0.005	55.4	11.5	< 0.005	2.5	< 0.005	40.3	0.635	3.4	24.9	< 0.01	1.3	1	0.03	< 0.5
S99-00402	52	< 0.01	< 0.006	0.28	6.71		< 0.01		316	< 0.005	75.1	6.3	< 0.005	4.1	< 0.005	31.4	0.121	1.7	23.3	< 0.01	3.2	1.4	< 0.004	< 0.5
S99-00403	-100	< 0.01	< 0.006	0.3	0.122		< 0.01		474	< 0.005	150	14.7	< 0.005	3.6	< 0.005	30.3	0.418	2.6	121	< 0.01	< 0.01	0.6	2.23	2.2
S99-00404	84	< 0.01	< 0.006	0.15	7.91		< 0.01		181.6	< 0.005	6.4	9.4	0.008	14.6	< 0.005	95.3	0.334	< 0.1	432	< 0.01	0.43	3	< 0.004	< 0.5
S99-00405	84	0.01	< 0.006	0.21	0.9		< 0.01		697	< 0.005	423	13.6	0.011	6.2	< 0.005	49.2	0.793	2.4	348	0.03	3.1	1.5	< 0.004	< 0.5
S99-00406	85	0.01	< 0.006	0.2	2.32		0.01		840	< 0.005	973	27.4	0.014	9.3	< 0.005	154	1.28	4.2	806	0.01	8.5	2.8	0.005	< 0.5
S99-00407	114	< 0.01	< 0.006	0.18	0.176		< 0.01		288	< 0.005	33.5	10.8	0.021	1.7	< 0.005	36.3	0.569	2.1	14.3	0.02	< 0.01	1	0.005	< 0.5
S99-00408	56	< 0.01	< 0.006	0.26	1.4		< 0.01		386	< 0.005	42.7	11	0.009	2.5	< 0.005	42.6	0.707	3.4	20.5	0.01	< 0.01	1.3	2.53	2.2
S99-00409	87	0.01	< 0.006	0.14	3.9		0.01		310	< 0.005	101	9.9	0.045	7.5	< 0.005	66	1.55	0.7	62.5	0.04	1.25	3.6	0.006	< 0.5
S99-00410	131	< 0.01	< 0.006	0.11	3.53		< 0.01		262	< 0.005	200	18.4	0.011	10.6	< 0.005	146	3.83	1	290	0.01	6.2	3.6	0.007	< 0.5
S99-00411	76	< 0.01	< 0.006	0.2	1.78		< 0.01		714	< 0.005	87.1	17.3	0.012	4.7	< 0.005	62.9	1.18	1.6	145	< 0.01	1.09	1.7	0.005	< 0.5
S99-00412	109	< 0.01	< 0.006	0.14	5.15		< 0.01		446	< 0.005	140	41.3	0.011	7.5	< 0.005	44.9	0.404	0.4	84.6	< 0.01	0.34	1.8	0.004	< 0.5
S99-00413	77	< 0.01	< 0.006	0.14	1.08		< 0.01		484	< 0.005	32	21.6	0.012	4	< 0.005	42.8	1.06	1.1	112	< 0.01	1.8	2.1	0.004	< 0.5
S99-00415	147	< 0.01	< 0.006	0.16	0.264		< 0.01		570	< 0.005	23.4	11.5	0.009	4.2	< 0.005	56.9	0.948	1	32.2	< 0.01	< 0.01	2	0.006	< 0.5
S99-00416	61	< 0.01	< 0.006	0.19	2.23		< 0.01		248	< 0.005	39.6	4.9	0.006	4.5	< 0.005	16.1	0.132	< 0.1	49	< 0.01	1.31	0.7	< 0.004	< 0.5
S99-00417	119	< 0.01	< 0.006	0.17	0.2		< 0.01		524	< 0.005	73.4	23.9	0.008	8.5	< 0.005	69.9	0.527	1.2	578	< 0.01	0.37	1.4	0.008	< 0.5

SAMPLE ID	Ptot mg/L	Pb ug/L	pH	Pr ug/L	Rb ug/L	Sb ug/L	SEC uS/cm	Se ug/L	Si mg/L	Sm ug/L	Sn ug/L	SO_4 mg/L	Sr mg/L	T °C	Tb ug/L	Th ug/L	Tl ug/L	Tm ug/L	U ug/L	V ug/L	Y ug/L	Yb ug/L	Zn ug/L
S99-00386	< 0.1	0.06	6.98	0.005	1.2	0.06	729		12.1	< 0.01	< 0.1	32.3	0.471	27	< 0.005		< 0.01	< 0.005	18.7	0.3	0.079	< 0.008	3
S99-00387	< 0.1	0.09	7.1	< 0.005	1	0.05	728		12.2	< 0.01	< 0.1	20.7	0.534	26.9	< 0.005		0.01	< 0.005	11.4	1.1	0.062	< 0.008	3
S99-00388	0.1	0.03	6.96	< 0.005	1	0.02	772		19.5	< 0.01	0.1	13.6	0.265	28.4	< 0.005		< 0.01	< 0.005	1.51	0.2	0.05	< 0.008	6
S99-00389	< 0.1	0.11	8.39	< 0.005	3.7	0.08	427		16.4	0.01	< 0.1	4.4	0.165	28.7	< 0.005		< 0.01	< 0.005	2.21	2.2	0.076	< 0.008	1
S99-00390	0.2	0.17	7.3	< 0.005	0.7	0.05	762		15.7	< 0.01	< 0.1	2.3	0.514	27.6	< 0.005		< 0.01	< 0.005	0.49	< 0.2	0.051	< 0.008	26
S99-00391	< 0.1	0.04	7.13	< 0.005	1.7	0.15	1473		12.2	< 0.01	< 0.1	91.3	0.56	25.4	< 0.005		< 0.01	< 0.005	41.3	1.2	0.051	< 0.008	10
S99-00392	0.3	0.04	7.12	< 0.005	3	0.02	672		17.7	< 0.01	< 0.1	1.1	0.322	28.1	< 0.005		< 0.01	< 0.005	0.36	< 0.2	0.025	< 0.008	
S99-00393	< 0.1	0.24	6.85	< 0.005	0.2	< 0.02	563		22.6	< 0.01	< 0.1	0.8	0.351	27.7	< 0.005		< 0.01	< 0.005	2.22	1.7	0.067	< 0.008	53
S99-00394	< 0.1	8.36	7.02	< 0.005	0.2	< 0.02	585		19.3	< 0.01	0.4	0.7	0.398	27.2	< 0.005		< 0.01	< 0.005	1.57	2.1	0.093	0.009	37
S99-00395	0.3	0.09	7.19	< 0.005	2.8	< 0.02	572		19.6	< 0.01	< 0.1	3.2	0.229	26.3	< 0.005		< 0.01	< 0.005	0.38	< 0.2	0.027	< 0.008	7
S99-00396	0.2	0.11	6.83	< 0.005	5.2	0.05	264		40.3	< 0.01	< 0.1	< 0.2	0.129	26.6	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.017	< 0.008	4
S99-00397	1.5	0.1	7.41	< 0.005	1.8	< 0.02	551		13.8	< 0.01	< 0.1	0.2	0.277	25.8	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.006	< 0.008	19
S99-00398	1.9	0.14	7.2	< 0.005	5	0.03	96.8		19.4	< 0.01	< 0.1	0.7	0.302	25.9	< 0.005		< 0.01	< 0.005	0.02	< 0.2	0.019	< 0.008	20
S99-00399	2.2	0.07	7.37	< 0.005	9.4	< 0.02	1910		13.4	< 0.01	< 0.1	0.6	0.483	26.3	< 0.005		< 0.01	< 0.005	0.03	< 0.2	0.026	0.008	13
S99-00400	0.1	0.1	6.84	< 0.005	2	< 0.02	265		39.3	< 0.01	0.4	< 0.2	0.124	26.4	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.01	< 0.008	9
S99-00401	1.3	0.08	6.88	< 0.005	3.4	< 0.02	531		20.6	< 0.01	< 0.1	0.3	0.224	26.2	< 0.005		< 0.01	< 0.005	0.03	< 0.2	0.019	< 0.008	31
S99-00402	1.5	0.19	6.93	< 0.005	2.8	0.11	446		22.9	< 0.01	0.5	0.3	0.153	26.7	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.024	< 0.008	14
S99-00403	0.2	0.07	7.35	< 0.005	3	< 0.02	772		17.8	< 0.01	< 0.1	0.5	0.173	27	< 0.005		< 0.01	< 0.005	1.43	< 0.2	0.035	< 0.008	8
S99-00404	0.2	0.08	6.67	< 0.005	7.7	< 0.02	2200		31.6	< 0.01	< 0.1	68.2	1.26	26.3	< 0.005		< 0.01	< 0.005	< 0.01	< 0.2	0.021	< 0.008	
S99-00405	0.2	0.05		< 0.005	4	0.03	1746		17.6	< 0.01	< 0.1	3.5	0.353	26.5	< 0.005		< 0.01	< 0.005	4.09	< 0.2	0.081	0.008	28
S99-00406	0.5	0.12	7.1	< 0.005	6.8	0.03	3300		16.2	< 0.01	< 0.1	0.7	1.06	26.1	< 0.005		< 0.01	< 0.005	6.61	< 0.2	0.09	< 0.008	23
S99-00407	0.5	0.04	7.33	0.006	1.3	< 0.02	411		19.7	< 0.01	< 0.1	0.4	0.179	25.8	< 0.005		< 0.01	< 0.005	0.11	0.2	0.037	< 0.008	8
S99-00408	0.5	0.15	7.26	< 0.005	1.5	< 0.02	530		18.4	< 0.01	< 0.1	0.3	0.24	26.7	< 0.005		< 0.01	< 0.005	1.07	< 0.2	0.036	< 0.008	11
S99-00409	0.3	9.23	6.79	0.012	3.4	0.04	887		25.1	0.02	< 0.1	12.9	0.387	26.1	< 0.005		< 0.01	< 0.005	0.21	0.2	0.087	0.009	
S99-00410	0.2	0.14	6.8	< 0.005	4.4	0.05	2140		20.3	< 0.01	< 0.1	69.2	1.02	25.5	< 0.005		< 0.01	< 0.005	0.31	0.2	0.046	< 0.008	29
S99-00411	0.2	0.15	7.1	< 0.005	3.1	< 0.02	1060		15.8	< 0.01	< 0.1	63.1	0.393	26.9	< 0.005		< 0.01	< 0.005	2.01	< 0.2	0.072	< 0.008	32
S99-00412	0.3	0.14	6.82	< 0.005	2.3	0.12	886		19	< 0.01	0.4	34.4	0.257	26.2	< 0.005		< 0.01	< 0.005	0.18	0.8	0.04	< 0.008	13
S99-00413	0.2	0.13	7.21	< 0.005	1.7	0.02	620		15.1	< 0.01	< 0.1	8	0.391	25.7	< 0.005		< 0.01	< 0.005	3.3	< 0.2	0.065	0.01	10
S99-00415	0.1	1.01	7.05	< 0.005	2.7	0.02	729		15.9	< 0.01	< 0.1	2	0.373	26.8	< 0.005		< 0.01	< 0.005	1.8	< 0.2	0.062	< 0.008	6
S99-00416	0.7	0.07	6.87	< 0.005	4.2	< 0.02	408		29.7	< 0.01	< 0.1	< 0.2	0.187	27.9	< 0.005		< 0.01	< 0.005	0.01	< 0.2	0.007	< 0.008	14
S99-00417	< 0.1	0.19	7.29	< 0.005	7.2	0.03	2180		11.3	< 0.01	< 0.1	126	0.458	26.1	< 0.005		< 0.01	< 0.005	4.19	< 0.2	0.053	< 0.008	10

E Mandari village survey

SAMPLE ID	SAMPLE FIELD ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	GEOCODE	As arsenator ug/L	As lab ug/L
S99-01559	M100	22/11/1999	22.9221	90.903	1994	stw	7.9	Mandari Union Council	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	71	40
S99-01560	M101	22/11/1999	22.9231	90.9029	1999	stw	7.9	Mandari CT Govt primary school	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	89	80
S99-01561	M102	22/11/1999	22.9228	90.9045	1997	stw	9.1	Md Abdul Manan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	86	80
S99-01562	M103	22/11/1999	22.9228	90.9046	1997	stw	7.9	Moulana Abul Khayer	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	57	50
S99-01563	M104	22/11/1999	22.9215	90.9022	1987	stw	9.1	Md Saifur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	78	50
S99-01564	M105	22/11/1999	22.9228	90.9022	1999	stw	7.9	South Mandari Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	167	140
S99-01565	M106	22/11/1999	22.9208	90.905	1996	stw	7.9	Md. Mofizur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	42	<30
S99-01566	M107	22/11/1999	22.9209	90.9055	1991	stw	11	Manadari Fatama Girl's High School	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	109	90
S99-01567	M108	22/11/1999	22.9178	90.9055	1996	stw	11	Abdul Malak	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	95	40
S99-01568	M109	22/11/1999	22.9191	90.9092	1986	stw	12.2	Md. Motyer Patwary	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	93	90
S99-01569	M110	22/11/1999	22.9166	90.907	1995	stw	7.9	Md. Feroz Alam Khan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	96	80
S99-01570	M111	22/11/1999	22.9161	90.9063	1985	stw	8.5	Pathan Bari Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	162	160
S99-01571	M112	22/11/1999	22.9217	90.908	1995	stw	9.1	Md. Belayet Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	145	130
S99-01572	M113	22/11/1999	22.9206	90.9097	1998	stw	9.1	Md Abdul Mannan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	89	80
S99-01573	M114	22/11/1999	22.9235	90.9097	1990	stw	11	Md. Abdul Khaleque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	18	<30
S99-01574	M115	22/11/1999	22.9235	90.9078	1970	stw	7.9	Hozal Karim Monse Bari	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	44	40
S99-01576	M117	23/11/1999	22.9208	90.9153	1974	stw	9.1	Md. Fokruddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	163	160
S99-01577	M118	23/11/1999	22.9264	90.9012	1999	dtw	228.6	Md. Shahab Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.25	<30
S99-01578	M119	23/11/1999	22.9208	90.9153	1998	stw	13.1	Md. Anwarul Hoque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	112	110
S99-01579	M120	23/11/1999	22.9252	90.9015	1994	stw	13.7	Md. Shaifuddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	106	110
S99-01580	M121	23/11/1999	22.9265	90.9028	1985	stw	7.6	Md. Abul Bashar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	121	90
S99-01581	M122	23/11/1999	22.9258	90.9026	1999	dtw	259.1	Md Abul Bashar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.25	<30
S99-01582	M123	23/11/1999	22.9258	90.9041	1997	stw	9.1	Md Abul Bashar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	60	60
S99-01583	M124	23/11/1999	22.9268	90.9041	1999	stw	11	Md. Tofazzal Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	111	120
S99-01584	M125	23/11/1999	22.9261	90.9054	1993	stw	9.1	Hossain Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	77	80
S99-01585	M126	23/11/1999	22.9258	90.9057	1999	stw	7.9	Abdul Maleque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	91	100
S99-01586	M127	23/11/1999	22.9275	90.9039	1988	stw	7.9	Md. Syed Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	85	80
S99-01587	M128	23/11/1999	22.9276	90.9056	1993	stw	15.9	Md. Zahir Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	108	120
S99-01588	M129	23/11/1999	22.9283	90.9046	1970	stw	14	Md. Nashir Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	300	250
S99-01589	M130	23/11/1999	22.9273	90.9055	1997	stw	16.8	Md. Abdur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	77	60
S99-01590	M131	23/11/1999	22.9282	90.9044	1980	stw	7.9	Md. Azizur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	66	60
S99-01591	M132	23/11/1999	22.9285	90.9042	1997	dtw	213.4	Md. Azizur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.25	<30
S99-01592	M133	23/11/1999	22.9279	90.906	1995	stw	9.1	Abdul Kader	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	88	80
S99-01593	M134	23/11/1999	22.9267	90.9097	1998	stw	9.1	Abdul Rahim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	93	100
S99-01594	M135	23/11/1999	22.9278	90.9079	1994	stw	9.1	Mohammad Ismail	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	76	70
S99-01595	M136	23/11/1999	22.9266	90.9068	1994	stw	7.9	Md. Shajahan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	97	70
S99-01596	M137	23/11/1999	22.9263	90.9075	1994	stw	10.7	Hozol Karim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	38	40
S99-01597	M138	23/11/1999	22.9265	90.9062	1998	stw	11	Abdur Rahman Patwary	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	45	40
S99-01598	M139	23/11/1999	22.9238	90.9073	1995	stw	7.9	Abdul Kuddus	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	43	40
S99-01599	M140	23/11/1999	22.9246	90.9069	1997	stw	7.9	Mohammad Mostafa	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	23	<30
S99-01600	M141	24/11/1999	22.9314	90.903	1994	stw	14	Md. Mizanur Rahim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	75	60
S99-01601	M142	24/11/1999	22.9334	90.9034	1994	stw	11	Begum Samsun Nahar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	60	70
S99-01602	M143	24/11/1999	22.9346	90.9036	1996	dtw	0	Md. Mubarak Mian	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.6	<30
S99-01603	M144	24/11/1999	22.9347	90.9033	1998	stw	11	Md. Mubarak Mian	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	54	40
S99-01604	M145	24/11/1999	22.9344	90.9033	1998	stw	9.1	Md. Mubarak Mian	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	69	50
S99-01605	M146	24/11/1999	22.9349	90.9026	1992	stw	9.1	Abdul Khayer	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	64	50
S99-01606	M147	24/11/1999	22.9351	90.9037	1994	stw	11	Md. Shah Alam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	89	90
S99-01607	M148	24/11/1999	22.9349	90.9024	1990	stw	11	Md. Faiz Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	43	40

SAMPLE ID	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-01559	< 0.01	< 0.1	0.017	37.9	< 0.003	< 0.002	< 0.008				2.12	5.7	< 0.004	30	1.59	< 0.003	15.9	0.1	24.9	5.8	0.195	< 0.002	0.007
S99-01560	< 0.01	0.3	0.018	62.1	< 0.003	< 0.002	< 0.008				0.929	17.1	0.009	62.1	0.618	< 0.003	201	0.5	19.2	1	0.438	< 0.002	0.138
S99-01561	< 0.01	0.1	0.013	55.5	< 0.003	< 0.002	< 0.008				1.51	9.6	< 0.004	56.3	1.27	< 0.003	42.1	0.2	23.2	0.8	0.267	< 0.002	0.029
S99-01562	< 0.01	0.1	0.016	60.8	< 0.003	< 0.002	< 0.008				1.31	8.5	0.005	62	1.37	0.004	32.3	0.2	22.1	0.4	0.275	< 0.002	0.036
S99-01563	< 0.01	0.4	0.016	33.9	< 0.003	< 0.002	< 0.008				1.24	15.1	0.004	33.7	0.479	0.004	217	0.6	18.7	0.4	0.244	< 0.002	0.119
S99-01564	0.03	< 0.1	0.008	29.6	< 0.003	< 0.002	< 0.008				3.75	8.8	0.004	29.4	1.56	< 0.003	13.8	0.3	26.6	< 0.2	0.186	< 0.002	0.14
S99-01565	< 0.01	< 0.1	0.014	49.6	< 0.003	< 0.002	< 0.008				0.513	12.7	< 0.004	43.8	0.854	< 0.003	15.6	0.2	20.2	< 0.2	0.291	< 0.002	0.088
S99-01566	< 0.01	< 0.1	0.005	27.6	< 0.003	< 0.002	< 0.008				1.87	8.8	0.004	33.1	1.02	< 0.003	11.7	0.5	26	1.1	0.189	< 0.002	0.031
S99-01567	0.02	0.3	0.003	23	< 0.003	< 0.002	< 0.008				0.333	8.1	0.005	16.9	0.413	0.005	104	0.3	19.7	1.7	0.118	< 0.002	0.008
S99-01568	< 0.01	0.1	0.06	54.4	< 0.003	< 0.002	< 0.008				3.19	20.9	0.004	67.2	0.7	< 0.003	39	0.7	20.1	17.6	0.466	< 0.002	0.017
S99-01569	0.04	< 0.1	0.02	27.5	< 0.003	< 0.002	< 0.008				0.907	13.4	< 0.004	30.1	0.812	< 0.003	22.4	0.4	22.1	0.5	0.201	< 0.002	0.063
S99-01570	< 0.01	< 0.1	0.019	26.3	< 0.003	< 0.002	< 0.008				6.28	9.2	0.007	21	2.14	< 0.003	16.9	0.2	26.2	6.1	0.174	< 0.002	0.044
S99-01571	< 0.01	< 0.1	0.011	31.9	< 0.003	< 0.002	< 0.008				2.12	13.3	< 0.004	35.9	1.04	< 0.003	40.3	0.3	19.1	3.2	0.231	< 0.002	0.008
S99-01572	< 0.01	< 0.1	0.009	24.7	< 0.003	< 0.002	< 0.008				4.86	5.4	0.01	22.6	1.16	< 0.003	36.9	0.2	25.1	7.4	0.107	< 0.002	0.012
S99-01573	< 0.01	0.1	0.009	22.6	< 0.003	< 0.002	< 0.008				0.44	11.6	0.005	25.5	0.429	0.004	43.7	0.2	17.8	5.4	0.155	< 0.002	0.015
S99-01574	< 0.01	0.3	0.003	9.2	< 0.003	< 0.002	< 0.008				0.272	7.3	0.007	9.74	0.149	0.005	124	0.4	16.7	1.2	0.0681	< 0.002	0.024
S99-01576	< 0.01	< 0.1	0.013	31.4	< 0.003	< 0.002	< 0.008				0.959	9.4	< 0.004	34.4	0.489	< 0.003	22.2	1	17.7	1.7	0.192	< 0.002	0.031
S99-01577	< 0.01	< 0.1	0.062	28	< 0.003	< 0.002	< 0.008				1.5	4.6	< 0.004	18.2	0.09	< 0.003	25.7	0.2	36.8	< 0.2	0.195	< 0.002	0.133
S99-01578	< 0.01	0.4	0.007	5.4	< 0.003	< 0.002	< 0.008				0.365	5.6	< 0.004	4.85	0.075	0.013	152	4.1	16.9	1.5	0.0377	< 0.002	0.008
S99-01579	< 0.01	< 0.1	0.004	19.4	< 0.003	< 0.002	< 0.008				1.14	7.9	< 0.004	20.7	0.282	< 0.003	22.7	1.2	21.3	0.6	0.116	< 0.002	0.016
S99-01580	< 0.01	< 0.1	0.007	21.6	< 0.003	< 0.002	< 0.008				1.63	6.4	< 0.004	28.7	0.608	< 0.003	14.7	0.5	21.4	1.6	0.144	< 0.002	0.052
S99-01581	< 0.01	< 0.1	0.076	27.5	< 0.003	< 0.002	< 0.008	-10	-2.1	-9	1.26	4.6	0.006	17.5	0.063	< 0.003	26.3	0.2	32.7	< 0.2	0.202	< 0.002	0.039
S99-01582	< 0.01	0.3	0.01	24	< 0.003	< 0.002	< 0.008	-20.2	-4.3	-34	1.11	9.5	< 0.004	21.9	0.31	0.006	134	0.8	18.3	36.4	0.152	< 0.002	0.007
S99-01583	< 0.01	< 0.1	0.011	30.5	< 0.003	< 0.002	< 0.008				0.625	5.8	0.007	24.7	1.2	0.004	12.7	0.2	18.5	0.2	0.144	< 0.002	0.024
S99-01584	< 0.01	< 0.1	0.008	24.9	< 0.003	< 0.002	< 0.008				1.15	5	< 0.004	23.6	1.03	< 0.003	13.7	0.2	21.7	< 0.2	0.126	< 0.002	0.009
S99-01585	< 0.01	< 0.1	0.006	23.7	< 0.003	< 0.002	< 0.008				2.31	4.1	0.007	21.3	1.22	< 0.003	20.2	0.4	26.7	1.2	0.112	< 0.002	0.01
S99-01586	< 0.01	0.1	0.017	47	< 0.003	< 0.002	< 0.008				1.91	10.1	< 0.004	46.8	0.84	< 0.003	31.5	1	19.8	13.4	0.27	< 0.002	0.015
S99-01587	< 0.01	0.4	0.054	41.2	< 0.003	< 0.002	< 0.008				2.74	17.9	< 0.004	47.7	0.471	0.007	214	2.3	18.3	0.2	0.356	< 0.002	0.009
S99-01588	< 0.01	< 0.1	0.021	36.7	< 0.003	< 0.002	< 0.008				4.7	23.4	0.004	31.4	1.35	< 0.003	17.5	0.6	22.8	8.7	0.187	< 0.002	0.019
S99-01589	< 0.01	0.1	0.007	44.4	< 0.003	< 0.002	< 0.008				1.06	11.1	< 0.004	51	0.729	0.003	25	0.4	21.2	0.6	0.271	< 0.002	0.066
S99-01590	< 0.01	< 0.1	0.01	47.9	< 0.003	< 0.002	< 0.008				3.6	11	< 0.004	53.3	0.734	< 0.003	37.6	0.5	20.8	1.6	0.296	< 0.002	0.113
S99-01591	< 0.01	< 0.1	0.065	27.1	< 0.003	< 0.002	< 0.008				1.54	4.1	0.005	17.6	0.102	< 0.003	26.2	0.2	36.8	< 0.2	0.193	< 0.002	0.012
S99-01592	< 0.01	< 0.1	0.011	26.9	< 0.003	< 0.002	< 0.008				0.819	6.8	< 0.004	31.7	1.14	< 0.003	21.5	0.2	26.1	6.8	0.176	< 0.002	0.032
S99-01593	< 0.01	0.1	0.013	30.6	< 0.003	< 0.002	< 0.008				5.25	10.2	0.006	31.9	1.67	< 0.003	60.7	0.3	22.6	6	0.202	< 0.002	0.037
S99-01594	< 0.01	0.3	0.051	77.3	< 0.003	< 0.002	< 0.008				1.99	22.4	0.018	102	1.82	< 0.003	333	0.2	20.6	68.7	0.653	< 0.002	0.015
S99-01595	< 0.01	0.4	0.026	50.9	< 0.003	< 0.002	< 0.008				0.959	20.8	0.011	60.7	0.723	0.003	334	0.4	18	2.6	0.425	< 0.002	0.037
S99-01596	< 0.01	0.2	0.021	41.4	< 0.003	< 0.002	< 0.008				0.553	15	0.01	50.9	0.91	< 0.003	143	0.2	19.9	1.3	0.315	< 0.002	0.022
S99-01597	< 0.01	0.1	0.012	28.7	< 0.003	< 0.002	< 0.008				0.46	10.5	< 0.004	32.8	0.648	< 0.003	65.2	0.2	19.9	2.2	0.198	< 0.002	0.02
S99-01598	< 0.01	< 0.1	0.013	32.5	< 0.003	< 0.002	< 0.008				0.459	11.9	< 0.004	42.7	0.719	< 0.003	28.6	0.2	19.6	1	0.228	< 0.002	0.014
S99-01599	< 0.01	0.2	0.016	22.7	< 0.003	< 0.002	< 0.008				0.282	15	< 0.004	28.2	0.454	< 0.003	158	0.2	18.2	0.5	0.186	< 0.002	0.026
S99-01600	< 0.01	0.2	< 0.002	25.9	< 0.003	< 0.002	< 0.008				< 0.005	12.9	< 0.004	29	0.234	0.005	131	0.4	19.6	14.3	0.177	< 0.002	< 0.004
S99-01601	< 0.01	0.1	< 0.002	9.7	< 0.003	< 0.002	< 0.008				0.286	6.6	< 0.004	9.83	0.168	0.004	72.8	0.9	17	0.5	0.0588	< 0.002	0.005
S99-01602	< 0.01	0.3	0.823	170	< 0.003	< 0.002	< 0.008				8	18.5	0.059	134	0.497	< 0.003	912	0.3	29.7	< 0.2	1.62	< 0.002	0.022
S99-01603	< 0.01	0.1	0.062	102	< 0.003	< 0.002	< 0.008				3.96	17.3	0.023	91.1	3.49	< 0.003	193	0.1	26.5	28.8	0.702	< 0.002	0.037
S99-01604	< 0.01	0.2	0.082	171	< 0.003	< 0.002	< 0.008				3.65	27.8	0.015	146	1.71	< 0.003	306	0.4	18.7	63.2	1.2	< 0.002	0.07
S99-01605	< 0.01	0.1	0.026	77.7	0.005	< 0.002	< 0.008				2.08	13.8	0.011	75.8	1.91	0.004	86.1	0.1	23.5	65.9	0.471	0.003	0.011
S99-01606	< 0.01	< 0.1	0.01	31.2	< 0.003	< 0.002	< 0.008				1.66	8.6	< 0.004	23.9	1.37	< 0.003	20.6	0.2	22.5	4.9	0.153	< 0.002	0.01
S99-01607	< 0.01	< 0.1	0.012	43.4	< 0.003	< 0.002	< 0.008				0.633	9.4	< 0.004	45	0.72	< 0.003	34.1	0.3	20.4	3.5	0.237	< 0.002	0.015

SAMPLE ID	SAMPLE FIELD ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	GEOCODE	As arsenator ug/L	As lab ug/L
S99-01608	M149	24/11/1999	22.9348	90.9016	1990	stw	11	Md. Eunus Mian	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	71	60
S99-01609	M150	24/11/1999	22.9348	90.9016	1996	stw	10.7	Md. Dulal Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	229	460
S99-01610	M151	24/11/1999	22.9349	90.9015	1997	dtw	259.1	Hossain Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	2.5	<30
S99-01611	M152	24/11/1999	22.9352	90.9004	1990	stw	11	Abdul Motalleb	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	101	90
S99-01612	M153	24/11/1999	22.9351	90.9002	1996	stw	11	Noor Mohammad	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	201	180
S99-01613	M154	24/11/1999	22.9353	90.9009	1997	stw	11	Abdul Shaheed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	96	100
S99-01614	M155	24/11/1999	22.9353	90.9008	1997	stw	11	Abul Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	106	100
S99-01615	M156	24/11/1999	22.9365	90.9014	1996	stw	11	Siddik Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	115	120
S99-01616	M157	24/11/1999	22.9353	90.9012	1997	stw	11	Md. Nuruzzaman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	173	170
S99-01617	M158	24/11/1999	22.9368	90.9024	1997	stw	12.2	Md. Enayet Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	90	70
S99-01618	M159	24/11/1999	22.9364	90.9015	1970	stw	7.9	Md.Noman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	81	140
S99-01619	M160	24/11/1999	22.9365	90.9013	1980	stw	11	Md. Abul Kalam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	141	70
S99-01620	M161	24/11/1999	22.936	90.9022	1993	stw	17.4	Md. Siddik Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	76	70
S99-01621	M162	24/11/1999	22.9366	90.9026	1996	stw	15.2	Mohammad Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	112	110
S99-01622	M163	24/11/1999	22.9367	90.9026	1970	stw	9.1	Abul Kalam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	106	100
S99-01623	M164	24/11/1999	22.9371	90.9033	1992	stw	16.8	Abdul Wadud (member)	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	60	50
S99-01624	M165	24/11/1999	22.9355	90.9027	1994	stw	11	Onial Chandra Devnath	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	84	80
S99-01625	M166	24/11/1999	22.9357	90.9027	1991	stw	13.7	Mr. Ratan Krishna Nath	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	53	40
S99-01626	M167	24/11/1999	22.9363	90.9052	1993	stw	11	Md. Sadik Ullah (member)	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	54	60
S99-01627	M168	25/11/1999	22.9373	90.9065	1995	stw	11	Md. Abdul Kader Bhuiyan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	33	<30
S99-01628	M169	25/11/1999	22.9361	90.9078	1995	stw	7.9	Md. Nurul Alam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	50	40
S99-01629	M170	25/11/1999	22.9361	90.9078	1999	stw	7.9	Md. Habib Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	131	110
S99-01630	M171	25/11/1999	22.9351	90.9087	1993	stw	7.9	Nurun Nabi	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	104	110
S99-01631	M172	25/11/1999	22.935	90.9086	1994	stw	13.7	Mohammad Ismail	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	77	80
S99-01632	M173	25/11/1999	22.9379	90.909	1998	dtw	365.8	Md. Rafiqul Islam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.25	<30
S99-01633	M174	25/11/1999	22.9385	90.913	1998	stw	7.9	Md. Abul Kashem	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	47	40
S99-01634	M175	25/11/1999	22.9371	90.914	1997	stw	9.1	Md. Abdus Sattar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	39	<30
S99-01635	M176	25/11/1999	22.9353	90.915	1998	stw	7.9	Maolana Alamgir Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	171	210
S99-01636	M177	25/11/1999	22.9346	90.9145	1991	stw	7.9	Md. Nurul Amin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	61	60
S99-01637	M178	25/11/1999	22.9315	90.9138	1996	stw	11	Mohammad Shahjahan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	32	<30
S99-01638	M179	25/11/1999	22.9315	90.9135	1993	stw	11	Shiraj Mian	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	35	<30
S99-01639	M180	25/11/1999	22.929	90.9146	1987	stw	7.9	East Mandari Govt. Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	94	90
S99-01640	M181	25/11/1999	22.9275	90.9157	1992	stw	7.9	Md. Ismail Master	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	27	<30
S99-01641	M182	25/11/1999	22.9255	90.9172	1996	stw	7.9	Dr. Sukumar Mojumdar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	64	60
S99-01642	M183	25/11/1999	22.9246	90.9159	1996	stw	8.5	Sheikh Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	37	<30
S99-01643	M184	25/11/1999	22.9267	90.9126	1988	stw	7.9	Abdul Hafiz	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	47	40
S99-01644	M185	25/11/1999	22.9227	90.9131	1988	stw	11	Moin Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	94	100
S99-01645	M186	25/11/1999	22.9357	90.9045	1993	stw	9.1	Md. Nurul Anwar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	48	40
S99-01646	M187	25/11/1999	22.9357	90.9043	1992	stw	9.1	Md. Tajul Islam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	163	170
S99-01647	M188	25/11/1999	22.9362	90.9048	1998	dtw	243.8	Abdur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.25	<30
S99-01648	M189	25/11/1999	22.9366	90.9051	1997	stw	7.9	Shafi Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	71	70
S99-01649	M190	25/11/1999	22.937	90.9042	1996	stw	8.5	Md. Hanif Master	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	62	60
S99-01650	M191	25/11/1999	22.9376	90.9039	1998	stw	7.9	Hazi Shaheed Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	39	40
S99-01651	M192	25/11/1999	22.938	90.9035	1997	stw	9.8	Md. Rafique Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	85	90
S99-01652	M193	25/11/1999	22.938	90.9048	1996	stw	7.9	Mohammad Hassan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	116	100
S99-01653	M194	25/11/1999	22.9373	90.9051	1995	stw	9.8	Aamir Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	70	60
S99-01654	M195	25/11/1999	22.9373	90.905	1996	stw	9.8	Mohammad Selim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	83	90
S99-01655	M196	25/11/1999	22.9373	90.9052	1996	stw	8.5	Mamotaj Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	46	60

SAMPLE ID	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-01608	< 0.01	0.2	0.007	38.5	< 0.003	< 0.002	< 0.008				0.555	11.8	< 0.004	34.8	0.504	0.004	89.4	0.6	19.8	10.8	0.226	< 0.002	0.012
S99-01609	< 0.01	< 0.1	0.025	59.8	0.01	0.002	< 0.008				7.68	15	< 0.004	69.4	2.02	0.005	43.5	0.1	20.8	6.4	0.413	0.003	0.026
S99-01610	< 0.01	< 0.1	0.069	27.9	< 0.003	< 0.002	< 0.008				2.27	2.8	0.008	15.6	0.076	< 0.003	29.9	0.2	35.1	< 0.2	0.179	< 0.002	0.018
S99-01611	< 0.01	0.6	0.014	28.5	< 0.003	< 0.002	< 0.008				0.402	15.3	< 0.004	28.2	0.327	0.011	308	0.7	17.7	0.8	0.201	< 0.002	0.013
S99-01612	< 0.01	0.1	0.016	40.7	< 0.003	< 0.002	< 0.008				1.76	10.9	< 0.004	46.7	0.727	< 0.003	43.2	0.7	20.9	3.6	0.269	< 0.002	0.016
S99-01613	< 0.01	0.3	0.024	10.6	< 0.003	< 0.002	< 0.008				0.299	9.3	0.009	11.3	0.243	0.006	132	1.4	18.6	0.4	0.0855	< 0.002	0.011
S99-01614	< 0.01	0.4	0.017	10.3	< 0.003	< 0.002	< 0.008				0.338	9	< 0.004	9.08	0.187	0.008	201	1.9	17.9	0.4	0.0759	< 0.002	0.006
S99-01615	< 0.01	0.4	0.027	16.8	< 0.003	< 0.002	< 0.008				0.435	8.5	< 0.004	12.9	0.213	0.012	213	2.8	18.2	0.5	0.104	< 0.002	0.012
S99-01616	< 0.01	0.1	0.022	73.2	< 0.003	< 0.002	< 0.008				5.62	12.3	0.011	70.4	2.97	< 0.003	85.3	0.2	21.8	42.1	0.567	< 0.002	0.022
S99-01617	< 0.01	< 0.1	0.016	83.8	< 0.003	< 0.002	< 0.008				2.4	14	< 0.004	79.2	1.25	< 0.003	47.7	0.4	24.3	44.5	0.521	< 0.002	0.015
S99-01618	< 0.01	0.3	0.035	21.8	< 0.003	< 0.002	< 0.008				1.22	12.1	< 0.004	22.5	0.487	0.005	148	1.7	15.5	0.9	0.166	< 0.002	0.009
S99-01619	< 0.01	< 0.1	0.004	32.8	< 0.003	< 0.002	< 0.008				0.59	10.6	< 0.004	32.7	0.412	< 0.003	21.6	0.5	20.7	0.4	0.203	< 0.002	0.043
S99-01620	< 0.01	< 0.1	0.006	30.7	< 0.003	< 0.002	< 0.008				0.708	9.4	< 0.004	33.1	0.497	0.003	33.5	0.5	22.3	3.8	0.21	< 0.002	0.011
S99-01621	< 0.01	0.3	0.012	12.4	< 0.003	< 0.002	< 0.008				0.885	5.1	< 0.004	6.66	0.147	0.007	148	2.6	18.8	6	0.058	< 0.002	0.005
S99-01622	< 0.01	< 0.1	0.012	28.6	< 0.003	0.002	< 0.008				1.57	6.2	0.007	24.8	1.97	< 0.003	10.7	0.1	22.6	1.6	0.159	< 0.002	0.029
S99-01623	< 0.01	< 0.1	0.014	36.2	< 0.003	< 0.002	< 0.008				2.08	10.1	0.01	35	1.49	< 0.003	16.5	0.1	29.8	15.8	0.161	< 0.002	0.01
S99-01624	< 0.01	0.1	0.008	62.4	< 0.003	0.002	< 0.008				1.14	12.4	0.006	55.7	0.659	0.005	25	0.4	20.6	7	0.364	0.002	0.028
S99-01625	< 0.01	< 0.1	0.027	58.3	< 0.003	0.002	< 0.008				2.53	14.3	0.016	45.5	3	< 0.003	50.7	0.1	26.2	23.3	0.304	< 0.002	0.051
S99-01626	< 0.01	< 0.1	0.009	24.9	< 0.003	< 0.002	< 0.008				1.54	8.2	0.009	29.4	1.72	< 0.003	17	0.1	28.9	1.5	0.168	< 0.002	0.008
S99-01627	< 0.01	0.5	0.038	76.6	< 0.003	< 0.002	< 0.008				0.781	19.2	0.021	86.8	1.17	< 0.003	553	0.2	17.4	87.7	0.642	< 0.002	0.019
S99-01628	< 0.01	0.2	0.023	81	< 0.003	< 0.002	< 0.008				0.713	14.6	0.012	67.8	1.9	< 0.003	152	0.2	21.6	24.8	0.468	< 0.002	0.009
S99-01629	< 0.01	< 0.1	0.066	148	< 0.003	< 0.002	< 0.008				5.07	24.6	0.021	95.1	5.96	< 0.003	218	0.2	23.6	137	0.912	< 0.002	0.011
S99-01630	< 0.01	< 0.1	0.008	27.4	< 0.003	< 0.002	< 0.008				1.17	5.6	< 0.004	25.7	1.59	< 0.003	25.3	0.2	20.8	5.2	0.156	< 0.002	0.006
S99-01631	< 0.01	0.2	0.011	27.3	< 0.003	< 0.002	< 0.008				0.39	12.2	< 0.004	28.9	0.461	0.003	114	1	19.5	22.3	0.183	< 0.002	0.009
S99-01632	< 0.01	< 0.1	0.089	36.8	< 0.003	< 0.002	< 0.008	-11.9	-2.3	-10	0.034	4.6	0.005	25.3	0.099	< 0.003	37.5	< 0.1	33.7	< 0.2	0.302	< 0.002	0.339
S99-01633	< 0.01	0.2	0.042	60.3	< 0.003	< 0.002	< 0.008				1.19	9.8	0.014	59.1	0.912	< 0.003	311	0.3	16.5	36.5	0.36	< 0.002	0.062
S99-01634	< 0.01	0.1	0.073	109	< 0.003	< 0.002	< 0.008				0.935	15.7	0.013	101	1.5	< 0.003	163	0.1	19.4	41.5	0.669	< 0.002	0.03
S99-01635	< 0.01	< 0.1	0.019	47.4	< 0.003	< 0.002	< 0.008				5.57	7.5	< 0.004	50	1.8	0.003	18.1	0.8	18.6	0.4	0.291	< 0.002	0.012
S99-01636	< 0.01	0.4	0.075	87.9	< 0.003	< 0.002	< 0.008				1.66	16.9	0.011	94.2	1.27	0.005	321	0.5	17.1	29.5	0.586	< 0.002	0.011
S99-01637	< 0.01	< 0.1	0.009	33.9	< 0.003	< 0.002	< 0.008				0.312	7.2	< 0.004	34.3	0.832	< 0.003	63.1	0.2	23	0.5	0.2	< 0.002	0.036
S99-01638	< 0.01	0.1	0.013	53	< 0.003	< 0.002	< 0.008				0.656	9.5	0.004	46.5	1.01	< 0.003	106	0.2	21.3	2.4	0.297	< 0.002	0.019
S99-01639	< 0.01	< 0.1	0.005	21.9	< 0.003	< 0.002	< 0.008				0.991	6	< 0.004	20.5	1.14	< 0.003	79.9	< 0.1	18.9	2	0.144	< 0.002	0.031
S99-01640	< 0.01	0.2	0.006	11.4	< 0.003	< 0.002	< 0.008				0.163	9.4	< 0.004	13.3	0.227	0.005	173	0.3	17.1	2.6	0.0892	< 0.002	0.03
S99-01641	< 0.01	0.2	0.013	33.7	< 0.003	< 0.002	< 0.008				2.56	10	< 0.004	31	0.564	0.006	117	0.6	21.2	1.4	0.21	< 0.002	0.013
S99-01642	< 0.01	0.1	0.016	51.3	< 0.003	< 0.002	< 0.008				0.796	12.6	< 0.004	54.4	0.924	< 0.003	69.4	0.2	19.7	5.2	0.311	< 0.002	0.032
S99-01643	< 0.01	0.1	0.004	17.5	< 0.003	< 0.002	< 0.008				0.16	12.6	< 0.004	22.2	0.273	< 0.003	73	0.3	18.8	3.2	0.144	< 0.002	0.013
S99-01644	0.05	0.3	0.016	31.4	< 0.003	< 0.002	0.008				2.03	12.6	0.004	29	0.376	0.006	149	1	19.8	0.3	0.214	< 0.002	0.026
S99-01645	0.01	< 0.1	0.006	24.7	0.003	0.003	< 0.008				0.421	6.8	0.006	26.9	0.697	0.004	30.7	0.2	20.2	7.4	0.155	0.003	0.041
S99-01646	0.02	< 0.1	0.007	30.5	< 0.003	< 0.002	< 0.008				1.26	5	0.006	24.6	2.38	< 0.003	14.4	0.1	22.7	3.2	0.165	< 0.002	0.008
S99-01647	0.03	< 0.1	0.139	59.6	< 0.003	< 0.002	< 0.008				4.2	4.9	0.011	33	0.488	< 0.003	47.1	0.2	35.6	0.6	0.371	< 0.002	0.05
S99-01648	0.02	< 0.1	0.016	32.2	< 0.003	< 0.002	< 0.008				0.672	7.2	< 0.004	27.3	0.772	< 0.003	18	0.3	28.9	1	0.192	< 0.002	0.015
S99-01649	0.02	< 0.1	0.018	43.7	< 0.003	< 0.002	< 0.008				1.94	8.6	0.006	44.1	1.39	< 0.003	26.6	0.1	25.6	23.8	0.218	< 0.002	0.011
S99-01650	< 0.01	< 0.1	0.012	27.3	< 0.003	< 0.002	< 0.008				0.249	6.7	< 0.004	28.8	0.591	< 0.003	13.4	0.2	21.5	3.2	0.15	< 0.002	0.012
S99-01651	0.02	< 0.1	0.019	45.5	< 0.003	< 0.002	< 0.008				1.77	11.2	0.004	47.3	1.6	< 0.003	15.5	0.2	23.1	0.3	0.291	< 0.002	0.011
S99-01652	0.03	< 0.1	0.013	48.2	< 0.003	< 0.002	< 0.008				1.08	6.8	< 0.004	43.8	1.55	< 0.003	16.4	0.2	22.8	5	0.224	< 0.002	0.021
S99-01653	0.01	< 0.1	0.016	46.5	< 0.003	< 0.002	< 0.008				8.01	7	0.005	46.9	1.89	< 0.003	32	< 0.1	24.3	22	0.246	< 0.002	0.036
S99-01654	0.01	0.4	0.014	38.8	< 0.003	< 0.002	< 0.008				1.73	11.8	0.006	38.5	0.696	0.009	282	0.8	19	4.1	0.277	< 0.002	0.101
S99-01655	0.02	0.1	0.011	33.4	< 0.003	< 0.002	< 0.008				1.08	7.3	< 0.004	38.6	1.05	< 0.003	68.4	0.1	20.9	23.8	0.206	< 0.002	0.045

SAMPLE ID	SAMPLE FIELD ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	GEOCODE	As arsenator ug/L	As lab ug/L
S99-01656	M197	26/11/1999	22.9127	90.8965	1996	stw	9.1	Md.Abdul Malek	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	104	120
S99-01657	M198	26/11/1999	22.9121	90.8963	1997	stw	7.9	Md. Abu Taher	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	470	470
S99-01658	M199	26/11/1999	22.9113	90.8968	1994	stw	9.1	Md. Shah Alam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	406	450
S99-01659	M200	26/11/1999	22.9115	90.8953	1993	stw	9.1	Nurul Amin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	70	90
S99-01660	M201	26/11/1999	22.9113	90.8943	1999	stw	9.1	Mohammad Ismail	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	46	50
S99-01661	M202	26/11/1999	22.9123	90.8935	1994	stw	9.1	Md. Mosharraf Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	82	70
S99-01662	M203	26/11/1999	22.9112	90.8932	1997	stw	10.7	Md. Noor Mohammad	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	453	490
S99-01663	M204	26/11/1999	22.9124	90.8924	1992	stw	9.1	Md. Khalequr Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	185	220
S99-01664	M205	26/11/1999	22.9134	90.8878	1985	stw	11	Prabindra Chandra Mojumdar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	490	570
S99-01665	M206	26/11/1999	22.9131	90.8881	1970	stw	7.9	Md. Nazir Bepari	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	279	310
S99-01666	M207	26/11/1999	22.9109	90.8862	1996	stw	9.1	Abdul Mokim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	408	480
S99-01667	M208	26/11/1999	22.9101	90.8863	1993	stw	9.1	Md. Abdur Rob Patwary	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	288	350
S99-01668	M209	26/11/1999	22.9122	90.8867	1996	stw	9.1	Moulana Mohammad Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	445	500
S99-01669	M210	26/11/1999	22.913	90.887	1980	stw	7.9	Lutfar Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	194	240
S99-01670	M211	26/11/1999	22.9133	90.8852	1980	stw	9.1	Mohammad Shajahan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	331	380
S99-01671	M212	26/11/1999	22.9132	90.8849	1985	stw	9.1	East Chand Khali Jame Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	378	430
S99-01672	M213	26/11/1999	22.9128	90.8978	1980	stw	9.1	Amin Bazar Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	41	50
S99-01673	M214	26/11/1999	22.913	90.8961	1997	stw	11	Md. Solaiman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	96	120
S99-01674	M215	26/11/1999	22.9134	90.8943	1980	stw	11	Md. Shaheed Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	89	100
S99-01675	M216	26/11/1999	22.9139	90.8943	1980	stw	11	Abdul Gofran	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	124	140
S99-01676	M217	26/11/1999	22.9144	90.8948	1993	stw	9.1	Abdul Rob	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	30	40
S99-01677	M218	26/11/1999	22.9142	90.8956	1980	stw		Dr. Mohammad Nizam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	350	380
S99-01678	M219	26/11/1999	22.9149	90.89	1970	stw	19.8	Abu Taher	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	93	110
S99-01679	M220	26/11/1999	22.9138	90.8896	1996	stw	7.9	Jiban Kumar Shiel	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	137	180
S99-01680	M221	26/11/1999	22.9143	90.8883	1991	stw	9.1	Mihir Chandra	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	257	290
S99-01681	M222	26/11/1999	22.9135	90.8911	1980	stw	7.9	Md. Jamal Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	182	230
S99-01682	M223	26/11/1999	22.9155	90.8916	1980	stw	9.1	Obayed Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	43	70
S99-01683	M224	26/11/1999	22.9159	90.8949	1985	stw	9.1	Abul Kalam Patwary	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	595	660
S99-01686	M227	27/11/1999	22.9401	90.9068	1984	stw	7.9	Adv. Ahmed Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	37	40
S99-01687	M228	27/11/1999	22.9409	90.9071	1997	stw	7.9	Abdul Maleuqe	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	100	90
S99-01688	M229	27/11/1999	22.9404	90.9084	1998	dtw	274.3	Noorani Madrasa	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.25	<30
S99-01689	M230	27/11/1999	22.9408	90.9096	1999	stw	7.9	North Mandari Govt. Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	114	110
S99-01690	M231	27/11/1999	22.9413	90.9106	1998	stw	7.9	Union Land Office	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	87	90
S99-01691	M232	27/11/1999	22.928	90.9119	1980	stw	11	Abul Kalam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	471	470
S99-01692	M233	27/11/1999	22.9249	90.9098	1990	stw	9.1	Abdul Rahim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	34	60
S99-01693	M234	27/11/1999	22.9247	90.9096	1980	stw	9.1	Mohusin Master	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	24	40
S99-01694	M235	27/11/1999	22.9242	90.9098	1998	stw	7.9	Abdul Wadud	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	102	120
S99-01695	M236	27/11/1999	22.9246	90.9148	1997	stw	9.1	Md. Shajahan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	57	70
S99-01696	M237	27/11/1999	22.9157	90.9026	1985	stw	11	Oli Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	322	300
S99-01697	M238	27/11/1999	22.9133	90.9047	1980	stw	7.9	Md. Ishaque Ali	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	53	60
S99-01698	M239	27/11/1999	22.9122	90.9049	1998	stw	9.1	Md. Mohiuddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	40	50
S99-01699	M240	27/11/1999	22.9123	90.9082	1985	stw	9.1	Mohammad Hanif	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	137	150
S99-01700	M241	27/11/1999	22.9115	90.9088	1997	stw	11	Md. Salam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	465	460
S99-01701	M242	27/11/1999	22.9111	90.9105	1999	stw	11	South Mandari Patwary Bari Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	62	70
S99-01702	M243	27/11/1999	22.9113	90.9117	1985	stw	9.8	Md. Nurul Islam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	58	70
S99-01703	M244	27/11/1999	22.9122	90.913	1996	stw	11	Kali Padha Singh	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	108	130
S99-01704	M245	27/11/1999	22.9156	90.9128	1997	stw	10.1	Roy Mohan Paul	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	88	100
S99-01705	M246	27/11/1999	22.9163	90.9136	1992	stw	11	Japan Aided non-Govt Primary School	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	79	90

SAMPLE ID	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-01656	0.01	< 0.1	0.005	31.4	< 0.003	< 0.002	< 0.008				2.83	7.2	0.004	33.7	0.732	< 0.003	26.3	0.3	24	0.9	0.158	< 0.002	0.007
S99-01657	0.04	0.3	0.018	18.7	< 0.003	< 0.002	< 0.008				1.83	6.3	< 0.004	13.5	0.065	0.015	220	4	16.6	0.4	0.111	< 0.002	0.013
S99-01658	0.03	< 0.1	0.042	73	< 0.003	< 0.002	< 0.008				18.8	12.5	0.005	75.8	1.08	< 0.003	56.4	0.7	17.6	19	0.59	0.002	0.133
S99-01659	0.03	< 0.1	0.01	53.1	< 0.003	< 0.002	< 0.008				1.54	10.2	< 0.004	49	0.679	0.006	42.2	0.4	21.2	1.3	0.287	< 0.002	0.024
S99-01660	0.02	0.1	0.01	38.2	< 0.003	< 0.002	< 0.008				1.71	9.3	< 0.004	32.1	0.554	0.004	52.9	0.3	18.4	3.7	0.205	< 0.002	0.01
S99-01661	0.01	0.2	0.014	36.5	< 0.003	< 0.002	< 0.008				1.04	9.1	0.004	40.2	0.393	0.005	23.1	0.6	22.2	2.5	0.239	< 0.002	0.007
S99-01662	0.06	0.3	0.071	74.3	< 0.003	< 0.002	< 0.008				8.45	10.7	0.004	47.2	0.448	0.008	186	1.3	14.2	< 0.2	0.421	< 0.002	0.018
S99-01663	0.04	0.1	0.012	41.3	< 0.003	< 0.002	< 0.008				2.11	8.7	< 0.004	37.6	0.67	0.007	33.2	0.7	16.7	2.4	0.197	< 0.002	0.014
S99-01664	0.02	0.2	0.013	29	< 0.003	< 0.002	< 0.008				4.9	14.4	< 0.004	46.6	0.595	< 0.003	36.1	1.1	10.4	< 0.2	0.286	< 0.002	0.008
S99-01665	0.02	< 0.1	0.009	36.2	< 0.003	< 0.002	< 0.008				1.75	11.2	< 0.004	39.5	0.521	0.005	33.7	1.4	14.6	< 0.2	0.223	< 0.002	0.036
S99-01666	0.04	0.1	0.019	62.6	< 0.003	< 0.002	< 0.008				7.49	11.9	0.005	44.9	0.187	0.003	126	1.3	13.7	< 0.2	0.41	< 0.002	0.015
S99-01667	0.03	< 0.1	0.008	44.9	< 0.003	< 0.002	< 0.008				9.69	6.8	< 0.004	37.5	0.538	< 0.003	53	0.9	17.1	1.3	0.245	< 0.002	0.008
S99-01668	0.02	0.1	0.006	24.8	< 0.003	< 0.002	< 0.008				3.68	11.6	< 0.004	27.8	0.602	< 0.003	47.2	1.5	12.9	0.2	0.186	< 0.002	0.007
S99-01669	0.01	< 0.1	0.007	29.1	< 0.003	< 0.002	< 0.008				4.32	12.3	< 0.004	34.7	0.399	0.004	36.2	1.5	18.2	1.2	0.212	< 0.002	0.015
S99-01670	< 0.01	< 0.1	0.004	21.5	< 0.003	< 0.002	< 0.008				2.96	6.8	< 0.004	21	0.222	0.003	34	1.6	17	< 0.2	0.134	< 0.002	0.012
S99-01671	0.04	0.2	0.018	41.5	< 0.003	< 0.002	< 0.008				4.5	13	0.006	43.9	0.179	0.004	147	1.8	14.3	0.3	0.348	< 0.002	0.013
S99-01672	0.04	< 0.1	0.01	28.5	< 0.003	< 0.002	< 0.008				3.05	5.9	0.011	31.9	0.878	< 0.003	84.4	0.2	21.6	18.7	0.157	< 0.002	0.013
S99-01673	0.33	< 0.1	0.02	28.6	0.011	< 0.002	0.012				3.49	6.8	< 0.004	28	0.735	< 0.003	12.7	2	21	0.4	0.168	< 0.002	0.019
S99-01674	0.02	< 0.1	0.015	23.5	< 0.003	< 0.002	< 0.008				3.14	6.8	< 0.004	21.1	0.667	< 0.003	10.3	0.9	19.9	< 0.2	0.134	< 0.002	0.219
S99-01675	0.02	< 0.1	0.018	46	< 0.003	< 0.002	< 0.008				1.28	11.1	< 0.004	37.7	0.915	< 0.003	14.2	0.3	19.4	0.3	0.289	< 0.002	0.039
S99-01676	0.02	< 0.1	0.02	40.7	< 0.003	< 0.002	< 0.008				0.566	8.6	< 0.004	50.1	0.984	< 0.003	23.5	0.2	25.2	7.6	0.284	< 0.002	0.017
S99-01677	< 0.01	< 0.1	0.016	19.6	< 0.003	< 0.002	< 0.008				5.22	6	< 0.004	16.8	0.784	< 0.003	8.9	1.4	15.8	< 0.2	0.123	< 0.002	0.093
S99-01678	0.02	< 0.1	0.008	32.7	< 0.003	< 0.002	< 0.008				0.862	6	< 0.004	35	0.829	< 0.003	21.9	0.7	22.7	2.7	0.22	< 0.002	0.018
S99-01679	0.03	< 0.1	0.006	20.9	< 0.003	< 0.002	< 0.008				5.17	11.2	< 0.004	23.1	0.715	< 0.003	12.3	1.4	18.5	< 0.2	0.169	< 0.002	0.012
S99-01680	0.04	< 0.1	0.003	14.7	< 0.003	< 0.002	< 0.008				3.13	9.1	< 0.004	22	0.414	< 0.003	23.9	1.9	16	< 0.2	0.136	< 0.002	0.007
S99-01681	0.02	< 0.1	0.014	38.1	< 0.003	< 0.002	< 0.008				6.47	7.3	< 0.004	34.6	1.25	< 0.003	17.7	0.8	21.4	1	0.23	< 0.002	0.036
S99-01682	0.16	< 0.1	0.012	49.9	< 0.003	0.005	0.011				2.88	5.7	< 0.004	36.3	0.915	< 0.003	13.8	0.4	24.5	0.4	0.219	< 0.002	0.082
S99-01683	0.02	0.2	0.048	45.8	< 0.003	< 0.002	< 0.008				5.16	9.6	< 0.004	43.5	0.346	0.003	64.8	2.3	17.3	2.1	0.35	< 0.002	0.008
S99-01686	0.01	< 0.1	0.006	24.1	< 0.003	< 0.002	< 0.008				0.804	4.4	< 0.004	24.7	0.611	< 0.003	26.1	0.2	22.7	5	0.121	< 0.002	0.018
S99-01687	0.01	< 0.1	0.008	25.8	< 0.003	< 0.002	< 0.008				1.21	4.8	< 0.004	30.4	1	< 0.003	16.2	0.2	24.3	3.9	0.15	< 0.002	0.008
S99-01688	0.04	< 0.1	0.061	26.4	< 0.003	< 0.002	< 0.008				1.65	3.5	0.007	18.6	0.108	< 0.003	33.1	0.3	34	0.3	0.208	< 0.002	0.024
S99-01689	0.03	0.1	0.043	64.9	< 0.003	< 0.002	< 0.008				11	10.8	0.017	66.1	2.23	< 0.003	229	0.6	24.4	108	0.447	< 0.002	0.065
S99-01690	0.01	< 0.1	0.05	38	< 0.003	< 0.002	< 0.008				20.7	13.4	0.01	28.3	0.886	< 0.003	71	0.9	18.7	23.9	0.218	< 0.002	0.022
S99-01691	0.02	< 0.1	0.008	20.5	< 0.003	< 0.002	< 0.008				3.28	8.6	0.006	20	1.15	< 0.003	25.3	0.8	12.5	2.2	0.174	< 0.002	0.033
S99-01692	0.11	< 0.1	0.018	29.8	< 0.003	< 0.002	< 0.008				0.434	16.3	< 0.004	38.5	0.693	< 0.003	27.5	0.2	17.9	3.5	0.237	< 0.002	0.044
S99-01693	0.01	0.3	0.005	8	< 0.003	< 0.002	< 0.008				0.161	10.3	< 0.004	11.1	0.169	0.011	194	0.3	16.5	11.2	0.073	< 0.002	0.03
S99-01694	< 0.01	0.1	0.019	23.8	< 0.003	< 0.002	< 0.008				7.1	21	0.004	45.4	0.651	< 0.003	89.5	1	17.4	81.4	0.185	< 0.002	0.008
S99-01695	0.01	< 0.1	0.015	30.9	< 0.003	< 0.002	< 0.008				2.03	28.5	< 0.004	38.6	0.662	< 0.003	45.9	0.2	20.3	17.5	0.23	< 0.002	0.011
S99-01696	0.02	0.1	0.034	61.9	< 0.003	< 0.002	< 0.008				4.95	12.4	< 0.004	45	2.08	0.004	101	0.3	18.6	0.6	0.383	< 0.002	0.073
S99-01697	0.01	< 0.1	0.011	34.7	< 0.003	< 0.002	< 0.008				1.38	7.7	0.005	33.9	0.758	< 0.003	55.3	0.2	23.9	17.8	0.178	< 0.002	0.009
S99-01698	0.02	< 0.1	0.047	48.7	0.003	< 0.002	< 0.008				39.8	27.6	0.004	27.1	1.56	< 0.003	15.7	1.7	26.6	0.7	0.236	0.002	0.065
S99-01699	0.01	0.5	0.02	32	< 0.003	< 0.002	< 0.008				1.91	23.3	0.011	50.1	0.395	0.006	521	1	14.8	7.6	0.365	< 0.002	0.018
S99-01700	< 0.01	0.3	0.005	14.8	< 0.003	< 0.002	< 0.008				0.723	13.1	< 0.004	20.5	0.065	0.009	240	3.7	10.3	7.9	0.153	< 0.002	0.004
S99-01701	0.02	0.4	0.014	52.6	< 0.003	< 0.002	< 0.008				1.45	15.6	0.011	45.7	0.378	0.007	344	0.7	18.1	29.2	0.383	< 0.002	0.013
S99-01702	0.02	0.1	0.011	25.8	< 0.003	< 0.002	< 0.008				0.747	10.3	< 0.004	30.9	0.539	< 0.003	121	0.7	19.4	3.1	0.192	< 0.002	0.007
S99-01703	0.01	< 0.1	0.031	33	< 0.003	< 0.002	< 0.008				3.49	13.3	< 0.004	38.5	0.402	< 0.003	45.9	1.2	19.9	0.5	0.259	< 0.002	0.017
S99-01704	0.03	< 0.1	0.014	37.9	< 0.003	< 0.002	< 0.008				0.354	12.9	< 0.004	49.9	0.654	0.003	28.5	0.4	18.3	0.3	0.282	< 0.002	0.015
S99-01705	0.03	0.2	0.023	51.3	< 0.003	< 0.002	< 0.008				0.766	15	0.005	68.5	0.992	0.005	70.1	0.2	19.2	4.1	0.386	< 0.002	0.029

SAMPLE ID	SAMPLE FIELD ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	GEOCODE	As arsenator ug/L	As lab ug/L
S99-01706	M247	27/11/1999	22.9159	90.9096	1998	stw	11	Tofazzal Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	46	60
S99-01707	M501	22/11/1999	22.9214	90.9027	1993	stw	7.9	Islamia Al-Amin Madrasa	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	152	140
S99-01708	M502	22/11/1999	22.9207	90.9023	1998	stw	7.9	Islamia Al-Amin Madrasa	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	83	90
S99-01709	M503	22/11/1999	22.9216	90.9022	1998	stw	7.9	Islamia Al-Amin Madrasa	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	103	100
S99-01710	M504	22/11/1999	22.9221	90.9019	1997	stw	8.5	Md. Noor Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	101	110
S99-01711	M505	22/11/1999	22.9224	90.9072	1991	stw	9.1	Rafi Uddin Noman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	47	50
S99-01712	M506	22/11/1999	22.9219	90.901	1996	stw	9.1	Maolana Mohi Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	113	120
S99-01713	M507	22/11/1999	22.9217	90.9007	1991	stw	11	Tajul Islam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	100	110
S99-01714	M508	22/11/1999	22.9227	90.9004	1995	stw	9.1	Md. Choudhury	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	106	110
S99-01715	M509	22/11/1999	22.9204	90.901	1996	stw	7.9	Anowar Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	100	100
S99-01716	M510	22/11/1999	22.92	90.901	1994	stw	9.1	Abul Kuddus	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	104	90
S99-01717	M511	22/11/1999	22.9197	90.8999	1996	dtw	259.1	Ikhte Khairul Amin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	0.25	<30
S99-01718	M512	22/11/1999	22.9191	90.9005	1996	stw	7.9	Nazrul Islam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	172	200
S99-01719	M513	22/11/1999	22.9192	90.8989	1998	stw	7.9	Fakrul Islam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	111	100
S99-01720	M514	22/11/1999	22.9186	90.8981	1994	stw	7.9	Ruhul Amin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	46	50
S99-01721	M515	22/11/1999	22.9189	90.8981	1992	stw	21.3	Md. Shahab Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	19	<30
S99-01722	M516	22/11/1999	22.9203	90.8972	1995	stw	7.9	Golam Mostafa	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	86	100
S99-01723	M517	22/11/1999	22.9203	90.8984	1995	stw	7.9	Md. Mantaz Uddin Patwary	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	67	80
S99-01724	M518	22/11/1999	22.9207	90.9143	1996	stw	7.9	Nurul Huda Patwary	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	84	70
S99-01725	M519	23/11/1999	22.9273	90.9008	1997	stw	7.9	Omar Faruque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	82	80
S99-01726	M520	23/11/1999	22.9277	90.8991	1972	stw	7.9	Zoynal Abedin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	163	190
S99-01727	M521	23/11/1999	22.926	90.8978	1998	stw	12.5	Abdul Wahab	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	89	90
S99-01728	M522	23/11/1999	22.926	90.8971	1995	stw	7.9	Hossain Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	160	120
S99-01729	M523	23/11/1999	22.925	90.8979	1996	stw	9.1	Hassan Ali	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	65	80
S99-01730	M524	23/11/1999	22.9233	90.8953	1993	stw	13.7	Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	80	90
S99-01731	M525	23/11/1999	22.9211	90.8963	1993	stw	7.9	Nuruzzaman Choukidar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	36	30
S99-01732	M526	23/11/1999	22.922	90.8945	1980	stw	9.1	Mohammad Karim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	42	50
S99-01733	M527	23/11/1999	22.9158	90.8993	1994	stw	7.9	Anowar Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	60	70
S99-01734	M528	23/11/1999	22.9149	90.9006	1996	stw	7.9	Abdul Matin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	44	40
S99-01735	M529	23/11/1999	22.9148	90.9014	1999	stw	7.9	Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	80	70
S99-01736	M530	23/11/1999	22.9165	90.8987	1993	stw	7.9	Bashir Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	46	50
S99-01737	M531	23/11/1999	22.9165	90.8985	1994	stw	21.3	Abul Khayer Patwary	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	238	250
S99-01738	M532	24/11/1999	22.9299	90.9021	1990	stw	7.9	Abdul Mannan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	62	60
S99-01739	M533	24/11/1999	22.9299	90.9021	1989	stw	14	Hazi Nuru Zaman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	136	160
S99-01740	M534	24/11/1999	22.9311	90.9012	1992	stw	14	Moklesur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	85	80
S99-01741	M535	24/11/1999	22.9312	90.9012	1997	stw	10.7	Nurul Amin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	310	390
S99-01742	M536	24/11/1999	22.9312	90.9012	1997	stw	10.7	Jahangir Alam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	604	560
S99-01743	M537	24/11/1999	22.9312	90.9012	1996	stw	11	Jahangir Alam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	281	250
S99-01744	M538	24/11/1999	22.9312	90.9012	1979	stw	7.9	Hazi Nuru Zaman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	614	550
S99-01745	M539	24/11/1999	22.9312	90.9012	1996	stw	17.1	Ruhul Amin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	338	320
S99-01746	M540	24/11/1999	22.9312	90.9012	1999	stw	15.9	Mohammad Shamsuddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	100	110
S99-01747	M541	24/11/1999	22.9309	90.9005	1995	stw	7.9	Abul Kashim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	109	110
S99-01748	M542	24/11/1999	22.9295	90.8998	1994	stw	7.6	Mohammad Hossain	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	256	230
S99-01749	M543	24/11/1999	22.9295	90.8998	1995	stw	16.8	Mofizullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	119	110
S99-01750	M544	24/11/1999	22.9313	90.9045	1999	dtw	228.6	Chaul Bepari Bari Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	2.5	<30
S99-01751	M545	24/11/1999	22.9337	90.9066	1989	stw	7.9	Md. Hedayet Ullah Master	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	63	50
S99-01752	M546	24/11/1999	22.9327	90.9069	1994	stw	7.9	Md. Zobi Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	33	40
S99-01753	M547	24/11/1999	22.9347	90.9075	1997	stw	7.9	Miapur Jame Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	44	40

SAMPLE ID	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-01706	0.02	< 0.1	0.016	35.1	< 0.003	< 0.002	< 0.008				0.673	13.1	< 0.004	32.8	0.604	0.004	15	0.3	20.4	0.5	0.227	< 0.002	0.014
S99-01707	0.01	< 0.1	0.012	25.7	< 0.003	< 0.002	< 0.008				2.76	4.5	0.01	22	1.68	< 0.003	28.5	0.3	24.7	6.6	0.145	< 0.002	0.006
S99-01708	0.02	0.1	0.017	35	< 0.003	< 0.002	< 0.008				1.35	7.5	< 0.004	30	1.12	< 0.003	61	0.3	24	17.7	0.214	< 0.002	0.007
S99-01709	0.02	< 0.1	0.028	32.8	< 0.003	< 0.002	< 0.008				32.8	4.3	0.01	21.5	1.88	< 0.003	50.8	0.7	21	9.9	0.152	< 0.002	0.019
S99-01710	0.02	0.2	0.02	31.4	< 0.003	< 0.002	< 0.008				1.62	8.1	0.01	28.4	1.41	0.003	124	0.2	24.3	11.3	0.205	< 0.002	0.008
S99-01711	0.02	0.1	0.014	31.3	< 0.003	< 0.002	< 0.008				0.359	10.1	0.005	30.6	0.545	0.004	41.9	0.2	20.2	0.9	0.187	< 0.002	0.009
S99-01712	0.06	0.6	0.09	79	< 0.003	< 0.002	< 0.008				2.45	11.3	0.011	42.5	0.641	0.006	519	1	18.8	81.4	0.361	< 0.002	0.011
S99-01713	0.02	< 0.1	0.035	57.7	< 0.003	< 0.002	< 0.008				5.12	10.1	0.012	42.1	1.82	< 0.003	60	0.3	26	21	0.28	< 0.002	0.008
S99-01714	< 0.01	< 0.1	0.009	22.8	< 0.003	< 0.002	< 0.008				3.01	3.5	0.007	19.9	1.69	< 0.003	11.8	0.2	27.1	1.6	0.123	< 0.002	0.007
S99-01715	0.02	< 0.1	0.024	39	< 0.003	< 0.002	< 0.008				2.08	9.2	0.004	32.2	1.18	< 0.003	14.4	0.2	20.4	1	0.209	< 0.002	0.036
S99-01716	0.02	0.2	0.016	24.4	< 0.003	< 0.002	< 0.008				0.926	6.9	< 0.004	20	0.391	0.009	130	1.4	18.4	1.1	0.152	< 0.002	0.006
S99-01717	< 0.01	< 0.1	0.063	24.6	< 0.003	< 0.002	< 0.008	-9.7	-2.1	-10	1.49	3.3	0.007	14.1	0.094	< 0.003	36.9	0.2	34	< 0.2	0.166	< 0.002	0.044
S99-01718	0.04	0.3	0.133	148	< 0.003	< 0.002	< 0.008				7.62	15.9	0.018	102	2.58	0.004	507	0.4	18.6	0.4	0.902	< 0.002	0.025
S99-01719	0.04	0.3	0.126	131	< 0.003	< 0.002	< 0.008				2.62	19.1	0.018	118	2.14	0.01	605	0.5	15.8	0.3	0.949	< 0.002	0.011
S99-01720	0.02	0.1	0.018	37.5	< 0.003	< 0.002	< 0.008				0.546	6.6	0.007	28	0.644	< 0.003	89.9	0.2	21.3	13.5	0.191	< 0.002	0.006
S99-01721	0.02	< 0.1	0.018	35	< 0.003	< 0.002	< 0.008				0.71	6.7	0.008	34.9	0.899	< 0.003	20.2	0.1	25.6	11.4	0.183	< 0.002	0.006
S99-01722	0.02	< 0.1	0.015	27.7	< 0.003	< 0.002	< 0.008				1.33	5.4	< 0.004	27.2	1.28	< 0.003	18.5	0.2	21	6.5	0.132	< 0.002	0.035
S99-01723	0.01	< 0.1	0.024	23.7	< 0.003	< 0.002	< 0.008				2.59	7.8	0.011	20.9	2.04	< 0.003	9.9	< 0.1	28	10.6	0.103	< 0.002	0.014
S99-01724	0.02	< 0.1	0.016	32.8	< 0.003	< 0.002	< 0.008				1.24	8.4	0.004	30.6	1.77	< 0.003	15.6	0.2	26.8	2.1	0.172	< 0.002	0.013
S99-01725	< 0.01	0.3	0.006	10.6	< 0.003	< 0.002	< 0.008				0.282	7.7	< 0.004	9.71	0.193	0.006	147	1.1	19.8	7.3	0.0732	< 0.002	0.02
S99-01726	0.01	0.2	0.01	28	< 0.003	< 0.002	< 0.008				3.32	9.5	< 0.004	27.5	0.753	0.004	78.5	1.3	20.1	2	0.193	< 0.002	0.068
S99-01727	0.01	0.1	0.022	35.3	< 0.003	< 0.002	< 0.008				0.479	8.5	< 0.004	30.6	0.44	0.004	29	0.4	21.7	0.4	0.209	< 0.002	0.007
S99-01728	0.02	0.1	0.01	29.8	0.005	< 0.002	< 0.008				4.23	7.6	< 0.004	26.7	0.663	0.007	54.3	< 0.1	22.7	6.6	0.156	0.002	0.009
S99-01729	0.02	0.1	0.019	41.9	< 0.003	< 0.002	< 0.008				0.886	8.4	0.006	33.2	1.16	< 0.003	76.1	0.4	23.4	0.8	0.226	< 0.002	0.008
S99-01730	0.02	< 0.1	0.013	36.2	< 0.003	< 0.002	< 0.008				1.81	5.8	0.007	27.1	2.65	< 0.003	20.9	0.1	26.8	10.9	0.199	< 0.002	0.012
S99-01731	0.02	0.1	0.014	38.5	< 0.003	< 0.002	< 0.008				0.466	5.6	< 0.004	29	0.692	< 0.003	24	0.2	21.6	3.9	0.173	< 0.002	0.008
S99-01732	0.02	0.1	0.018	50.2	< 0.003	< 0.002	< 0.008				0.54	8.3	0.009	53.8	1.4	< 0.003	63	0.1	23.5	19	0.267	< 0.002	0.018
S99-01733	0.02	< 0.1	0.01	28.7	< 0.003	< 0.002	< 0.008				1.34	5.9	0.006	25.3	1.33	< 0.003	11.6	0.1	21.6	1.4	0.129	< 0.002	0.007
S99-01734	0.01	< 0.1	0.011	33.7	< 0.003	< 0.002	< 0.008				1.43	5.4	0.005	28.2	0.933	< 0.003	23.4	0.2	22.4	1.7	0.172	< 0.002	0.016
S99-01735	< 0.01	< 0.1	0.009	19	< 0.003	< 0.002	< 0.008				1.66	5	0.006	19.6	0.735	< 0.003	104	0.6	20.7	13.3	0.115	< 0.002	0.007
S99-01736	0.01	< 0.1	0.008	30.9	< 0.003	< 0.002	< 0.008				0.067	5.2	0.006	27.2	1.29	< 0.003	34.2	< 0.1	26.8	13.7	0.167	< 0.002	< 0.004
S99-01737	0.02	0.3	0.015	39.7	< 0.003	< 0.002	< 0.008				0.541	9.1	< 0.004	26.7	0.411	0.037	240	1	15.1	0.3	0.253	< 0.002	0.05
S99-01738	0.02	< 0.1	0.013	38.9	< 0.003	< 0.002	< 0.008				2.4	7.9	0.005	50.5	0.986	< 0.003	53.8	0.2	21.6	40.6	0.255	< 0.002	0.01
S99-01739	0.03	0.1	0.01	38.7	< 0.003	< 0.002	< 0.008				3.95	14.1	< 0.004	50.1	0.878	0.004	30.3	0.6	21.5	1.7	0.297	< 0.002	0.017
S99-01740	0.03	< 0.1	0.022	64	< 0.003	< 0.002	< 0.008				1.49	12.2	< 0.004	65.1	1.24	< 0.003	37.2	0.4	22.6	63.6	0.405	< 0.002	0.029
S99-01741	0.02	0.2	0.055	52.4	< 0.003	< 0.002	< 0.008				4.35	14.6	0.005	53.7	1.13	0.006	39.5	1.6	12.8	1	0.383	< 0.002	0.009
S99-01742	0.02	< 0.1	0.02	37.1	< 0.003	< 0.002	< 0.008				13.4	12.5	0.004	33.2	1.37	< 0.003	25.6	0.7	15.7	7	0.31	< 0.002	0.016
S99-01743	0.07	0.1	0.1	89.9	< 0.003	< 0.002	< 0.008				6.65	15.8	0.006	86.7	1.07	< 0.003	47.2	1.4	14.3	0.4	0.566	< 0.002	0.013
S99-01744	0.06	0.1	0.085	72.9	< 0.003	< 0.002	< 0.008				4.62	15.9	< 0.004	70.4	1.07	0.009	36.8	1.4	11.4	< 0.2	0.516	< 0.002	0.021
S99-01745	0.02	0.2	0.056	58.4	< 0.003	< 0.002	< 0.008				1.91	13.4	< 0.004	54.9	1.03	0.01	36	1.2	15.4	2.5	0.396	< 0.002	0.011
S99-01746	0.02	0.2	0.046	50.3	< 0.003	< 0.002	< 0.008				1.1	13.2	< 0.004	50.1	0.72	0.011	44.2	0.6	17.4	9.4	0.356	< 0.002	0.009
S99-01747	0.03	< 0.1	0.025	65.8	< 0.003	< 0.002	< 0.008				5.96	8.3	0.012	53.5	1.54	< 0.003	47.1	0.1	23.3	47.4	0.278	< 0.002	0.012
S99-01748	0.01	< 0.1	0.008	20.2	0.003	< 0.002	< 0.008				2.24	8.3	0.005	18.9	1.28	< 0.003	9.8	0.3	17.2	2.3	0.136	< 0.002	0.009
S99-01749	0.02	0.2	0.004	7.4	0.02	< 0.002	< 0.008				0.322	6.2	< 0.004	7.39	0.18	0.004	68.8	2.1	18.8	0.6	0.0576	< 0.002	0.022
S99-01750	0.05	< 0.1	0.01	30.1	< 0.003	< 0.002	< 0.008				1.44	2.7	0.005	25.9	0.915	< 0.003	21.2	< 0.1	19	13.8	0.115	< 0.002	0.019
S99-01751	0.04	< 0.1	0.009	24.5	< 0.003	< 0.002	< 0.008				0.672	6.4	0.006	24.8	1.09	< 0.003	13.6	0.1	24.9	0.4	0.145	< 0.002	0.015
S99-01752	0.02	< 0.1	0.011	35.5	< 0.003	< 0.002	< 0.008				0.35	7.6	0.004	33.9	0.888	< 0.003	15.7	0.1	20.3	3	0.193	< 0.002	0.014
S99-01753	0.02	< 0.1	0.005	25.2	< 0.003	< 0.002	0.011				0.238	7.8	< 0.004	27.1	0.538	< 0.003	18.8	0.3	21	8.4	0.142	< 0.002	0.016

SAMPLE ID	SAMPLE FIELD ID	SAMPLE DATE	LAT degree	LONG degree	YEAR CONST	WELL TYPE	DEPTH m	OWNER	DIVISION	DISTRICT	UPAZILA	UNION	GEOCODE	As arsenator ug/L	As lab ug/L
S99-01754	M548	24/11/1999	22.9339	90.908	1995	stw	7.9	Mohammad Hanif	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	61	70
S99-01755	M549	24/11/1999	22.9339	90.9081	1979	stw	8.5	Mohammad Lokman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	95	90
S99-01756	M550	24/11/1999	22.9346	90.9096	1995	stw	7.9	Md. Nazir Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	54	60
S99-01757	M551	25/11/1999	22.9328	90.9035	1994	stw	7.9	Main Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	70	60
S99-01758	M552	25/11/1999	22.9325	90.9025	1994	stw	7.9	Aminul Isalm	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	70	70
S99-01759	M553	25/11/1999	22.9316	90.9052	1996	stw	7.9	Sikkandar Ali	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	70	60
S99-01760	M554	25/11/1999	22.9312	90.9025	1997	stw	18.3	Md. Lokhman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	560	590
S99-01761	M555	25/11/1999	22.9296	90.9037	1999	stw	7.9	Nazir Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	106	130
S99-01762	M556	25/11/1999	22.9342	90.9048	1996	stw	7.9	Oazi Ullah Bhuiyan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	31	40
S99-01763	M557	25/11/1999	22.9327	90.9057	1965	stw	9.1	Mobaraque Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	46	40
S99-01764	M558	25/11/1999	22.9317	90.9088	1995	stw	7.9	Abdul Sattar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	59	60
S99-01765	M559	25/11/1999	22.9266	90.9085	1997	stw	7.9	Hassan Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	6.2	<30
S99-01766	M560	25/11/1999	22.9316	90.9093	1995	stw	7.9	Abdul Mannan	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	44	40
S99-01767	M561	25/11/1999	22.9319	90.9066	1970	stw	7.9	Siddik Ullah Master	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	73	90
S99-01768	M562	25/11/1999	22.9308	90.905	1995	stw	12.2	Mohammad Mostafa	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	52	50
S99-01769	M563	25/11/1999	22.932	90.908	1990	stw	7.9	Dudu Mian	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	63	50
S99-01770	M564	25/11/1999	22.912	90.9014	1995	stw	7.9	Momen Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	70	80
S99-01771	M565	25/11/1999	22.9134	90.8989	1994	stw	7.9	Mohammad Ali	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	58	50
S99-01772	M566	25/11/1999	22.9272	90.9029	1994	stw	9.1	Bhuiyan Hat	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	62	60
S99-01773	M567	26/11/1999	22.9121	90.8978	1984	stw	7.9	Md. Monsur Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	70	70
S99-01774	M568	26/11/1999	22.9162	90.8975	1984	stw	7.9	Mohsin Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	28	<30
S99-01775	M569	26/11/1999	22.9173	90.8964	1989	stw	7.9	Mokhter Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	228	220
S99-01776	M570	26/11/1999	22.9179	90.8943	1994	stw	7.9	Abdur Rauf	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	42	40
S99-01777	M571	26/11/1999	22.9204	90.8943	1994	stw	7.9	Md. Noor Nabi	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	41	40
S99-01778	M572	26/11/1999	22.9196	90.8975	1992	stw	9.1	Shafi Uddin Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	16	<30
S99-01779	M573	26/11/1999	22.9153	90.8962	1995	stw	7.9	Manik	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	35	40
S99-01780	M574	26/11/1999	22.9153	90.8946	1972	stw	12.2	Monsur Ahmed Kahn	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	243	270
S99-01781	M575	26/11/1999	22.9152	90.8927	1995	stw	7.9	Toshlim	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	79	80
S99-01782	M576	26/11/1999	22.9151	90.8908	1999	stw	7.3	Maolana Noor-Uz- Zaman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	22	<30
S99-01783	M577	26/11/1999	22.9195	90.8906	1992	stw	7.9	Master Bari Jame Mosque	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	81	80
S99-01784	M578	26/11/1999	22.9174	90.8895	1996	stw	7.9	Chand Mian	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	21	<30
S99-01785	M579	26/11/1999	22.9163	90.8914	1993	stw	7.9	Fazlur Rahman	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	62	60
S99-01786	M580	26/11/1999	22.9143	90.8978	1998	stw	7.9	Sultan Ahmed	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	106	110
S99-01787	M581	26/11/1999	22.9113	90.8966	1974	stw	12.2	Ruhul Amin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	29	30
S99-01788	M582	26/11/1999	22.9112	90.8966	1999	stw	11.3	Ali Akhbar	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	64	60
S99-01789	M583	26/11/1999	22.9143	90.9019	1993	stw	7.9	Mohammad Shah Alam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	49	40
S99-01790	M584	26/11/1999	22.9146	90.9013	1999	stw	13.7	Health And Family Welfare Centre	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	614	620
S99-01791	M585	27/11/1999	22.9148	90.9012		stw	0	Health And Family Welfare Centre	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	412	310
S99-01792	M586	27/11/1999	22.9142	90.9012	1996	stw	7.9	Abdul Matin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	65	100
S99-01793	M587	27/11/1999	22.9143	90.9004	1986	stw	7.9	Md. Abu Taher	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	91	60
S99-01794	M588	27/11/1999	22.9152	90.9015	1997	stw	9.1	Siddik Ullah	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	707	700
S99-01795	M589	27/11/1999	22.9146	90.903	1997	stw	7.9	Toshlim Uddin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	89	90
S99-01796	M590	27/11/1999	22.919	90.9027	1996	stw	7.9	Abul Kalam	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	61	60
S99-01797	M591	27/11/1999	22.9143	90.8997	1991	stw	7.9	Mohsin	Chittagong	Lakshmipur	Lakshmipur Sadar	Mandari	25143	54	70

SAMPLE ID	Al mg/L	B mg/L	Ba mg/L	Ca mg/L	Co mg/L	Cr mg/L	Cu mg/L	^{13}C ‰	^{18}O ‰	^{2}H ‰	Fe mg/L	K mg/L	Li mg/L	Mg mg/L	Mn mg/L	Mo mg/L	Na mg/L	P mg/L	Si mg/L	SO_4 mg/L	Sr mg/L	V mg/L	Zn mg/L
S99-01754	0.02	< 0.1	0.013	35.7	< 0.003	< 0.002	< 0.008				1.57	6	0.005	38.3	1.22	< 0.003	20.5	0.2	26.5	13.6	0.201	< 0.002	0.008
S99-01755	0.03	< 0.1	0.028	64.1	< 0.003	< 0.002	< 0.008				7.96	7.3	0.018	53.5	6.33	< 0.003	33.8	0.1	29.8	32.7	0.331	< 0.002	0.015
S99-01756	0.03	0.2	0.027	74.9	< 0.003	< 0.002	< 0.008				2.38	16.8	0.016	73.1	3.26	< 0.003	186	0.1	23.1	77	0.517	< 0.002	0.054
S99-01757	0.02	< 0.1	0.007	33.8	< 0.003	< 0.002	< 0.008				1.06	7.3	0.004	40.2	1.01	< 0.003	33.4	0.2	22.8	10.9	0.192	< 0.002	0.023
S99-01758	< 0.01	0.5	0.006	19.4	< 0.003	< 0.002	< 0.008				0.488	10.3	< 0.004	20.8	0.293	0.007	240	0.7	18.8	1.7	0.139	< 0.002	0.017
S99-01759	0.04	0.2	0.01	30.7	< 0.003	< 0.002	< 0.008				1	11.5	< 0.004	32.8	0.825	0.004	126	0.3	19.7	5.3	0.197	< 0.002	0.01
S99-01760	0.07	0.5	0.094	67.2	< 0.003	< 0.002	< 0.008				3.9	11.3	0.005	39.8	0.618	0.024	474	1.8	11.4	1.1	0.363	< 0.002	0.015
S99-01761	0.03	0.1	0.022	60.2	< 0.003	< 0.002	< 0.008				4.79	8.5	0.02	57.5	3.33	< 0.003	146	0.2	26	54.7	0.365	< 0.002	0.058
S99-01762	0.05	0.7	0.097	129	< 0.003	< 0.002	< 0.008				0.598	24.4	0.031	138	2.17	0.003	860	0.2	18.1	55.1	0.999	< 0.002	0.04
S99-01763	0.02	0.3	0.025	56.8	< 0.003	< 0.002	< 0.008				0.673	13.2	0.014	56.7	1.45	< 0.003	302	0.2	19.7	16.6	0.406	< 0.002	0.012
S99-01764	0.02	< 0.1	0.014	38.3	< 0.003	< 0.002	< 0.008				0.782	6.8	0.005	43.9	1.71	< 0.003	41	0.2	26.1	3.4	0.218	< 0.002	0.009
S99-01765	0.02	< 0.1	0.012	25.1	< 0.003	< 0.002	< 0.008				0.693	8.4	0.01	22.4	1.66	< 0.003	11.8	< 0.1	27	1	0.105	< 0.002	0.009
S99-01766	0.04	< 0.1	0.019	48.1	< 0.003	< 0.002	< 0.008				1.07	6.9	0.009	47.5	2.66	< 0.003	21.9	< 0.1	21.8	3.5	0.253	< 0.002	0.019
S99-01767	0.02	0.2	0.015	39.8	< 0.003	< 0.002	< 0.008				0.985	13.9	0.005	40	0.549	< 0.003	102	0.5	19.9	43.5	0.265	< 0.002	0.014
S99-01768	0.03	0.2	0.03	69.2	< 0.003	< 0.002	< 0.008				0.663	17.8	0.015	89.4	1.62	< 0.003	246	0.2	18.5	52.1	0.542	< 0.002	0.037
S99-01769	0.03	0.2	0.03	68.9	< 0.003	< 0.002	< 0.008				0.55	18.3	0.014	90.5	1.7	< 0.003	245	0.2	18.6	52.8	0.533	< 0.002	0.033
S99-01770	0.02	< 0.1	0.015	33.8	< 0.003	< 0.002	< 0.008				4.47	8.3	0.011	28.2	1.2	< 0.003	77.3	0.2	22.8	20	0.134	< 0.002	0.008
S99-01771	0.02	0.1	0.01	50.3	0.003	< 0.002	< 0.008				3.48	9	0.013	49.9	1.62	0.003	86.7	< 0.1	24.3	24.1	0.303	0.003	0.009
S99-01772	0.03	0.3	0.012	56.8	< 0.003	< 0.002	< 0.008				1.71	14.2	0.011	77.4	1.32	0.004	175	0.4	19.5	3.5	0.385	< 0.002	0.008
S99-01773	0.02	< 0.1	0.004	22.5	< 0.003	< 0.002	< 0.008				1.19	5.4	0.005	24.1	0.869	< 0.003	73.9	0.3	23.7	6.3	0.123	< 0.002	0.008
S99-01774	0.02	0.3	0.035	59.9	< 0.003	< 0.002	< 0.008				0.416	13.6	0.014	44.1	0.864	0.014	338	0.2	22	0.8	0.397	< 0.002	0.04
S99-01775	0.03	0.1	0.019	49.9	< 0.003	< 0.002	< 0.008				2.79	8.6	< 0.004	40.6	0.958	0.006	49.7	0.4	18.3	2.6	0.287	< 0.002	0.147
S99-01776	0.03	0.1	0.018	48.8	< 0.003	< 0.002	< 0.008				1.09	10.6	< 0.004	45.4	0.971	< 0.003	57.8	0.3	23.5	8.7	0.269	< 0.002	0.033
S99-01777	0.02	< 0.1	0.04	52.4	< 0.003	< 0.002	< 0.008				1.26	22.9	0.005	48.7	1.08	< 0.003	50.5	0.1	20.8	37.4	0.248	< 0.002	0.015
S99-01778	0.02	< 0.1	0.01	22.2	< 0.003	< 0.002	< 0.008				3.02	13.9	0.004	20.9	1.21	< 0.003	9.7	< 0.1	21.6	2.8	0.0861	< 0.002	0.022
S99-01779	0.02	< 0.1	0.018	39.8	< 0.003	< 0.002	< 0.008				0.598	8.1	0.005	46.1	1.17	< 0.003	49	0.1	26.2	11.5	0.258	< 0.002	0.009
S99-01780	0.03	< 0.1	0.027	57.7	< 0.003	< 0.002	< 0.008				6.04	7.7	< 0.004	29.9	1.04	0.004	24	1.1	17.4	0.3	0.254	< 0.002	0.02
S99-01781	0.01	0.1	0.018	40.3	< 0.003	< 0.002	< 0.008				0.97	12.8	0.004	44.2	0.473	0.004	15.4	0.7	22.1	0.4	0.239	< 0.002	0.008
S99-01782	0.01	< 0.1	0.005	26.4	< 0.003	< 0.002	< 0.008				0.198	4.9	< 0.004	25.4	0.506	< 0.003	14	0.3	24	0.3	0.131	< 0.002	0.049
S99-01783	0.02	< 0.1	0.011	32.7	< 0.003	< 0.002	< 0.008				3.15	4.3	< 0.004	26.3	1.34	< 0.003	16.5	0.3	22.2	2.5	0.149	< 0.002	0.018
S99-01784	0.02	0.1	0.016	54.9	< 0.003	< 0.002	< 0.008				0.228	6.9	0.004	39.4	0.796	< 0.003	41	0.2	22.1	4.3	0.262	< 0.002	0.021
S99-01785	0.03	< 0.1	0.016	52.5	< 0.003	< 0.002	< 0.008				2.2	7	< 0.004	25.6	0.62	0.006	17.3	0.7	19.6	0.4	0.227	< 0.002	0.012
S99-01786	0.02	< 0.1	0.012	57.9	< 0.003	< 0.002	< 0.008				1.44	9.8	0.006	41.4	2.16	< 0.003	17.5	0.1	21.9	0.5	0.285	< 0.002	0.01
S99-01787	0.02	< 0.1	0.005	36.3	< 0.003	< 0.002	< 0.008				0.13	7.9	< 0.004	33.5	0.503	< 0.003	21.9	0.2	19.6	< 0.2	0.192	< 0.002	0.029
S99-01788	0.02	0.1	0.008	38.3	< 0.003	< 0.002	< 0.008				0.314	9.3	< 0.004	32.3	0.651	0.005	56	0.3	19.3	0.4	0.213	< 0.002	0.048
S99-01789	0.01	0.3	0.014	38.1	< 0.003	< 0.002	< 0.008				0.27	8	0.01	25.7	0.429	0.003	318	0.4	19	5.6	0.222	< 0.002	0.044
S99-01790	0.09	0.4	0.145	111	< 0.003	< 0.002	< 0.008				9.97	18.3	0.012	103	0.59	0.013	678	1.2	11.4	0.2	0.882	< 0.002	0.021
S99-01791	0.07	0.4	0.082	92.5	< 0.003	< 0.002	< 0.008				0.435	17.9	0.013	90.1	0.42	0.014	625	< 0.1	10.2	0.5	0.697	< 0.002	1.01
S99-01792	0.02	0.1	0.011	44.9	< 0.003	< 0.002	< 0.008				0.378	7.7	0.009	39.6	0.774	0.005	114	0.7	20.8	1	0.251	< 0.002	0.06
S99-01793	0.03	0.1	0.02	70.4	< 0.003	< 0.002	< 0.008				0.92	9.9	0.009	49	1.18	0.005	81.5	0.4	24.6	3.2	0.377	< 0.002	0.04
S99-01794	0.04	0.7	0.734	184	< 0.003	< 0.002	< 0.008				19.1	29.3	0.025	192	0.416	< 0.003	1320	1.2	13	0.8	1.58	< 0.002	0.031
S99-01795	0.02	0.3	0.026	51	< 0.003	< 0.002	< 0.008				1.42	8.6	0.01	32.1	0.578	0.003	267	0.4	19	2	0.268	< 0.002	0.013
S99-01796	0.02	0.4	0.032	36.1	< 0.003	< 0.002	< 0.008				0.57	12.2	0.009	30.6	0.502	0.004	252	0.3	19.2	13.8	0.233	< 0.002	0.009
S99-01797	0.01	< 0.1	0.006	25.4	< 0.003	< 0.002	< 0.008				0.558	6.5	< 0.004	24.1	0.367	0.005	107	0.4	19.3	0.6	0.147	< 0.002	0.057

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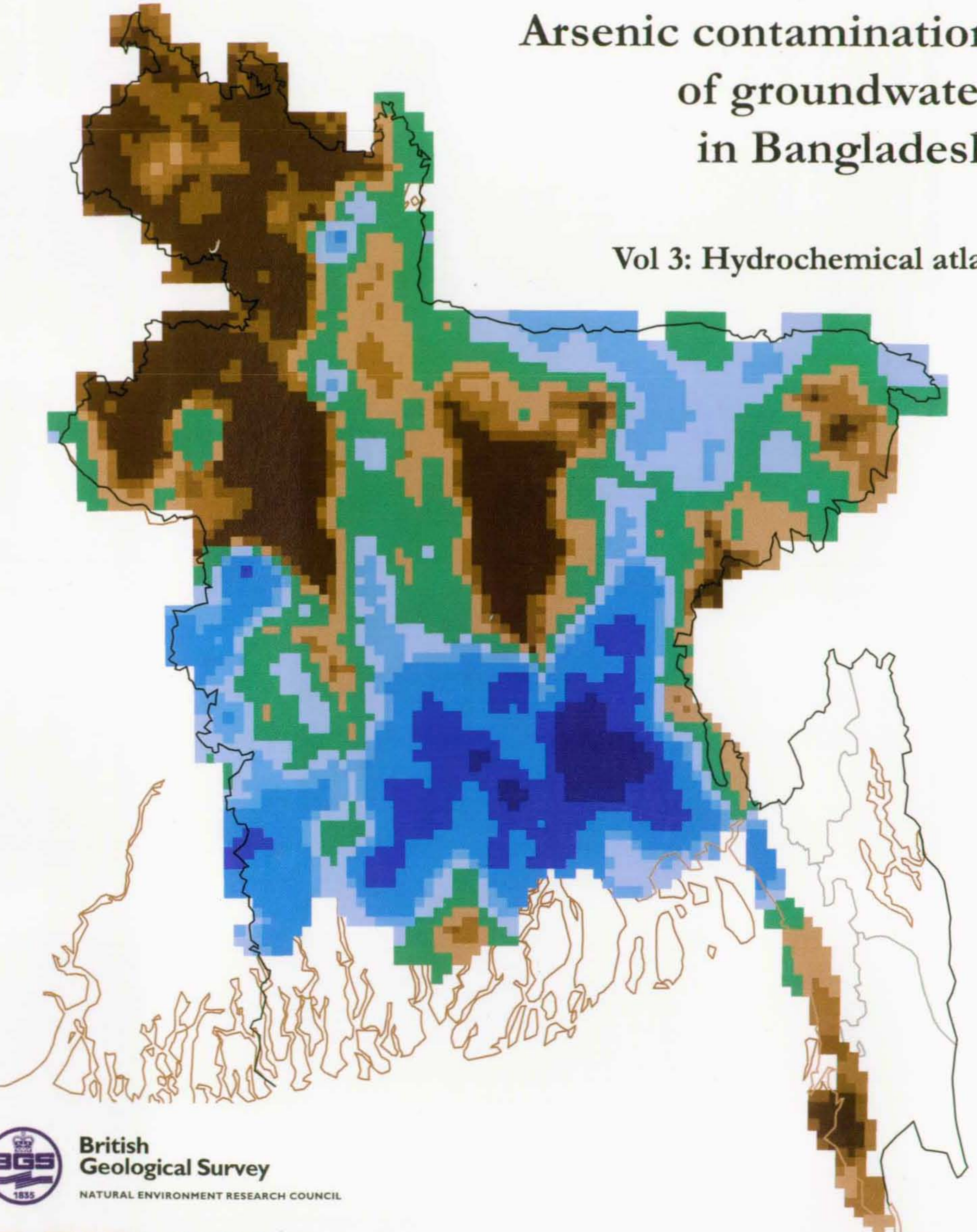
Arsenic contamination of groundwater in Bangladesh

Vol 3: Hydrochemical atlas



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Vol 3: Hydrochemical atlas

D G Kinniburgh and P L Smedley (Editors)

February 2001

The full report comprises four volumes:

Volume 1. Summary
Volume 2. Final report
Volume 3. Hydrochemical atlas
Volume 4. Data compilation

Further information can also be viewed and downloaded from our website at www.bgs.ac.uk/arsenic/Bangladesh

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Cover Illustration
Map of Bangladesh showing the regional distribution of arsenic in groundwater found during the National Hydrochemical Survey

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1 The National Hydrochemical Survey

The DPHE/BGS National Hydrochemical Survey (NHS) was carried out in two phases during March-June 1998 and May-July 1999, principally to investigate the distribution of arsenic in Bangladesh groundwaters. However, advantage was taken of the effort involved in sample collection to also assess the distributions of other related or otherwise diagnostic constituents of Bangladesh groundwaters. The survey involved the collection of 3534 groundwater samples from tubewells in 61out of the 64 districts of Bangladesh and 433 of the 496 *upazilas*. The three districts excluded belonged to the Chittagong Hill Tracts. This resulted in a sample density of around 8 samples per *upazila* on average, or approximately one sample per 37 km^2.

The sampled wells are only a very small proportion, approximately 0.05–0.1%, of the total number of wells. Nonetheless, every effort was made to sample the wells as randomly as possible given various practical constraints. Specifically sample selection was made without prior knowledge of arsenic concentrations. Most wells sampled were Government-drilled (DPHE) wells since it was relatively easy to determine details of their age, depth and construction. They were thought to be similar in construction to the more abundant private wells. This was a critical consideration in choosing the sampling strategy adopted by the survey. Discussion of the sampling strategy, sample collection and analysis is given in more detail in the *National Hydrochemical Survey* chapter of the Main Report.

Maps of the various parameters measured are given in the following pages. When plotting the maps, class boundaries for most parameters were based on rounded quartile values, i.e. each class interval contained approximately the same number of wells. This enabled any overall pattern to be clearly seen irrespective of the absolute range of values. The actual percentage of wells in each class interval is given by the histograms seen in the insets to the NHS maps. However, some of the health-related elements (arsenic, manganese, barium, boron, fluoride, iodide) are also divided according to WHO guideline values, Bangladesh standard values or otherwise useful class boundaries. The class intervals used in the BWDB maps were the same as for the NHS maps. The Mandari village maps were based on rounded quartile values for this area rather than the NHS values. In the case of well depth, class boundaries are on the basis of rounded quartiles, except that the deepest quartile has been further subdivided into ≤150 m and >150 m categories. Each parameter includes a map, statistical summary, histograms, a variogram and discussion. Discussion of the distributions in many cases uses the physiographic classification of Bangladesh given by Alam et al. (1990).

The atlas also includes maps of groundwater chemistry from the survey of the 113 sites sampled from the BWDB Water-Quality Monitoring Network as well as from more detailed investigations in the project's three Special Study Areas. These surveys include a more comprehensive set of chemical constituents than was possible in the National Survey.

The appearance of maps depends strongly not only on the underlying data but also on various subjective decisions made in preparing the maps: the extent of data smoothing, if any; the colours chosen and the way that these are interpreted by the display device (printer or monitor); the number of class intervals used; the symbols used, if any, their size and the order in which the symbols are printed. The order of printing may affect the appearance of the map where there is overlap of the symbols. In most of the point source maps given here, the number of classes was limited to four since it is often only possible to display at most four distinctive colours without fear of confusion. The lowest concentration class symbols were plotted first, then the next higher class, and so on, finishing with the highest concentration class. This means that, if anything, the maps will tend to overemphasise the importance of the higher classes since these class symbols will be plotted on top of any overlapping lower class symbols. In general, this effect is not large but care has to be taken when interpreting clusters of points in the NHS maps.

All of the 3534 samples from the NHS were analysed for arsenic and all but four were also analysed for a wide range of other major and minor elements. Most of these elements were determined by ICP-AES in the BGS laboratories. Arsenic was determined by either ICP-AES with hydride generation or more usually by AFS with hydride generation. Results from both methods were in good agreement. Filtered (0.22 μm) samples were always used. A range of trace elements, which is shown in the Special Study Areas and BWDB maps, was determined by ICP-MS. Chloride, nitrate, alkalinity, nitrite, ammonium, fluoride, bromide and iodide are also given in the Special Study Areas maps, and chloride, fluoride and iodide in the BWDB Water-Quality Monitoring Network maps. These were measured by automated colorimetry in the BGS laboratories (some bromide analyses were carried out by ion chromatography). Further details of sampling and analytical methods are given in Chapter 7 of the Main Report. Only elements substantially above detection limits have been included.

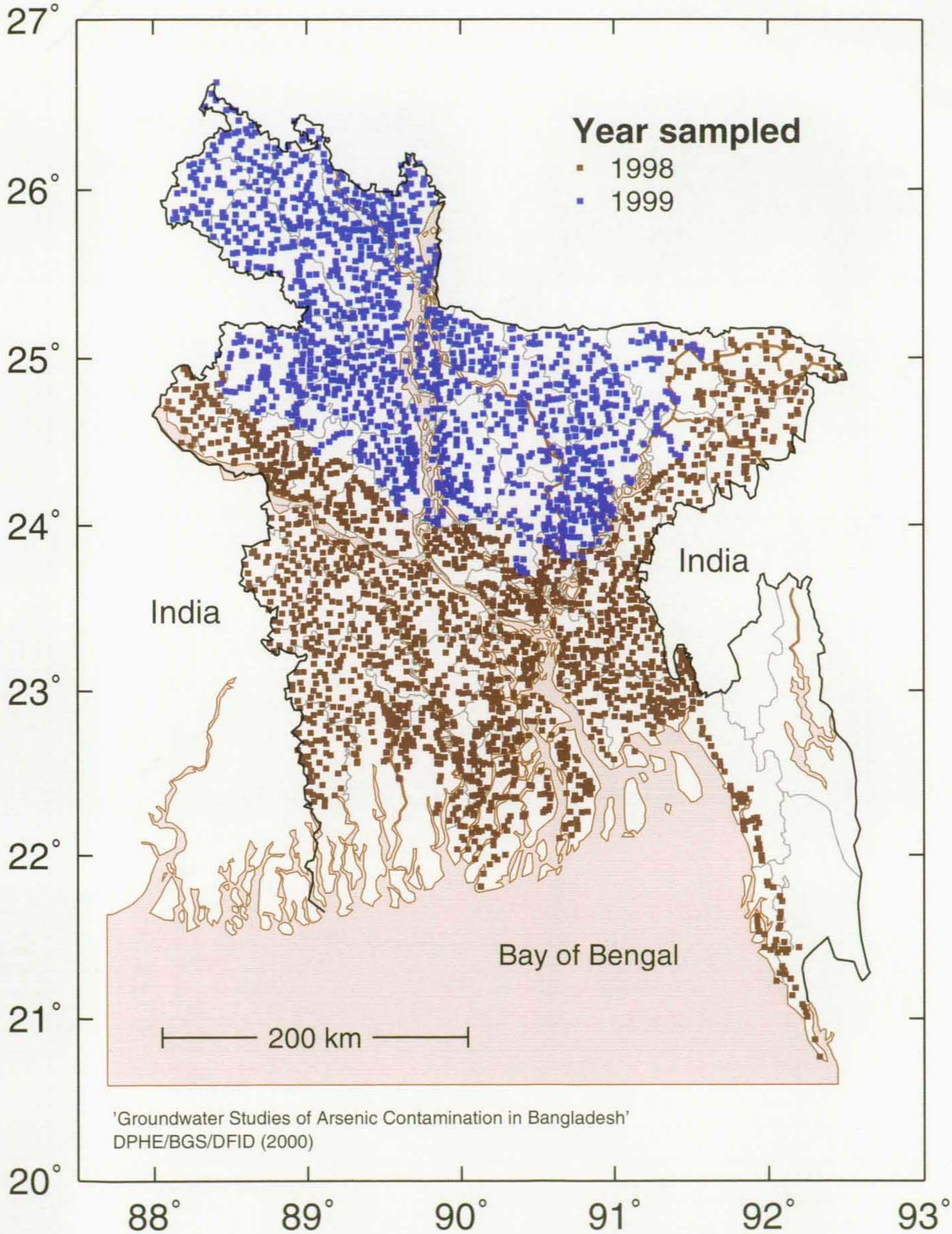
Gif and pdf images of the maps, as well as the underlying data files, can be downloaded from the BGS website at www.bgs.ac.uk/arsenic/Bangladesh. A fuller discussion of the maps and their significance is given in the appropriate chapters of the main report.

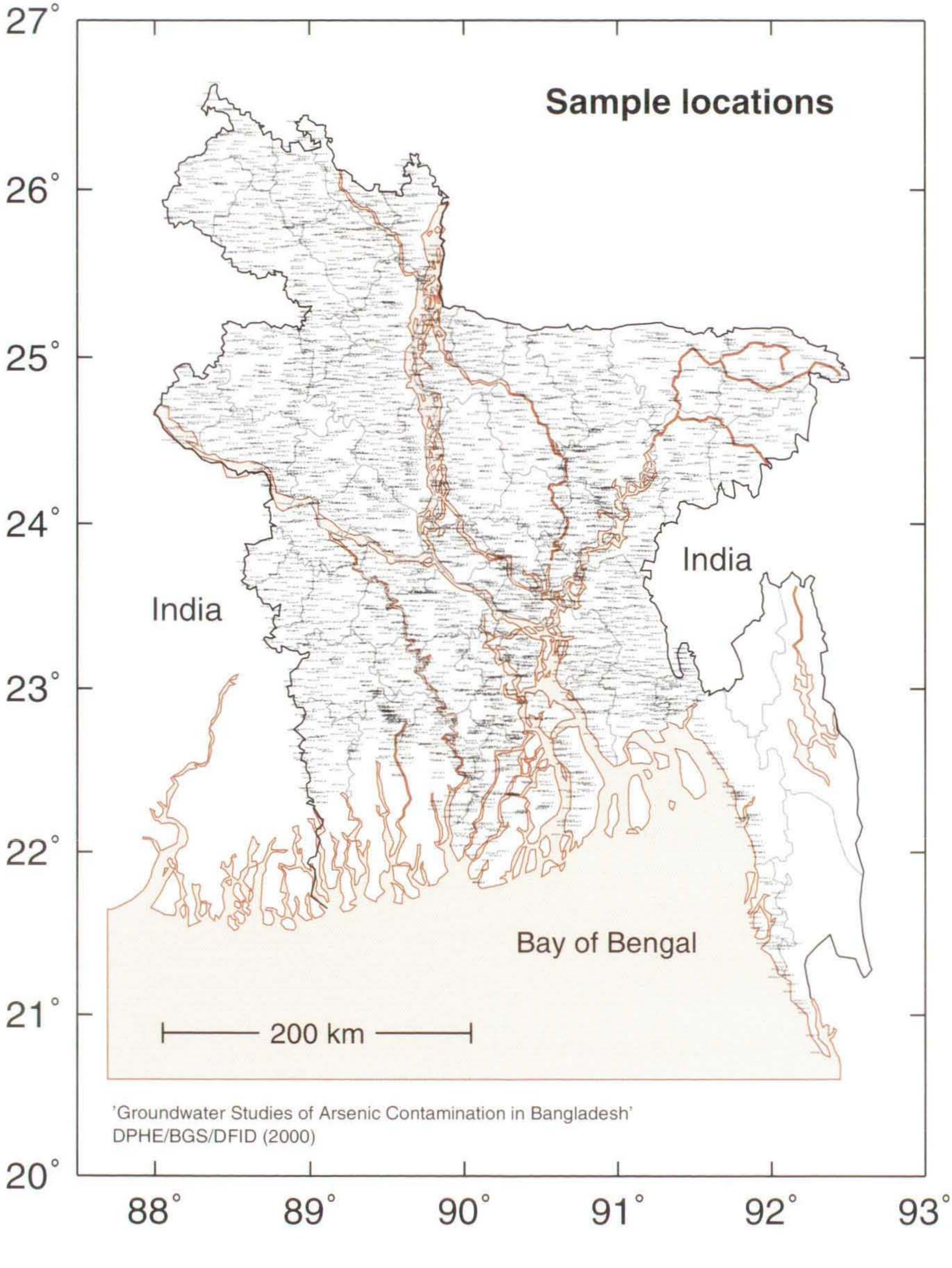
SAMPLES

The survey was carried out in two phases: the first phase (March–June 1998) covered what were at the time believed to be the worst-affected southern and eastern districts of Bangladesh while the second phase (May–July 1999) completed the remainder of Bangladesh apart from the three districts of the Chittagong Hill Tracts (CHT)). Sample locations for the National Hydrochemical Survey are given in Sample location map. At the printed scale, the text in this map is too small to read but the field sample numbers (e.g. RIP1234) can be read by zooming in on the pdf file.

The CHTs were excluded from this national survey because at the time of initiating this survey, the predominantly older sediments of the CHTs were not thought to give rise to high arsenic groundwaters. This is still believed to be the case. Groundwater is used less in the CHTs and existing wells are relatively sparse and often remote and difficult to access. Including the CHTs during the Rapid Investigation Phase would have detracted from what were known to be areas of higher priority elsewhere. We were also aware that our chosen sample density for the main survey was in any case low in relation to the likely scales of variation.

The basic sampling strategy was based on a stratified random approach in which the stratification was by area. The aim was to sample the survey area as uniformally spatially as feasible, and within each strata (approximately 1/9 of a *upazila*) to select a well randomly. In the event some areas were more sparsely sampled than others, mainly due to poor site accessibility (lack of roads, flooded areas). Site accessibility was a particular problem in the Sundarbans area of the south west and in the flooded *haor* regions of the Sylhet and Atrai Basins. Lack of available wells was also a factor in the Madhupur Tract.


Year sampled
1998
1999
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)


Sample locations
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

GEOLOGY

For each groundwater sample collected, the equivalent surface geological unit is given in the accompanying map. Data and standard abbreviations are taken from the 1:1,000,000 geological map of Bangladesh (Alam et al., 1990) and from digitised maps prepared by EGIS. It is important to note that the map indicates the geology at the surface and not at the depth of the aquifer from which the groundwaters were abstracted. With increasing well depth these are likely to be less related. However, many of the chemical features of the Bangladesh groundwaters do show some spatial correlation with the surface geology and so this is retained as a potentially useful attribute. The classification was carried out automatically using the recorded GPS reading and the digitised geological database. There may therefore be some misclassification close to geological boundaries or where the resolution of the map was insufficient to capture the true field variation.

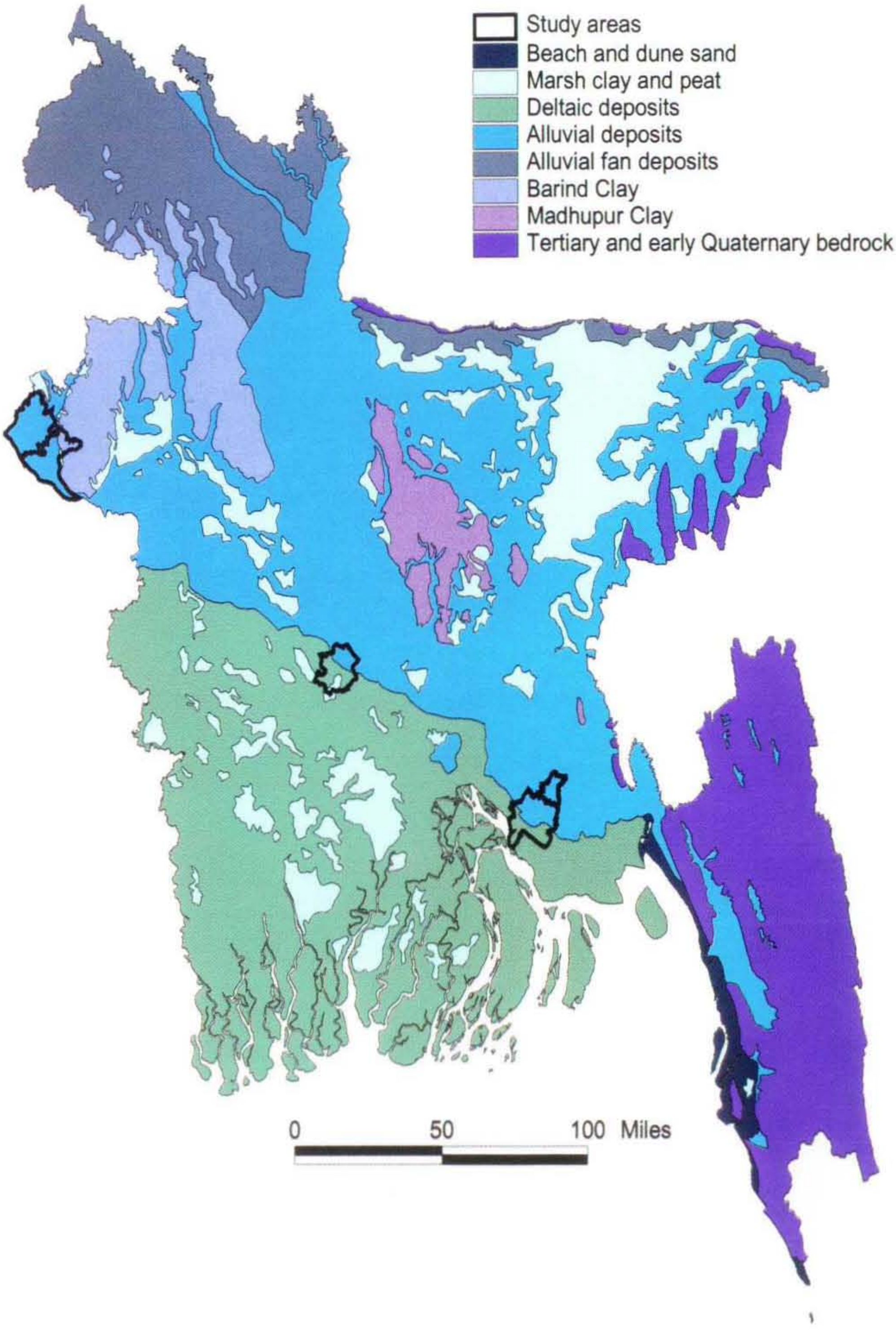
A simplified geological map of Bangladesh is shown below. The geology is dominated by the delta environment which defines the borders of Bangladesh. The major features are the recent (Holocene age) deltaic sediments in southern Bangladesh, the alluvial sediments of central Bangladesh (also Holocene) and older Pleistocene sediments of the uplifted Barind and Madhupur Tracts.

For each groundwater sample collected, the equivalent surface geological unit at that site was allocated by GIS using a digitized form of the geological map. The distribution of geological units sites is given in the map. Data and standard abbreviations (Table 1.1) are taken from the 1:1,000,000 geological map of Bangladesh (Alam et al., 1990) and from digitised maps by EGIS. It is important to note that the map indicates the geology at surface and not at the depth of the aquifer from which the groundwaters were abstracted. With increasing well depth these are likely to be less related. However, many of the chemical features of the Bangladesh groundwaters do show some spatial relationship with the surface geology.

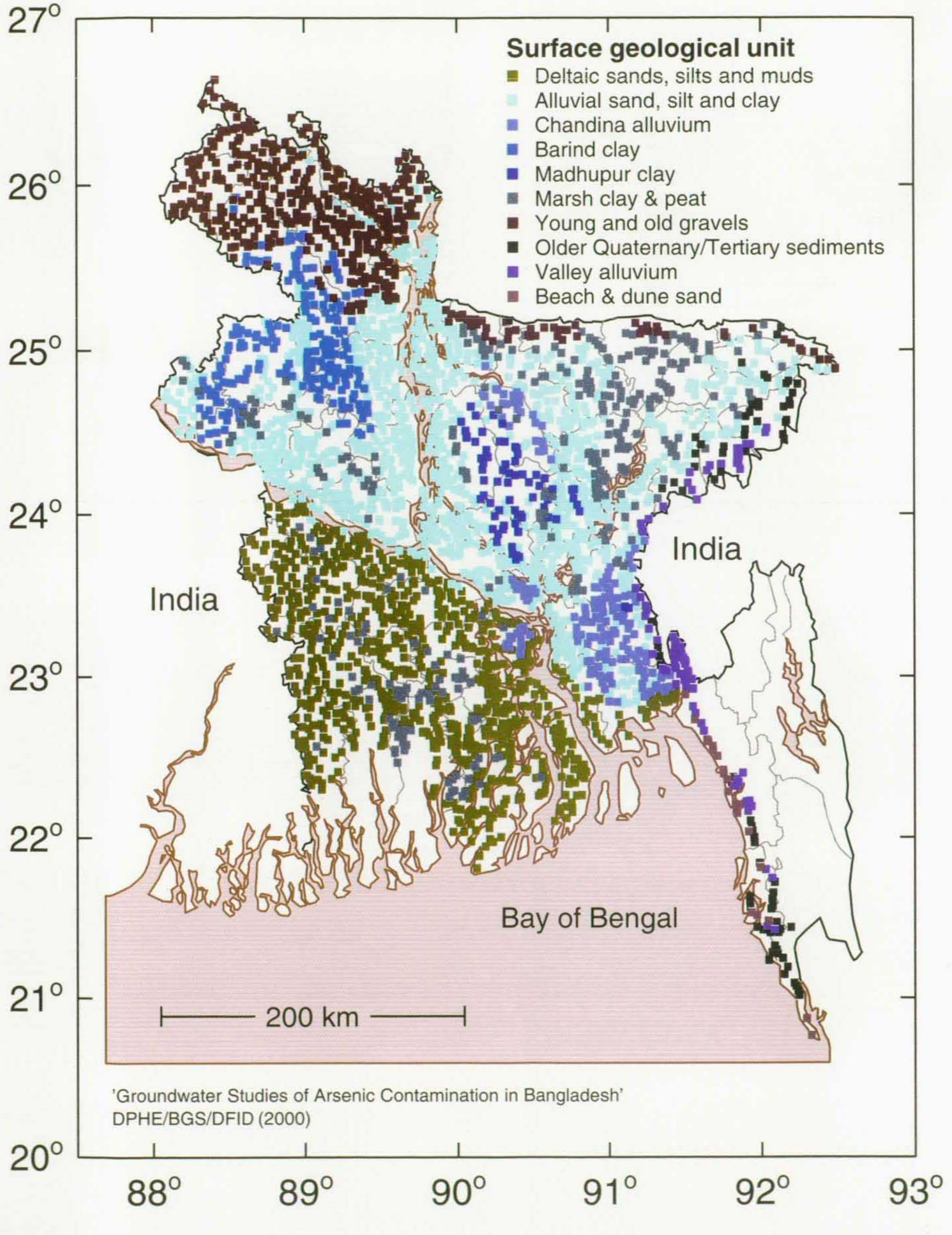
Table 1.1. Abbreviations used for defining geological formations based on the Bangladesh geological map

Unit	Description
asl	Alluvial silt and loam
asc	Alluvial silt and clay
dsl	Deltaic silt and loam
dt	Tidal deltaic deposits
ppc	Marsh clay and peat
afy	Young gravelly sand
ac	Chandina alluvium
asd	Alluvial sand
afo	Old gravelly sand
ava	Valley alluvium & colluvium
rm	Madhupur clay residuum
rb	Barind clay residuum
de	Estuarine deposits
dsd	Deltaic sand
QTdd/QTdt/Tt	Dihing & Dupi Tila undiv./Dupi Tila Formation/Tipam Sandstone Formation

Bangladesh - simplified geology



After Alam et al. (1990)

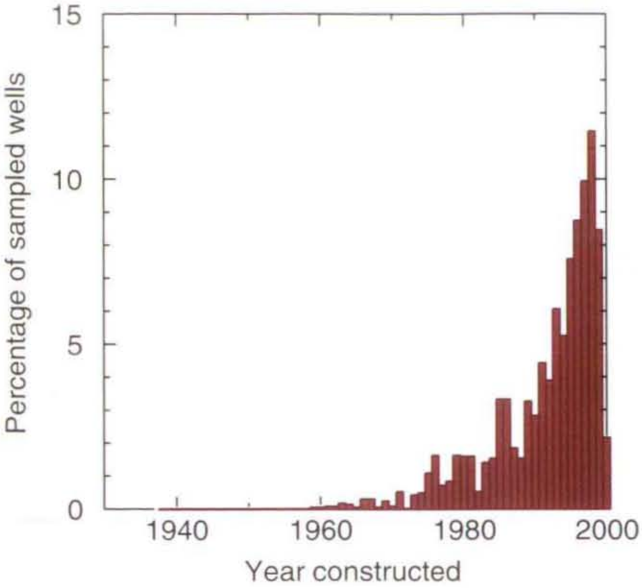

Surface geological unit
Deltaic sands, silts and muds
Alluvial sand, silt and clay
Chandina alluvium
Barind clay
Madhupur clay
Marsh clay & peat
Young and old gravels
Older Quaternary/Tertiary sediments
Valley alluvium
Beach & dune sand
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

AGE OF WELL

The oldest well sampled was constructed in 1937 and the most recent in 1999, the year of the second phase of the sampling. Construction of tubewells did not start in earnest until the 1970s and then expanded at an exponential rate.

The histogram opposite illustrates the considerable growth in the number of installed tubewells in recent years. 41% of the sampled wells have been installed since 1995 and 68% (two thirds) since 1990. About half of the wells have been constructed in 1993 or more recently and two thirds since 1990. This points to the significant expansion in the installation of tubewells by DPHE in recent years. Most of the tubewells sampled during the National survey were DPHE-constructed wells but there has also been a parallel increase in the number of private tubewells. The total number of wells in Bangladesh is not known with certainty but is believed to be somewhere in the region of 6–11 million, mostly private wells. DPHE are believed to have installed approximately 1.3 million wells.

There are regional variations in the age distribution with the greatest percentage of 'old' (pre-1980) wells sampled in the Khulna area and the smallest percentage in the Rajshahi area and north-western Bangladesh.

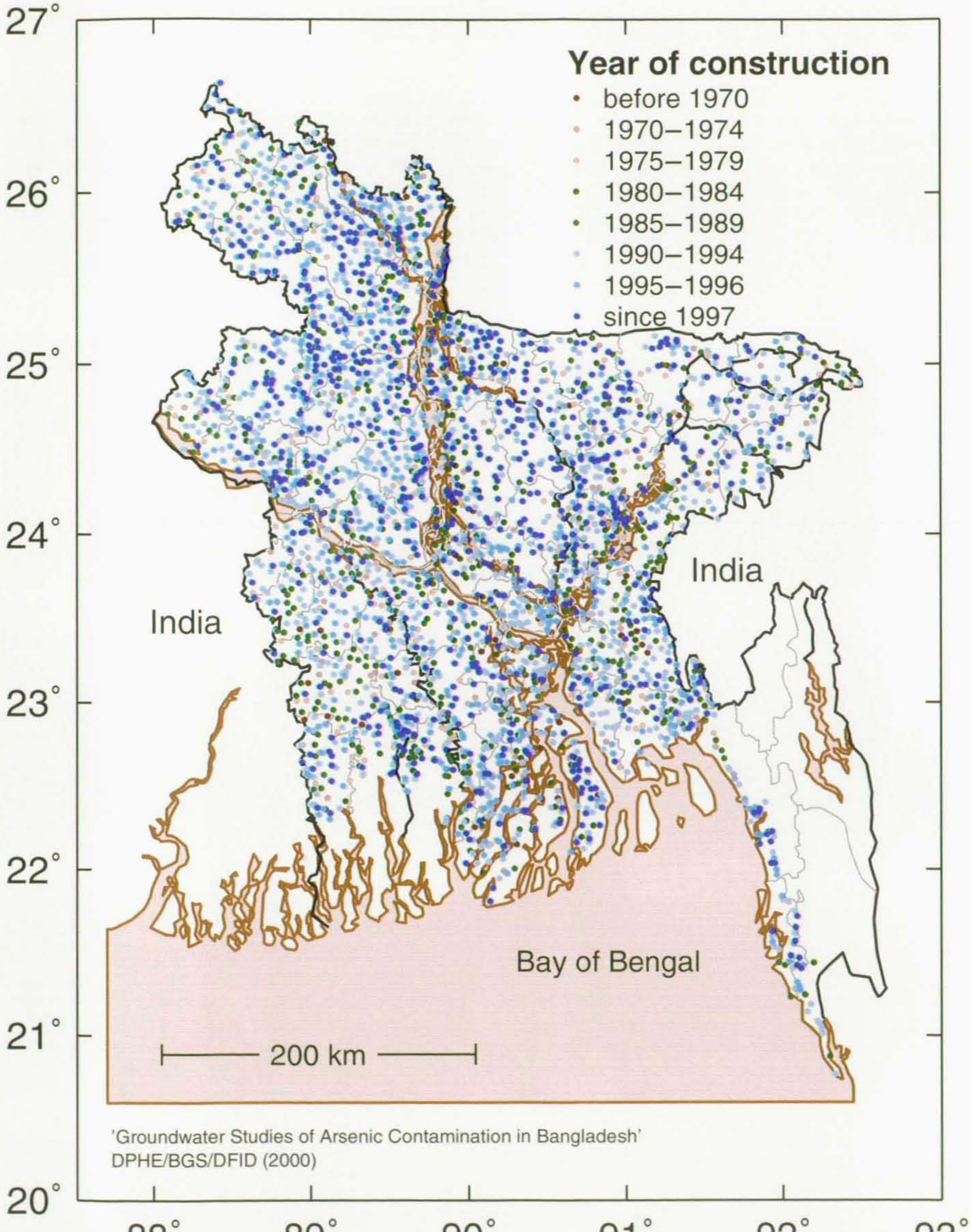


Age distribution of sampled wells.

WELL DEPTH

Sampled wells in the National Hydrochemical Survey had a very large range of depths – these ranged from 7 m to 362 m. Sampled well depths also show a large spatial variability, but some distinct geographical patterns exist (Table 1.4). The shallowest groundwaters (<22 m) are mainly concentrated in the Tista Fan area of northern Bangladesh, the Jamuna (Brahmaputra) valley, the eastern part of the Barind Tract and in coastal areas of the south-east and south-west. In the coastal areas, groundwater is either abstracted from very shallow levels or very deep levels (>150 m) as a result of high salinity at intermediate depths. Deep groundwaters are also found in the north-eastern parts of Bangladesh as a result of lack of availability of good aquifers (sands) at shallower levels.

As drilling and well completion is usually restricted to the shallowest levels at which water is struck, the well depth map indicates the minimum depth at which acceptable quantities (or in the case of salinity, quality) of groundwater can be found.



Year of construction
before 1970
1970–1974
1975–1979
1980–1984
1985–1989
1990–1994
1995–1996
since 1997
India
India
Bay of Bengal
200 km
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

ARSENIC

The point-source maps for arsenic show the distributions based on both rounded quartiles and on health criteria, including the WHO guideline value of 10 $\mu g\ L^{-1}$ and the Bangladesh standard for arsenic of 50 $\mu g\ L^{-1}$. The maps include groundwaters from both the shallow (≤150 m depth) and deep (>150 m) aquifers. The rounded quartile map is also displayed in terms of a gray scale. A high resolution and detailed map of the arsenic point source data is also given. This map can be downloaded from the BGS website and is best printed at A2 portrait size (42.0 cm x 59.4 cm) using a colour printer.

The maps indicate the large spatial variability in arsenic concentrations. Concentrations range between <0.25 $\mu g\ L^{-1}$ and 1660 $\mu g\ L^{-1}$ with an overall median value in the shallow groundwaters of 6 $\mu g\ L^{-1}$ and in the deep groundwaters of about 1 $\mu g\ L^{-1}$. Considering the shallow groundwaters only, 47% exceed the WHO guideline value and 27% exceed the Bangladesh standard. Only 3 out of the 327 deep wells sampled (1%) exceed 50 $\mu g\ L^{-1}$.

Despite the variability, some distinct regional patterns exist. These patterns are best revealed by smoothing the point source data. We did this using a technique called disjunctive kriging after transforming the data with Hermite polynomials (for details, see the *Scales of variation* chapter in the main report). Other smoothing techniques would give broadly similar patterns. The maps) show distinct regional trends with a clear geological control. Low arsenic concentrations tend to be found in the older sediments.

However, given the very high degree of village-scale spatial variability observed, care has to be taken when interpreting this smoothed map. There will be wells within 'low' arsenic (blue) areas that are high in arsenic and wells within 'high' arsenic (red) areas that are low in arsenic. The map shows average concentrations that reflect regional patterns but it does not give any indication of the variability of individual wells around these average values. Normally, one of the advantages of kriging is that it is possible to produce a map of the associated variances (or errors) associated with a kriged map. However, because of the high censoring of the data at low concentrations, we were not confident enough of these variances to present them here.

The greatest proportion of high-arsenic wells (and the highest average arsenic concentrations) are in the south-east of Bangladesh, to the south of Dhaka. High concentrations are also found in the groundwaters of the Jamuna Valley and with patchy high values in the south-west and the north-east (Sylhet Basin). Sporadic highs ('hot spots') are also found in other areas. One such hot spot is that of Chapai Nawabganj in the extreme west and is described more fully in the Main Report, Chapter Special Study Areas.

Despite the considerable variability, the patterns of arsenic distribution often show a good relationship with surface geology. Low concentrations are picked out well in the older Pleistocene plateaux of the Barind and Madhupur Tracts. This reflects the older age of the Dupi Tila aquifer from which these groundwaters are abstracted, having a longer history of groundwater flow and flushing. Low concentrations are also found in the deep groundwaters from the southern coastal area (Barisal). During past Quaternary glacial intervals, relative sea levels would have been much lower than at present (around 120 m at ca. 21 ka BP). This would have involved greater groundwater hydraulic gradients, lower river base levels and hence much active groundwater flow and flushing, as well as longer history of sediment diagenesis. Sediment age, groundwater flow history and amounts of flushing are considered to be major factors in determining the arsenic concentrations in the Bangladesh aquifers.

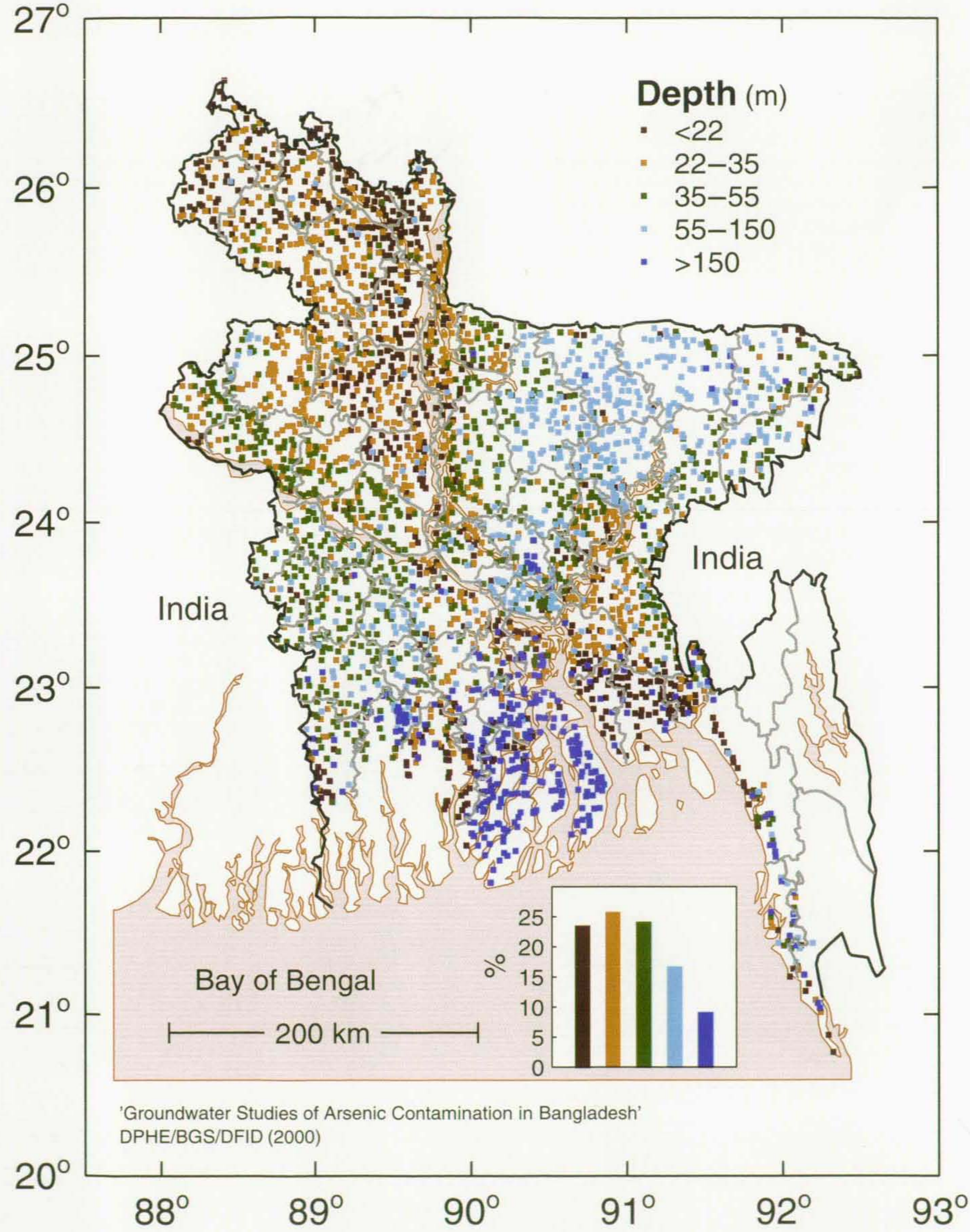
The highest arsenic concentrations and the greatest proportion of high-arsenic wells are in the Holocene alluvial and deltaic sediments. The overall worst-affected area in the south-east generally correlates with the low-lying (distal) part of the Bengal delta, where sediments are on average more fine-grained than further upstream and groundwater flow rates are likely to be slowest. The groundwaters in the worst-affected area are strongly reducing and show evidence of sulphate reduction. Some contain methane.

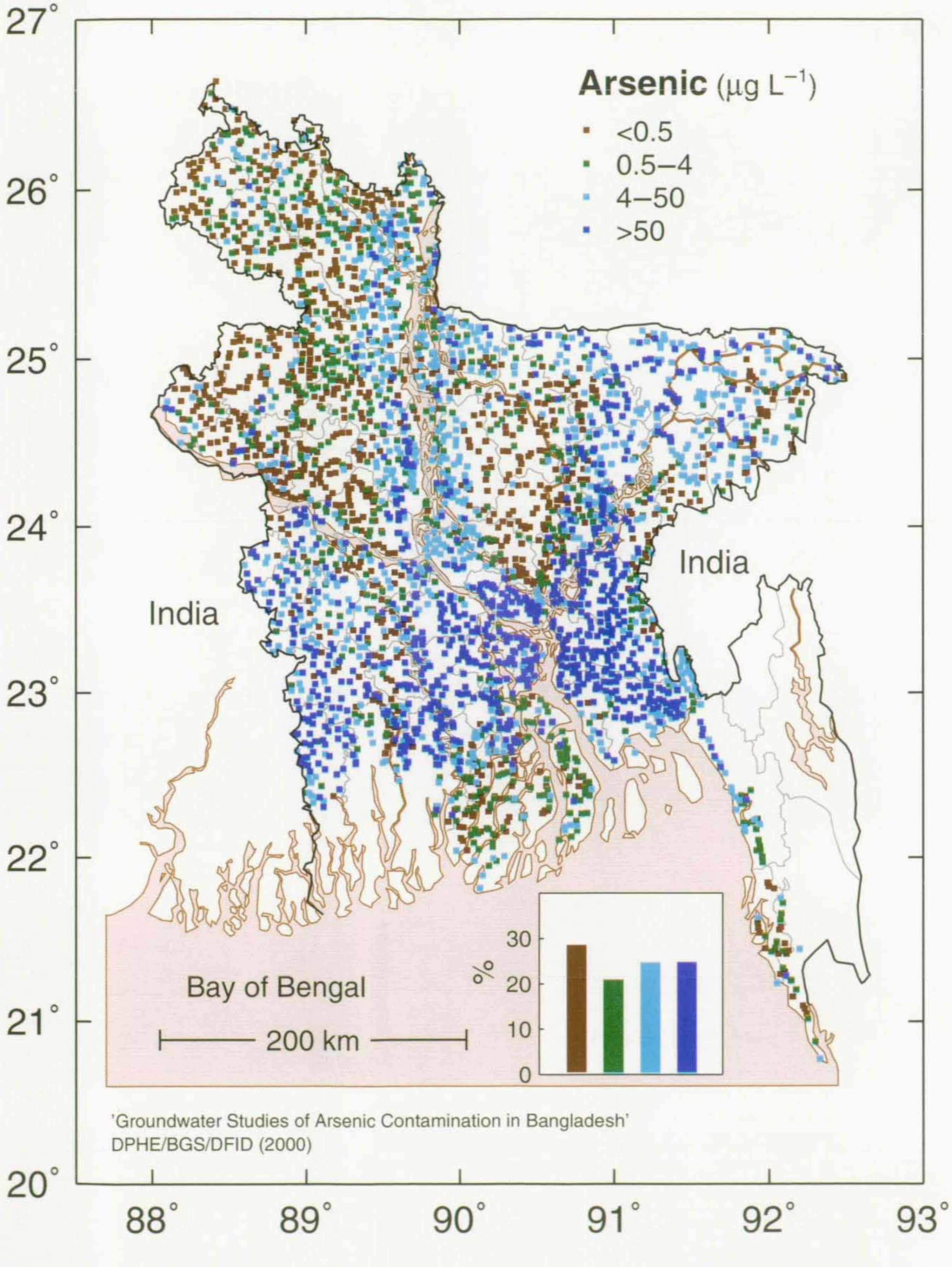
High arsenic concentrations are also found in some groundwaters from the Holocene sediments of the Jamuna Valley. These are also reducing groundwaters, although they appear to be more oxidising than the high-arsenic groundwaters further south. Groundwaters from this area have some of the highest concentrations of iron in Bangladesh (up to 48 $mg\ L^{-1}$ and often >10 $mg\ L^{-1}$) and manganese (up to 10 $mg\ L^{-1}$) and higher overall sulphate concentrations (see maps) than the high-arsenic groundwaters further south. It is thought that these sediments are undergoing reduction but have reached less advanced stages than those further south. This may be for a number of reasons, including less abundant impermeable material (silt/clay) at surface, shallow tubewells and deeper water levels (greater thickness of unsaturated zone) and perhaps more active groundwater flow.

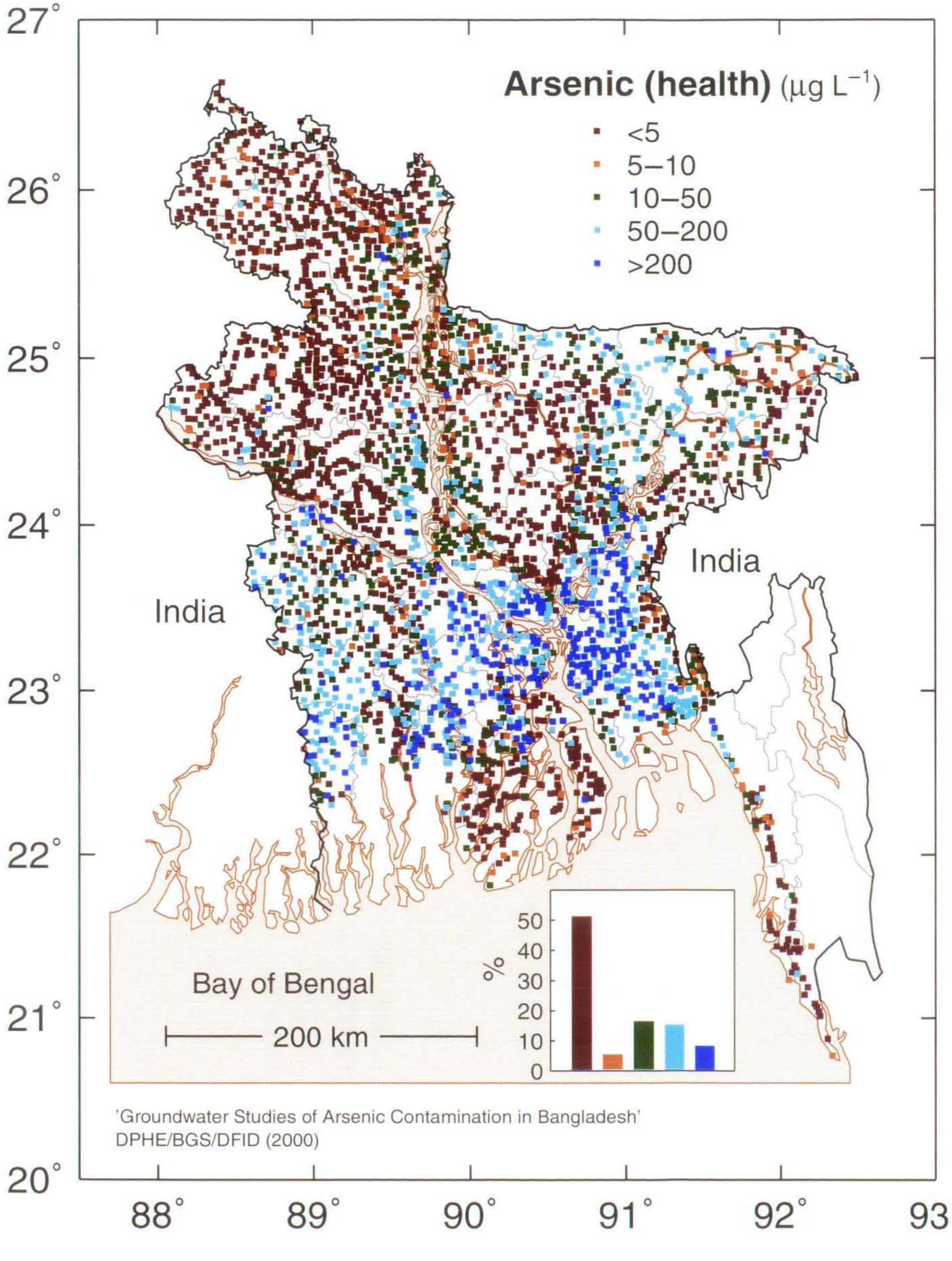
However, the high-arsenic groundwaters in the Jamuna Valley have mostly very low sulphate concentrations (typically 1 $mg\ L^{-1}$ or less) and are hence more strongly reducing. It is possible that the high-sulphate wells from the Jamuna Valley result from some sulphide oxidation, although if this is happening, it is not associated with arsenic mobilisation. The general association of high arsenic concentrations with low sulphate in the Jamuna Valley, as elsewhere in Bangladesh, precludes the process of sulphide oxidation as the major cause of arsenic release.

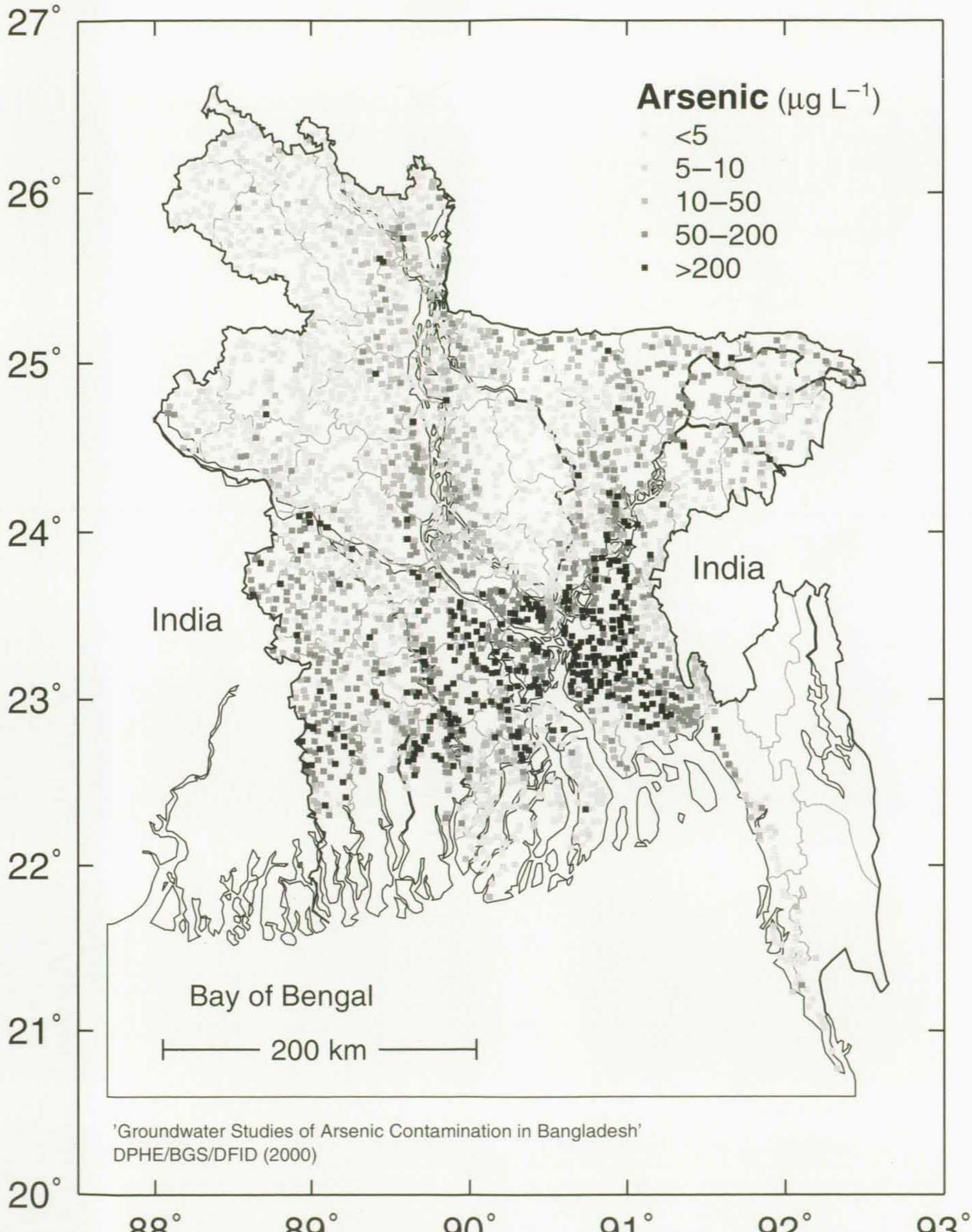
Low overall concentrations of arsenic are found in northern Bangladesh in the Tista Fan sediments. These are more coarse grained than the sediments in the distal parts of the delta, lack an overlying impermeable layer, groundwaters are shallow and groundwater gradients greater. This part of the aquifer is therefore relatively oxidising and more actively flushed.

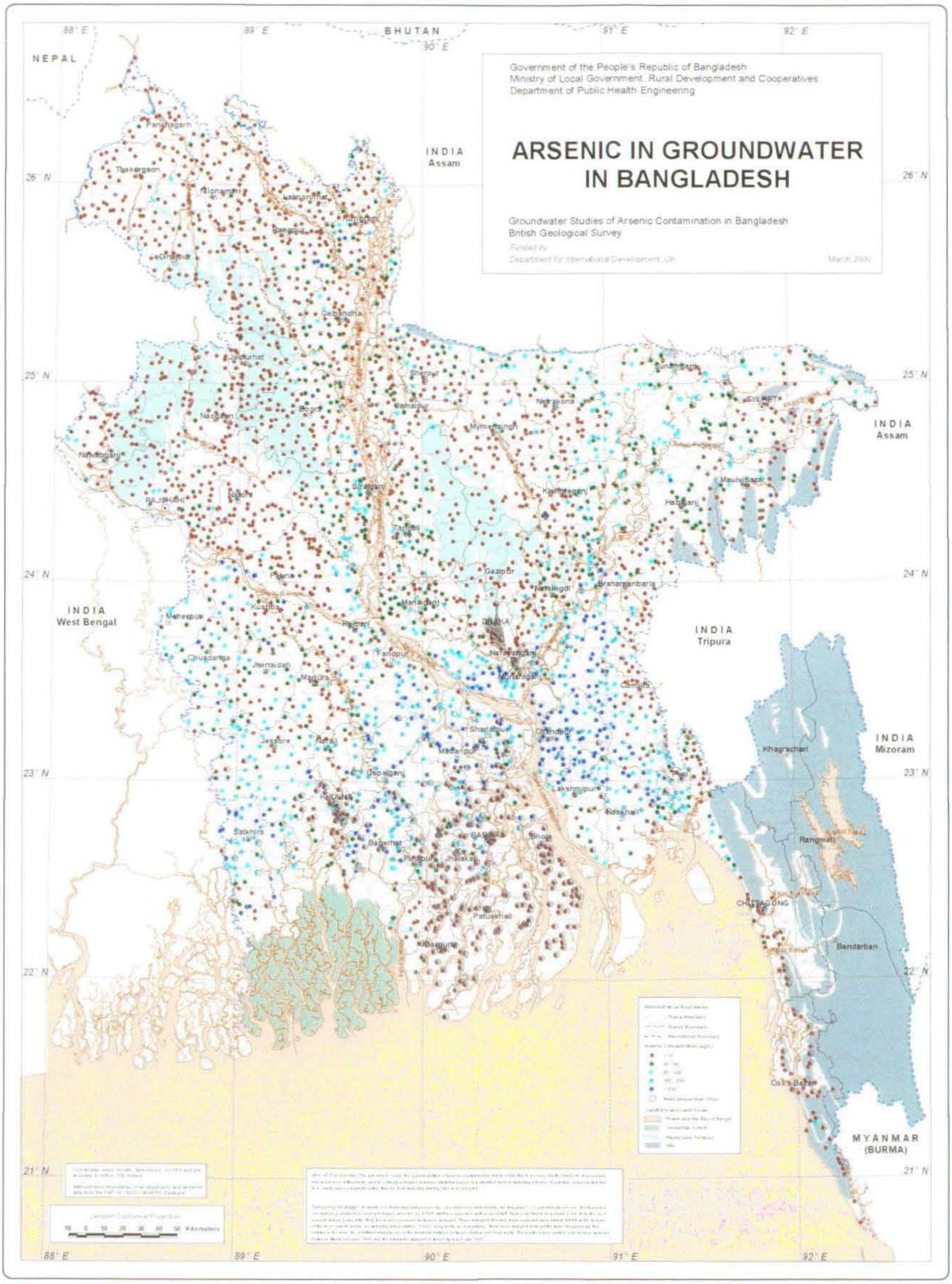
The smoothed arsenic map highlights the low arsenic concentrations of the uplifted Pleistocene plateaux in north central Bangladesh (Barind and Madhupur Tracts) and the Tista Fan in the extreme north. It also emphasises the worst-affected area of Bangladesh in the south-east.

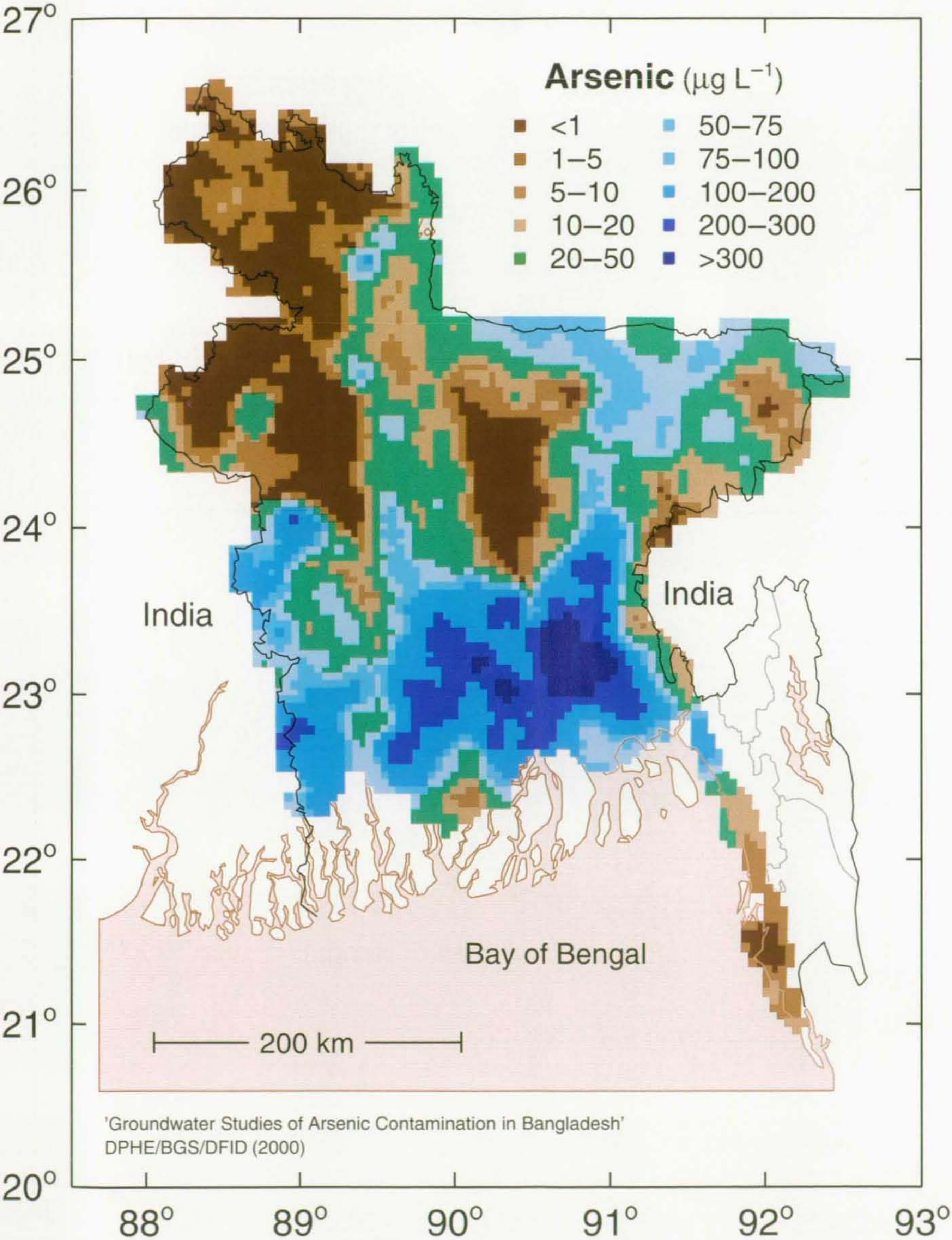

Depth (m)
<22
22–35
35–55
55–150
>150
India
India
Bay of Bengal
200 km
%
25
20
15
10
5
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

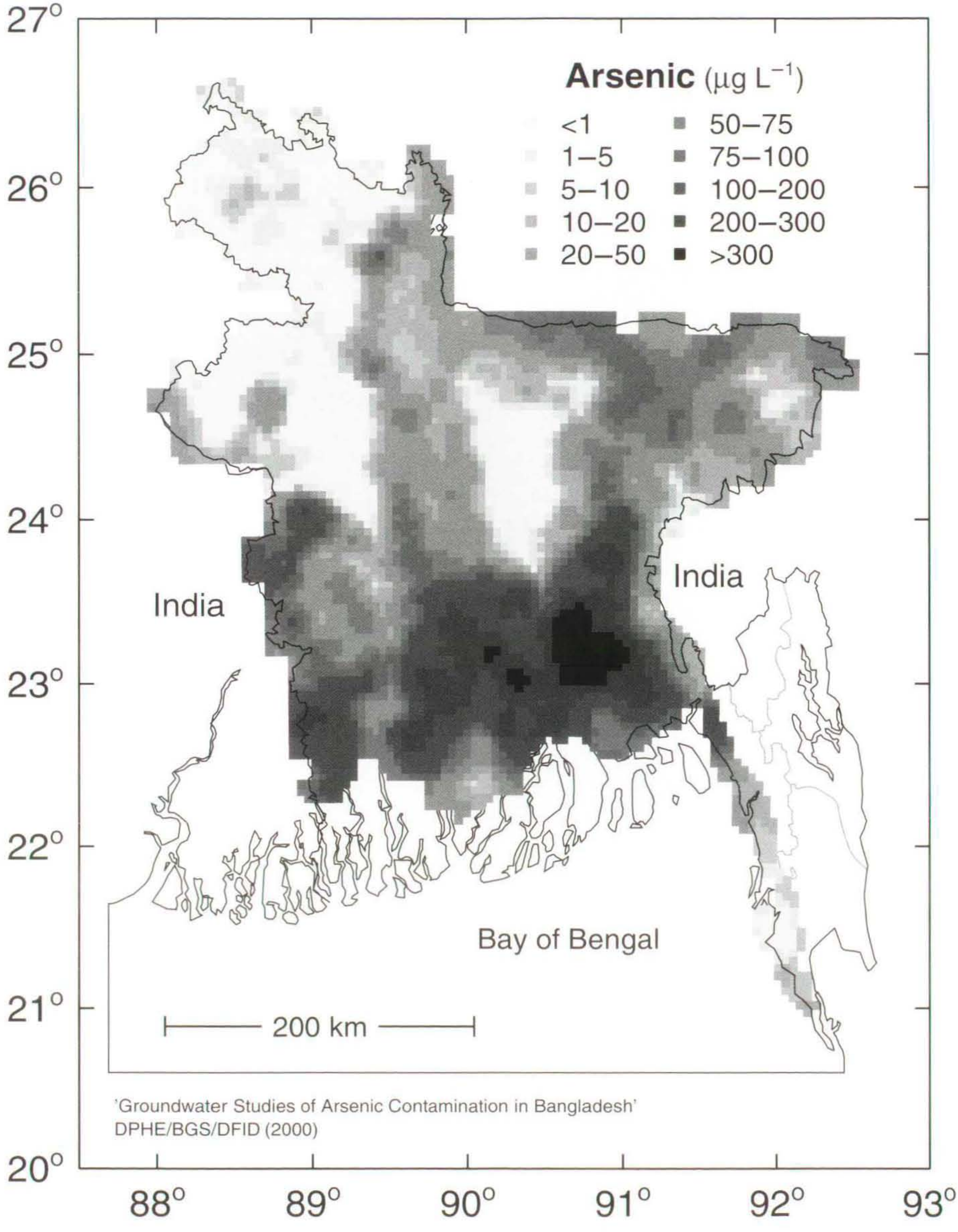

Arsenic (μg L⁻¹)
<0.5
0.5–4
4–50
>50
India
India
Bay of Bengal
200 km
%
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)


Arsenic (health) (μg L⁻¹)
<5
5–10
10–50
50–200
>200
India
India
Bay of Bengal
200 km
%
50
40
30
20
10
0
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°


27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
Arsenic (μg L⁻¹)
<5
5–10
10–50
50–200
>200
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)


Government of the People's Republic of Bangladesh
Ministry of Local Government, Rural Development and Cooperatives
Department of Public Health Engineering
ARSENIC IN GROUNDWATER IN BANGLADESH
Groundwater Studies of Arsenic Contamination in Bangladesh
British Geological Survey
NEPAL
BHUTAN
INDIA Assam
INDIA West Bengal
INDIA Tripura
INDIA Mizoram
MYANMAR (BURMA)
88° E
89° E
90° E
91° E
92° E
26° N
25° N
24° N
23° N
22° N
21° N
Panchagarh
Thakurgaon
Nilphamari
Lalmonirhat
Kurigram
Rangpur
Dinajpur
Gaibandha
Joypurhat
Sherpur
Sunamganj
SYLHET
Naogaon
Bogra
Jamalpur
Netrakona
Mymensingh
Nawabganj
Maulvibazar
RAJSHAHI
Natore
Sirajganj
Kishoreganj
Habiganj
Tangail
Pabna
Gazipur
Narsingdi
Brahamanbaria
Kushtia
Manikganj
Meherpur
Rajbari
DHAKA
Chuadanga
Jhenaidah
Faridpur
Narayanganj
Munshiganj
Magura
Comilla
Jessore
Narail
Shariatpur
Chandpur
Madaripur
Khagrachari
Gopalganj
Lakshmipur
Noakhali
KHULNA
Satkhira
Bagerhat
Pirojpur
Jhalakati
BARISAL
Bhola
Rangamati
CHITTAGONG
Patuakhali
Barguna
Bandarban
Cox's Bazar
Kilometers

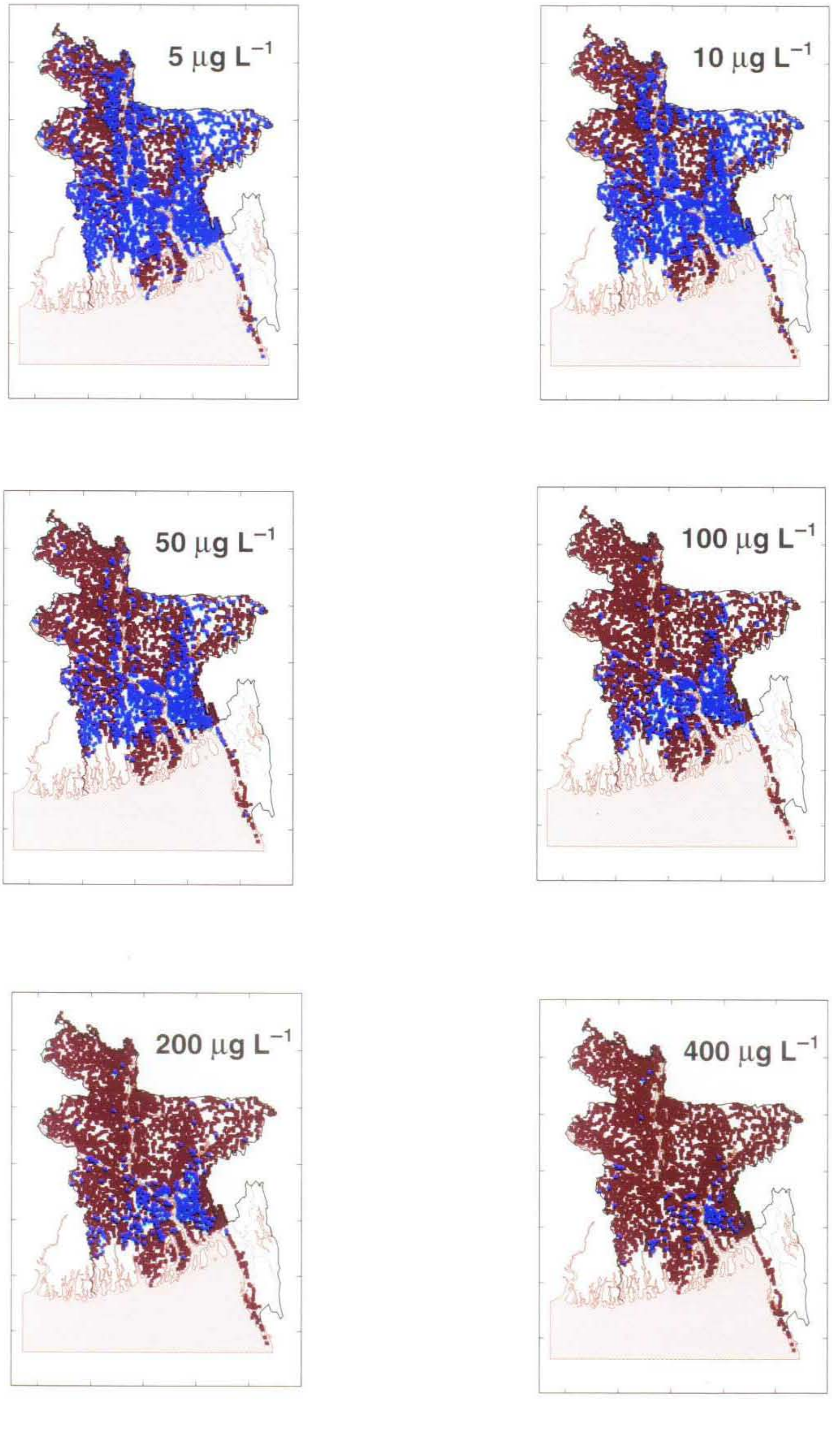

27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
Arsenic (μg L⁻¹)
<1
1–5
5–10
10–20
20–50
50–75
75–100
100–200
200–300
>300
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)


Arsenic (μg L⁻¹)
<1
1–5
5–10
10–20
20–50
50–75
75–100
100–200
200–300
>300
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

The estimated population exposed to arsenic in the drinking water from the smoothed distribution (kriging to a 5 km grid) is about 35 million at greater than 50 μg L^{-1} and 57 million at greater than 10 μg L^{-1}. This differs slightly from estimates based on *upazila*-averaged statistics, which are around 28 million and 46 million people respectively. The problem is clearly very large.

Maps plotted with different concentration thresholds of arsenic are also shown for the shallow (≤150 m) wells. In these maps, the colour of a plotted tubewell is determined by whether it is below (blue) or above (red) the given threshold value, namely 5, 10, 25, 50, 100 and 200 μg L^{-1}. The maps become progressively more blue as the threshold value is raised. This is a useful way of highlighting the few very high arsenic wells.

These threshold maps show clearly the area of relatively low arsenic concentrations in the shallow wells that are found following the present-day Gorai River Valley in the Kushtia region and which extends southwards through Khulna and the Pusur and Sibsa Valleys near Bhairab to the Bay of Bengal. This Gorai-Bhairab feature could reflect the course of an old main river channel, possibly the palaeo-Atrai (see the '*Geology and Sedimentology*' Chapter in the Final Report).


5 μg L−1
10 μg L−1
50 μg L−1
100 μg L−1
200 μg L−1
400 μg L−1

BARIUM

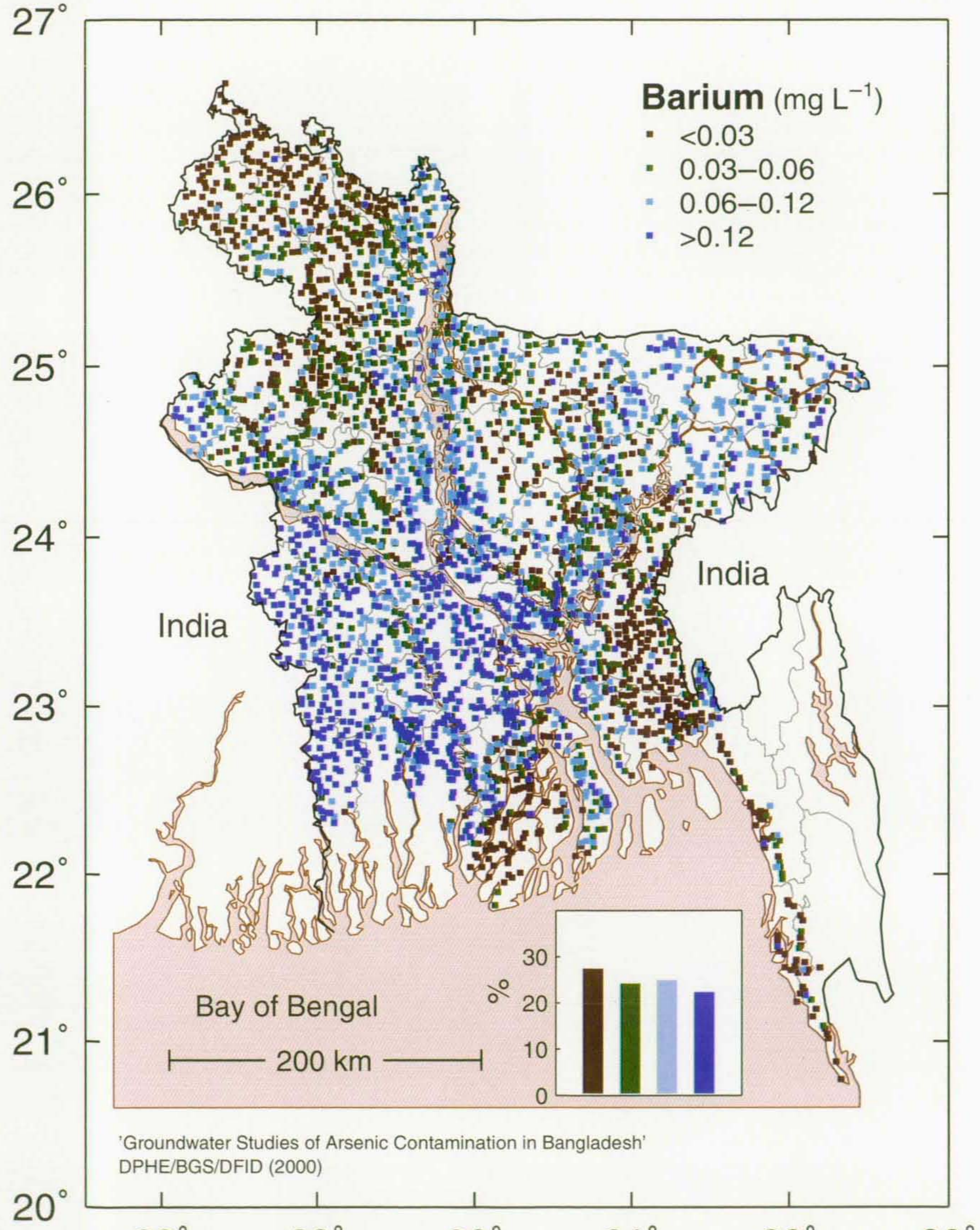
Concentrations of barium have a similar range in both the shallow and deep groundwaters of Bangladesh. (<0.06 mg L^{-1} to 1.4 mg L^{-1} and <0.06 mg L^{-1} to 1.0 mg L^{-1} respectively). Despite much spatial variability, the map shows some regional trends in barium concentration in the groundwaters. Highest concentrations are found most prevalently in the south-west of Bangladesh. More patchy highs are found in the Jamuna Valley and the north-east (Sylhet Basin). The highest concentrations to some extent reflect those of the other alkaline earth elements (calcium, magnesium, strontium) but the spatial distribution is much less distinct. Barium concentrations are likely to be limited dominantly by the solubility of barite. This may to some extent explain why barium concentrations are generally lower in northern Bangladesh, as sulphate concentrations are correspondingly relatively high.

BORON

Concentrations of boron in the groundwaters are commonly close to the detection limit by the ICP-AES method (0.01 mg L^{-1} to 0.1 mg L^{-1}). The results should therefore be viewed with a degree of caution. Nonetheless, some regional patterns in boron concentration are apparent, and a boron map and interpretation has therefore been included here.

Concentrations of boron vary between <0.01 mg L^{-1} and 1.6 mg L^{-1} in the shallow groundwaters and between <0.01 mg L^{-1} and 2.2 mg L^{-1} in the deep groundwaters. The distribution of high boron concentrations also shows many similarities with sodium. Sodium concentrations are relatively high in the deep groundwaters (mainly sampled from near-coastal Barisal and from Sylhet), with a median value of 238 mg L^{-1} compared to 38 mg L^{-1} in the shallow groundwaters. Highest boron concentrations are found in the south and south-east of the country and in the haor region of north-eastern Bangladesh. Relatively high concentrations are also found in the groundwaters from the Atrai Floodplain in the west. The regional highs are believed to reflect the distribution of saline groundwater resulting from past marine inundation. Highest concentrations are found in the south and south-east of the country and in the haor region of north-eastern Bangladesh. Relatively high concentrations are also found in the groundwaters from the Atrai Floodplain in the west which is also thought to reflect a palaeosalinity signature.

The 1998 WHO guideline value for boron in drinking water is 0.5 mg L^{-1}. Only 5% of groundwaters from the National Hydrochemical Survey (all sampled groundwaters) exceeded this value, most being from the southern coastal region and from the north-eastern haor region. Considering the deep aquifer alone, 30% of samples exceeded 0.5 mg L^{-1}. In these high-boron groundwaters, the sodium concentration usually exceeded 200 mg L^{-1}. The seawater boron contribution for a groundwater with 200 mg L^{-1} Na (all assumed to be derived from seawater) would be only 0.082 mg L^{-1} and so it is likely that some sodium has been preferentially flushed from the aquifer as it has freshened.

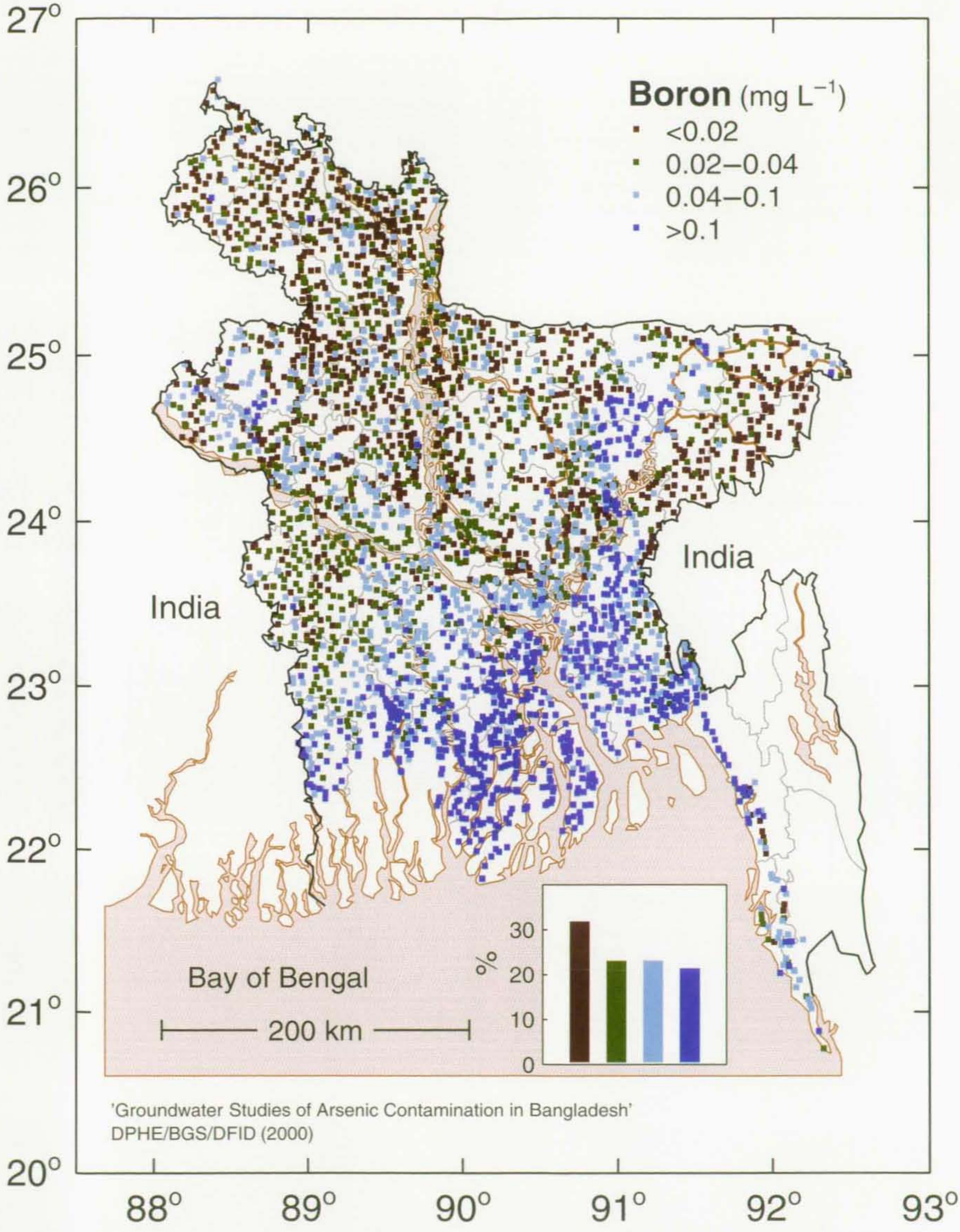

Barium (mg L⁻¹)
<0.03
0.03–0.06
0.06–0.12
>0.12
India
India
Bay of Bengal
200 km
%
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

CALCIUM

Groundwaters from most of the Bangladesh aquifers appear to be of calcium-bicarbonate type, with the exception of more saline groundwaters, predominantly near the coast, which have sodium as the dominant cation. In most Bangladesh groundwaters therefore, calcium is an important component. Concentrations range between 0.01 mg L^{-1} and 366 mg L^{-1} in the shallow groundwaters and between 0.4 mg L^{-1} and 280 mg L^{-1} in the deep groundwaters. Median concentrations are 35 mg L^{-1} in the shallow aquifers and 17 mg L^{-1} in the deep aquifers, the differences reflecting higher salinity of the sampled deep groundwaters.

There is a notable spatial variation in calcium concentrations that relates to sediment type and provenance and to soil type. Soils from south-western Bangladesh are calcareous. The aquifers from this region, composed of sediments associated with the Ganges (Padma) river system and derived from source regions in the west, also probably contain free carbonate minerals. Dissolution of carbonate in the sediments, principally calcite but also possibly dolomite, is likely to have given rise to the relatively high concentrations. The divide between high-calcium and low-calcium groundwaters is a sharp line on the north side of the Atrai Floodplain.

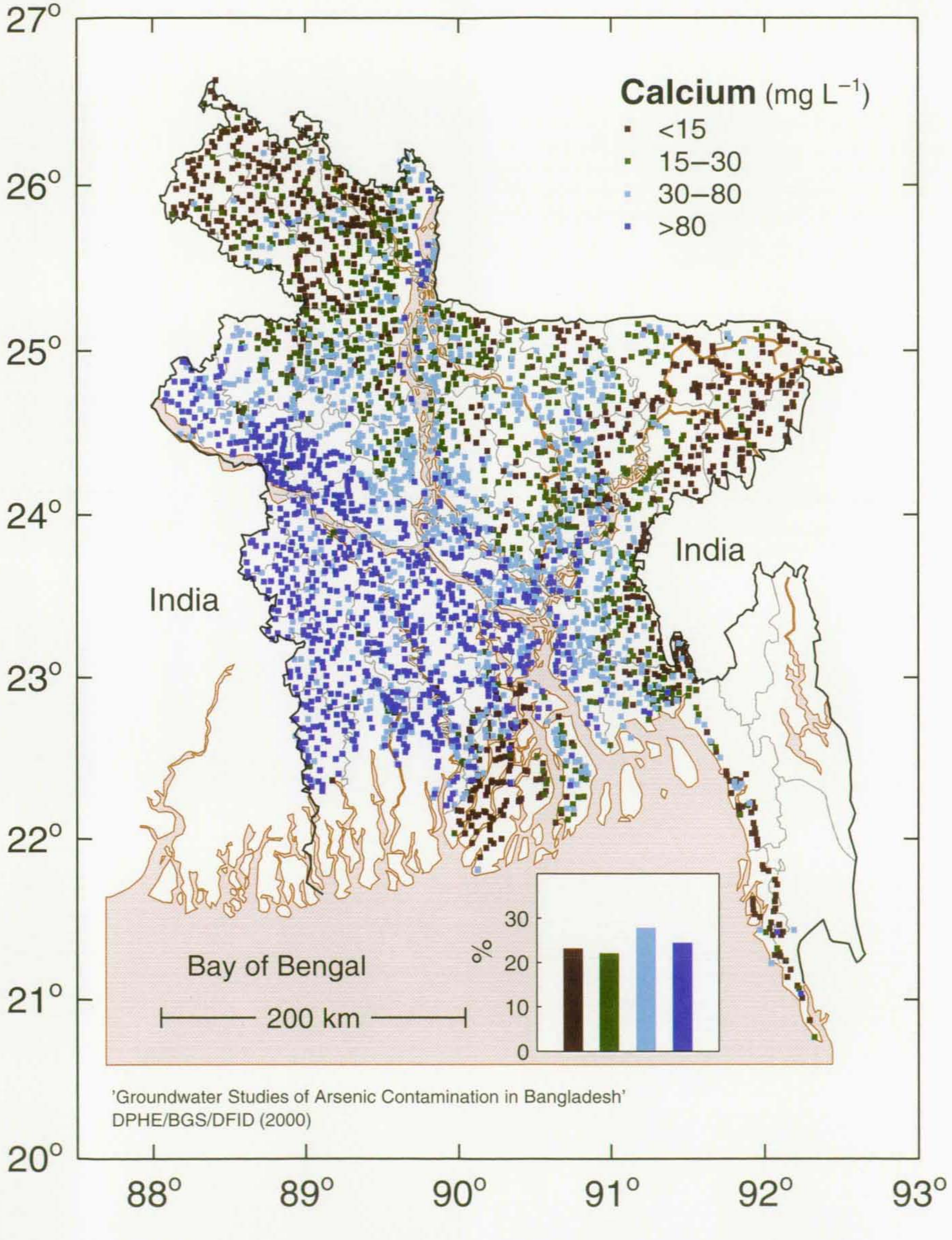
Especially low calcium concentrations are found in groundwaters from the Tista Fan deposits and the Sylhet Basin, both of which have non-calcareous grey and dark grey soils and in parts of the north-east (Sylhet), some deposits of peat. Low concentrations are also found in the deep groundwaters from the south coastal area (Barisal–Patuakhali).

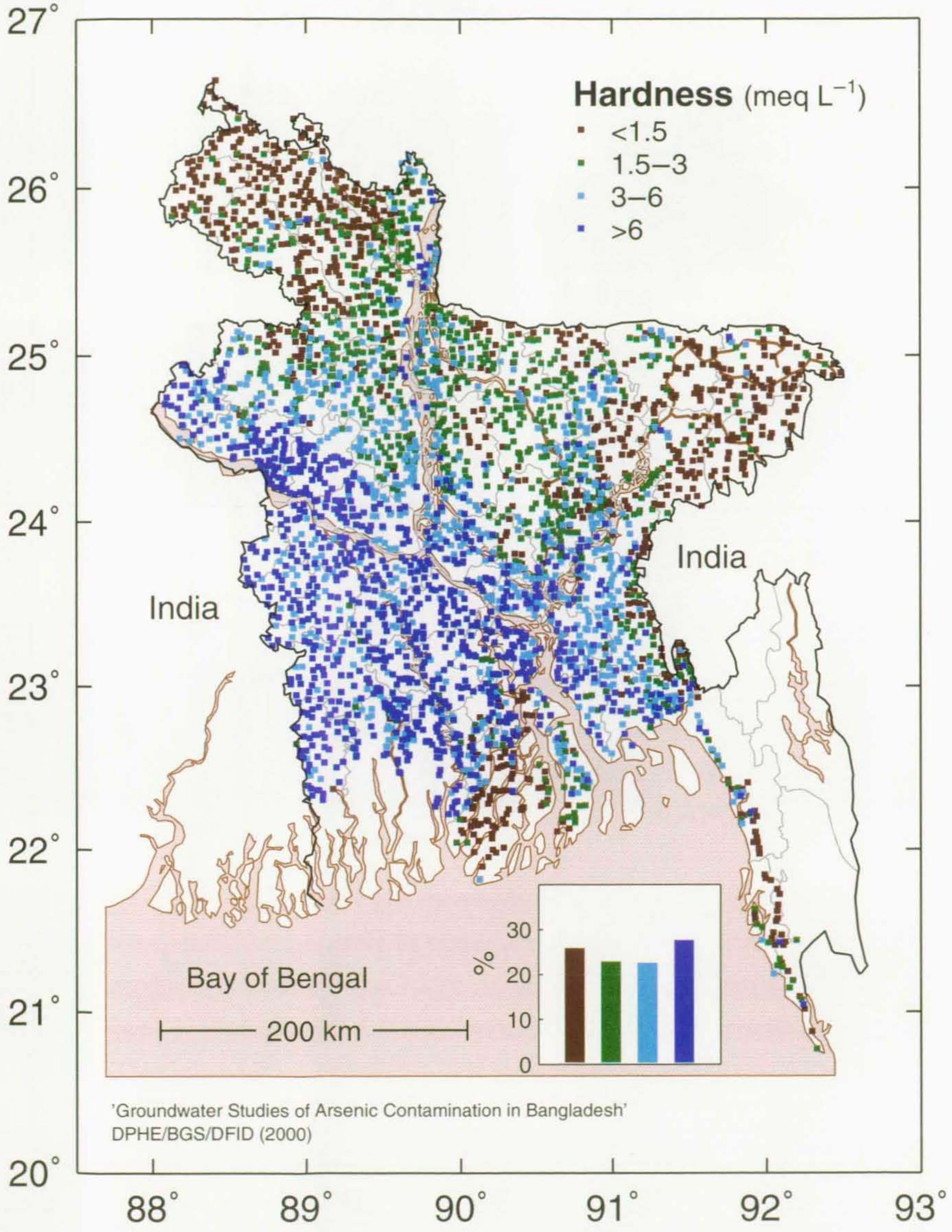

Boron (mg L^{-1})
<0.02
0.02–0.04
0.04–0.1
>0.1
India
India
Bay of Bengal
200 km
%
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

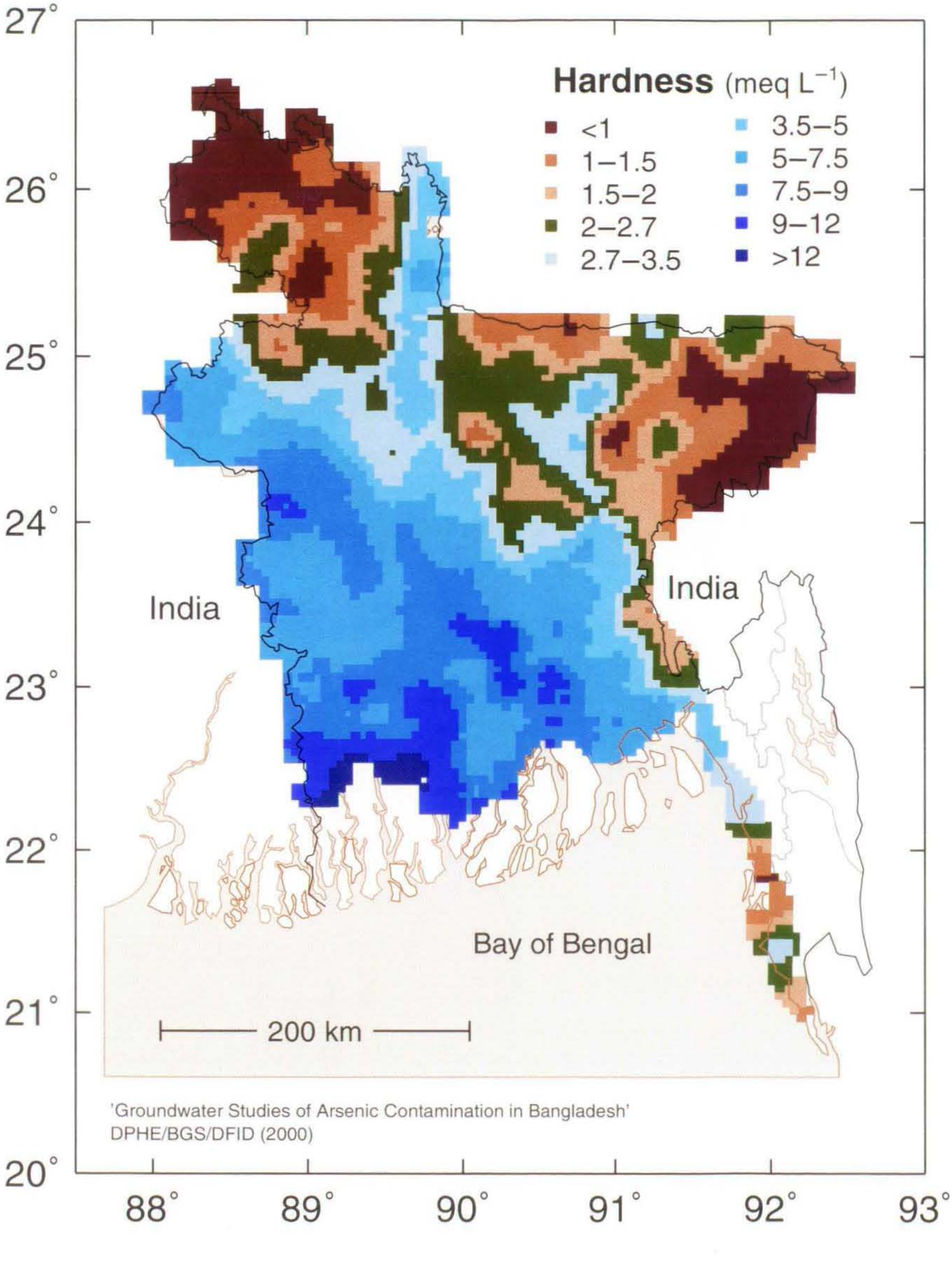
HARDNESS

Groundwater hardness has been calculated by the summation of analysed calcium and magnesium concentrations and is expressed as meq L^{-1}. The smoothed map shows the distribution of hardness in the Bangladesh groundwaters.

As expected, the regional distribution shows the same trends as for calcium and magnesium, i.e. the hardness is greatest in the southern half of Bangladesh where the sediments tend to contain carbonate minerals and where the residual marine influence is also greatest. Most Bangladesh groundwaters would be classified as 'hard'. The maximum hardness is 35 meq L^{-1} (1 meq L^{-1} is equivalent to 50 mg $CaCO_3$ L^{-1}) and is found in a shallow (13 m depth), saline groundwater from Pirojpur district in the southern coastal region. The median hardness in the shallow groundwaters is 3.3 meq L^{-1} whereas the median for the deep groundwaters is 1.8 meq L^{-1}. The hardest waters, which quite often have a hardness exceeding 12 meq L^{-1}, are widely scattered across southern Bangladesh while the softest waters with a hardness of less than 0.25 meq L^{-1} are concentrated in the Sylhet region. The deep groundwaters from the Patuakhali region are relatively soft.


Calcium (mg L⁻¹)
<15
15–30
30–80
>80
India
India
Bay of Bengal
200 km
%
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)


27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
Hardness (meq L^{-1})
<1.5
1.5–3
3–6
>6
India
India
Bay of Bengal
200 km
%
30
20
10
0
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

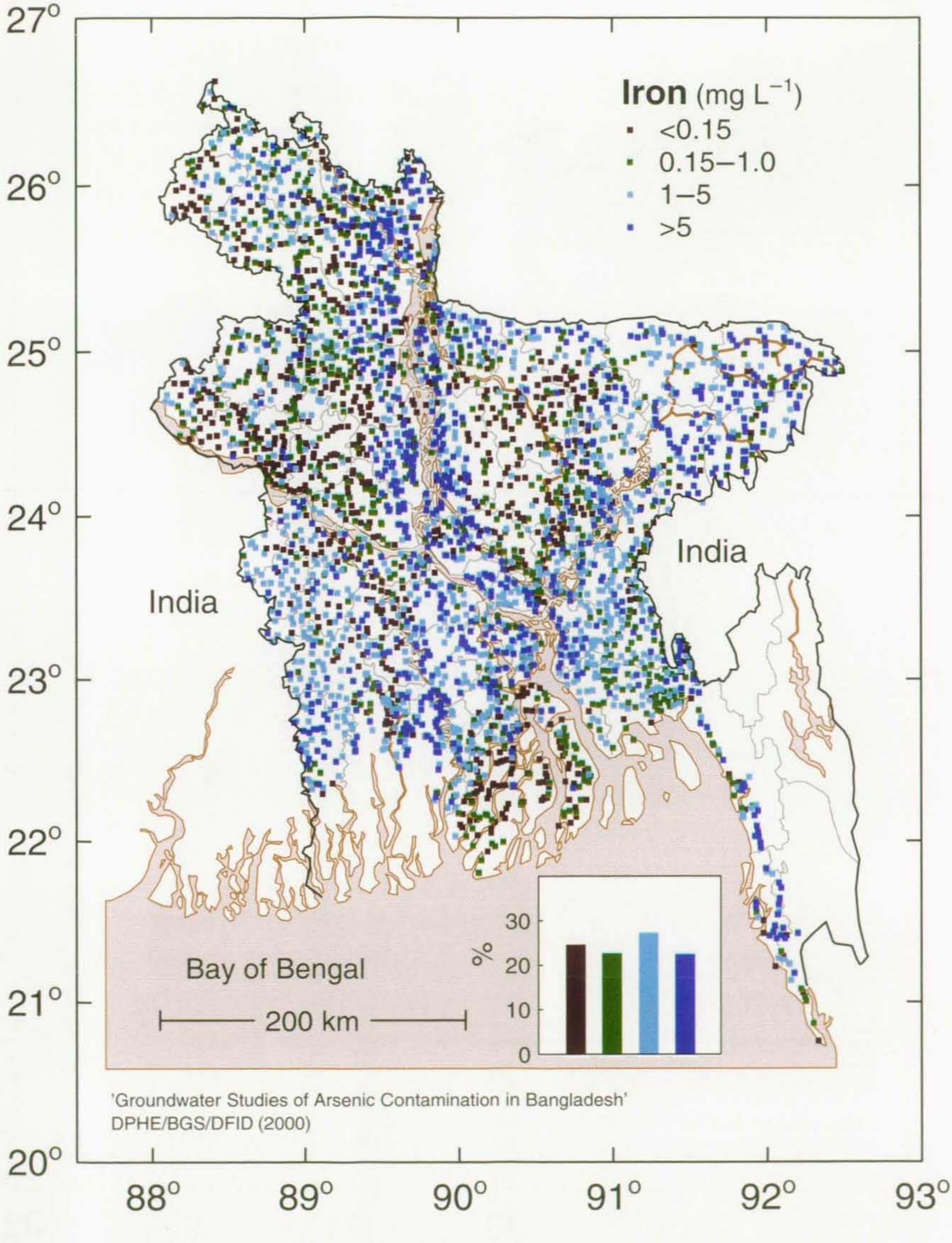


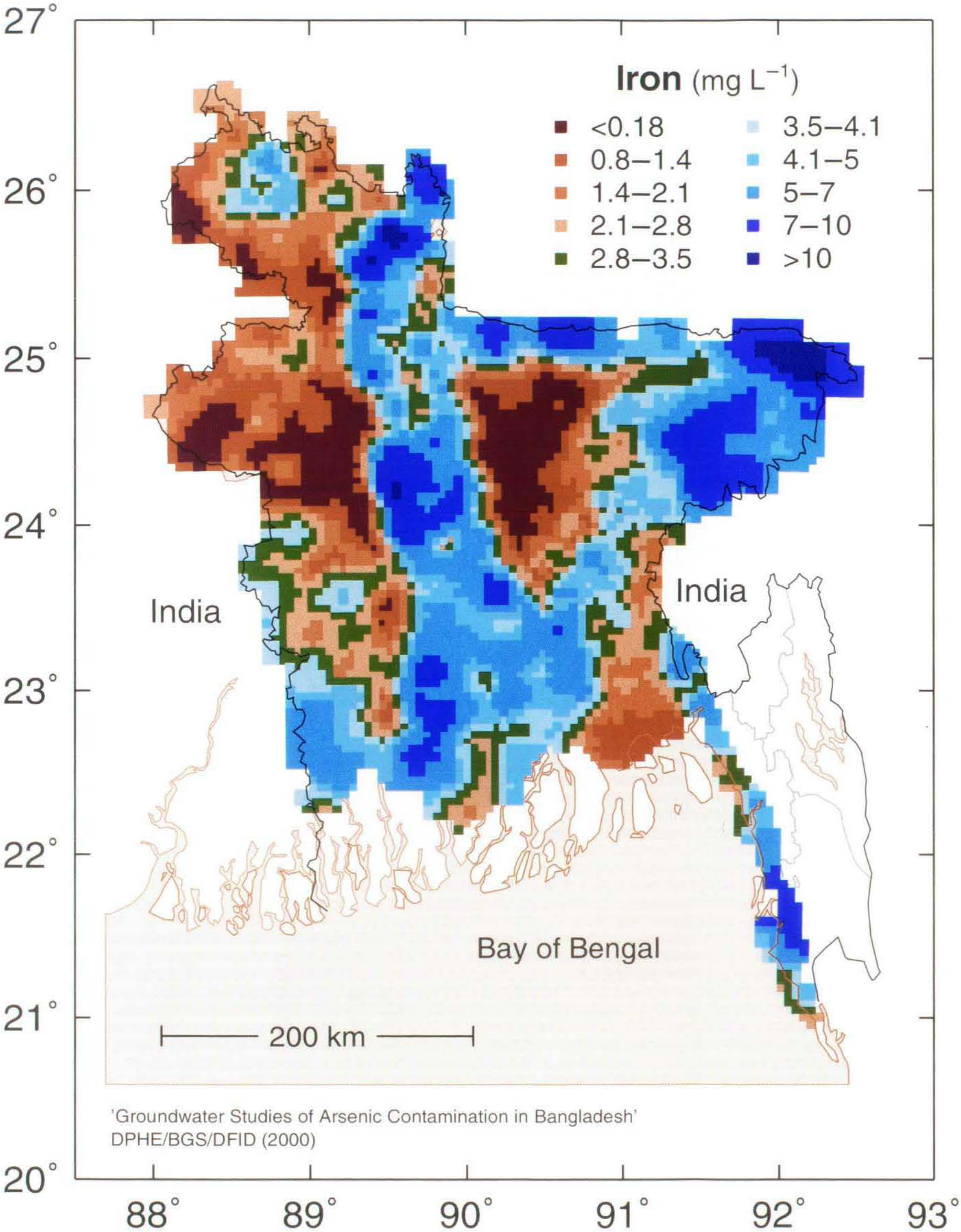
Hardness (meq L⁻¹)
<1
1–1.5
1.5–2
2–2.7
2.7–3.5
3.5–5
5–7.5
7.5–9
9–12
>12
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

IRON

Iron concentrations in the groundwater range between <0.004 and 61 mg L^{-1}, with median values of 1.4 mg L^{-1} and 0.2 mg L^{-1} in the shallow and deep groundwaters respectively. Concentrations are high in most of the groundwaters of Bangladesh as a result of the predominance of reducing conditions in the aquifers. Concentrations are high but patchy in the south (south of the River Ganges) and in the north-east. The proportion of wells with high iron concentrations and the concentrations themselves are particularly high in the Jamuna Valley, with many exceeding 10 mg L^{-1}.

Lowest overall concentrations are found in the groundwaters from the Barind and Madhupur Tracts, the deep groundwaters of Barisal and in north-western parts of the Tista Fan. These patterns are clearly shown in the smoothed iron map (Figure 1.x). The Dupi Tila aquifers of the Barind and Madhupur Tracts and the deep aquifers of Barisal are older (Plio-Pleistocene) sediments with longer histories of groundwater flow and sediment diagenesis. The sediments of the Barind and the Madhupur Tracts are commonly brown or yellowish brown in colour and reflect past episodes of oxidation. The iron in these groundwaters may therefore be less labile than that associated with the younger Holocene deposits. In the Tista Fan, the low concentrations probably relate to the occurrence of relatively oxidising conditions (with presence of oxidised sands in the aquifers), coarse sediment grain size and relatively active groundwater movement.


Iron (mg L⁻¹)
<0.15
0.15–1.0
1–5
>5
India
India
Bay of Bengal
200 km
%
0
10
20
30
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)


Iron (mg L⁻¹)
<0.18
0.8–1.4
1.4–2.1
2.1–2.8
2.8–3.5
3.5–4.1
4.1–5
5–7
7–10
>10
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

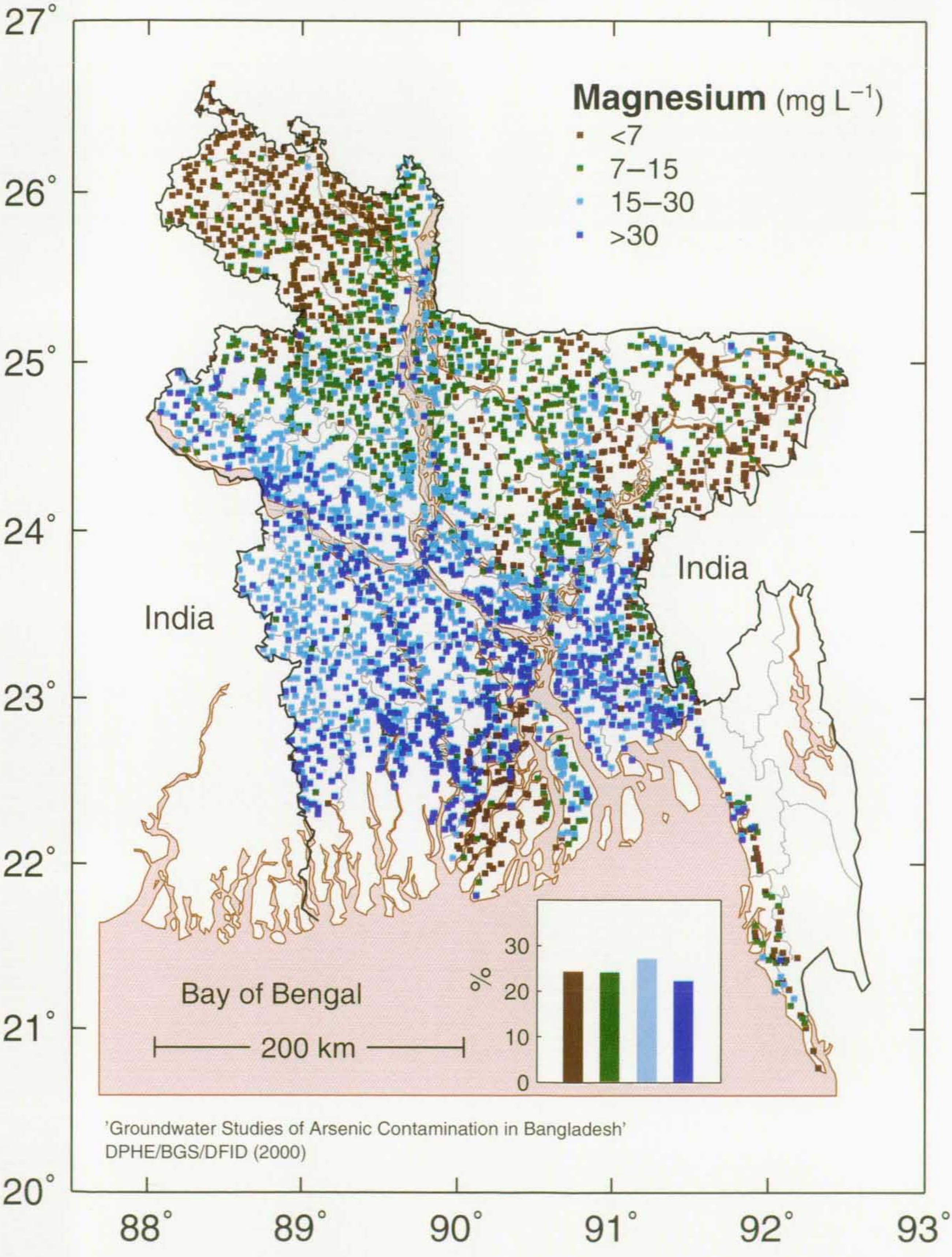
MAGNESIUM

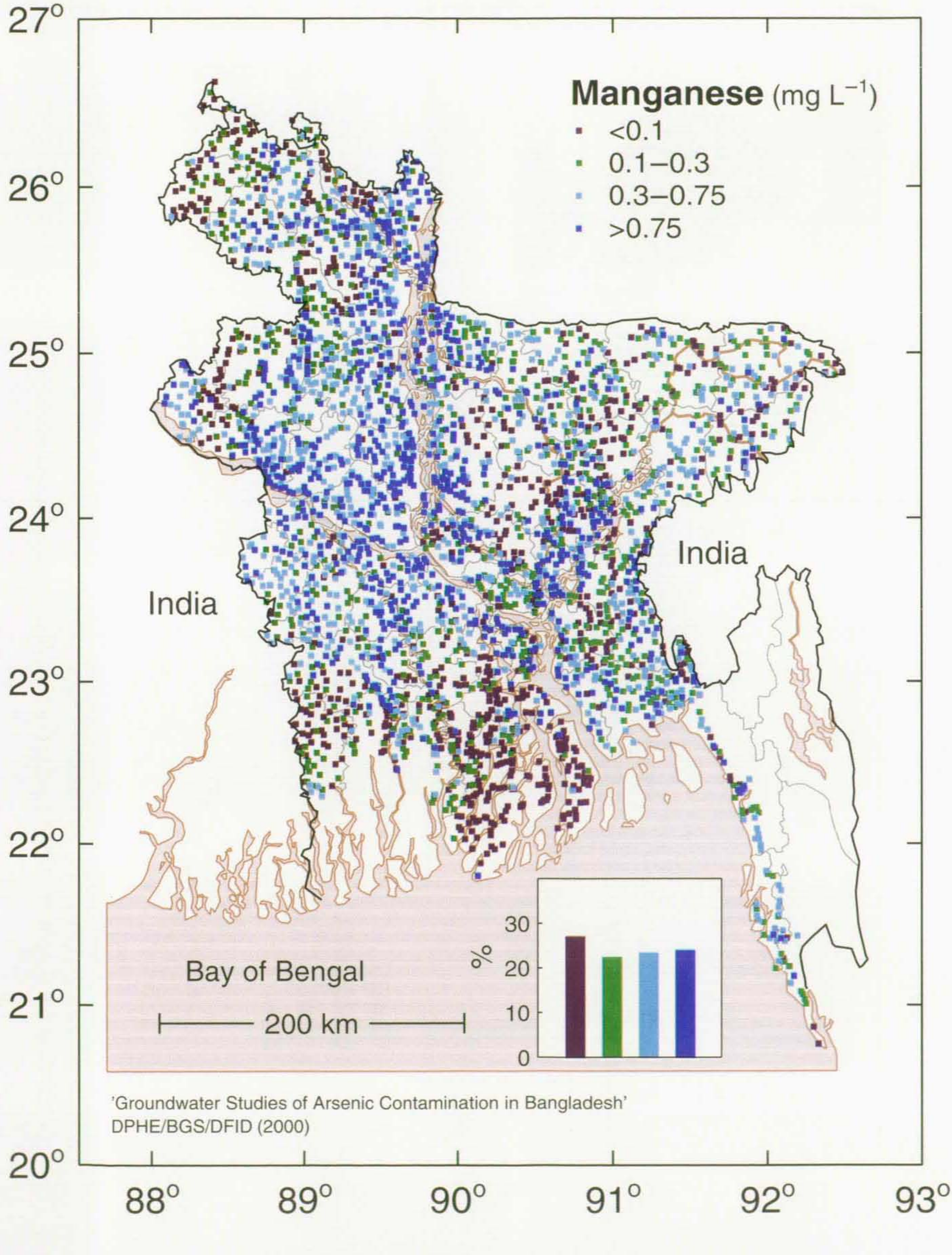
Magnesium concentrations range between <0.04 mg L^{-1} and 305 mg L^{-1} in the shallow groundwaters and between and 0.7 mg L^{-1} and 137 mg L^{-1} in the deep groundwaters, with median values of 16 mg L^{-1} and 11 mg L^{-1}, respectively. The distribution of magnesium in the groundwaters closely resembles that of calcium (Figure 1.x) and is likely to result from the dissolution of free carbonate minerals in the aquifers and overlying soils. Some of the magnesium in groundwaters from southern Bangladesh is also likely to be related to saline intrusion as seawater has relatively high magnesium concentrations (around 1300 mg L^{-1}).

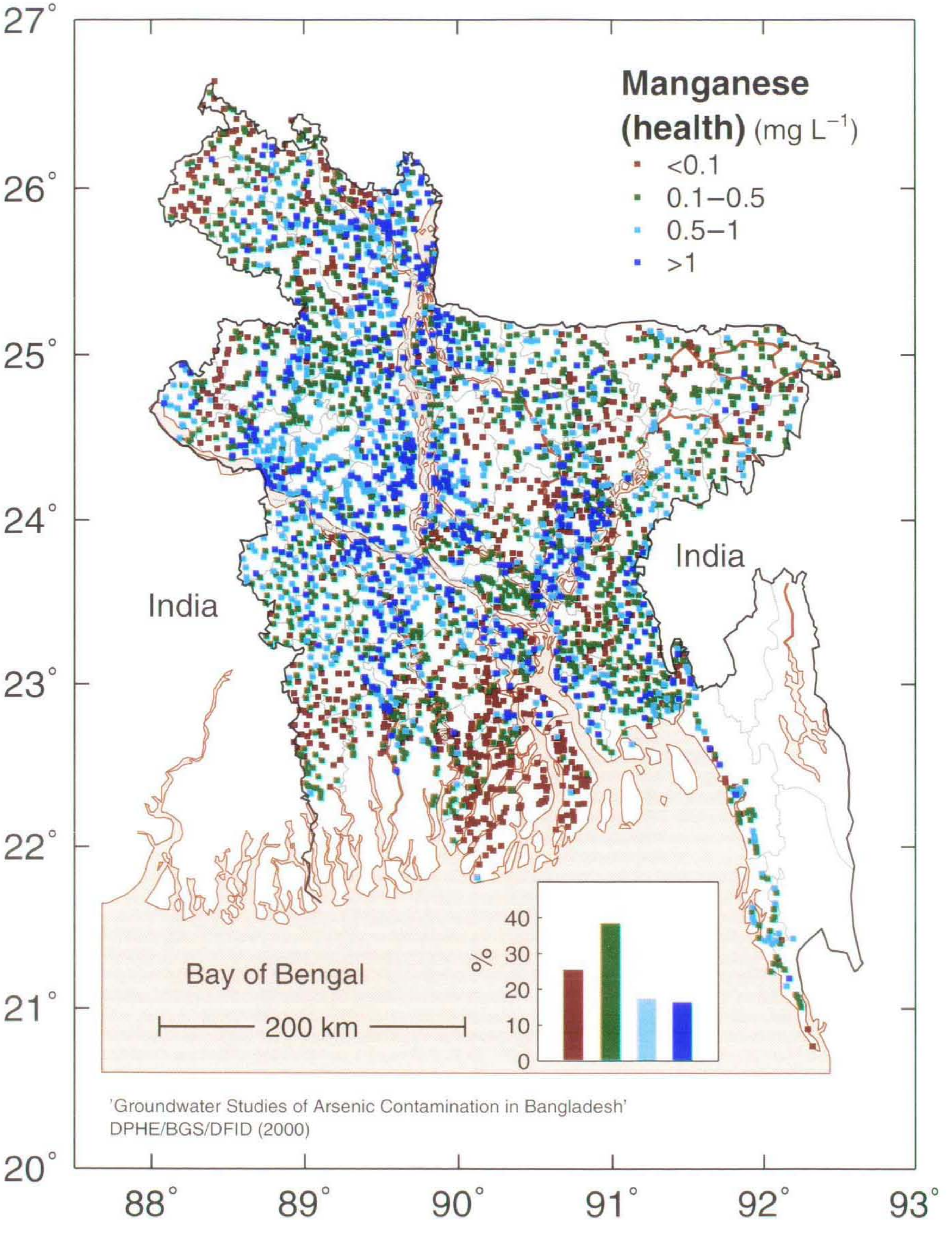
MANGANESE

Concentrations of manganese in the Bangladesh groundwaters were measured between <0.002 mg L^{-1} and 10 mg L^{-1}. Median concentrations in the shallow and deep aquifers respectively were 0.34 mg L^{-1} and 0.03 mg L^{-1}. This highlights the large difference in concentrations between the shallow and deep aquifers, as seen with arsenic. Concentrations are highest in the Holocene aquifers from Rajshahi–Pabna area (Ganges, Atrai Floodplains) the Jamuna Valley and the eastern part of the Tista Fan (Young Gravelly Sand Unit of Alam et al., 1990). The high concentrations are believed to reflect the distribution of groundwaters which are less reducing than those found in the lower parts of the Bengal delta. The spatial distribution of manganese differs from that of iron and arsenic.

Maps are also given of the distribution of manganese concentrations based on health-related class boundaries and also on the relationships between manganese and arsenic. The WHO health-based guideline value for manganese is 0.5 mg L^{-1}. 35% of groundwater samples collected in the survey exceeded this value. The smoothed map for manganese shows a distinctly different pattern from arsenic and iron. The arsenic vs manganese map highlights the spatial differences between the two elements.


Magnesium (mg L⁻¹)
<7
7–15
15–30
>30
India
India
Bay of Bengal
200 km
30
20
10
0
%
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)


27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
Manganese (mg L⁻¹)
<0.1
0.1–0.3
0.3–0.75
>0.75
India
India
Bay of Bengal
200 km
%
0
10
20
30
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

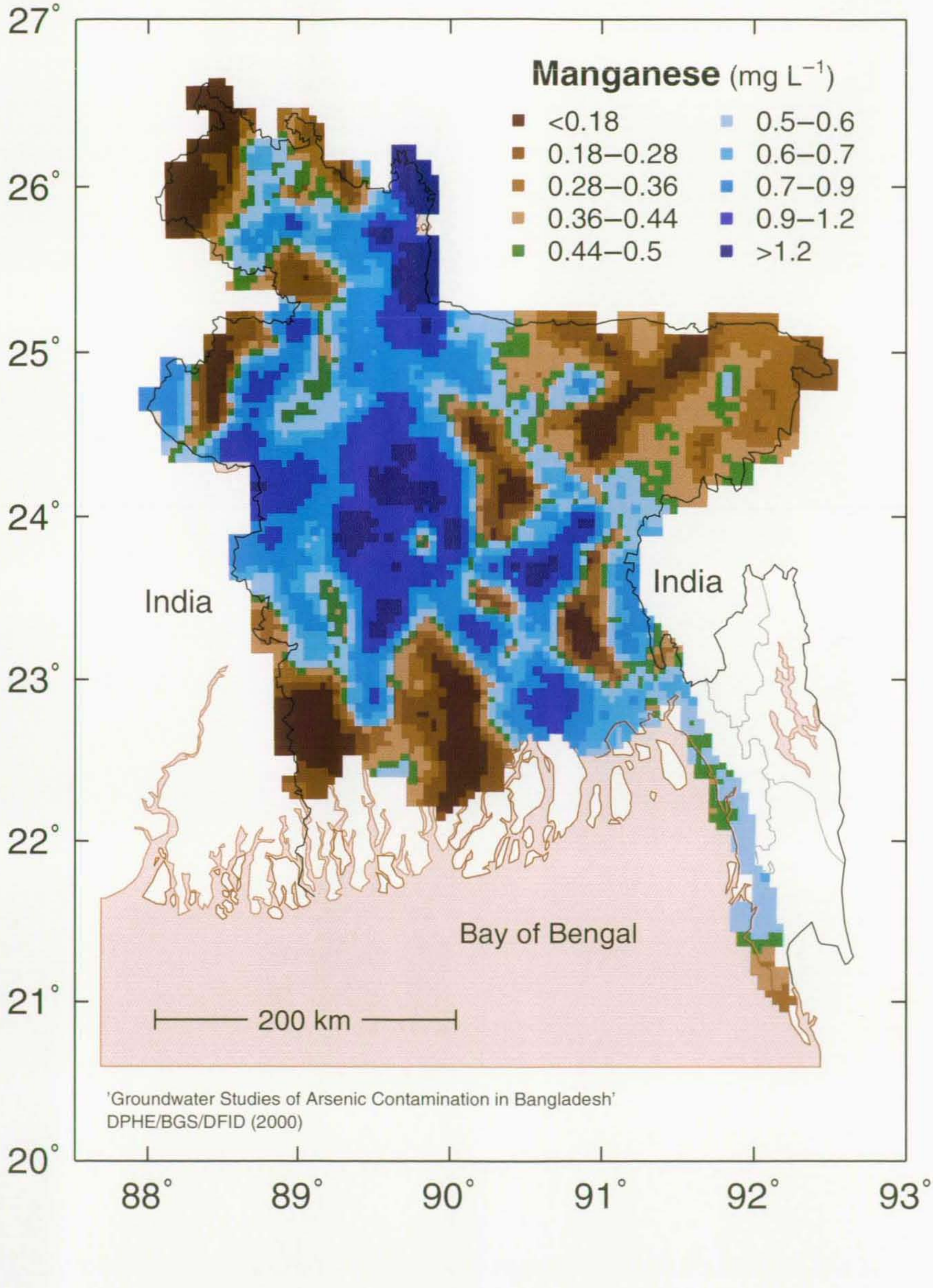

27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
Manganese
(health) (mg L⁻¹)
<0.1
0.1–0.5
0.5–1
>1
India
India
Bay of Bengal
200 km
40
30
20
10
0
%
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

PHOSPHORUS

Concentrations of phosphorus range between <0.1 mg L^{-1} and 19 mg L^{-1} in the shallow groundwaters and between <0.1 mg L^{-1} and 6.1 mg L^{-1} in the deep groundwaters. Median concentrations in each are 0.29 mg L^{-1} and 0.33 mg L^{-1} respectively. These concentrations are relatively high compared to average groundwater compositions.

The map shows that highest concentrations (>1 mg L^{-1}) are mainly found in south-eastern and north-eastern Bangladesh and along the Jamuna Valley. The distribution shows many similarities with that of arsenic, although in contrast to arsenic, many of the deep groundwaters of Barisal have relatively high concentrations (often >1 mg L^{-1} P). The phosphorus is believed to derive by desorption from iron oxides and from organic matter. Dissolution of detrital apatite from sediments is also a likely contributor. The prevalence of high concentrations even in the deep groundwaters (>150 m) precludes fertilisers as a major source.

Dissolved phosphate is likely to compete with dissolved arsenic species (arsenite, arsenate) for adsorption sites on iron and other oxides and the high observed phosphorus concentrations may be an additional factor in the mechanism of arsenic mobilisation in the Bangladesh groundwaters. However, the presence of high phosphorus concentrations in many of the deep groundwaters with low arsenic concentrations indicate that this may be only one of a number of factors involved in arsenic release.

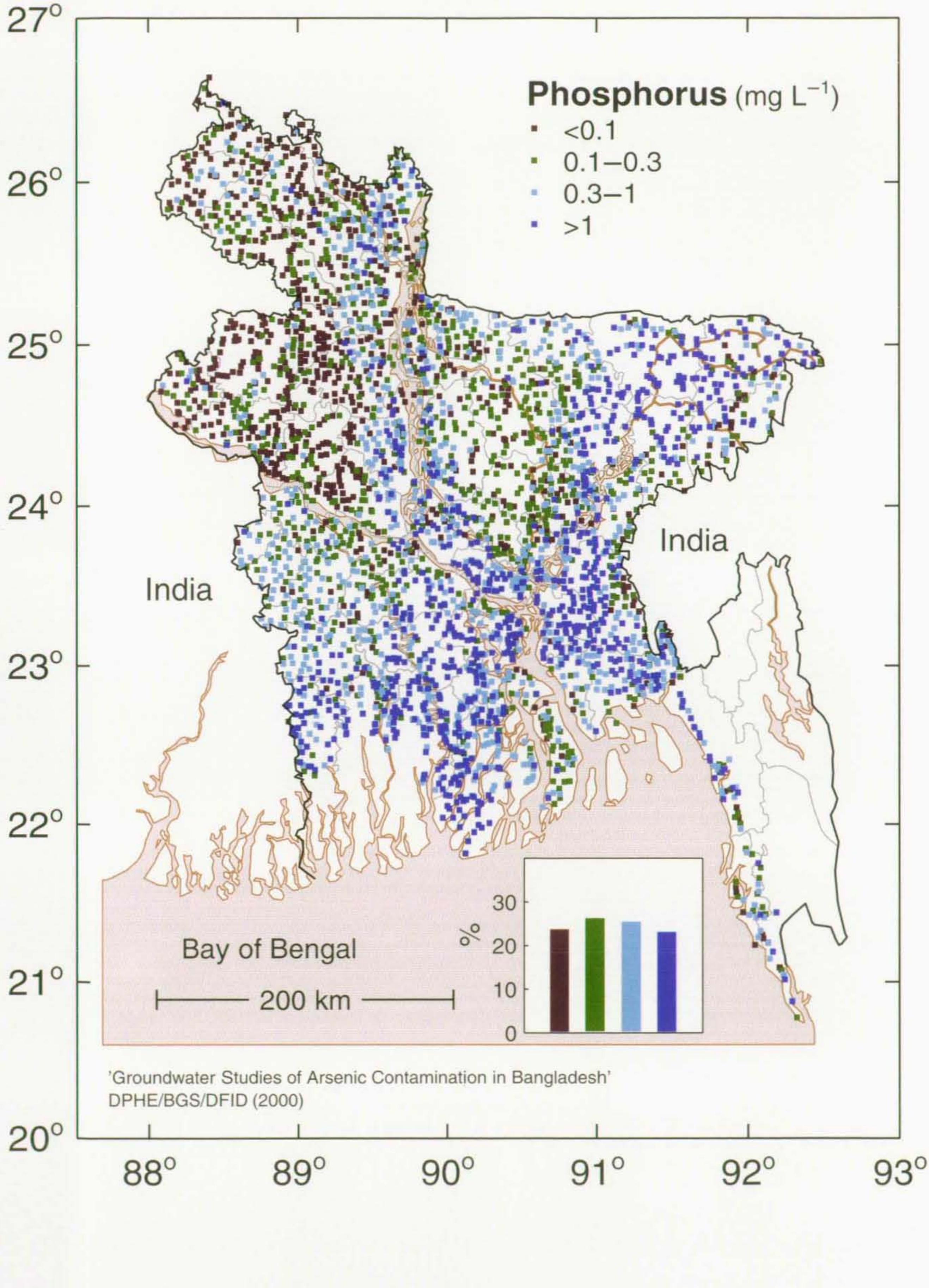


Manganese (mg L⁻¹)
<0.18
0.18–0.28
0.28–0.36
0.36–0.44
0.44–0.5
0.5–0.6
0.6–0.7
0.7–0.9
0.9–1.2
>1.2
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

POTASSIUM

Concentrations of potassium have a comparable range in the shallow and deep groundwaters of Bangladesh, with ranges of between <0.6 mg L^{-1} and 4.0 mg L^{-1} in the shallow groundwaters and between and <0.6 mg L^{-1} 3.8 mg L^{-1} in the deep groundwaters. Median values are slightly higher in the deep aquifers (shallow and deep being 2.2 mg L^{-1} and 3.3 mg L^{-1} respectively). Concentrations in the deep groundwaters of Barisal are often high, though variable.

The map shows that the highest potassium concentrations occur in the south-east of Bangladesh with some relatively high concentrations in the groundwaters from the Jamuna Valley. Derivation of potassium is believed to be largely by mineral reactions in the aquifers, principally deriving from clay minerals and from weathering of micas. The distribution likely reflects the relative abundance of clay minerals in the southern part of the delta where deposits are more typically fine-grained.

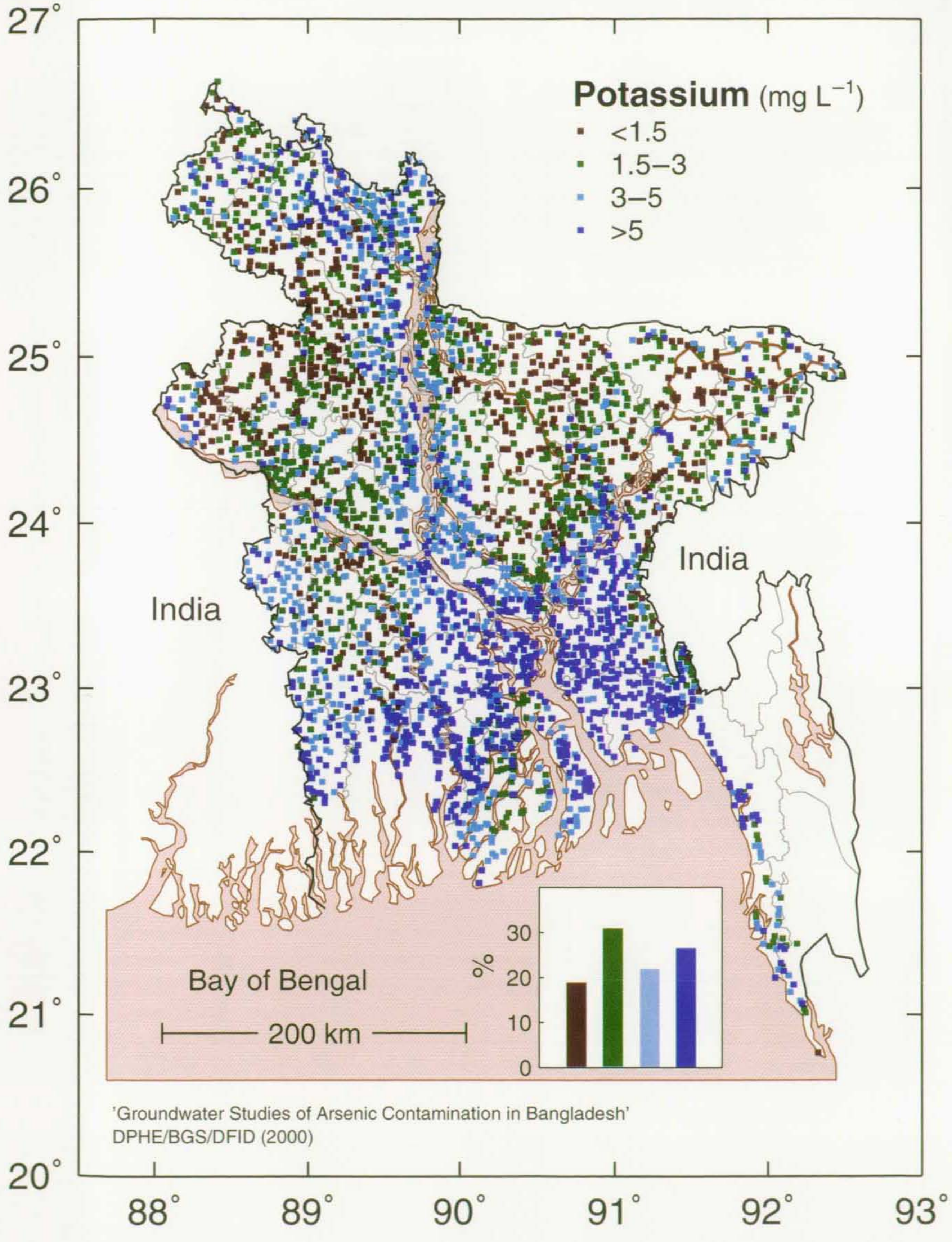

Phosphorus (mg L⁻¹)
<0.1
0.1–0.3
0.3–1
>1
India
India
Bay of Bengal
200 km
%
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

SILICON

Concentrations of silicon in Bangladesh groundwaters are commonly high, the ranges in the shallow and deep groundwaters being <10–21 mg L^{-1} and 2–16 mg L^{-1} respectively. Median values are 20 mg L^{-1} and 13 mg L^{-1} respectively. Maximum concentrations are likely to be limited by solubility with silicate minerals (quartz, cristobalite, amorphous silica).

The regional distribution of silicon shows that highest concentrations are generally found in groundwaters from the Barind and Madhupur Tracts and the western part of the Tista Fan. Sporadic highs also occur in south-east Bangladesh. The highest observed concentrations (>30 mg L^{-1}) are found in the majority of samples from the Madhupur Tract, from the northern part of the Barind Tract and in the south-east border region with Tripura. The high concentrations are believed to reflect more enhanced reaction of silicate minerals as a result of long groundwater residence times in the aquifers.

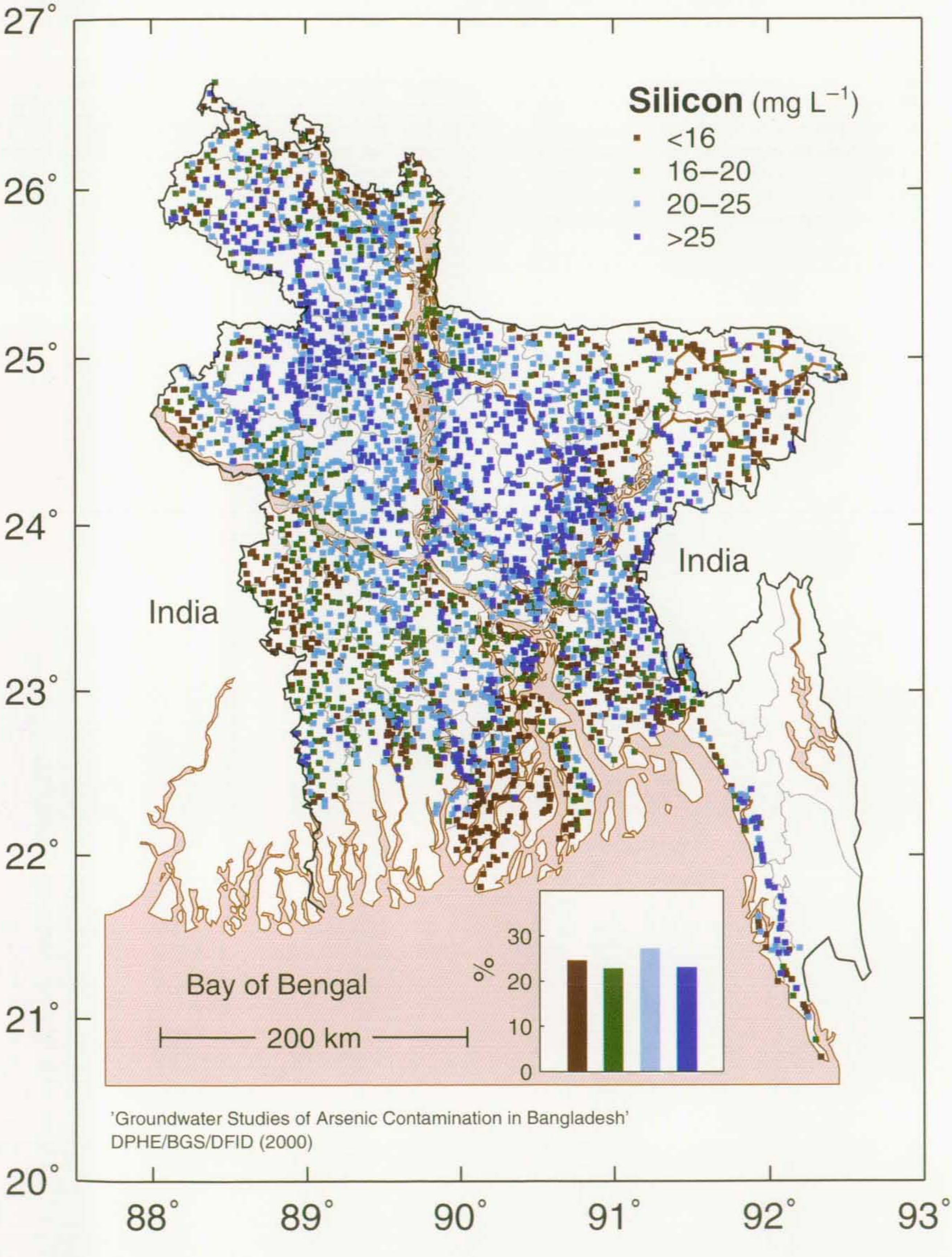
Relatively low concentrations (<16 mg L^{-1}) have been found in the deep groundwaters from southern Bangladesh (Barisal region) and from the Sylhet Basin. The reason for this is not clear.


Potassium (mg L^{-1})
<1.5
1.5–3
3–5
>5
India
India
Bay of Bengal
200 km
%
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

SODIUM

Concentrations of sodium vary between 0.7 mg L^{-1} and 73 mg L^{-1} in the shallow groundwaters and between 2.5 mg L^{-1} and 251 mg L^{-1} in the deep groundwaters. Concentrations are overall greater in the deep groundwaters, but this is because a large proportion of these were collected from the Barisal region of southern (coastal) Bangladesh, as well as from Sylhet area.

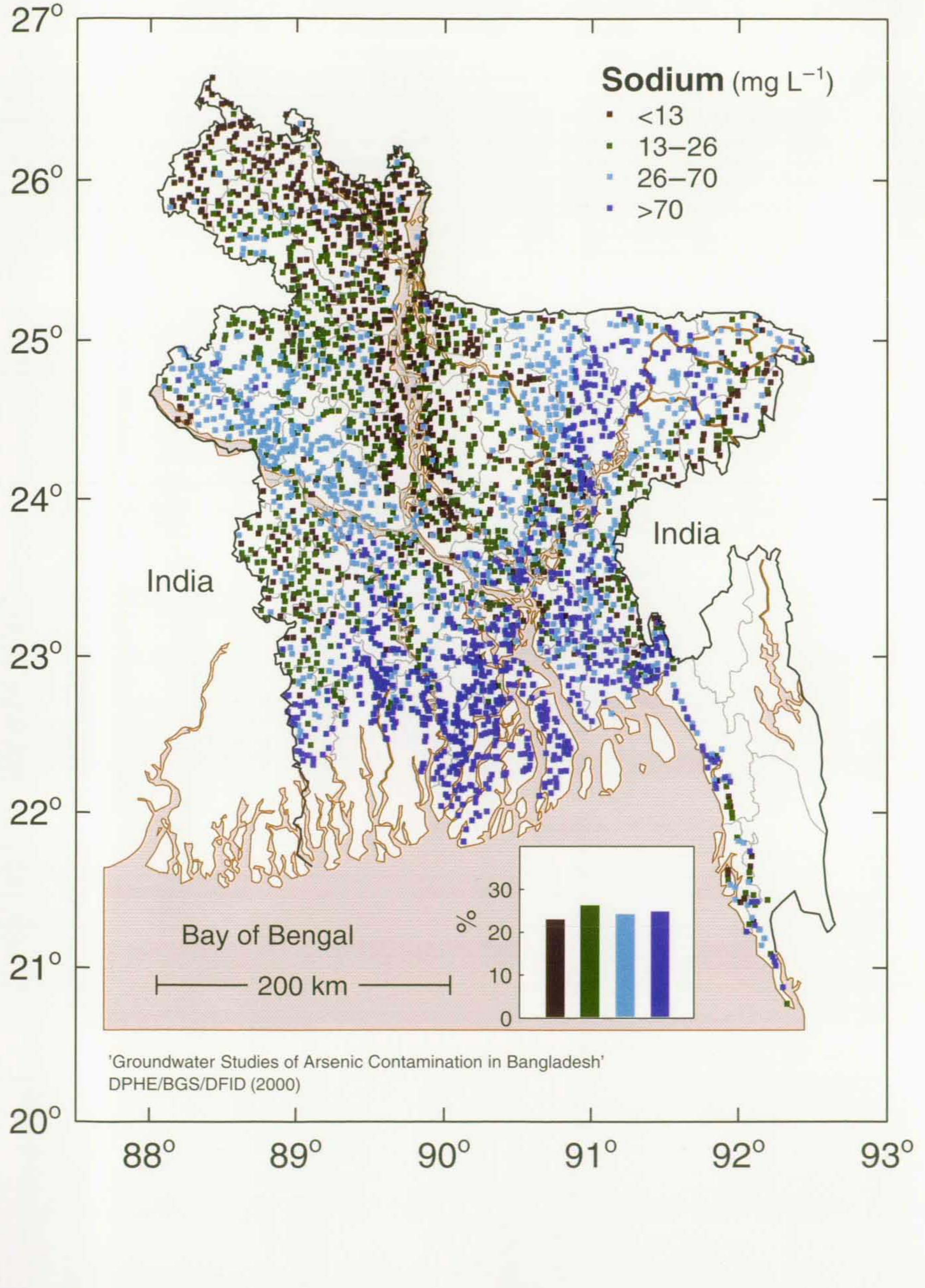
The map shows the highest sodium concentrations are mainly found in the south and south-eastern parts of Bangladesh and in the low-lying hoar region of the north-east (Figure 1.x). High concentrations reflect past inundation of the delta by seawater and past (and possibly present) episodes of saline intrusion in response to variations in relative sea level. Following the last glacial period, rising sea levels resulted in marine inundation of these areas between around 6500–4000 years ago. Relatively low sodium concentrations are found in the comparatively high ground of the Madhupur and Barind Tracts, the Sylhet Hills (Dihing and Dupi Tila outcrops) on the eastern border and the Tista Fan region in the north, as well as along the Jamuna Valley.


27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
Silicon (mg L^{-1})
<16
16–20
20–25
>25
India
India
Bay of Bengal
200 km
30
20
10
0
%
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

STRONTIUM

Concentrations of strontium range between <0.2 mg L^{-1} and 1.6 mg L^{-1} in the shallow groundwaters and between <0.2 mg L^{-1} and 3 mg L^{-1} in the deep groundwaters. Strontium is likely to be derived dominantly from reaction with carbonate minerals, although mixing with saline waters is likely in the areas affected by past or present saline intrusion (seawater has a strontium concentration of around 8 mg L^{-1}). Relatively high concentrations in the deep groundwaters probably reflect this increased salinity, especially those from the coastal area.

The regional distribution of strontium in the groundwaters to a large extent resembles that of calcium and magnesium and, as with these elements, reflects dissolution of carbonate minerals in the sediments and soils. Some high concentrations in the south are also likely due to saline influences. Lowest concentrations are found in groundwaters from the Tista Fan and from the Sylhet Basin. Low concentrations are also found in the deep groundwaters of the extreme south (coastal) part of Bangladesh, in line with the low calcium concentrations.

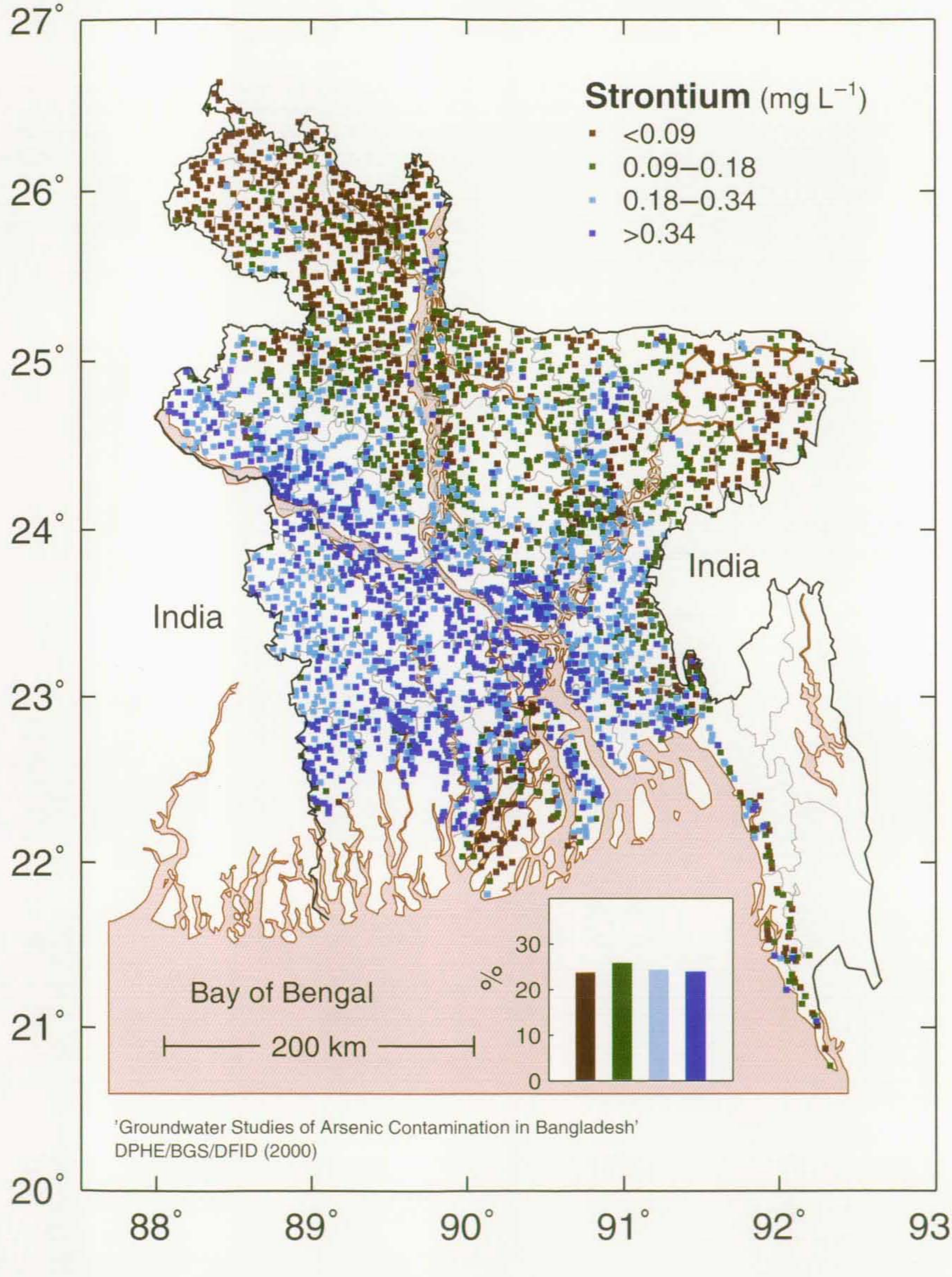

Sodium (mg L⁻¹)
<13
13–26
26–70
>70
India
India
Bay of Bengal
200 km
%
0
10
20
30
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

SULPHATE

Concentrations of sulphate in groundwaters from the National Hydrochemical Survey range between <0.2 mg L^{-1} and 753 mg L^{-1} in the shallow groundwaters and between <0.2 mg L^{-1} and 96 mg L^{-1} in the deep groundwaters. Sulphate concentrations are mainly very low in the Bangladesh groundwaters, the median values in both the shallow and deep groundwaters being <1 mg L^{-1}. The map of sulphate distribution shows that concentrations are generally lowest in the south-west and southern parts as well as in north-eastern Bangladesh. The deep groundwaters of Barisal also have mostly low concentrations (<4 mg L^{-1}). Concentrations are typically higher (>4 mg L^{-1}) in the north, particularly in groundwaters from the Tista Fan, the Jamuna Valley and the Rajshahi–Pabna area (Ganges and Atrai Floodplains).

The low concentrations of sulphate (around 1 mg L^{-1} or less) occur under strongly reducing conditions and often occur in areas affected by residual seawater (southern Bangladesh, Sylhet Basin) which would be expected to have increase sulphate concentrations as a result of the high values found in seawater (around 2700 mg L^{-1}). The low concentrations suggest that bacterial sulphate reduction has occurred. Supporting evidence for the process of sulphate reduction in the aquifers comes from enriched sulphur-34 isotopic compositions in a limited number of groundwater samples from the Special Study Areas, and in the more saline groundwaters of Lakshmipur *upazila*, low SO_4/Cl ratios relative to seawater, indicating sulphate loss from solution. Sulphate reduction appears to have been an important process in both the shallow and deep aquifers.

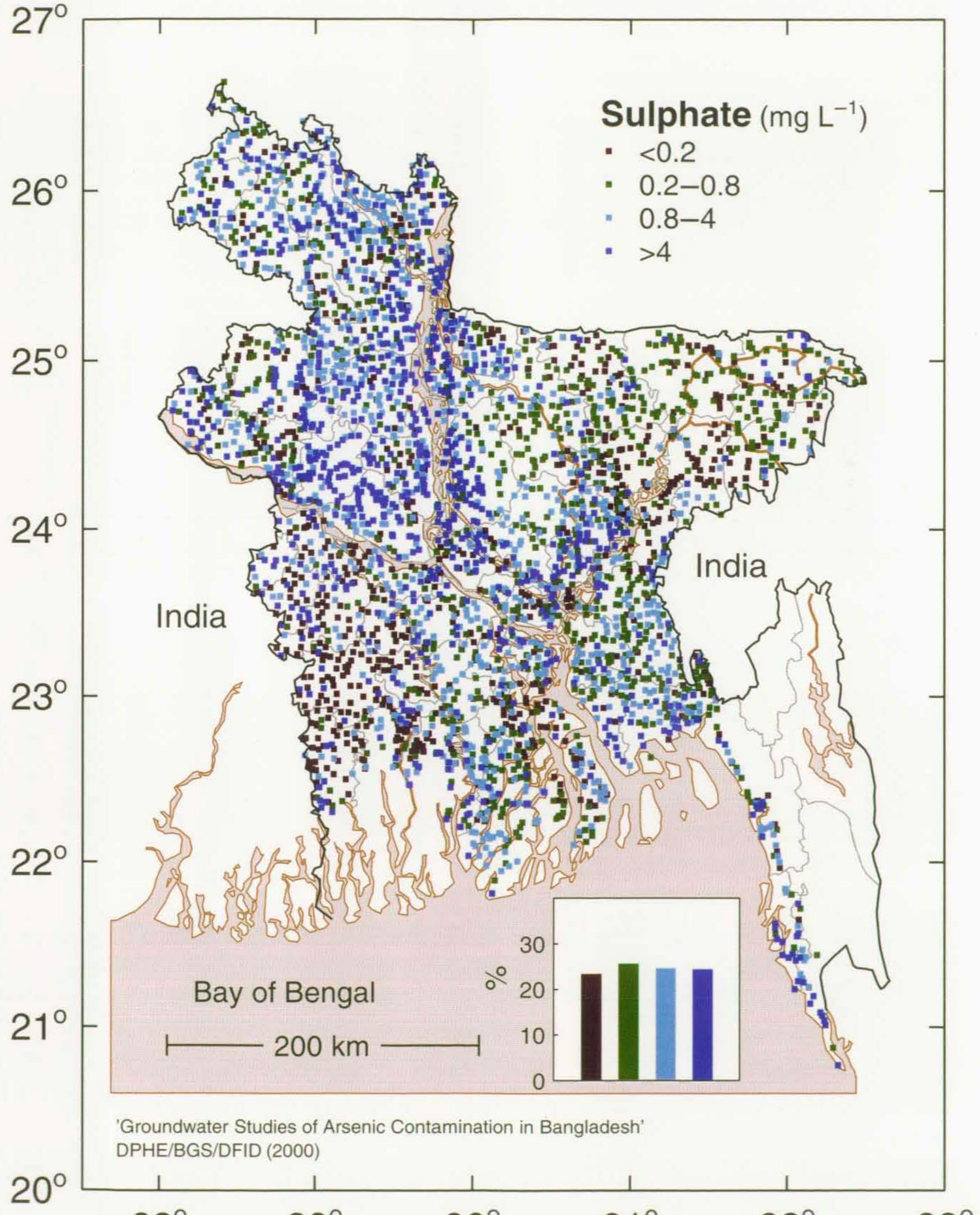
The sulphate map shows that higher concentrations are found in shallow groundwaters from the northern Ganges Floodplain, The Jamuna Valley and the Tista Fan aquifers and from parts of the Barind Tract (although Madhupur Tract groundwaters appear to have low concentrations, of typically <1 mg L^{-1}). These are considered to be more oxidising groundwaters than those in the lower parts of the delta. The sulphate present may either be derived from recharge (following concentration by evapotranspiration), or surface pollution (many of the groundwaters from the Jamuna Valley in particular are abstracted from shallow depths), or derived from oxidation of sulphide minerals (pyrite) in the aquifers. These processes are difficult to distinguish in practice. In any case, if the relatively high sulphate concentrations are derived by oxidation of pyrite, this appears not to be a mechanism for arsenic release into the groundwaters as these high-sulphate waters have typically low arsenic concentrations. In the Jamuna Valley where high arsenic concentrations exists, these are generally in low-sulphate groundwaters (Main Report, Chapter National Hydrochemical Survey).


Strontium (mg L−1)
<0.09
0.09–0.18
0.18–0.34
>0.34
India
India
Bay of Bengal
200 km
%
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

Arsenic and Iron

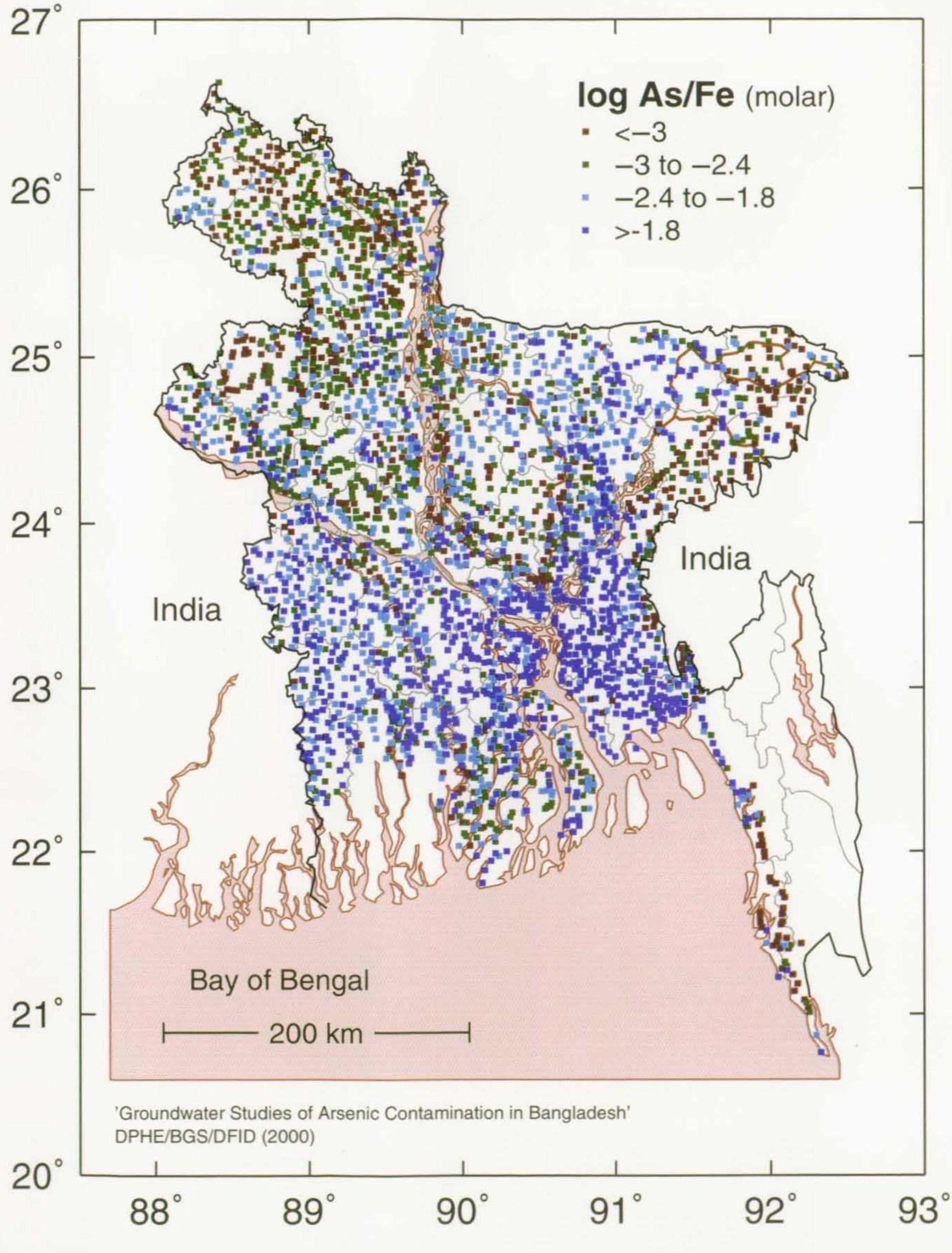
Most Bangladesh groundwaters have high concentrations of both Fe and As by world standards, and it is often found that these two elements can be strongly correlated, although this is by no means always the case. Indeed, on a well-by-well basis, the Fe concentration in a well water generally provides a poor predictor of the As concentration. Nevertheless, it is clear that iron oxides are closely associated with the development of high As groundwaters in Bangladesh, and the ratio can be informative. In particular, simple reductive dissolution would predict a strong relationship and, all other things being equal, should give a relatively constant As/Fe ratio/

The observed ratio, As/Fe (plotted in terms of its logarithm) shows some clear spatial trends with the highest ratios tending to be found in the areas with high absolute As concentrations.


Sulphate (mg L^{-1})
<0.2
0.2–0.8
0.8–4
>4
India
India
Bay of Bengal
200 km
%
0
10
20
30
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

ARSENIC AND MANGANESE

Many groundwaters from north-western Bangladesh in particular have low arsenic but high manganese concentrations. The survey showed that 8% of samples exceeded both 50 $\mu g\ L^{-1}$ arsenic and 0.5 $mg\ L^{-1}$ manganese, while 48% of samples were below both these criteria. Altogether, 36% of samples which had arsenic below 50 $\mu g\ L^{-1}$ had manganese concentrations above 0.5 $mg\ L^{-1}$. Groundwater from the Barind and Madhupur Tracts, the deep aquifer in southern coastal Bangladesh and Sylhet (and Dhaka) and from the coarser sediments of north-western Bangladesh tended to comply on both counts.

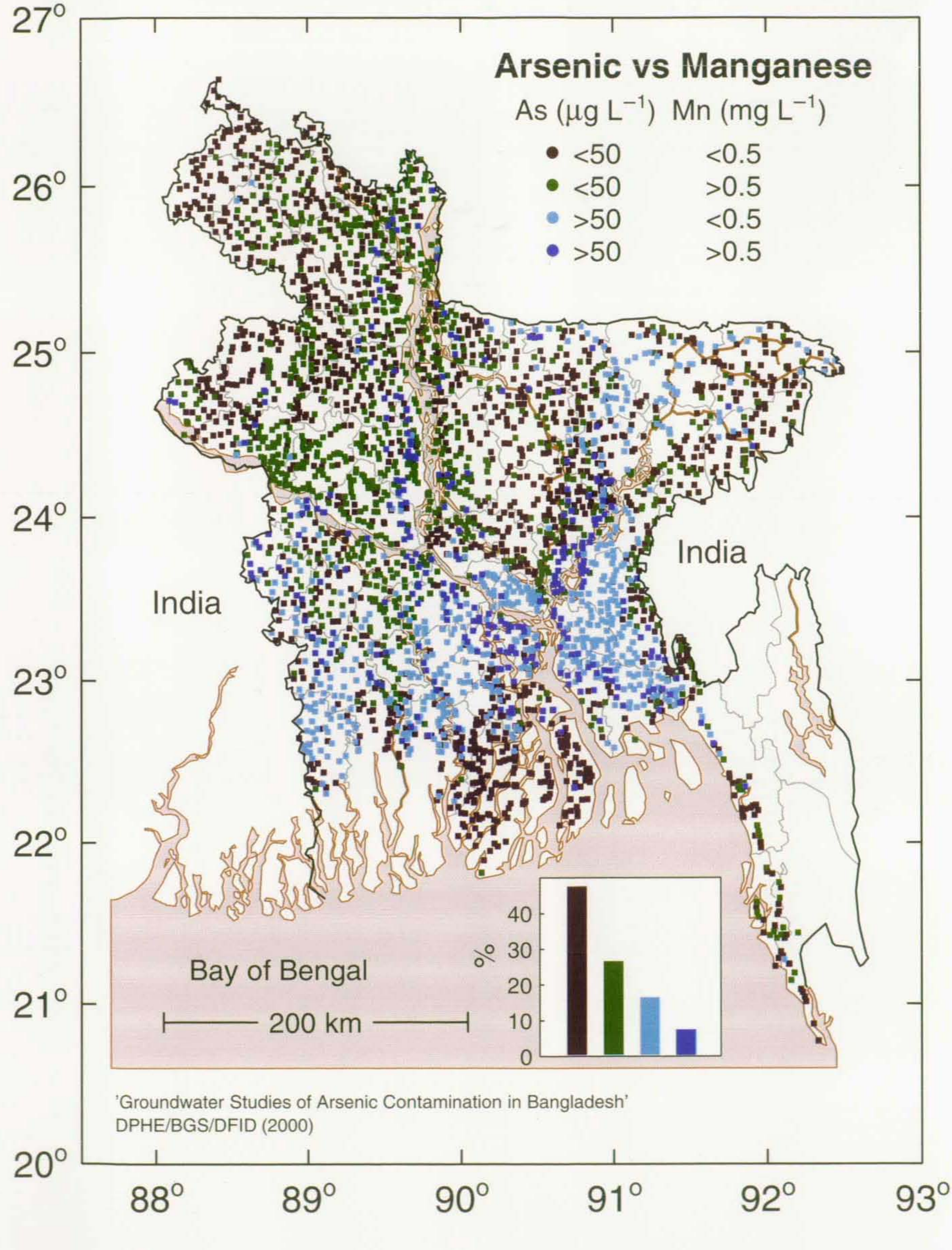


log As/Fe (molar)
<–3
–3 to –2.4
–2.4 to –1.8
>-1.8
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

IRON AND MANGANESE

Bangladesh groundwaters have unusually high concentrations of both Fe and Mn by world standards. This reflects the highly reducing nature of the groundwaters and probably the presence of relatively high concentrations of poorly ordered oxides, and therefore rather soluble oxides, in the very young the sediments of the delta region.

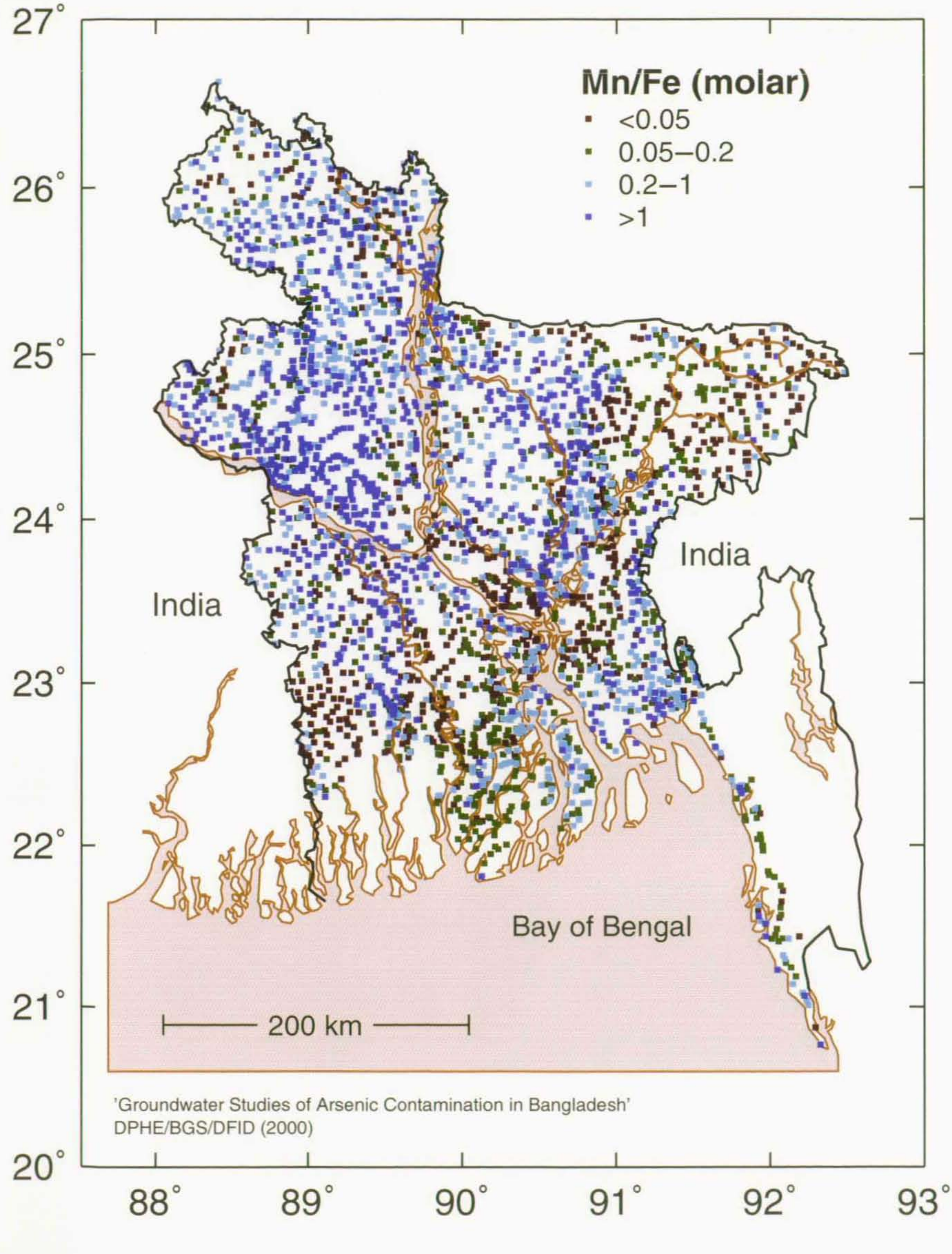
While Fe and Mn both dissolve under reducing conditions, their chemistries are significantly different with Mn oxides tending to dissolve before Fe oxides as groundwaters become progressively more reducing. This is dictated by their relative positions in the standard redox sequence as well as kinetic factors. This means that there is often some separation between Fe and Mn in the environment. This appears to be the case with a large and systematic variation in the Mn/Fe ratio



Arsenic vs Manganese
As (μg L−1) Mn (mg L−1)
<50 <0.5
<50 >0.5
>50 <0.5
>50 >0.5
India
India
Bay of Bengal
200 km
%
40
30
20
10
0
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

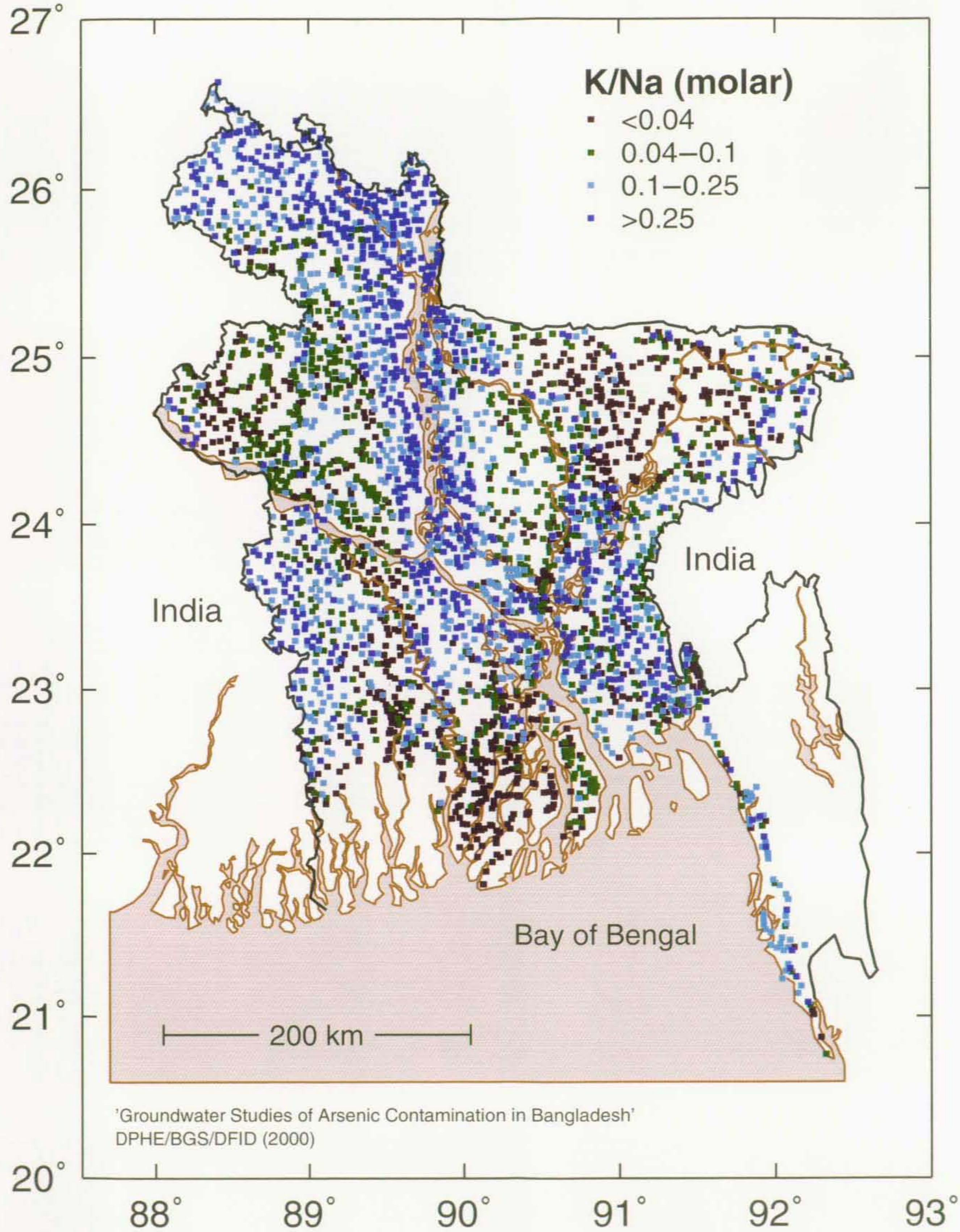
SODIUM AND POTASSIUM

The K/Na ratio shows both the influence of saline intrusion, which gives a low ratio in southern Bangladesh due to high salinity, and the weathering of minerals such as feldspars and micas, in the sandy sediments (relatively high K and low Na in northern Bangladesh).


Mn/Fe (molar)
<0.05
0.05–0.2
0.2–1
>1
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

REFERENCE

Alam, M.K., Hasan, A.K.M.S., Khan, M.R. and Whitney, J.W. 1990. Geological map of Bangladesh, scale 1:1,000,000. Geological Survey of Bangladesh, Dhaka.


K/Na (molar)
<0.04
0.04–0.1
0.1–0.25
>0.25
India
India
Bay of Bengal
200 km
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/DFID (2000)

2 The BWDB Water-Quality Monitoring Network

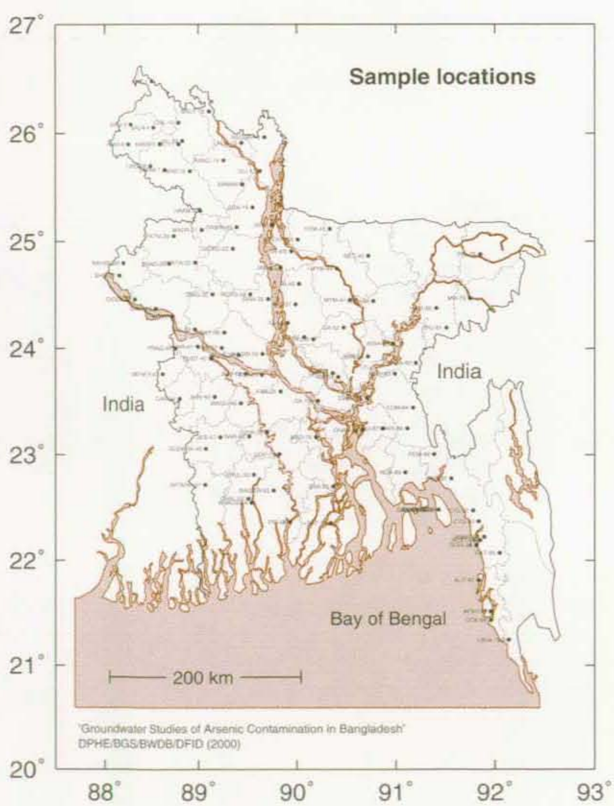
INTRODUCTION

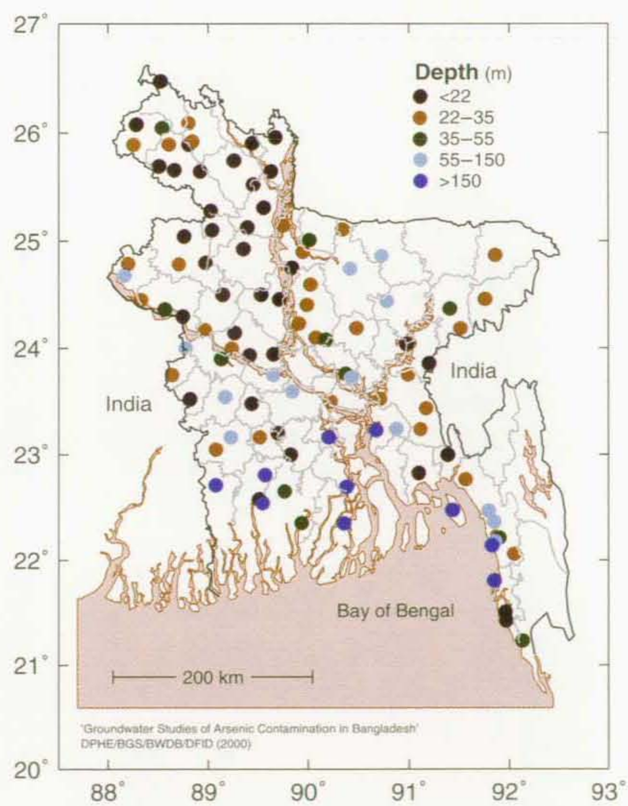
A survey of groundwater quality has also been carried out from the 113 tubewells in the BWDB Water-Quality Monitoring Network. This is a national network with sites located in all districts except the three districts of the Chittagong Hill Tracts and Sunamganj in the north-east. The tubewells in the network are monitored approximately bi-annually by BWDB for water levels and a range of other chemical constituents. The survey was carried out during May–July 1998, except for 11 samples from the north-east which were collected in June 1999 due to accessibility problems in 1998.

At the time of planning the 1998 survey, it was not clear that the more complete survey of northern Bangladesh would go ahead and so this rather limited BWDB network provided an indication of the likely range of water quality to be found over the whole of Bangladesh. A number of minor elements not previously analysed by BWDB or DPHE were included in the suite of elements that were analysed.

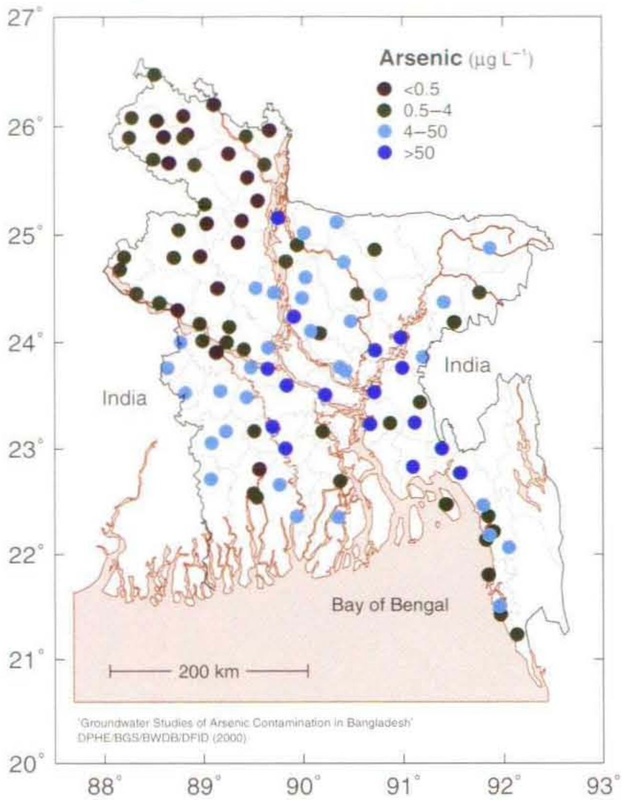
A discussion of the data is given in Chapter 6 (*The National Hydrochemical Survey)* of the Main Report

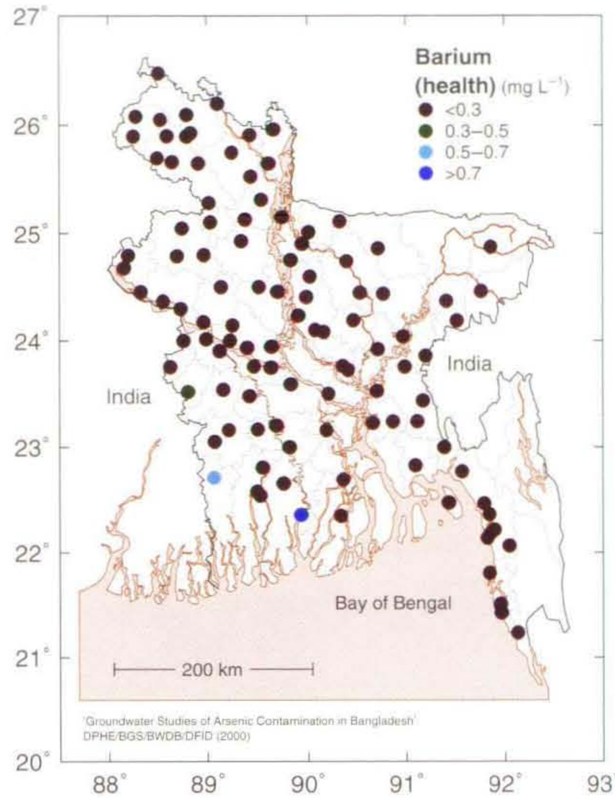
SITE DETAILS

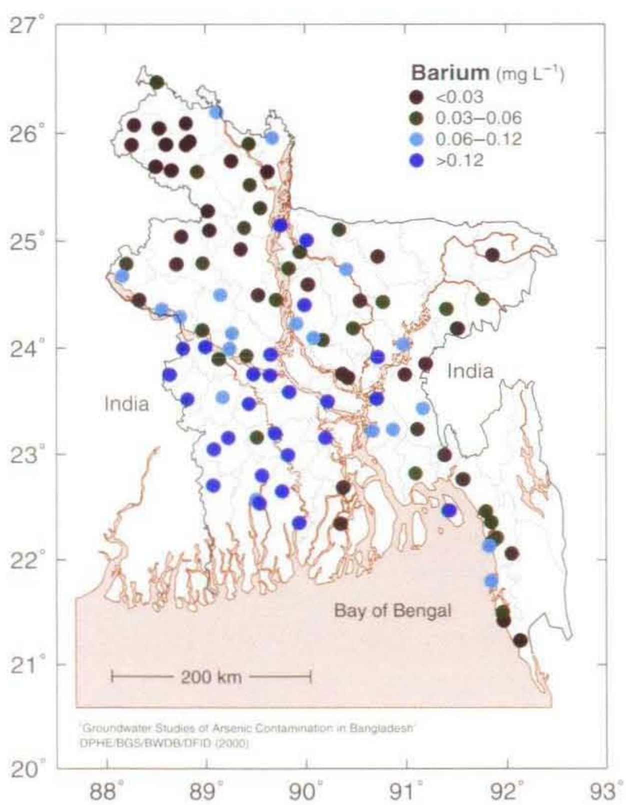


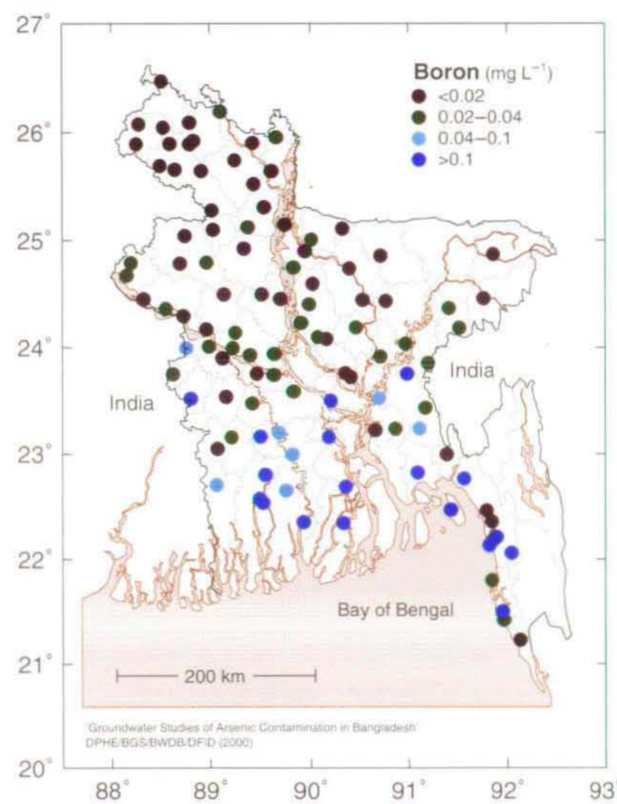


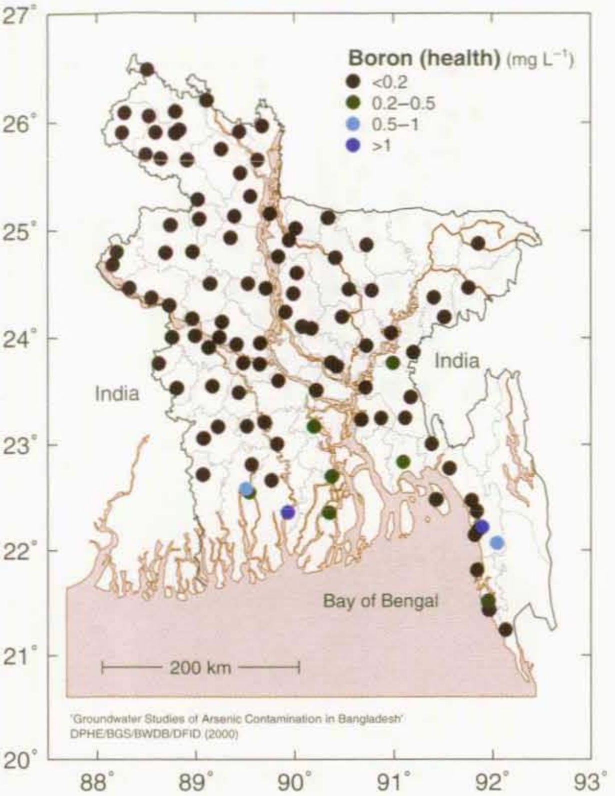
WATER-QUALITY PARAMETERS



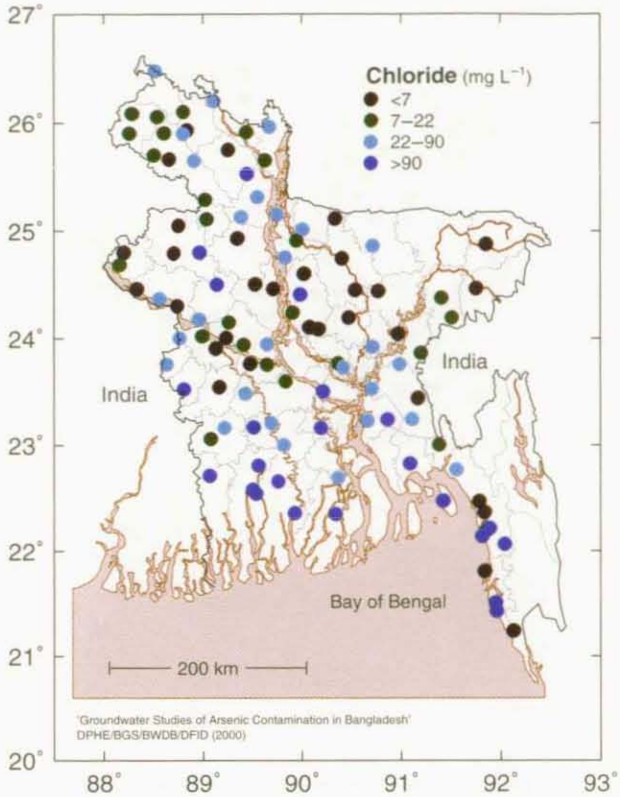




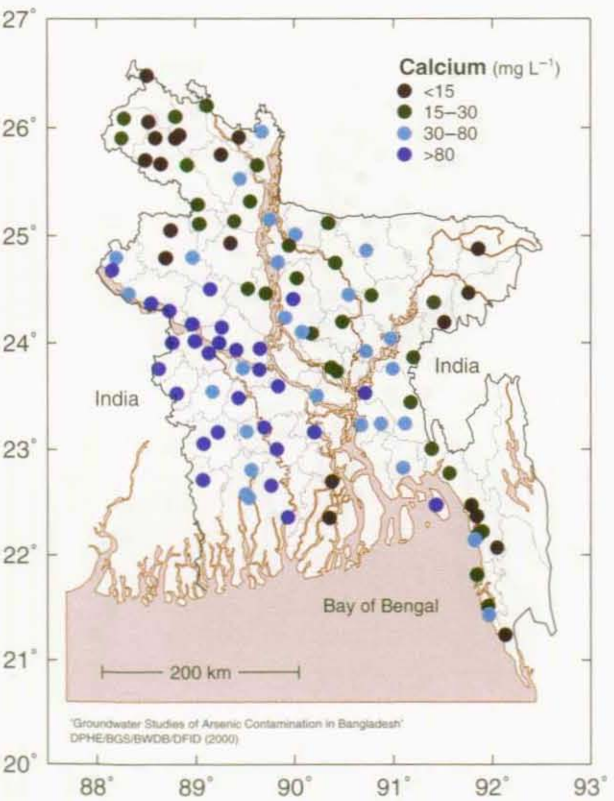




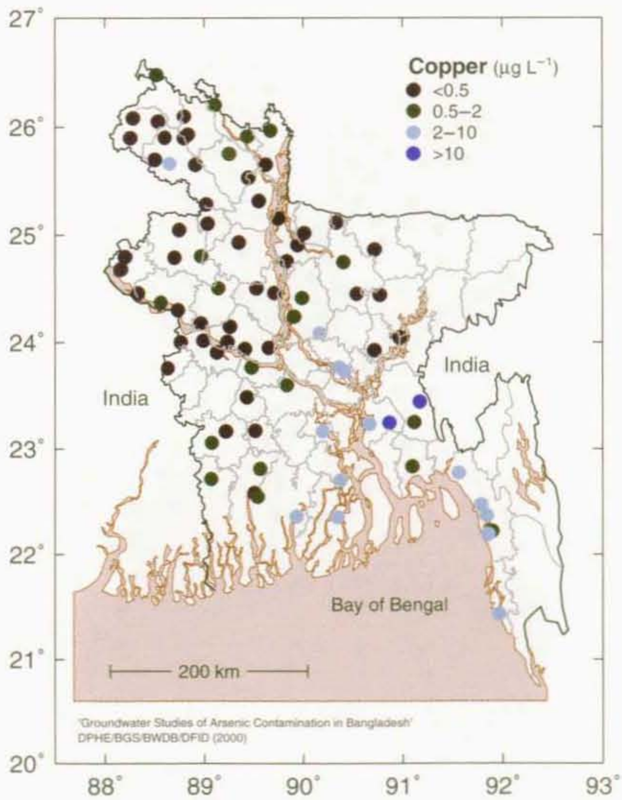
Boron (health) (mg L⁻¹)
<0.2
0.2–0.5
0.5–1
>1
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°



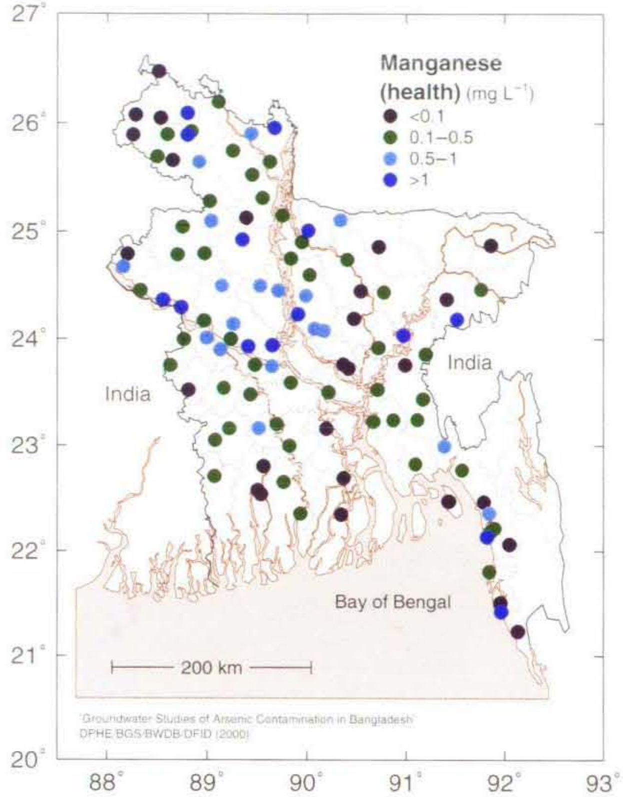
Chloride (mg L⁻¹)
<7
7–22
22–90
>90
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

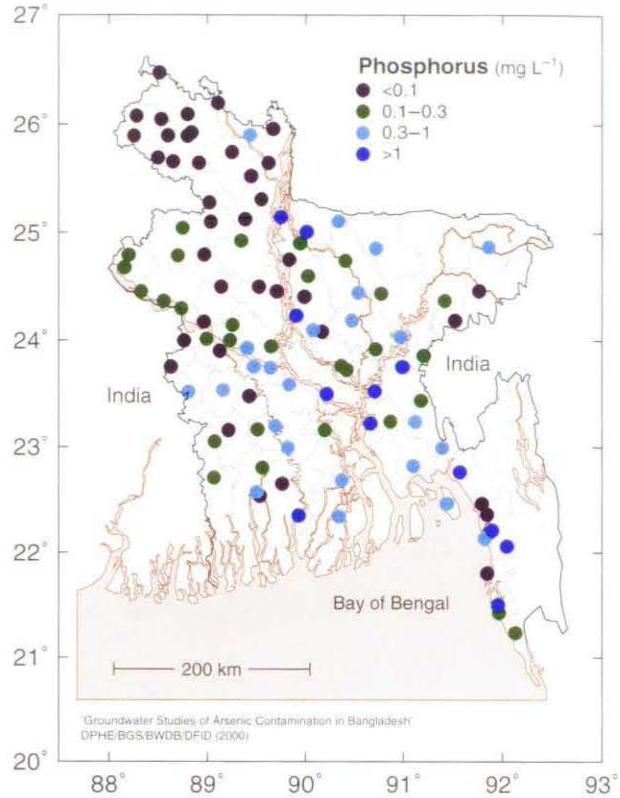


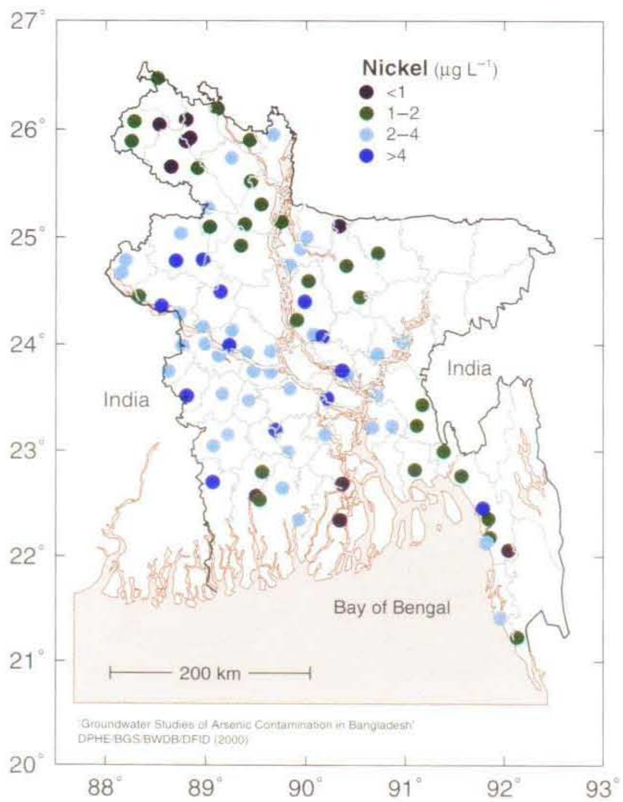
Calcium (mg L⁻¹)
<15
15–30
30–80
>80
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

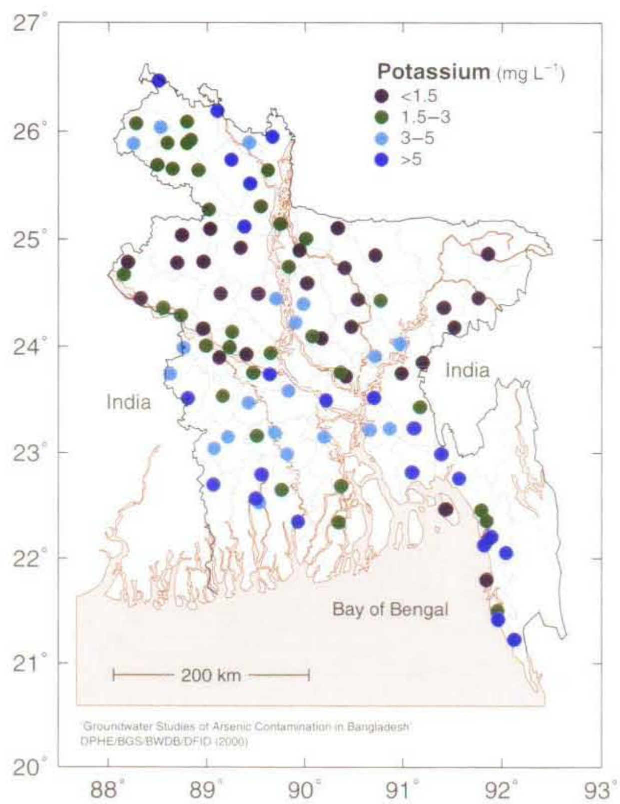


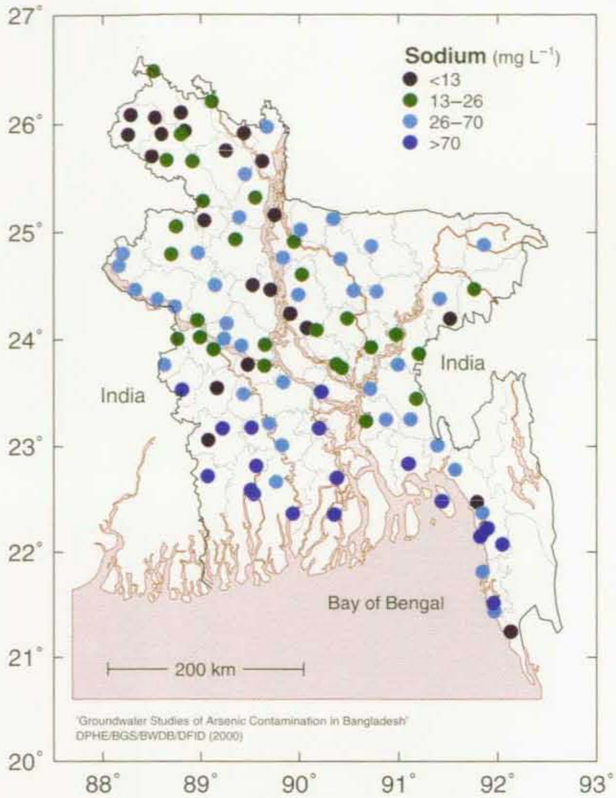
Copper (μg L⁻¹)
<0.5
0.5–2
2–10
>10
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

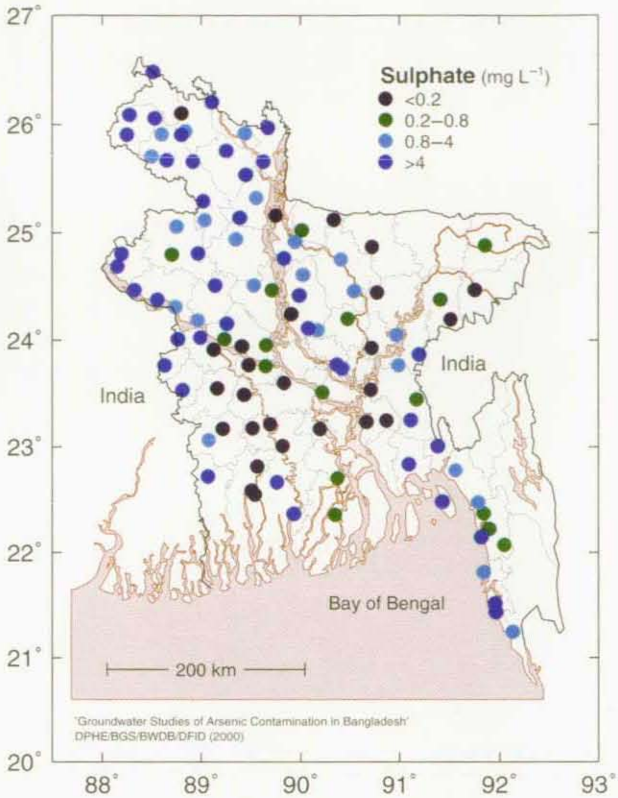

Manganese (health) (mg L⁻¹)
<0.1
0.1–0.5
0.5–1
>1
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

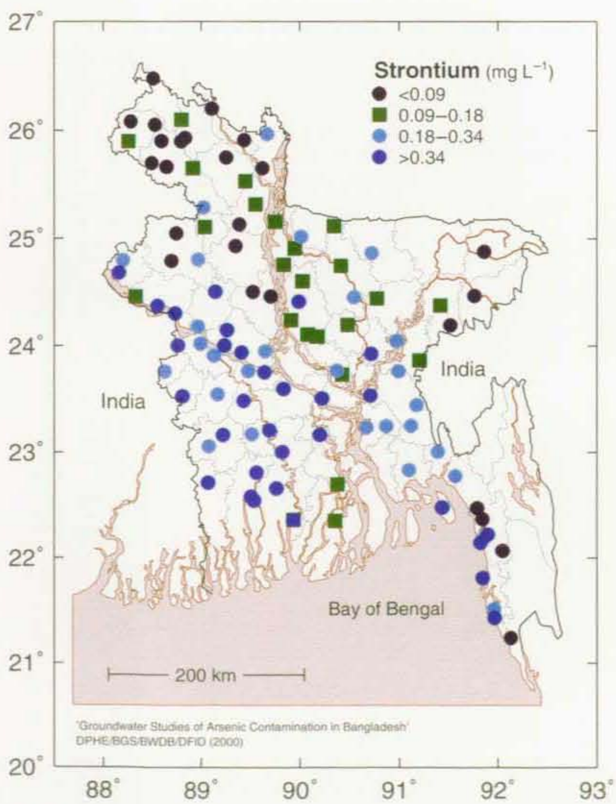

Phosphorus (mg L⁻¹)
<0.1
0.1–0.3
0.3–1
>1
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°

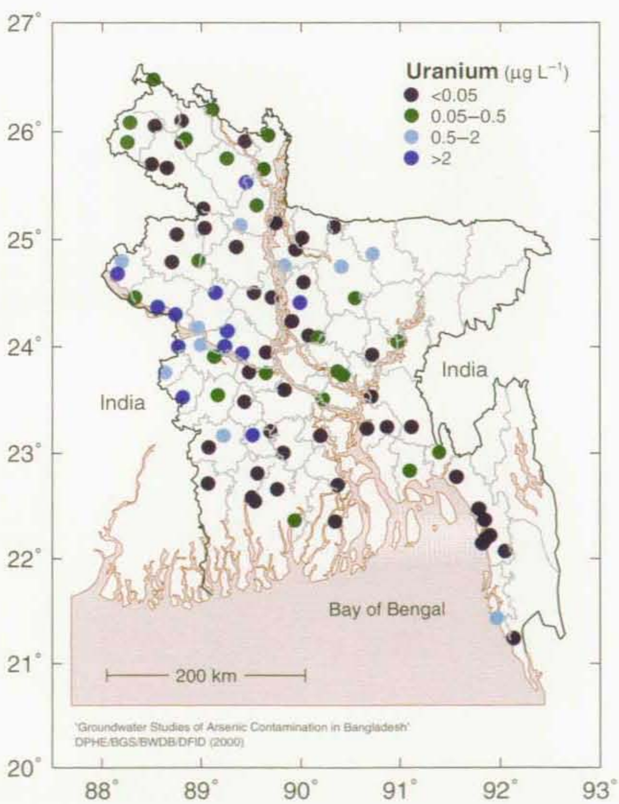

Nickel (μg L⁻¹)
<1
1–2
2–4
>4
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°


Potassium (mg L⁻¹)
<1.5
1.5–3
3–5
>5
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh'
DPHE/BGS/BWDB/DFID (2000)
27°
26°
25°
24°
23°
22°
21°
20°
88°
89°
90°
91°
92°
93°


Sodium (mg L⁻¹)
<13
13–26
26–70
>70
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh' DPHE/BGS/BWDB/DFID (2000)
27° 26° 25° 24° 23° 22° 21° 20°
88° 89° 90° 91° 92° 93°


Sulphate (mg L⁻¹)
<0.2
0.2–0.8
0.8–4
>4
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh' DPHE/BGS/BWDB/DFID (2000)
27° 26° 25° 24° 23° 22° 21° 20°
88° 89° 90° 91° 92° 93°


Strontium (mg L⁻¹)
<0.09
0.09–0.18
0.18–0.34
>0.34
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh' DPHE/BGS/BWDB/DFID (2000)
27° 26° 25° 24° 23° 22° 21° 20°
88° 89° 90° 91° 92° 93°


Uranium (µg L⁻¹)
<0.05
0.05–0.5
0.5–2
>2
India
India
Bay of Bengal
200 km
'Groundwater Studies of Arsenic Contamination in Bangladesh' DPHE/BGS/BWDB/DFID (2000)
27° 26° 25° 24° 23° 22° 21° 20°
88° 89° 90° 91° 92° 93°

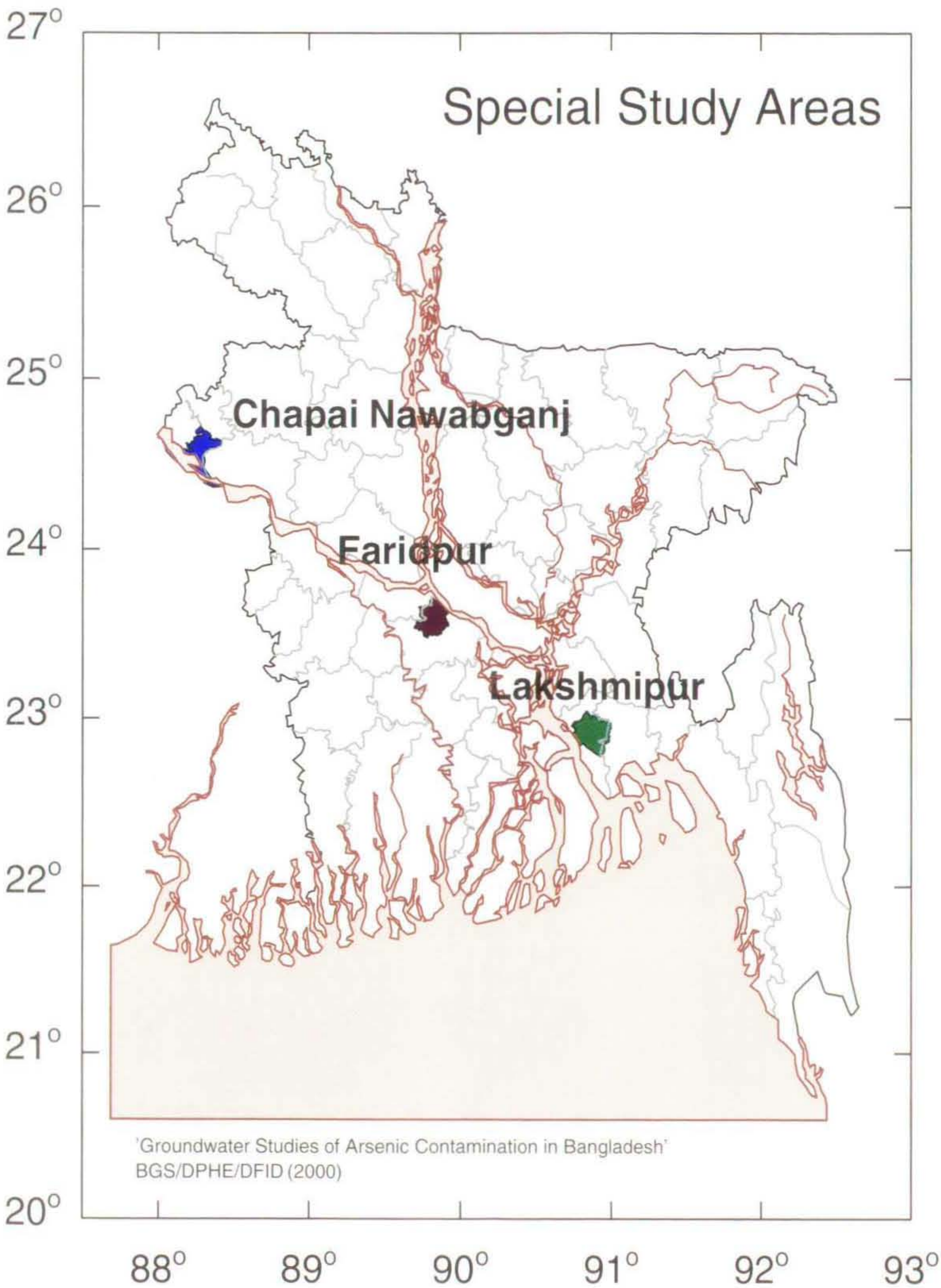
3 Special Study Areas

INTRODUCTION

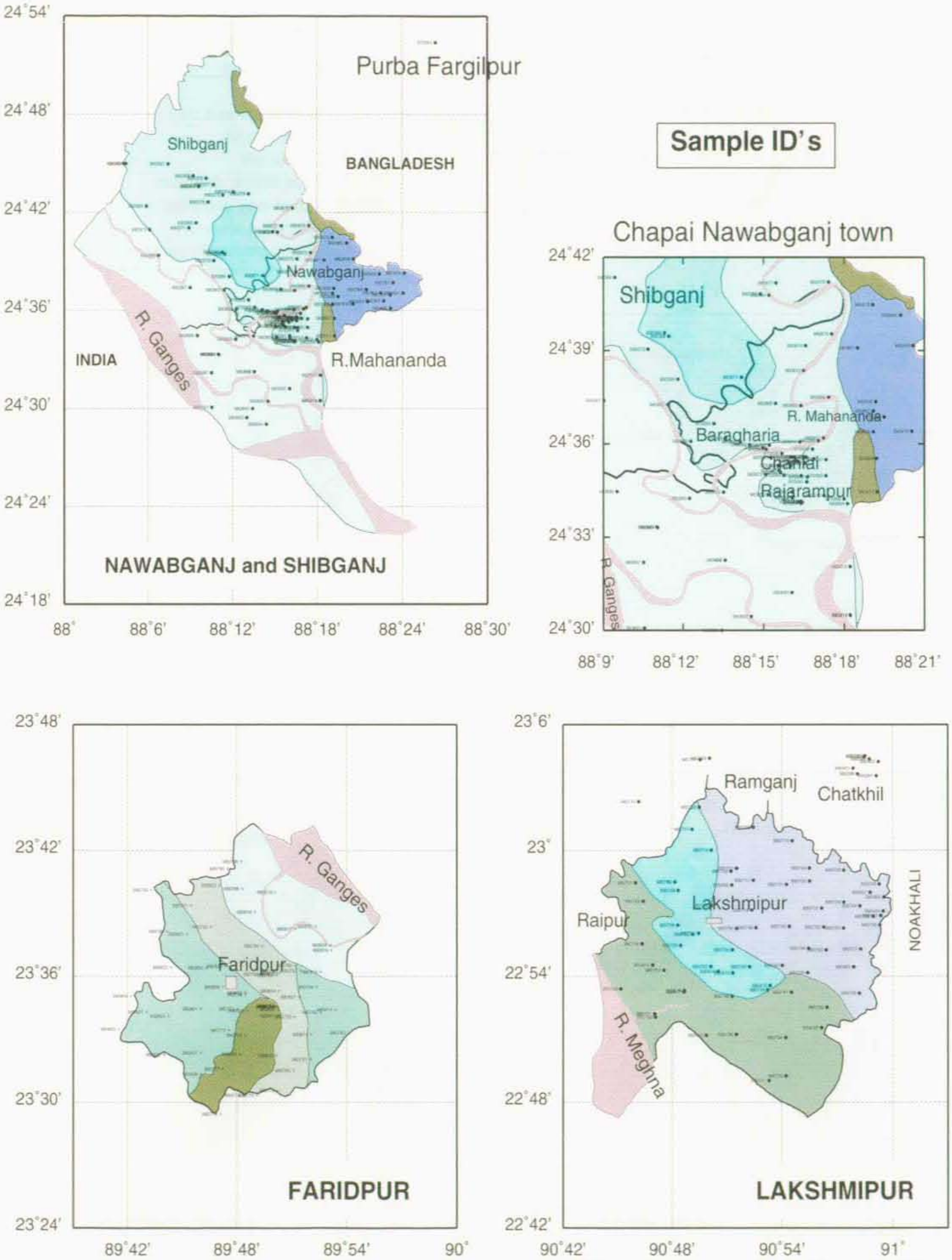
Chemical data collected for groundwaters from the National Hydrochemical Survey give useful information about the inorganic groundwater quality and the regional variations but interpretation is limited by the range of determinands analysed. More detailed analysis of the national survey samples, including anion, trace-element and isotopic analysis, was beyond the scope of the project. However, these parameters are of great potential value in assessing hydrogeochemical processes in the aquifers and for this reason, three Special Study Areas were chosen in which to carry out more detailed groundwater chemical analysis. These study areas were also the focus of mineralogical and sediment chemistry investigations, groundwater monitoring and flow modelling. The areas chosen were the headquarter (sadar) *upazilas* of the Districts of Lakshmipur, Faridpur and Nawabganj. Samples were also collected from Shibganj, the neighbouring *upazila* to Chapai Nawabganj headquarter *upazila* (Nawabganj District) and Chatkhil (neighbouring *upazila* to Lakshmipur headquarter *upazila*). The areas were selected as they have recognised arsenic problems, are distributed widely across the alluvial and deltaic plain of Bangladesh in different sections of the Bengal drainage system and have differing geological and hydrogeological characteristics.

Details of the sampling and analytical methods and a discussion of the data are given in Chapter 7 (*Hydrogeochemistry of three Special Study Areas*) of the Main Report.

Location of Special Study Areas



SAMPLE ID'S



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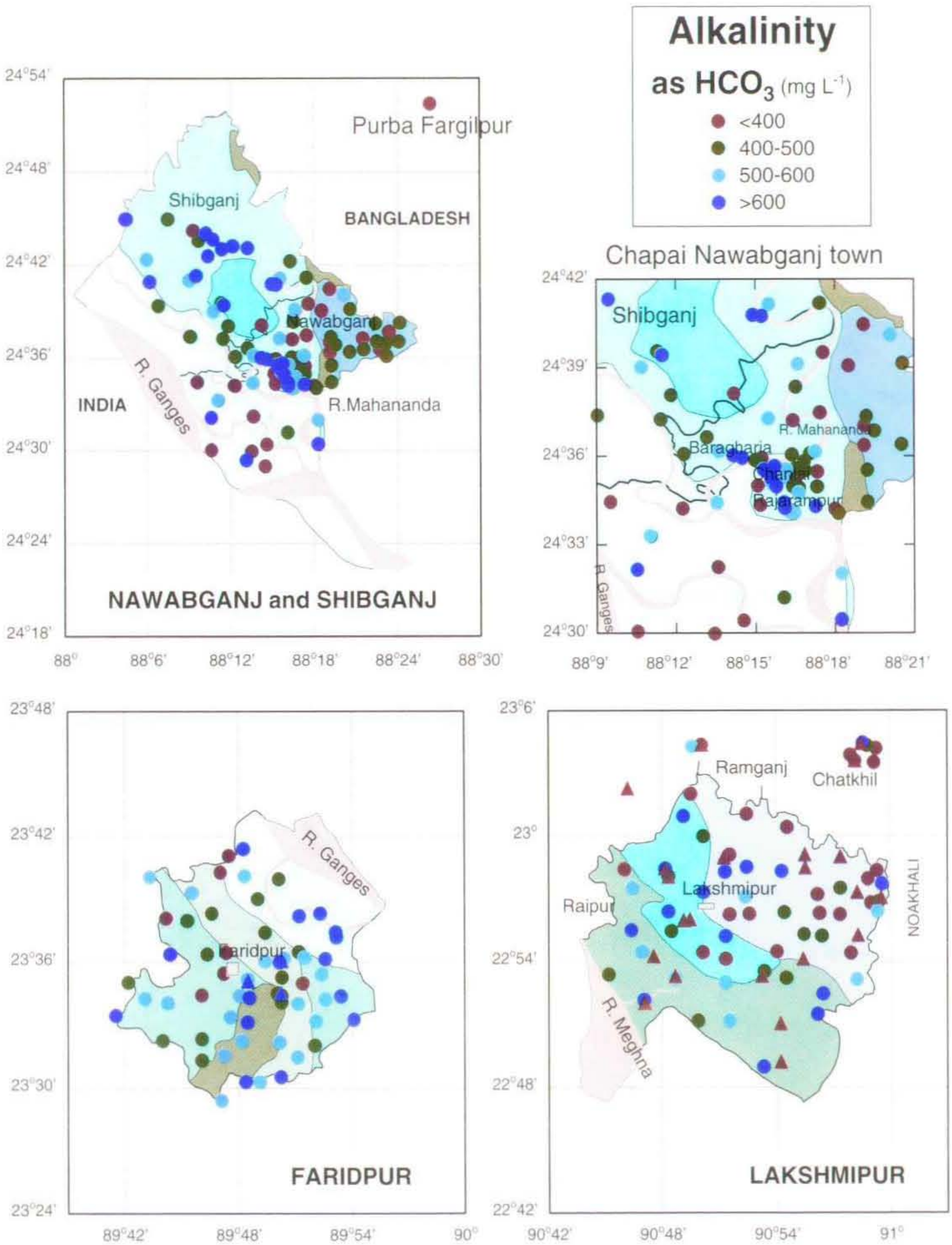
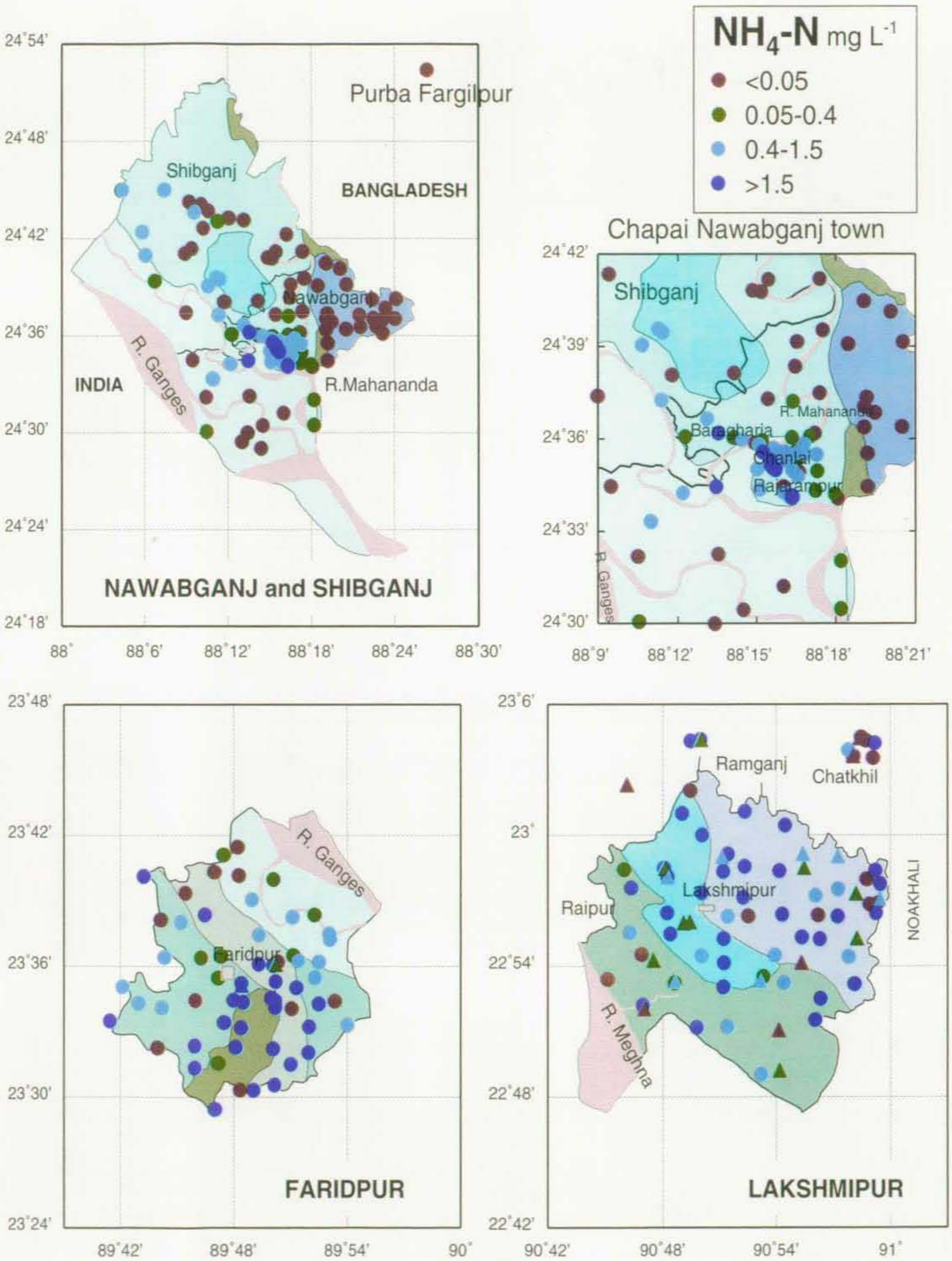
BGS/DPHE/DFID (2000)

ALKALINITY



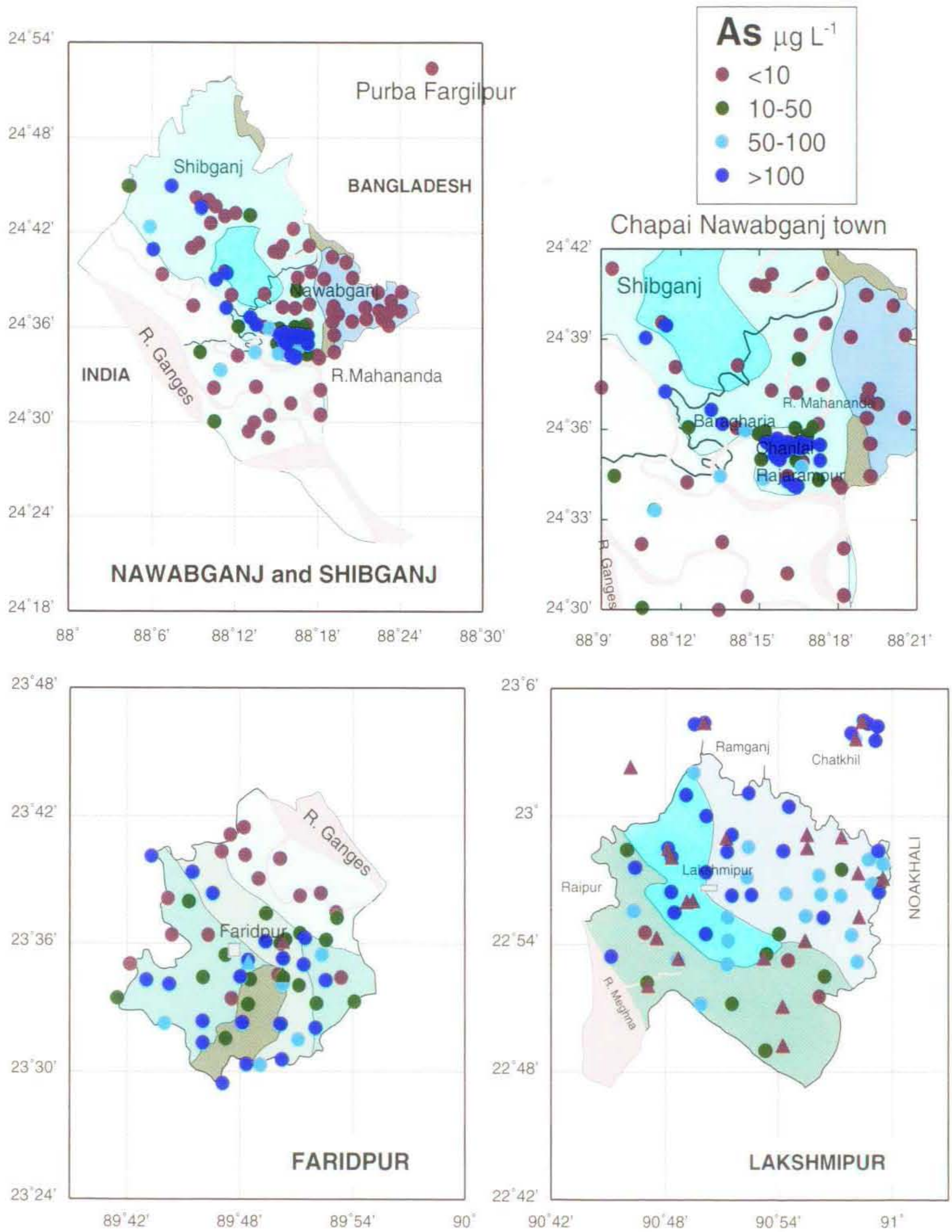
'Groundwater Studies of Arsenic Contamination in Bangladesh'
BGS/DPHE/DFID (2000)

AMMONIUM



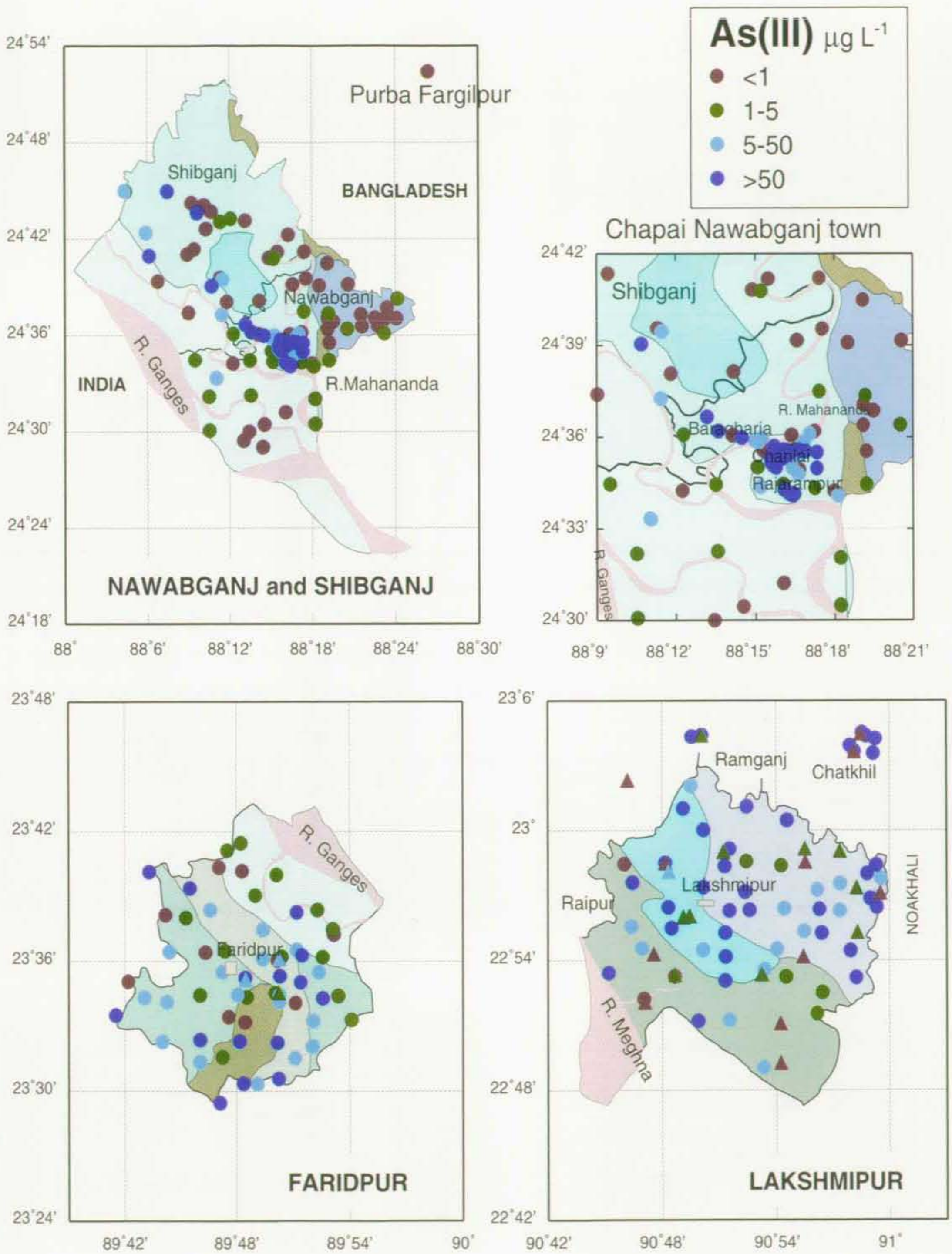
'Groundwater Studies of Arsenic Contamination in Bangladesh'
BGS/DPHE/DFID (2000)

ARSENIC (TOTAL)



'Groundwater Studies of Arsenic Contamination in Bangladesh'
BGS/DPHE/DFID (2000)

ARSENIC (AS(III))



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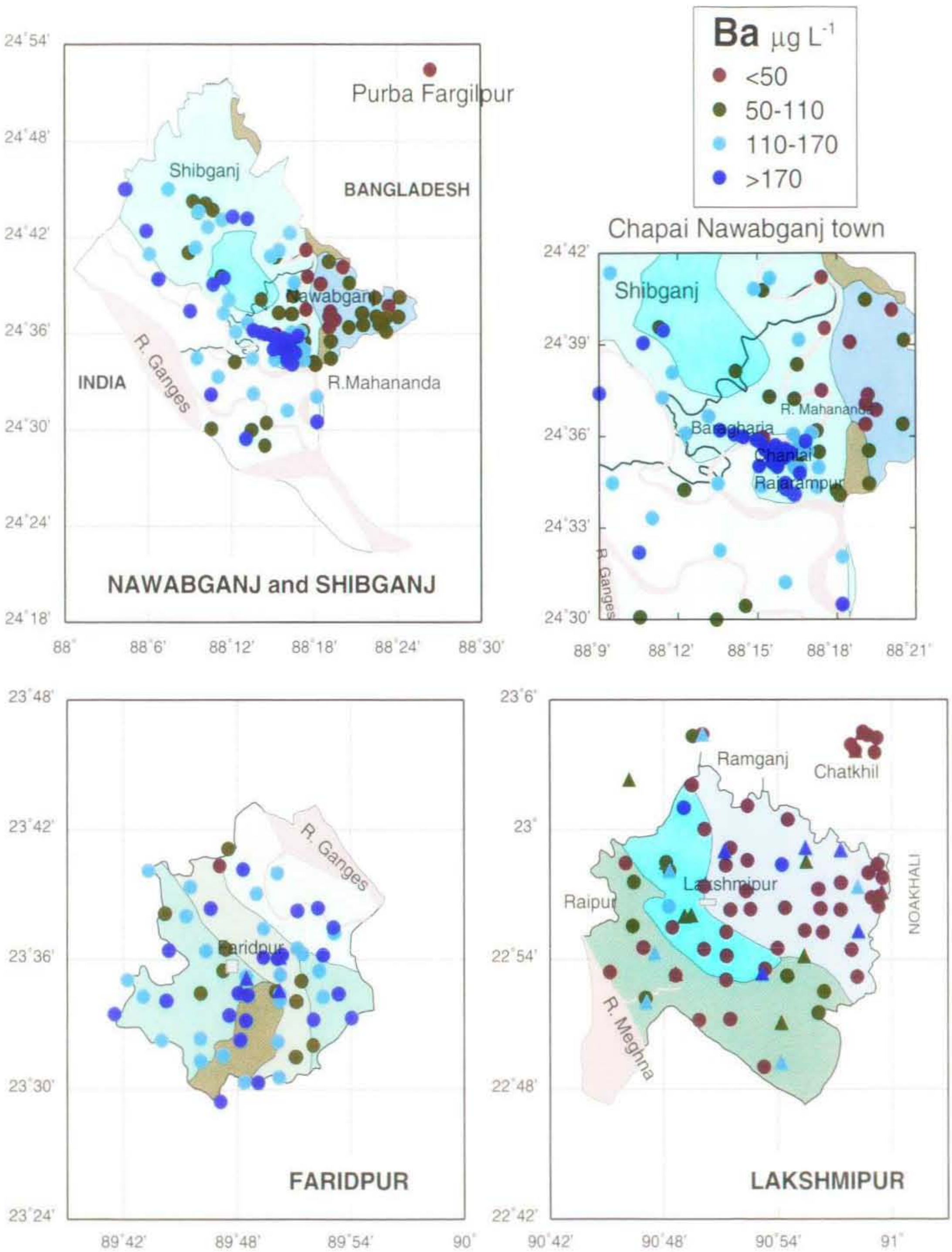
BGS/DPHE/DFID (2000)

BARIUM



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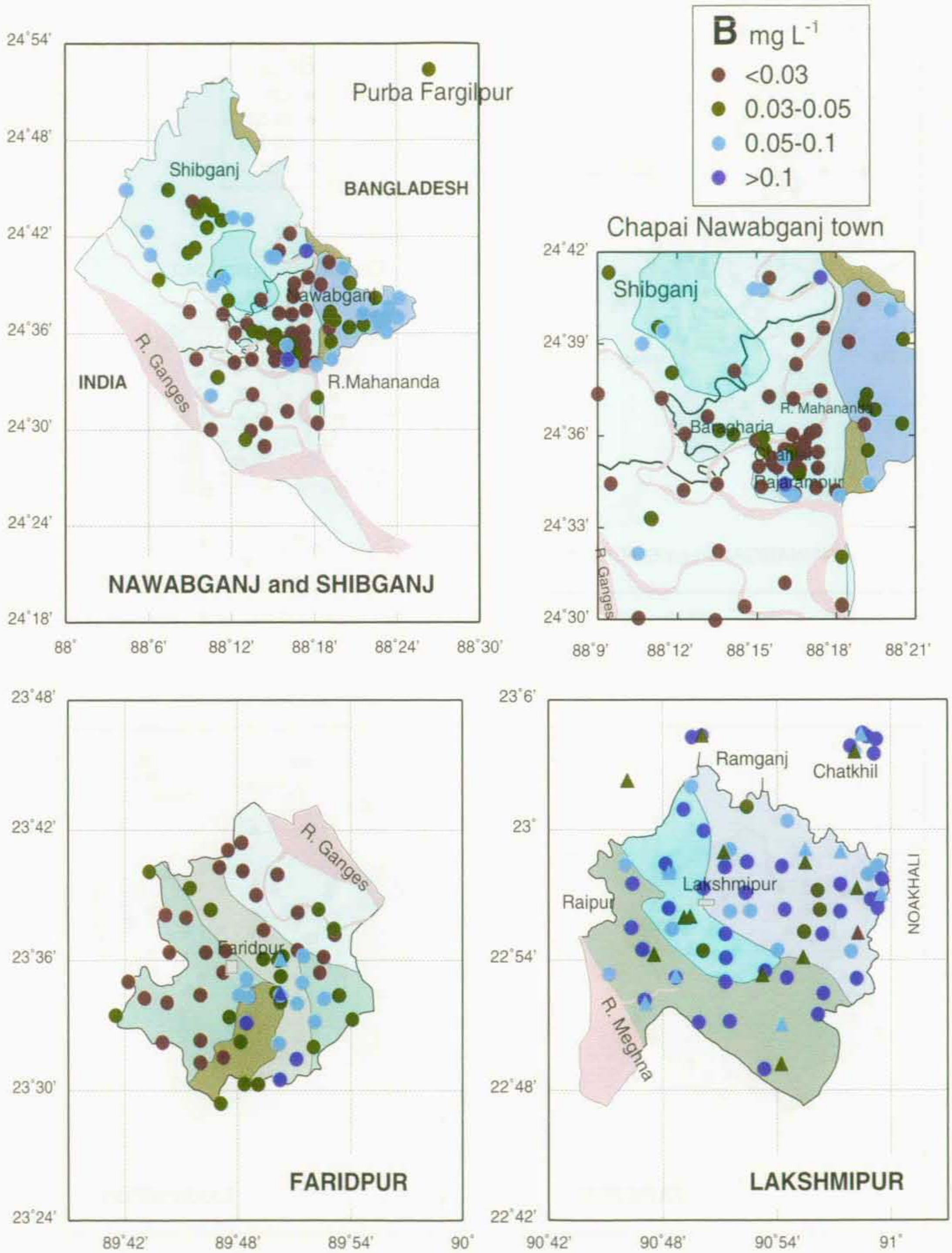
BGS/DPHE/DFID (2000)

BORON



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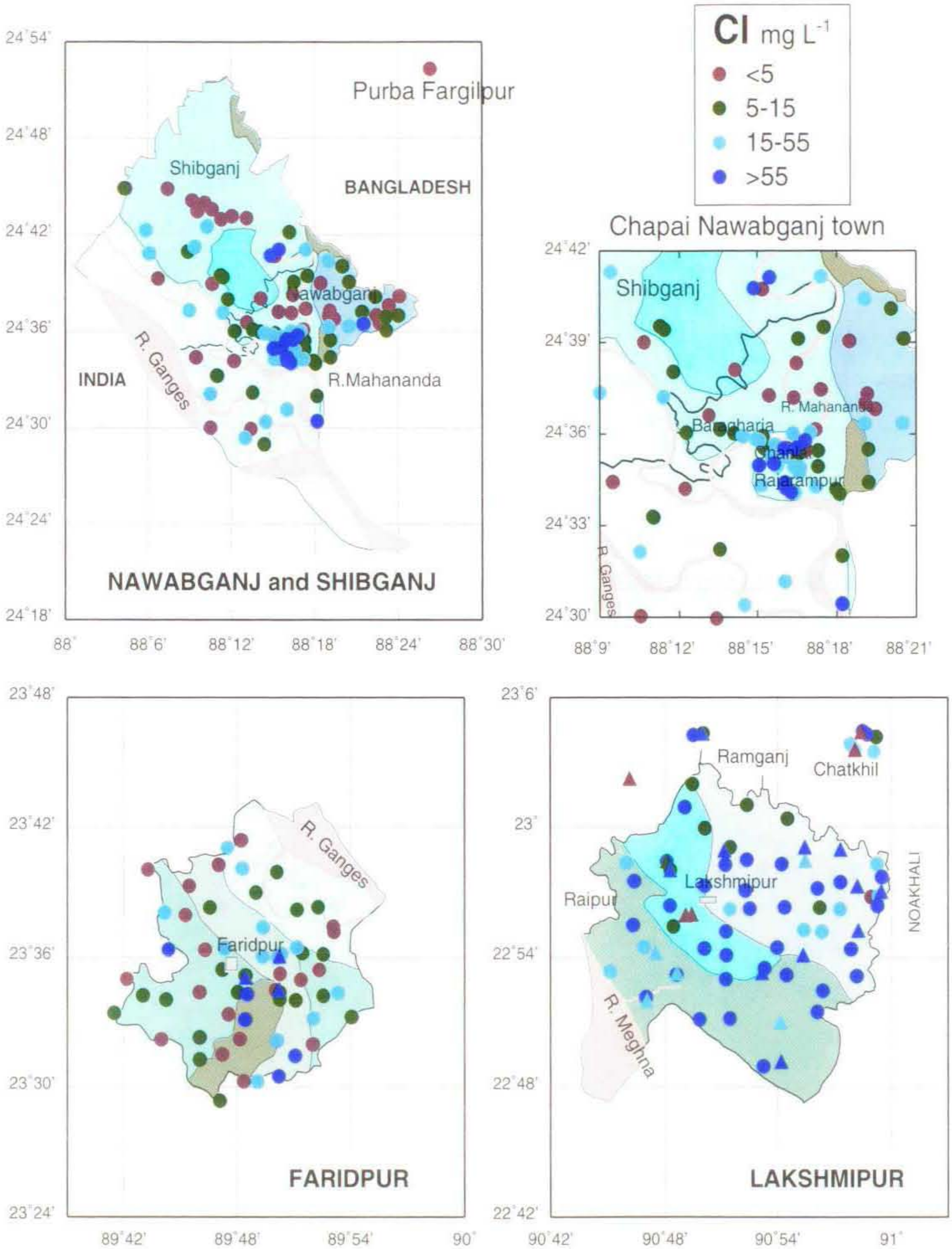
BGS/DPHE/DFID (2000)

CHLORIDE



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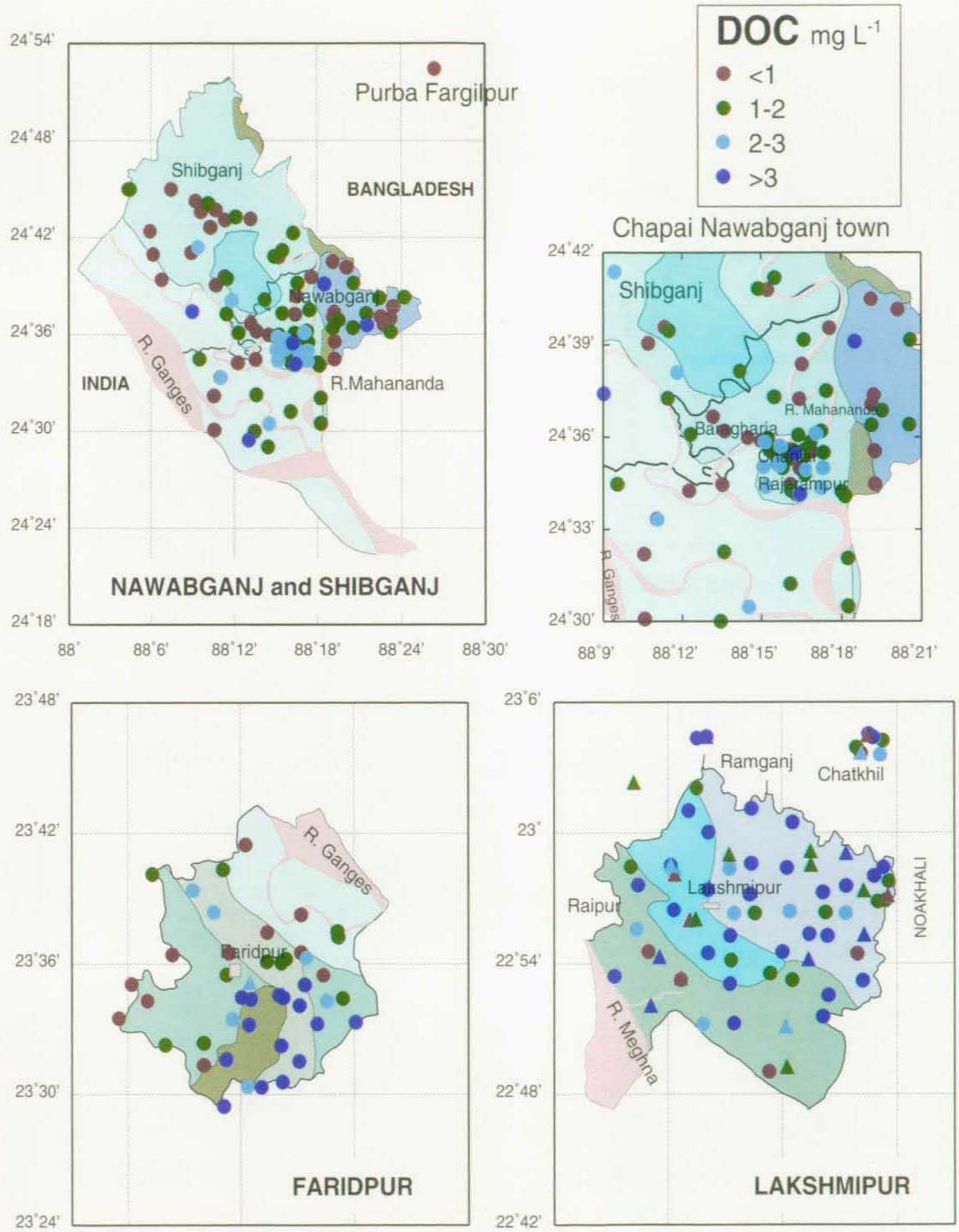
BGS/DPHE/DFID (2000)

DISSOLVED ORGANIC CARBON



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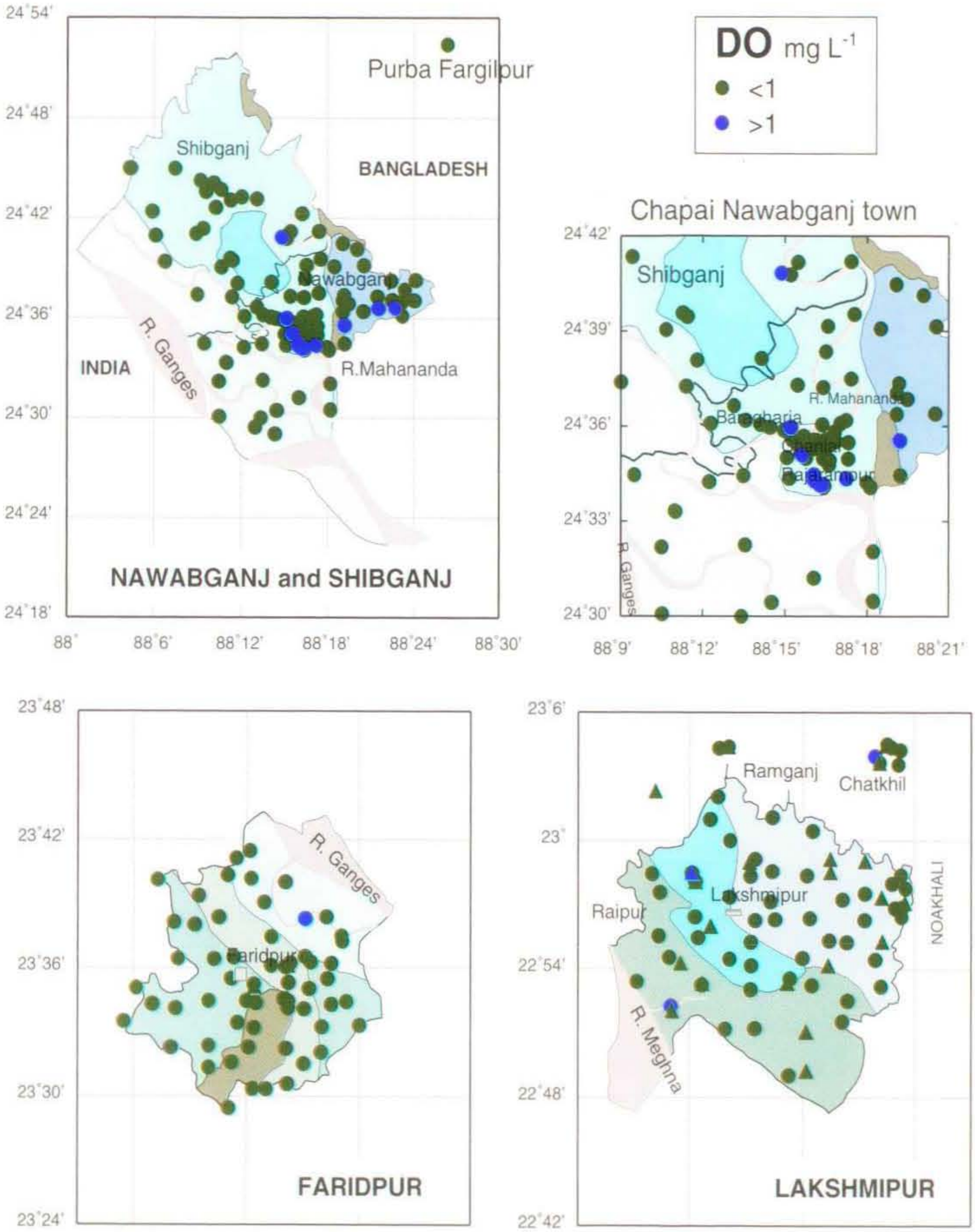
BGS/DPHE/DFID (2000)

DISSOLVED OXYGEN



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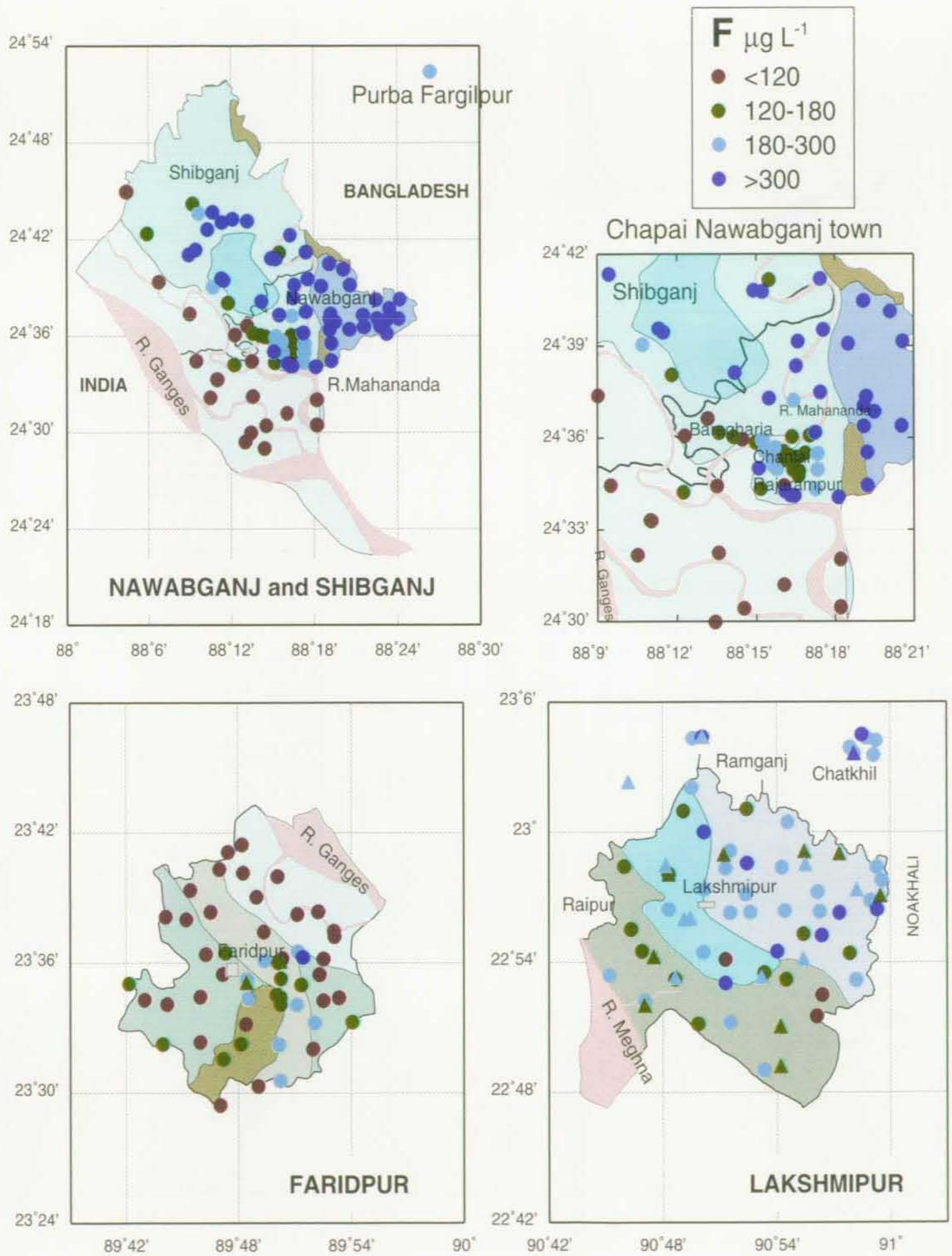
BGS/DPHE/DFID (2000)

FLUORIDE



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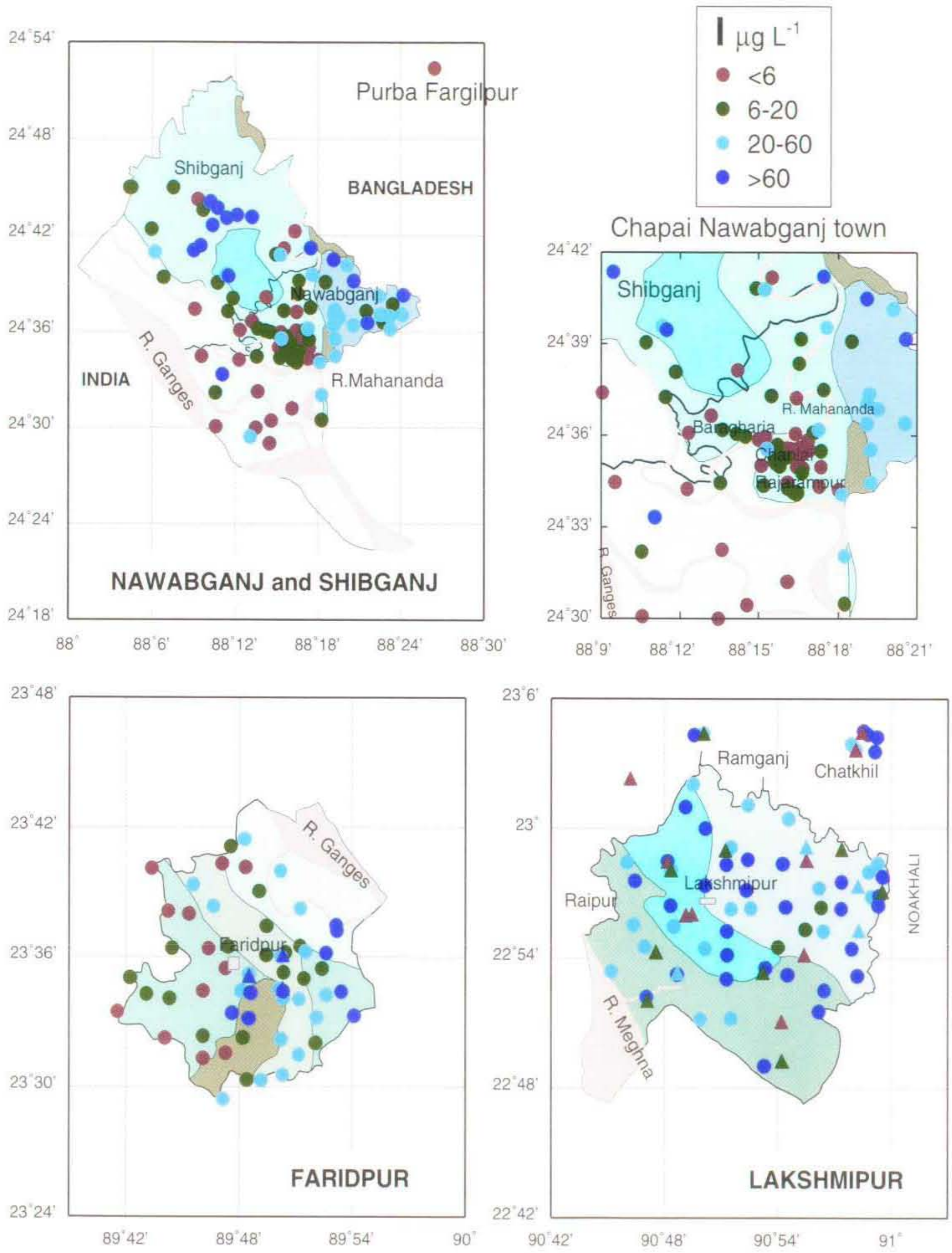
BGS/DPHE/DFID (2000)

IODIDE



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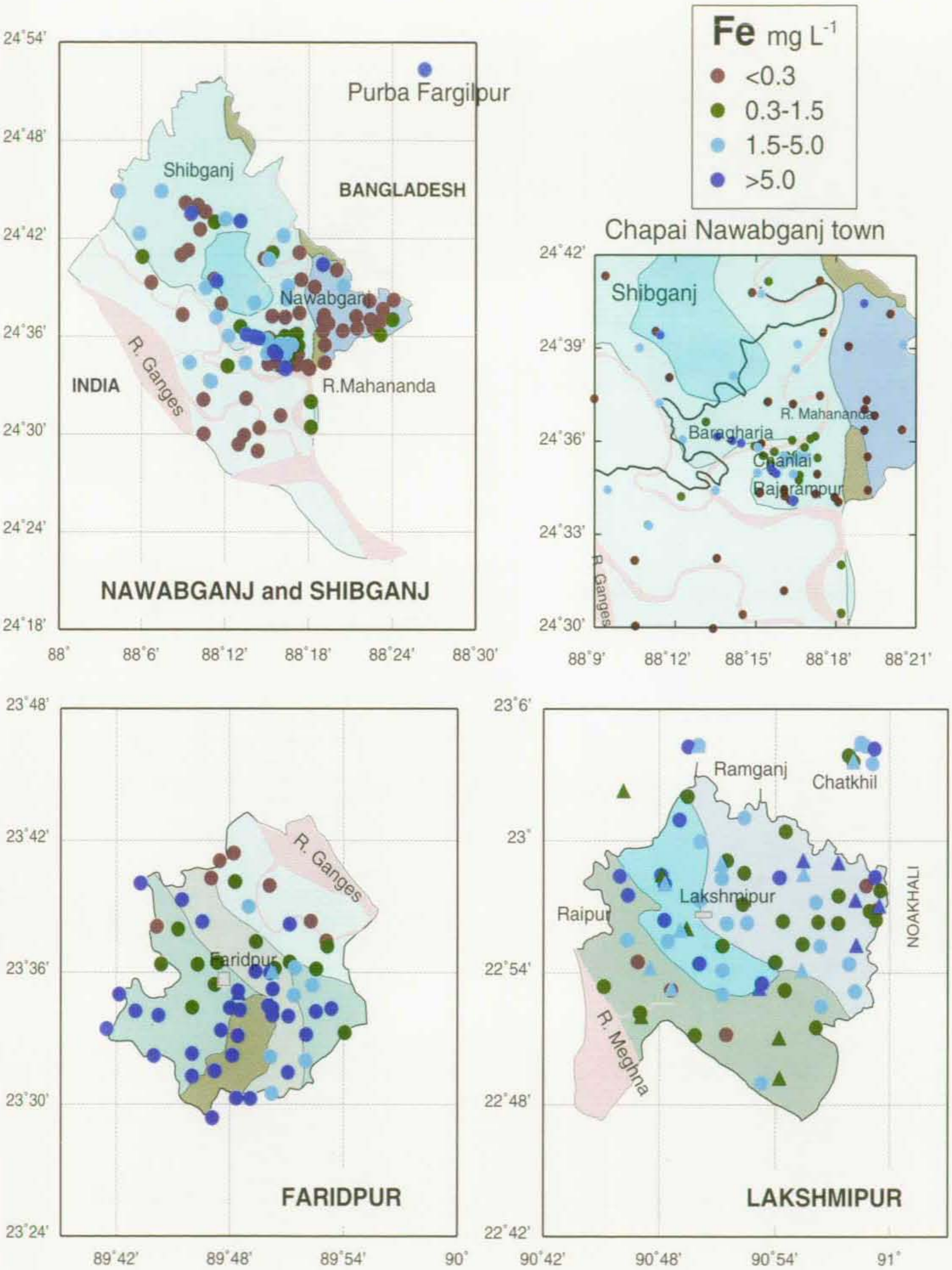
BGS/DPHE/DFID (2000)

IRON



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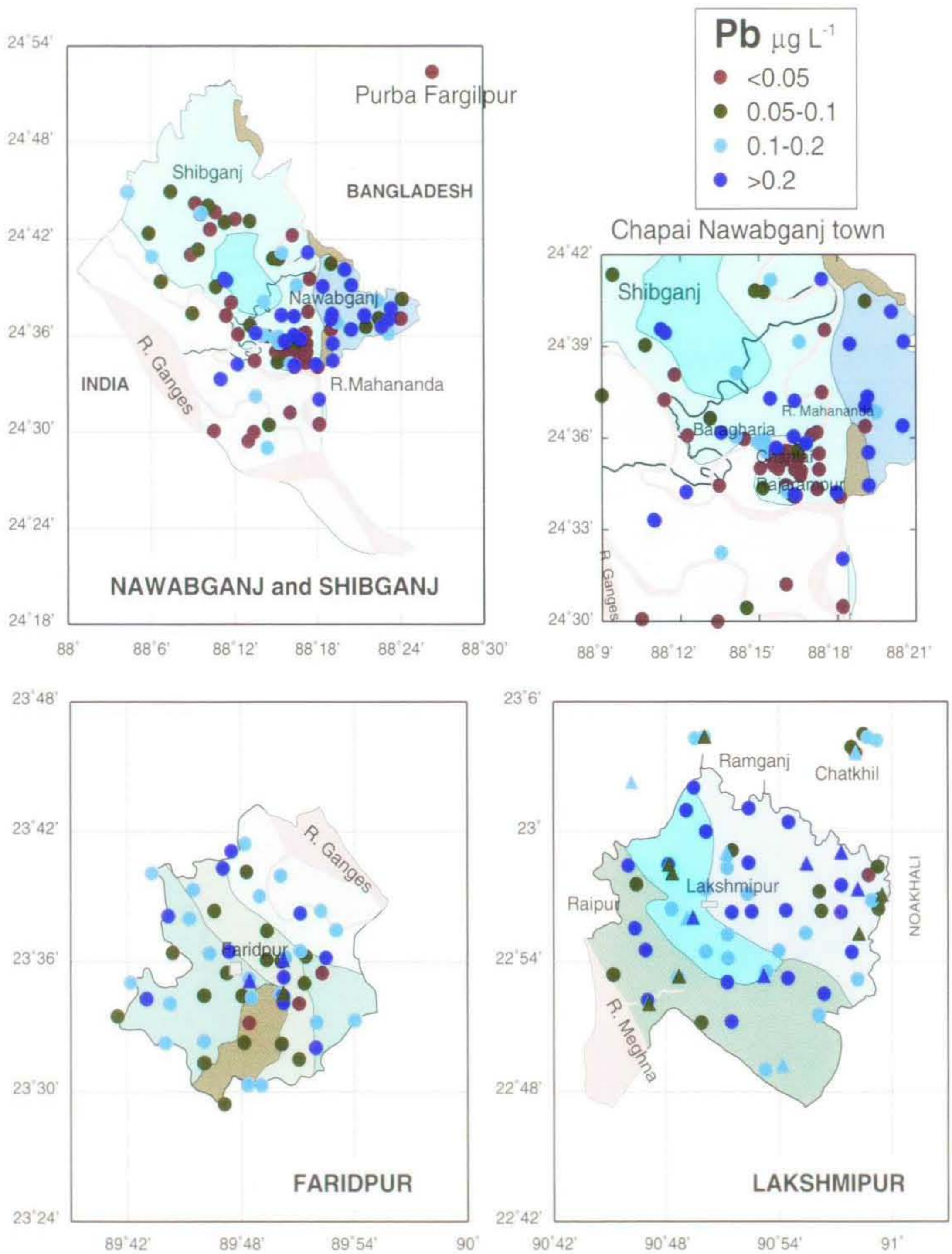
BGS/DPHE/DFID (2000)

LEAD



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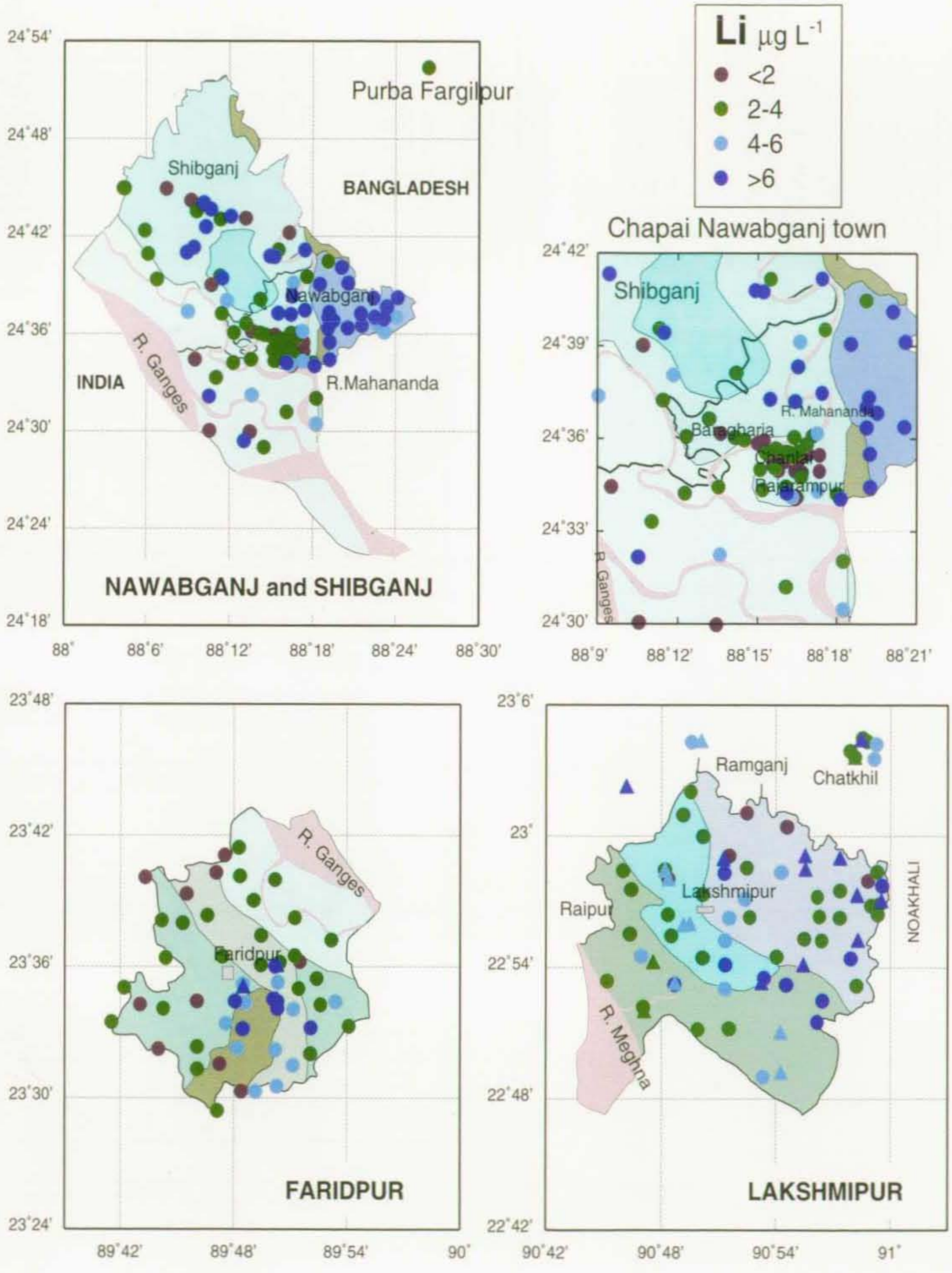
BGS/DPHE/DFID (2000)

LITHIUM



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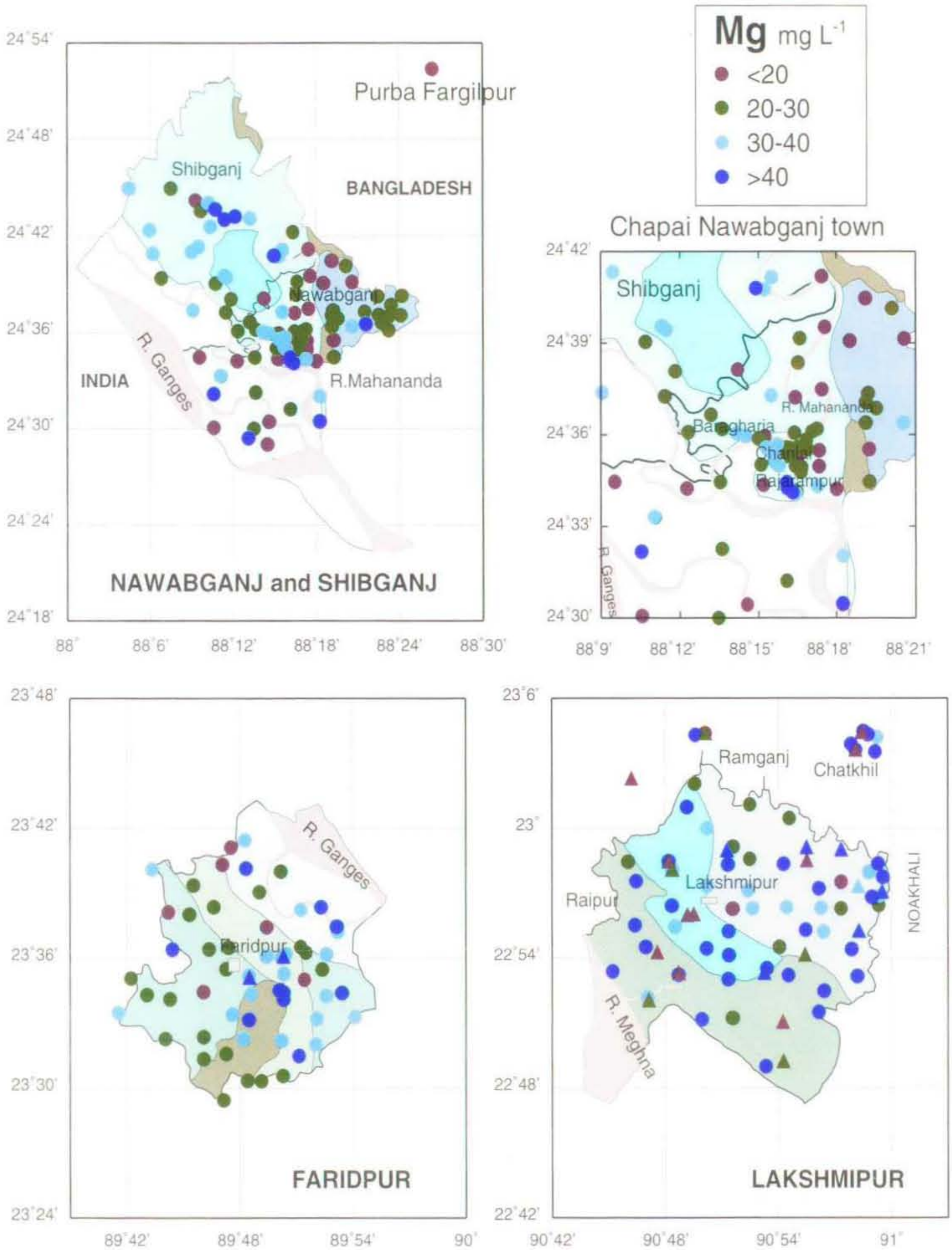
BGS/DPHE/DFID (2000)

MAGNESIUM



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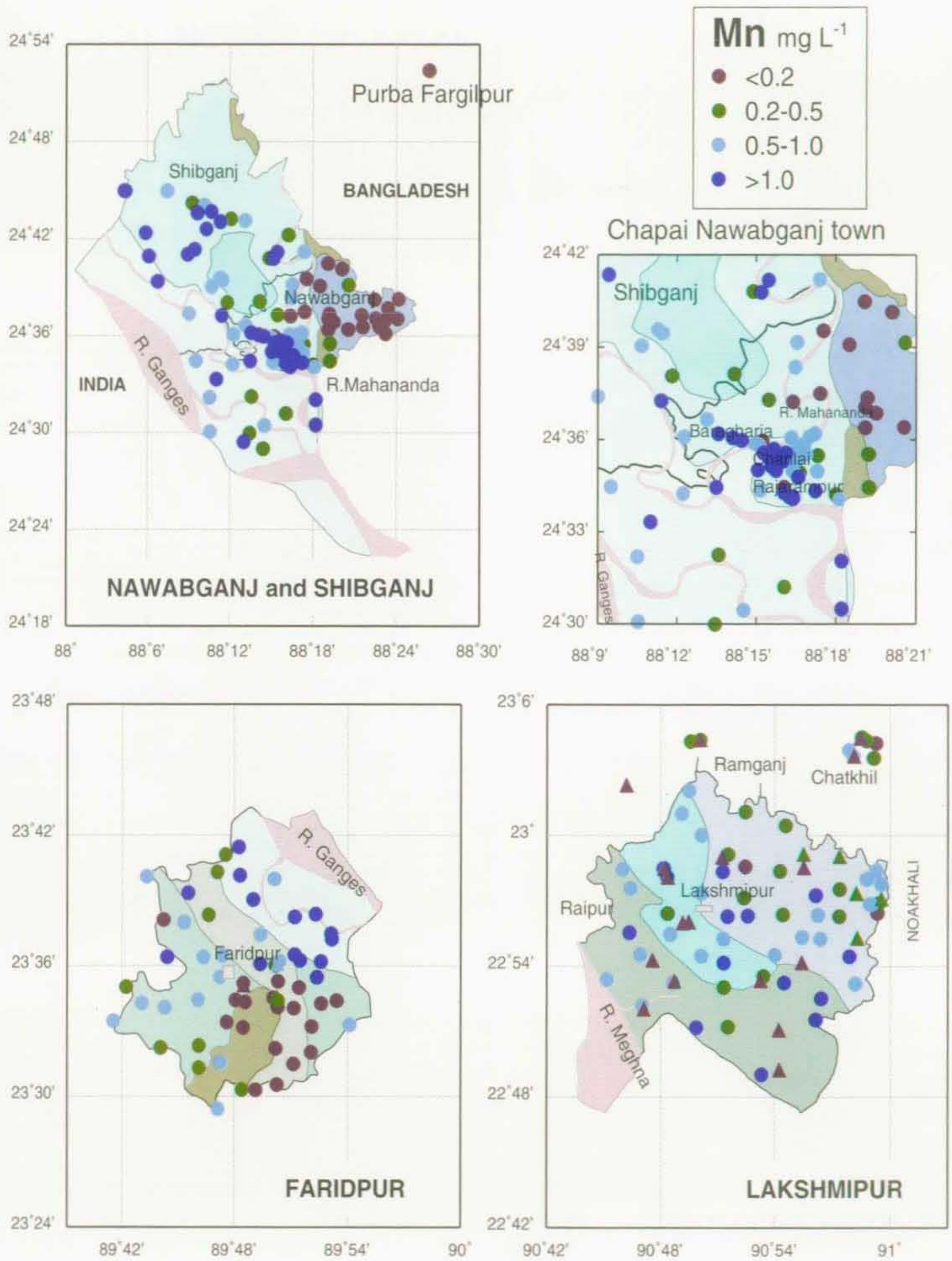
BGS/DPHE/DFID (2000)

MANGANESE



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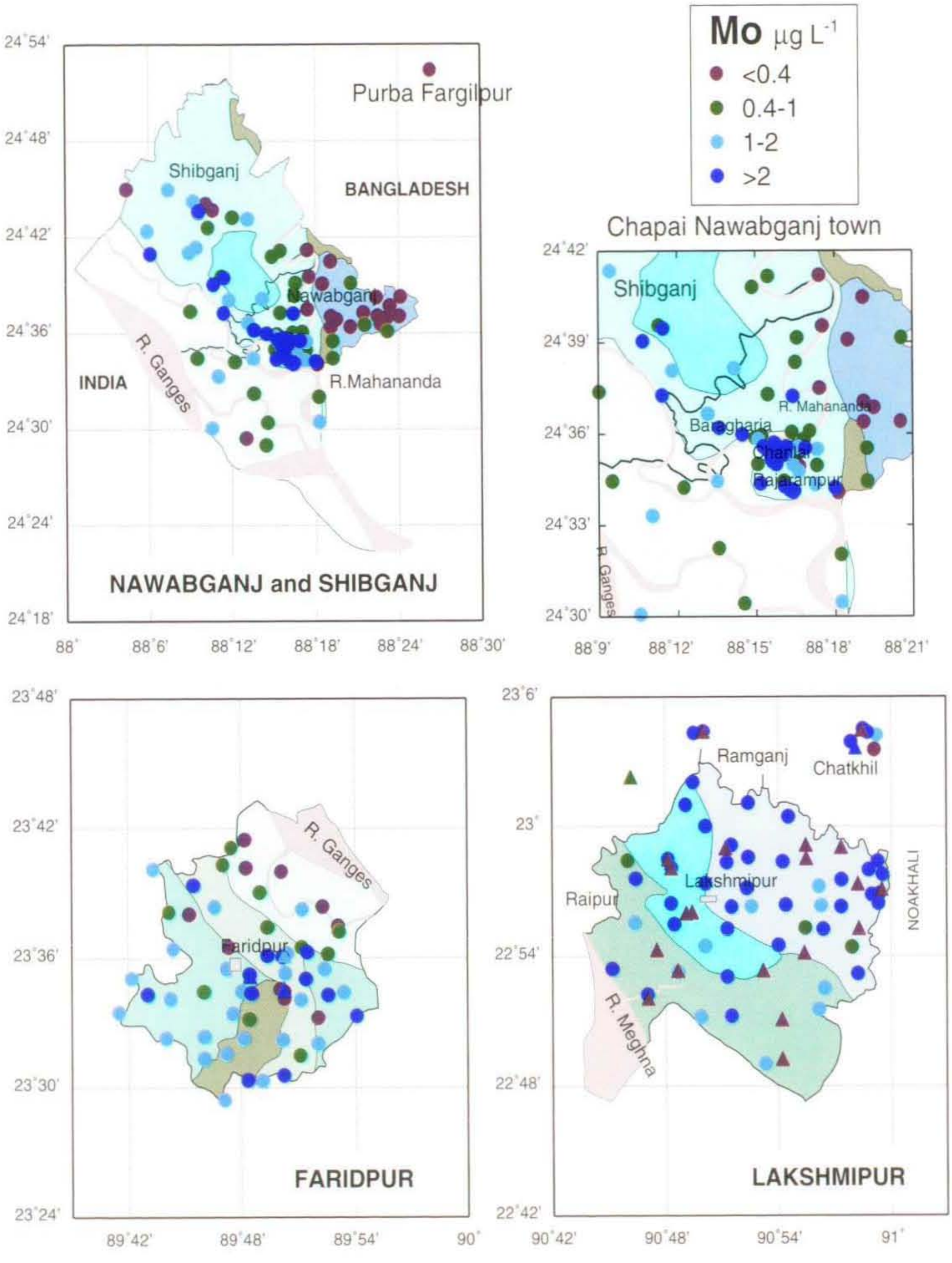
MOLYBDENUM



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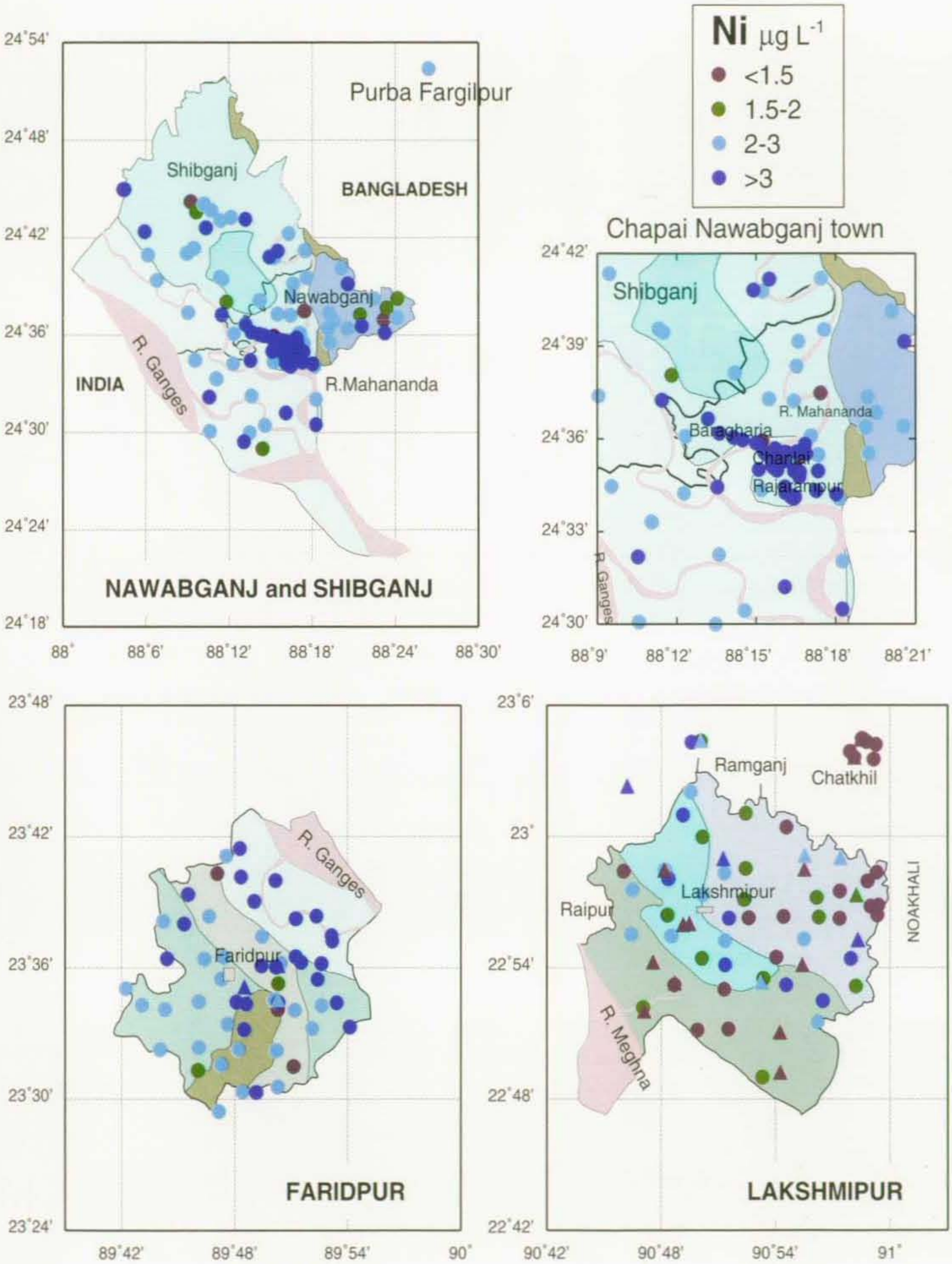
NICKEL



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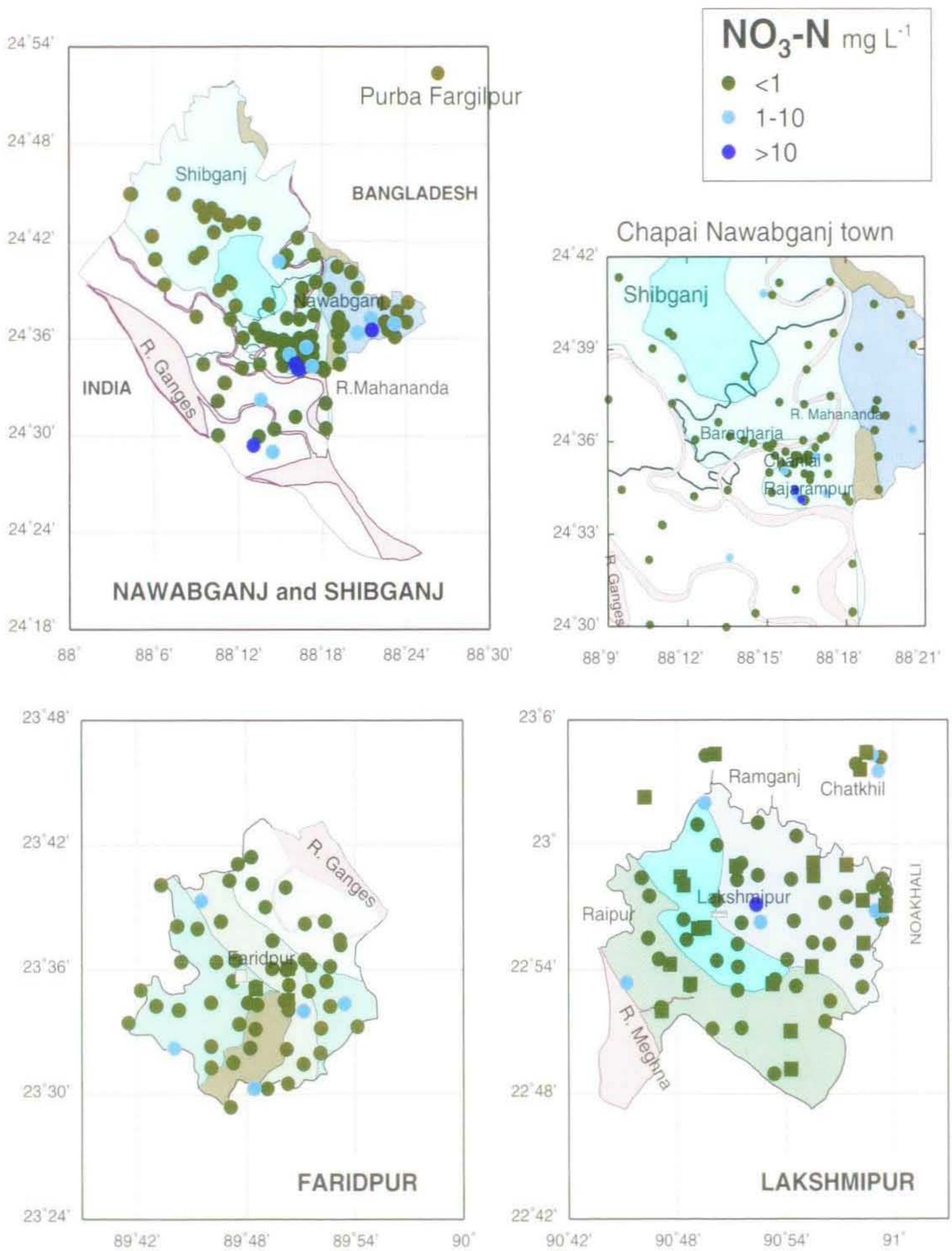
NITRATE



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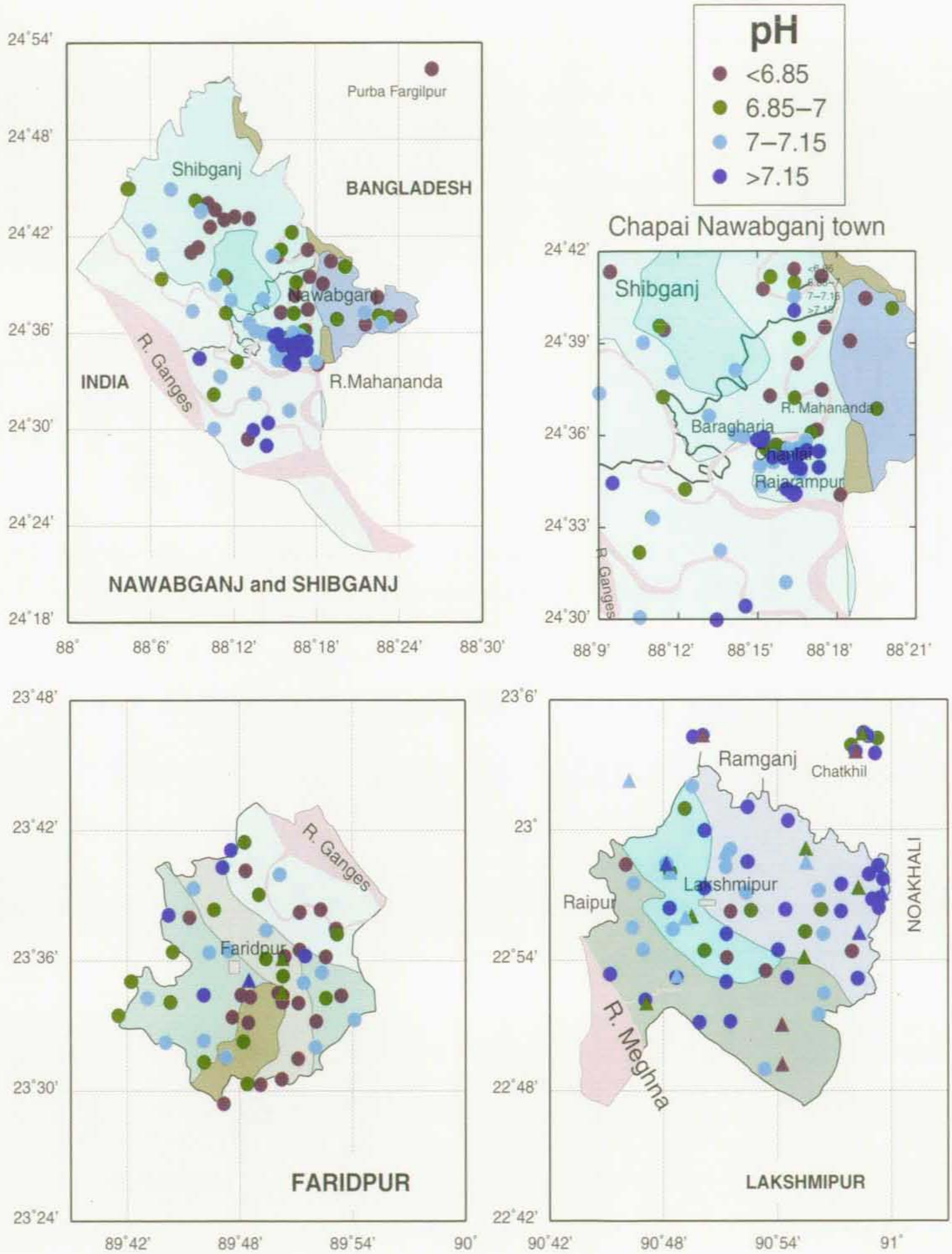
pH



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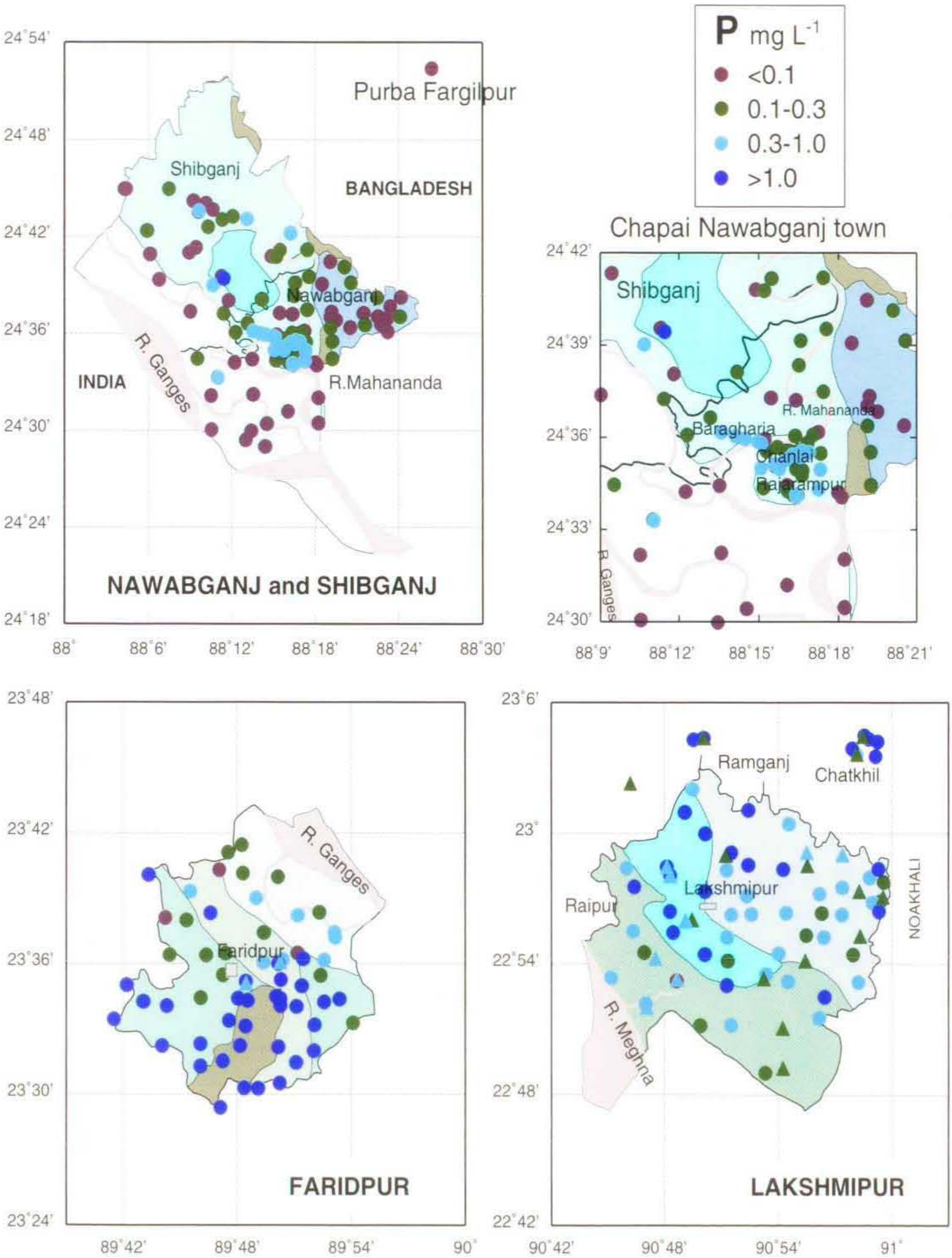
PHOSPHORUS



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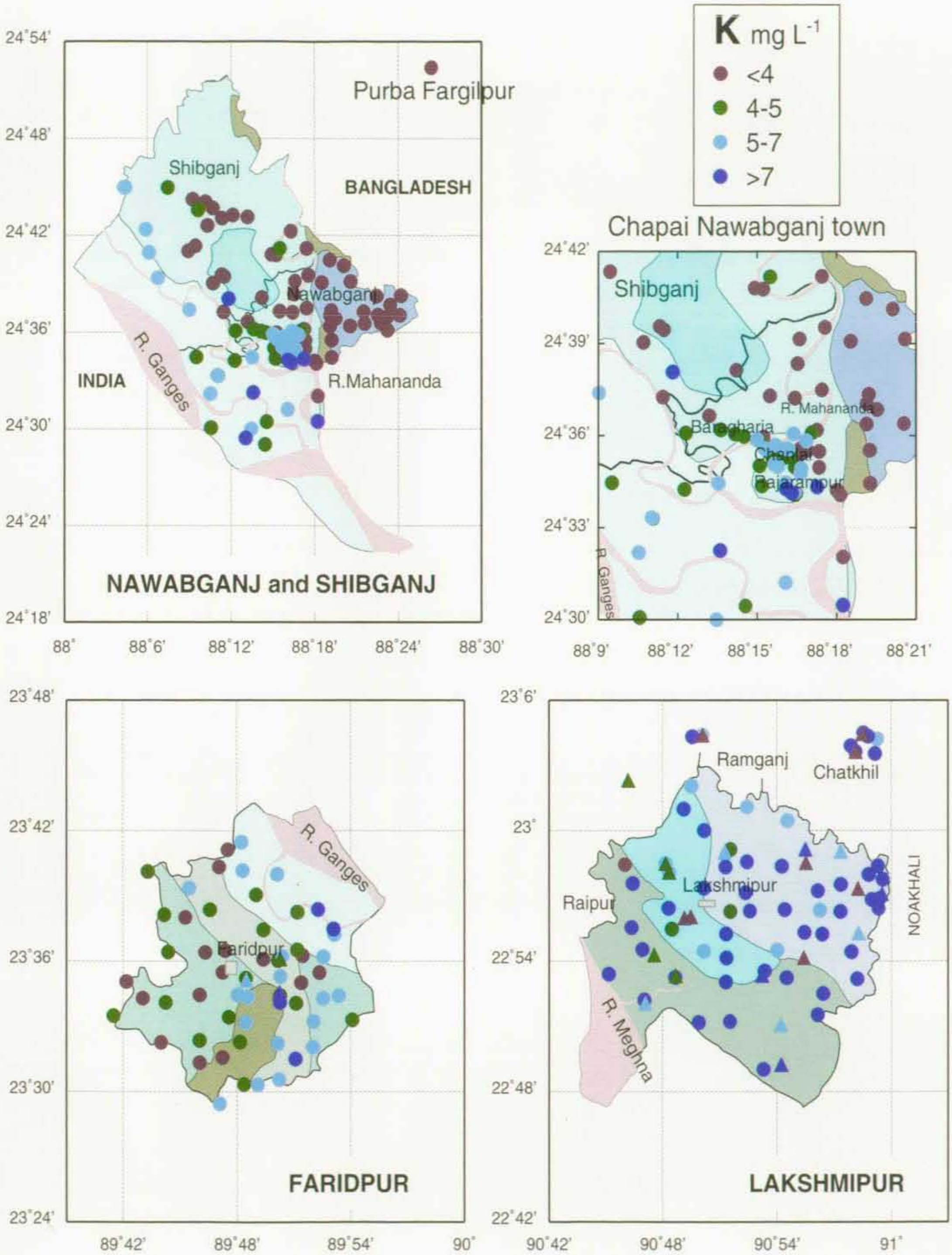
BGS/DPHE/DFID (2000)

POTASSIUM



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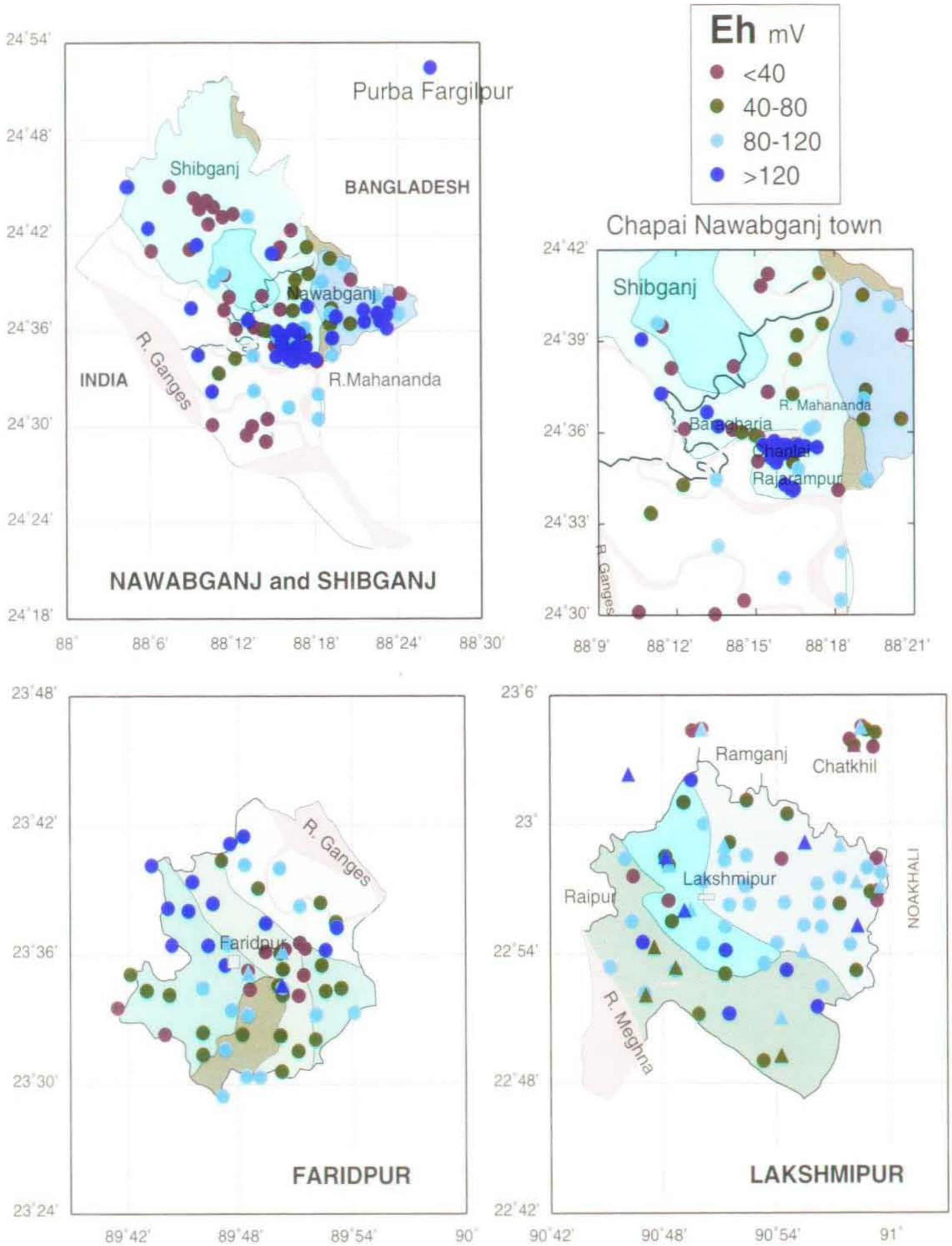
REDOX POTENTIAL



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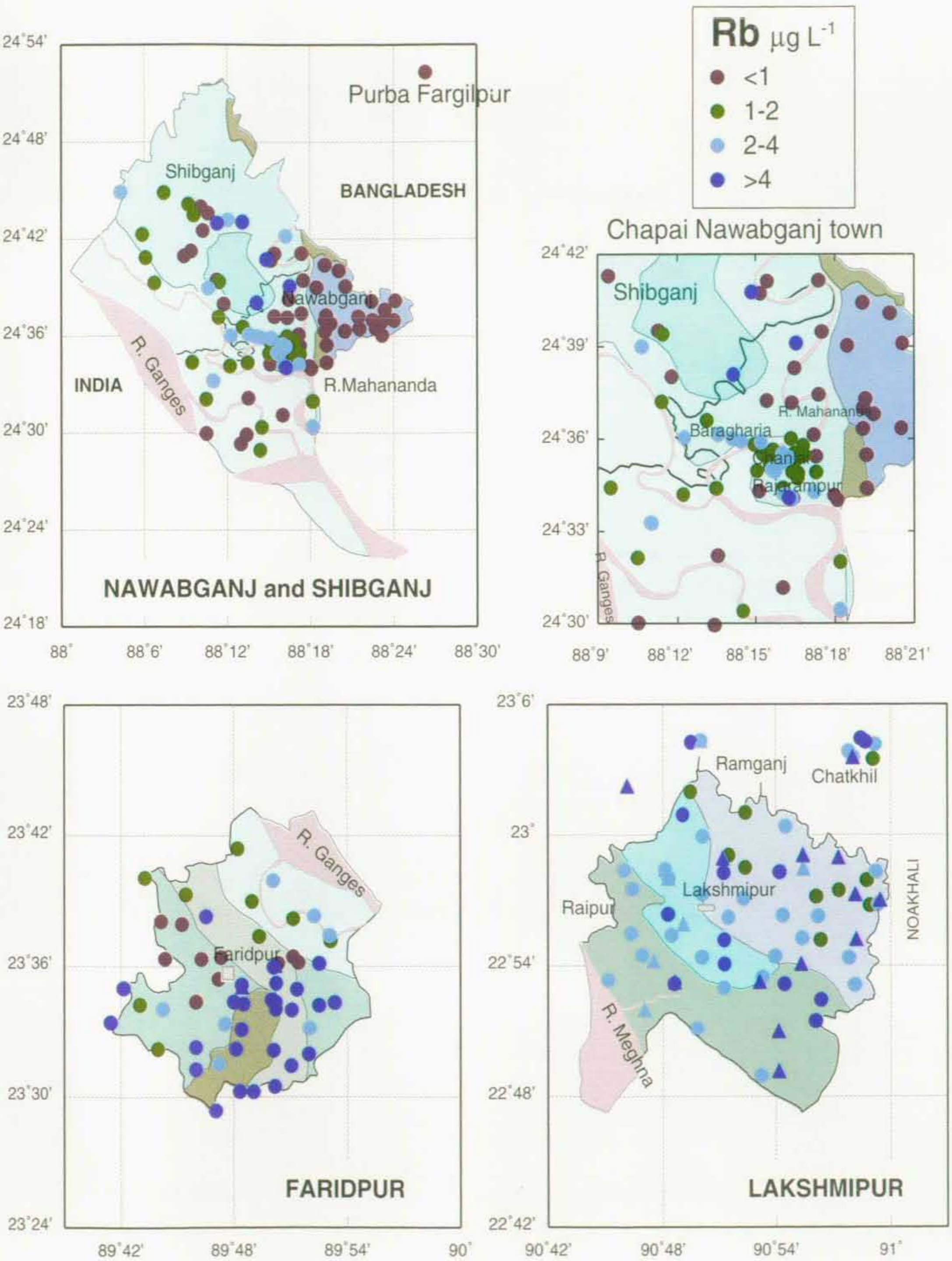
RUBIDIUM



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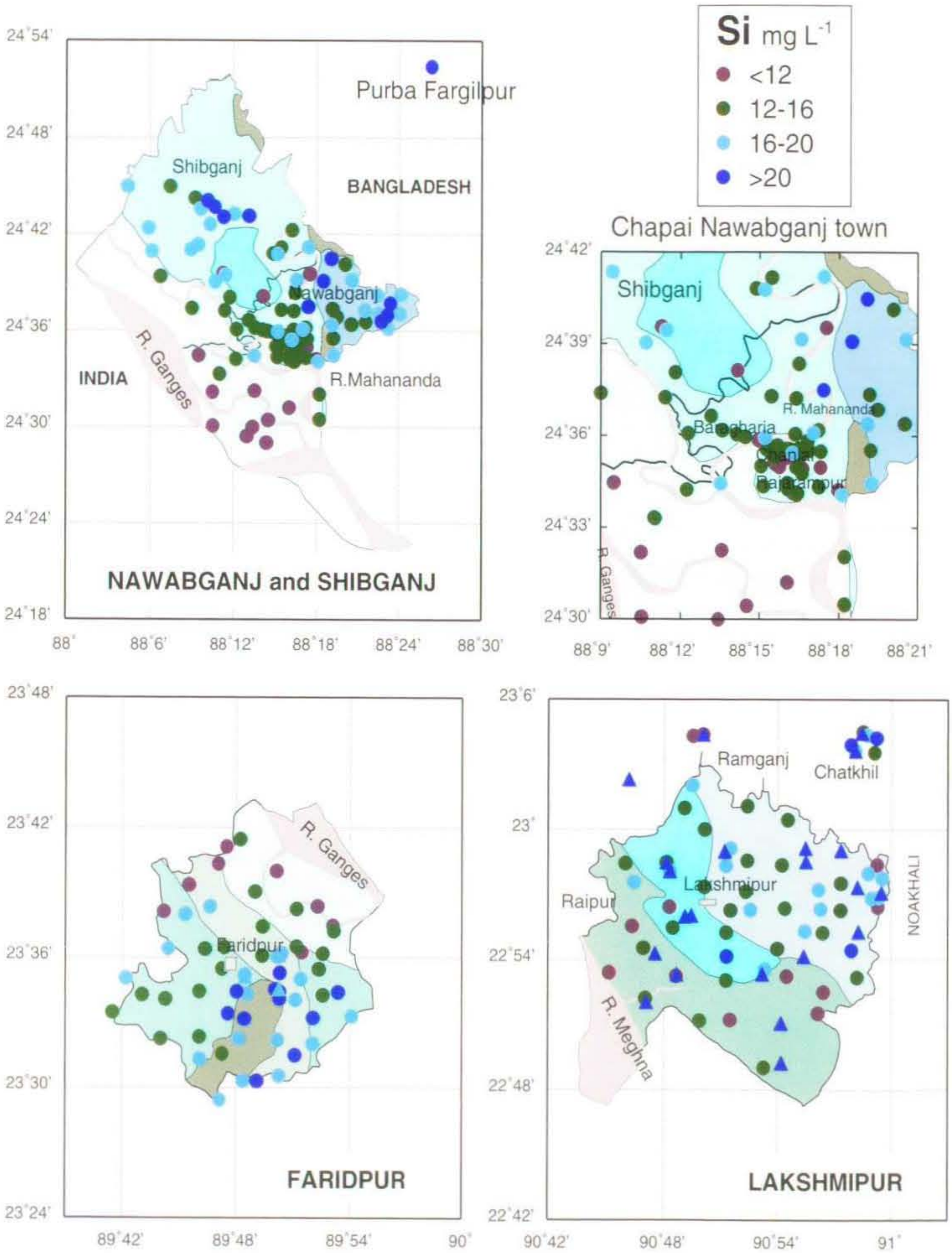
SILICON



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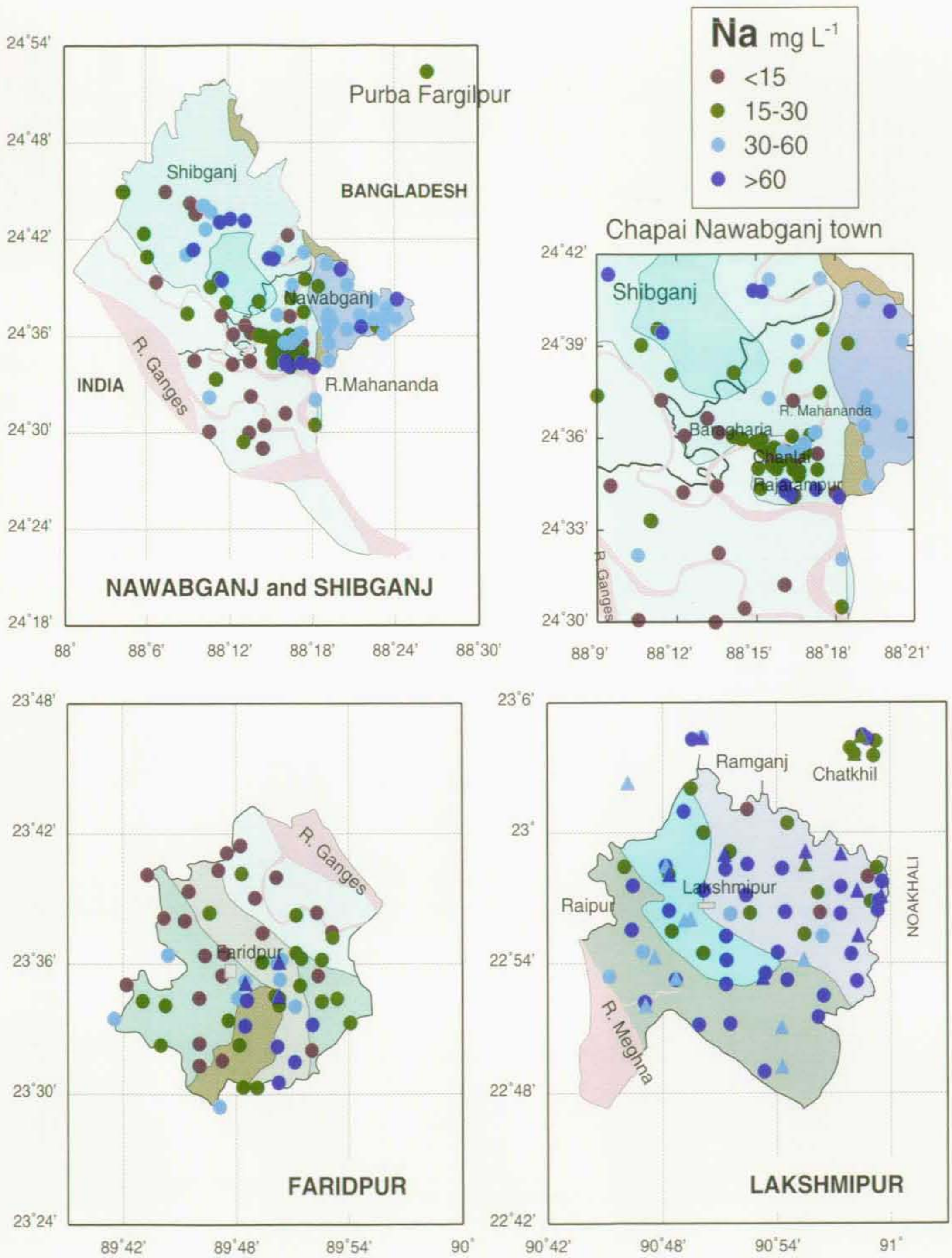
SODIUM



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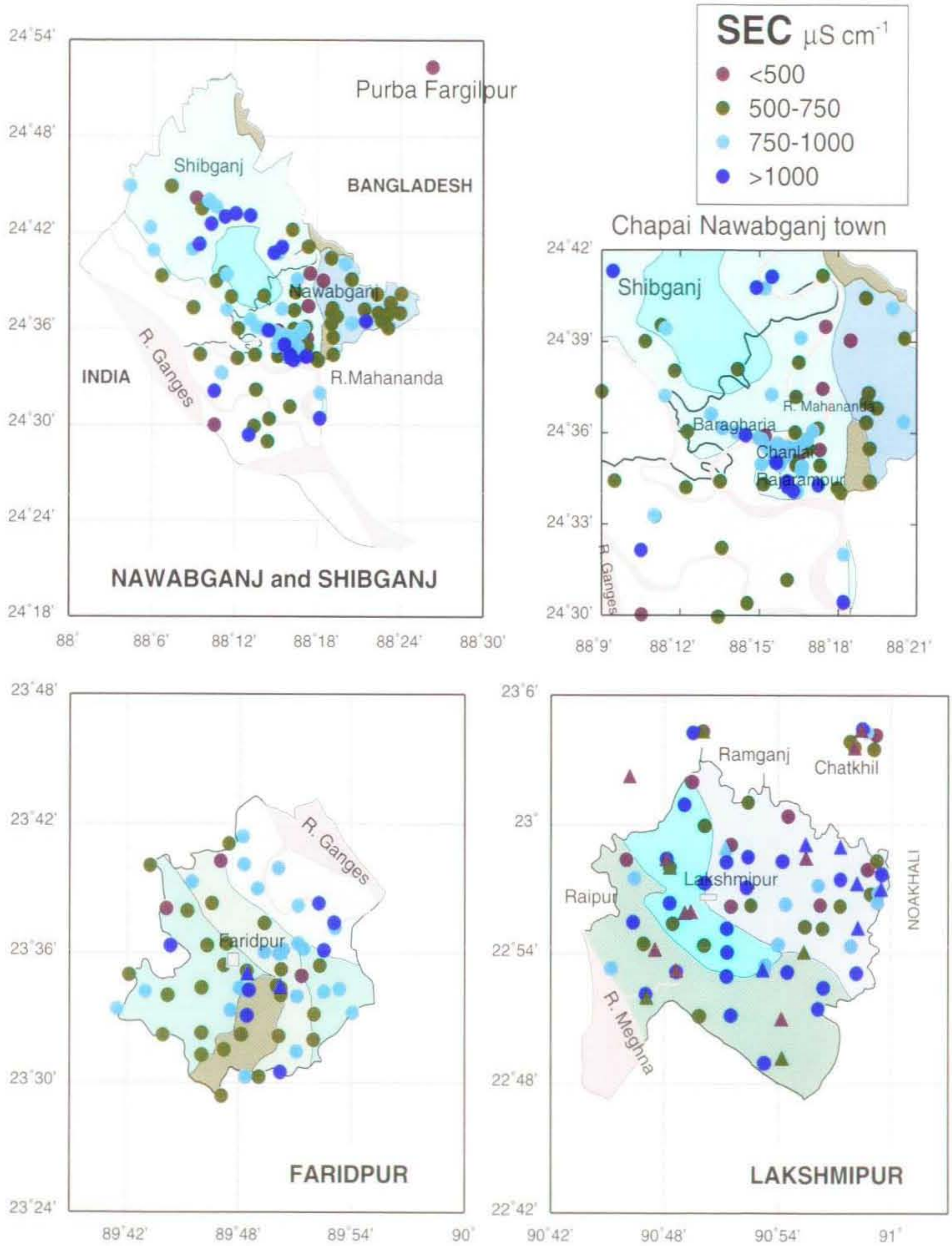
BGS/DPHE/DFID (2000)

SPECIFIC ELECTRICAL CONDUCTANCE



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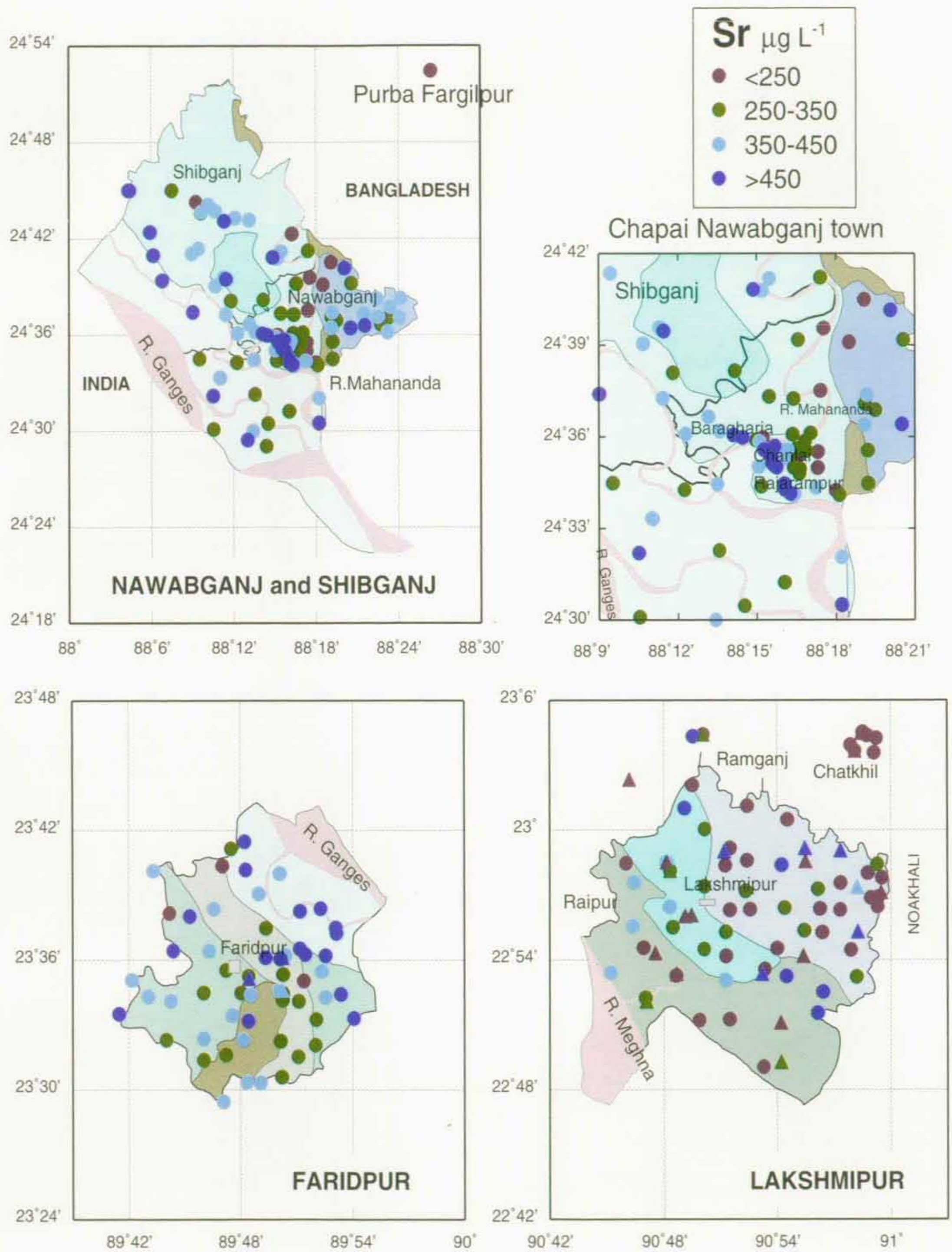
BGS/DPHE/DFID (2000)

STRONTIUM



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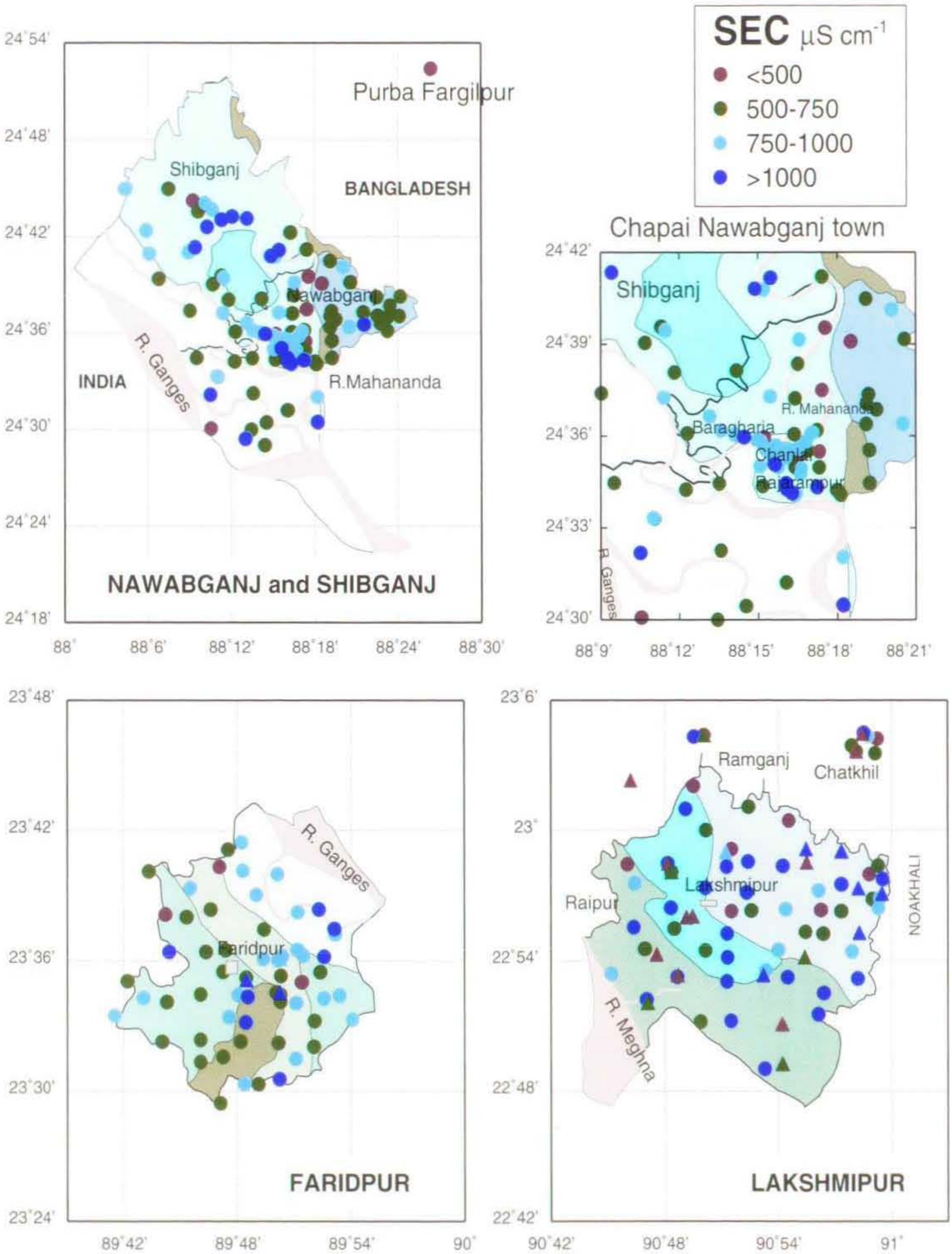
SULPHATE



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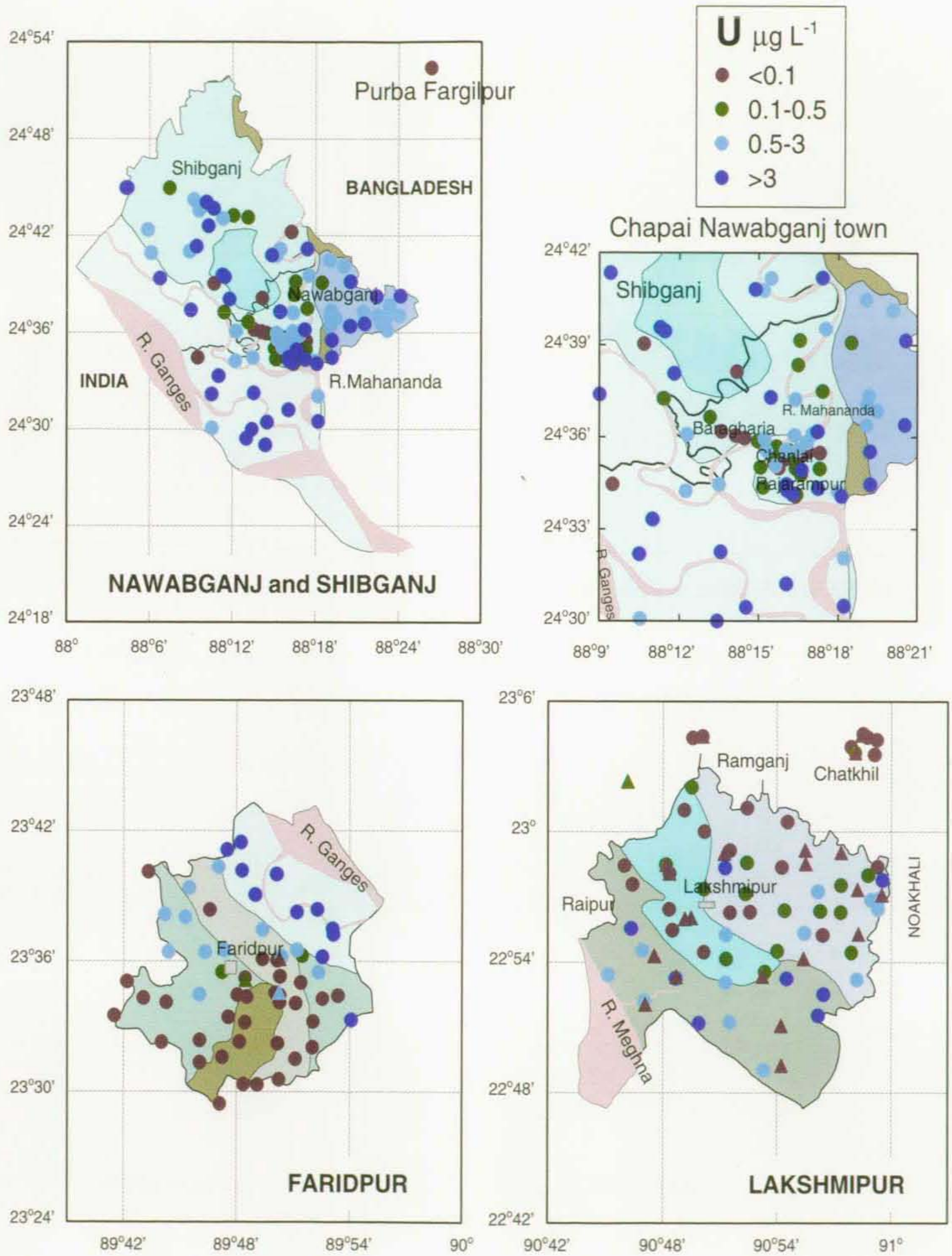
BGS/DPHE/DFID (2000)

URANIUM



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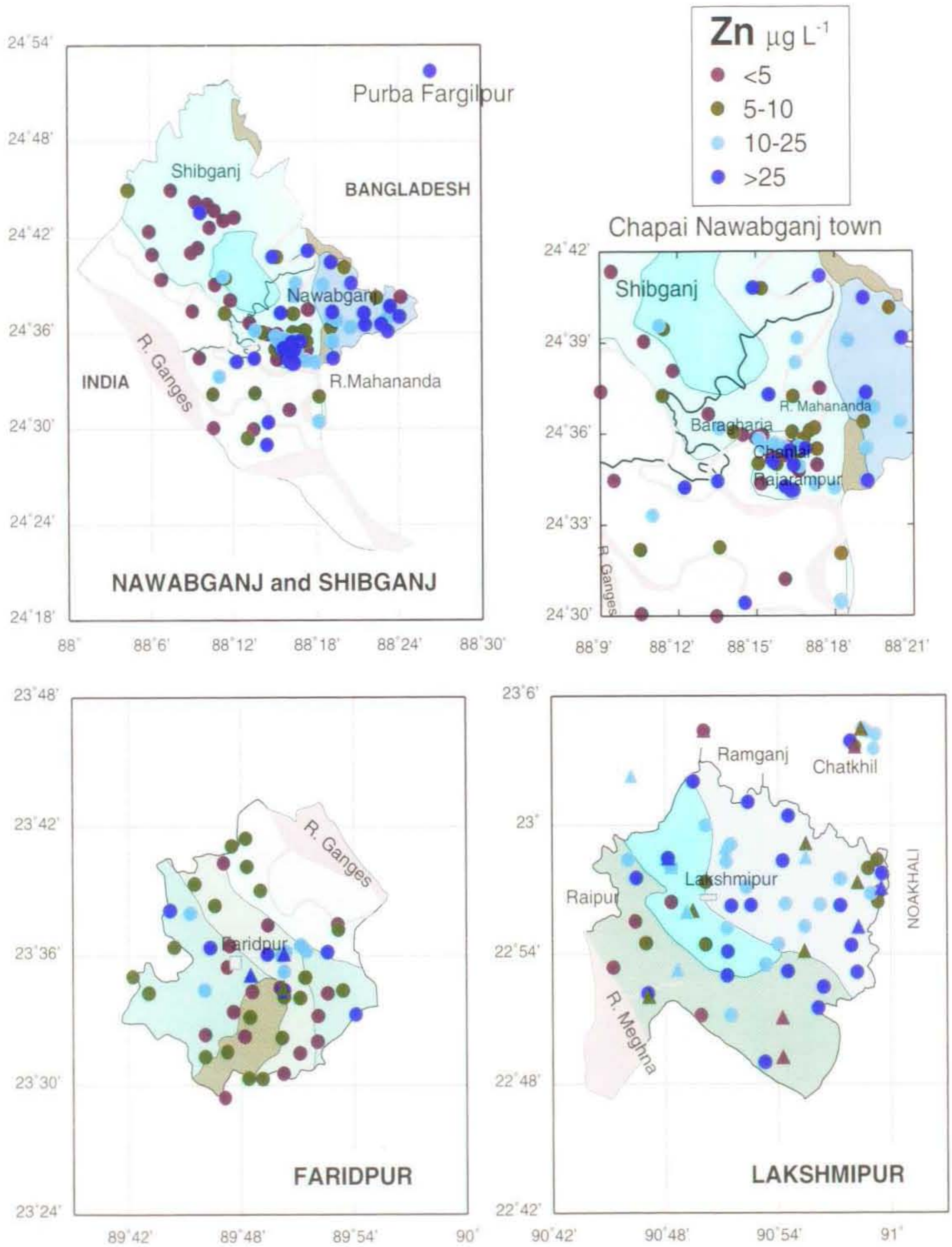
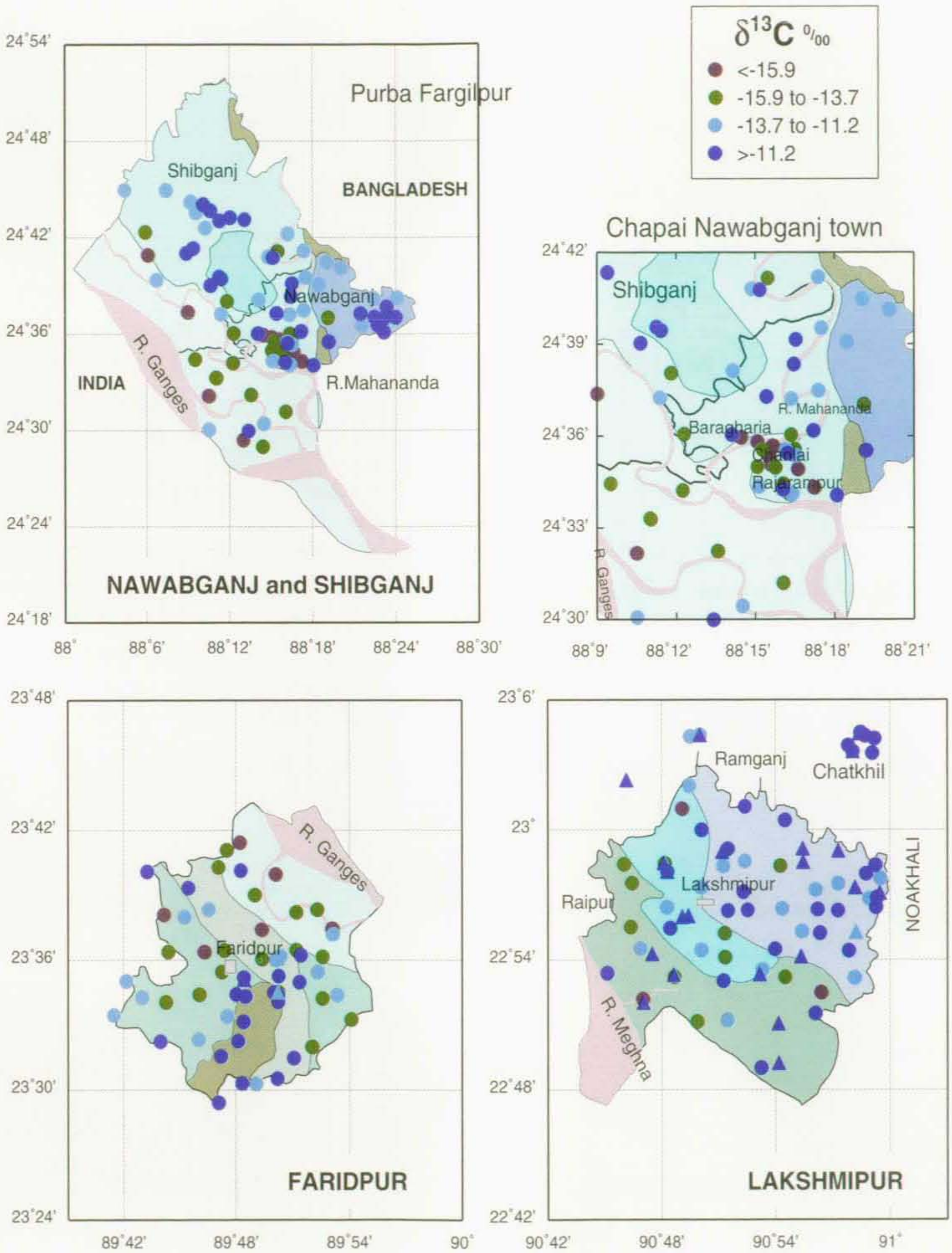
BGS/DPHE/DFID (2000)

ZINC



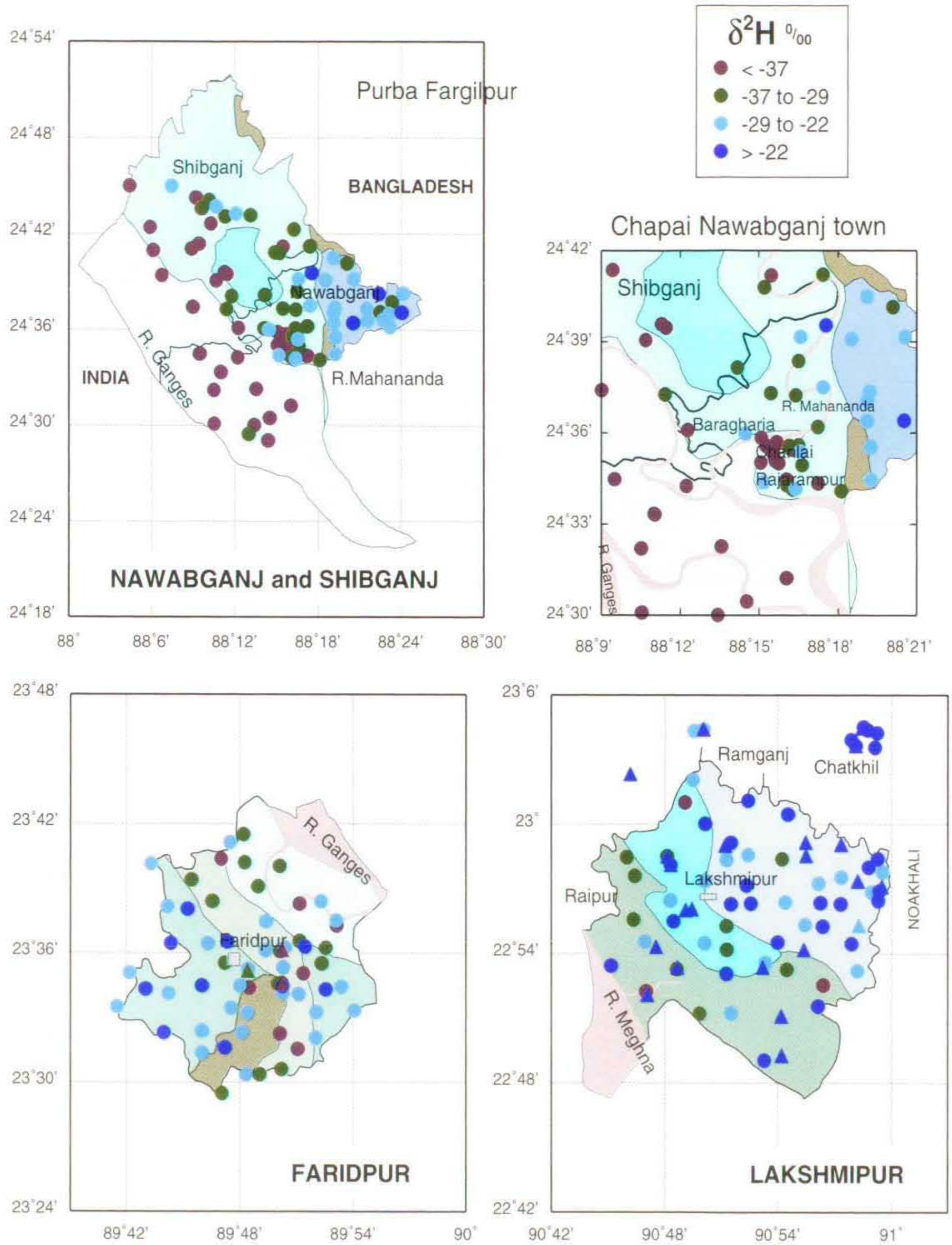
'Groundwater Studies of Arsenic Contamination in Bangladesh'
BGS/DPHE/DFID (2000)

CARBON-13



'Groundwater Studies of Arsenic Contamination in Bangladesh'
BGS/DPHE/DFID (2000)

HYDROGEN ($^2H/^1H$)



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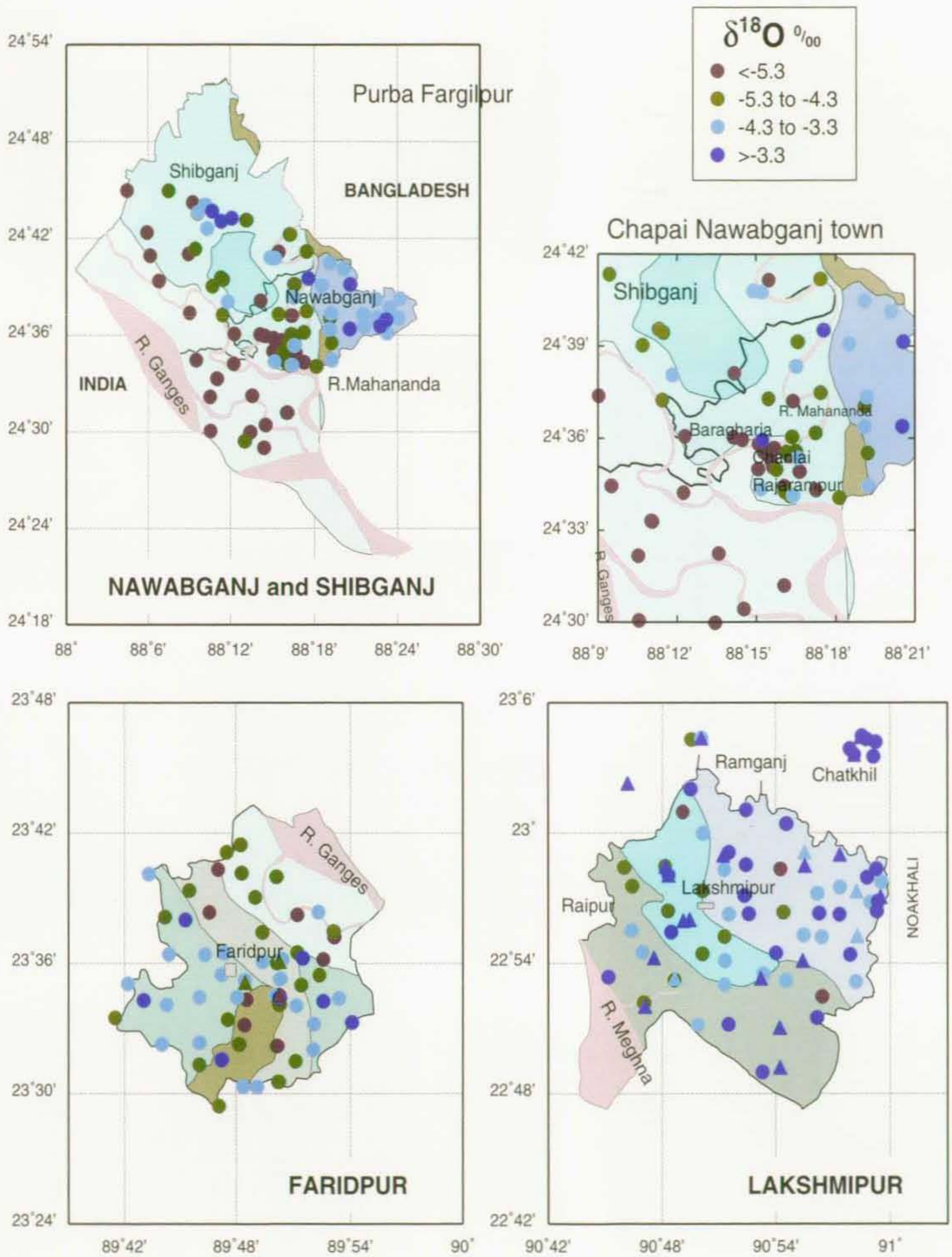
BGS/DPHE/DFID (2000)

OXYGEN ($^{18}O/^{16}O$)



'Groundwater Studies of Arsenic Contamination in Bangladesh'
BGS/DPHE/DFID (2000)

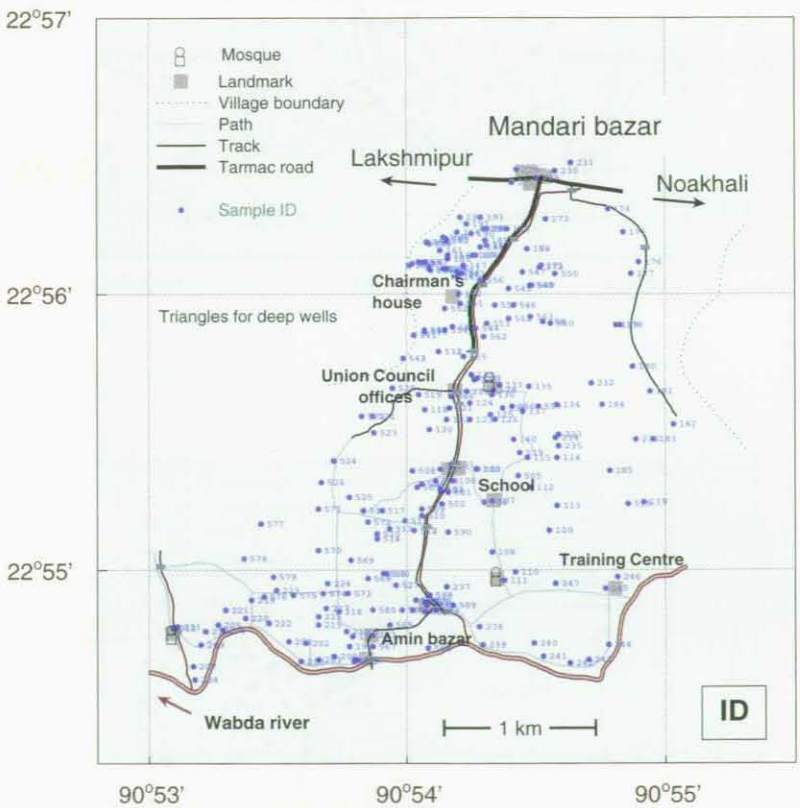
4 A village survey: Mandari, Lakshmipur

A rapid hydrochemical survey of the mouza (village) of Mandari, Lakshmipur District was carried out during November 1999.

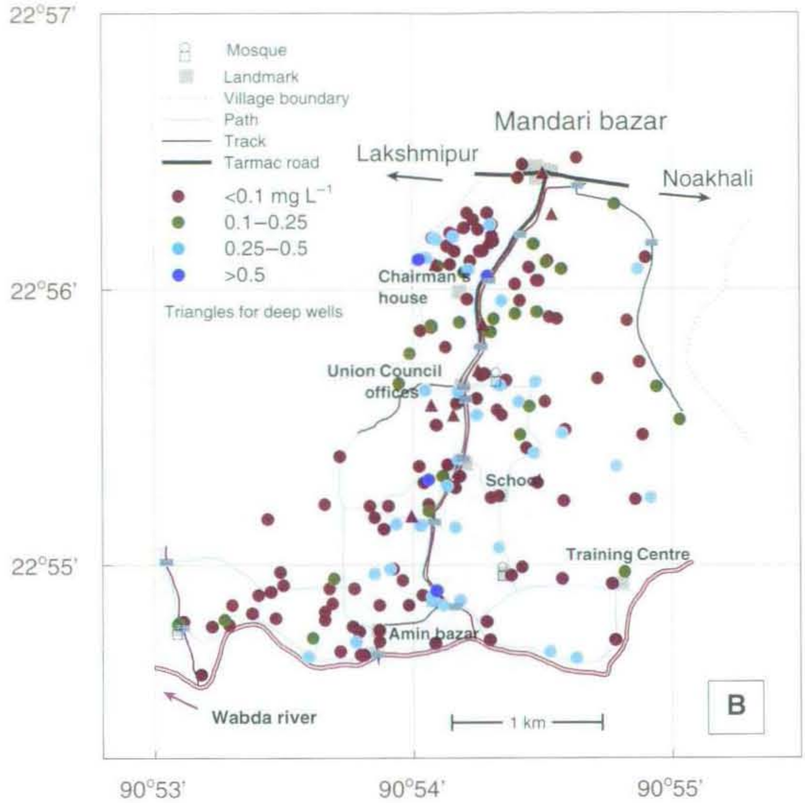
Arsenic in the survey was measured in a various field 'laboratories' using an Arsenator developed and operated by Professor Walter Kosmus of Karl-Franzens University of Graz, Austria.

The shallow wells in Mandari are at a fairly uniform depth — mostly in the range 30–36 ft (9–11 m). Additional analyses were also carried out on acidified samples by ICP-AES as with the other surveys. A discussion of the data is given in Chapter 8 *A village survey: Mandari, Lakshmipur District* of the Main Report.

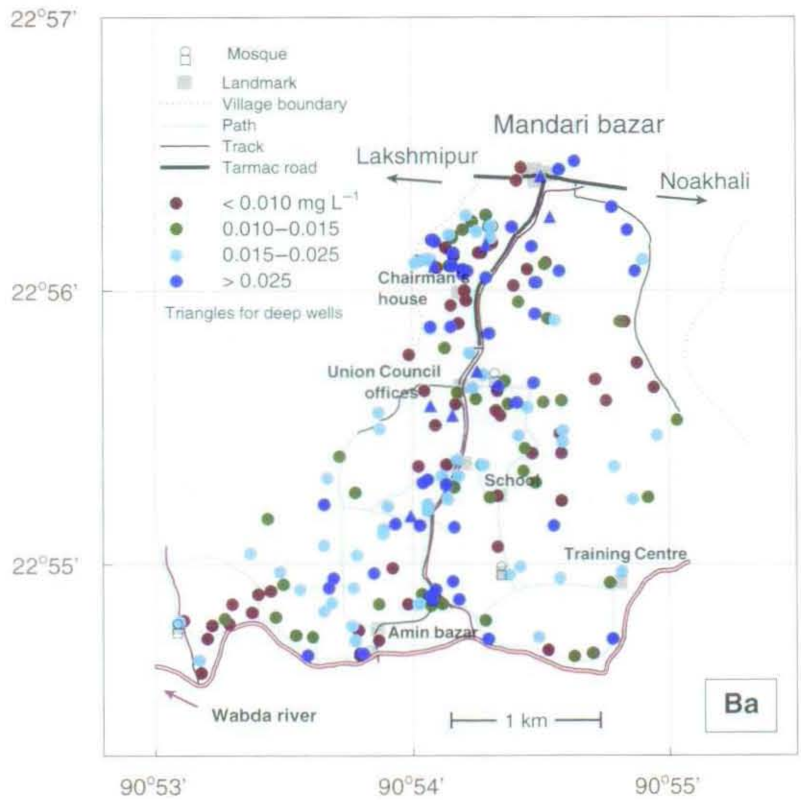
SAMPLE POINTS



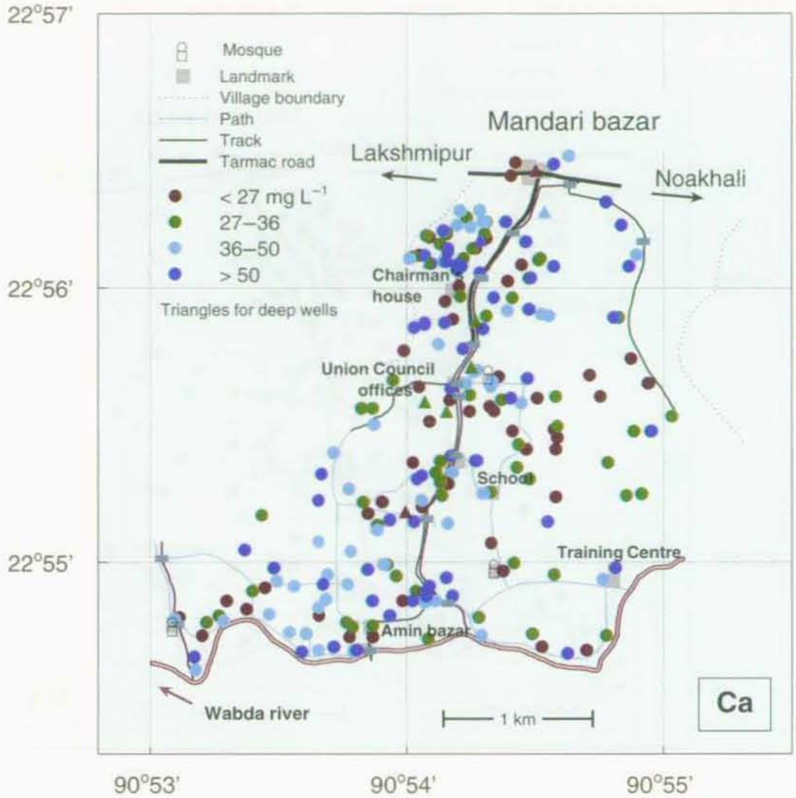
Boron



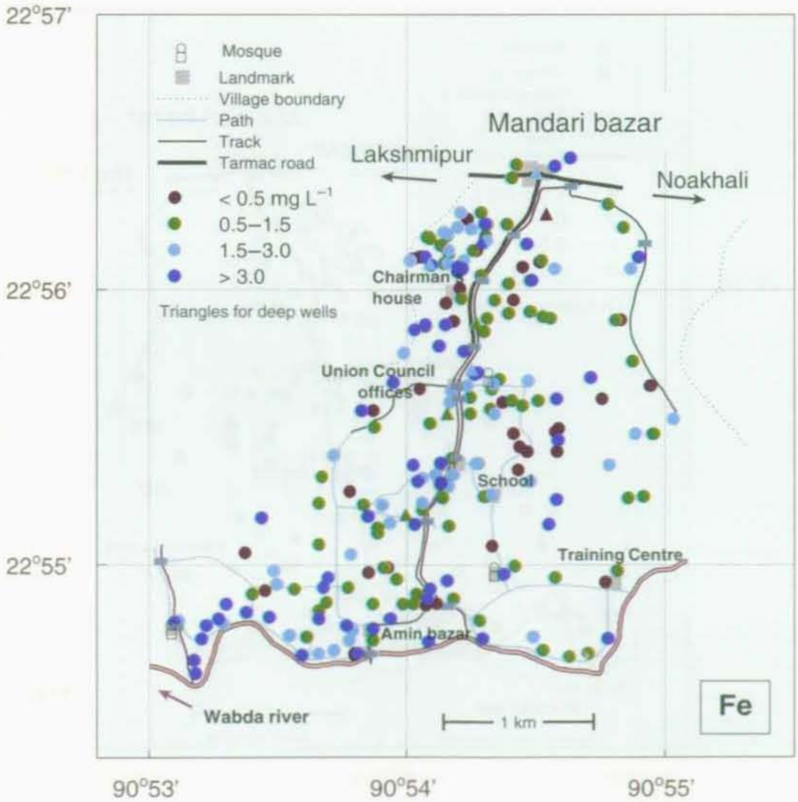
Barium



CALCIUM



IRON



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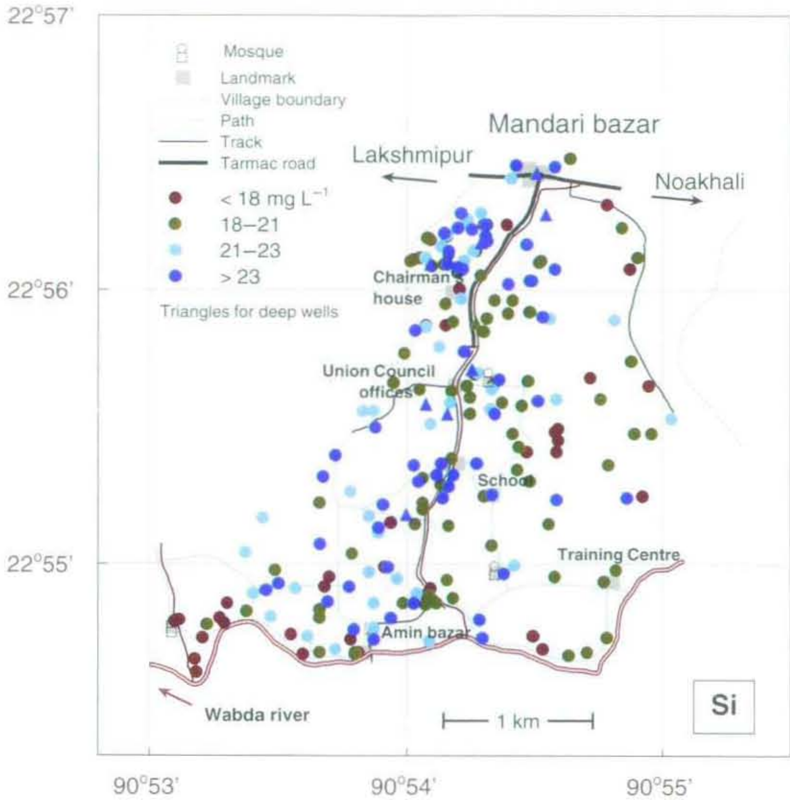

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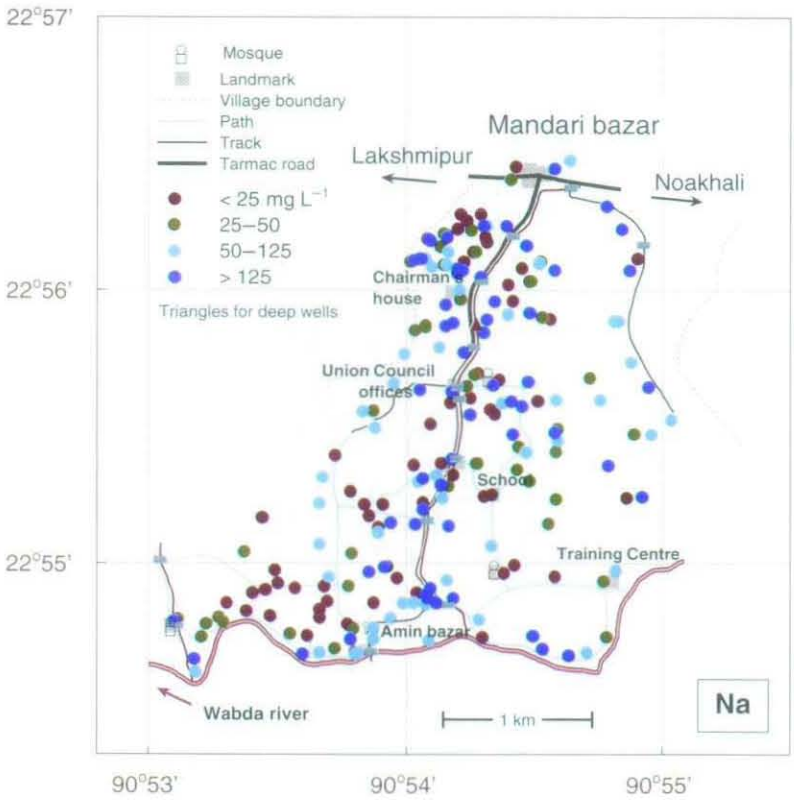

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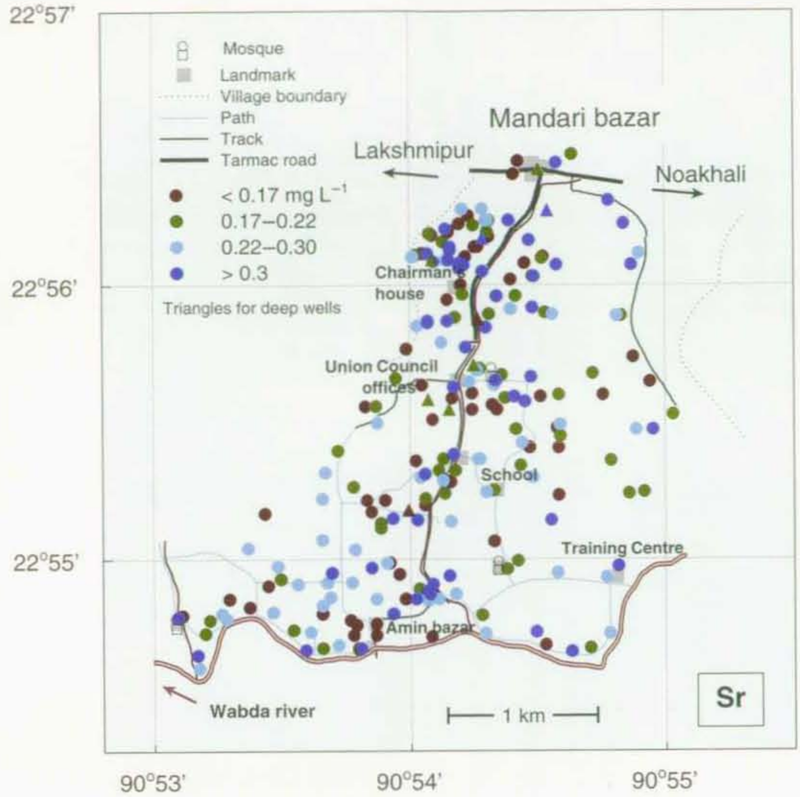

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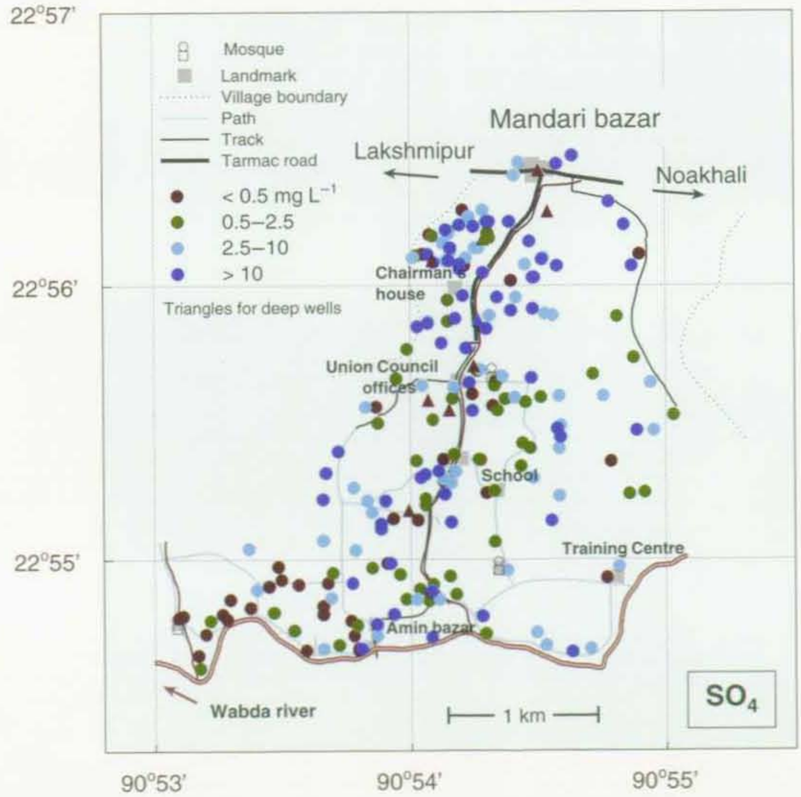

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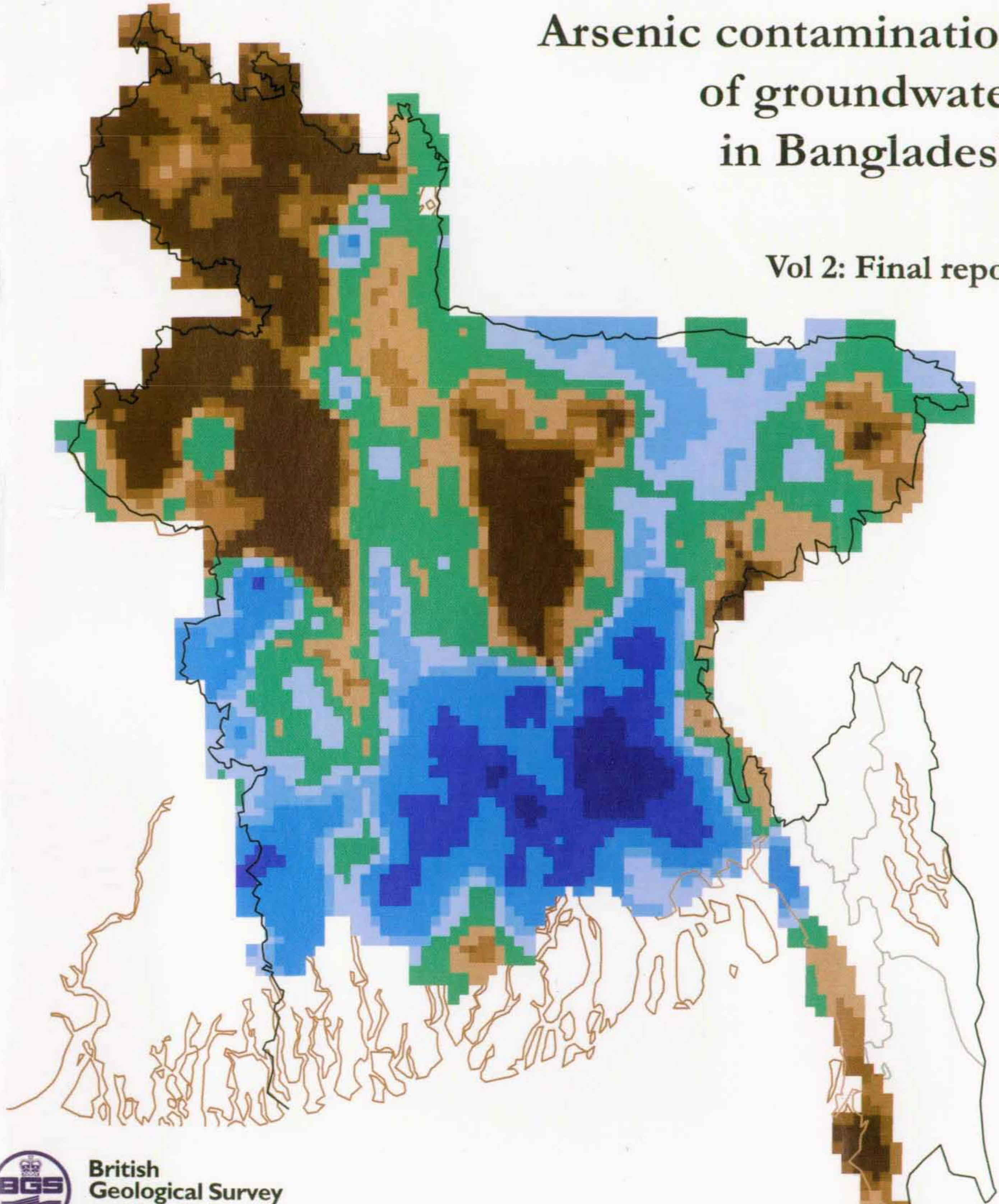

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Vol 2: Final Report

D G Kinniburgh and P L Smedley (Editors)

February 2001

The full report comprises four volumes:

Volume 1. Summary
Volume 2. Final report
Volume 3. Hydrochemical atlas
Volume 4. Data compilation

Further information can also be viewed and downloaded from our website at www.bgs.ac.uk/arsenic/Bangladesh

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Map of Bangladesh showing the regional distribution of arsenic in groundwater found during the National Hydrochemical Survey

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Abbreviations

AAN	Asian Arsenic Network
BAMWSP	Bangladesh Arsenic Mitigation Water Supply Project
BGS	British Geological Survey
BWDB	Bangladesh Water Development Board, Government of the People's Republic of Bangladesh
CEC	Centre of Environmental Chemistry, Hanoi National University
DANIDA	Danish Agency for Development Assistance
DCH	Dhaka Community Hospital
DFID	UK Department for International Development
DPHE	Department of Public Health Engineering, Government of the People's Republic of Bangladesh
DTW	Deep tubewell
DU	Dhaka University
DWASA	Dhaka Water Supply and Sewerage Authority
EAWAG	Swiss Federal Institute for Environmental Science and Technology
EGIS	Environment and Geographic Information System Supply Project for Water Sector Planning
GBM	Ganges-Brahmaputra-Meghna
GoB	Government of the People's Republic of Bangladesh
GPS	Global Positioning System
GSB	Geological Survey of Bangladesh
HG-AFS	Hydride-generation atomic-fluorescence spectrometry
HTW	Hand-pump tubewell
ICP-AES	Inductively-coupled-plasma atomic-emission spectrometry
ICP-MS	Inductively-coupled-plasma mass spectrometry
IDA	International Development Association
JICA	Japan International Cooperation Agency
LGED	Local Government Engineering Department, Government of the People's Republic of Bangladesh
MMI	Mott MacDonald International
MML	Mott MacDonald Ltd
MMP	Sir M MacDonald and Partners
MPO	Master Plan Organisation
NESP	National Emergency Screening Programme, part of BAMWSP
NERC	Natural Environment Research Council (UK)
NHS	DPHE/BGS National Hydrochemical Survey
NIPSOM	National Institute for Preventative & Social Medicine
REE	Rare-earth element
SDDC	Silver diethyl dithiocarbamate
SEM	Scanning electron microscopy
SOES	School of Environmental Studies, Jadavpur University, Calcutta
SPARRSO	Space Research and Remote Sensing Organisation, Government of the People's Republic of Bangladesh
STW	Shallow tubewell
UNDP	United Nations Development Programme
UNDTCD	United Nations Department for Technical Cooperation in Development
UNICEF	United Nations Children's Emergency Fund
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WHO	World Health Organisation
XRF	X-ray fluorescence

Note: Use of the word 'upazila' in place of 'thana'

On April 20, 2000, the Government of Bangladesh issued a directive to use the word '*upazila*' in place of 'thana'. This reflects the passage of the Upazila Parishad Act (1998) which came into effect on February 1, 1999. The directive has been honoured in this report. '*Upazila*' is also sometimes spelt '*upazilla*'.

Executive summary

A survey of well waters (n=3534) from throughout Bangladesh, excluding the Chittagong Hill Tracts, has shown that water from 27% of the 'shallow' tubewells, that is wells less than 150 m deep, exceeded the Bangladesh standard for arsenic in drinking water (50 $\mu g\ L^{-1}$). 46% exceeded the WHO guideline value of 10 $\mu g\ L^{-1}$. Figures for 'deep' wells (greater than 150 m deep) were 1% and 5%, respectively. Since it is believed that there are a total of some 6–11 million tubewells in Bangladesh, mostly exploiting the depth range 10–50 m, some 1.5–2.5 million wells are estimated to be contaminated with arsenic according to the Bangladesh standard. 35 million people are believed to be exposed to an arsenic concentration in drinking water exceeding 50 $\mu g\ L^{-1}$ and 57 million people exposed to a concentration exceeding 10 $\mu g\ L^{-1}$.

There is a distinct regional pattern of arsenic contamination with the greatest contamination in the south and south-east of the country and the least contamination in the north-west and in the uplifted areas of north-central Bangladesh. However, there are occasional arsenic 'hot spots' in the generally low-arsenic regions of northern Bangladesh. In arsenic-contaminated areas, the large degree of well-to-well variation within a village means that it is difficult to predict whether a given well will be contaminated from tests carried out on neighbouring wells.

The young (Holocene) alluvial and deltaic deposits are most affected whereas the older alluvial sediments in the north-west and the Pleistocene sediments of the uplifted Madhupur and Barind Tracts normally provide low-arsenic water. Water from dug wells from a highly contaminated hot spot in northern Bangladesh was also found to normally comply with the WHO guideline value for arsenic and so could be a possible source of low-arsenic water, given the appropriate sanitary precautions.

The arsenic is of natural origin and is believed to be released to groundwater as a result of a number of mechanisms which are poorly understood. This release appears to be associated with the burial of fresh sediment and the generation of anaerobic (oxygen-deficient) groundwater conditions. It probably occurred thousands of years ago. The arsenic is thought to be desorbed and dissolved from iron oxides which had earlier scavenged the arsenic from river water during their transport as part of the normal river sediment load. We call this the iron oxide reduction hypothesis. Natural variations in the amount of iron oxide at the time of sediment burial may be a key factor in controlling the distribution of high arsenic groundwaters. Limited evidence suggests that the isolated arsenic hot spots found in northern Bangladesh occur in areas containing sediments particularly rich in iron oxides, and their accompanying adsorbed arsenic load.

While there is evidence for sulphide minerals in some of the sediments, and in some cases indirect evidence for their oxidation, there is no support for the 'pyrite oxidation' hypothesis in which pyrite oxidation in the zone of water table fluctuation is assumed to release arsenic and ultimately to be responsible for the groundwater arsenic problem. There is no evidence to support the proposition that the groundwater arsenic problem is caused by the recent seasonal drawdown of the water table due to a recent increase in irrigation abstraction.

Monitoring of groundwaters at two-weekly intervals at a number of sites, and at different depths, has shown some variation with time but there is as yet no convincing evidence for seasonal changes. Dramatic changes in contamination are not expected within such a short timescale. A monitoring programme should be undertaken at a range of sites to monitor possible long-term changes. In the three contaminated areas studied in most detail, the arsenic concentration increases most rapidly between 10–20 m below ground level.

While arsenic is the single greatest problem in Bangladesh groundwaters, other elements of concern from a health point of view, are manganese, boron and uranium. Some 35% of the groundwaters sampled exceeded the WHO guideline value for manganese (0.5 $mg\ L^{-1}$). The spatial pattern of the arsenic and manganese problem areas was significantly different and only 33% of shallow well waters complied with the WHO guideline values for both arsenic and manganese.

It is unlikely that the regional pattern of arsenic contamination revealed by this, and other studies, will substantially change as more testing refines the picture. There is therefore an urgent need for the arsenic mitigation programme to provide, as a priority, a safe source of drinking water in the worst-affected areas which have now been clearly identified.

Deep groundwaters, where available, appear to offer a long-term source of safe drinking water. Experience gained so far indicates that the great majority of these would not only pass the current Bangladesh standard for arsenic but would pass all other existing national and international standards and guidelines for arsenic. The likelihood of a manganese exceedance is also much lower in these deep groundwaters. Most of the deep groundwaters tested in our surveys were from the southern coastal region where the shallow groundwaters are affected by salinity and these deep groundwaters may not be typical of those from elsewhere in Bangladesh. Therefore the nationwide availability and sustainability of this resource needs to be established in terms of quality, quantity and sustainability. The possible impact of the large-scale abstraction of irrigation water on the deep aquifer also needs to be considered.

From a worldwide perspective, drinking water derived from aquifers showing similar characteristics to those of the Bengal Basin should be considered 'at risk' and need to be systematically tested for arsenic.

1 Introduction

The definitive history of the discovery of the Bengal Basin groundwater arsenic problem has yet to be written. In retrospect, there were certainly early indications but these were often not widely reported or their significance was not fully appreciated. A useful summary is given in Smith et al. (2000).

The first reported case of arsenic-contaminated groundwater (greater than 50 µg As L^{-1}) from the Bengal Basin was recorded in 1978 in West Bengal (Acharyya et al., 2000) and the first cases of arsenic poisoning there were diagnosed in 1983. These early cases of arsenic-induced skin lesions were identified by K.C. Saha then at the Department of Dermatology, School of Tropical Medicine in Calcutta, India (Saha, 1995; Smith et al., 2000). The first patients seen were from West Bengal but by 1987 several patients had already been identified who came from neighbouring Bangladesh (Smith et al., 2000).

The contamination of groundwater by arsenic in Bangladesh was first confirmed by the Department of Public Health Engineering (DPHE) in Chapai Nawabganj in late 1993 following reports of extensive contamination in the adjoining area of West Bengal. The issue of arsenic contamination in West Bengal achieved international recognition in 1995 when the School of Environmental Studies (SOES) at Jadavpur University, Calcutta hosted an international conference on the subject. Arsenic-affected patients from both West Bengal and Bangladesh were presented to the participants.

Since the mid-1990s, SOES in conjunction with Dhaka Community Hospital have conducted field investigations over much of Bangladesh including a large number of water analyses and tissue analyses. In February 1998, DCH and SOES held an international conference on arsenic in Dhaka that once again raised public awareness of the issue.

BGS first became involved in the groundwater arsenic issue in Bangladesh when it was awarded a grant by the UK Department for International Development (DFID) to study arsenic contamination of groundwater in Bangladesh and Argentina. Initial investigations were carried out in Chapai Nawabganj in February 1997. These confirmed the high arsenic contamination of groundwater in that area and established the reducing nature of the groundwaters. The data obtained pointed away from the pyrite oxidation hypothesis then being promoted by West Bengal scientists.

In early 1997, a World Bank Fact Finding Mission under the leadership of Professor Guy Alaerts visited Bangladesh to investigate the possible scope for assisting the Government of Bangladesh with the arsenic mitigation effort. Two BGS geoscientists accompanied that mission. At that time, the scale of the problem was not known and the mission identified a number of activities, one of which was a Rapid Investigation Programme to map what were then believed to be the worst-affected areas of Bangladesh and to identify the cause of the arsenic contamination.

Shortly after the World Bank visit, the DPHE with UNICEF assistance carried out a massive screening programme of wells for arsenic across the whole of Bangladesh using simple field-test kits. Some 23,000 wells were randomly tested by DPHE staff. The results of this survey showed for the first time the scale of the problem and identified the centre of the worst-affected area as an area south-east of Dhaka. Northern Bangladesh was also found to be substantially 'uncontaminated' in terms of the prevailing Bangladesh drinking water standard for arsenic (50 µg L^{-1}). However, some hot spots had been found in northern Bangladesh, including Chapai Nawabganj, largely because arsenic patients had been identified there. Subsequent testing has confirmed the overall pattern that emerged from this survey.

Since that time, many Bangladeshi and international organisations have become involved in the groundwater arsenic problem. It has been widely reported in the national and international press. This interest continues. In 1998 as a result of the World Bank Fact Finding Mission, the Government of Bangladesh was offered a $44 million World Bank loan in order to set up an arsenic mitigation programme. DPHE was identified as the lead Government Department and seconded a senior official to lead the programme. BAMWSP, the Bangladesh Arsenic Mitigation Water Supply Project, was created for this purpose.

The present BGS-DPHE project, funded by DFID, began its Rapid Investigation Phase, or Phase I, in January 1998. Mott MacDonald Ltd provided the local Team Leader and much logistical support for this Phase of the project. The principal aims of Phase I were to: (i) compile, review and database existing groundwater and sediment arsenic data from Bangladesh; (ii) review Bangladesh geology and hydrogeology; (iii) carry out a systematic groundwater quality survey using laboratory analyses of what were then believed to be the 41 worst-affected districts of Bangladesh (out of 64 districts); (iv) carry out detailed geochemical investigations in three Special Study Areas, and (v) model the movement of groundwater and arsenic in a typical Bangladesh situation. Phase I was completed in December 1998 and a six-volume report produced in early 1999. A summary of the results and the arsenic data were also put on the web.

Phase II of the present project continued from Phase I. The remainder of Bangladesh, excluding the three Chittagong Hill Tract districts, was surveyed and the detailed studies in the three Special Study Areas located in Chapai Nawabganj, Faridpur and Lakshmipur continued. This included the installation and monitoring of sets of piezometers placed at different depths. These were sampled at two-weekly intervals for nearly a year and provided the first detailed data for the variation of Bangladesh water quality with depth and with time. The complete set of water samples collected during the arsenic survey were also analysed for a wide range of inorganic constituents to give detailed maps for the variation in a range of water quality parameters. These have been collated to give the National Hydrochemical atlas of Bangladesh. A rapid survey of a single village in south-east Bangladesh also enabled us to test a more sensitive and more accurate field-test kit, the Arsenator, designed by Professor Kosmus, Karl Franzens University, Graz, Austria. It also provided some quantitative indication of the nature of the spatial variation in groundwater quality at the village scale. We have also undertaken a world-wide review of arsenic occurrence, a detailed re-evaluation of the geology and sedimentology of Bangladesh aquifers, some further hydrogeological and hydrochemical modelling, geostatistical interpretation of some of our chemical data and an initial study of the mineralogy and geochemistry of Bangladesh sediments.

Phase II of the project finished at the end of March 2000 and a seminar presenting the principal findings was given in Dhaka on 30th March 2000. The full results of the project are presented in four volumes. This volume forms the main report and is accompanied by the National Hydrochemical atlas, a separate 20-page Summary Report and a data volume. The Summary, a large number of water quality maps and the point source water quality data were placed on the BGS website and made available for downloading at the end of May 2000. It is intended to mirror this on a local web site when available and to make the complete report available in paper form, on CD and on the web.

It is now clear that the scale of the groundwater arsenic problem in Bangladesh is very large and that many important questions remain to be answered. First and foremost is the need to provide an immediate source of safe drinking water in the worst-affected areas. This needs to be followed by a longer-term programme to provide viable long-term sources of safe drinking water. Our national map for arsenic, along with the data of others, provides a basis for choosing the priority areas for rapid action.

There are still important scientific questions to answer. These include the nature of the mineral source of arsenic in the sediments, how it is released into the groundwater, why the problem is so severe in Bangladesh and how the extent and severity of the contamination will change in the future. These questions are not merely academic but have important implications for the future water resources strategy of Bangladesh. If, as has been strongly promoted by some, the increased seasonal drawdown of the water table as a result of recent irrigation abstractions were responsible for the problem, then this immediately puts the use of groundwater for irrigation in conflict with its use for drinking water. Any substantial diminution of irrigation would have serious implications for the food self-sufficiency of Bangladesh and the rural economy. We do not believe that this is the primary cause but such assertions can only be countered by reasoned argument and we hope that this report contains the data to support such arguments.

Then there is the problem of the deep aquifer. Our studies, and those of others, have shown that the deep aquifer in southern Bangladesh is overwhelmingly 'arsenic-free'. But there have been persistent reports from West Bengal that deep wells often become contaminated within a few years. This too has serious implications since the deep aquifer appears to offer one of the viable long-term options for water supply in some of the arsenic-affected areas of Bangladesh. Questions over possible slow, long-term changes will take a long time to answer but the monitoring programmes required need to be put in place now.

It is often assumed that arsenic analysis is reasonably straightforward, even tedious. We have been fortunate in having a good set of 'tools' at our disposal and yet even so, it has been a continual struggle to ensure high-quality data. Many laboratory methods for arsenic determination exist and a wide range of field-test kits have been tested in Bangladesh and elsewhere. Many of the existing field-test kits are not sensitive or reliable enough to fully achieve their role, and setting up and maintaining reliable laboratories for arsenic determinations in Bangladesh remains a challenge. Reliable arsenic analyses are clearly essential, and should never be taken for granted. The new generation of field-test kits now emerging looks more promising.

2 Arsenic in groundwaters across the world

2.1 IMPORTANCE OF ARSENIC IN DRINKING WATER

Arsenic is a ubiquitous element found in the atmosphere, soils and rocks, natural waters and organisms. It is mobilised in the environment through a combination of natural processes such as weathering reactions, biological activity and volcanic emissions as well as through a range of anthropogenic activities. Most environmental arsenic problems are the result of mobilisation under natural conditions, but man has had an important impact through mining activity, combustion of fossil fuels and through the use of arsenic in pesticides, herbicides, crop desiccants and as an additive to animal feed. Although the use of arsenical products such as weed-killers and wood preservatives has decreased significantly in the last few years, their impact on the environment at least locally, is likely to remain for some years.

Of the various sources of arsenic in the environment, drinking water probably poses the greatest threat to human health. Drinking water is derived from a variety of sources depending on local availability: surface water (rivers, lakes, reservoirs and ponds), groundwater (aquifers) and rain water. These sources are very variable in terms of arsenic risk. Alongside obvious point sources of arsenic contamination, seriously high concentrations are mainly restricted to groundwaters. These are where the greatest number of, as yet unidentified, high-arsenic sources are likely to be found. This chapter therefore focuses on arsenic concentrations in groundwaters and aquifers.

The WHO guideline value for As in drinking water was provisionally reduced in 1993 from 50 $\mu g\ L^{-1}$ to 10 $\mu g\ L^{-1}$. The new recommended value is based largely on analytical capability. If the standard basis for risk assessment applied to industrial chemicals were applied to arsenic, the maximum permissible concentration would likely be lower still. The EC maximum admissible concentration (MAC) for As in drinking water is to be reduced to 10 $\mu g\ L^{-1}$ in line with current health evidence. The USEPA has also recently introduced a revised maximum contaminant level (MCL) of 10 $\mu g\ L^{-1}$ for public water supplies in the USA. The Japanese limit for drinking water is also 10 $\mu g\ L^{-1}$.

Whilst many national authorities are seeking to reduce their limits in line with the WHO guideline value, many countries and indeed all affected developing countries, still operate at present to the 50 $\mu g\ L^{-1}$ standard, in part because of lack of adequate testing facilities for lower concentrations.

Until recently, arsenic was often not on the list of constituents in drinking water routinely analysed by national laboratories, water utilities and NGOs and so the body of information about the distribution of arsenic in drinking water is not as well known as for many other drinking-water constituents. In recent years, it has become apparent that both the WHO guideline value and current national standards are quite frequently exceeded in drinking-water sources, and often unexpectedly so. Indeed, arsenic along with fluoride, are now recognised as the most serious inorganic contaminants in drinking water on a worldwide basis. In areas of high arsenic concentrations, drinking water provides a potentially major source of arsenic in the diet and so its early detection is of great importance.

2.2 SOURCES OF ARSENIC

2.2.1 Minerals

Major arsenic minerals

Arsenic occurs as a major constituent in more than 200 minerals, including elemental arsenic, arsenides, sulphides, oxides, arsenates and arsenites. A list of some of the most common As minerals is given in Table 2.1. Most are ore minerals and their alteration products. The greatest concentrations of these minerals therefore occur in mineralised areas and are commonly found in close association with the transition metals as well as Cd, Pb, Ag, Au, Sb, P, W and Mo. The most widespread As ore mineral is arsenopyrite, FeAsS. It is generally assumed that arsenopyrite, together with the other dominant As-sulphide minerals realgar and orpiment, are only formed under high temperature conditions in the earth's crust, although there is currently some debate about whether arsenopyrite can form at low temperatures as an authigenic mineral.

Rock-forming minerals

Though not a major component, arsenic is also often present in varying concentrations in other common rock-forming minerals. As the chemistry of arsenic follows closely that of sulphur, the greatest concentrations of the element tend to occur in sulphide minerals, of which pyrite is the most abundant. Concentrations in pyrite, chalcopyrite and galena can be very variable, even within a given grain, but in some cases reach up to several weight percent (Table 2.2). Arsenian pyrite is a relatively common mineral especially in ore bodies and As concentrations up to almost 80,000 mg kg^{-1} have been reported (Table 2.2). Arsenic is also present in the crystal structure of many sulphide minerals as a substitute for sulphur.

Besides being an important component of ore bodies, pyrite is also formed in low-temperature sedimentary environments under reducing conditions (authigenic pyrite). Authigenic pyrite plays a very important role in present-day geochemical cycles. It is present in the sediments of many rivers, lakes and the oceans as well as in many aquifers. Pyrite commonly forms preferentially in zones of intense reduction such as around buried plant roots or other nuclei of decomposing organic matter. It is often

Table 2.1. Major arsenic minerals occurring in nature

Mineral	Composition	Occurrence
Native arsenic	As	Hydrothermal veins
Niccolite	NiAs	Vein deposits and norites
Realgar	AsS	Vein deposits, often associated with orpiment, clays or limestones, also hot-spring deposits
Orpiment	As_2S_3	Hydrothermal veins, hot springs, volcanic sublimation product
Cobaltite	CoAsS	High-temperature deposits, metamorphic rocks
Arsenopyrite	FeAsS	The most abundant As mineral, dominantly mineral veins
Tennantite	$(Cu,Fe)_{12}As_4S_{13}$	Hydrothermal veins
Enargite	Cu_3AsS_4	Hydrothermal veins
Arsenolite	As_2O_3	Secondary mineral formed by oxidation of arsenopyrite, native arsenic and other As minerals
Claudetite	As_2O_3	Secondary mineral formed by oxidation of realgar, arsenopyrite and other As minerals
Scorodite	$FeAsO_4.2H_2O$	Secondary mineral
Annabergite	$(Ni,Co)_3(AsO_4)_2.8H_2O$	Secondary mineral
Hoernesite	$Mg_3(AsO_4)_2.8H_2O$	Secondary mineral, smelter wastes
Haematolite	$(Mn,Mg)_4Al(AsO_4)(OH)_8$	
Conichalcite	$CaCu(AsO_4)(OH)$	Secondary mineral
Pharmacosiderite	$Fe_3(AsO_4)_2(OH)_3.5H_2O$	Oxidation product of arsenopyrite and other As minerals

present as framboidal grains.

Pyrite is not stable in aerobic systems and oxidises to iron oxides with the release of large amounts of sulphate and acidity as well as many trace elements. The presence of pyrite as a minor constituent in sulphide-rich coals is ultimately responsible for the production of 'acid rain' and acid mine drainage (AMD), and for the presence of arsenic and other trace metal problems around coal mines and areas of intensive coal burning.

High As concentrations are also found in many oxide minerals and hydrous metal oxides, either as part of the mineral structure or as adsorbed species. Concentrations in Fe oxides can also reach weight percent values (Table 2.2), particularly where they form as the oxidation products of primary iron sulphide minerals which have an abundant supply of arsenic. Adsorption of arsenate to hydrous iron oxides is particularly strong, even at very low arsenic concentrations (Goldberg, 1986; Manning and Goldberg, 1996; Hiemstra and van Riemsdijk, 1996). Adsorption to hydrous Al and Mn oxides may also be important if these oxides are present in quantity (e.g. Peterson and Carpenter, 1983; Brannon and Patrick, 1987). Arsenic may also be sorbed to the edges of clays and to the surface of calcite (Goldberg and Glaubig, 1988). The degree of adsorption onto these minerals is minor compared to Fe oxides but they are nonetheless common minerals in many sediments. Adsorption reactions are responsible for the relatively low concentrations of arsenic found in most natural waters.

Arsenic concentrations in phosphate minerals are variable but can also reach high values, for example up to 1000 mg kg^{-1} in apatite (Table 2.2). However, phosphate minerals are much less abundant than oxide minerals and so make a correspondingly small contribution to the arsenic concentrations of most sediments.

Arsenic can also substitute for Si^{4+}, Al^{3+}, Fe^{3+} and Ti^{4+} in many mineral structures and is therefore present in many other rock-forming minerals, albeit at much lower concentrations. Most common silicate minerals contain around 1 mg kg^{-1} or less. Carbonate minerals usually contain less than 10 mg kg^{-1} (Table 2.2).

2.2.2 Rocks, sediments and soils

Igneous rocks

Arsenic concentrations are generally low in most igneous rocks. Ure and Berrow (1982) quoted an average value of 1.5 mg kg^{-1} for all rock types (undistinguished). Averages for different types distinguished by silica content (Table 2.3) are slightly higher than this value but generally less than 5 mg kg^{-1}. Volcanic glasses are only slightly higher with an average of around 5.9 mg kg^{-1} (Table 2.3). Overall, there is relatively little difference between the different rock types.

Metamorphic rocks

Arsenic concentrations in metamorphic rocks tend to reflect the concentrations in their igneous and sedimentary precursors. Most have around 5 mg kg^{-1} or less. Pelitic rocks (slates, phyllites) typically have the highest concentrations with on average around 18 mg kg^{-1} (Table 2.3).

Sedimentary rocks

The concentration of As in sedimentary rocks is typically in the range 5–10 mg kg^{-1} (Webster, 1999), i.e. slightly above average terrestrial abundance. Average sediments are enriched in As relative to igneous rocks. Sands and sandstones tend to have the lowest concentrations, reflecting the low As concentrations of their dominant minerals, quartz and feldspars. Average sandstone As concentrations are around 4 mg kg^{-1} (Table 2.3) although Ure and Berrow (1982) gave a lower average figure of 1 mg kg^{-1}.

Argillaceous deposits have a broader range and higher average As concentrations than sandstones, typically an average of around 13 mg kg^{-1} (Table 2.3; Ure and Berrow, 1982). The higher values reflect the larger proportion of sulphide minerals, organic matter and clays. Black shales have As concentrations typically at the high end of the range, principally because of their high pyrite content. Data given in Table 2.3 suggest that marine argillaceous deposits have higher concentrations than non-marine deposits. This may also be a reflection of the grain-size distributions, with potential for a higher proportion of fine material in offshore pelagic sediments as well as systematic differences in sulphur and pyrite contents. Sediment provenance is also a likely important factor. Particularly high As concentrations have been determined for shales from mid-ocean settings (Mid-Atlantic Ridge average 174 mg kg^{-1}; Table 2.3). Atlantic Ridge gases may in this case be a high-As source.

Arsenic concentrations in coals and bituminous deposits are variable but often high. Samples of organic-rich shale (Kupferschiefer) from Germany have As concentrations of 100–900 mg kg^{-1} (Table 2.3). Coal samples have been found with up to 35,000 mg kg^{-1}, although generally low concentrations of 2.5–17 mg kg^{-1} were reported by Palmer and Klizas (1997).

Carbonate rocks typically have low concentrations, reflecting the low concentrations in the constituent minerals (ca. 3 mg kg^{-1}; Table 2.3).

Table 2.2. Typical arsenic concentrations in common rock-forming minerals

Mineral	As conc. range (mg kg^{-1})	References
Sulphide minerals:		
Pyrite	100–77000	Baur & Onishi (1969); Arehart et al. (1993); Fleet and Mumin (1997)
Pyrrhotite	5–100	Boyle & Jonasson (1973)
Marcasite	20–600	Dudas (1984)
Galena	5–10000	
Sphalerite	5–17000	
Chalcopyrite	10–5000	
Oxide minerals:		
Haematite	up to 160	
Fe oxide (undifferentiated)	up to 2000	
Fe(III) oxyhydroxide	up to 76000	Pichler et al. (1999)
Magnetite	2.7–41	
Ilmenite	<1	
Silicate minerals:		
Quartz	0.4–1.3	
Feldspar	<0.1–2.1	
Biotite	1.4	
Amphibole	1.1–2.3	
Olivine	0.08–0.17	
Pyroxene	0.05–0.8	
Carbonate minerals:		
Calcite	1–8	
Dolomite	<3	
Siderite	<3	
Sulphate minerals:		
Gypsum/anhydrite	<1–6	
Barite	<1–12	
Jarosite	34–1000	
Other minerals:		
Apatite	<1–1000	
Halite	<3	
Fluorite	<2	

Some of the highest observed As concentrations, often several thousand mg kg^{-1}, are found in ironstones and Fe-rich rocks. Phosphorites are also relatively enriched in As. In these rocks, concentrations of up to ca. 400 mg kg^{-1} have been measured.

Unconsolidated sediments

Concentrations of As in unconsolidated sediments are not notably different from those in their indurated equivalents, with muds and clays having typically higher concentrations than sands and carbonates. Values are typically 3–10 mg kg^{-1}, depending on texture and mineralogy (Table 2.3). High concentrations tend to reflect the amounts of pyrite or Fe oxides present. Increases are also typically found in mineralised areas. Placer deposits in streams can have very high concentrations as a result of the abundance of sulphide minerals.

Average As concentrations for stream sediments in England and Wales are in the range 5–8 mg kg^{-1} (AGRG, 1978). Similar concentrations have also been found in river sediments where groundwater-arsenic concentrations are high: Datta and Subramanian (1997) found concentrations in sediments from the River Ganges averaging 2.0 mg kg^{-1} (range 1.2–2.6 mg kg^{-1}), from the Brahmaputra River averaging 2.8 mg kg^{-1} (range 1.4–5.9 mg kg^{-1}) and from the Meghna River averaging 3.5 mg kg^{-1} (range 1.3–5.6 mg kg^{-1}).

Cook et al. (1995) found concentrations in lake sediments ranging between 0.9–44 mg kg^{-1} (median 5.5 mg kg^{-1}) but noted that the highest concentrations were present up to a few kilometres down-slope of mineralised areas. The upper baseline concentration for these sediments is likely to be around 13 mg kg^{-1} (90th percentile). They also found concentrations in glacial till of 1.9–170 mg kg^{-1} (median 9.2 mg kg^{-1}; Table 1.4) and noted the highest concentrations down-ice of mineralised areas (upper baseline, 90th percentile, 22 mg kg^{-1}).

Relative arsenic enrichments have been observed in reducing sediments in both nearshore and continental-shelf deposits (Peterson and Carpenter, 1986; Legeleux et al., 1994). Legeleux et al. (1994) noted concentrations increasing with depth (up to 30 cm) in continental shelf sediments as a result of the generation of increasingly reducing conditions. Concentrations varied between sites, but generally increased with depth, and were in the range 2.3–8.2 mg kg^{-1} (Table 2.3).

Soils

Baseline concentrations of As in soils are of the order of 5–10 mg kg^{-1}. Boyle and Jonasson (1973) quoted an average baseline concentration in soils of 7.2 mg kg^{-1} (Table 2.3) and Shacklette et al. (1974) quoted an average of 7.4 mg kg^{-1} (901 samples) for American soils. Ure and Berrow (1982) gave a higher average value of 11.3 mg kg^{-1}. Peats and bog soils can have higher concentrations (average 13 mg kg^{-1}; Table 2.3), principally because of increased prevalence of sulphide mineral phases under the reduced conditions. Acid sulphate soils which are generated by the oxidation of pyrite in sulphide-rich terrains such as pyrite-rich shales, mineral veins and dewatered mangrove swamps

Table 2.3. Typical arsenic concentrations in rocks, sediments, soils and other surficial deposits

Rock/sediment type	As conc. average (range) (mg kg^{-1})	No of analyses	Reference
Igneous rocks:			
Ultrabasic rocks (peridotite, dunite, kimberlite etc)	1.5 (0.03–15.8)	40	Baur & Onishi (1969); Boyle & Jonasson (1973);
Basic rocks (basalt)	2.3 (0.18–113)	78	Ure and Berrow (1982);
Basic rocks (gabbro, dolerite)	1.5 (0.06–28)	112	Riedel and Eikmann (1986)
Intermediate (andesite, trachyte, latite)	2.7 (0.5–5.8)	30	
Intermediate (diorite, granodiorite, syenite)	1.0 (0.09–13.4)	39	
Acidic rocks (rhyolite)	4.3 (3.2–5.4)	2	
Acidic rocks (granite, aplite)	1.3 (0.2–15)	116	
Acidic rocks (pitchstone)	1.7 (0.5–3.3)		
Volcanic glasses	5.9 (2.2–12.2)	12	
Metamorphic rocks:			
Quartzite	5.5 (2.2–7.6)	4	Boyle and Jonasson (1973)
Hornfels	5.5 (0.7–11)	2	
Phyllite/slate	18 (0.5–143)	75	
Schist/gneiss	1.1 (<0.1–18.5)	16	
Amphibolite and greenstone	6.3 (0.4–45)	45	
Sedimentary rocks:			
Marine shale/mudstone	3–490		Boyle and Jonasson (1973);
Shale (Mid-Atlantic Ridge)	174 (48–361)		Cronan (1972)
Non-marine shale/mudstone	3.0–12		Welch et al. (1988)
Sandstone	4.1 (0.6–120)	15	Riedel and Eikmann (1986)
Limestone/dolomite	2.6 (0.1–20.1)	40	Baur and Onishi (1969)
Phosphorite	21 (0.4–188)	205	
Iron formations and Fe-rich sediment	1–2900	45	
Evaporites (gypsum/anhydrite)	3.5 (0.1–10)	5	
Coals	0.3–35,000		Belkin et al. (2000)
Bituminous shale (Kupferschiefer, Germany)	100–900		
Unconsolidated sediments:			
Various	3 (0.6–50)		Azcue and Nriagu (1995)
Alluvial sand (Bangladesh)	2.9 (1.0–6.2)	13	This Volume
Alluvial mud/clay (Bangladesh)	6.5 (2.7–14.7)	23	This Volume
River bed sediments (Bangladesh)	1.2–5.9		Datta and Subramanian (1997)
Lake sediments, Lake Superior	2.0 (0.5–8.0)		Allan and Ball (1990)
Lake sediments, British Colombia	5.5 (0.9–44)	119	Cook et al. (1995)
Glacial till, British Colombia	9.2 (1.9–170)		Cook et al. (1995)
World average river sediments	5		Martin and Whitfield (1983)
Stream and lake silt (Canada)	6 (<1–72)	310	Boyle and Jonasson (1973)
Loess silts, Argentina	3–18		Arribére et al. (1997); Smedley et al. (2000a)
Continental margin sediments (argillaceous, some anoxic)	2.3–8.2		Legeleux et al. (1994)
Soils:			
Various	7.2 (0.1–55)	327	Boyle and Jonasson (1973)
Peaty and bog soils	13 (2–36)	14	
Acid sulphate soils (Vietnam)	6–41	25	Gustafsson and Tin (1994)
Acid sulphate soils (Canada)	1.5–45	18	Dudas (1984); Dudas et al. (1988)
Soils near sulphide deposits	126 (2–8000)	193	Boyle and Jonasson (1973)
Contaminated surficial deposits:			
Mining-contaminated lake sediment, British Colombia	342 (80–1104)		Azcue et al. (1994; 1995)
Mining-contaminated reservoir sediment, Montana	100–800		Moore et al. (1988)
Mine tailings, British Colombia	903 (396–2000)		Azcue et al. (1995)
Soils and tailings-contaminated soil, UK	120–52,600	86	Kavanagh et al. (1997)
Tailings-contaminated soil, Montana	up to 1100		Nagorski and Moore (1999)
Industrially polluted inter-tidal sediments, USA	0.38–1260		Davis et al. (1997)
Soils below chemicals factory, USA	1.3–4770		Hale et al. (1997)
Sewage sludge	9.8 (2.4–39.6)		Zhu and Tabatabai (1995)

can also be relatively enriched in As. Dudas (1984) found As concentrations up to 45 mg kg^{-1} in the B horizons of acid sulphate soils derived from the weathering of pyrite-rich shales in Canada. Concentrations in the overlying leached (eluvial, E) horizons were low (1.5–8.0 mg kg^{-1}) as a result of volatilisation or leaching of As to greater depths. Gustafsson and Tin (1994) found similarly increased concentrations (up to 41 mg kg^{-1}) in acid sulphate soils from

2.3.3 Iron and arsenic in reduced sediments

Since one of the principal sources of arsenic in natural waters is believed to be from the release of arsenic from iron oxides following a change to reducing conditions, it is important to understand any changes that take place to the iron oxides themselves. The sequence of processes that occur during the onset of anaerobic conditions has been widely studied in lakes, soils and sediments although usually not from the point of view of arsenic. This sequence begins with the consumption of oxygen and an increase in dissolved CO_2 from the decomposition of organic matter. Next, NO_3^- decreases by reduction to NO_2^- and the gases N_2O and N_2. Insoluble manganic oxides dissolve by reduction to soluble Mn^{2+} and hydrous ferric oxides are reduced to Fe^{2+}. These processes are followed by SO_4^{2-} reduction to S^{2-}, then CH_4 production from fermentation and methanogenesis, and finally reduction of N_2 to NH_4^+. During sulphate reduction, the consequent sulphide reacts with any available iron to produce FeS and ultimately pyrite, FeS_2. Iron is often more abundant than sulphur so that there is 'excess iron' beyond that which can be converted to pyrite (Widerlund and Ingri, 1995). Arsenic(V) reduction would normally be expected to occur after Fe(III) reduction but before SO_4^{2-} reduction.

Iron from iron oxides is solubilised as Fe^{2+} under reducing conditions, giving rise to characteristically high Fe waters which in reducing groundwaters tend to range from 0.1–30 mg L^{-1} Fe. The reaction is microbially mediated (Lovley and Chappelle, 1995). There is also evidence for solid-state transformations of the iron oxides under reducing conditions. This is most obviously reflected in a colour change from reddish/orange/brown/tan colours to grey/green/blue colours. Changes to the magnetic properties have also been documented (Sohlenius, 1996).

Direct analysis of the Fe(II) and Fe(III) contents of iron oxides from reduced lake waters and sediments often indicates the presence of a mixed Fe(II)-Fe(III) oxide with an approximate average charge on the iron of +2.5 (Davison, 1993). The particle size of these oxides is often extremely small (Canfield, 1989) which makes them difficult to observe with many of the usual imaging techniques. Mössbauer spectroscopy is useful for identifying the form of iron oxides in sediments including anoxic sediments (Boughriet et al., 1997; Drodt et al., 1997).

The exact fate of iron during reduction is not well understood, in part because of the likely fine-grained nature of the minerals produced. Green rusts are one possible product. These were originally referred to as a 'hydrated magnetite' and given a composition '$Fe_3(OH)_8$'. They are layered mixed Fe(II)–Fe(III) hydroxides which contain an interlayer anion to balance the charge, often sulphate or carbonate. Boughriet et al. (1997) suspected the presence of either green-rust-like compounds, Fe(III)-Fe(II)-$(CO_3)(OH)$ or $Fe(II)_xCa_{1-x}CO_3$ solid solutions, in anoxic sediments from the Seine Estuary. They used ^{57}Fe Mössbauer spectroscopy to characterise the iron. Green rusts have also been identified in anaerobic soils and are thought to play an important role in controlling soil solution Fe concentrations (Genin et al., 1998).

Authigenic magnetite is another possible product in reducing environments (Fredrickson et al., 1998). Magnetite is frequently found in sediments as a residual detrital phase from rock weathering but very fine-grained magnetite is also formed by so-called 'magnetotactic' bacteria. Magnetite formation has been established under reducing conditions in the laboratory (Guerin and Blakemore, 1992). However, under strongly reducing conditions magnetite is unstable and in the presence of high concentrations of H_2S slowly converts to pyrite over a period of 100 years or more (Canfield and Berner, 1987). At the sediment/water interface in oceans, partial oxidation of primary magnetite (Fe_3O_4) can lead to a coating of the iron oxide, maghemite, γ-Fe_2O_3. Further burial and reduction leads to the dissolution of the primary magnetite (Torii, 1997).

2.3.4 Arsenic release from soils and sediments following reduction

There is considerable evidence from laboratory studies that arsenic is released from soils following flooding and the development of anaerobic conditions (Deuel and Swoboda, 1972; Hess and Blanchar, 1977; McGeehan and Naylor, 1994; McGeehan, 1996; Reynolds et al., 1999). Similar evidence is available from laboratory and field studies of marine and lake sediments. Numerous studies have demonstrated the release of both phosphorus (Mortimer, 1942; Farmer et al., 1994; Slomp et al., 1996) and arsenic below the redox boundary in freshwater and marine sediments (Moore et al., 1988; De Vitre et al., 1991; Sullivan and Aller, 1996).

This release has long been associated with iron-oxide dissolution. Deuel and Swoboda (1972) found that reducing an untreated black clay soil led to the release of As and that the amount released was related to the total arsenic content of the soil and the redox potential. They proposed that the release was primarily due to reduction (and dissolution) of 'ferric arsenates' rather than to changes in the As speciation. Arsenic release occurred rapidly — in less than a week.

A similar response has been noted in strongly reducing reservoir sediments from western Montana, USA (Moore et al., 1988). When redox conditions changed from an oxidising, oxide-dominated environment to a reducing, sulphide-dominated environment at about 65 cm depth there was a dramatic increase in pore water As concentrations from <20 µg L^{-1} to more than 500 µg L^{-1} at 95 cm depth. This increase was ascribed to oxide dissolution. De Vitre et al. (1991) showed that there was a rapid increase in pore water As concentrations (up to about 30 µg L^{-1}) with depth in a lake sediment and that this was mirrored by an increase in dissolved Fe. Upwardly diffusing Fe^{2+} was oxidised near the sediment-water interface and precipitated as an iron oxide which then adsorbed the upwardly diffusing As. Guo et al. (1997) measured the rate of release of As (and other metals) as a metal-spiked sediment was progressively reduced. Arsenic was rapidly released after the Fe and Mn had dissolved, suggesting that dissolution rather than desorption was the controlling process. Selective extractions suggested most of the As in the sediments was associated with Fe and Mn oxides.

A few studies have attempted to differentiate between the oxidation states of arsenic sorbed by sediments. Masscheleyn et al. (1991) measured the release of As and other metals following the flooding and reduction of an arsenic-contaminated soil and found that the release of some As occurred before Fe dissolution but that the amount of As released rapidly increased as the amount of iron-oxide dissolution increased. Both As(V) and As(III) were released. Rochette et al. (1998) demonstrated with XANES spectroscopy that reducing conditions can lead to the conversion of As(V) to As(III) in the solid phase of arsenic minerals. Preliminary results based on XANES also indicate a change in solid-state speciation of the As in Bangladesh sediments in going from oxidising to reducing conditions (Foster et al., 2000).

The As concentration in sediments is often too low and/or the particles too small for direct investigation of solid phase arsenic speciation using techniques such as XAFS and PIXE and so selective dissolution has been most widely used. A number of extraction 'schemes' exist which attempt to allocate elements to particular solid phases. Unfortunately, none of these schemes is perfect or universally applicable and there is little consensus on the best techniques to use. The interpretation is particularly difficult for minor and trace constituents which may be released by both dissolution and desorption processes. Nonetheless, these extractants can probe the solid phase in a useful way that reflects to a varying extent the nature of an element in the solid phase, and therefore its potential behaviour or availability. In particular, such techniques are particularly useful for characterising the very fine-grained minerals or organic phases that are presently poorly characterised by direct examination but which nevertheless play an important role in the behaviour of many trace elements.

The usefulness of the various extractants should increase as our quantitative understanding of the dissolution kinetics of typical minerals increases and as the various sorption/desorption reactions involved are quantified. In the meantime, they can serve as a useful guide to the forms of the elements present and to significant variations in such forms, but care has to be taken in interpreting their results in a quantitative and uncritical way.

Gómez-Ariza et al. (1998) have developed a method to speciate solid phase arsenic based on selective extraction of sediments with hydroxylamine hydrochloride, an acidic and reducing extractant that is rather selective for extracting manganese oxides but that also partially extracts iron oxides. Hydroxylamine hydrochloride did not reduce the As(V) during the extraction.

Brannon and Patrick (1987) studied the kinetics of As release and speciation (As(V), As(III), organic) from freshwater sediments when incubated under both oxidising and reducing conditions. This included sediments with and without added As(V). Most of the native and added As was found in the 'moderately reducible' (oxalate-extractable) fraction. During incubation, there was a steady release of As over the three months of the experiments. This was as As(V) under oxidising conditions and as As(III) under anaerobic conditions. There was no concomitant release of Fe (or Al or Mn) indicating that reductive dissolution of iron oxides was not responsible for the As release. Brannon and Patrick (1987) speculated that a change in the structure of the iron oxides may have been important. McGeehan (1996) was not sure whether the As(V) reduction found in flooded soils occurs in the soil solution or on the soil particles.

Riedel et al. (1997) monitored the release of metals when a column of estuarine sediment was subjected to reducing conditions for several months. Both As and Mn were released following reduction. Widerlund and Ingri (1995) noted that the As concentration in pore water from two sediment cores from the Kalix estuary, Sweden was controlled by the reductive dissolution of iron oxides. The location of the pore water maximum As concentration did not correspond with that of the sediment maximum As concentration.

Azcue and Nriagu (1995) found that the As concentrations in sediment pore waters from a mine-affected lake, Lake Moira, were up to 4–6 times greater than in the lake water. They suggested that this was due to the reductive dissolution of iron oxides. About 50 $\mu g\ L^{-1}$ of As was released for each mg L^{-1} Fe dissolved.

Manning and Goldberg (1997a) measured As(V) and As(III) adsorption by three Californian soils and found that the soils with the highest citrate-dithionite-bicarbonate extractable Fe and %clay had the greatest affinity for both As(III) and As(V). As(V) sorbed to a greater extent than As(III) at the micromolar As concentrations used suggesting that As would be released when As(V) is reduced to As(III).

Cummings et al. (1999) showed that there can be release of As(V) from hydrous ferric oxide (Hfo) without pre-reduction of the As(V) to As(III). Scorodite, an iron arsenate mineral (Table 2.1), was in part transformed to various ferrous arsenates. They suggested that as the structural Fe^{3+} was reduced, sorbed As(V) was released into solution.

All of these studies demonstrate the ability of soils and sediments to release As when subjected to reducing conditions but there is no clear consensus on the precise mechanisms involved, particularly with respect to the roles played by reductive desorption, reductive dissolution and diagenetic changes to the minerals.

2.3.5 Transport of arsenic

The transport and adsorption of chemicals are closely related in that adsorption slows down the transport of a chemical compared with the water flow (Appelo and Postma, 1994). In the simplest case of a linear adsorption isotherm, this relationship is straightforward and the partition coefficient, Kd, defines a constant retardation factor. With non-linear adsorption, which is most likely to be the case for arsenic adsorption, the value of Kd varies with concentration and is related to the slope of the isotherm. Normally, the Kd decreases with increasing concentration, leading to less retardation at high concentrations and ultimately to self-sharpening and diffuse fronts. For example, the greater the non-linearity, the longer it will take to flush completely all of the arsenic from an aquifer – the last remaining fraction is removed reluctantly because the binding is so strong at low concentrations.

Since transport is so closely related to the adsorption isotherms, it follows that arsenite and arsenate should travel through an aquifer with different velocities leading the range of pH of interest in groundwaters (pH 6–9) whereas As(V) sorption declines rapidly above pH 8.5 or so. Therefore while As(V) is much more strongly bound at low pH, at about pH 8–9 or above, As(III) binding can be greater than As(V) binding under similar conditions. This rapid decline in As(V) adsorption therefore occurs in a pH range that is found in groundwaters and is one factor that can lead to high As groundwaters.

Groundwaters invariably contain a range of other anions at concentrations exceeding that of As and these can be expected to compete for binding sites. The most relevant are phosphate, silicate, bicarbonate and dissolved organic carbon. All of these can be high in As-rich groundwaters and it can be difficult to differentiate 'cause' from 'effect'. The specific adsorption of positively charged $Ca^{2+}$and Mg^{2+} will tend to enhance the adsorption of As(V) thereby tending to counteract the some of the effects of anion competition. In reducing groundwaters, Fe^{2+} may also be important.

These competitive interactions can have an important influence on the shape of the arsenic adsorption isotherms and hence on the partitioning and transport of arsenic in groundwater environments. For example, if the oxide surface is dominated by adsorbed phosphate (which is quite likely in many natural environments), then this phosphate will effectively control the electrostatic potential of the surface not the adsorbed As(V). This means that additional As(V) sorption will have little influence on the electrostatics and will lead to an adsorption isotherm that is more like a Langmuir isotherm than a Freundlich isotherm. In effect, the excess phosphate reduces the high loadings expected in low As(V), low phosphate systems. Interactions such as these could therefore play an important role in controlling the mobility of As in natural waters.

While the Dzombak and Morel (1990) Diffuse Layer Model (DLM) and database have been widely used to model As sorption in 'pure' laboratory systems, they have not been so well tested under the more demanding conditions found in natural waters where competition for binding sites can be expected to be intense. Some competition data suggest reasonable predictions under some conditions (Wilkie and Hering, 1996) but the DLM may overestimate some interactions, e.g. As(V)-P competition. The CD-MUSIC model of Hiemstra and van Riemsdijk (1999) looks more promising for describing, and even predicting, the scale of these interactions. However, there is not at present a readily-usable database of sorption parameters for this model. A verified competitive adsorption model and database for the common oxides and groundwater solutes is urgently needed. It would go a long way to enabling many of the complex issues involved in understanding the evolution of arsenic-rich groundwaters to be untangled.

It is difficult to study mineral-water interactions directly in aquifers. Most studies, including those with a bearing on arsenic in groundwater, have been undertaken either in soils, or in lake or ocean sediments and usually from quite shallow depths. There is much to be learned from these studies since the same general principles are expected to apply. One of the most important areas where cross-fertilisation of ideas can occur is in understanding the behaviour of iron oxides in reducing soils and sediments and the influence of this on the release of arsenic. Korte (1991) speculated some time ago that desorption of arsenic from iron oxides could occur in reducing, alluvial sediments and that this could lead to high-arsenic groundwaters. He anticipated that this could be quite widespread but suggested that it would be most important in small, low yielding alluvial aquifers of local significance (Korte, 1991; Korte and Fernando, 1991) whereas it has in fact turned out to be most problematic in large, productive deltaic aquifers such as those of the Bengal Basin.

2.3.2 Arsenic interactions in sediments

The major minerals binding arsenic (as both arsenate and arsenite) in sediments are the metal oxides, particularly those of iron, aluminium and manganese. About 50% of the iron in freshwater sediments is typically in the form of iron oxides and about 20% of the iron is 'reactive' iron. Clays also adsorb arsenic because of the oxide-like character of their edges, as do carbonates. Of these components, adsorption by iron oxides is probably most important in aquifers because of their great abundance and strong binding affinity. Nevertheless, if studies of soil phosphate are a guide, then aluminium oxides can also be expected to play a significant role when present in quantity. Experience from water treatment (Edwards, 1994) suggests that below pH 7.5 aluminium hydroxides are about as effective as iron hydroxides (on a molar Fe-Al basis) for adsorbing As(V) but that iron salts are more efficient at higher pH and for adsorbing As(III). Activated alumina is quite widely used for removing As from water.

The interactions of arsenic with iron oxides have been studied in considerable detail in the laboratory and therefore provide the best insight into the likely behaviour of arsenic-mineral interactions in aquifers. However, most of these laboratory studies, particularly the older studies, have been undertaken at rather high arsenic concentrations and there is a paucity of reliable adsorption data at the low $\mu g\ L^{-1}$ level of relevance to natural waters. In addition, there is uncertainty over the extent to which the Fe oxides most commonly studied in the laboratory reflect the Fe oxides found in nature.

Field data for As(V) adsorption to natural 'diagenetic' Fe oxides (captured in a lake with vertically-installed Teflon sheets) closely paralleled the laboratory data of Pierce and Moore (1982) which was included in the Dzombak and Morel (1990) database (De Vitre et al., 1991). However, it was considerably greater than that calculated using Hingston et al.'s (1971) data for As(V) adsorption on goethite highlighting the great potential of freshly-formed 'amorphous' iron oxides for binding arsenic. Paige et al. (1997) measured the As/Fe ratios during the acid dissolution of a synthetic ferrihydrite containing adsorbed As(V) and concluded that the dissolution was incongruent (i.e. iron and arsenic were not released in the same proportion as found in the bulk mineral) and that the initial As released was probably initially sorbed on the surface of the very small ferrihydrite particles. The same is likely to happen during reductive dissolution. The adsorbed As also slowed down the acid dissolution of the ferrihydrite.

the Mekong delta of Vietnam.

Although the dominant source of As in soils is geological, additional inputs may be derived locally from industrial sources such as smelting and fossil-fuel combustion products and agricultural sources such as pesticides and phosphate fertilisers. Ure and Berrow (1982) quoted concentrations in the range 366–732 mg kg^{-1} in orchard soils as a result of the historical application of arsenical pesticides to fruit crops.

Continued irrigation of crops with arsenic-rich groundwater could also significantly enhance the As concentration in the soil since much of the added As can be expected to be retained in the soil layer.

Contaminated surficial deposits

Arsenic concentrations much higher than baseline values have been found in sediments and soils contaminated by the products of mining activity, including mine tailings and effluent. Concentrations in tailings piles and tailings-contaminated soils can reach up to several thousand mg kg^{-1} (Table 2.3). The high concentrations reflect not only increased abundance of primary arsenic-rich sulphide minerals, but also secondary iron arsenates and iron oxides formed as reaction products of the original ore minerals. The primary sulphide minerals are susceptible to oxidation in the tailings pile and the secondary minerals have varying solubility in oxidising conditions in groundwaters and surface waters. Scorodite ($FeAsO_4.2H_2O$) is metastable under most groundwater conditions and tends to dissolve incongruently, forming iron oxides and releasing arsenic into solution (Robins, 1987). Secondary arsenolite (As_2O_3) is also relatively soluble. Arsenic bound to iron oxides is relatively immobile, particularly under oxidising conditions.

2.2.3 The atmosphere

The concentrations of arsenic in the atmosphere are usually low but as noted above, are increased by inputs from smelting and other industrial operations, fossil-fuel combustion and volcanic activity. Concentrations amounting to around 10^{-5}–10^{-3} μg m^{-3} have been recorded in unpolluted areas, increasing to 0.003–0.18 μg m^{-3} in urban areas and greater than 1 μg m^{-3} close to industrial plants. Much of the atmospheric arsenic is particulate. Total arsenic deposition rates have been calculated in the range <1–1000 μg m^{-2} a^{-1} depending on the relative proportions of wet and dry deposition and proximity to contamination sources (Schroeder et al., 1987). Values in the range 38–266 μg m^{-2} a^{-1} (29–55% as dry deposition) were estimated for the mid-Atlantic coast (Scudlark and Church, 1988).

Airborne arsenic is transferred to water bodies by wet or dry deposition and may therefore increase the aqueous concentration slightly. However, there is little evidence to suggest that atmospheric arsenic poses a real health threat for drinking-water sources. Atmospheric arsenic arising from coal burning has been postulated as a major cause of lung cancer in parts of China (Guizhou Province), but the threat is from direct inhalation of domestic coal-fire smoke together with the consumption of food, especially chillis dried over coal fires, rather than from drinking water affected by atmospheric inputs of arsenic.

Arsine gas, AsH_3, like methane, would be expected to be released from strongly reducing soils. Mixing arsenic-rich sludge material from small-scale arsenic removal plants with cow dung has been advocated as one way of dealing with the contaminated sludge. This procedure relies on the strongly reducing conditions created by the dung promoting the reduction of the As and its loss to the atmosphere as arsine gas.

2.3 MINERAL-WATER INTERACTIONS

2.3.1 Relevance to arsenic mobilisation

As with most trace metals, the concentration of arsenic in natural waters is probably normally controlled by some form of solid-solution interaction. This is most clearly the case for soil solutions, interstitial waters and groundwaters where the solid/solution ratio is large but it is also often true in open bodies of water (oceans, lakes and reservoirs) where the concentration of solid particles is small but still significant. In these open bodies, the particles are of both mineral and biological origin. In most soils and aquifers, mineral-As interactions are likely to dominate over organic matter-As interactions, although organic matter may interact indirectly through its reactions with the surfaces of minerals and its role in controlling redox reactions.

Knowing the types of interaction involved is important because this will govern the response of As to changes in water chemistry. It will also determine the modelling approach required for making predictions about possible future changes and for understanding past changes in arsenic concentrations.

The importance of oxides in controlling the concentration of arsenic in natural waters has been appreciated for a long time (Livesey and Huang, 1981; Matisoff et al., 1982; Korte, 1991; Korte and Fernando, 1991). Clays can also adsorb As(III) and As(V) (Manning and Goldberg, 1997b). Frequently, one of the best correlations between the concentration of As in sediments and other elements is with iron. This is also the basis for the use of iron, aluminium and manganese salts in water treatment, including for arsenic removal (e.g. Edwards, 1994). The As content of residual sludges can be in the range 1,000–10,000 mg kg^{-1} (Driehaus et al., 1998; Forstner and Haase, 1998).

Arsenic adsorption onto iron oxides has been quite extensively studied and the data for hydrous ferric oxide (Hfo) in particular has been well documented (Dzombak and Morel, 1990). The extent of adsorption is strongly dependent on the arsenic speciation (and hence redox status), arsenic concentration, pH and the concentration of competing anions such as phosphate. The shapes of the As(III) and As(V) isotherms are very different reflecting the weak electrostatic contribution in the case of As(III) and the strong electrostatic contribution in the case of As(V). The As(III) isotherm resembles a Langmuir isotherm with a near-linear isotherm at low As concentrations and a maximum adsorption at high concentrations (see Chapter 12). The As(V) isotherm like phosphate is strongly nonlinear which means that As(V) loadings can be high even at very low solution As concentrations.

As(III) sorption is practically independent of pH over

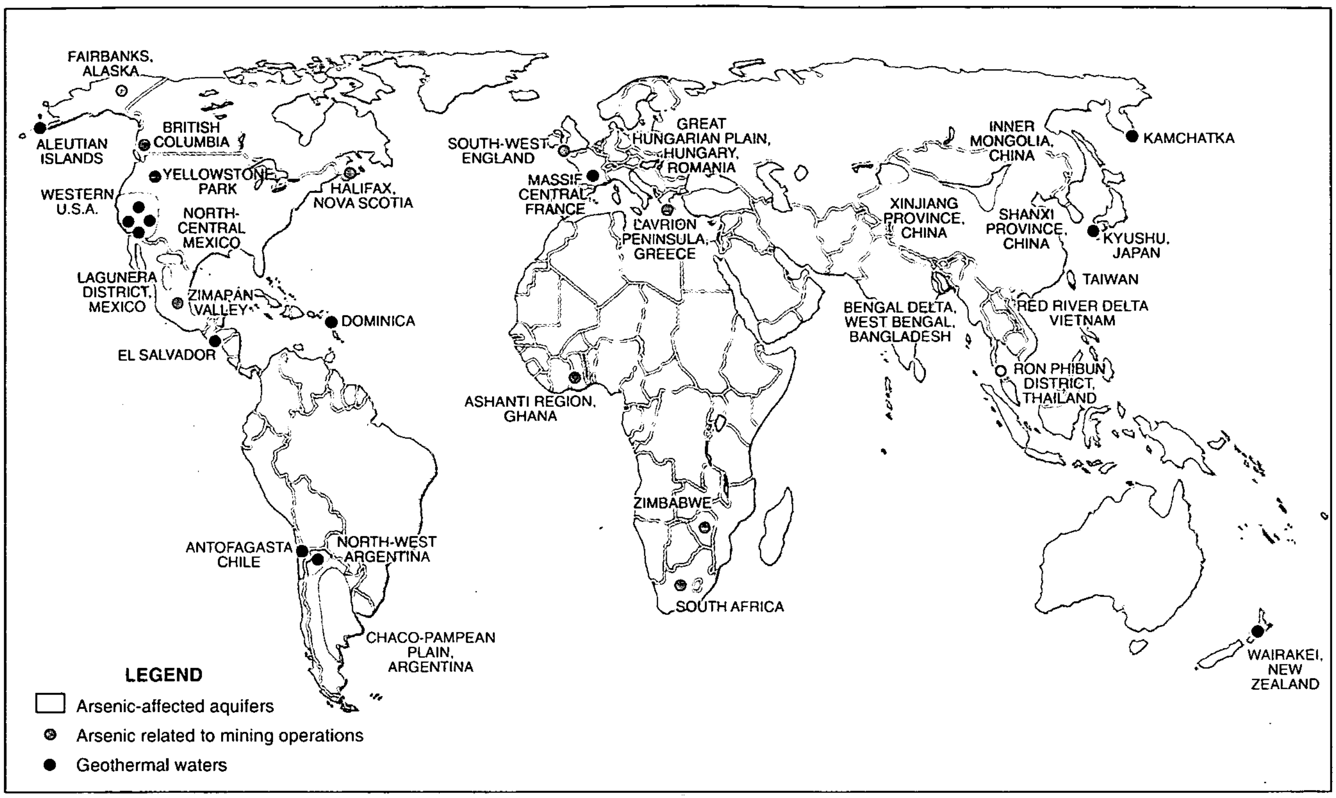


Figure 2.1. Documented cases of arsenic problems in groundwater related to natural contamination. Cases include some of the major mining and geothermal occurrences reported in the literature.

to their increased separation along a flow path. This was demonstrated by Gulens et al. (1979) using breakthrough experiments with columns of sand and various groundwaters pumped continuously from piezometers. They studied As(III) and As(V) mobility with groundwaters having a range of Ehs and pHs using radioactive ^{74}As ($t_{1/2}$=17.7 d) and ^{76}As ($t_{1/2}$=26.4 hr) to monitor the breakthrough of As. They showed that: (i) As(III) moved 5–6 times faster than As(V) under oxidising conditions (pH 5.7); (ii) with a 'neutral' groundwater (pH 6.9), As(V) moved much faster than at pH 5.7 but was still slower than As(III); (iii) with reducing groundwater (pH 8.3), both As(III) and 'As(V)' moved rapidly through the column; (iv) when the amount of As injected was substantially reduced, the mobility of the As(III) and As(V) was greatly reduced.

This chromatographic effect may account in part for the highly variable As(III)/As(V) ratios found in many reducing aquifers. Such a separation is used to advantage to speciate arsenic with various columns. Chromatographic separation during transport will also tend to uncorrelate any correlations found at the source, for example in the As versus Fe relationship, thus complicating a simple interpretation of well water analyses.

There have been few studies of the transport of arsenic in aquifers typical of those contaminated from natural sources. Most studies of arsenic leaching have concerned industrially-contaminated sites. Kuhlmeier (1997a,b) studied the transport of arsenic in highly-contaminated clayey and sandy soils from around an old arsenic herbicide plant in Houston, Texas. He used column experiments to estimate 'apparent' Kd's. These were time- and implicitly concentration-dependent and for the sandy soils ranged from 0.26 L kg^{-1} after one pore volume to 3.3 L kg^{-1} after 6 pore volumes. They were not too different for the clayey materials. However, the overall As concentrations were very high — the groundwater was heavily contaminated with As (408–464 mg L^{-1}) mostly with MMAA. The sediment contained only a few mg kg^{-1} of inorganic As. Baes and Sharp (1983) gave Kd values of 1.0–8.3 L kg^{-1} (median 3.3) for As(III) binding by soils and 1.9–18.0 L kg^{-1} (median 6.7) for As(V).

2.4 GROUNDWATER ENVIRONMENTS SHOWING ENHANCED ARSENIC CONCENTRATIONS

2.4.1 World distribution of groundwater arsenic problems

A number of large aquifers in various parts of the world have been identified with problems from As occurring at concentrations above 50 μg L^{-1}, often significantly so. The most noteworthy occurrences are in parts of West Bengal and Bangladesh, Taiwan, northern China, Hungary, Mexico, Chile, Argentina and many parts of the USA but particularly the south-west, (Figure 2.1). Occurrences of mining related As problems have also been recorded in many parts of the world, including Thailand, Ghana, Greece, Austria and parts of the USA (Figure 2.1). Arsenic associated with geothermal waters has also been reported in several areas, including hot springs from parts of the

USA, Japan, Chile, Argentina, France, Dominica, Kamchatka and New Zealand.

Localised groundwater arsenic problems are now being reported from an increasing number of countries and many new cases are likely to be discovered. Until recently, arsenic was not traditionally on the list of elements routinely tested by water quality testing laboratories and so many arsenic-rich sources undoubtedly remain to be identified. The revision of the drinking water standard for arsenic in a number of countries has prompted a reassessment of the situation in many countries. The recent discovery of arsenic contamination on a large scale in Bangladesh has highlighted the need for a rapid assessment of the situation in alluvial aquifers worldwide.

While natural high arsenic groundwaters are not uncommon, they are by no means typical of most aquifers and only exist under special circumstances. These relate to both the geochemical environment and the past and present hydrogeology. Paradoxically, high arsenic groundwaters do not usually appear to be directly related to areas of high arsenic concentrations in the source rocks. This is because of the high solid/solution ratio in aquifers and the low drinking water limits of arsenic – even a rock containing 1 mg As kg^{-1} would produce a groundwater with a concentration of some 3–10 mg As L^{-1} if all of the arsenic were to dissolve. Therefore only a small fraction of the arsenic needs to dissolve to produce a relatively high-arsenic groundwater.

Distinctive groundwater arsenic problems occur under both reducing and oxidising groundwater conditions; also in both 'wet' and 'arid' environments. Below we discuss the characteristics of the arsenic problems worldwide through a series of type examples. These examples have been ordered according to the type of environment under which they are developed.

2.4.2 Reducing environments

Bangladesh and West Bengal

In terms of the population exposed, As problems in groundwater from the alluvial and deltaic aquifers of Bangladesh and West Bengal represent the most serious occurrences identified globally. Concentrations in groundwaters from the affected areas have a very large range from <0.5 μg L^{-1} to ca. 3200 μg L^{-1}. Resultant health problems were first identified in West Bengal in the late 1980s although the first confirmation in Bangladesh was not made until 1993. Around 6 million in West Bengal are believed to be at risk from drinking water with >50 μg L^{-1} As (Table 2.4). Around 5000 patients have been identified with As-related health problems in West Bengal (including skin pigmentation changes) and at least 6000–7000 in Bangladesh.

As with Bangladesh, the affected aquifers in West Bengal are generally shallow (less than 100–150 m deep), of Holocene age and comprise a mixed sequence of micaceous sands, silts and clays deposited by the rivers Ganges and Hoogli and their tributaries. The sediments are derived from the upland Himalayan catchments and from basement complexes of the northern and western parts of West Bengal. In most affected areas, the sediment sequence is capped by a layer of clay or silt (of variable thickness) which effectively restricts entry of air to the aquifers. This, together with an abundance of recent solid organic matter deposited with the sediments, has resulted in the development of highly reducing aquifer conditions and dominance of As in solution as As(III). As with Bangladesh, deeper groundwaters from the sediment sequence in West Bengal (>100–150 m depth, probably of Pleistocene age) have generally low As concentrations (<10 μg L^{-1}).

The characteristic chemical features of the high-arsenic groundwaters of West Bengal are high iron (>0.2 mg L^{-1}), manganese (>0.5 mg L^{-1}), bicarbonate (>500 mg L^{-1}) and often phosphorus (>0.5 mg L^{-1}) concentrations, and low chloride (<60 mg L^{-1}), sulphate (<1 mg L^{-1}), nitrate and fluoride (<1 mg L^{-1}) concentrations, with pH values close to or greater than 7 (AIP Steering Committee, 1991; CGWB, 1999). However, the correlations are far from perfect and where good correlations with arsenic are found, these are usually only applicable locally and are therefore of limited value for quantitative prediction of arsenic concentrations at a larger scale. For example, some workers have found a positive correlation between arsenic and iron in localised studies (e.g. Nag et al., 1996), but this is not true of the region as a whole.

As with Bangladesh, the regional distribution of the high-arsenic waters in West Bengal is known to be extremely patchy (AIP Steering Committee, 1991; CSME, 1997), presumably in part because of great variation in sedimentary characteristics and variations in abstraction depth. Estimates of the proportions of tubewells affected in West Bengal are not well-documented and difficult to assess. However, the indications are that the degree of contamination is not as severe in West Bengal as in the worst-affected districts of Bangladesh (e.g. Dhar et al. 1997). Certainly, the overall areal extent of contamination in West Bengal is less than in Bangladesh.

Taiwan

The south-west coastal zone of Taiwan was perhaps the first area to be identified as a problem area for health effects arising from chronic arsenic exposure. Problems have also been identified subsequently in aquifers of NE Taiwan (Hsu et al., 1997). Awareness of the problem began during the 1960s (e.g. Tseng et al., 1968) and arsenic-related health problems have been well-documented by several workers since then (e.g. Chen et al., 1985). Taiwan is the classic area for the identification of black-foot disease but a number of other typical health problems, including internal cancers, have been described.

Kuo (1968) observed As concentrations in groundwater samples from south-west Taiwan ranging between 10 μg L^{-1} and 1800 μg L^{-1} (mean 500 μg L^{-1}, n=126) and found that half the samples analysed had concentrations between 400 μg L^{-1} and 700 μg L^{-1}. A large study carried out by the Taiwan Provincial Institute of Environmental Sanitation established that 119 townships in the affected area had As concentrations in groundwater of >50 μg L^{-1} and 58 townships had >350 μg L^{-1} (Lo et al., 1977).

The high As concentrations are found in deep artesian well waters abstracted from sediments which include fine sands, muds and black shale (Tseng et al., 1968). The groundwaters are therefore likely to be strongly reducing and hence may be analogous to groundwaters in the affected areas of Bangladesh and West Bengal. This is supported by the observation that the As is present largely as As(III) (Chen et al., 1994). However, the hydrogeochemistry of the area is poorly understood in detail. Groundwater from shallow wells in the area have low arsenic concentrations (Guo et al., 1994).

Vietnam

The aquifers of the large deltas of the Mekong and Red Rivers are now widely exploited for drinking water. The total number of tubewells in Vietnam is unknown but could be on the order of one million with perhaps 150,000 in the Red River delta region. The majority of these are private tubewells. The aquifers exploited are of both Holocene and Pleistocene age.

In the Red River delta region, the Holocene sediments form the shallowest aquifer but these may be only 10–15 m deep and in some cases are entirely absent. Older Pleistocene sediments are then exposed at the surface. Unlike Bangladesh, even when the Holocene sediments are present, there is not always a layer of fine silt-clay at the surface and so the uppermost Holocene aquifer can behave as an unconfined aquifer. Normally the Holocene sediments are separated from the underlying Pleistocene sediments by a clay layer several metres thick although 'windows' in this clay layer exist where there is hydraulic continuity between the Holocene and Pleistocene aquifers. The total thickness of sediments is typically 100–200 m. The capital city of Hanoi is now largely dependent on groundwater for its public water supply.

The groundwaters in the delta regions are usually strongly reducing with high concentrations of iron, manganese and ammonium. Much of the shallow aquifer in the Vietnamese part of the Mekong delta region is affected by salinity and cannot be used for drinking water.

Little was known about the arsenic concentrations in groundwater in Vietnam until recently. UNICEF and EAWAG/CEC (Hanoi National University) are now carrying out extensive investigations to assess the scale of the problem. Preliminary results from Hanoi (Berg et al., 2000; Wegelin et al., 2000) indicate that there is a significant arsenic problem in shallow tubewells in the city, particularly in the south. There appears to be a seasonal pattern with significantly higher concentrations in the rainy season. This could be related to the local hydrology since there are significant interactions between the aquifer and the adjacent Red River.

Little is known about the arsenic concentrations in groundwater from the middle and upper parts of the Mekong delta (and into adjacent Cambodia and Laos) and other smaller alluvial aquifers in Vietnam but investigations are presently taking place.

Northern China

Arsenic occurrence has been found at high concentrations (in excess of the Chinese national standard of 50 $\mu g\ L^{-1}$) in groundwaters from Inner Mongolia as well as Xinjiang and Shanxi Provinces (Figure 2.1; Wang, 1984; Wang and Huang, 1994; Niu et al., 1997). The first cases of As poisoning were recognised in Xinjiang Province in the early 1980s. Wang (1984) found As concentrations in groundwaters from the province at up to 1200 $\mu g\ L^{-1}$. Wang and Huang (1994) reported As concentrations of between 40 $\mu g\ L^{-1}$ and 750 $\mu g\ L^{-1}$ in deep artesian groundwater from the Dzungaria Basin on the north side of the Tianshan Mountains (stretch of ca. 250 km). Arsenic concentrations in artesian groundwater from deep boreholes (up to 660 m) were found to increase with depth. Shallow (non-artesian) groundwaters had observed As concentrations between <10 $\mu g\ L^{-1}$ and 68 $\mu g\ L^{-1}$. The concentration of As in the saline Aibi Lake was reported as 175 $\mu g\ L^{-1}$, while local rivers had concentrations between 10 $\mu g\ L^{-1}$ and 30 $\mu g\ L^{-1}$. Artesian groundwater has been used for drinking in the region since the 1960s and chronic health problems have been identified as a result (Wang and Huang, 1994).

In Inner Mongolia, concentrations of As in excess of the Chinese national standard have been identified in groundwaters from aquifers in the Huhhot Basin, Ba Meng Region, and Tumet Plain (e.g. Luo et al., 1997; Ma et al., 1999). These areas include the cities of Boutou and Togto. In the Huhhot Basin, the problem is found in groundwaters from Holocene alluvial and lacustrine aquifers under highly reducing conditions and is worst in the lowest-lying parts of the basin (Smedley et al., 2000b). Concentrations have been found in the groundwaters at up to 1500 $\mu g\ L^{-1}$, with a significant proportion of the As being present as As(III). Shallow groundwaters in the region are commonly saline as a result of evaporative concentration and many have high fluoride concentrations, although these do not generally correlate with high As concentrations. In the affected region, As-related disease has been identified by Luo et al. (1997). Recognised health effects include lung, skin and bladder cancer as well as prevalent keratosis and skin-pigmentation problems.

Hungary and Romania

Concentrations of As above 50 $\mu g\ L^{-1}$ have been identified in groundwaters from alluvial sediments in the southern part of the Great Hungarian Plain and in parts of neighbouring Romania (Figure 2.1). Concentrations up to 150 $\mu g\ L^{-1}$ (average 32 $\mu g\ L^{-1}$, n=85) have been recorded by Varsányi et al. (1991). The Great Hungarian Plain, some 110,000 km^2 in area, consists of a thick sequence of subsiding Quaternary sediments. Groundwaters vary from Ca-Mg-HCO_3-type in the recharge areas of the basin margins to Na-HCO_3-type in the low-lying discharge regions. Groundwaters in deep parts of the basin (80–560 m depth) with high As concentrations are reducing with high concentrations of Fe and NH_4 and many have reported high concentrations of humic acid (up to 20 mg L^{-1}; Varsányi et al., 1991). The groundwaters have highest As concentrations in the lowest parts of the basin, where the sediment is fine grained.

2.4.3 Arid oxidising environments

Mexico

The Lagunera Region of north central Mexico has a well-documented groundwater arsenic problem with significant resulting chronic health problems. The region is arid and groundwater is an important resource for potable supply. Groundwaters from the region are predominantly oxidising with neutral to high pH. Del Razo et al. (1990) quoted pH values for groundwaters in the range 6.3 to 8.9. They found As concentrations in the range 8 μg L^{-1} to 624 μg L^{-1} (average 100 μg L^{-1}, n=128), with half the samples having concentrations greater than 50 μg L^{-1}. They also noted that most (>90%) of the groundwater samples investigated had As present predominantly as As(V). Del Razo et al. (1994) determined the average concentration of As in drinking water from Santa Ana town in the region as 404 μg L^{-1}. The estimated population exposed to As in drinking water with >50 μg L^{-1} is around 400,000 in Lagunera Region (Del Razo et al., 1990). Groundwaters from the region also have high concentrations of fluoride (up to 3.7 mg L^{-1}; Cebrián et al., 1994).

High As concentrations have also been identified in groundwaters from the state of Sonora in north-west Mexico. Wyatt et al. (1998) found concentrations in the range 2–305 μg L^{-1} (76 samples) with highest concentrations in groundwaters from the towns of Hermosillo, Etchojoa, Magdalena and Caborca. The As concentrations were also positively correlated with fluoride. Highest observed F concentration in the area was 7.4 mg L^{-1}. It is also believed that high arsenic groundwaters have been found in other parts of northern Mexico.

Chile

Health problems related to As in drinking water were first recognised in northern Chile in 1962. Typical symptoms included skin-pigmentation changes, keratosis, squamous-cell carcinoma (skin cancer), cardiovascular problems and respiratory disease (Zaldivar, 1974). More recently, As ingestion has been linked to lung and bladder cancer. It has been estimated that around 7% of all deaths occurring in Antofagasta between 1989 and 1993 were due to past exposure to As in drinking water. Since exposure was chiefly in the period 1955–1970, this pointed to a long latency period of cancer mortality. Other reported symptoms include impaired resistance to viral infection and lip herpes (Karcher et al., 1999).

High As concentrations have been recorded in surface waters and groundwaters from Administrative Region II (incorporating the cities of Antofagasta, Calama and Tocopilla) of northern Chile (Cáceres et al., 1992). The region is arid (Atacama Desert) and water resources are limited. High As concentrations are accompanied by high salinity (due to evaporation) and high B concentrations. Arsenic values below 100 μg L^{-1} in surface waters and groundwaters are apparently quite rare, and concentrations up to 21,000 μg L^{-1} have been found. Karcher et al. (1999) quoted ranges of 100 μg L^{-1} to 1000 μg L^{-1} in raw waters (average 440 μg L^{-1}). The As is present in the waters mostly as arsenate. However, the hydrogeochemistry of the aquifers of Chile is as yet poorly understood. The aquifers are composed of volcanogenic sediments though these have not been characterised in detail. In Antofagasta, concentrations of As in the sediments are ca. 3.2 mg kg^{-1} (Cáceres et al., 1992). Additional As exposure from smelting of copper ore has also been noted in northern Chile (Cáceres et al., 1992).

Arsenic treatment plants were installed in the towns of Antofagasta and Calama in 1969 to mitigate the problems. Today, the urban population of the major towns are supplied with treated water from the Rivers Toconce and Loa (Karcher et al., 1999) which is transported from the foot of the Andes mountains to the treatment works. However, rural communities still largely rely on untreated water supplies which contain As.

Argentina

The Chaco-Pampean Plain of central Argentina constitutes perhaps one of the largest regions of high-arsenic groundwaters known, covering around 1 million km^2. High concentrations of arsenic have been documented from Córdoba, La Pampa, Santa Fe and Buenos Aires Provinces in particular. Symptoms typical of chronic arsenic poisoning, including skin lesions and some internal cancers, have been recorded in these areas (e.g. Hopenhayn-Rich et al., 1996). The climate is temperate with increasing aridity towards the west. Groundwaters are derived from Quaternary deposits of loess (mainly silt) with intermixed rhyolitic or dacitic volcanic ash (Nicolli et al., 1989; Nicolli and Merino, 2001; Smedley et al., 1998, 2001a). The sediments display abundant evidence of post-depositional diagenetic changes under semi-arid conditions, with common occurrences of calcrete in the form of cements, nodules and discrete layers, sometimes many centimetres thick.

Nicolli et al. (1989) found arsenic concentrations in groundwaters from Córdoba in the range 6–11500 μg L^{-1} (median 255 μg L^{-1}). Nicolli and Merino (2001) in a study of the Carcarañá River Basin (Córdoba and Santa Fe Provinces) found concentrations in the range <10–720 μg L^{-1} (mean 201 μg L^{-1}) and Smedley et al. (1998) found concentrations for groundwaters in La Pampa Province in the range <4–5280 μg L^{-1} (median 145 μg L^{-1}). The groundwaters often have high salinity and the arsenic concentrations are generally well-correlated with other anion and oxyanion elements (F, V, HCO_3, B, Mo). They are also predominantly oxidising and under the pertaining arid conditions, with pronounced silicate and carbonate weathering reactions, often have high pH values (range typically 7.0–8.7). Arsenic is dominantly present as As(V) (Smedley et al., 1998, 2001a). Metal oxides in the sediments (especially Fe and Mn oxides and hydroxides) are thought to be the main source of dissolved arsenic, caused by desorption under high-pH conditions (Smedley et al., 2000a) although derivation from volcanic glass has also been cited as a potential source (Nicolli et al., 1989; Nicolli and Merino, 2001).

2.4.4 Mixed oxidising and reducing environments

South-western USA

Many areas have been identified in the USA with arsenic problems in groundwater (Welch et al., 2000). Most of the worst-affected and best-documented cases occur in the south-western states (Nevada, California, Arizona). However, within the last decade, parts of Maine, Michigan, Minnesota, South Dakota, Oklahoma and Wisconsin have been found with concentrations of arsenic exceeding 10 $\mu g\ L^{-1}$ and smaller areas of high arsenic groundwaters have been found in many other States. Much water analysis and research has been carried out in the USA, particularly in view of the reduction in the USEPA drinking-water limit and public concern over the possible long-term health effects. Occurrences in groundwater are therefore noted to be widespread, although of those reported, relatively few have significant numbers with concentrations greater than 50 $\mu g\ L^{-1}$. A recent review of the analyses of some 17,000 water analyses from the USA suggested that around 40% exceeded 1 $\mu g\ L^{-1}$ and about 5% exceeded 20 $\mu g\ L^{-1}$ (percentage above 50 $\mu g\ L^{-1}$ unknown; Welch et al., 1999). The As is thought to derive from various sources, including natural dissolution/desorption reactions, geothermal water and mining activity. The natural occurrences of arsenic in groundwater are found under both reducing and oxidising conditions in different areas.

In Nevada, at least 1000 private wells have been found to contain As concentrations in excess of 50 $\mu g\ L^{-1}$ (Fontaine, 1994). The city of Fallon, Nevada (population 8000) is served by a groundwater supply with an As concentration of 100 $\mu g\ L^{-1}$ which for many years was supplied without treatment. Welch and Lico (1998) reported high As concentrations, often exceeding 100 $\mu g\ L^{-1}$ but with extremes up 2600 $\mu g\ L^{-1}$, in shallow groundwaters from the southern Carson Desert. These are apparently largely present under reducing conditions, having low dissolved-oxygen concentrations and high concentrations of dissolved organic C, Mn and Fe. The groundwaters also have associated high pH (>8) and high concentrations of P (locally >4 $mg\ L^{-1}$) and U (>100 $\mu g\ L^{-1}$; Welch and Lico, 1998). The high As and U concentrations were thought to be due to evaporative concentration of groundwater, together with the influence of redox and desorption processes involving metal oxides.

In groundwaters from the Tulare Basin of the San Joaquin Valley, California, a large range of groundwater As concentrations from <1 $\mu g\ L^{-1}$ to 2600 $\mu g\ L^{-1}$ have been found (Fujii and Swain, 1995). Redox conditions in the aquifers appear to be highly variable and high As concentrations are found in both oxidising and reducing conditions. The proportion of As present as As(III) increases in the groundwaters with increasing well depth. The groundwaters from the Basin are often strongly affected by evaporative concentration with resulting high TDS values. Many also have high concentrations of Se (up to 1000 $\mu g\ L^{-1}$), U (up to 5400 $\mu g\ L^{-1}$), B (up to 73,000 $\mu g\ L^{-1}$) and Mo (up to 15,000 $\mu g\ L^{-1}$; Fujii and Swain, 1995).

Robertson (1989) also noted the occurrence of high As concentrations in groundwaters under oxidising conditions in alluvial aquifers in the Basin and Range Province in Arizona. Arsenic in the groundwater is present predominantly as As(V) and was observed to correlate well with Mo, Se, V, F and pH. Of the 467 samples analysed, 7% had As concentrations greater than 50 $\mu g\ L^{-1}$. Arsenic concentrations in the sediments ranged between 2–88 $mg\ kg^{-1}$. Oxidising conditions were found to persist in the aquifers down to significant depths (600 m) despite significant groundwater age (up to 10,000 years old). The high arsenic (and other oxyanion) concentrations are a feature of the closed basins of the province.

2.4.5 Geothermal sources

Arsenic associated with geothermal waters has been reported in several areas, including hot springs from parts of the USA, Japan, chile, Kamchatka, New Zealand, France and Dominica (e.g. Welch et al., 1988; Criaud and Fouillac, 1989). As noted above, parts of Salta Province of north-west Argentina also have thermal springs with high As concentrations.

In the USA, occurrences of As linked to geothermal sources have been summarised by Welch et al. (1988). Reported occurrences include Honey Lake Basin, California (As up to 2600 $\mu g\ L^{-1}$), Coso Hot Springs, California (up to 7500 $\mu g\ L^{-1}$), Imperial Valley, California (up to 15,000 $\mu g\ L^{-1}$), Long Valley, California (up to 2500 $\mu g\ L^{-1}$) and Steamboat Springs, Nevada (up to 2700 $\mu g\ L^{-1}$). Geothermal waters in Yellowstone National Park also contain As (<1–7800 $\mu g\ L^{-1}$ in geysers and hot springs) and have given rise to high concentrations (up to 370 $\mu g\ L^{-1}$) in waters of the Madison River (Nimick et al., 1998). Geothermal inputs from Long Valley, California are believed to be responsible for high concentrations (20 $\mu g\ L^{-1}$) of As in the Los Angeles Aqueduct which provides the water supply for the city of Los Angeles (Wilkie and Hering, 1998).

Welch et al. (1988) noted a general relationship between As and salinity in geothermal waters from the USA. Despite a lack of good positive correlation between As and Cl, geothermal waters with As greater than ca. 1000 $\mu g\ L^{-1}$ generally had Cl concentrations of 800 $mg\ L^{-1}$ or more. Wilkie and Hering (1998) noted the high alkalinity and pH values (average pH 8.3) as well as high Cl and B concentrations of geothermal waters in Long Valley.

Geothermal waters from Kyushu, Japan have been found to have As concentrations in the range 500–4600 $\mu g\ L^{-1}$ (26 samples). The waters are typically of Na-Cl type and the As is present almost entirely present as As(III) (Yokoyama et al., 1993).

Elevated As concentrations have been documented in waters from the geothermal areas of New Zealand. Robinson et al. (1995) found an As concentration in groundwater from the Wairakei geothermal field of 3800 $\mu g\ L^{-1}$ and found river and lake waters receiving inputs of geothermal water from the Wairakei, Broadlands, Orakei Korako and Atiamuri geothermal fields to have concentrations up to 121 $\mu g\ L^{-1}$. Concentrations diminished significantly downstream away from the geothermal input areas.

2.4.6 Arsenic mineralisation and mining-related arsenic problems

Thailand

Probably the worst recorded case of As poisoning related to mining activity is that of Ron Phibun District in Nakhon Si Thammarat Province of southern Thailand. Health problems were first recognised in the area in 1987. Around 1000 people have been diagnosed with As-related skin disorders, particularly in and close to Ron Phibun town (Williams, 1997).The affected area lies within the South-East Asian Tin Belt. Arsenic concentrations have been found at up to 5000 $\mu g\ L^{-1}$ in shallow groundwaters from Quaternary alluvial sediment that has been extensively dredged during mining operations. Deeper groundwaters from older limestone aquifers have been found to be less contaminated (Williams et al., 1996) although a few high As concentrations occur, presumably also as a result of contamination from the mine workings. The mobilisation of As is believed to be caused by oxidation of arsenopyrite, exacerbated by the former tin-mining activities. Recent mobilisation in groundwater has occurred during post-mining groundwater rebound (Williams, 1997).

Ghana

Several workers have reported the effects of mining activity on the environment in Ghana. Ghana is an important gold-mining country and mining has been active since the late 19th century. Today, Ghana produces about one third of the world's gold. The most important mining area is the Ashanti Region of central Ghana. As with Ron Phibun District in Thailand, the gold is associated with sulphide mineralisation, particularly arsenopyrite. Arsenic mobilises in the local environment as a result of arsenopyrite oxidation, induced (or exacerbated) by the mining activity. Around the town of Obuasi, high As concentrations have been noted in soils close to the mines and treatment works (Amasa, 1975; Bowell, 1992; 1993). Some high concentrations have also been reported in river waters close to the mining activity (Smedley et al., 1996).

Despite the presence of high As concentrations in the contaminated soils and in bedrocks close to the mines, Smedley et al. (1996) found that many of the groundwaters of the Obuasi area had low As concentrations, with a median concentration in tubewell waters of just 2 $\mu g\ L^{-1}$. Some high concentrations were observed (up to 64 $\mu g\ L^{-1}$) but these were not generally in the vicinity of the mines or related directly to mining activity. Rather, the higher concentrations were found to be present in relatively reducing groundwaters (Eh 220–250 mV). Oxidising groundwaters, especially from shallow hand-dug wells, had low As concentrations. This was taken to be due retardation of As by adsorption onto hydrous ferric oxides under the ambient low pH condition of the groundwaters (median pH 5.4 in dug wells; 5.8 in tubewells; Smedley et al., 1996).

United States

Arsenic contamination from mining activities has been identified in numerous areas of the USA, many of which have been summarised by Welch et al. (1988; 1999). Groundwater from some areas has been reported to have very high As concentrations locally (up to 48,000 $\mu g\ L^{-1}$). Well-documented cases of As contamination include the Fairbanks gold-mining district of Alaska (Wilson and Hawkins, 1978; Welch et al., 1988), the Coeur d'Alene Pb-Zn-Ag mining area of Idaho, (Mok and Wai, 1990), Leviathan Mine, California (Welch et al., 1988), Kelly Creek Valley, Nevada (Grimes et al., 1995), Clark Fork river, Montana (Welch et al., 2000) and Lake Oahe in South Dakota (Ficklin and Callender, 1989). Some mining areas of the USA have significant problems with acid mine drainage resulting from extensive oxidation of iron sulphides. In these, pH values can to extremely low and iron oxides dissolve and release bound arsenic. Iron Mountain has some extremely acidic mine-drainage waters with negative pHs and As concentrations in the milligram per litre range (Nordstrom et al., 2000).

In Wisconsin, high concentrations of As together with SO_4 and many other trace metals (Fe, Cu, Co, Cd, Ni, Pb) and acidic conditions have been found in groundwaters affected by oxidation of secondary pyrite cements in sandstone as a result of aquifer dewatering (Schreiber et al., 2000; Weissbach et al., 2000). Arsenic concentrations up to 12 $mg\ L^{-1}$ have been recorded, the highest values occurring where water levels fluctuate around the zone of mineralisation. Recently oxidised material is leached into the groundwater during intervals of rising water levels.

Other areas

Many other areas have increased concentrations of As in soils, sediments and waters as a result of mining activity. Documented cases include the Lavrion region of Greece, associated with lead- and silver-mining activity (Komnitsas et al., 1995), the Zimapán Valley of Mexico, parts of southwest England (Thornton and Farago, 1997), South Africa, Zimbabwe and Bowen Island, British Columbia (Boyle et al., 1998). Although severe contamination of the environment has often been documented in these areas, the impact on groundwaters used for potable supply is usually minor.

3 Geology and sedimentology

3.1 Physical Setting

3.1.1 Background

The Bengal Basin in Bangladesh contains a 15 km thick sequence of Cretaceous to Recent sediments and occupies some 100,000 km^2 of lowland floodplain and delta. The combined deltas of the Ganges, Brahmaputra and Meghna (GBM) river systems lie within Bangladesh. These experience high rates of discharge and sediment transport during the annual monsoon season. The GBM produces the greatest total sediment load of any river system in the world (Table 3.1). The large volume of sediment eroded from the Himalayas has resulted in the formation of the submarine Bengal Delta that extends beyond the latitude of northern Sri Lanka. The recent studies of Goodbred and Kuehl (1999) suggest that some 1500 x 10^9 m^3 of sediment fill has accumulated in the flood plain and delta plain areas of the Bengal Basin in the last 7,000 years or so.

Sediment load is greatest in the Brahmaputra and much less in the Meghna. In Assam, the Brahmaputra is aggrading with accumulation of much coarse-grained material within an alluvial fan that extends a short way into northern Bangladesh. In a similar fashion, the Tista and Mahananda rivers have formed a fan-cone south of Darjeeling, extending into north-western Bangladesh. This is composed of coarse sands, gravels, pebbles and cobbles. Downstream of its confluence with the Tista, the Brahmaputra flows due south to its confluence with the Ganges at Aricha.

In the valley between the Barind and the Madhupur Tracts (Figure 3.1), the Brahmaputra is a braided sand river with a channel some 10 km wide (Thorne et al., 1993). During 1986–87 the sediment load carried by the river, measured at Bahadurabad in Jamalpur District, totalled some 6.72×10^{11} kg of which 1.62×10^{11} kg was fine to medium sand and 5.04×10^{11} kg was silt and mica (Thorne et al., 1993). Miah (1988) observed that the Brahmaputra was thought not to be depositing sediment along this reach. Goodbred and Kuehl (1999) estimated a long-term total annual sediment load for the Ganges-Brahmaputra system of some 10^{12} kg a^{-1}. Approximately $^1/_3$ of this has been deposited in the delta and flood plain areas, $^1/_3$ as a sub-aqueous prograding delta in the Bay of Bengal and $^1/_3$ in the deep sea. Modern budgets suggest a similar distribution. An average of some 7.0 km^2 of new land has been formed at the mouth of the delta annually since 1782 with some 4.4 km^2 a^{-1} since 1840 (Allison, 1998; Allison et al., 1998).

Sediment loads vary by two orders of magnitude seasonally, with the maximum load in August. Some 10% of the discharge occurs during the four months of the SW Indian monsoon. Sediments have accumulated within the incised channels following the low sea level during the glacial maximum and within the subsiding delta where accommodation space is being produced at about 0.5 mm a^{-1}.

Much of the sediment load of the main rivers has been eroded by glacial and periglacial activity from the high Himalayas and should therefore be moderately fresh when deposited. These sediments include eroded ultramafic rocks from the northern parts of the high Himalayas and

Table 3.1. Average monthly discharge and sediment load of major rivers. Discharge figures are long-term monthly averages (pre-Farakka barrage) in m^3 s^{-1} (Rashid, 1991). Sediment loads are in millions of tons per annum (Coleman, 1969)

	Ganges (Harding Bridge)		Brahmaputra (Bahadurabad)		Meghna (Bhairab Bazaar	
Month	Flow	Sediment (1958–62)	Flow	Sediment (1958–62)	Flow	Sediment (1961–62)
January	3113	2.0	5194	4.0	594	0.02
February	2712	1.4	4308	2.5	495	0.01
March	2312	0.9	4711	3.6	635	0.06
April	2056	0.8	6823	9.7	937	0.06
May	1971	0.8	15844	36.4	1934	0.26
June	4311	3.9	32488	87.6	3821	1.40
July	17871	48.7	44080	121.6	7814	7.50
August	37546	168.8	45107	163.6	8279	3.70
September	36970	156.1	36295	117.8	8222	4.80
October	17244	81.6	21955	42.9	6239	2.28
November	7109	10.5	10477	12.1	3078	0.08
December	4195	3.2	6737	5.4	990	0.01

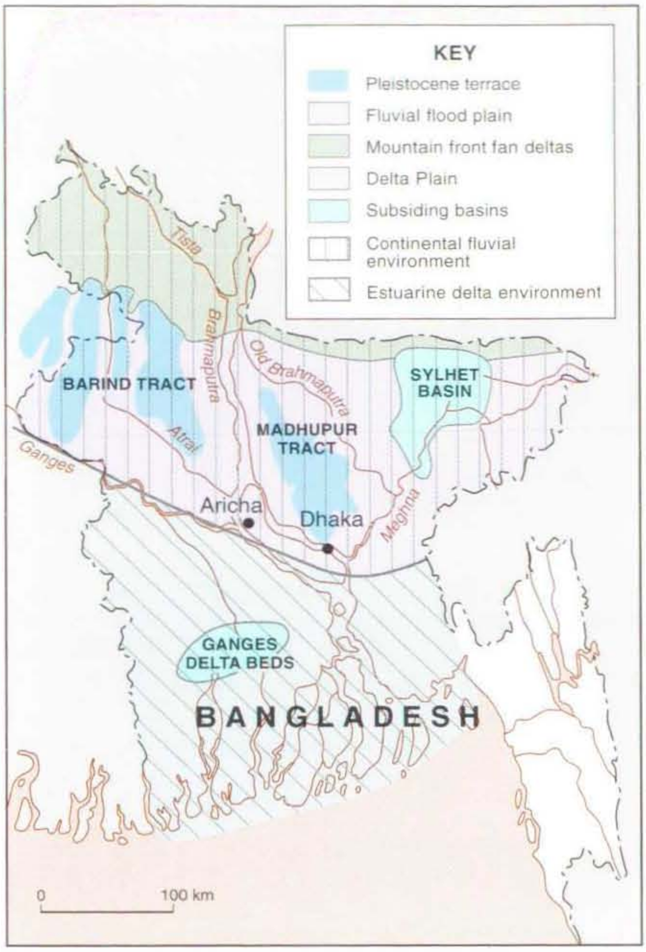


Figure 3.1. Brahmaputra/Ganges/Meghna delta system: environments of sediment deposition and main geomorphic units.

granitic and high-grade metamorphic rocks from the central and southern parts. These are the main sources of the dominant mineralogy: quartz, biotite and feldspar. At lower altitudes, the main rivers cross the Damodar and Darjeeling coalfields (coals and shales containing significant amounts of pyrite), the Rajmahal Traps (basalts with significant pyrite) and the Gangetic Plains (lateritic materials).

The geomorphology of the GBM system has developed in response to a series of glacio-eustatic sea-level cycles and long-term tectonic activity. The unconsolidated near-surface Pleistocene to Recent fluvial and estuarine sediments that underlie much of Bangladesh form prolific aquifers. Studies of the geomorphology, geology, and hydrogeology of the GBM system have been prompted by:

- major flood events and their effects upon infrastructure;
- exploration for gas and minerals;
- development of groundwater for irrigation and rural/urban water supply;
- academic research and general survey work.

3.1.2 Geomorphology

Quaternary sediments of the GBM system were deposited in two geomorphologically distinct environments to the north and to the south of the Ganges and lower Meghna rivers. To the north, continental fluviatile sediments were deposited within mountain front fan deltas and floodplains of the major rivers. To the south, thinly bedded alluvial sediments were deposited within an estuarine delta environment.

During the Quaternary, patterns of river incision and sediment deposition in the GBM system were mainly controlled by climatic change and sea-level oscillations related to periods of glaciation (Umitsu, 1993). Sediments derived from erosion of the Himalayas and the Indo-Burman Hills were deposited in this area by major river systems. Morgan and McIntire (1959) and Coleman (1969) noted that the present north-south direction of flow of the Jamuna-Brahmaputra is at variance with the course of the then Old Brahmaputra main channel reported by Fergusson (1863). Rashid (1991) described how the Tista changed its main course following a catastrophic flood in 1787. Changes in the courses of the Brahmaputra, Tista, Ganges and other rivers of the GBM system have been caused by tectonic activity. Morgan and McIntire (1959) first described the geomorphology and near-surface geology of the Bengal Basin using aerial photography to distinguish the main geomorphologic units (Figure 3.1). These include:

- mountain front fan deltas of the Tista and Brahmaputra;
- fluvial floodplains of the Ganges, Brahmaputra, Tista and Meghna Rivers;
- the delta plain of the lower GBM system south of the Ganges-Meghna valleys, including the moribund Ganges delta and the Chandina Plain;
- Pleistocene terraces of the Barind and Madhupur Tracts and associated fault systems;
- subsiding basins within the eastern Ganges tidal delta and the Sylhet basin adjacent to the Dauki Fault.

Coleman (1969) described patterns of fluvial sediment deposition by the GBM rivers and their distributaries. Brammer (1996) explained the distribution of the soils and physiographic regions of Bangladesh. He contrasted the high calcium carbonate contents of the Ganges-derived sediments with the low contents of those deposited by the Brahmaputra and Meghna rivers. Bristow (1987), Bristow and Best (1993), Bristow (1993), Thorne et al. (1993) and Bristow (1999) reported further studies of the geomorphology and sedimentology of the Brahmaputra including the causes of channel avulsion, or switching, between the old and young Brahmaputra courses. Goswami (1985), in his study of the upper reaches of the Brahmaputra in Assam, commented that the 8.7 magnitude earthquake of 1950 with its epicentre in Assam resulted in several large landslides that dammed various tributaries of the Brahmaputra.

The bursting of these natural dams produced devastating floods that carried large volumes of sediment downstream. Miah (1988) and Brammer (1990a) documented

Table 3.2. Main stratigraphic units of the Cenozoic and Quaternary sediments within the Bengal Basin. Based on Alam et al. (1990)

Stage	Group	Formation	Lithology
Holocene		Alluvium	Silt, sand, gravel and clay
Pleistocene/Pliocene (up to 6375 m)	Madhupur	Dihing Formation/ Madhupur Clay	Yellow to yellowish grey, massive, fine to medium sandstone and claystone/sticky clay
		Dupi Tila Formation	Yellow to ochre, pink, light brown, light grey to greyish-white sandstone, siltstone and conglomerate. Several oxidised, iron-rich, clayey palaeosols. Petrified wood
Pleistocene/Neogene	Tipam Group (U. Jamalganj in NW)	Girujan Clay	Grey to greenish grey, red mottled, silty shale, shale and claystone
Neogene		Tipam Sandstone	Light yellow to yellowish grey, grey, brownish grey and orange fine to medium grained pebbly sandstone, siltstone and shale
	Surma Group (L. Jamalganj in NW)	Boka Bil Formation	Greenish to bluish grey and yellowish grey marine pyritic shale, siltstone and very fine to medium grained sandstone, marine fossils
Miocene (3100 m)		Bhuban Formation	Grey to bluish grey fine to medium sandstone, siltstone, claystone
Oligocene (800–1000 m)		Barail Formation Bogra Formation in the NW	Brown, yellow-brown, pink and grey sandstone, siltstone and carbonaceous shale
Late Eocene (Eocene 600–800 m) Middle–Early Eocene	Jaintia Group	Kopili Formation	Grey, greenish grey to black silty claystone, fossiliferous shale, thin beds of glauconitic sandstone and limestone
		Sylhet Limestone	Grey to greyish brown massive nummulitic limestone
Eocene and Palaeocene		Tura Formation	Grey, brown, pink and greyish-white ferruginous sandstone, coal and shale
Late-Middle Cretaceous	Upper Gondwana	Sibganj Trapwash	Coarse yellow brown sandstone; white clay; volcanic ash
Early Cretaceous–Jurassic		Rajmahal Traps	Amygdaloidal basalt; serpentinised andesite; shale; agglomerate
Late Permian	Lower Gondwana	Paharpur Formation	Sandstone; feldspathic greywacke; coal, shale; coarse sandstone
Early Permian	Lower Gondwana	Kuchma Formation	Coarse grained sandstone, shale; thick coal seams
Precambrian		Basement Complex	Gneiss and schist

the major GBM system floods of 1987 and 1988. In response to these catastrophic floods, a series of studies was undertaken under the Flood Action Plan of the 1990s to investigate aspects of river channel movement, bedform structure, bank erosion and sediment deposition in response to flood events (Brammer, 1990b).

3.1.3 Geology

Morgan and McIntire (1959) described the Pleistocene Madhupur and Barind Tracts separated by the Jamuna-Brahmaputra River, and other Quaternary surfaces such as the Chandina surface of the Bengal Basin. Sengupta (1966) reporting the results of oil and gas exploration undertaken in the Indian sector of West Bengal, described the depth distribution of thick Cretaceous to Recent sediments and the tectonic evolution of the Bengal Basin. Banerji (1984) described the stratigraphy and composition of the Cenozoic sediments and associated rocks of the basin. Seismic surveys with follow-up drilling have shown the presence of significant gas and oil reserves in north-eastern and eastern Bangladesh. Salt et al. (1986) and Lindsay et al. (1991) used seismic data to interpret the geological evolution of western Bangladesh. Alam et al. (1990) combined geological information derived from remotely-sensed data, superficial deposits and data from oil field exploration to produce a national geological map of Bangladesh, including an annotated description of the main geological units. This is summarised in Table 3.2. National gravity and aeromagnetic data have been used to determine the thickness of the Cretaceous to Recent sediment pile and the nature of the basement beneath Bangladesh (Rahman et al., 1990). Jones (1985) analysed borehole data from oil exploration to assess the possible distribution of deep aquifers (1800 m depth) beneath the GBM. Little pre-Pleistocene geology is exposed within Bangladesh; these rocks are only seen in the eastern hills and along the southern edge of the Shillong Plateau in the north-east.

3.1.4 Structural Geology

Tectonic processes have played a major role in the development of the GBM delta system. The Bengal Basin, at the junction of the Tibetan, Indian and Burmese continental plates, formed after the separation of the Indian plate from the southern continent of Gondwana (Curray and Moore, 1974). Initially, marine sediments were deposited within the Basin during Cretaceous times. During the Eocene, the Indian Plate collided with the Burmese Plate, and sediments eroded from the uplifted Burmese Hills were deposited within the Basin. The Indian Plate further collided with the Tibetan and Burmese Plates during Miocene times, causing a large influx of sediment into the basin south of the Himalayas and west of the Burmese Hills.

During the Pliocene, large-scale movement along the

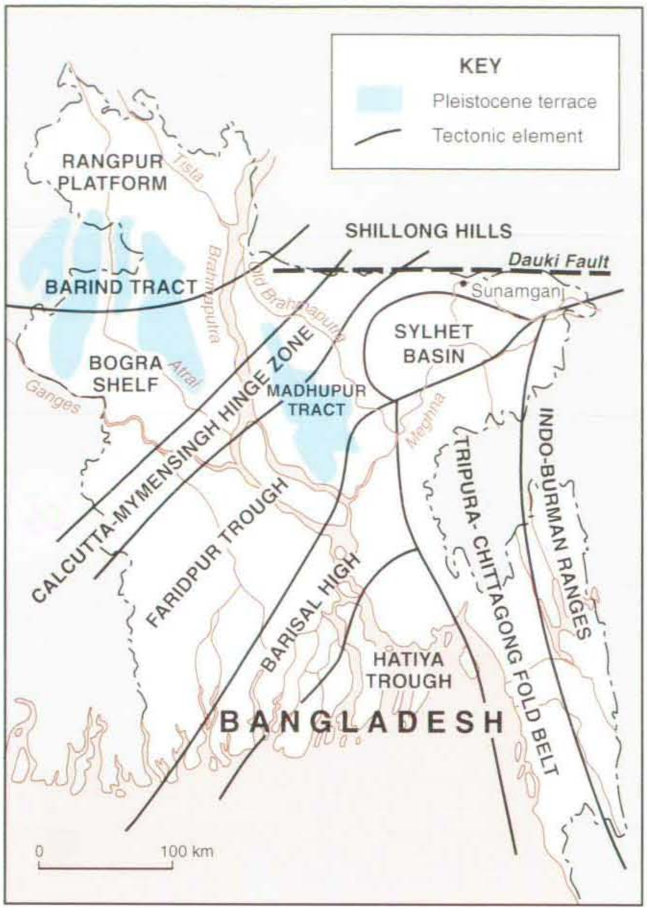


Figure 3.2. Brahmaputra/Ganges/Meghna delta system: tectonic elements.

Dauki Fault caused uplift of the Shillong Plateau and subsidence of the Garo-Rajmahal Gap. The entry of the Brahmaputra into the Bengal Basin was thus diverted from the area east of Sylhet to the west of the Shillong Hills. This tectonic activity resulted in the formation of the north-south-trending Tripura-Chittagong fold belt (Alam, 1989). Two other main structural trends are apparent; east-west, as seen in the Dauki Fault, and north-east–south-west, the trend of the Hinge Zone. Fault systems occur parallel and normal to these two trends.

The Barind and Madhupur Tracts form two uplifted and tilted horst blocks separated by a north-south trending faulted graben, now occupied by the Brahmaputra River (Khandoker, 1987). The Bengal Basin can be divided into two crustal domains about a north-east to south-west palaeo-continental margin, namely the Calcutta-Mymensingh Hinge Zone. The Rangpur Platform and Bogra Shelf form a basement high beneath a thin cover of Cretaceous to Recent sediments in north-western Bangladesh in the Garo-Rajmahal gap to the west of the Shillong hills. South and south-east of the Hinge Zone are the Faridpur, Hatiya and Sylhet Troughs, areas of thick sediment underlain by oceanic crust that continue to subside above the plate subduction zone (Figure 3.2) (Lindsay et al., 1991).

The Dauki Fault forms the southern edge of the Shillong Hills and is an intercrustal thrust zone developed at the junction of the Indian and Tibetan Plates (Khan, 1991). The Shillong Massif is presently undergoing north-south compressional shortening by being thrust over the 15 ± 2 km thick pile of sediments to the south (Johnson and Alam, 1991). The Great 1897 Assam Earthquake whose epicenter was beneath the western Shillong Massif indicates ongoing tectonic activity (Mukhopadhyay et al., 1997). Mukhopadhyay (1984) and Khandoker and Hoque (1990) reported that this earthquake also altered the courses of the Tista, Padma and Atrai rivers, all developed on apparent fault lineaments within the Bengal Basin. The 1897 earthquake was particularly destructive in the Sunamganj area of the Sylhet Basin where, adjacent to the Dauki Fault, severe damage was caused to masonry. Many crevices, through which sand and water were ejected, appeared in an area of ongoing tectonic subsidence.

3.1.5 Quaternary Geology

The Quaternary period, of about 1800 ka duration, is dominated by the effects of approximately 120 ka glacio-eustatic cycles. At the time of the glacial maximum during the most recent cycle, 21 ka BP, sea levels declined by up to 130 m below present-day levels. Approximately 20 such cycles occurred during the Quaternary (Williams et al., 1993). The study of Quaternary sediments has been hampered by lack of suitable correlative data for mapping pre-last-interglacial sediments. Studies undertaken in the USA of sediments of similar age have used palaeosols and peat horizons to establish lithostratigraphic boundaries (Clark and Lea, 1992). Seismic data can be interpreted to produce stratigraphic sequences within prograding deltas but the application of such methods of analysis to continental fluviatile sequences is difficult (Emery and Myers, 1996). The lithostratigraphy of Quaternary sediments in Bangladesh has been studied by:

- Davies (1989) – the Dhaka/Manikganj area;
- Mott MacDonald (MMI, 1992) – central and north-eastern areas;
- Umitsu (1993) – the Brahmaputra Valley between Jamalpur and Aricha;
- Ahmed (1994) – the Barind Tract;
- Monsur (1995) – the Madhupur Tract;
- Goodbred and Kuehl (1998, 1999, 2000) – Brahmaputra floodplain, Sylhet Basin and south-central floodplain and delta plain.

Data sources

Many of the data referred to here were derived from boreholes drilled for groundwater irrigation projects. Little geological information has been obtained from the 6–11 million hand-drilled domestic tubewells and shallow irrigation tubewells installed throughout Bangladesh. Representative sediment samples have mostly been obtained from deep tubewells (DTWs), drilled by reverse circulation, for irrigation by the Bangladesh Agricultural Development Corporation (BADC) and urban water supplies by the Department of Public Health Engineering (DPHE). Such

The Geological Survey of Bangladesh (GSB) has drilled deep boreholes to explore for coal, limestone, hard rock, oil and gas deposits. Regional aeromagnetic, gravity and seismic surveys have also been undertaken. Additional information is available from:

- the Khulna Power station groundwater supply project;
- mapping projects undertaken by MSc and PhD students at the Dept. of Geology, University of Dhaka;
- sediment provenance studies of parts of the GBM system by the Department of Geology, University of Dhaka.

Hydrogeological studies undertaken in Bangladesh include:

- a UNDTCD/BWDB national study (UNDP, 1982);
- JICA investigation of deep alluvial sediments as part of a study for the Brahmaputra (Jamuna) bridge foundations (included drilling of exploration boreholes, sediment analyses and radiocarbon dating (Umitsu, 1987; Umitsu, 1993);
- IDA 4000 Deep Tubewells project in Sylhet, Kapasia and Comilla (MMP reports 1983–1993);
- BGS study of the design of 2 cusec-capacity deep tubewells and geology and hydrogeology of Late Quaternary and Holocene sediments in the Dhamrai, Saturia, Manikganj, Singair and Savar areas (part of the IDA 4000 Deep Tubewell project; Davies, 1989);
- a BGS hydrochemical survey of aquifers in central and north-eastern Bangladesh (Davies and Exley, 1992).

Borehole data from the above sources and sediment logs from the current study have been used to construct a series of geological cross-sections across the GBM system. These provide the first indication of sediment distribution with depth within the two primary environments of sediment deposition. Geological data are not yet available from the 170 deep test boreholes drilled during 1997–2000 for UNICEF.

3.2 SEA-LEVEL CHANGE AND PATTERNS OF SEDIMENTATION

The Quaternary period comprises four stages:

- Holocene 10–0 ka BP;
- Upper Pleistocene 128–10 ka BP with glacial maximum at 21 ka BP;
- Middle Pleistocene 750–128 ka BP;
- Lower Pleistocene 1800–750 ka BP (based on the Olduvai palaeomagnetic event at 1800 ka).

3.2.1 Sea-level change during the Upper Pleistocene and Holocene

The Upper Pleistocene includes the last interglacial-glacial period between 128–10 ka BP. Worldwide studies of sea-level movement, in response to glacio-eustatic events during the Holocene and Late Quaternary have been undertaken by Chappel and Shackleton (1986) and Pirazzoli (1991) and others. Shifts in sea level and climatic effects are inferred from studies of oxygen isotopes from ice core sections and dating of corals within areas of tectonic uplift in Barbados and New Guinea (Aharon and Chappell, 1986; Chappell and Shackleton, 1986; Shackleton, 1987; and Williams et al., 1993). The Upper Pleistocene stage is divided into three substages after the interglacial substage:

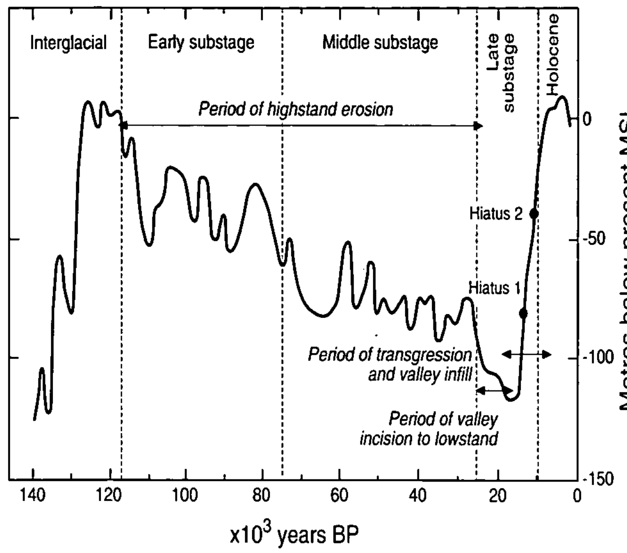


Figure 3.4. Sea-level changes during the last interglacial-glacial transition (after Pirazzoli, 1991).

- Late substage, 24–10 ka BP with the glacial maximum period of 17–21 ka BP;
- Middle substage, 74–24 ka BP;
- Early substage, 117–74 ka BP;
- Interglacial, 128–117 ka BP.

Sea level was at about the present level during the last interglacial period. During the 100 ka duration of the Early and Middle substages (Figure 3.4), sea levels declined and were about 50 m below present-day sea level (mbpdsl) by 74 ka BP. Levels oscillated between 50 and 100 mbpdsl during the Middle substage (Figure 3.4). By 18 ka BP in the Late substage, sea level had declined to 120 mbpdsl, and remained at that level during the period of glacial maximum. By the Holocene stage at 10 ka BP, sea level had risen to about 45 mbpdsl. Sea level fell by several metres at 10 ka BP (Hiatus 1) before rising again. During the Middle Dryas, sea level declined for a short period (Hiatus 2) before reaching present-day levels at about 7 ka BP. The present coastline appears to have largely developed about 3 ka BP (Goodbred and Kuehl, 2000).

The significant fact is that present-day sea levels are higher than during most of the last 128 ka. Hydraulic gradients now are therefore much less than they would have been during most of that period. Also the depth of the unsaturated zone, and the opportunity for deep weathering of the sediments, is now less than during most of the last 128 ka.

Patterns of sedimentation during the last 30 ka can be

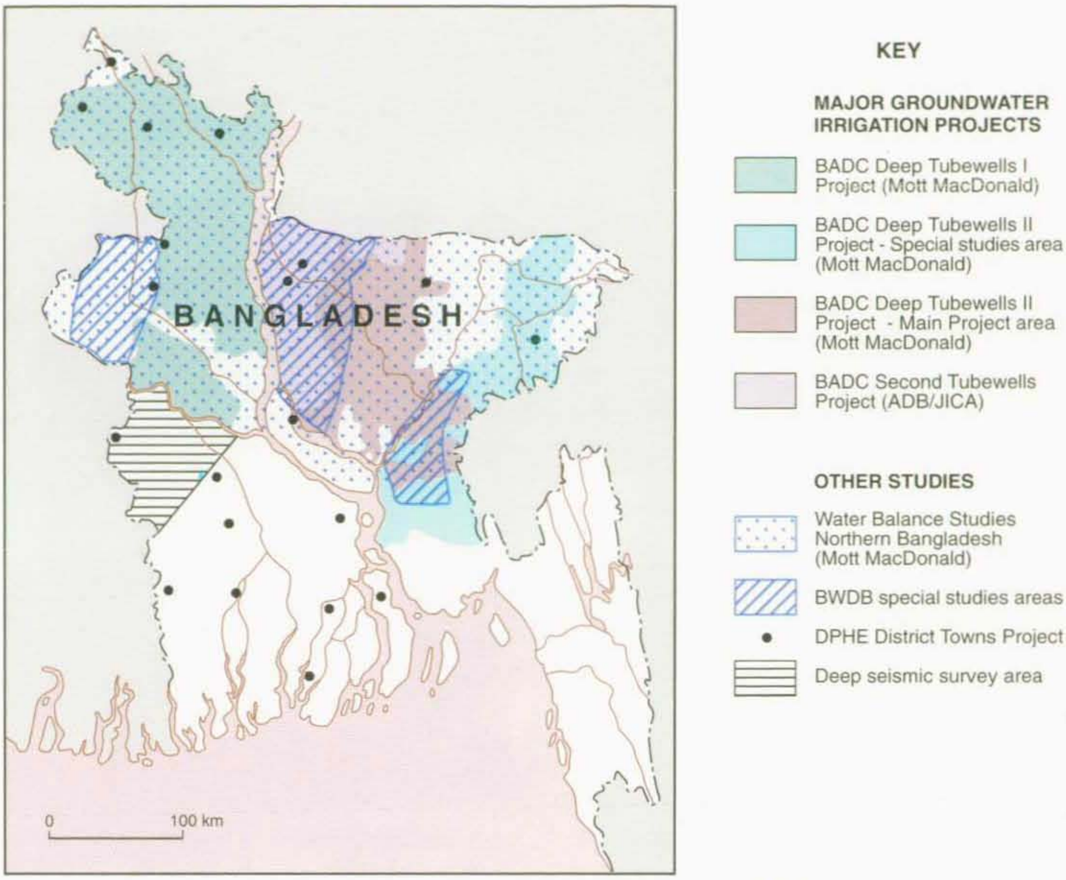


Figure 3.3. Map showing the locations of the main hydrogeological studies undertaken in Bangladesh.

sediment samples were normally obtained at five feet (1.52 m) intervals specifically for the definition of screenable horizons. The locations of these studies are shown in Figure 3.3 and outlined below.

The BADC implemented programmes for the installation of several thousand 2-cusec-capacity deep tubewells to supply groundwater for irrigation. These include:

- 3000 DTW Project (1972–1977) – with IDA and Sir M MacDonald and Partners;
- 4000 DTW project (1983–1993) – with IDA/ODA/Australian Aid and Mott MacDonald;
- Barind Integrated Area Development Project (mid 1980s – early 1990s);
- Milners/BADC project (late 1970s to late 1980s);
- Second 500 Deep Tubewell Project in Tangail, Jamalpur and Sherpur (1987–1990) with ADB and JICA;
- 200 Deep Tubewells Bangladesh Project in Dinajpur with the Abu Dhabi Fund for Arab Economic Development (mid 1980s);
- Sir M MacDonald and Partners (MMP) assessment of hydrogeological conditions within the northern half of the country (MMP, 1983).

The DPHE supplies water by reticulation to urban areas and by the construction of hand-pumped tubewells in rural areas. Geological borehole logs and reports are available from the following:

- Coastal Areas Project – with BWDB and IWACO consultants;
- 18 District Towns Project – with DHV consultants;
- 9 District Towns Project – with DANIDA.

As part of the 9 District Towns Project, several deep boreholes were drilled in the Lakshmipur-Noakhali area to develop a deep sand aquifer containing fresh water below several sandy zones affected by saline intrusion. These deep boreholes were drilled by direct circulation, with bentonite mud. Lithological samples were obtained at 3 m intervals and boreholes were logged using wireline equipment on reaching the required depth. Geological logs were interpreted from resistivity and natural gamma wireline logs run in three boreholes. Deep boreholes have tapped a similar deep freshwater sand aquifer within the Khulna-Barisal area (Haskoning/IWACO, 1981).

Since 1978, the Bangladesh Water Development Board (BWDB) has, with the assistance of UNDTCD, drilled a series of deep exploration boreholes country-wide and in a series of special study areas. The deep borehole logs held by BWDB provide the only data on lithological variation within the Quaternary sediments at depths below 150 m for much of Bangladesh.

Table 3.3. Monsoon change during 0–30 ka BP related to sedimentation offshore of the Indus Fan (Von Rad et al., 1999)

Period ka BP	Substage	Monsoon strength	Sediment description
0–7	Late Holocene	Low	Laminated sediments with high carbon content
7–9.5	Early Holocene (Middle Dryas)	High	High sand input, bioturbated
10–12	Preboreal	Low	Low sand input, low carbon concentration, distinctly laminated sediments
12–13	Younger Dryas cool period	High	Light coloured bioturbated sediments, moderate sand input low carbon, high rates of sediment accumulation
13–15	Bolling Allerød	Low	Increased carbon, moderate sand input, laminated sediments
15–17	H1	High	Low carbon, high sand input, light in colour, bioturbated
17–22	Peak Glacial	Low	Moderate carbon, laminated sediments
22–25	H2	High	Bioturbated lighter sediments
25–27.5	D/O3	Low	Laminated sediments
27.5–30.5	H3	High	Bioturbated lighter sediments

D/O – Warm interstadials – Dansgaard Oeschger events, H – Cool interstadials – Heinrich events

related to monsoon change in the offshore area of the Indus Fan (Table 3.3). Periods of greater monsoon intensity coincided with rises in sea level and greater sediment inflow, marked by an influx of lighter, more arenaceous sediments to the fan. Conversely, periods of less intense monsoon activity were typified by an influx of finer-grained darker sediment, rich in organic carbon. This sequence can be correlated with the geological log of the Lakshmipur test borehole (LPW6) to identify periods of high and low monsoon intensity during the last 20 ka.

3.2.2 Sedimentation patterns in alluvial/deltaic environments

The GBM delta system is believed to have begun to develop some 11,000 years ago, some 2,000–3,000 years before many other deltas began their rapid development (Goodbred and Kuehl, 2000). This rapid development of deltas was a response to the slow-down in the rate of post-glacial sea level rise.

Scholle and Spearing (1982), Walker (1984), Reading (1986) and Miall (1996) describe patterns (or facies) of sediment deposition within alluvial and deltaic environments. The application of sequence stratigraphy to these depositional environments is discussed in Emery and Myers (1996).

Several examples of the practical application of facies analysis to the study of deltaic and fluviatile environments are available. Davies (1989) described patterns of deposition within the fluvial sediments of the Young Brahmaputra floodplain at its confluence with the Ganges from exploration borehole data. Mathers et al. (1996) used analysis of Landsat imagery to define the distribution of modern highstand deposits, i.e. deposits formed during periods of high relative sea level, where sediment deposition is largely in low-energy environments and hence sediments are typically fine grained. Mathers et al. (1996) used borehole and micropalaeontological data to define lowstand (high-energy environments, coarse-grained sediments) and transgressive tract sediment distribution, and to predict the location of Upper Pleistocene and Holocene aquifers within the Red River delta of Vietnam.

Koss et al. (1994) studied the effects of base sea-level change on fluvial, coastal plain and shelf systems under laboratory conditions. They were able to model the development of drainage patterns under flow regimes coupled with (a) rapid and slow falls in base sea level, (b) lowstand hiatus, and (c) rapid and slow rise in base level, differentiating between highstand, lowstand and transgressive system tracts. The results enable interpretation of sediment deposition patterns during the last interglacial-glacial cycle and earlier eustatic-glacial cycles in the Bengal Basin. They suggest that the major period of sediment deposition occurred during the period of sea-level rise and transgression following the glacial maximum of each cycle. Blum and Törnqvist (2000) reviewed knowledge of the effects of Quaternary sea-level change upon patterns of fluvial sediment deposition.

Patterns of sediment deposition within deltaic environments, described by Coleman and Prior (1982), Miall (1984) and Elliot (1986), applicable to the Bengal Basin environment are summarised in Table 3.4. The large sediment discharge of the GBM system allowed initial delta growth some time earlier than the global average. Radiocarbon dating of wood, peat and other organic debris retrieved from Bangladesh sediments from depths of 20-70 m has given calendar dates of 5 ka–7 ka BP (Goodbred and Kuehl, 2000) in line with the time of rapid deposition.

Walker and Cant (1984) and Miall (1996) described patterns of sediment deposition within fluvial environments; and Nilsen (1982), Rust and Koster (1984) and Collinson (1986) have described fan-delta environments. Those aspects most applicable to the Bengal Basin are summarised in Table 3.5. Recognition of the effects of sea-level change within fluvial and fan-delta sequences is difficult (Emery and Myers, 1996).

Away from the main channels and areas of active erosion, only silts and very fine sands with peats were deposited within waterlogged areas. Occasionally a river channel course may have been altered by avulsion to temporarily deliver an influx of sediment into such areas, e.g. the moribund Ganges delta and Sylhet Basin.

Table 3.4. Patterns of sediment deposition within Bengal deltaic environments during the Upper Pleistocene and Holocene

Period/event	Major channels	Minor channels
128–28 ka BP Steady decline in sea level in delta plain to –40 to –65 m.	• Slow inland erosion along major channels • Planation of highstand deposits • Slumping of valley sides	• Slow inland erosion of highstand deposits along dendritic drainage • Slumping of valley sides
28–21 ka BP Rapid fall in base level	• Rapid headward and downward valley incision • Erosion and retreat of valley sides	• Incision of dendritic drainage
21–18 ka BP Lowstand sea level hiatus at glacial maximum	• Delta deposition of coarsening-upward sequences along incised channels • Headward erosion and valley side retreat	• Stream captures • Valley deepening
18–5 ka BP Rapid base level rise	• Deposition of fining upward, braided coarse sediments aggrading as delta lobes back-stepping up valley from delta front • Filling of main valley to former highstand level • Deposition of medium sands in meandering channels; deposition of fine sands, silts and peats in inter channel areas • Crevasse-splay sands during flood events • Laminated fine sediments deposited during cyclones	• Laminated fine sediments deposited during cyclones • Main channels infilled to former highstand level • Medium to fine sands deposited by meandering distributaries • Minor crevasse-splay sands deposited during floods • Laminated fine sediments deposited during cyclones

Table 3.5. Patterns of sediment deposition within Bengal fluvial environments during the Upper Pleistocene and Holocene

Period/event	Major channels	Minor channels
128–28 ka BP Decline in sea level in delta plain area to –40 to –65 m.	• Slow erosion and retreat of valley sides in highstand deposits	• Slow erosion and retreat of valley sides in highstand deposits
28–21 ka BP Rapid fall in base level	• Rapid headward valley incision, erosion and retreat of valley sides • Incision and erosion of fan delta gravels and conglomerates at head of fluvial system • Coarse sediments deposited from gravity flows as prograding delta fans in incised valley • Stream gradient increases with sea level, sediments are eroded and transported into delta	• Degree of incision is dependent upon rate of stream discharge • Retreat of valley sides by slumping
21–18 ka BP Lowstand sea level hiatus at the glacial maximum	• Transport of coarse load by gravity flow • Deposition as prograding alluvial fans along channel • Continued erosion and retreat of valley sides	• Previous highstand deposits are removed by erosion
18–5 ka BP Rapid base-level rise	• Base flow gradients decline, straight incised channels are infilled with prograding braided channel fan coarse sands and gravels • Fining-upward highstand fluvial sediments deposited in active then anatomising meandering rivers • Overbank flood micaceous very fine sands and silts deposited between active channels and anastomosing distributaries	• Fining-upward fluvial sediments deposited by meandering rivers after backfilled to base of highstand deposits • Overbank flood micaceous fine sands and silts deposited between active and anastomosing channels

3.2.3 Pre-Upper Pleistocene Sedimentation

Events before the last interglacial are difficult to discern and date below the base level of incision of the last glacial maximum. Sediments deposited during earlier glacial-interglacial cycles are preserved within the subsiding and aggrading delta complex. The formation of interstitial clays and weak iron-oxide cements associated with the throughflow of oxygen-rich waters during lowstand events may have affected these nonlithified sediments.

The effects of weathering, with the formation of near-surface clay residuum, are most apparent within areas of uplifted sediments in the Pleistocene Tracts. In the absence of fossil material, litho-stratigraphic correlation of these sequences depends upon recognition of fining-upward, very coarse to very fine sequences and peat and palaeosol horizons. The boundary between continental fluvial sediments and delta/marine sediments is transitional, dependent on the amount of space created by river channel incision. The rate of base-level fall, the cohesiveness of the material being incised, the load carrying capacity of the river and the climatic regime present affect the latter.

The nature of the pre-last-interglacial sediments at depths greater than 150 m can only be investigated

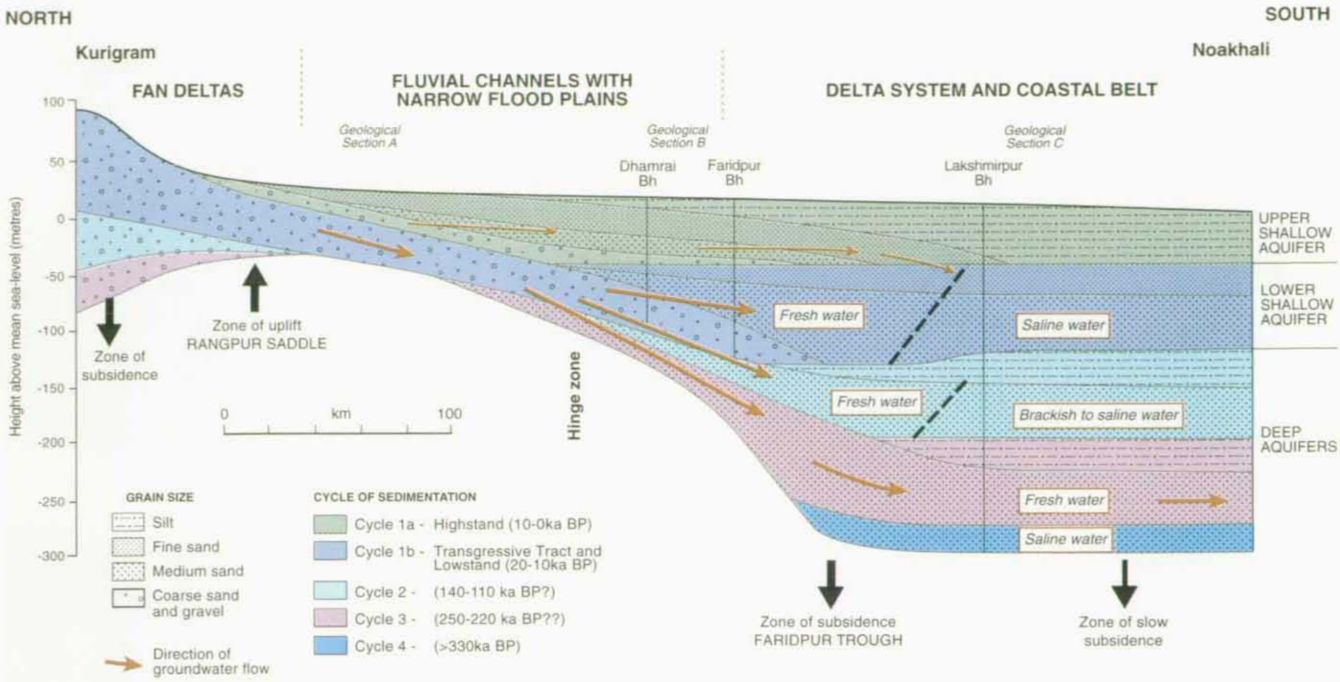


Figure 3.5. Hydrogeological cross-section from north to south across Bangladesh. Particularly shown are the geological structure and groundwater flow patterns within Mid to Upper Quaternary sediments.

through the drilling of deep exploration boreholes and the use of shallow to deep seismic survey methods. Jones (1985) used oil and gas exploration borehole data to assess the nature of the deeper aquifers between 150 m and 1800 m. Lindsay et al. (1991) interpreted deep seismic survey data obtained during oil and gas exploration in western Bangladesh. They described the marine sedimentary sequence of deposition and tectonic episodes in the area since Cretaceous times.

Inspection of one of the seismic records showed the presence of numerous stacked channels within Pleistocene to Pliocene fluvial sediments at 400–1700 m depth. These mark the extent of the modern delta sediments deposited during the last 5 Ma. Lindsay et al. (1991) noted that these channels are about 8–10 km wide and 100 m deep, similar to the present day Brahmaputra channel. The rate of tectonic subsidence appears to increase from 0.17 mm a^{-1} in the north-west at the Indian border, to 0.26 mm a^{-1} at Jessore and 0.5 mm a^{-1} in the south-east between Lakshmipur and Faridpur. In south-east Bangladesh and the coastal region, medium to coarse sands within such channels form sources of good-quality water. Enhanced digital data could be used to define the distribution of channels below 300 m in western Bangladesh, an area where shallow groundwater sources are frequently contaminated with arsenic.

3.3 Regional characterisation of sediments

3.3.1 Overview

Limited geological borehole data, with varying levels of detail, are available from the Quaternary sediments of Bangladesh as discussed above. Using these data, a geological cross section has been constructed, showing the structure within the Mid to Upper Quaternary sediments north to south through central Bangladesh (Figure 3.5).

Figure 3.5 also indicates the locations of the three geological sections (A, B and C) derived from the DPHE/BGS test boreholes drilled in the three Special Study Areas (Chapter 7) as part of this project. At the northern end of the section, subsidence occurs along the Himalayan Main Boundary Fault, accommodating a wedge of coarse sediments deposited as fanglomerates. These thin to the south of the Rangpur Saddle uplift zone. Within this zone, there has been incision of the main Brahmaputra valley along which basal fan-delta sediments were deposited between uplifted Pleistocene Tracts. These coarse-grained sediments thin and pinch out south of the Hinge Zone and pass laterally into sandy deltaic deposits within the subsiding Faridpur Trough. Here, several fining-upward sequences have been deposited, each equating with deposition during a glacial/interglacial cycle. In the coastal zone, this alternation of sandstones and silts contains saline water above fresh water in a series of discrete aquifers. Away from the coastal zone of saline intrusion, these aquifers unite to form a single body of fresh water (Figure 3.5).

3.3.2 The BGS/DPHE test boreholes

Motivation

Few detailed geological data describing the Upper Pleistocene and Holocene sediments of Bangladesh are available. The most detailed investigations which had been undertaken before this project were probably those concerned with the building of the Bangabandhu (Jamuna) bridge. During the inception stage of this project, some detailed sediment investigations were also being undertaken by DPHE, BWDB and DU as part of their arsenic investigations. These were supported in part by UNICEF. Three deep boreholes (down to 152 m) were drilled in Chapai Nawabganj, a known arsenic hot spot, with continuous coring undertaken to provide sediment for mineralogical investigations and arsenic analysis. These showed the presence of a thick layer of clay below about 45 m. The absence of a deeper aquifer within the top 152 m limited the options for a possible safe drinking water supply below the highly contaminated shallow aquifer.

Little was known of the detailed geology in the main part of the delta region further south and east. We also wanted to install a series of nested piezometers at different depths in order to see how arsenic concentrations, and other geochemical parameters, varied with depth and with time. The results from these piezometers would provide information that would help to determine the cause of the unusually high arsenic concentrations being found in Bangladesh groundwaters. Specifically we wanted to identify the approximate position of the redox boundary and how arsenic and sulphate concentrations varied with depth. The pyrite oxidation hypothesis would predict high sulphate and arsenic concentrations near the surface while the iron oxide reduction hypothesis would predict a build-up of arsenic at greater depths with generally low sulphate concentrations. We also wanted to obtain a general indication of the variation of the arsenic content of the sediments with depth and location.

Therefore as part of this project it was decided to drill a deep (150 m) test borehole and a series of shallow piezometers in each of our three Special Study Areas. Detailed logs were made from the recovered core. The spatial and temporal changes were expected to be greatest close to the surface and so it was decided to install the piezometers at approximately 10 m intervals down to 50 m. It was also decided to sample the water from the piezometers at two weekly intervals. This setup was felt to be the minimum required to give some idea of the variation with depth while not providing an overwhelming number of samples for chemical analysis during the routine monitoring. An important aspect of the water quality monitoring programme was to monitor a wide range of solutes, not just arsenic, in order to be able to identify the likely geochemical changes taking place with depth and time.

Drilling and construction of the DPHE/BGS test boreholes

The three cored test boreholes were drilled by BWDB using a Boyles diamond coring rig. This skid-mounted rig, illustrated in Figures 3.6 and 3.7, uses 3.05 m long 70 mm diameter drill-rods with 100 mm diameter drag bits to ream and deepen the borehole between core runs. Continuous split spoon core samples were obtained for detailed analysis at 0.3 m intervals to a depth of 46 m at Lakshmipur and Faridpur and 50 m at Chapai Nawabganj. Thereafter undisturbed core samples 0.3 m long were obtained at 3.05 m intervals to 153 m at Lakshmipur, and 131 m at Faridpur. The latter borehole was completed to 155 m but cored sampled could not be obtained below 131 m due to the presence of gravel in the hole. On some earlier projects, the BWDB had removed the samples by forcing them out of the plastic tubes so that only disturbed samples could be obtained.

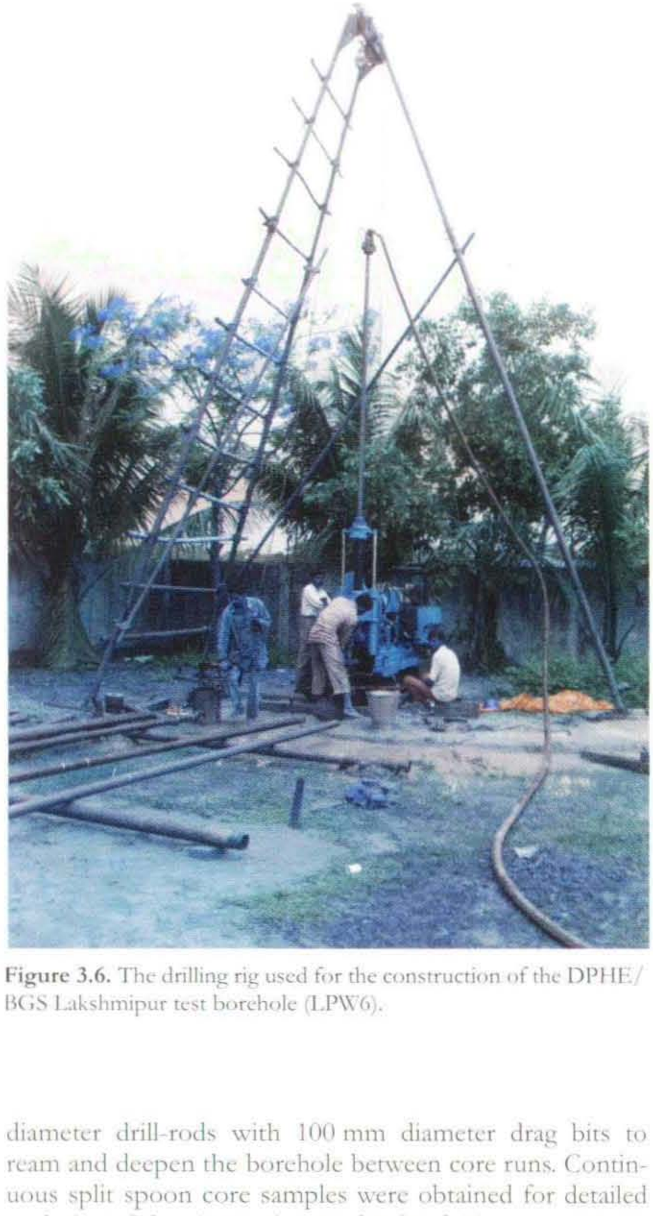


Figure 3.6. The drilling rig used for the construction of the DPHE/BGS Lakshmipur test borehole (LPW6).

For this project, most of the sample tubes were cut length-wise so that variations in sediment bedding and texture could be observed, photographed and described. Representative samples from each of the test boreholes are illustrated in the plates described below.

At each site, a series of 5 piezometer boreholes completed to depths of 10, 20, 30, 40 and 50 m where possible.

Sampling sites and piezometer construction

Piezometers were installed at Chapai Nawabganj, Faridpur and Lakshmipur. The Chapai Nawabganj piezometers

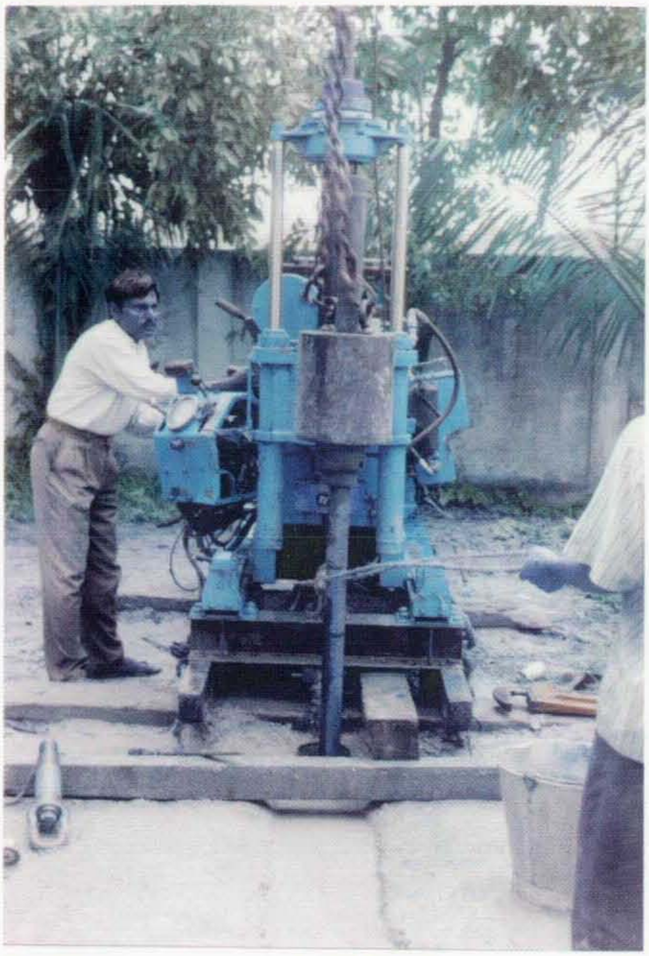


Figure 3.7. Close-up of the drilling rig used for the construction of the DPHE/BGS Lakshmipur test borehole (LPW6).

were installed in the grounds of Chanlai Primary School, within the 'hot spot' area described in detail later (Chapter 7). Piezometers in Faridpur were installed close to the Union Parisad Building of Faridpur Municipality and those in Lakshmipur were installed within the DPHE compound. The individual piezometers were installed at 10 m, 20 m, 30 m and 40 m at Chapai Nawabganj and at 10 m, 20 m, 30 m, 40 m, 50 m and 150 m at both Faridpur and Lakshmipur. In each case, the piezometers were drilled as discrete holes, drilled within about 3 m of each other and centered on the deep, cored borehole. Drilling of these shallow piezometers was carried out using the 'sludger method' (hand-flapped percussion drilling). After all of the holes had been drilled to the desired depth, the screening and casing were installed and the piezometers completed at the surface. They were sealed at all but the prescribed depths. The absence of a deep piezometer at Chapai Nawabganj reflects the lack of viable aquifer at depth in that region. In addition, due to the presence of clay at 50 m, the 50 m well at Chapai Nawabganj (CPW5) was not completed as a piezometer.

Each piezometer was constructed with a 1 m GI pipe at the top (with $^1/_3$ above the ground), followed by a section of PVC casing. A section of 2 m PVC screen was used at the desired depth, followed by a 0.5 m bail plug. Sections were joined together using liquid cement and sealing tapes. At Faridpur, 38 mm diameter casing and screens were used. At Chapai Nawabganj and Lakshmipur, casing diameter was increased to 51 mm for easier access of the sampling pump. The screened section was packed with coarse sand. Bentonite was used to seal the portion immediately above the screened section. Cement grout was used up to the surface to seal the annulus. The high-quality seals used in each piezometer preclude the possibility of hydraulic connection between the various piezometers. The wells were developed for up to several hours until turbidity disappeared. A cement platform was constructed around each piezometer and rubber bungs were used to minimise air contact.

Of the other wells in the monitoring network, the three dug wells are located in Chapai Nawabganj and the hand-pump tubewells are from all three areas. These were mostly into the shallow aquifer, but one deep tubewell (LHTW7, depth 275 m) was also monitored at Lakshmipur. This was situated around 40 m from the Lakshmipur piezometers. The other dug wells and tubewells were all located within 1 km of the piezometer clusters.

3.3.3 Chapai Nawabganj

Alluvial sediments deposited by the meandering channels of the Ganges and Mahananda Rivers underlie much of the Chapai Nawabganj area. The floodplain lies at about 20 m above mean sea level (asl). A north-south-trending fault, downthrown to the west, forms a boundary between the present course of the Mahananda River and the elevated (40 m asl) Barind Tract to the east. The sediments underlying the Chapai Nawabganj area can be divided into four units (Figure 3.8).

1. 0–45 m of grey silts and very fine-grained sandy overbank flood deposits with interbedded fine to medium channel sands.
2. 45–80 m of grey fine, medium and coarse sands in a meandering channel system deposited upon orange grey hard clays and siltstones of the Barind Tract formation.
3. Ganges sediments laterally interdigitating with sediments of the Mahananda River meander belt. This sequence of 35–45 m of sediments is composed of grey-brown micaceous, fine to medium channel sands with associated silty overbank sediments. Clay deposits occur along the faulted junction with the Barind Tract to the east. Orange-grey, weathered and lithified clays, silts and very fine sands of the Barind Tract Formation underlie the alluvial sediments. A thin, very hard dark red tabular ferricrete occurs at the contact surface.
4. The Barind Tract Formation, which forms the hills to the east, is made up of orange-grey clays and silty, very fine sandstones with interbedded fine to coarse sandstone (Ahmed and Burgess, 1995). The sandstones form an aquifer that is terminated by the fault zone to the west. The fault line is marked by a number of elongated swampy depressions that appear to be fed by water rising along the fault from the sandstone aquifer within the Barind Tract Formation (Figure 3.8).

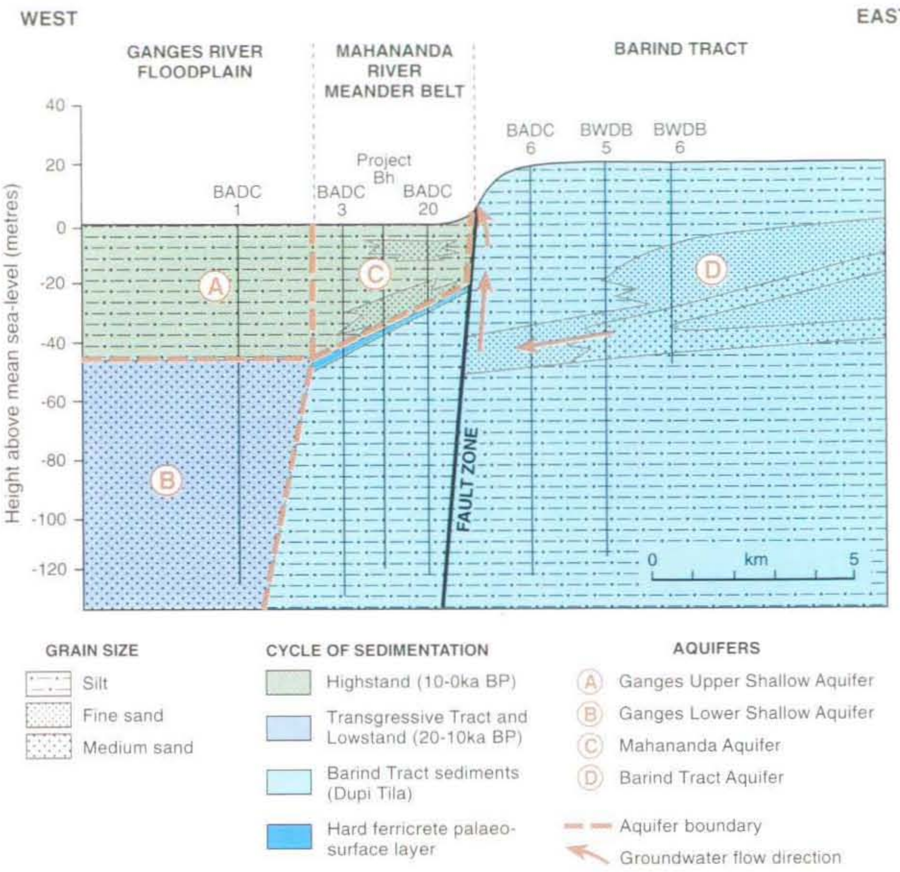


Figure 3.8. Geological cross section through the Chapai Nawabganj Special Study Area.

The Chapai Nawabganj test borehole (CPW5) was drilled to a depth of 50 m through 37 m of unconsolidated fluviatile sediments which unconformably overlie lithified, weathered clayey siltstones of the Barind Tract formation (Figure 3.9). The Barind Tract clayey silts are oxidised yellow brown fluviatile overbank sediments (Figure 3.10, CN18) capped with a hard dark red tabular lateritic ferricrete band, indicative of hot humid climatic conditions. Overlying these are two sequences of grey-brown unconsolidated fluviatile micaceous sands. These were deposited in the active meander channel of the Mahananda River, the lower some 5 ka BP (Figure 3.10, CN13) and the latter from 1.9 ka BP (Figure 3.10, CN6; Table 3.6). The upper 11 m of fluvial sands were deposited within a waning meander channel, capped by over-bank flood micaceous silts (Figure 3.10 CN3). These fluvial sediments form a highstand sequence deposited adjacent to the floodplain of the Ganges River.

Lithological logs of other boreholes from Chapai Nawabganj and neighbouring *upazilas* are shown in Figure 3.11. Boreholes DW1 and DW2 were drilled in 1998 by BWDB-DU in the centre of the Chapai Nawabganj arsenic hot spot area in order to obtain more sedimentological information about the hot spot. The boreholes each show a surface layer of brown to grey-brown overbank silts with underlying fine to medium and coarse sands down to around 40 m. Below this, fine grey silts and clays predominate.

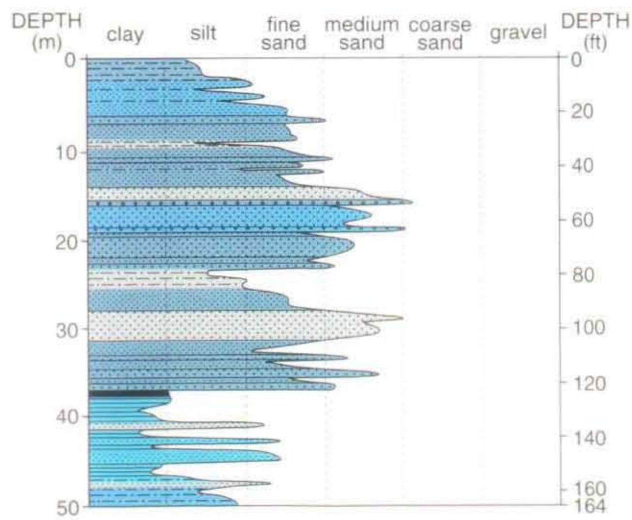
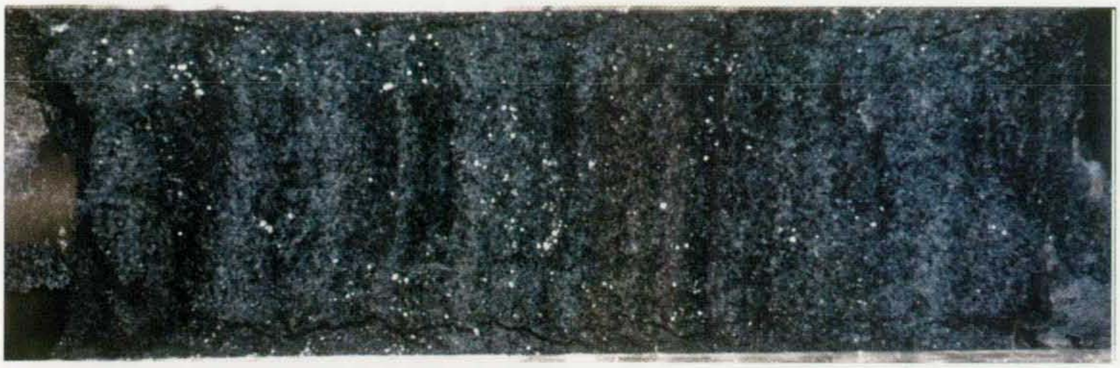


Figure 3.9. Lithological log of the DPHE/BGS test borehole at Chapai Nawabganj (CPW5). The colouring reflects the colour of the sediments.

Table 3.6. Radiocarbon dates of samples obtained from the Chapai Nawabganj test borehole (CPW5)

Sample No.	Depth (m)	Age
AA36199	18.90	1310±180
AA36213	24.99	1895±45
AA36214	25.60	5140±120

CN3 31–32 ft, 9.5–9.8 m Light brown/grey fine sand with little mica; above dark brown grey silty very fine sand with thin light grey-brown layers, a little mica and some pelecipod fragments. The top sand has been forced up into overlying dark brown grey silty very fine sand.



CN6 52–54 ft, 15.8–16.5 m Brown micaceous medium sand with darker very micaceous layers containing dark brown mica; above light grey medium sand with some black mica; above brown medium to coarse sand.

CN13 94–96 ft, 28.7–29.3 m Light grey cross bedded medium sand with little mica, above grey very micaceous medium to fine sand with black to clear coarse-grained micas; above light grey fine to medium sand with little mica and some orange stained grains.

CN18 126–128 ft, 38.4–39.0 m 2.5Y6/4 light yellow brown finely laminated clayey silt becoming more clayey and greyer with depth.

Figure 3.10. Photographs of core from the Chapai Nawabganj test borehole (CPW5). The scale is indicated by the length of the core.

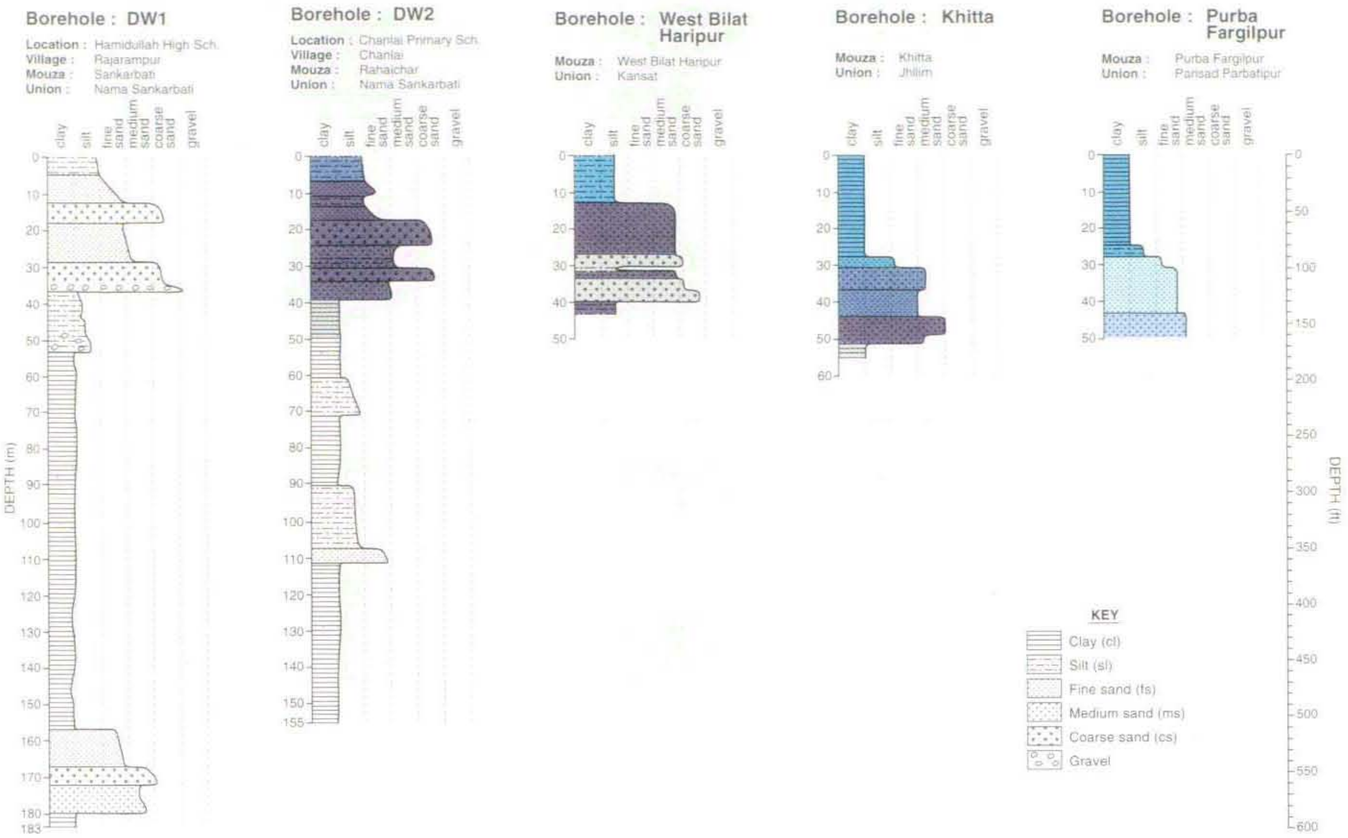


Figure 3.11. Lithological logs of selected boreholes from Chapai Nawabganj and surrounding areas (DW1 and DW2). After Khan et al. (1998).

The borehole at West Bilat Haripur (samples courtesy of the Barind Integrated Agricultural Development Project) is located in the Ganges River floodplain area and shows a similar sequence of fine surface silts and underlying aquifer sands at around 12–40 m depth (Figure 3.11).

Boreholes at Khitta, 12 km east of Chapai Nawabganj town and Purba Fargilpur, 25 km north of the town are sequences in the Barind Tract showing well-developed grey fine silt and clay from approximately 0–30 m with underlying fine to medium yellow-brown sands of the Barind Aquifer (Dupi Tila Formation). Samples from these five boreholes displayed in Figure 3.11 have been subjected to geochemical investigation and are described more fully in Chapter 11.

3.3.4 Faridpur

The geological section investigated at Faridpur is about 17 km wide and 220 m deep (Figure 3.12). The section is composed of alluvial sediments deposited by the Brahmaputra/Atrai/Ganges system during the last 240 ka and consists of two main sections, a shallow aquifer, 60–120 m thick (Cycles 1a, 1b; Figure 3.12) and a deep aquifer 100–160 m thick (Cycles 2, 3).

The section is based upon geological data from five borehole logs provided by BWDB and a description of core and chip samples obtained from the Faridpur test borehole drilled for this project.

The shallow aquifer can be divided into two main parts:

(1) The *upper shallow aquifer highstand sediments* (Cycle 1a, 0–45 m) are composed of:

- near-surface grey micaceous silts and clays deposited as overbank deposits that thicken from east to west (0–20 m);
- grey micaceous fine to medium sands deposited within waning meander channels and dipping from east to west (0–45 m);
- basal grey medium sands with disseminated wood and mica deposited within active channels.

(2) The *lower shallow aquifer Transgressive Tract and lowstand sediments* (Cycle 1b) are composed of fining-upward gravels and coarse to medium sand within a channel, some 75 m deep and 5 km wide, located to the west of the present Padma Channel. Between 80–120 m depth, the main channel of the shallow aquifer has been incised into the pre-existing sediment.

To the west, thin medium sands were deposited within an adjacent distributary channel from 45–70 m depth, on top of pre-existing highstand deposits. To the east, the main channel is abutted against a thick sequence of overbank silts and fine sands. These are pre-existing highstand deposits, forming a barrier between the incised channel and that of the main Brahmaputra Channel to the east, capping the deep aquifer system below. Evidence from the Faridpur test borehole indicates that these sediments have been extensively weathered, with deposition of red-brown iron oxide cement and kaolin clay.

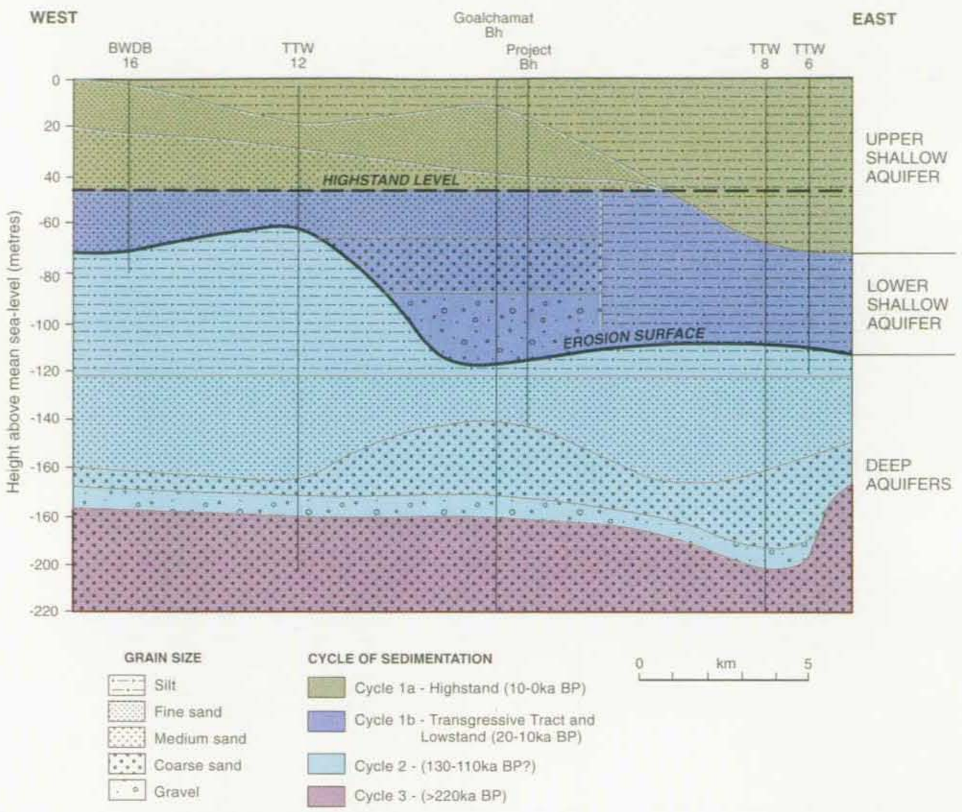


Figure 3.12. Geological cross-section through the Faridpur Special Study Area.

The deep aquifer, found below an undulating erosion surface and the highstand deposits, are composed of sediments deposited presumably during the 120–240 ka BP interglacial period, which have been preserved by subsidence. These sediments overlie two stacked sequences of fining-upward gravels and coarse to medium sands which are deposited within the basal sections of pre-existing incised main channels, themselves deposited during Cycles 2 and 3. The coarse sands and gravels, 60–80 m thick, form the deep aquifer above an erosion surface of sandy clays.

The Faridpur test borehole (FPW6) was drilled to a depth of 155 m (Figure 3.13) through 133 m of unconsolidated fluvial sediments deposited by the Brahmaputra River, underlain by brown-grey, medium and fine fluvial sands of possible Middle Pleistocene age (Dupi Tila Formation) (Table 3.7). A continuous core was obtained from 0–62 m, below which samples were cored 1 m in every 3 m. Representative sectioned core samples, summarised in Table 3.7, are described and illustrated in Figure .

These highlight the very micaceous nature of the sediments between 0–45 m depth and the low mica content of coarse sands below. Radiocarbon dating of organic matter from the cored sequence shows that the grey sediments at less than 91 m depth have been deposited since the last glacial maximum at 21 ka BP (Table 3.8).

The fine-grained silts and peats at 45 m depth form the Hiatus 2 (Middle Dryas) horizon that can be correlated with a similar horizon on the other side of the Brahmaputra in BGS test borehole logs at Saturia, Manikganj and Dhamrai. A geological section between Faridpur and Dhamrai through the main channel of the Brahmaputra

Table 3.7. Lithology and facies of deposition recognised in the Faridpur test borehole (FPW6)

Depth (m)	Lithology and facies of deposition
Highstand fluviatile sequence	
0–13	Brown grey micaceous silts to fine sands deposited within a waning channel capped by overbank flood silts (FD3 and FD4)
13–25	Brown grey fine to medium fining-upwards sands deposited by an actively meandering channel (FD6)
25–44	Grey fining upward fine to medium sands with disseminated wood and ferricrete fragments (FD11)
44–45	Hiatus 2 layer composed of a grey micaceous peaty clay with thin hard platey brown iron carbonate fragments (FD15).
Transgressive Tract	
44–71	Grey fining-upward medium to fine to medium micaceous sands deposited within active to waning meander channels (FD19).
71–98	Grey micaceous fining-upward medium and fine sands with basal coarse sand and gravel, deposited in an active meander channel. Grey micaceous silty fine sand between 73–80 m (FD21).
98–110	Grey coarse to medium fining-upward sands deposited with an active braided channel sequence (FD26).
Lowstand/TransgressiveTract	
110–134	Structureless grey coarse sands and gravels with a conglomeratic base, deposited under braided channel to gravity-flow conditions – forming the base of the Transgressive Tract sediments deposited within the incised Brahmaputra Channel (FD34).
Pre-Lowstand deposits	
134–155	Brown grey medium to fine sand

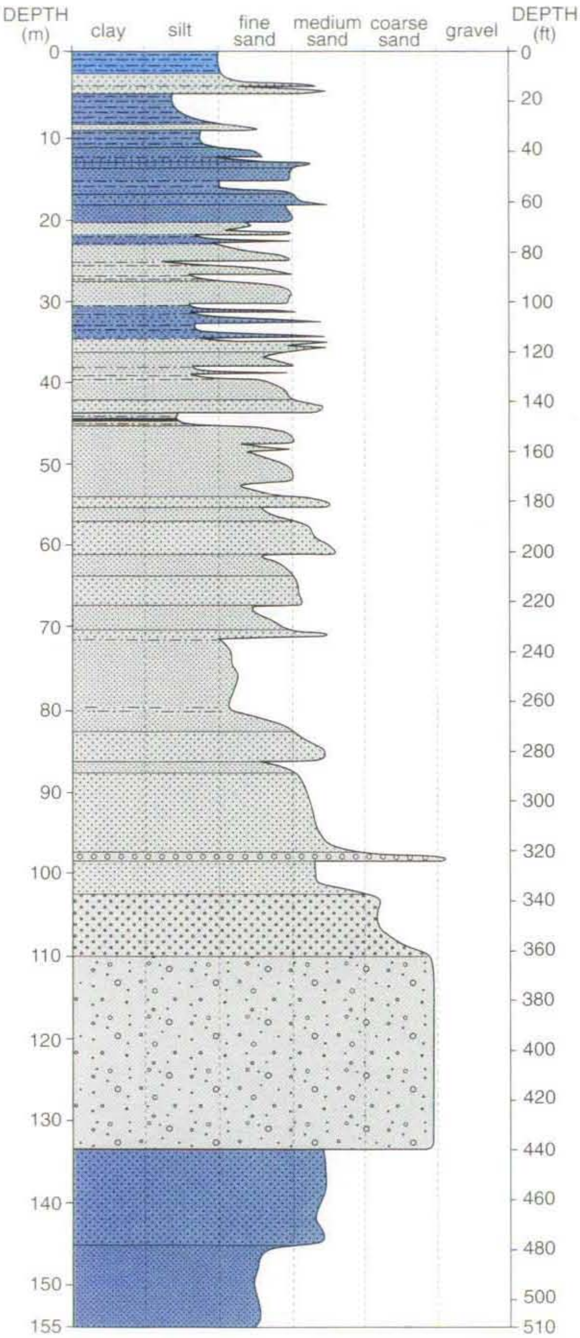


Figure 3.13. Lithological log of the DPHE/BGS test borehole at Faridpur (FPW6). The colouring reflects the colour of the sediments.

Table 3.8. Radiocarbon dates of samples taken from the Faridpur test borehole (FPW6)

Sample No	Depth (m)	Age (Years BP)
AA36203	6.2	106.6±0.58
AA36204	9.2	3085±50
AA36198	9.8	960±45
AA36197	10.2	855±45
AA36212	44.5	8260±75
AA36209	55.2	11890±80
AA36211	73.2	18560±130
AA36208	91.4	22690±190
AA36210	125	9925±70

shows the distribution of the four main layers that comprise the shallow aquifer. Also shown is a remnant pre-100 ka lowstand segment composed of reddened fluvial sediments beneath the Dhamrai area (see Figure 4.8).

3.3.5 Lakshmipur

The Lakshmipur test borehole (LPW6) was drilled to a depth of 153 m (Table 3.9) through unconsolidated deltaic sediments, deposited within the incised Padma channel. A continuous core was obtained to 62 m, discontinuous core being taken thereafter at 3 m intervals from every 10 m drilled (Figure 3.15).

The compositions of the deltaic deposits examined are summarised in Table 3.9. Representative sectioned core

Table 3.9. Lithology and facies of deposition recognised in the Lakshmipur borehole log

Depth (m)	Lithology and facies of deposition
Highstand deposits within lower delta plain	
0–24	Thinly interbedded organic-rich dark grey micaceous siltstones with crevasse-splay sands deposited during cyclonic events (LK3, LK6 and LK7)
24–35	Brown grey micaceous fine to medium sands formed as a crevasse-splay deposit (LK10 and LK11)
35–47	Interbedded grey silts and micaceous brown grey very fine to fine sands deposited by small overbank floods and crevasse splays. The peat at 45–47 m was deposited at the Hiatus 2 horizon at about 7.5 ka BP during the Middle Dryas event. (LK16 and LK18).
Transgressive tract sediments	
47–50	Brown fine crevasse-splay sand
50–60	Thinly interbedded brown grey micaceous silts and fine sands deposited within an abandoned channel.
60–75	Grey fine to medium sands deposited within an active distributor channel. Finer grained sediments between surface and 75 m were deposited within the lower delta plain environment under tidal and storm flood influences.
Coarse sandy sediments, deposited as delta lobe deposits within the incised channel.	
75–115	Grey fining-upward sequence of coarse to fine sands, capped by a thick brown peat deposit at 75–80 m, deposited in an active meandering channel that waned to be infilled with organic debris. The peat is the Hiatus 1 horizon at the base of the Holocene (10 ka BP).
115–130	Grey fining-upward coarse to fine sands deposited within an active meandering channel. The dark grey silt at 115–116 m may mark the Bolling Allerød event horizon of 13–15 ka BP.
Lowstand/basal transgressive tract	
130–150	Grey coarsening-upward sequence of sandy silts to medium to fine sand that could have been deposited at the beginning of the marine transgression between 15–17 ka BP thus forming the basal sediments within the incised channel.
Glacial maximum at 17–22 ka BP	

FD3 30–31 ft, 9.1–9.4 m Dark grey sticky clayey silt above light brownish grey fine sand with several interbedded thin dark brown micaceous bands with odd wood fragments.

FD4 37–38 ft, 11.3–11.6 m Dark grey brown silt; above interbedded layers of light grey and dark grey fine sand, the dark grey layers are very micaceous with much biotite.

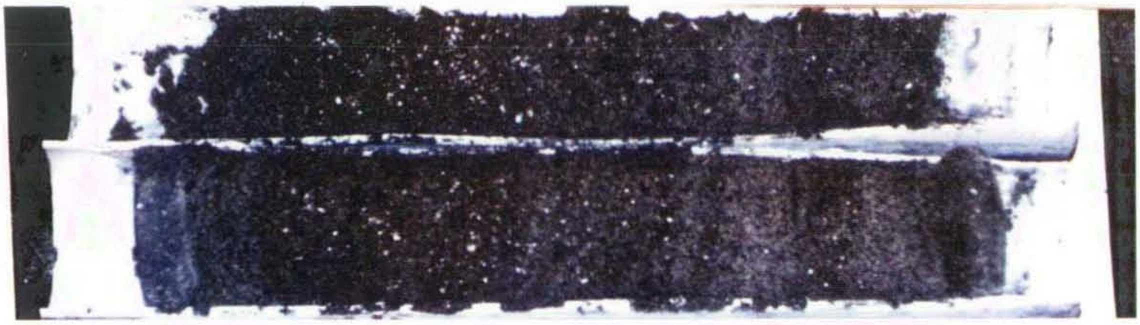
FD6 60–61 ft, 18.3–18.6 m Brownish grey to grey micaceous medium to fine sand.

FD11 111–112 ft, 33.8–34.1 m Light grey fine to medium sand with some clear mica.

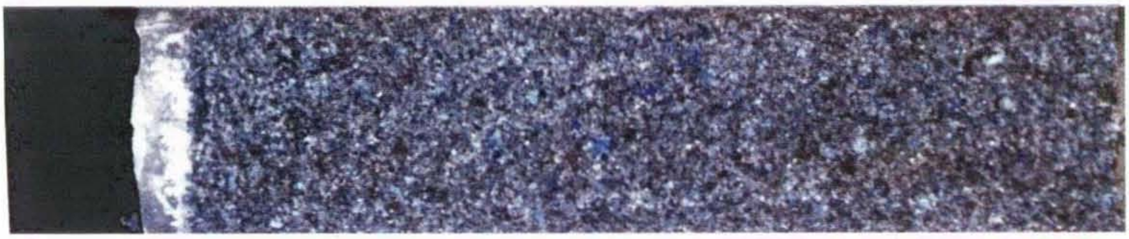
FD15 146–147 ft, 44.5–44.8 m Hard dark grey very micaceous slightly clayey silts with included sub-angular to sub-rounded platey orange brown fragments of ferricrete (or pottery?) with large fragment of black peat.

Figure 3.14. Photographs of core form the Faridpur test borehole (FPW6). .The scale is indicated by the length of the core.

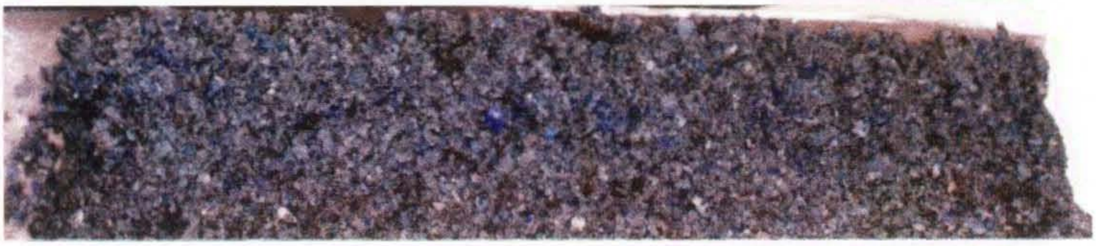
FD19 220–221 ft, 67.1–67.4 m Grey fine to medium fairly micaceous sands.



FD21 251–252 ft, 76.5–76.8 m Light grey fine sand with some mica above black micaceous silt, above black very micaceous silty fine sand, above black to dark grey micaceous fine sand, above grey fine sand.



FD26 340–341 ft, 103.6–103.9 m Grey coarse to medium quartz sand.



FD34 430–431 ft, 131.1–131.4 m Grey quartzose coarse sand and fine-sized gravel with some medium sand, mainly fairly well rounded clear quartz grains, some large prominent sub-angular pink and yellow white quartzite and black angular amphibolite fragments.

Figure 3.14 continued.

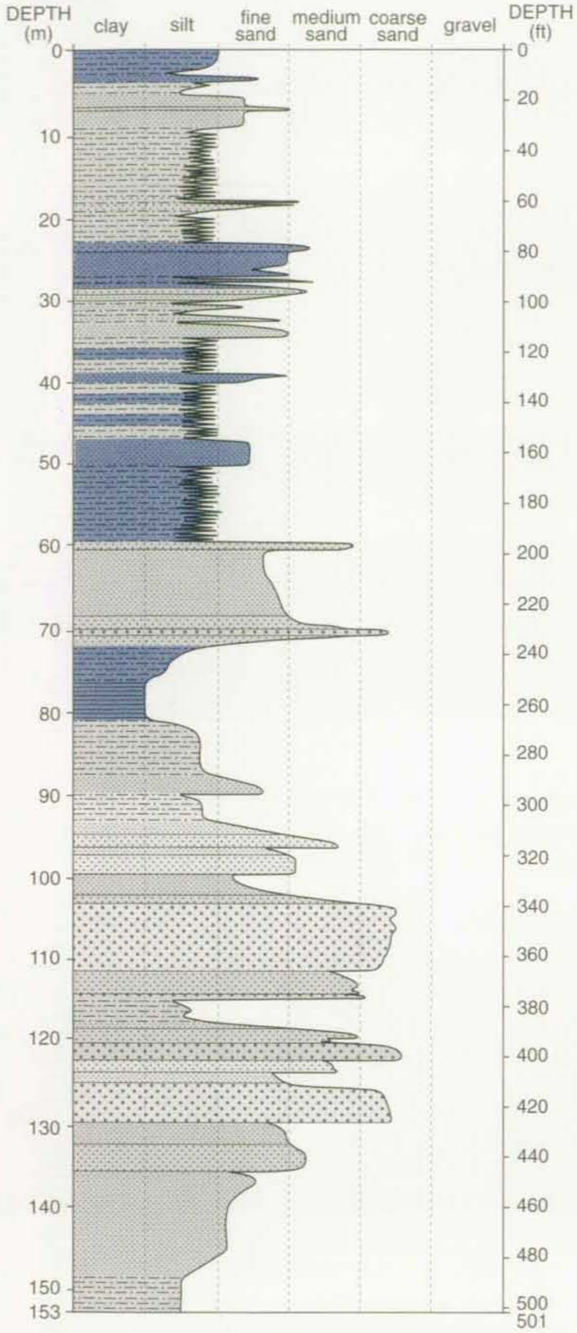


Figure 3.15. Lithological log of the DPHE/BGS test borehole at Lakshmipur (LPW6). The colouring reflects the colour of the sediments.

samples are described and illustrated in Figure 3.16. These highlight the thinly-bedded alternations of micaceous silt and sands with interbedded peats that characterise the upper 45 m of sediment, periodically deposited by flood waters. Radiocarbon dating of organic carbon collected from the cored sequence above 140 m depth has produced a mixed series of dates (Table 3.10). Such mixed sequences with date inversions have been reported from other estuarine sediment profiles in the Nile, Brahmaputra and Yangtze deltas (Stanley and Hait, 2000). These patterns may be due to the reworking of detrital organic material such as wood fragments. However, the ages derived from a thick peat zone at 76–80 m are in excess of 40 ka BP. These are anomalous and difficult to explain. If these dates are correct, then this peat layer would mark the limit of incision during the last interglacial period. Sediments above the peat layer would therefore have been deposited during the last 10 ka.

Table 3.10. Radiocarbon dates with depth of samples taken from the Lakshmipur test borehole (LPW6)

Sample No	Depth (m)	Age (Years BP)
AA36202	10.7	110±0.58
AA36215	35.4	6920±60
AA36216	38.7	10020±85
AA36217	45.4	8870±75
AA36218	46.0	7860±65
AA36219	46.3	9155±70
AA36200	51.8	8000±85
AA36201	54.9	8355±65
AA36220	55.2	9210±70
AA36221	73.2	8855±70
AA36205	91.7	11320±75
AA36207	116.1	6525±60
AA36206	137.5	12585±95

Table 3.11. A summary of the hydrogeological units of the Raipur-Lakshmipur-Eklashpur area

Depth (m)	Lithology and water content
0–25	Inter-tidal zone alternating thin micaceous silts and very fine sands with peat and disseminated wood fragments deposited by annual cyclonic events
25–100	Upper fast zone fluvial medium to fine and medium sands containing saline water
100–130	Micaceous clay and silt aquiclude
130–190	Middle fast zone of fluvial silty fine to medium sands and interbedded medium to coarse sands, containing brackish to saline groundwaters
190–230	Silty clay aquitard
230–280	Lower fast zone of fluvial medium to fine sands with thin basal coarse sands containing fresh water
280–320	Silts, clays and fine to medium sands, capped by a hard layer, containing brackish to saline water

Data from the Lakshmipur boreholes were correlated with geological information from boreholes drilled by DANIDA/DPHE in the Raipur-Lakshmipur-Eklashpur area of the delta. The lithological logs of these boreholes are interpreted from geophysical borehole logs, with little colour definition. Below the 150 m depth of the Lakshmipur cored borehole, the ages of the highstand/lowstand and estuarine/deltaic deposits have not been determined. The depth distribution of lithologies and aquifers in the Raipur-Lakshmipur-Eklashpur area is summarised in Table 3.11 and in Figure 3.17. Note that the main freshwater aquifer lies at 230–280 m, below the level of incision at the last glacial maximum. Saline and brackish to saline waters occur in sandy layers above this horizon.

LK3 14–15 ft, 4.3–4.6 m Light grey fine sand (>2" thick); above grey to brown silty fine sand with some mica (2" thick); brown grey to dark orange brown iron oxide rich silty fine sand with some mica (1.5" thick); Grey silty very fine sand (>2" thick).

LK6 48–49 ft, 14.6–14.6 m Alternations of dark grey silt and light grey fine sand: silt (>0.5" thick); above sand (0.25" thick); above silt (0.5" thick); above sand (0.25" thick); above silt (0.5" thick); above sand (0.25" thick); above silt (0.75" thick); above sand (0.25" thick); above silt (0.25" thick); above sand (0.5" thick); above silt (0.5" thick); above sand (0.5" thick); above silt (0.5" thick); above sand (1" thick); above very micaceous dark grey silt (1" thick); above light grey micaceous fine sand (>0.5" thick).

LK7 55-56 ft, 16.8- 17.1 m Light grey to grey fairly micaceous fine-grained sand (>2.5" thick); above alternating layers of grey silt and light grey fairly micaceous fine-grained sand with thin black detrital mica bands (2" thick); above light grey fairly micaceous fine-grained sand (0.75" thick); above dark grey very micaceous silty fine-grained sand with much black detrital mica (0.75" thick); above dark grey very micaceous fine-grained sand with black mica below a thin light grey fairly micaceous fine-grained sand (>1.5" thick).

LK10 92-93 ft, 28.0-28.3 m Dark grey silt with some finely disseminated mica (>1" thick); above light grey fine to medium-grained sand (1.5" thick); above dark grey silt with a black micaceous base (0.5" thick); above light grey fine-grained sand (1" thick); above grey fairly micaceous silty fine-grained sand (0.75" thick); above light brownish grey fine-grained sand (0.5" thick); above grey silty fine-grained sand (0.5" thick); above light brownish grey fine-grained sand (1" thick); above brown grey fairly micaceous fine-grained sand (1.5" thick); above light brownish grey fine-grained sand (>1.25" thick).

Figure 3.16. Photographs of core form the Lakshmipur test borehole (LPW6). The scale is indicated by the length of the core.

LK11 95–96 ft, 29.0–29.3 m Brown grey fine to medium sand (>1" thick); above light brownish grey medium to fine grained sand with some clear mica and black opaque grains (1.25" thick); above brown grey silty fine to medium sand with increased clear mica (0.75" thick); above dark brown grey fairly micaceous fine sand with much black mica (1" thick); above dark grey very micaceous fine sand with much dark brown and black micas (1" thick); above light brown clean fine sand with no mica (0.75" thick); above black detrital very coarse grained mica (1.5" thick); above dark grey fine sand with fine to medium sand at base and capping of grey fairly micaceous fine sand with much black mica (>0.75" thick).

LK16 133–134 ft, 40.5–40.8 m Dark brownish grey silt and very fine sand (>1" thick); above laminated dark brown grey silts (3.25" thick); above dark grey brown fairly micaceous silts interbedded with light brown grey fine sand with odd thin brown very micaceous layer (0.75" thick); above greyish brown fine sand with some clear mica interbedded with dark brown fairly micaceous sandy silt (1.5" thick); above two cycles of brown silt above thin grey brown fine sand (1" thick); above dark brown silt (0.75" thick); above dark brown micaceous very fine sand (0.25" thick); above dark brown silt (>0.5" thick).

LK18 149–150 ft, 45.4–45.7 m Dark grey sandy silt with a thin brown peat layer at 1.5" (>2.12" thick); above light brown grey fine sand with dark brown wood fragments (1.37" thick); above dark grey sandy silt with a thin brown peat layer at 4.25" (1.37" thick); above brown grey sandy silt and light brown grey very fine sand (1.37" thick); above laminated dark grey silts with thin peat layers at 7.37", 7.75" and 8.25" (>2.5" thick).

Figure 3.16 continued.

3.4 Conceptual models

3.4.1 Delta floodplain environment

A conceptual model of Upper Pleistocene and Holocene sediment distribution in the delta has been developed (Figure 3.18). This uses lithological data from the Faridpur, Lakshmipur and Chandina areas related to sea-level change and regional tectonism. This model suggests that by the 20 ka glacial maximum, the Padma channel was incised to a lowstand depth of 130 m and former highstand deposits have been eroded from the adjacent areas. Marine transgression followed, during which time saline water entered the former transgressive sediment sequence forming the channel sides. During the transgression, backfill of the channel started from 20 ka at Faridpur where prograding coarse-grained sediments were deposited from braided streams.

From about 13 ka BP onward at Lakshmipur, where finer-grained upward-fining sediments were deposited, probably under marine conditions, backfilling also occurred. By 10 ka at the start of the Holocene, the prograding sediment pile had backfilled to about 50 mbpdsl at Faridpur but was at 80 mbpdsl at Lakshmipur. At this time, there was a marine hiatus when sea level appeared to decline. This hiatus is marked by a thick peat horizon within the Lakshmipur site. Following this hiatus, the rejuvenated marine transgression was followed by a similar hiatus at 7.5 ka BP during the Middle Dryas period, by which time the incised valley had been backfilled 45 m bpdsl at both sites.

The level of this second hiatus coincides with the base of the following highstand sequence, deposited during a third stage of marine transgression. During this highstand period, river gradients were shallow, with the main rivers and their distributaries depositing fine sediment within a wide delta plain environment. Whereas typical fluviatile fining-upward channel sediments were deposited at Farid-

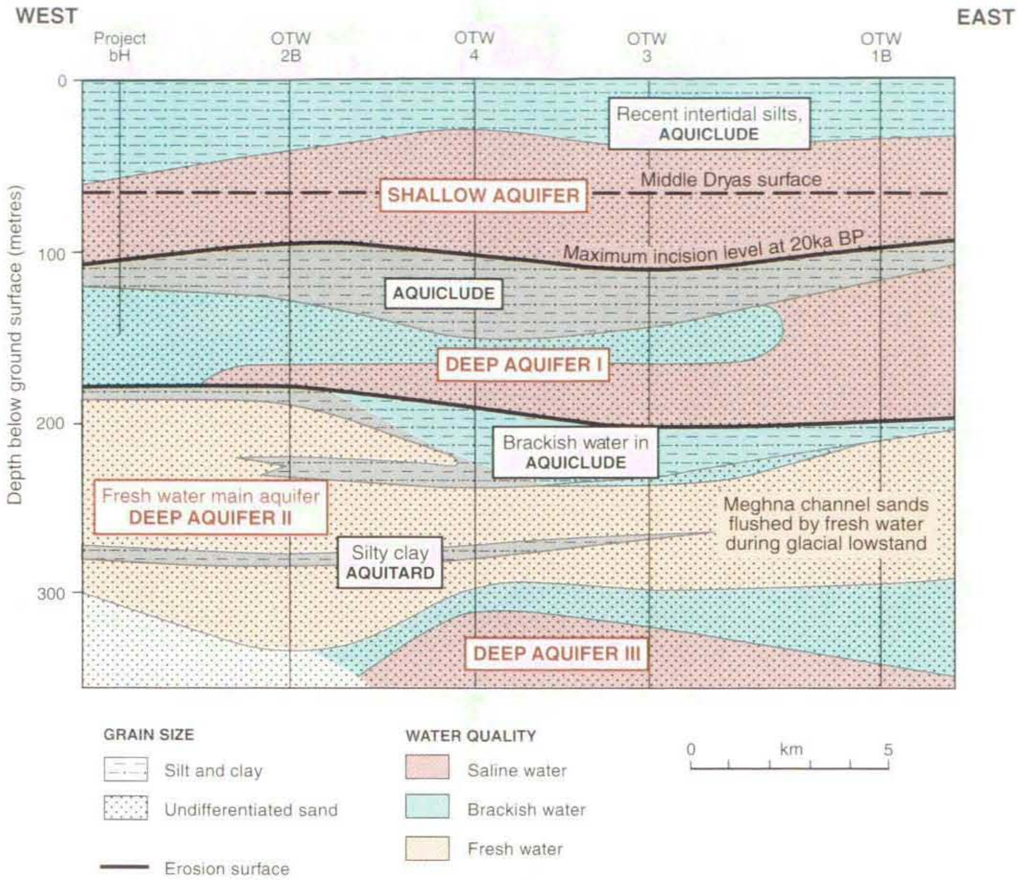


Figure 3.17. Geological cross-section through the Lakshmipur Special Study Area.

pur, predominantly thinly bedded estuarine flood sediments composed of thin alternations of fine sands, silts and organic-rich clays were deposited within the Lakshmipur area further south.

3.4.2 Fluvial floodplain environment

Data from BADC deep tubewells and BGS test boreholes (Davies, 1989) from the Dhamrai, Singair, Manikganj, Saturia and Savar areas, were used to construct a conceptual model of the Upper Pleistocene and Holocene sediments beneath the Brahmaputra fluvial floodplain west of Dhamrai (Figure 3.19). To the east of Dhamrai, these sediments are faulted against coarse fluvial sediments that underlie the red-brown Madhupur Clay Residuum of the Savar area.

These borehole data are mainly limited to the depth of channel incision, about 90 m. Good colour definition and the dense pattern of boreholes allows good litho-correlation, enabling an understanding of weathering patterns and the relative ages of sediment deposition. The 45 m deep highstand base is defined by a clayey palaeosol layer in the Dhamrai area that is absent in Manikganj to the west. Lowstand/transgressive sediments are composed of braided river coarse sands and gravels with a conglomerate base that unconformably overlie loosely cemented red/orange weathered sands of the Dupi Tila Formation.

Colour and weathering patterns indicate several cycles of incision and deposition in successive glacial events. In each case, the highstand deposits appear to be stripped off by erosion and adjacent sediments weathered. The faulted boundary between the incised channel and the Madhupur Tract may be a series of rotational slippage faults developed along the unstable side of the deeply-incised valley or a series of en-echelon faults developed along the Brahmaputra (Jamuna) valley fault/zone of weakness. Conglomeratic material at the base of the Upper Pleistocene sequence, derived from fan-deltas of the Tista/Brahmaputra river systems, was deposited as a series of prograding fan deltas.

The Dupi Tila formation is found beneath the incised Brahmaputra channel and the Madhupur Tract to the east Davies (1994). A geological log of the Bhaluka borehole, located within the central part of the Madhupur Tract, shows a sequence of red-brown and grey fluvial coarse sands occurring beneath thick red-brown Madhupur Clay Residuum. These sediments, similar to the poorly-cemented fluvial sediments found in the Dhamrai/Manikganj area, were probably deposited by the palaeo-Brahmaputra that has since migrated to the west with each successive glacio-eustatic cycle. Early diagenetic processes are apparent including formation of clays and iron oxide cements.

3.4.3 Regional geological cross-sections

A series of geological cross sections has been constructed

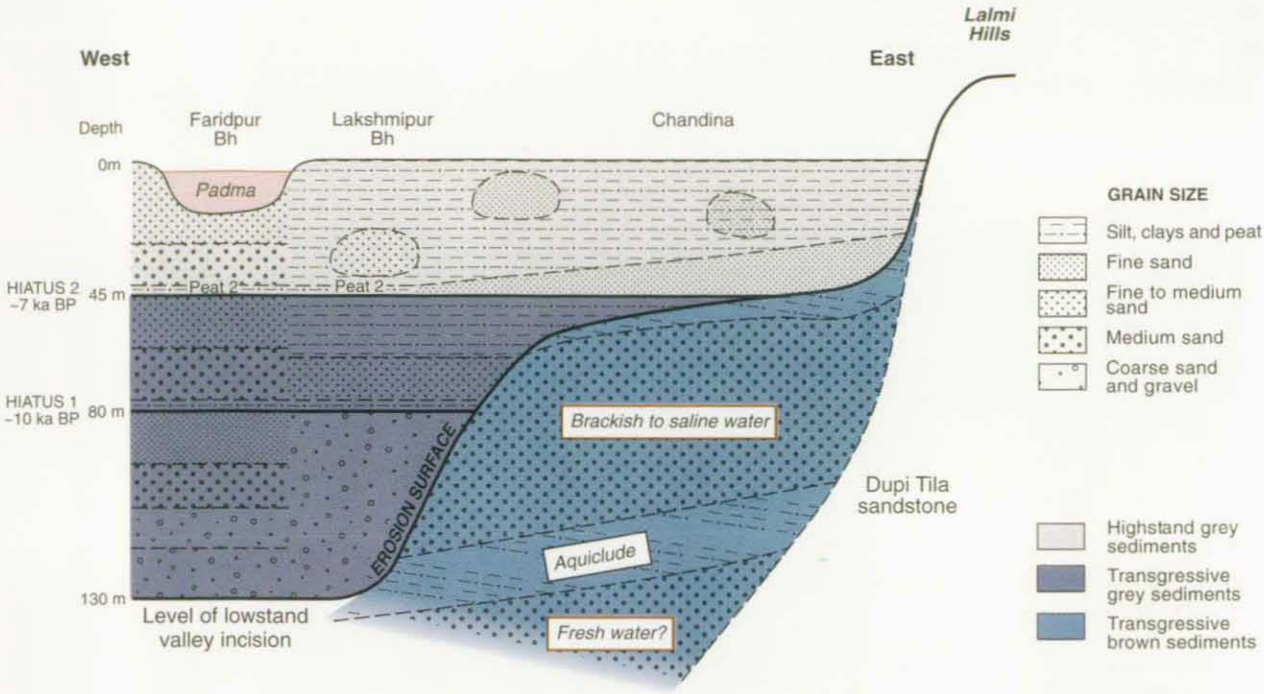


Figure 3.18. Hydrogeological cross section of the south-east GBM delta, showing Late Quaternary sediments.

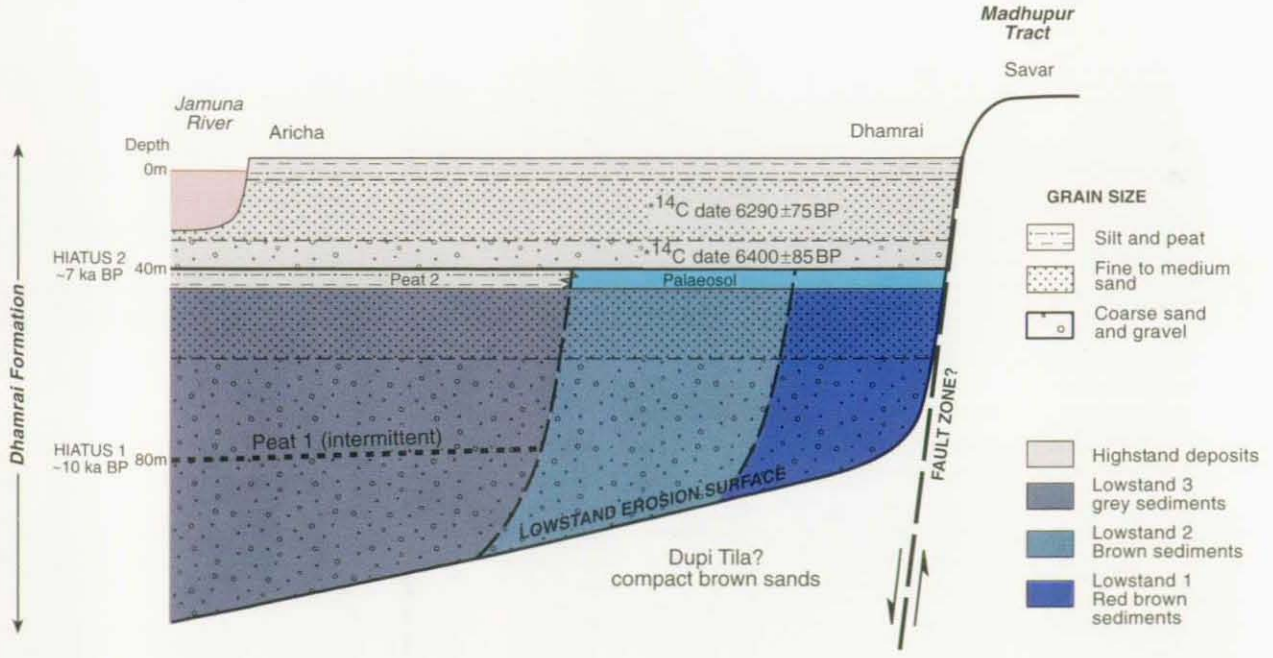


Figure 3.19. Geological cross-section through the Late Quaternary fluvial sediments within the incised Jamuna channel, central GBM system.

using data from exploration, irrigation and municipal borehole records held by BWDB, with the aim of indicating the probable sediment distribution in the upper 300 m of the GBM. These sections have been divided according to approximate base of highstand at 40 m bpdsl, the limit of glacial maximum base level at about 120 m bpdsl, and deep pre-last lowstand sediments occurring between 120 m and 300 m bpdsl. The aim is to assess the potential of a deep aquifer being found below 150 m bpdsl.

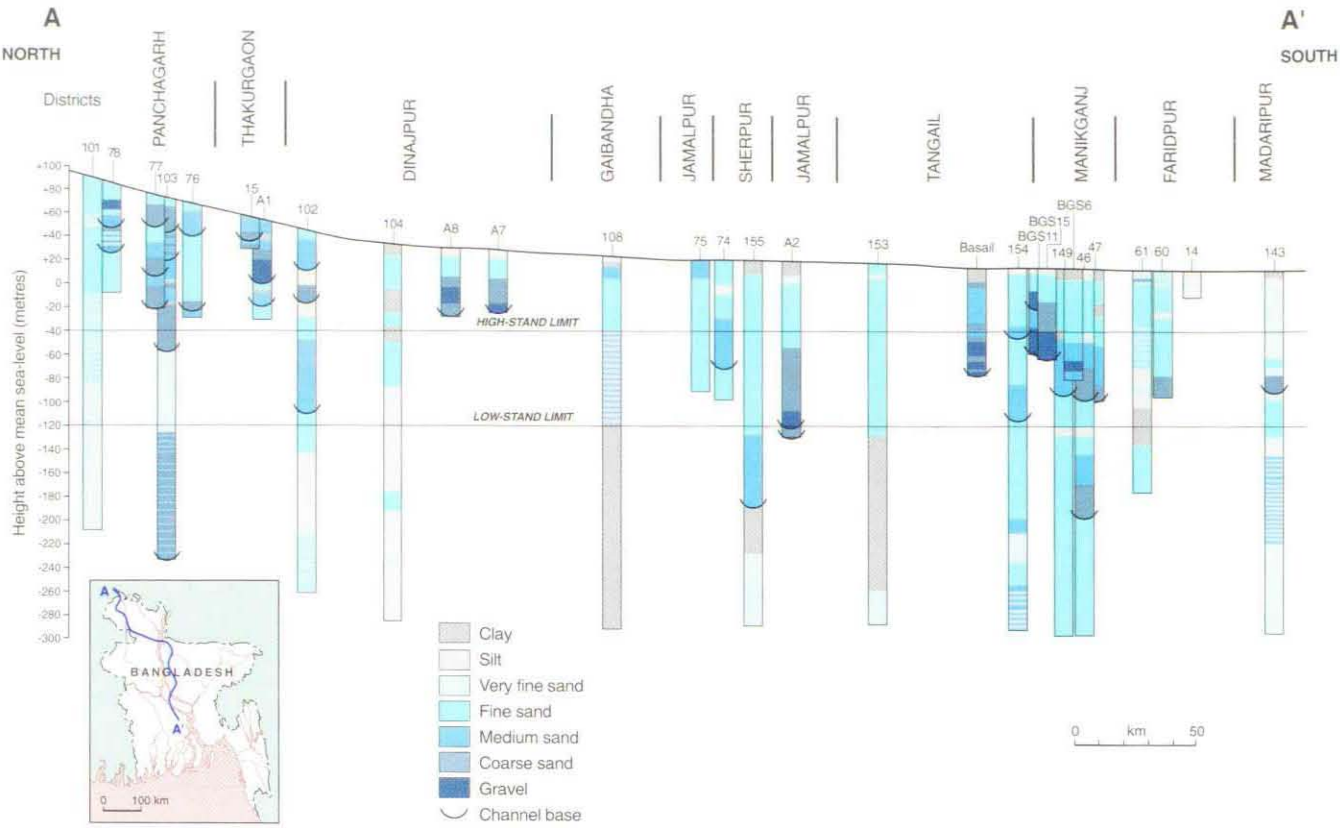


Figure 3.20. Section A: Geological section from Panchagarh–Sherpur–Madaripur.

Section A: Panchagarh–Sherpur–Madaripur

This section runs (Figure 3.20) from Tetulia in the north-western corner of Bangladesh through the Tista Fan to Sherpur on the Jamuna from where it runs due south along the left bank of the Jamuna to Manikganj and thence to Faridpur. At Tetulia, Panchagar and Thakurgaon, boreholes penetrate fining-upward coarse to medium sands and gravels of the Tista Fan delta cone above the highstand limit. Stacked coarse-sand channel sediments occur down to 240 m at Panchagar, possibly associated with the former course of the Tista, otherwise very fine sands and silts predominate below the lowstand level. Between Dinajpur and Gaibandha, boreholes tend to penetrate thick sequences of very fine sands, clays and silts of the sub-Barind Dupi Tila deposits, found to depths of 260-280 m bpdsl. Near-surface gravels in highstand river channel deposits occasionally occur down to about 20 m bpdsl.

At Gaibandha, fine to medium sands occur within the highstand zone, overlying lowstand sandy silts and sub-lowstand clays to 280 m bpdsl. At Sherpur and Jamalpur, fining-upward sequences of medium to fine sands occur to sub-lowstand levels above deep very fine sands and clays. At Jamalpur, the lowstand channel of the Old Brahmaputra contains a fining-upward sequence of gravel and coarse to fine sand and near-surface silts. Consolidated black shales have been found at depth within municipal water supply boreholes at Sherpur, where sub-lowstand medium sands have been proved to about 180 m bsl. Within the central Young Brahmaputra floodplain, at Bh153, lowstand to highstand fine sands overlie thick shales and very fine sands to 300 m bpdsl.

Between Basail and Manikganj, lowstand coarse fining-upward gravels and coarse to medium sands occur as transgressive tract deposits between 40–100 m bpdsl. These are underlain by brown consolidated very fine to medium sands with infrequent coarse channel deposits beneath the lowstand limit. Across the Padma in Faridpur, highstand and lowstand alluvial silts, very fine and fine sands occur. Clays and medium to fine sands to 300 m bpdsl underlie these. Deep aquifer coarse to medium stacked deposits underlie much of the Tista Fan within the Panchagarh area.

Within the Dinajpur and Gaibandha area of the Rangpur Saddle, thick fine sands and clays occur at depth that are unlikely to form deep aquifers. In the Jamuna-Brahmaputra valley between Basail and Manikganj, the incised channel is underlain by brown consolidated fine to medium sands with some coarse sands that should form useful deep aquifers. Only at Jamalpur are stacked thick coarse sands found below 120 m depth, within the former course of the palaeo-Brahmaputra that continues southward into the Madhupur Tract.

Section B: Chapai Nawabganj–Aricha–Sylhet

This section (Figure 3.21) runs from Chapai Nawabganj via Rajshahi along the north side of the Ganges to Aricha, thence eastward across the Madhupur Tract into the valley of the Meghna and then the Sylhet Basin. The section

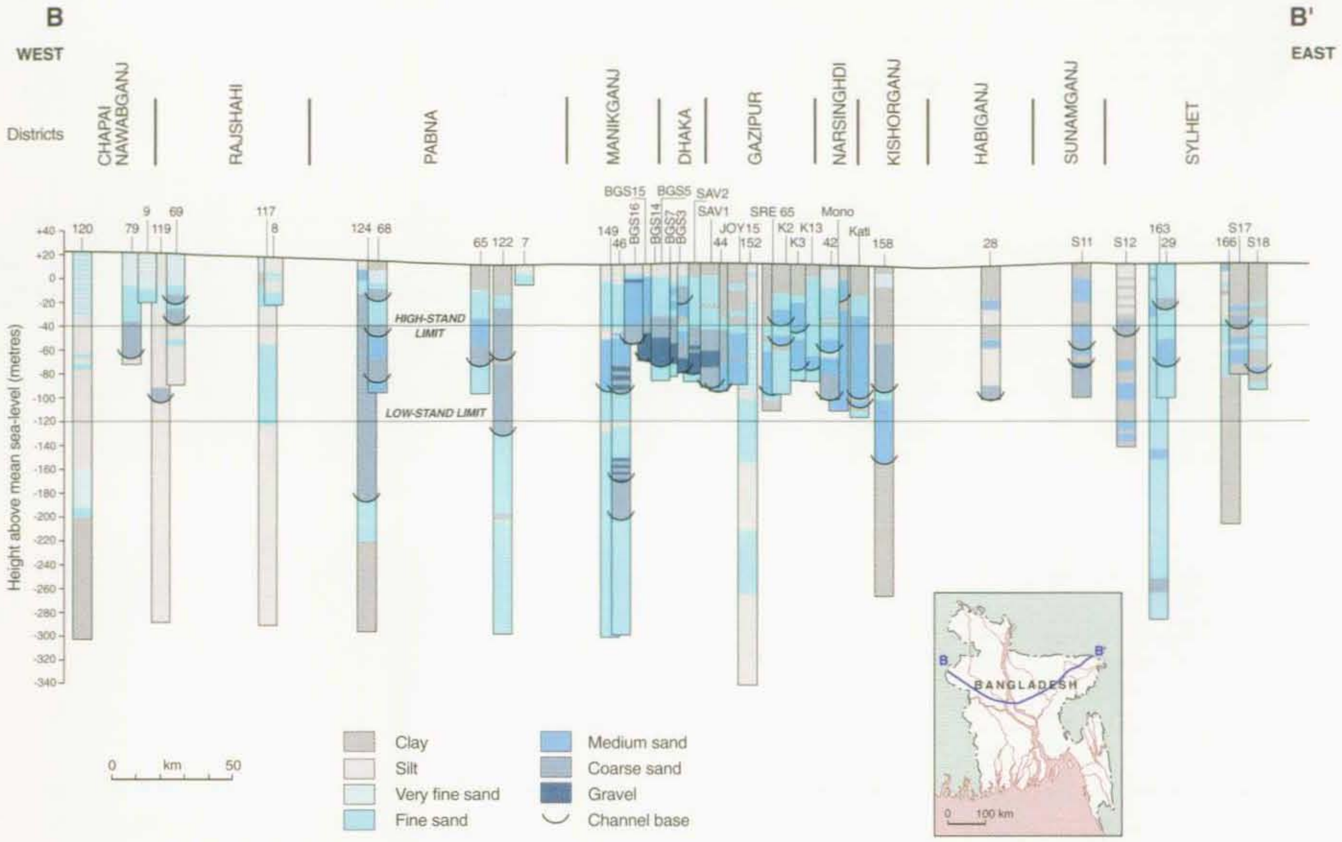


Figure 3.21. Section B: Geological section from Chapai Nawabganj–Aricha–Sylhet.

between Shibganj (Bh120) and Charghat (Bh117) is underlain by thick sequences of clays, silts and very fine sands below the highstand limit. Only along the course of the Mahananda River are medium to coarse channel sands deposited at Bh79.

At Ishurdi (Bh124), a thick sequence of stacked main channel coarse sands deposited by the Ganges are found to a depth of 190 m bpdsl, below the lowstand limit of incision. Towards Aricha (Bh122), thick main channel medium to coarse sands are present between the lowstand and highstand limits, deposited by the Atrai-Gur-Tista system. Fining-upward sequences of gravels and coarse to medium sands with basal conglomerate occur within the lowstand to highstand Transgressive Tract of the Brahmaputra main channel beneath the Dhamrai-Manikganj area.

On both sides of the Brahmaputra, the lowstand limit is underlain by thick sequences of fine sand with some indication of main channel stacking at Bh46. The coarse-grained lowstand to highstand gravels and coarse sands continue under the western part of the Madhupur Tract beneath an eastward thickening highstand Madhupur Clay Residuum. The eastern half of the Madhupur Clay Residuum thins toward the Old Brahmaputra, overlying lowstand to highstand medium to fine sands.

The lowstand to highstand sediments of the Old Brahmaputra in Monohadi and Katihadi are characterised by medium to coarse sands with highstand fine to very fine sands and clays which are typical overbank deposits. Medium to coarse sands are characteristic of the Meghna River deposits but these also include some thick clayey highstand deposits. Within the western Sylhet Basin, thin medium sands occur in thick clay and silt sequences, with minor medium to coarse sand horizons. Early Pleistocene or older consolidated sands and clays underlie the eastern part of the Sylhet basin. This section indicates that away from the present channels of the Ganges and Brahmaputra, little coarse-grained material occurs at depths greater than 130 m bgl.

Some coarse sediments occur beneath the Madhupur Tract, reinforcing the view that the Brahmaputra channel has migrated to the west with successive glacio-eustatic cycles of incision and back-filling, leaving remnant coarse deposits east of the channel. There is some evidence of main channel stacking of coarse sediments in the Madhupur Tract which implies that this was formerly an area of subsidence. These stacked channel deposits should form good aquifers especially if they are found to be present at depth below Dhaka. Further east, some deep coarse sediments may occur beneath the channel of the Old Brahmaputra but only fine deposits are to be found within the subsiding Sylhet Basin and the consolidated fold belts further east. These fine-grained deep deposits will make poor aquifers.

Section C: Meherpur–Dhaka–Feni

This section (Figure 3.22) runs from west to east along the southern side of the Ganges to Manikganj and thence south westward through the Chandina area towards Feni.

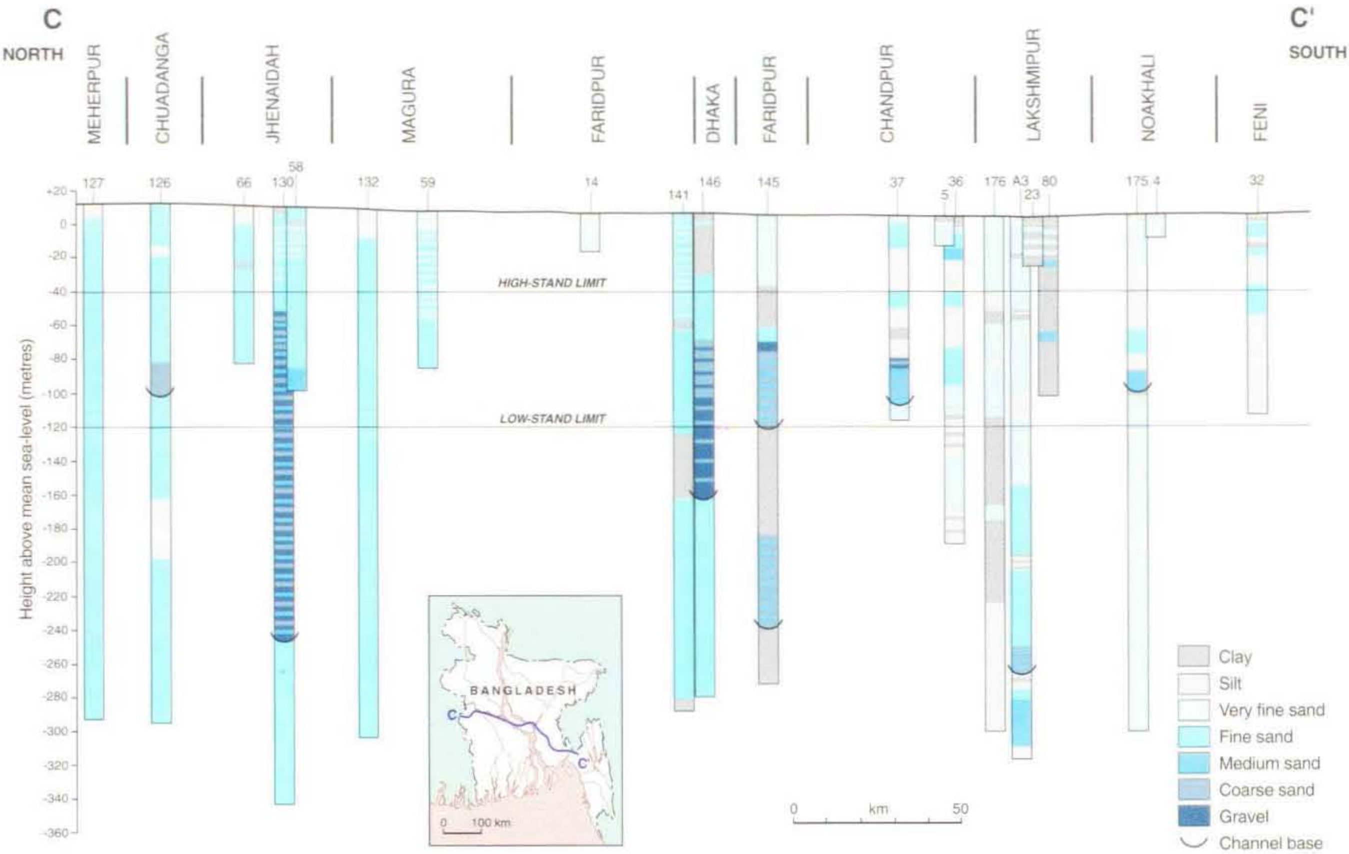


Figure 3.22. Section C: Geological section from Meherpur–Dhaka–Feni.

The western half of this section, south of the Ganges, is primarily underlain by deep sequences of fine-grained sand. However, Jhenaidah is underlain by stacked sequences of coarse sands and gravels between 50–240 m bpdsl. These coarse sediments appear to have been deposited in the former main channel of the Ganges River previously flowing south from the Ishurdi/Kushtia area towards the south-west.

In the region of the Padma the section is underlain by stacked, fining-upward coarse to medium sand, interbedded with very fine sand within the lowstand to highstand and sub-lowstand sequences at Madaripur. East of the Padma between Chandpur, Lakshmipur, Noakhali and Feni, the section includes thick alternations of silts and fine to medium sands deposited within an estuarine delta plain. The stacked main channel deposits at Jhenaidah and in the vicinity of the Padma will form good deep aquifers. However, the rest of the western half of the section is underlain by very fine sediments with poor water-yielding characteristics. Within the eastern half of the section, saline water has been recognised at shallow depth. An alternative freshwater-yielding deep aquifer has already been recognised.

Section D: Meherpur–Manikganj–Chittagong

This section (Figure 3.23) is somewhat similar to section C but runs from west to east to the south of the Ganges. It follows the delta through Faridpur, across the Padma into the Lakshmipur area to the southwest and thence towards Feni. This section passes through similar sediments to those encountered by section C. Fine sands and clays predominate along the southern side of the Ganges as far as Faridpur where main channel medium to coarse sands and gravels occur between the lowstand and highstand levels. Stacked sequences of medium sands occur beneath the Meghna between 60–320 m bpdsl.

To the south east in Ramganj, Begumganj and Feni, thick sequences of fine sands, silts and clays deposited within the delta plain predominate. At Begumganj, stacked cycles of medium to coarse sands separated by clays may indicate a former main channel of the Meghna. The stacked main channel deposits at Faridpur (Bh142) and in the vicinity of the Meghna (Bh83) will form good deep aquifers. However, fine sediments with poor water-yielding characteristics underlie the rest of the western half of the section. In the eastern half of the section, saline water has been found at shallow depths. However, an alternative freshwater-yielding deep aquifer is also usually present. The lateral extents of the stacked main channel sediments at Begumganj (Bh174) need further investigation.

Section E: Satkhira–Lakshmipur–Feni

This section (Figure 3.24) runs west to east across the southern part of the Ganges Delta. Within the lowstand to highstand sequence, a distributary system depositing medium to fine sands transgresses from east (Bh133) to west (Bh138). Beneath this transgression thick silts, clays and fine sands occur to a depth of 300 m bpdsl or more. Within the east of the area, Bh139 intersects coarse to

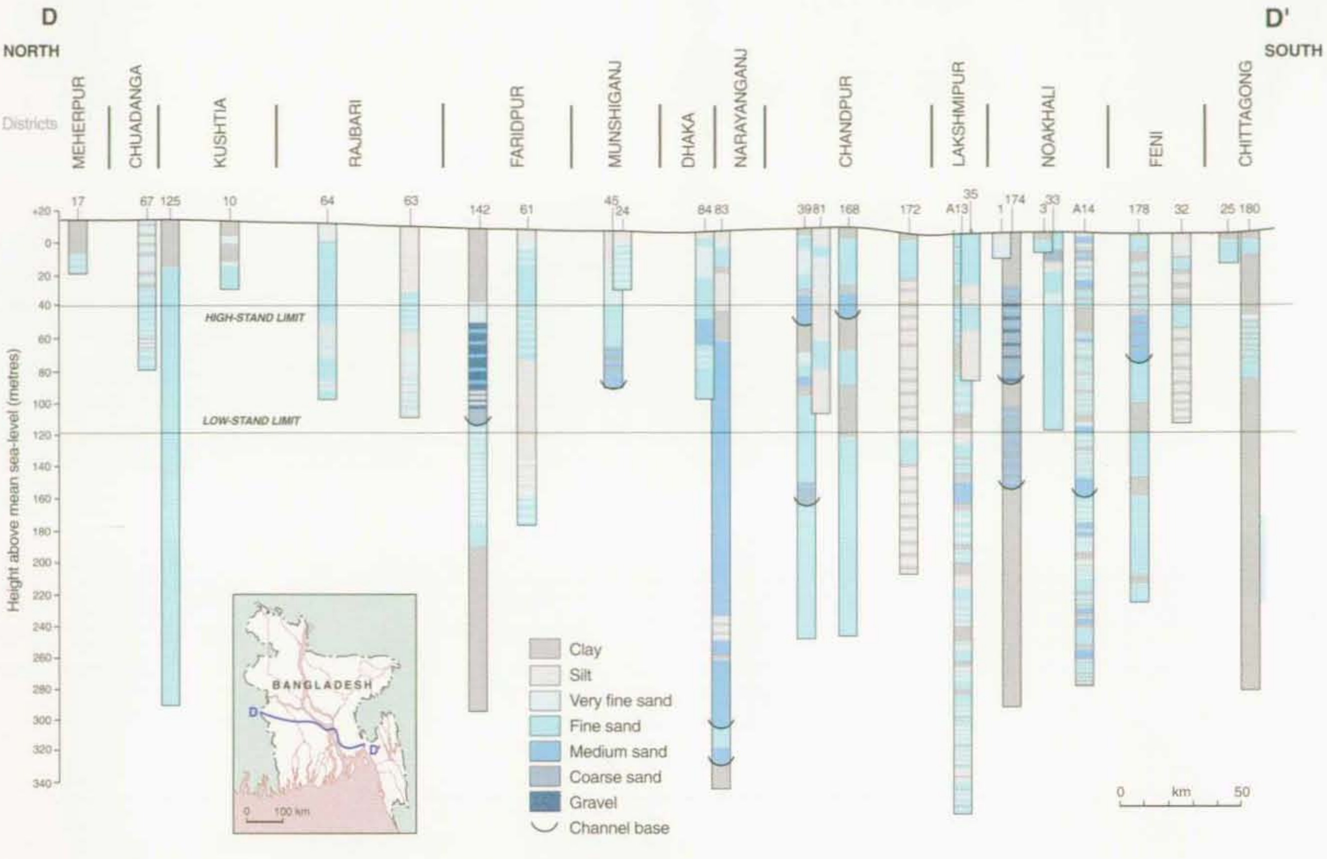


Figure 3.23. Section D: Geological section from Meherpur–Manikganj–Chittagong.

medium sands at depths of 80–160 m and 220–300 m. These stacked sediments infill the former main channel of the palaeo Brahmaputra, that formerly flowed south from the Faridpur area during pre lowstand and early lowstand times. Only the stacked main channel sediments occurring at depth beneath Khulna offer the prospect of potential aquifers. To the west, the area is underlain by thick sequences of clay with little groundwater potential.

These geological sections can only provide a first indication of the distribution of sediments below 150 m depth. More exploration boreholes need to be drilled and logged to characterise the distribution and potential of the deep aquifer. Information from these boreholes also needs to be correlated with the available seismic and other relevant data from oil and gas exploration activities.

3.5 SUMMARY

There are few available sets of detailed geological data from Bangladesh and these are mainly of a localised nature. Analysis of the available borehole data suggests that at the last interglacial highstand, the Ganges flowed south along the present India-Bangladesh border to enter the Bay of Bengal at Calcutta. At that time, the Tista probably flowed along an incised channel through the Barind Tract, presently occupied by the Atrai, then southward through the present Faridpur area. The Brahmaputra and Meghna rivers occupied their present courses (Figure 3.25).

During the early and middle glacial period, erosion occurred along the main river channels with planation of the interfluves. During this period, the Ganges probably moved from its former course towards its present one by the process of channel switching, migration and/or river capture. This reduced the effects of planation of the land surface in western Bangladesh to the anastomosing distributaries. Areas such as the Sylhet Basin subsided and the Barind and Madhupur Tracts continued to rise slowly and tilt to the east.

During the glacial maximum, sea level dropped rapidly, promoting the rapid incision of the main rivers. This action, together with possible tectonic activity, may have resulted in the Mahananda, Ganges and Atrai Rivers attaining their present channels through river capture (Figure 3.26). Aggradation began when incised head-channels of the main rivers cut back into fan delta systems along the Himalayan Front. Gravity flow of coarse-grained material along these channels resulted, with the formation of prograding fans in the lower reaches of the incised channels (Figure 3.27).

During the sea-level rise and transgression that followed, the main channels were backfilled with fining-upward fluvial sequences within an initially braided river and then latterly in meandering channels. This process was not smooth, as indicated by a hiatus at the start of the Holocene marked by a peat deposit and another at the Middle Dryas. A renewal of marine transgression followed each event.

Following the Middle Dryas event at 7.5 ka, rivers spread out across the main floodplain, to flow through

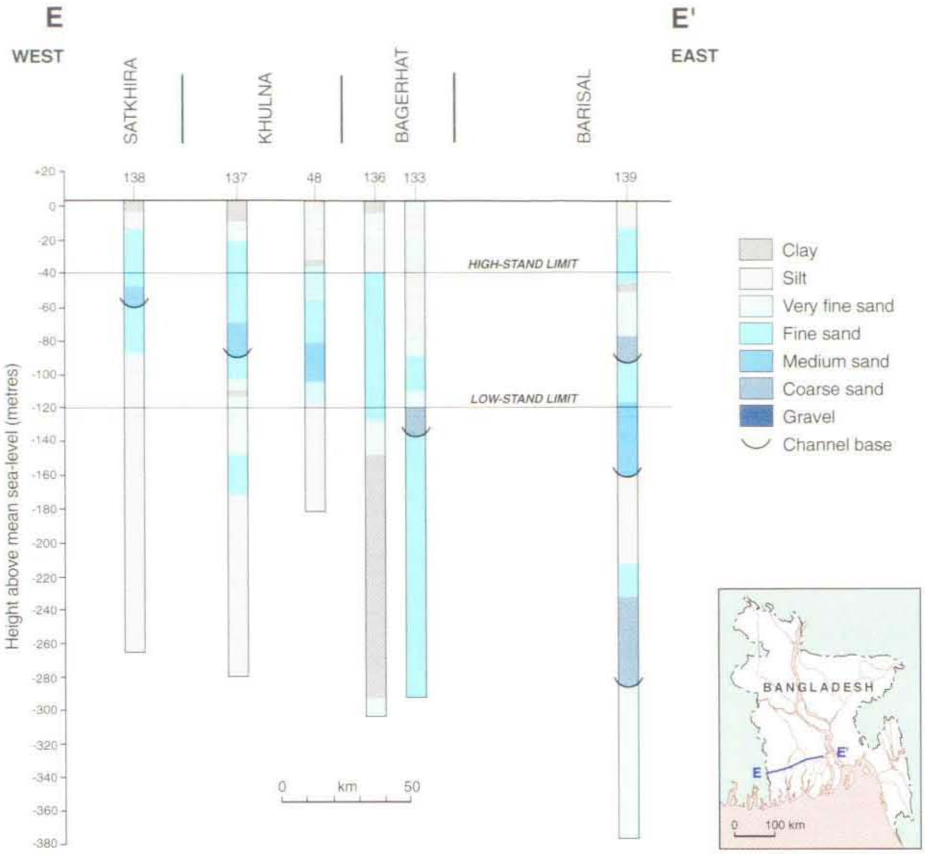


Figure 3.24. Section E: Geological section from Satkhira–Lakshmipur-Feni.

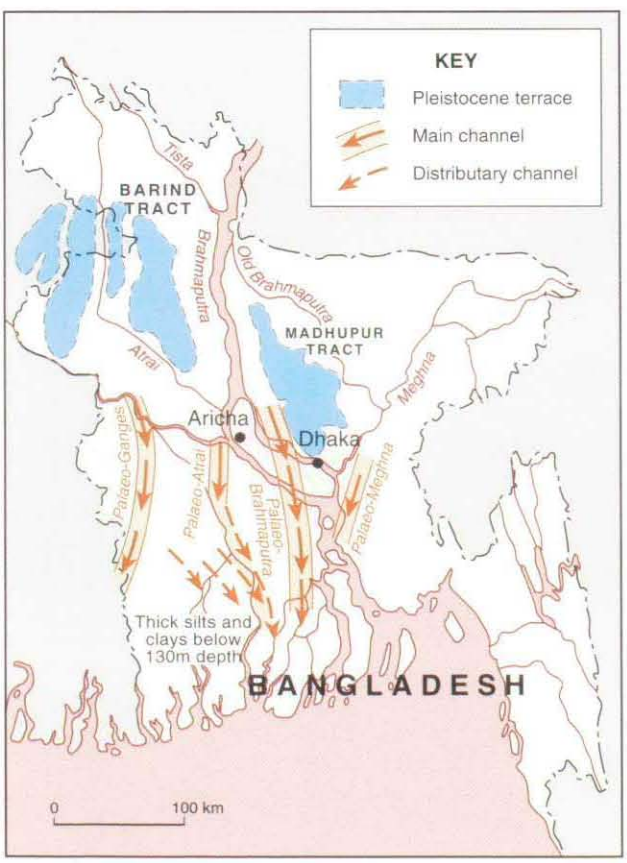


Figure 3.25. Possible main river channels at the time of the last interglacial highstand (120 ka BP).

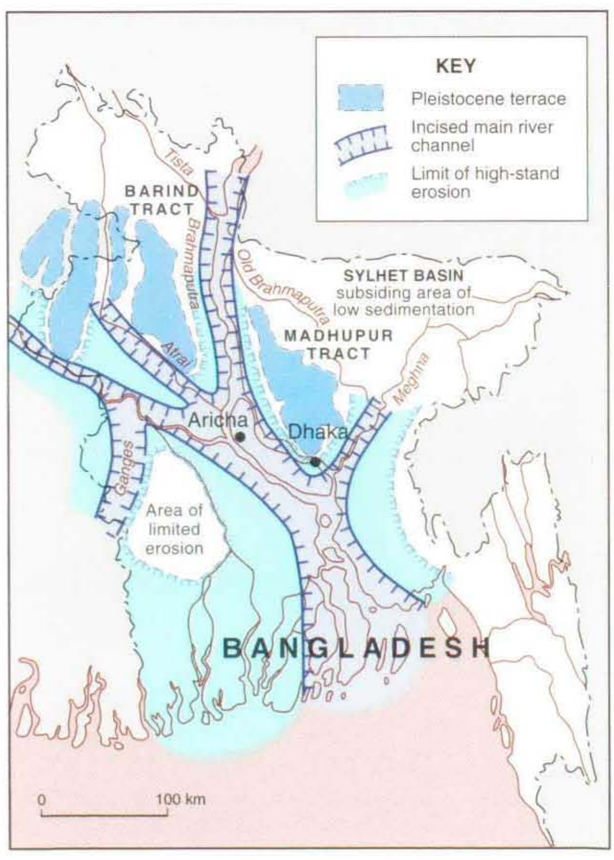


Figure 3.26. Incisional main river channels at the time of the glacial maximum (21 ka BP).

been drilled to about 300 m providing information about stacked-channel deposits that may be used to define areas of subsidence.

An understanding of sediment provenance, micropalaeontology and additional ^{14}C dating of organic carbon deposits, as well as recognition of additional tephra deposits such as the Toba Ash at 74,000 years BP (Acharyya and Basu, 1993) would provide additional much-needed correlation tools.

3.6 CONCLUSIONS

Sediment deposition within the Bengal Basin is controlled by the interaction of tectonic activity and cycles of glacio-eustatic sea-level change.

The Ganges/Brahmaputra/Meghna delta system can be divided into two main areas:

- a stable northern block in which fluvial sediments predominate along the floodplains of the major rivers and in locally subsiding basins;
- a subsiding delta area in which sediments accumulate at a high rate. Subsidence may be of the order of 0.5 mm a^{-1}.

Little sediment is presently accumulating along the channels of the main river floodplains within the fluvial zone. Valleys tend to have been incised, backfilled and then incised again to a similar depth during repeated cycles of glacio-eustatic erosion. Some lateral accumulation takes place. The debris that accumulates within the mountain-front fan delta cones is presumably eroded and removed during the glacial lowstand and early Transgression Tract period. Finer-grained sediments accumulate within the subsiding areas that are normally bypassed by the main channels, receiving sediment intermittently through temporary avulsion of the main channels into these areas, e.g. the Sylhet and Atrai-Gur Basins.

Within the delta area, subsidence above the subduction zone causes the accumulation of sediments in a stacked channel form. The limited evidence available suggests that coarse-grained channel sediments appear to be stable within zones of limited width and that the main rivers tend to be present in an area for several successive cycles of sedimentation, only changing course due to tectonic activity. Hence areas between the main channels are underlain by predominantly very thick sequences of fine-grained sediments, while other areas located adjacent to the main channels are underlain by coarse-grained sediments. It is the main river channels that have been subject to the greatest erosion and deposition.

From hydrochemical and mineralogical evidence to be presented later, the sediments containing groundwaters with the highest concentration of arsenic are the shallow fine-grained highstand deposits with radiocarbon dates generally less than 10 ka old. These are concentrated within the tide-affected areas of the active Ganges, moribund Ganges, lower Meghna and lower Brahmaputra delta areas.

The areas least affected by groundwater arsenic contamination are the Madhupur, Barind and Tripura Tracts that contain older uplifted Pleistocene sediments from which the arsenic has either been flushed by repeated cycles of groundwater throughflow or the geochemical conditions have been such that it was never released. The Tista Fan sediments also tend to be low in arsenic perhaps in part because of the high rate at which water is presently moving through them. They tend to be quite coarse-grained sediments and also appear to have a low concentration of iron oxides with a correspondingly low arsenic load (see Chapter 11).

Brown sediments have never been shown to give rise to a significant groundwater arsenic problem in Bangladesh. The remaining areas consisting of grey, usually micaceous, sediments yield groundwaters with variable arsenic concentrations. Some areas such as the Jamuna-Brahmaputra floodplain and the area underlain by the former main courses of the Ganges in western Bangladesh have exploitable coarse-grained aquifers at depth which may be low in arsenic. Fine-grained sediments at depth underlie other areas such as much of western Bangladesh and the Sylhet Basin. These have little potential for groundwater development and in addition may contain arsenic that could eventually affect adjacent aquifers.

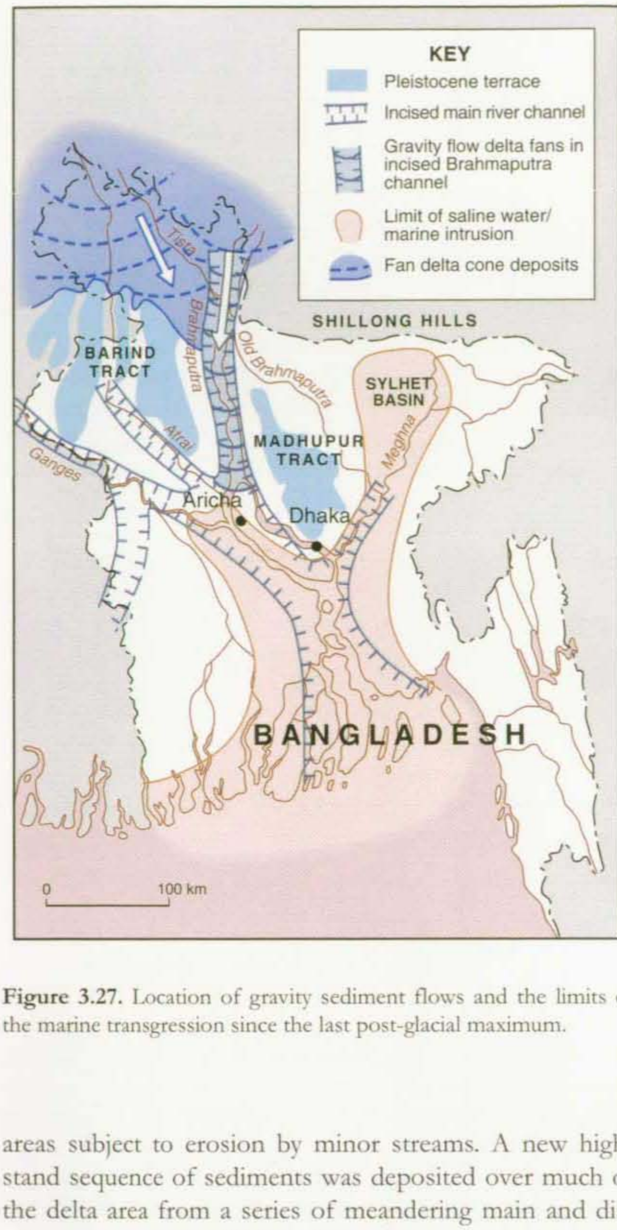


Figure 3.27. Location of gravity sediment flows and the limits of the marine transgression since the last post-glacial maximum.

areas subject to erosion by minor streams. A new highstand sequence of sediments was deposited over much of the delta area from a series of meandering main and distributary channels. Within these low-gradient, high-discharge systems of high sediment load, channel switching and migration were prominent processes. The Brahmaputra appears to have periodically avulsed or shifted away from its present main channel to the east to feed sediment intermittently into the subsiding Sylhet Basin. This basin, an area of accumulation of fine-grained organic-rich sediments, appears to have been inundated with sea water during the post Middle Dryas marine transgression.

Recent tectonic activity and major floods have resulted in marked changes in the courses of the main rivers of the GBM system, e.g. the Tista River switching from the course of the Atrai River to its present confluence with the Brahmaputra at Chilmari some 200 years ago.

According to the available evidence, the area of the GBM can be divided into two primary sediment deposition environments: a continental fluvial environment, and an estuarine delta plain, respectively north and south of the Ganges/Meghna channels.

The continental fluvial environment includes:

- Mountain front fan-deltas – a series of large delta fans formed where major rivers emerge from the Himalayas into the mountain front plain. Such rapidly-aggrading fan cones are composed of very coarse alluvial material and reflect a large-scale switch of river channel courses. These fans formed primary sources of gravity-flow material during the latter stages of valley incision during the glacial maximum when the rivers incised into older, underlying deposits.
- Fluvial floodplains – these mainly occur within fault-controlled valleys that run between Pleistocene terraces or form antecedent valleys that cut through the Pleistocene terraces. Antecedent valleys, such as the Atrai, which cut through the Barind Tract are dependent upon the course of the Tista River. This periodically switches flow direction across the Tista Fan for stream water and sediment supply. The Brahmaputra occupies a straight, fault-controlled course between the Barind and Madhupur Tracts. The Transgressive Tract sediments deposited by the river during successive cycles of glacio-eustatic change appear to have accreted laterally. Therefore there would seem to be little long-term sediment accretion within the fluvial floodplains. Most deposits have been eroded to the same maximum glacial depth during valley incision.
- Pleistocene terraces – the Madhupur and Barind Tracts seem to be elongated uplifted blocks composed of fluvial sediments deposited under glacio-eustatic cyclic conditions. These have been subject to various degrees of weathering and diagenesis. The sediments underlying the western half of the Madhupur Tract are similar in form to those currently being deposited along the Jamuna, whilst those underlying the eastern half are similar to those deposited by the Old Brahmaputra.
- Subsiding basin – in the Sylhet Basin, aggradation has occurred during the highstand period during periodic avulsion of the Old Brahmaputra channel into the low-lying area that has also been affected by marine inundation.

The estuarine delta plain includes:

- Delta plain – this is an area of general subsidence where accumulation of coarse-grained sediments occurred along the main valleys only. Accumulation of fine-grained sediments occurred away from the main channels within areas fed by distributary channels. The stacking of channel sequences, noted from geological logs within this area, are indicative of a subsiding region.
- Subsiding basins – marked subsidence appears to have occurred within swampy areas of the Ganges tidal delta with the deposition of peaty deposits. These depressions occur along the Faridpur Trough and include the Sylhet Basin which may be located above the still active plate subduction zone.
- Sub-lowstand level – deep boreholes provided limited geological data but were sufficient to form a broad picture of earlier cycles of sedimentation, where these were preserved. In the delta area, these boreholes have

Table 4.2. Main aquifer divisions within the fluvial and deltaic areas of Bangladesh

This study	UNDP, 1982	Fluvial area	Delta area
Upper shallow aquifer	Composite aquifer	Grey highstand braided floodplain aquifer (U Dhamrai Fm)	Grey highstand floodplain aquifer of dendritic distributary system
Lower shallow aquifer	Main aquifer	Grey coarse grained transgressive tract/lowstand aquifer in incised channels (L Dhamrai Fm)	Grey transgressive tract/lowstand aquifer within incised channels
Deep aquifers	Deep aquifer	Red-brown Dupi Tila of the Chandina area, and Barind and Madhupur Tracts.	Grey sub-150 m deep aquifers composed of cyclic, vertically stacked aquifers in subsiding delta

- the northern hills and fan deltas;
- the Early to Middle Pleistocene floodplains and terraces;
- the Late Pleistocene to Holocene fluvial floodplains and delta areas.

The main aquifers are:

- Late Pleistocene to Holocene coarse sands, gravels and cobbles of the Tista and Brahmaputra mega-fans and basal fan delta gravels along the incised Brahmaputra channel (Figures 3.5 and 3.27) (MMP, 1977; UNDP, 1982 and MMP 1983);
- Late Pleistocene to Holocene braided-river coarse sands and gravels deposited along the incised palaeo-Ganges, lower Brahmaputra and Meghna main channels (Figures 3.5 and 3.26) (UNDP, 1982; MMP, 1983; Davies et al., 1988; Davies and Exley, 1992; MMI, 1992 and Davies, 1994);
- Early to Middle Pleistocene stacked fluvial main channel medium to coarse sands at >150 m depth in the Khulna, Noakhali, Jessore/Kushtia and western moribund Ganges Delta areas in the subsiding delta basin. Younger Late Pleistocene to Holocene sands contain saline groundwater at the coast (Figures 3.5, 3.17 and 3.26) (Haskoning/IWACO, 1981 and UNDP, 1982);
- Early to Middle Pleistocene red-brown medium to fine sands underlie grey Holocene medium to fine sands in the Old Brahmaputra and Chandina areas (Figures 3.1 and 3.18) (UNDP, 1982; MMP, 1983; MMI, 1992 and Davies & Exley, 1992).
- Early to Middle Pleistocene coarse to fine fluvial sands of the Dupi Tila Formation underlie the Madhupur and Barind Tracts, capped by deposits of Madhupur Clay Residuum (Welsh, 1966). The Madhupur sediments, deposited during several pre-200 ka BP glacio-eustatic cycles in former channels of the Brahmaputra, have undergone several periods of flushing and weathering resulting in the formation of red iron-oxide cements and interbedded grey sticky clays (Figures 3.1 and 3.19) (UNDP, 1982; MMP, 1983 and MMI, 1992). The aquifers that underlie much of the Barind Tract are also of fluvial origin but are thinner with more clay (MMP, 1977).

The main features of the aquifer systems used in this study and the earlier UNDP study are summarised in Table 4.2.

In most of the groundwater studies undertaken in Bangladesh, the aquifer system has not been divided stratigraphically. Conceptual models of hydrogeological conditions, based on simple lithological rather than stratigraphic units, have been used to assess the engineering and hydraulic properties of aquifers and deep tubewell designs to depths of about 150 m. The aquifers have been divided into two groups according to colour and degree of weathering, factors that relate to relative age and aquifer properties. These groups are (Clark and Lea, 1992):

- the grey sediments mainly deposited during the last 20 ka;
- the red-brown sediments mainly older than 100 ka with iron oxide cements and grey smectitic clays.

The three layer aquifer model (after UNDP, 1982 and Barker and Herbert, 1989)

The most commonly used conceptual model which has been applied to understand the effects of recharge and abstraction in these aquifer systems has been the three layer model of UNDP (1982) (Table 4.3). This was subsequently adopted for the National Water Plan assessments.

Barker et al. (1989) developed a three-layer model to analyse detailed test-pumping data obtained from 16 sites in the Dhamrai, Manikganj and Saturia area of the Brahmaputra-Jamuna valley. They concluded that:

- the lower coarser-grained part of the shallow aquifer was in general about 4 times more permeable than the upper shallow aquifer;
- transmissivities obtained by applying the Jacob method of test-pumping data analysis tended to overestimate the transmissivity due to the effect of leakage from the upper layer to the lower layer;

Table 4.3. The three-layer aquifer model (after UNDP, 1982 and Barker and Herbert, 1989)

Layer	Description	Geology	Thickness (m)
1	Upper clay and silt	Upper clay and silt	5–15
2	Upper Shallow or Composite aquifer	Silty to fine sand	1–60
3	Lower Shallow or Main aquifer	Medium to coarse grained sand and gravel	5–75

4 Hydrogeology

4.1 Introduction

The deposits of thick unconsolidated Pleistocene and Holocene alluvial sediments of the Ganges, Brahmaputra and Meghna (GBM) delta system form one of the most productive aquifer systems in the world. Most of this system is fully recharged each year by the annual monsoon rains and floods. Deeper aquifers are exploited within the coastal regions below shallow zones of saline water intrusion. Jones (1985), using data derived from oil and gas exploration, suggested that fresh water may also be available from older Tertiary strata down to depths of 1800 m. The BADC initiated development of groundwater in the 1960s to enable dry season irrigation of cereals. Study of the hydrogeology and groundwater resources of Bangladesh was begun in the 1970s by BWDB under the guidance of the UNDP. UNICEF, recognising that large quantities of groundwater existed at shallow depth, advocated the installation of large numbers of hand-drilled boreholes equipped with suction pumps. Some 6–11 million hand-pumped tubewells are estimated to have been installed to date, enabling the dramatic increase in the percentage of the population with access to 'safe' drinking water during 1988-98 (Table 4.1). The maximum depth to which tubewells can be drilled using traditional methods without a power rig is shown in Figure 4.1.

Detailed investigations of the geology and hydrogeology of the Quaternary alluvial aquifers were initiated during the 1980s. Many of the available data were collected during major irrigation projects undertaken in the north-western, north-central and north-eastern parts of Bangladesh. During these projects, emphasis was placed upon understanding the physical properties of the aquifers and the design of deep tubewells. The nature of the data collected reflected the need to avoid screen blockage, the reduction of borehole specific capacity and formation collapse due to sand pumping – problems that had caused the failure of large numbers of similar boreholes in Pakistan.

Table 4.1. Percent of the population of Bangladesh with access to safe drinking water

Year	Urban	Rural	Total	Reference
1983	29	43	42	UNICEF (1987)
1983-86	29	43	41	UNICEF (1988)
1985-87	24	49	46	UNICEF (1990)
1985-88	24	49	46	UNICEF (1991)
1988-91	82	81	84	UNICEF (1994)
1990-1998	99	95	95	UNICEF (2000)

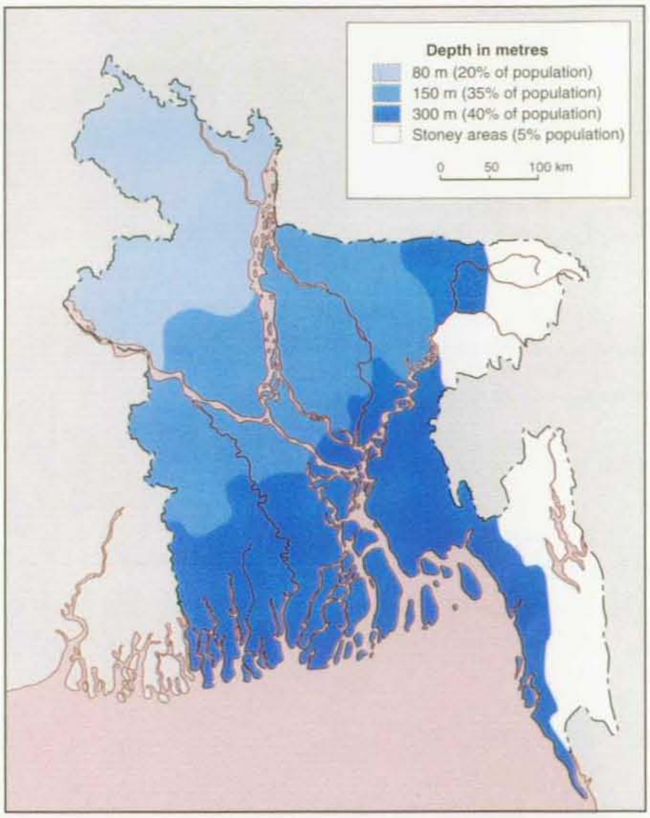


Figure 4.1. Maximum depth of drilling possible without a powered rig (NWMP, 2000).

At present, the extensive abstraction of groundwater for irrigation and domestic water supply is being questioned because of its extensive contamination with arsenic.

The GBM is a large, low-lying fluvial and tidal delta area whose surface dips southward away from a series of fan deltas located along the Himalayan Main Boundary Fault zone (Figures 3.1). The main channel of the Brahmaputra falls 20 m in 250 km between its confluence with the Tista River at Kurigram and its confluence with the Ganges at Aricha (Thorne et al., 1993). Patterns of rainfall, runoff and recharge are outlined below, along with the aquifer properties. These provide some indication of the development potential of the shallow and deep aquifer systems. The variation of groundwater level is discussed with reference to seasonality. Conceptual models of parts of these aquifer systems are also presented.

4.2 Aquifer distribution

The principal geomorphological units and depositional environments of Bangladesh have been summarised in Chapter 3. The landforms of the country can be divided into three main types:

Table 4.4. The four-layer aquifer model of Bangladesh (after EPC/MMP, 1991)

Layer	Description	Layer Geology	Thickness (m)
1	Upper Aquitard	Upper alluvial sequence; micaceous silts and fine sands	5–25
2	Upper Shallow Aquifer	Upper alluvial sequence medium to fine sands	20–40
3	Lower Aquitard	Lower alluvial sequence clays and very fine sands	2–10
4	Lower Shallow Aquifer	Lower alluvial sequence medium to coarse sands and gravels	25–60

- the results obtained were consistent with hydraulic conductivities of aquifer samples (taken during drilling) based on a simple falling-head apparatus (Davies and Herbert, 1990).

A more flexible, four-layer model was developed by EPC/MMP (1991) so that vertical head differences could be taken into account (Table 4.4). The subdivision of Bangladesh aquifers into three or four layers has proved adequate for assessing the water balance for aquifers in much of the country.

4.3 RAINFALL, RUNOFF AND RECHARGE

The headwaters of the major river systems that combine to form the GBM system mainly drain parts of the Himalayan mountains and plains of India, Nepal and southern Tibet. Only 7.5 per cent of their combined catchment area of 1.5 million km^2 lie in Bangladesh. The mean annual rainfall in the headwaters ranges from 300 mm in Nepal to 11,615 mm at Cherrapunji on the Meghalaya Plateau. Within Bangladesh, the mean annual rainfall rises from 1,250 mm in the western central region to more than 5,000 mm in the north-east. Bangladesh experiences a tropical monsoon climate with mean monthly minimum temperatures from 10–12°C in January to 20–25°C in June to August, and mean monthly maximum temperatures from 25–28°C in January to 32–35°C in June to August. Humidity and temperature increase during March to May followed by a hot and very wet period from June to October.

Monthly evapotranspiration rises from 70 to 90 mm in the coolest month of January to about 180 mm from March to May and stabilises at between 115 and 145 mm during the monsoon, before falling in November (Table 4.5). Long-term monthly average rainfall data for the four principal cities show strong seasonal patterns. Up to 85% of the annual rainfall occurs during the May to September monsoon. This coincides with the peak inflow of the major rivers and annual flooding (Table 3.1). Less than 5% of the mean annual rainfall occurs during the five-month dry season between November and March (Table 4.5). During this period, when there is almost zero effective rainfall, agriculture is not sustainable without irrigation. The need for water in these critical months has been the driving force behind most of the groundwater development programmes from which much of the knowledge of the regional hydrogeology has been gained.

The degree of flooding is very variable. Catastrophic floods were recorded during 1987 and 1988 (Table 4.6) and more recently in 1998. Flooding in Bangladesh has up to three components depending on the location:

- Tidal rise with the onset of the monsoon causes back-up of the main rivers in the delta resulting in water level rise during the first part of the monsoon. The tidal height may reach a maximum of 4.5 m, high enough to flood nearly 33% of the delta (Miah, 1988).
- River flows increase and water levels rise during March to May, initially affecting water levels in the floodplains adjacent to the main channels. During April, the Brahmaputra starts to rise with snow melt from the Himalayas and the Meghna rises with pre-Monsoon rainfall

Table 4.5. Long term mean monthly rainfall and potential evapotranspiration for four cities in Bangladesh (Rashid, 1991)

Month	Dhaka		Chittagong		Rajshahi		Khulna	
	Rainfall 1953–77	ET_o	Rainfall 1947–77	ET_o	Rainfall 1947–78	ET_o	Rainfall 1947–78	ET_o
January	9	89	7	73	13	72	8	88
February	20	110	15	113	10	93	19	107
March	55	169	53	153	29	135	36	150
April	114	188	119	178	81	170	93	162
May	265	188	242	177	266	168	184	171
June	375	133	589	133	520	133	350	115
July	463	144	759	146	439	134	393	118
August	323	140	547	141	319	129	286	113
September	276	128	279	136	279	123	280	112
October	166	120	60	125	160	110	161	120
November	29	99	61	105	9	89	25	103
December	0	94	10	93	1	73	15	88
Annual total	*2095*	*1602*	*2741*	*1573*	*2126*	*1429*	*1850*	*1447*

Table 4.6. Flooded areas 1954-1988 (from Miah, 1988 and Brammer, 1990a)

Year	Flooded area (km²)	% total land area flooded
1954	36920	25.6
1955	50700	35.2
1956	35620	24.7
1960	28600	19.8
1961	28860	20.0
1962	37440	26
1963	43160	29.9
1964	31200	21.6
1965	28600	19.8
1966	33540	23.3
1967	25740	17.8
1968	37440	26
1969	41600	28.8
1970	42640	29.6
1971	36475	25.3
1972	20800	14.4
1973	29900	20.7
1974	52720	36.6
1975	16590	11.5
1976	28418	19.7
1977	12548	8.7
1978	10832	7.5
1980	33077	22.9
1982	3149	2.1
1983	11112	7.7
1984	28314	19.6
1985	11427	7.9
1986	4589	3.1
1987	57491	39.9
1988	82000	56.9

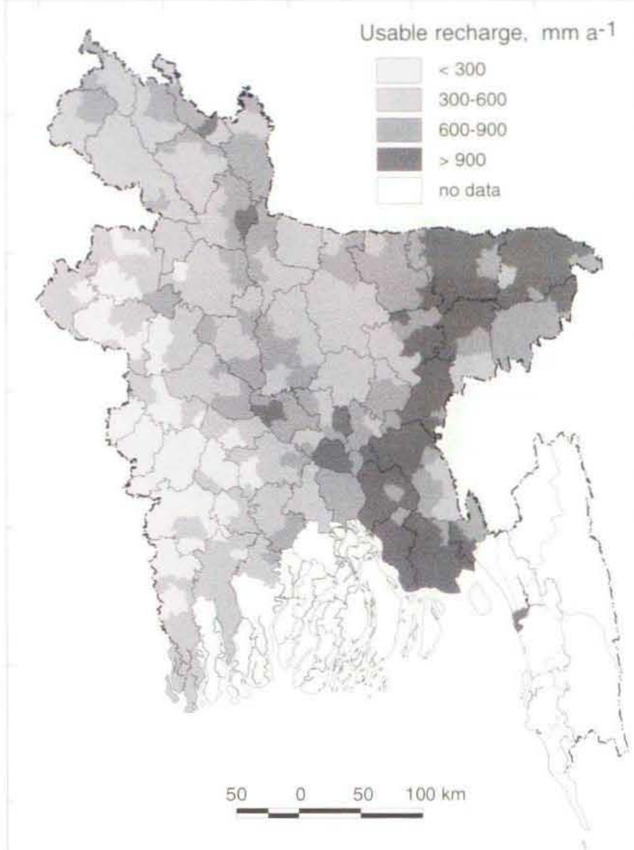


Figure 4.2. Actual recharge across Bangladesh (from DPHE/BGS/MML, 1999).

from the Shillong Hills. During May, the Ganges rises with snow melt water. With the onset of the monsoon rains proper in June-July, all three rivers rise rapidly, the Brahmaputra peaking in July-August and the Ganges in August-September. All river levels then fall rapidly during September to November following the end of the monsoon. Floodwaters on the floodplains drain away slowly during the first part of the dry season in November-December (Brammer, 1990a).

- Rainfall starts with heavy pre-monsoon storms during April–May, accumulating in depressions. The main monsoon rainfall of June-August is increasingly ponded on the land by the rising water levels and is accompanied by infiltration from the adjacent rivers. Thereafter, groundwater levels rise to above ground surface (Brammer, 1990a). The rate of direct recharge of rainwater is dependent upon soil type with the slowest recharge taking place through the Madhupur Clay Residuum on the Pleistocene Tracts.

Estimates of potential and actual recharge can be made using the specific yield of near-surface sediments and the wet-dry seasonal difference in groundwater levels. It is important to distinguish between actual and potential recharge. The former is the quantity of water that infiltrates to the water table. This has normally been estimated on an annual basis as a volume or as an equivalent depth of water. The water table may rise to the ground surface during the monsoon so that all storage capacity is used up and no more water is able to infiltrate. This 'aquifer full' condition means that further rain or flood water which would have infiltrated instead becomes 'rejected recharge' or run off and adds further to surface flooding. The potential recharge is the quantity, based on climatic factors, which could have infiltrated had vacant storage capacity existed, and is thus the sum of actual and rejected recharge. Within the Pleistocene Terrace areas, recharge occurs via incised antecedent drainage channels that cut through the near-surface clays into the underlying sandstones.

The most systematic description of recharge in Bangladesh is that provided by the MPO Potential Recharge Model (DPHE/BGS/MML, 1999). The model is *upazila*-based and performs an annual water balance for the soil zone using long-term meteorological and agricultural data. A synthetic flood hydrograph is generated and applied across the range of soil types. Eighteen crop types, twelve of which are irrigated and four rainfed, are considered in the model. The long-term average potential recharge is estimated, and then a number of deductions are made to take account of factors such as baseflow to rivers to derive what is termed 'actual recharge'. The distribution of actual recharge across the country is shown in Figure 4.2. The

Table 4.8. Relationship between average aquifer test results and geological formation

Aquifer Type/District or Region	Transmissivity (m^2 d^{-1})	Storage coefficient	Ref
Deep Aquifer semi-confined by Upper Shallow Aquifer (Chandina Formation)			
Comilla District	1200	1.3×10^{-3}	1
Noakhali District	617		6
Sylhet Floodplains	460	5.6×10^{-4}	4
Lower Shallow Aquifer (Dhamrai Formation)			
Dhaka (Dhamrai)	3480	8.5×10^{-4}	7
Manikganj	4211	3.9×10^{-4}	7
Tangail	2803	2.9×10^{-3}	1
Upper Shallow Aquifer (Highstand Alluvium)			
Bogra District	2380	1.1×10^{-3}	1
Dinajpur District	2755	2.8×10^{-3}	1
Nawabganj	3172	6.7×10^{-3}	9
Pabna District	4316		1
Rangpur	4384	2.6×10^{-3}	1
Jessore District	3660	1.9×10^{-3}	1
Kushtia District	3780	2.0×10^{-3}	1
Deep Aquifer (Old Deep Aquifer Alluvium)			
Khulna District	3100	1.0×10^{-3}	5
Deep Aquifer (Dupi Tila Formation)			
Dhaka City	1333	8.3×10^{-4}	8
Madhupur Tract	1161	1.7×10^{-3}	1,3,4
Sylhet Hills	249	1.3×10^{-5}	2
Barind Tract	1835	1.6×10^{-2}	9

References: 1 UNDP (1982); 2 HTS/MMP (1967); 3 MMP/HTS (1982); 4 MMI (1992); 5 Rus (1985); 6 MMI (1993); 7 Barker et al. (1989); 8 EPC/MMP (1991); 9 Ahmed (1994).

Table 4.9. Correlation of lithology with hydraulic conductivity and specific yield (MMP/HTS, 1982; Davies and Herbert, 1990)

	Characteristic hydraulic conductivity (m d^{-1})		Characteristic specific yield (%)	
Lithology	Terraces	Flood-plains	Terraces	Flood-plains
Clay	—	—	0.5	3
Silt	—	0.4	4	5
Very fine sand	8	—	—	—
Fine sand	13	12	8	16
Fine – medium sand	17	26	—	—
Medium – fine sand	21	43	—	—
Medium sand	25	57	20	20
Medium – coarse sand	34	61	—	—
Coarse – medium sand	38	63	—	—
Coarse sand	46	95	25	25
Gravel (clayey)	25	40	30	30

mination of specific yield for the upper shallow aquifer. Some results have been obtained by test pumping (Welsh, 1977; Pitman, 1981; Davies et al., 1988), and correlations have also been made between specific yield and lithology (Table 4.9).

Measurements of hydraulic conductivity were undertaken on a representative series of 150 grey sediment samples. These were obtained during the drilling of test boreholes by reverse circulation using a simple falling-head permeameter (Table 4.8; Davies and Herbert, 1990). The results were correlated with aquifer parameters derived from the analysis of detailed yield/drawdown and recovery test-pumping data and found to be valid (Barker et al., 1989). Such correlations, between lithological descriptions and aquifer parameters, have since been used successfully in water-resource planning and tubewell design. Table 4.9 provides an indication of the hydraulic conductivity values obtained empirically from specific capacity (yield-drawdown) and lithological information accumulated in BADC deep tubewell projects. In some parts of the country, the permeabilities of grey sands are about twice those of brown sands. It is now believed that most of the grey sands belong to the Dhamrai Formation and most of the brown sands to the Dupi Tila. The brown coloration of the latter is indicates weathering by oxidation and leads to reduced permeability. However, a simple correlation of permeability and colour cannot be applied to all areas.

4.5 GROUNDWATER ABSTRACTION AND TUBEWELLS

Groundwater abstraction is from a large number of hand-pump tubewells (HTWs) for domestic supply, shallow and deep tubewells (STWs and DTWs) for irrigation and public water supply (PWS) boreholes for domestic supply in cities and district towns. There are also an increasing number of hand-pump deep tubewells (HDTWs). 'Deep' here refers to the depth of the screened interval – the water table is invariably shallow which means that a simple suction hand pump can still be used even for these deep well.

Considerable uncertainty surrounds the exact number of the various types of well present in Bangladesh but estimates are: HTW, 6–11 million; STW, 0.5 million, and DTW, 55,000. Irrigation wells (STWs and DTWs) are typically shallow (<100 m) with multiple screens in an unconfined aquifer. The water level is commonly near the surface and within the limit of suction pumps (7 m). The pump intake is set above the screen level, but the screens are set lower (typically 30 m bgl for STW and 100 m bgl for DTW), depending on where the appropriate coarse lithology is encountered. Pumping of this type of well causes vertical gradients to be developed as the well induces flow from the water table to the well screen. This depletion of the water table is replenished during the wet season as long as total abstraction does not exceed the available resources.

Deep hand-pump tubewells are currently being installed by DPHE and others in areas with arsenic-contaminated shallow groundwaters. Their major disadvantage is the cost, usually at least ten times greater than for a typical HTW.

Shallow tubewells (STWs) of 15 L s^{-1} (0.5 cusecs) capacity are constructed using 75 mm or 100 mm diameter pipe and screen. Well losses due to uphole friction loss can be large and have a marked effect upon the specific capacgreatest scope for recharge is into the coarse-grained sediments that infill the incised channels along the Jamuna and Meghna valleys, while the least is into the fine-grained sediments that underlie the western districts of Chuadanga and Meherpur. In general, the rate of recharge through the poorly permeable clays that cap the Pleistocene terraces is less than through the unconsolidated micaceous silts on the river floodplains because of lower hydraulic conductivities and a lesser tendency to flood.

4.4 AQUIFER PROPERTIES

The locations of the main aquifers in Bangladesh is indicated by the distribution of average transmissivities (UNDP, 1982) (Figure 4.3). Aquifer transmissivity is related to sediment age, grain size and degree of weathering (Table 4.7).

Estimates of aquifer hydraulic conductivity and transmissivity have been obtained from:

- about 500 pumping tests conducted on deep tubewells with observation piezometers (Pitman, 1981; UNDP, 1982);
- 7000 commissioning tests on BADC single production deep tubewells (MMP, 1977; MMI, 1992);
- detailed test pumping and flow logging of 16 experimental boreholes with observation piezometers (Davies et al., 1988)
- tests on municipal tubewells (Welsh, 1966; Haskoning/IWACO, 1981 and EPC/MMP, 1991).

These datasets can be seen as complementary. The aquifer tests conducted with observation boreholes provide detailed insights into the groundwater-flow regime in the vicinity of wells and accurate aquifer parameter determinations. The simpler tests undertaken on a large number of single production deep tubewells, when analysed using the Logan approximation method, provide a broad geographical distribution of aquifer characteristics. These results have been interpreted to give transmissivity values from which estimates of hydraulic conductivity have been derived after making assumptions about the degree of partial penetration and/or the relationship between screen length and effective aquifer thickness. Table 4.8 summarises these aquifer test results.

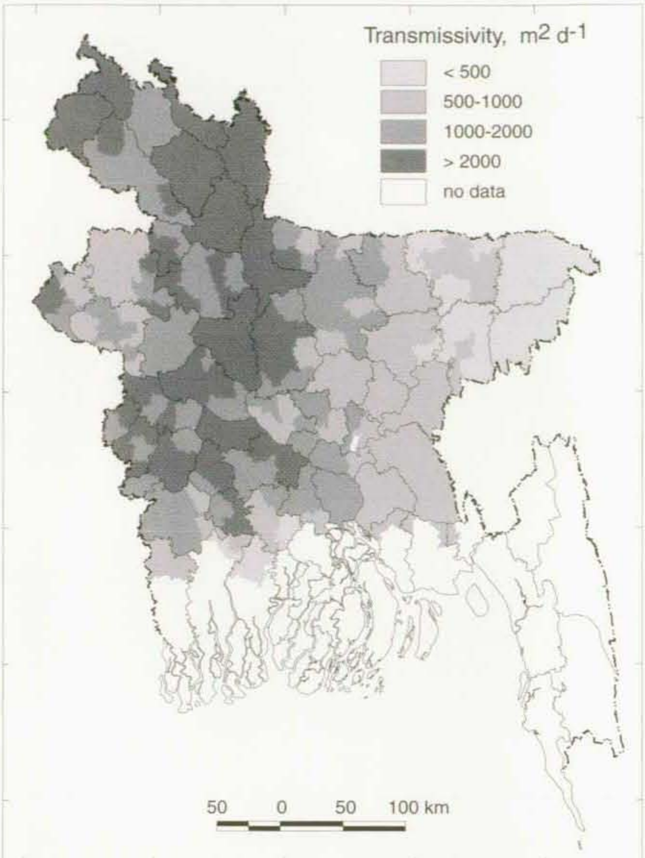


Figure 4.3. Map of the variation in aquifer transmissivity across Bangladesh.

Leaky to confined aquifer storage coefficients have been determined from many pumping tests undertaken on the Lower Shallow Aquifer and the Deep Aquifer, the latter in the Pleistocene Tract and Old Brahmaputra areas. Average values fall within the narrow range of 1.3×10^{-5} to 6.7×10^{-3} (Table 4.8). The storage coefficient determines the short-term water-level response close to pumping wells but over periods of weeks and months, most aquifers in Bangladesh exhibit either unconfined or semi-confined responses. Also, long-term water-level decline is found within the unconfined upper shallow aquifer over large areas. As a consequence, interest has focused on the deter-

Table 4.7. The main aquifers in Bangladesh, their lithologies, relative ages and transmissivities (UNDP, 1982)

Aquifer	Lithology	Age	Transmissivity ($m^2\ d^{-1}$)
Brahmaputra - Tista Fan and Brahmaputra basal gravels	Grey coarse sand, gravel and cobbles	Late Pleistocene and Holocene	3500–7000
Ganges, Lower Brahmaputra and Meghna main channels	Grey coarse to medium sands and gravel	Late Pleistocene and Holocene	3000–5000
Deeper cyclic aquifers of main delta and coastal areas	Grey medium to coarse sands	Early to Mid Pleistocene	1000–3000
Old Brahmaputra and Chandina fluvial aquifers and fine silts of the Sylhet basin	Red-brown medium to fine-grained weathered sands	Early to Mid Pleistocene (Dupi Tila?)	300–3000
Madhupur and Barind Tract weathered fluvial aquifers beneath surface clay residuum	Red-brown to grey medium to coarse sands and interbedded clays	Early to Mid Pleistocene (Dupi Tila?)	500–3000

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Table 4.10. Approximate wet season regional groundwater gradients (BWDB, 1993)

Location	Gradient (m km^{-1}) Maximum	Gradient (m km^{-1}) Minimum
North	2	0.5
Central	0.5	0.1
Southern	0.1	0.01

ity of the suction pump used as the pumped water approaches about 5 m below ground surface. Deep tubewells (DTWs) are constructed with 36 mm upper well casing and 15 mm diameter or 20 mm diameter lower well casing and screen. These borehole are equipped with deep-set shaft drive turbine pumps powered by surface-mounted diesel or electric motors to produce 58 L s^{-1} of groundwater from the main shallow aquifer. The pumping efficiencies of such boreholes can be high. Similar designs of boreholes and pumps are used for supply of groundwater to larger towns where dry-season drawdowns can be large, as in Dhaka and Joydebpur.

Well design and construction in Bangladesh can have a marked effect on groundwater use over the dry season. Typically, the shallow water table combined with deep set screens in boreholes means that water has to be drawn tens of metres up a borehole. This causes large frictional losses and can lead to significant reduction of well use over an irrigation season. For example, hand pumps built using 38 mm diameter casing can cause very high frictional losses in the well and create 1–2 m more drawdown. The large frictional losses can increase the pumping head beyond the practical limit of suction pumps (c. 7 m) and result in the well being unusable for the rest of the dry season. This has led to the use of the more expensive force-mode Tara pump in some areas, particularly north-western Bangladesh.

4.6 GROUNDWATER LEVELS

The water table or piezometric surface within soft unconsolidated alluvial sediment aquifers of the large, low-lying and gently sloping GBM floodplain and delta system is invariably shallow allowing easy installation of cheap hand-drilled tubewells. Regional hydraulic gradients are very low, reflecting the low topographic gradients (Table 4.10). In the southern coastal areas, the piezometric surface in the deep aquifer is approximately 1.0–1.5 m above mean sea level and so in low lying areas, the deep wells can be artesian.

In addition to the influence of the strongly seasonal rainfall, runoff and recharge, other features of the Bangladesh aquifer systems are:

- The maximum depth to groundwater is very similar in all years despite significant differences in demand for irrigation water. Increased abstraction has lowered dry-season water levels and drawdowns with succeeding years especially within the less transmissive 'brown' sediments.
- The aquifers are effectively full from August to October, so that any excess potential recharge is rejected by the groundwater system during the latter part of the monsoon season.
- Although peak groundwater levels vary between years, they tend to be the same at the start of the irrigation season in January. This suggests that groundwater levels are controlled by local base levels in the rivers and that any additional recharge during the monsoon is lost as increased baseflow in November and December.
- In areas of high abstraction from deep aquifers with brown sediments, groundwater levels often fail to recover fully by the start of the following dry season indicating possible over-abstraction, as in Dhaka and Joydebpur.

Groundwater levels are recorded at a nationwide network of piezometers maintained by BWDB. The system was established with the assistance of the UNDP. Currently 1230 water levels are recorded weekly (every Monday at 6.00 a.m.). All of these are for shallow wells. In addition, BWDB maintain 20 autographic water level recorders for daily records. Some of the above data are available on a PC database (Microsoft Access) but the data have not yet been fully verified. DPHE also record wet- and dry-season water levels with a one-per-union network of approximately 4400 wells.

As mentioned above, groundwater levels are affected by tidal surges due to cyclones and monsoons (southern half of the delta), groundwater abstraction and increased river flow due to melt waters from the Himalayas and from monsoon rainfall.

The decline in water levels due to abstraction for irrigation during the dry season through the use of shallow and deep tubewells can be significant, especially in areas of thick near-surface silt and very fine sand layers with low specific yields. In low-lying areas of increased annual abstraction for irrigation, as in the Jamuna and Ganges delta floodplains, shallow tubewell use may be halted due to decline of water levels below the suction level before the end of the dry season. In such areas, crop irrigation has to be completed using water from deep tubewells. Such a regional decline in water level renders many hand-operated suction pumps inoperative towards the end of the dry season.

In the Madhupur and Barind Tracts, where water levels are relatively deep, only DTWs can be used to supply groundwater for irrigation. Tara hand pumps are now used for domestic supply in areas with deeper water levels. In the Old Brahmaputra floodplain and Chandina areas, both shallow and deep tubewells are used, but drawdowns in the less permeable lower aquifer can be much greater than those in the upper highstand aquifer.

Examples of hydrographs (Figure 4.4) from the main aquifers are used to indicate the annual amplitude of seasonal water-level change, the effects of annual recharge and the effects of increased abstraction for irrigation or urban supply.

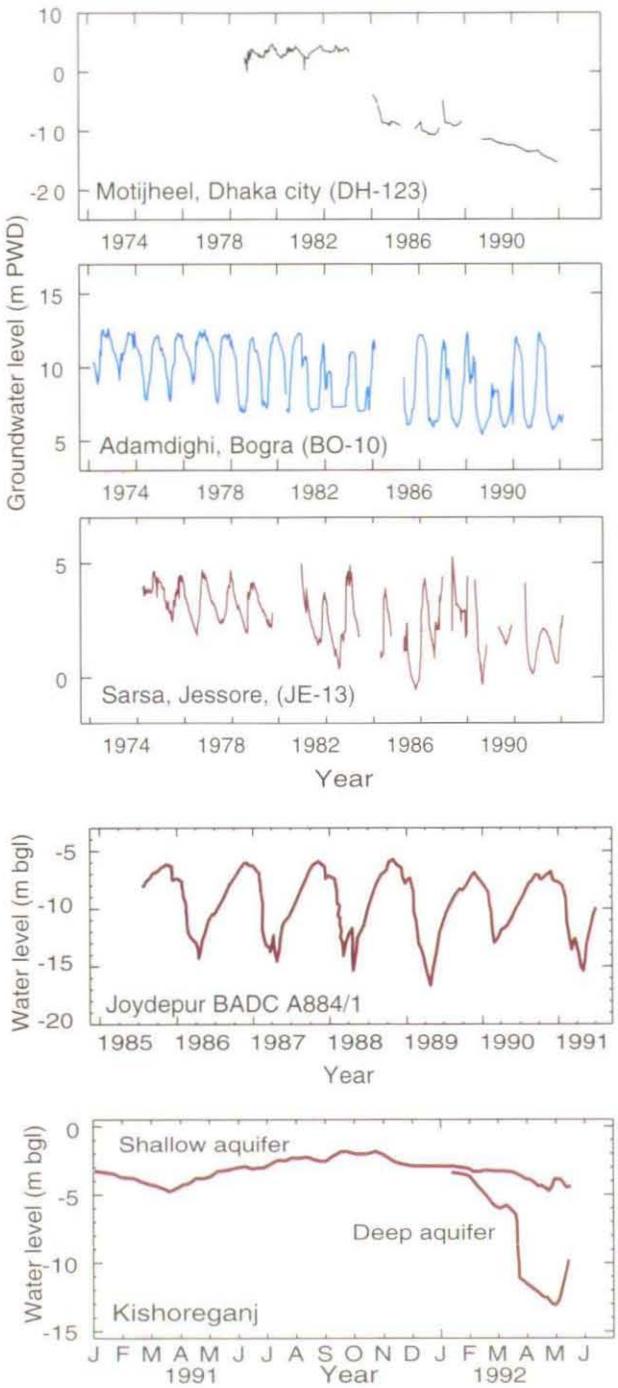

Figure 4.4. Examples of hydrographs from selected sites in the main aquifers of Bangladesh.

Dhamrai, Dhaka District

At Dhamrai, an autographic water-level recorder was installed in the lower shallow or main aquifer of the Brahmaputra floodplain. Seasonal water-level fluctuations of about 5 m have been recorded. Dry-season base water levels are about −10.0 m below datum, whereas wet season peaks increase from −5.5 m in 1989 to −4.0 m in 1991. Base levels in 1989 and 1990 were reached at the end of April whereas base level was reached during mid March in 1991, indicative of early rains or the early onset of the monsoon during that year. In all three years, peak levels were reached between mid July and early October. The amplitude of annual fluctuations indicates that suction mode hand pumps and shallow tubewells can be used in this area.

Mothijheel, Dhaka City

Dhaka draws its domestic water supplies from a series of deep tubewells installed within the Dupi Tila aquifer. The volume of groundwater abstracted has grown rapidly over the last 20 years. The groundwater from the Dupi Tila aquifer beneath Dhaka is free of arsenic contamination. The monitoring point at Mothijheel was changed in 1983 from a shallow dug well in the Madhupur Clay to a piezometer screened at 30 m depth in the Dupi Tila Formation. Back projection of the piezometer trend suggests that the Dupi Tila aquifer became unconfined in the early 1970s, while a perched water table was maintained in the Madhupur Clay, presumably from sources of urban recharge such as leaking water mains, storm drains and sewers. A seasonal fluctuation of 2 m has been recorded within the perched aquifer. Within the Dupi Tila aquifer, a 1 m seasonal fluctuation is recorded. Between 1979 and 1989, the water level has declined by 10 m at an average of 1 m a^{-1}, indicative of over abstraction from the Dupi Tila aquifer below Dhaka.

Adamdighi, Bogra District

The hydrograph from Adamdighi is representative of an area of intensive irrigation using groundwater from highstand shallow aquifer deposits which are not affected by arsenic contamination. Between 1980 and 1993, irrigation increased from about 10% to practically 100% of the irrigable area as a result of the installation of large numbers of private shallow tubewells. During 1972–1978 the annual seasonal fluctuation of water level was 3.5–4.5 m. Between 1978–1989 the annual seasonal fluctuation increased to 4.5–6.5 m. Between 1989–1993, the base level of seasonal fluctuation has remained at 6.5 m below aquifer full levels. During years of heavy rainfall, recharge is achieved to give the aquifer-full level at 12.5 m above datum. However, during years of low rainfall, water levels fail to recover to aquifer-full levels, notably during 1989 when water levels recovered to only 8.5 m above datum, some 4 m below the aquifer-full level. Dry-season base levels continued to decline during the 1993–2000 period and so shallow tubewell operation in this area will now be difficult during the latter part of the dry season. The zone of intermittent aeration reaches down to about 6.5 m bgl.

Sarsa, Jessore District

The hydrograph from Sarsa is representative of an area of intensive irrigation within the moribund Ganges delta area where groundwater is badly affected by arsenic contamination. About 77% of the irrigable area was irrigated using groundwater of which 70% of this was obtained from shallow tubewells. The monitoring site was changed from a dug well to a piezometer in 1988. The natural seasonal fluctuation is about 3 m from an aquifer-full level of 5 m above datum. The piezometer hydrograph is very peaky in nature with dry season base levels reaching –0.5 m below datum. Wet season peaks are normally reached at the end of October, but frequently do not recover to the aquifer-full level during years of low rainfall. Thus, the zone of intermittent aeration reaches down to 6 m below ground level indicating that shallow tubewells and hand-pumped boreholes may become inoperative during the latter part of the dry season, especially where screens are deep-set and friction losses during pumping become significant.

Joydebpur, Gazipur District

At Joydebpur, an autographic water-level recorder has been installed within the Dupi Tila aquifer of the southern Madhupur Tract. The hydrograph recorded seasonal water level fluctuations of the order of 8–10 m. Dry-season base water levels are about –12 to –16 m below datum whereas wet-season peaks reached about –6 m below datum during 1985 to 1988, with a decrease to –7 m below datum during 1990 and 1991. Base levels in 1985 to 1989 and 1991 were reached in mid-April whereas base level was reached in mid-March in 1990, indicative of early rains or the early onset of the monsoon during that year. Peak levels were reached by September during 1985 to 1989, but were only reached by the end of October in 1990 and 1991. The amplitude of annual fluctuations indicate that suction mode hand pumps or shallow tubewells cannot be used in this area.

Kishoreganj, Kishoreganj District

The hydrographs (Figure 4.4) show water levels from a shallow piezometer in the highstand upper shallow aquifer and a deep piezometer in the underlying Dupi Tila aquifer. Within the upper shallow aquifer, water levels fluctuate between a dry-season level at –5 m bgl and September–October wet season peak at –2 m bgl. The deep aquifer water level declines to –13 m bgl during the dry season. These levels indicate that shallow tubewells and hand pumps can be installed within the upper shallow aquifer, whereas only deep tubewells can be used for abstraction from the Dupi Tila aquifer. Arsenic contamination occurs sporadically within the shallow aquifer. Therefore contaminated water may be drawn down into the underlying Dupi Tila aquifer by pumping.

The hydrographs from Adamdighi, Sarsa and Dhamrai reflect the concern that high-density usage of STWs and DTWs could lower water levels in various parts of Bangladesh sufficiently to affect operation of HTWs during the late dry season. UNICEF and DPHE are now installing Tara pumps in such areas where late dry-season water levels lie at 6 m or more bgl (Figure 4.5). Maximum depths to groundwater reflect the seasonal variation, except where there is significant drawdown due to over abstraction in urban parts of Dhaka and Chittagong. The influence of geology and geomorphology is shown by the deeper water levels found in the Madhupur and Barind Tracts.

In summary, water-level fluctuations at a particular site reflect the aquifer, its proximity to major rivers, and abstraction rates. Grey alluvial sediments, making up the upper and lower shallow aquifers, have increased drawdowns due to irrigation abstraction but are fully recharged during the annual monsoon.

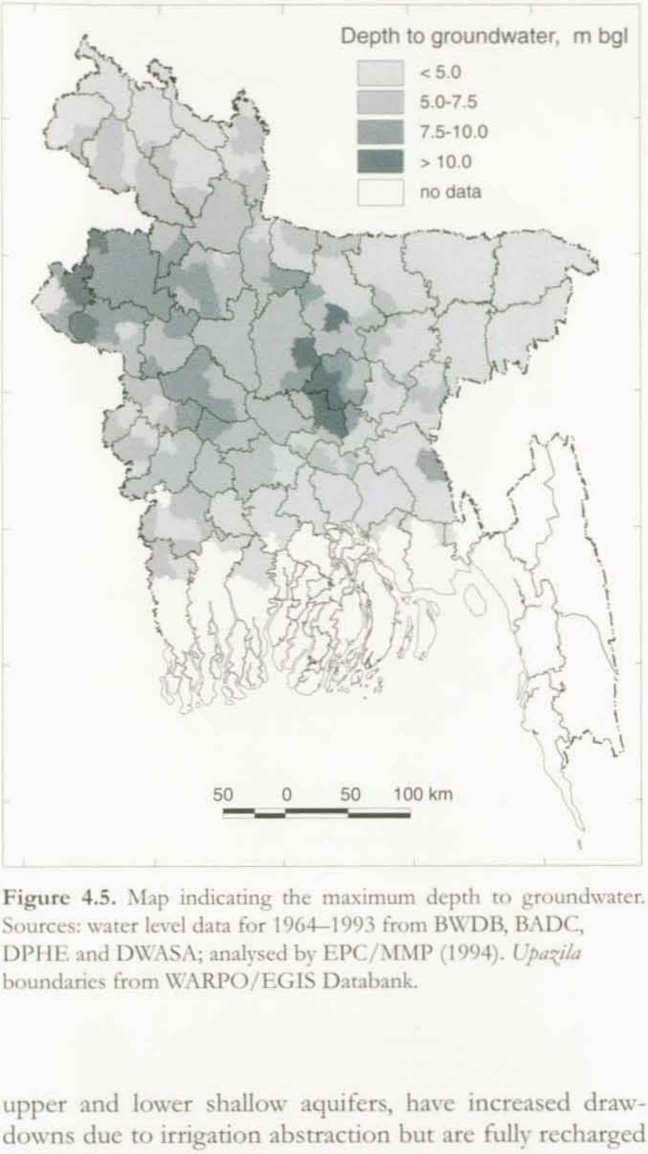

Figure 4.5. Map indicating the maximum depth to groundwater. Sources: water level data for 1964–1993 from BWDB, BADC, DPHE and DWASA; analysed by EPC/MMP (1994). *Upazila* boundaries from WARPO/EGIS Databank.

Grey delta sediments are finer-grained than alluvial sediments and therefore have a lower hydraulic conductivity. Irrigation abstraction therefore causes a greater drawdown than for the alluvial aquifers. During years with a relatively 'dry' monsoon, full recovery may not occur.

The deep aquifers with red-brown sediments have much larger drawdowns in the dry season but normally show a full recovery by the end of the monsoon. Only in areas of very high abstraction (major cities and industrial centres) is the annual recovery incomplete.

In general, groundwater gradients over the country are low, typically between 1 m km^{-1} (1:1000) in the north of the country to as low as 0.01 m km^{-1} (1:100,000) in the south.

4.7 GROUNDWATER USAGE

Irrigation coverage has been increasing steadily with time as shown in Figure 4.6. This map and the following statistics are derived from the National Minor Irrigation Census 1996/1997 undertaken by the National Minor Irrigation Development Project, Ministry for Agriculture and Food, Government of Bangladesh.

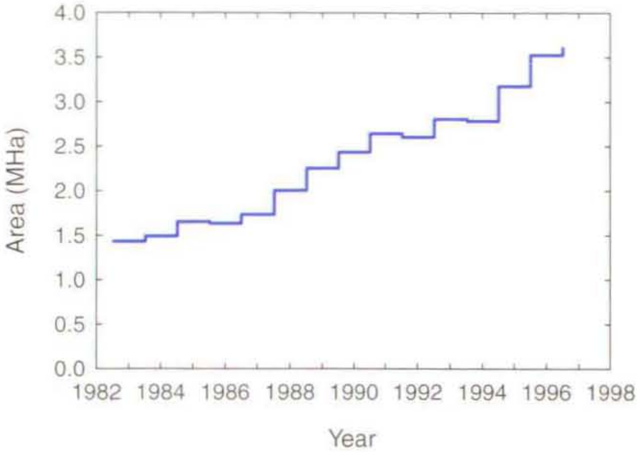

Figure 4.6. Change since 1982 in total irrigated area in Bangladesh.

Table 4.11. Summary of change in use of irrigation technologies, expressed as a percentage of the overall irrigation volume

Mode of irrigation	1982–83	1996–97
Groundwater		
Shallow tubewell	24	56
Deep tubewell	15	13
Manual operated pump unit	1	1
Surface water		
Low-lift pump	22	15
Traditional	28	5
Canal	10	10

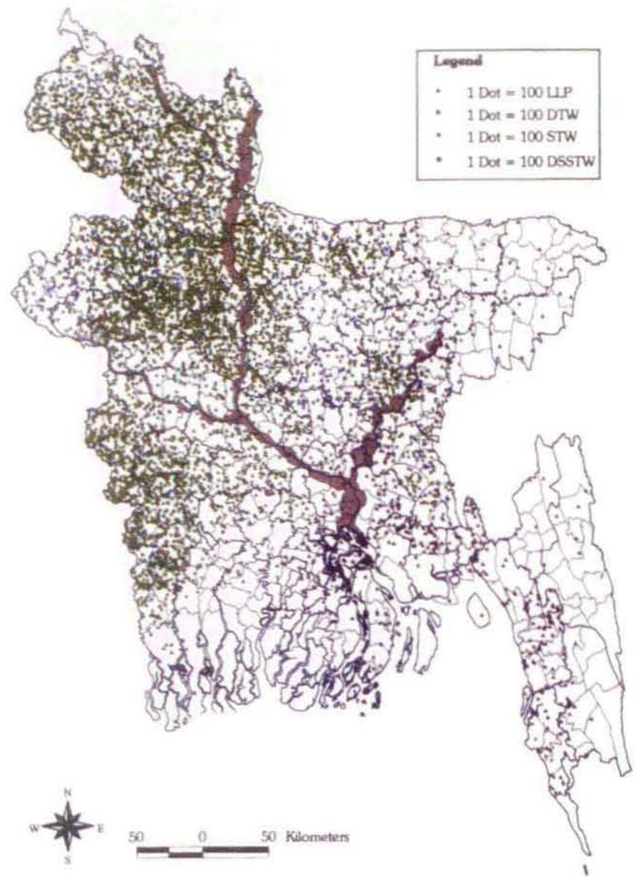

Figure 4.7. Distribution of irrigation technologies used in Bangladesh about 1996.

The total area under irrigation coverage has risen from 1.52 million hectares (Mha) in 1982–1983 to 3.79 Mha by 1996–1997. The increase is largely attributable to the installation of different types of irrigation wells, particularly shallow wells. In addition, the proportion of irrigation drawn from groundwater has also changed significantly (Table 4.11). In 1982–1983, groundwater represented 40% of the total irrigation consumption. This had risen to 70% by 1996–1997. Table 4.12 shows the number of units of irrigation equipment that were potentially available during the year 1996–1997.

Figure 4.7 shows the distribution of irrigation technologies in Bangladesh. It is clear from the map that groundwater irrigation is extensive in the north-west and western parts of the south-west and north-central regions. Groundwater irrigation is less extensive in eastern part of the north-east, in the south-east and south-eastern part of the south-west regions. There is almost no irrigation in the hill districts.

Table 4.12. Summary of irrigation abstraction modes operating in Bangladesh during 1996-1997

Aquifers	Technology	Units operating	Units non-operating	Total units
Highstand grey fine to medium sands within floodplains, with shallow (<5 m) water table	shallow tubewells (STW)	600,276	13,284	613,559
Fine to medium sands within floodplains, fairly deep (<7 m) dry season water table	Deep set STW	26,245	615	26,860
Fine to medium sands within floodplains with deep (<10 m) dry season water tables	Very deep set STW	3,313	99	3,412
	All shallow tubewells	629,834	13,998	643,831
Grey or red-brown transgressive tract medium to fine sands with a deep water table	Force mode tubewells	201	18	219
Transgressive to lowstand grey and red-brown coarse grained sediments	Deep tubewells	25,210	5,663	30,873
Very shallow aquifers and open bodies of water	Low lift pumps	62,875	2,949	65,824

Table 4.14. Estimates of flow and time for flushing for the aquifer units of the Brahmaputra Channel between Faridpur and Dhamrai under early Holocene gradient

Aquifer	Upper part of present-day lower shallow	Lower shallow
Approx. age (ka BP)	~10	15 to 18
Gradient (m km^{-1})	0.28	0.28
Width (km)	45	45
Transmissivity (m^2 d^{-1})	1325	2325
Flow (m^3 d^{-1})	16695	29295
Thickness (m)	55	40
Seepage velocity (m d^{-1})	6.75×10^{-3}	1.63×10^{-3}
Porosity (-)	0.2	0.3
Darcy velocity (m d^{-1})	3.37×10^{-2}	5.43×10^{-2}
Volume of groundwater (m^3)	1.238×10^{11}	1.350×10^{11}
Time to replace one pore volume (ka)	20	13

Table 4.15. Estimates of flow rates and time for flushing for Upper Ganges, Lower Ganges and Mahananda Channel sequences at Chapai Nawabganj under present-day gradients

Aquifer	Upper Ganges	Lower Ganges	Mahananda
Approx. age (ka BP)	2–5	5–15	2–5
Gradient (m km^{-1})	0.08	0.08	0.08
Width (km)	5	5	4
Transmissivity (m^2 d^{-1})	570	2500	350
Flow (m^3 d^{-1})	228	1000	112
Thickness (m)	40	80	40
Seepage velocity (m d^{-1})	1.14×10^{-3}	2.5×10^{-3}	7.00×10^{-4}
Porosity (–)	0.05	0.1	0.05
Darcy velocity (m d^{-1})	2.28×10^{-2}	2.50×10^{-2}	1.40×10^{-2}
Volume of groundwater (m^3)	1.000×10^{9}	4.000×10^{9}	8.000×10^{9}
Time to replace one pore volume (ka)	12	11	20

8400 m^3 d^{-1}. By comparison, it is calculated to take about 71 ka to flush the upper part of the lower shallow aquifer once at a flow rate of 4770 m^3 d^{-1}. This difference is largely due to differences in the porosities of the aquifers.

It is assumed that porosity increases with depth as the sediments become progressively coarser. The calculated time needed to replace the groundwater is 20–71 ka. The ages of the lowstand sediments are between 15 ka and 18 ka BP whereas the highstand sediments are about 10 ka old. This implies that the highstand deposits forming the widely-exploited upper shallow aquifer will not have even been completely flushed once since deposition and will therefore tend to contain concentrations of arsenic greater than in the lower, coarser parts of the system.

At the beginning of the Holocene (10 ka BP), hydraulic gradients were likely to have been higher: increasing from 20 m in 250 km (1:12,500) at the present time to 70 m in 250 km (1:3600) at 10 ka BP. The evidence for this is a combination of lower sea levels and higher river gradients

Table 4.16. Estimates of flowrates and time for flushing for a cross section through Faridpur (see Figure 4.9)

Layer	Column A	Column B	Column C	Column D
a. Block transmissivities (m^2 d^{-1})				
1	1870	125	1230	150
2a	1140	920	5020	240
2b	780	780		40
3a	120	120	430	1720
3b	1830	1830	1830	1830
3c	940	940	940	940
3d	1220	1220	1400	1220
b. Block throughflow rates (m^3 d^{-1})				
1	598.4	40	492	60
2a	364.8	294.4	2008	96
2b	249.6	249.6		16
3a	38.4	38.4	172	688
3b	585.6	585.6	585.6	585.6
3c	300.8	300.8	300.8	300.8
3d	390.4	390.4	560	488
c. Time to replace block volume (a)				
1	12362	184932	12529	68493
2a	11265	11167	10233	14269
2b	10976	13172		321062
3a	114155	85616	27875	6969
3b	2339	4678	3509	3509
3c	5465	5465	5465	5465
3d	8772	10527	9173	8772

demonstrated by the coarse nature of base load carried by the rivers (Davies et al., 1988). This implies that the rate of flow through the aquifers was greater and therefore the early flushing was more rapid, a single pore volume being displaced in a much shorter time (Table 4.14). Comparing the results with those for the Lower Shallow aquifer under present-day gradients (Table 4.14) shows a decrease of flushing time from 44 ka to 13 ka. This demonstrates that the groundwater in the lower aquifer could have been flushed at least once since deposition.

A similar calculation can be carried out for flow along the transmissive parts of the aquifer system for Chapai Nawabganj. Table 4.15 demonstrates that stored groundwater from sediments underlying the Mahananda River (Figure 3.8) is the slowest to be replaced. This takes about 20 ka as opposed to 10–12 ka for the groundwater in the Ganges sediments. This corresponds with the higher arsenic concentrations observed in the groundwater from the Mahananda sediments. Flow in the Barind Tract is predominately from east to west. This has not been considered in the present calculations as any groundwater flowing through the Barind Tract flows out via a series of springs along the faulted junction between the Mahananda sediments and the Barind Tract.

The calculation of through flow and the time to replace volume of groundwater for Faridpur is complicated by the distribution of sediments (Figure 3.12). To investigate the distribution of flow rates, the section has been divided into a series of blocks (Figure 4.9). The transmissivity, flow rate and time to replace the volume of each block were deter-

4.8 GROUNDWATER FLOW AND AQUIFER FLUSHING

Regional groundwater flow

Groundwater generally flows through the fluvial sediments of the northern part of the GBM system from north to south, mainly through the coarse sands and gravels of the lower shallow aquifer (Figure 3.5). South of the Hinge Zone, within the delta area, stacked main channel deposits from several cycles of glacio-eustatic deposition form a series of fining-upward aquifer units separated by very fine sand, silt and clay aquicludes (deep aquifer sediment cycles 2–4 in Figure 3.5). Within the coastal zone the shallow and deep aquifers 1a, 1b and 2 have been intruded by saline water. The deep aquifer cycle 3 contains freshwater that probably flowed along stacked channel deposits from the present Ganges and Padma Rivers. This indicates a possible recharge mechanism to deeper aquifers found in the coastal zone where they form sources of arsenic-free water.

Basin-wide flow

Most flow probably takes place through the infilled, incised channels under the major rivers. It is therefore necessary to examine flow through a typical incised channel in order to attempt to quantify the flow in different aquifers. This will enable the extent of flushing to be estimated. By selecting an estimate of the gradient at the present day and one likely to have been in existence 10 ka BP, it is possible to define two rates of flushing. A section is shown across the Brahmaputra River just before its confluence with the Ganges River (Figure 4.8). The infilled trench is split into a near-surface aquitard and three aquifers:

- the *aquitard* (layer 1) is composed of micaceous overbank silts and micaceous fine sands 10–20 m thick. These have a high porosity but low permeability;
- an *upper shallow aquifer* (layer 2, highstand) is composed of micaceous fine to medium sands 25–35 m thick;
- the upper part of the *lower shallow aquifer* (layer 3, lowstand) is composed of micaceous medium to fine sands about 0–30 m thick. Layer 2 is separated from Layer 3 by an intermittent grey to red clay layer. The main part of the lower shallow aquifer (layer 4, lowstand) is composed of coarse to medium sands, gravels and basal cobbles about 50–65 m thick.

Table 4.13. Estimates of flow and time for flushing for the aquifer units of the Brahmaputra Channel between Faridpur and Dhamrai under present-day gradients

Aquifer	Upper shallow	Upper part of lower shallow	Lower shallow
Approx. age (ka BP)	5 to 8	~10	15 to 18
Gradient (m km^{-1})	0.08	0.08	0.08
Width (km)	45	45	45
Transmissivity (m^2 d^{-1})	950	1325	2325
Flow (m^3 d^{-1})	3420	4770	8370
Thickness (m)	45	55	40
Seepage velocity (m d^{-1})	1.69×10^{-3}	1.93×10^{-3}	4.65×10^{-3}
Porosity (-)	0.05	0.2	0.3
Darcy velocity (m d^{-1})	3.38×10^{-2}	9.64×10^{-3}	1.55×10^{-2}
Volume of groundwater (m^3)	2.531×10^{11}	1.238×10^{11}	1.350×10^{11}
Time to replace one pore volume (ka)	20	71	44

The present-day flows are calculated for each of these three aquifer units and are given in Table 4.13. These estimates show that with the present hydraulic gradient, it will take about 44 ka to flush the lower shallow aquifer (lowstand) once (one pore volume) given a flow rate of

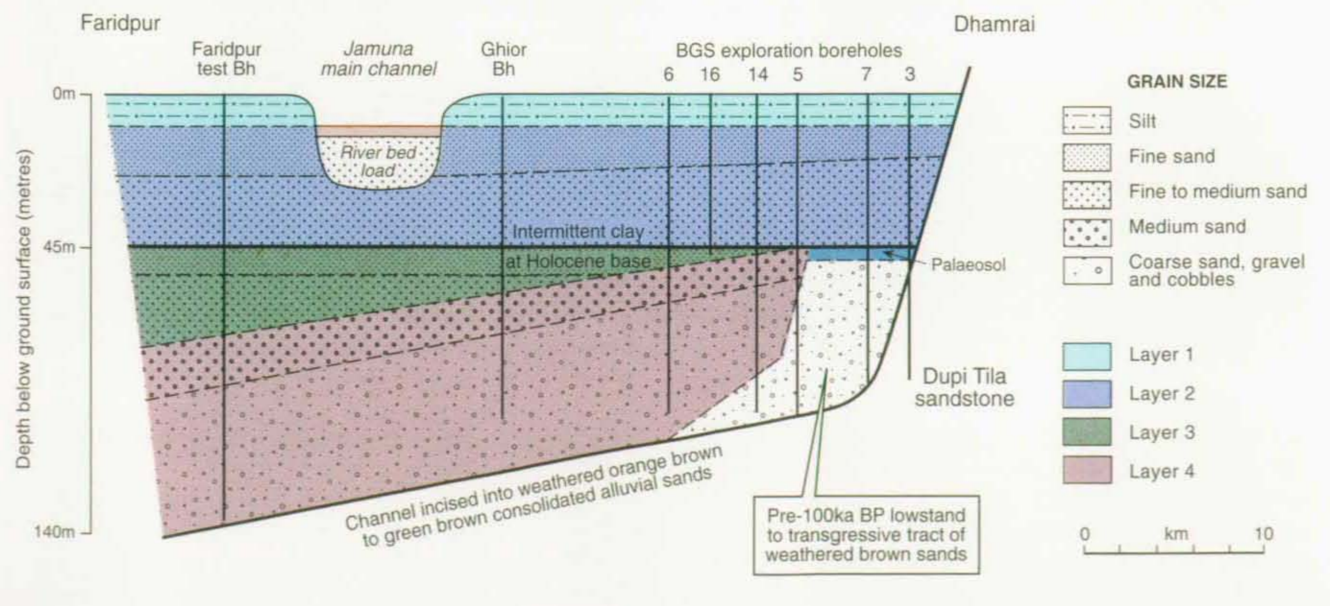

Figure 4.8. Geological cross-section through the Jamuna Channel alluvial deposits showing the four-layer aquifer structure.

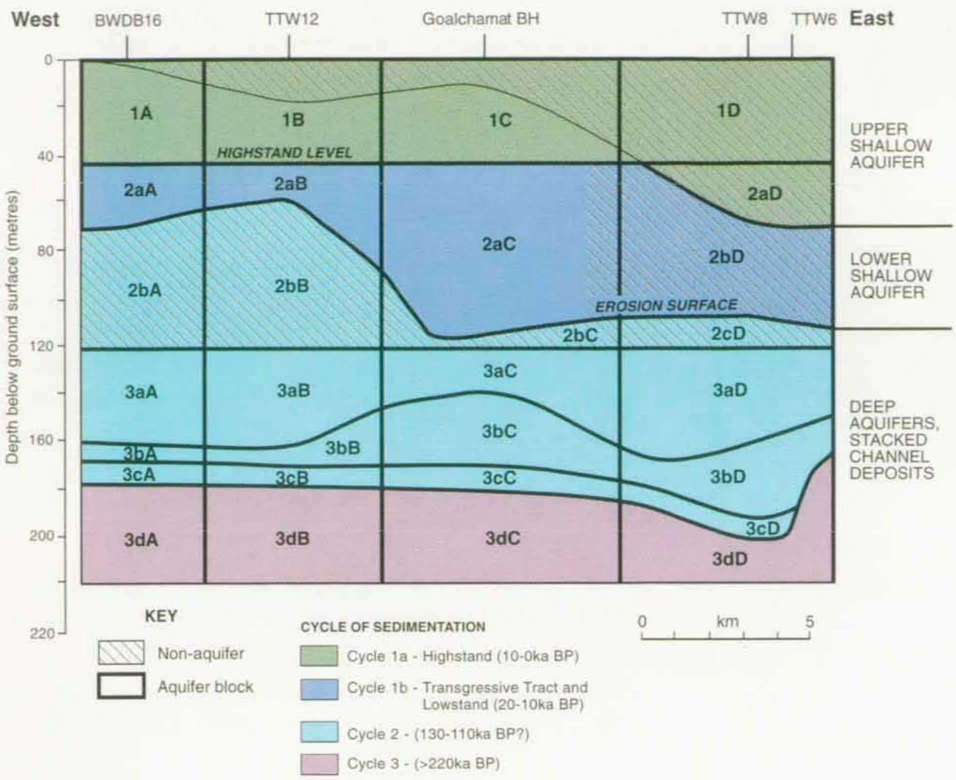

Figure 4.9. Hydrogeological cross section through the shallow and deep aquifers of the Faridpur area. shows the blocks used for the calculation of aquifer throughflow rates.

mined (Tables 4.16a-c). These and other aquifer parameters are summarised for the main aquifer units in Table 4.17. The deep aquifer consists of a series of stacked channels infilled with coarse material. This is obviously very transmissive and will exhibit a significantly shorter time for flushing than the upper part of the aquifer. This is confirmed in Table 4.16c which indicates that it takes some 2.5 ka–5 ka to flush the deep aquifer once. This is in contrast to the corresponding upper aquifer which takes between 10 ka–15 ka to be flushed once. Since the sediments making up the deep aquifer were deposited over 140 ka ago, it is likely that this part of the system has been flushed quite a few times.

These simple estimates of throughflow and times to flush have demonstrated that the transmissive parts of the aquifer system can be flushed in some 10 ka. In some cases, where sediments are very transmissive, flushing is estimated to take less than 5 ka. Since the highstand sequence was deposited around 10 ka ago, transmissive sediments that predate this will have already been flushed to some extent.

The deltaic and alluvial sedimentary environments in Bangladesh are such that major rivers have been alternatively incising and filling the same channels for at least 1 million years. This has led to a series of incised channels surrounded by infills of finer sediments. Both of these facies contain fining-upward sequences, but the incised channels are coarser than the surrounding areas with the sequence starting with medium to coarse sand. In contrast, the areas between the channels contain thick sequences of clay that will tend to inhibit recharge and locally reduce groundwater flow rates.

Therefore the sediments in the incised channels are highly transmissive with a transmissivity of approximately 3000 $m^2 d^{-1}$ and a porosity of 20%. They are likely to be flushed in approximately 10 ka. The surrounding sediments have a medium/low transmissivity (300 $m^2 d^{-1}$) and a high porosity (60%) and will take some 300 ka to flush under a similar gradient. This is an important distinction as the finer sediments will tend not to be flushed within a glacial cycle.

4.9 Conceptual model of seasonal flow patterns

Seasonal groundwater movement due to climatic and abstraction controls is most evident within the shallow aquifer systems of Bangladesh. Therefore the mechanisms of seasonal recharge to, and discharge from, the shallow aquifer systems need to be understood. A segment of the Faridpur-Dhamrai cross section was selected to investigate

Table 4.17. Summary of aquifer parameters for the upper shallow, lower shallow and deep aquifers at Faridpur

Aquifer	Upper shallow	Lower shallow	Deep
Approx. age (ka BP)	5 to 8	8–23	>140
Gradient (m km^{-1})	0.08	0.08	0.08
Width (km)	18	18	18
Transmissivity ($m^2 d^{-1}$)	125–1870	40–5020	120–1830
Flow ($m^3 d^{-1}$)	1190	3287	6311
Thickness (m)	45–60	75–90	90
Porosity (-)	0.10–0.15	0.05–0.20	0.10–0.15
Time to replace one pore volume (ka)	12–185	10–321	2.3–114

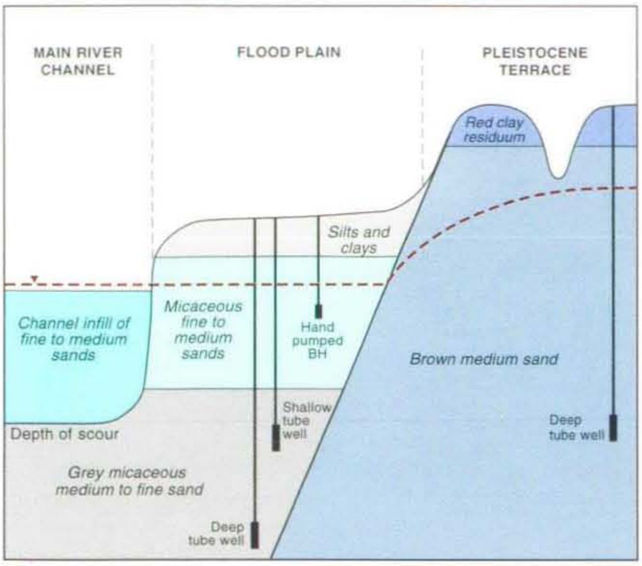

Figure 4.10. Conceptual model – basic hydrogeological units and main irrigation pumping methods.

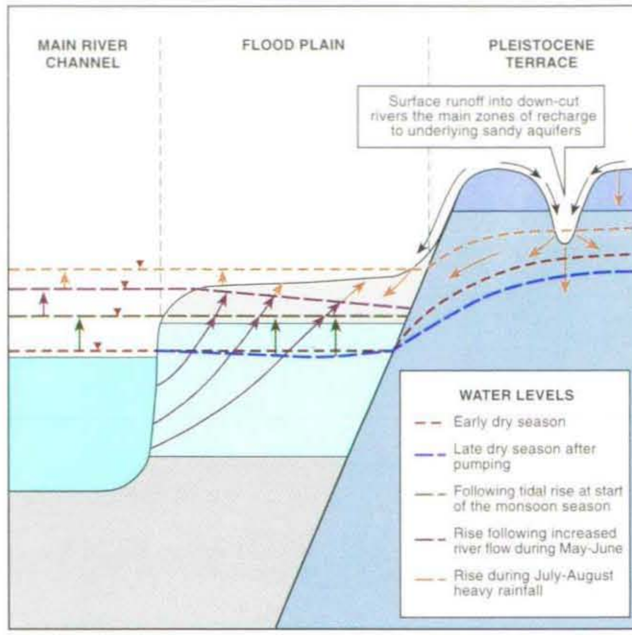

Figure 4.11. Conceptual model – water flow patterns and resultant water levels during the dry season and the following wet season. The effects of irrigation and flooding during the onset and course of the monsoon season are shown.

seasonal patterns of water inflow and outflow from the main rivers and the adjacent floodplains. Seasonal aspects of water flow are also considered as well as the influence of rainfall on the floodplain and Pleistocene Tracts (Figure 4.10).

The selected segment corresponds with a transect from the main channel of the Brahmaputra across the adjacent floodplain to the Madhupur Pleistocene Terrace. The floodplain is underlain by grey, micaceous medium to fine sands belonging to the upper shallow aquifer and is capped by very micaceous low-permeability silts and clays. The Pleistocene Terrace is underlain by deep aquifer sediments capped by Red Clay Residuum that is incised by antecedent drainage channels. Groundwater is abstracted from the shallow aquifer in the floodplain using hand pumps and shallow and deep irrigation tubewells. Only deep tubewells are used in the Pleistocene Tract. The main river is assumed to be in hydraulic continuity with the shallow aquifer system (Figure 4.10).

During the December to March dry season, groundwater is abstracted in the floodplain and Pleistocene Tract areas for the irrigation of crops. Shallow tubewells will be used in the floodplain until water levels decline to below suction level, maybe by March, from when the irrigation will be completed using deep tubewells. Regional drawdowns of the order of only 2–3 m will result from the abstraction of groundwater for irrigation within the floodplain area. In the Pleistocene Tract, water-level drawdowns of the order of 10 m are more typical (Figure 4.11).

With the onset of the monsoon season toward the end of April and the associated tidal rise in the Bay of Bengal, water levels begin to rise. There is a general rise of water levels within the aquifers beneath the floodplains but no change within the Pleistocene Tracts.

During May and June, melt water from the Himalayas will have reached Bangladesh, causing a further rise in river levels. This results in a rise of water levels in the floodplain due to lateral flow of water into the fine to medium sands below the surface silts causing a rise in water level adjacent to the river. The effect of this moves into the floodplain away from the river but causes no change within the Pleistocene Tracts.

The monsoon rains start in earnest during August. Groundwater and river levels rise further in response to these rains (Figure 4.11) and cause:

- flooding of floodplains;
- recharge through floodplain soils and near-surface silts, filling the shallow aquifer and therefore rejecting further potential recharge;
- flow along antecedent channels within the Pleistocene terrace areas with direct recharge to sand layers below the clay residuum;
- seepage through the clay residuum surface.

Following the end of the monsoon in December, water levels rapidly decline in the main channel, in the Madhupur aquifer beneath the clay residuum and in the floodplains. Surface runoff and water-level declines are slow in the near-surface silts and in the very micaceous fine to medium sands. There is delayed seepage from the near-surface silt layers. Excess water flows from the Pleistocene Tracts and the floodplain towards the river through the shallow aquifer (Figure 4.12).

4.10 Summary

4.10.1 Groundwater flow and aquifer flushing

The five main sedimentary aquifer units considered in this study were deposited within distinct fluvial and delta plain imately 12 ka. Therefore it is likely that the lowstand sediments of the Brahmaputra valley will have been flushed at least once since deposition while the highstand deposits may have only been flushed once.

In the Chapai Nawabganj section, the rate of groundwater flow through the upper and lower Ganges sediments and the Mahananda river alluvium was estimated to take 12 ka for the Upper Ganges, 11 ka for the Lower Ganges and 20 ka for the Mahananda. Therefore only the Lower Ganges sediments would have been completely flushed since deposition.

In Faridpur, the flushing times (one pore volume) for the upper shallow aquifer, lower shallow aquifer and deep aquifers were estimated to be 12–185 ka. Therefore none of these deposits would have been flushed completely since deposition. Within the lower shallow aquifer, estimated times required for a single flushing varied between 10 ka for the coarse-grained sediments of the incised channel up to 320 ka for the fine-grained sediments found on either side of these sediments. Therefore only the coarse channel sediments would have been flushed and completely since deposition. Within the deep aquifers, times required for a single flush are estimated to vary between 2 ka and 115 ka. Since all of these sediments are greater than 140 ka old, even the finest-grained sediments will probably have been flushed at least once, while the coarse basal sediments will have been flushed many times.

4.10.2 Implications for arsenic

Clearly the variation of the arsenic concentration in groundwaters can be related in part to the the past history of groundwater flushing of the aquifers. This in turn depends on the age of the sediment, the hydraulic properties of the aquifer and past and present groundwater flow regimes. Other factors related to the source of arsenic and its mobilisation are also likely to be important but, all other things being equal, the following hydrogeological factors are likely to be contributory.

Low arsenic concentrations may be associated with:

- coarse sands – at the base of incised channels in fluvial areas (possibly stacked channels in delta regions);
- relatively high hydraulic conductivity, medium porosity;
- high present-day groundwater gradients and/or historically high gradients due to the influence of the past glacial maximum;
- relatively rapid flushing, some 2–10 ka per pore volume;
- sediments greater than 10 ka old.

High arsenic concentrations may be associated with:

- areas with low recharge, either because of relatively low rainfall, high evaporation or high runoff;
- silts and fine sands within alluvial floodplains and delta areas leading to low groundwater flow rates;
- other horizons with a low hydraulic conductivity;
- areas with low groundwater gradients even at the time of the last glacial maximum;
- areas where flushing takes 50–200 ka per pore volume even during the last glacial maximum;
- areas with low gradients at the present time leading to flushing times exceeding 200 ka;
- regions of especially low flow, perhaps inside river meanders, in closed basins and in the dead zones of aquifers.

The deep aquifer can be seen to be largely free of arsenic and could be a possible source of irrigation and drinking water. Over much of Bangladesh, the groundwater in the shallow aquifer is known to be arsenic contaminated. Since pumping will induce flow both laterally and vertically, exploiting the lower shallow and the deep aquifers by pumping can be viewed as a competition between the lateral or regional flows and vertical flows. The ratio of these two inflows to the well has important implications for the movements of contaminants. Typically, high arsenic concentrations are found in the younger and shallower aquifers. Creation of vertical gradients will therefore result in the arsenic being transported down into the deeper parts of the system and the concentration in the deeper wells will tend to increase with time until the source of arsenic in the shallow aquifer becomes depleted.

Lateral inflows to a deep aquifer will be derived from areas with generally low arsenic concentrations but may also include a contribution from shallower, and potentially contaminated, horizons. Therefore, determining the ratio of the lateral flows to the vertical flows will be important in determining the impact of pumping deeper parts of the system.

The likely pattern of flow to a well also has implications for the design of boreholes. It is desirable to have the shortest feasible length of screen placed at the deepest level to maximise the travel time between the upper aquifer and the well. It is also important to avoid construction of wells with multiple screens in different horizons especially where the shallow groundwaters are known or expected to be contaminated with arsenic and other elements.

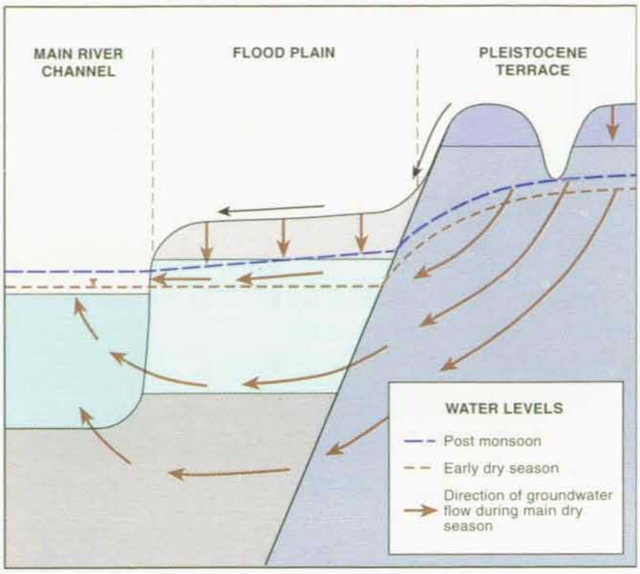

Figure 4.12. Conceptual model – water flow patterns and water level change following the end of the monsoon season and during the early dry season.

environments as part of the GBM system. These are:

- Late Pleistocene to Holocene *Tista mega-fanglomerate* and *Brahmaputra channel basal gravel aquifers* composed of coarse sands, gravels and cobbles;
- Late Pleistocene to Holocene *Ganges, Lower Brahmaputra and Meghna main-channel shallow aquifers* composed of braided and meandering river sediments;
- Early to Middle Pleistocene *coastal and moribund Ganges delta deep aquifers* composed of stacked, main channel medium to coarse sands at >130 m;
- Early to Middle Pleistocene *Old Brahmaputra and Chandina deep aquifers* composed of red-brown medium to fine sands underlying Holocene grey medium to fine sands;
- Early to Middle Pleistocene *Madhupur and Barind Tract aquifers* composed of coarse to fine fluvial sands of the Dupi Tila Formation, confined by near-surface clay residuum deposits.

Various conceptual models have been devised mainly for the study of the fluvial aquifers of the northern half of the GBM system. There has been a tendency to differentiate between the aquifers composed of younger grey sediments and those consisting of older red-brown sediments that occur within the GBM system. Three- and four-layer models have been developed and applied to understand the effects of recharge, abstraction and throughflow within the red-brown and grey aquifers.

Groundwater systems are strongly influenced by the annual monsoon rainfall and its intensity. There are distinct wet and dry seasons with flooding common during the wet season. Irrigation using groundwater is necessary during the dry season. Annual flooding of floodplains occurs as a combination of increased river flow due to melt water from the Himalayas, tidal-level increase in the Bay of Bengal and intense monsoon rainfall, which seems to have become more intense in recent years. Usually the whole aquifer system receives sufficient recharge to become full by the end of each monsoon season.

Aquifer physical properties have been summarised from a number of published accounts. Hydraulic conductivities determined for grey sediments are estimated to be in the range 0.4–100 m d^{-1}. Those for red-brown sediments are in the range 0.2–50 m d^{-1}. These give a ratio of hydraulic conductivities of 2:1 for grey:red-brown sediments. There has been little investigation of the deep aquifer and, therefore reliable aquifer parameters for this aquifer are as yet largely unknown. Borehole logs indicate the high degree of sediment heterogeneity across Bangladesh.

The thicknesses of near-surface silt and very fine sand layers govern the availability of groundwater to HTW and STW pumps. Therefore it is important to set the aquifer system in the correct sedimentological context.

In general, groundwater gradients over the country are low, typically between 1 m km^{-1} in the north of the country to as low as 0.01 m km^{-1} in the south. These low gradients may be a strong factor in determining the groundwater chemistry and chemical heterogeneity due to low rates of flushing of the aquifers. Groundwater head and corresponding gradients are difficult to define adequately.

By the latter part of the dry season, groundwater levels can become depressed by abstraction from STWs and private domestic tubewells. Use of these can be restricted as water levels decline. This results in an increase of DTW use, further depressing groundwater levels. The seasonal cycle of groundwater heads is influenced by irrigation abstraction which takes place only during the dry season. The effect of seasonality differs across Bangladesh.

In general, the regional groundwater flow in the aquifers of Bangladesh is from north to south, with local variation near major rivers. However, the regional flows are not well understood. Evidence suggests that there is some interaction between groundwater flow within the fluvial deposits in incised channels and the flow within the stacked channels in the delta sequences. In the coastal region, from Khulna to Lakshmipur, there is known to be fresh groundwater at depth, below shallower saline aquifers. The water in this aquifer also has a very low arsenic concentration and there is also anecdotal evidence that artesian flow sometimes occurs from boreholes in the deep coastal aquifer.

Groundwater flushing rates have been estimated for the Brahmaputra valley, the River Mahananda–Chapai Nawabganj area and Faridpur. These are summarised below. The Brahmaputra valley or channel consists of highstand, transgressive and lowstand sediments which, under present-day conditions with a gradient of 0.1 m km^{-1}, are flushed once in approximately 20 ka (highstand), 70 ka (transgressive tract) and 44 ka (lowstand). Since the highstand deposits are less than 10 ka old, they have not yet been completely flushed since deposition. At the beginning of the highstand period 10 ka BP, flow gradients were of the order of 0.3 m km^{-1}. Flushing of the transgressive tract is estimated to take approximately 20 ka while flushing of the lowstand is estimated to take approx-

5 Groundwater flow modelling

The transport of arsenic is determined by the overall movement of groundwater. It is therefore important to understand the pattern of groundwater flow and the factors that may affect it in order to understand the present and possible future movement of arsenic. If groundwater flow rates are extremely small, then diffusion will be the dominant mechanism by which arsenic moves. The diffusive flux is often orders of magnitude lower than advective flux in a flowing system. The transport of arsenic in systems without a significant advective flux will therefore be extremely slow.

The complexity of the Bangladesh aquifers in terms of the variation in sedimentological characteristics both laterally and with depth is clearly very great (Chapter 3). Indeed, it is probably so great that the difficulty and expense of building hydrogeological models of water and solute movement incorporating the level of detail seen in the borehole logs would rarely be justified. Below, the effect that different simplifications of the aquifer system can have on groundwater flow patterns is examined.

In order to understand the movement of arsenic in aquifers, it is important to have some knowledge of the way that water typically moves in the aquifers and how this varies under different flow conditions and management policies – under natural flows and with abstraction for domestic use (hand pumps) and for irrigation (motorised pumps). Some estimate is required of the depth to which groundwater flow occurs and what impact pumping has on the depth of flow. This is particularly relevant for the groundwater arsenic problem since it is known that the highest arsenic concentrations are found in the 'shallow' aquifer and there is naturally concern about the possible movement of arsenic to the, as yet, largely uncontaminated 'deep' aquifer. We were also interested in the effect that river geometry, specifically meanders, could have on the initial stages of aquifer flushing. Questions such as these can be answered at least in part with simple hydrogeological models. The development of such models is described below.

5.1 Objectives of modelling

The overall aim was to examine groundwater flow, with the specific objectives as follows:

1. calculate the relative magnitudes of flow in shallow and deep aquifers
2. investigate whether downward flow contaminates the deeper part of the groundwater system with arsenic
3. determine the effect of pumping on the movement of arsenic to irrigation wells and deep tubewells
4. estimate over what timescale arsenic will affect pumping wells.

In addition to these objectives, the regional flow of groundwater is discussed and its possible influence on distribution and movement of arsenic evaluated.

5.1.1 Methodology and approach

The modelling was undertaken in four steps:

1. develop an understanding of how the aquifer system works by creating a vertical slice model and using typical parameters and boundary conditions for Bangladesh aquifers;
2. determine how flow is distributed vertically through the groundwater system using particle tracking techniques;
3. increase the complexity of layering and investigate the effect of this on the vertical distribution of flows;
4. introduce abstraction and determine the travel times from the water table to the well screen.

5.1.2 Simplifications

The purpose of the modelling presented in this section is to investigate the patterns of flow in both the shallow and deep aquifers and what influences them.

In order to investigate these effects, a staged approach was taken, starting with a simple model and then increasing the complexity. It was necessary to simplify the work sufficiently to enable the influence of the hydraulic properties of the aquifer and the effect of pumping to be evaluated. As discussed in Section 4.3, the groundwater system exhibits marked seasonality due to the monsoon rains during May to September. This results in a seasonal pattern of rise and fall of groundwater heads influenced by tidal responses, recharge and increased river stage. The monsoon rains are important in producing seasonality in surface water bodies and groundwater systems but the primary aim of this work was to determine the long-term influence on the vertical distribution of groundwater flows and their effect on arsenic distribution. Therefore, for simplicity, seasonality was not included but it should be included if the models are to be developed further.

5.2 Generic model

5.2.1 Introduction

With the exception of the extreme north-west region of Bangladesh, the hydraulic gradients are generally low reflecting the flat topography of the delta region (Section 4.6). However, even small gradients can be important in highly transmissive environments especially over long timescales, and the timescales of interest here vary from a few years up to geological timescales of tens of thousands of years. The following factors could affect these gradients:

- the balance between recharge and evaporation which affects the water table height;
- the transmissivity and vertical hydraulic conductivity of the aquifer;
- the spacing between rivers;
- the location and depth of the aquifer.

The modelling presented in this Chapter has used MODFLOW and MODPATH to determine the factors that control the vertical distribution of groundwater flow. Vertical flows are determined by the vertical distribution of heads, i.e. hydraulic gradients. These are characterised by:

- the depth of aquifer;
- the amount of recharge;
- the presence of low hydraulic conductivity layers;
- the vertical distribution of hydraulic conductivity.

5.2.2 Methodology

The approach adopted was to set up a steady-state two-dimensional vertical-slice model using appropriate parameters, which are described below. Once this had been done, particle tracking was used to trace the movement of the water from the surface through the aquifer. By counting how many particles travelled through a particular horizon, the model could be used to determine the flows at different depths. Flows were calculated for three horizons within the model which were representative of the thicknesses of the 3-layer conceptual model used for the Faridpur region. This conceptual model was introduced in Section 4.2 and further developed in Section 4.9. Flows were calculated for the following three horizons:

(i) upper shallow aquifer: 0–40 m below ground level (bgl);

(ii) lower shallow aquifer: 40–130 m bgl;

(iii) deep aquifer: 130–400 m bgl.

Once the flow through the different horizons had been established, a number of sensitivity simulations were undertaken to investigate how the patterns of flow changed in response to changing various model parameters. The final application of the model was to introduce a 3-layer hydrogeological model in which each of the layers had a different hydraulic conductivity. This enabled the distribution of vertical flows to be determined based on a more realistic representation of the actual vertical heterogeneity of the aquifers in Bangladesh.

5.2.3 Description of the base case

The 'base case' here is a steady-state vertical-slice model with a uniform hydraulic conductivity. As discussed above, the steady state assumption ignores the obvious seasonality of the groundwater system. This was necessary in order to simplify the problem.

The main features of the base case model are presented

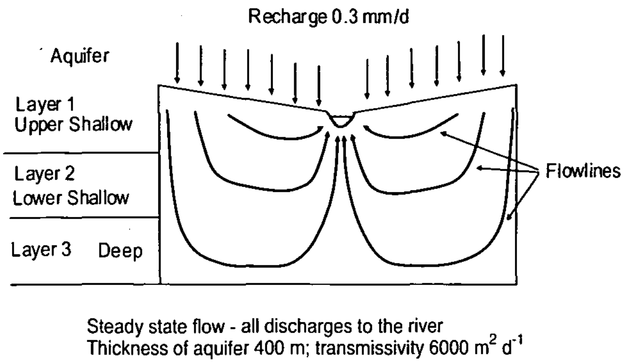

Figure 5.1. The vertical slice model.

in Figure 5.1 and detailed below:

- thickness 400 m;
- length 2550 m;
- hydraulic conductivity 15 m d^{-1};
- ratio of horizontal to vertical conductivity 1:10;
- net recharge of 0.3 mm d^{-1};
- no flow boundaries all around model, with the exception of a single river as the only outflow.

The thickness of the aquifer was chosen to be 400 m to allow the bottom boundary to be deep enough so as not to influence the pattern of groundwater flow.

The hydraulic conductivity is derived from the transmissivity given in the hydrogeological map of the Faridpur district. This indicates a transmissivity of between 2000–3500 m^2 d^{-1} for an aquifer thickness of 200 m. Thus a hydraulic conductivity of between 10 and 17 m d^{-1} is suggested, and 15 m d^{-1} was chosen as a representative value for the present modelling. The ratio of horizontal hydraulic conductivity to vertical hydraulic conductivity is based on the flow modelling undertaken in Phase I (DPHE/BGS/MML, 1999)

No-flow boundaries were chosen for both the base of the aquifer and the lateral boundaries. The lateral boundaries therefore represent the limits of the groundwater catchments. Early calculations with the model demonstrated that the river spacing was important in order to keep the regional gradients to the low values observed in the field. This implies that rivers provide one of the important controls for keeping groundwater gradients closely tied to topography.

The net recharge estimate of 0.3 mm d^{-1} is also based on the work carried out in Phase I (see Table 4.2 in Volume S3 of DPHE/BGS/MML, 1999). This is summarised in Table 5.1. Although low, this estimate is representative of the difference between the long-term infiltration and the long-term average evaporation.

This value of recharge so derived can be checked by using the observed seasonal variation in groundwater head (see Section 4.6), coupled with an estimate of specific yield to obtain an order of magnitude estimate of recharge. The results from this calculation are presented in Table 5.2 and

Table 5.3. Comparison of the layers referred to by different conceptual models used in this project

Depth (m bgl)	Phase I modelling		This chapter		*Geology and sedimentology* chapter	
	Layer	Geology	Layer	Description	Layer	Sub-division
0–10	1	Silt	1	Highstand Kh = 15 m d^{-1}	Shallow aquifer	Upper shallow aquifer
10–45	2	Micaceous fine to medium sands	1			
45–90	3	Micaceous fine to medium sands	2			Lower shallow aquifer
90–140	4	Medium to coarse sands with gravels and cobbles	2	Lowstand Kh = 45 m d^{-1}		
140–400	Not included		3	Deep aquifer Kh = 5 m d^{-1}	Deep aquifer	

Table 5.4. Sensitivity of calculated groundwater flows to various parameters

Parameter	Changes made from basecase	Effect on the vertical distribution of groundwater flow
Thickness	200 m and 100 m thickness	Increasing the thickness of the aquifer decreases the amount of groundwater flow at depth (In terms of groundwater flow below 10% thickness; 44% for base case; 52% for 200m thickness and 64% for 100 m thickness)
Recharge	Doubled and halved	No real change in terms of percentage flow per hydrogeological layer
Low hydraulic conductivity layer	Very low conductivity layer added at 25 m bgl	Including thin, low hydraulic conductivity layer dramatically reduces amount of flow reaching the middle and lower layer (from 84% to 48%)
Increased hydraulic conductivity layering	Three layer hydrogeological model introduced	Changing to three layer hydrogeological model decreases flow to deeper part of aquifer (from 24% to 8%)

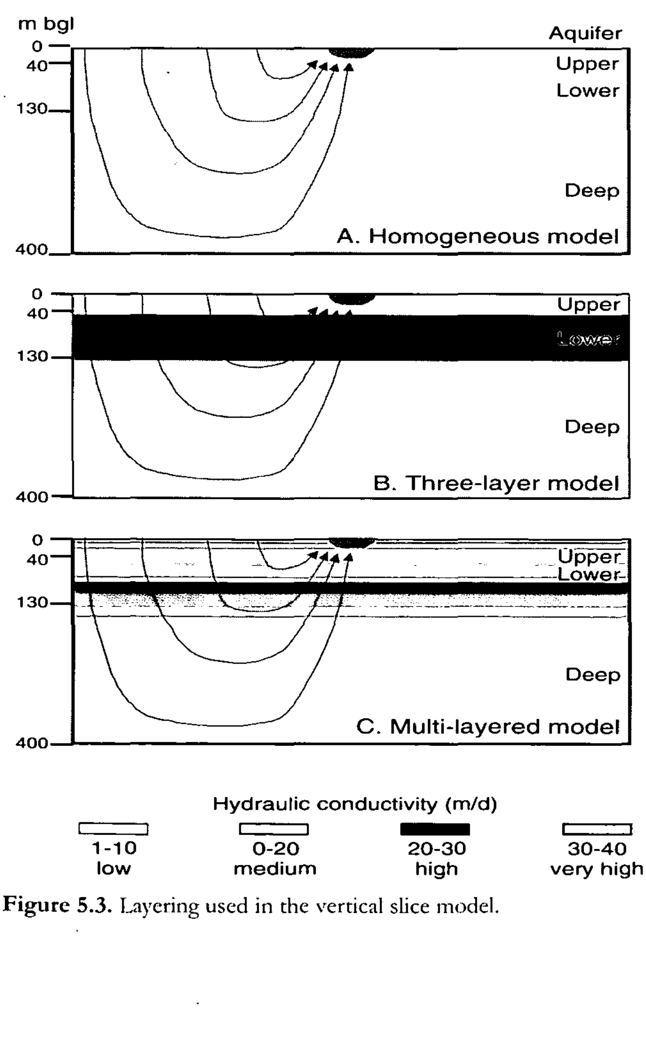

Figure 5.3. Layering used in the vertical slice model.

thickness of the aquifer decreases the flow in the upper layer;

- introducing a low hydraulic conductivity layer dramatically reduces flow below the depth of this layer.

Introducing the 3-layer hydraulic conductivity model, however, increases the flow through the middle layer at the expense of flow through both the upper and lower layers. The most transmissive part of both the 3-layer and 4-layer models occurs in the layer representing sediments deposited between the highstand and lowstand limit. This will therefore be the layer through which the majority of the flow occurs. For Faridpur, this is between 40 and 130 m bgl, but the exact depth interval will vary in different parts of the country.

5.3 SITE SPECIFIC MODEL: FARIDPUR

The aim of this modelling work was to see how the flows changed with depth as the complexity of the representation of the layering increased. Four simulations were used to progress from a homogeneous aquifer to a layered aquifer based on the Faridpur borehole log. The model was split into three horizons and the vertical distribution of groundwater flow was determined as described above. The flow passing though each of these layers was calculated for each of the four simulations.

5.3.1 Outline geology and hydrogeology

The Special Study Area of Faridpur was chosen as an example area for determining groundwater flows in a rela-

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90–140	4	Medium to coarse sands with gravels and cobbles	2			
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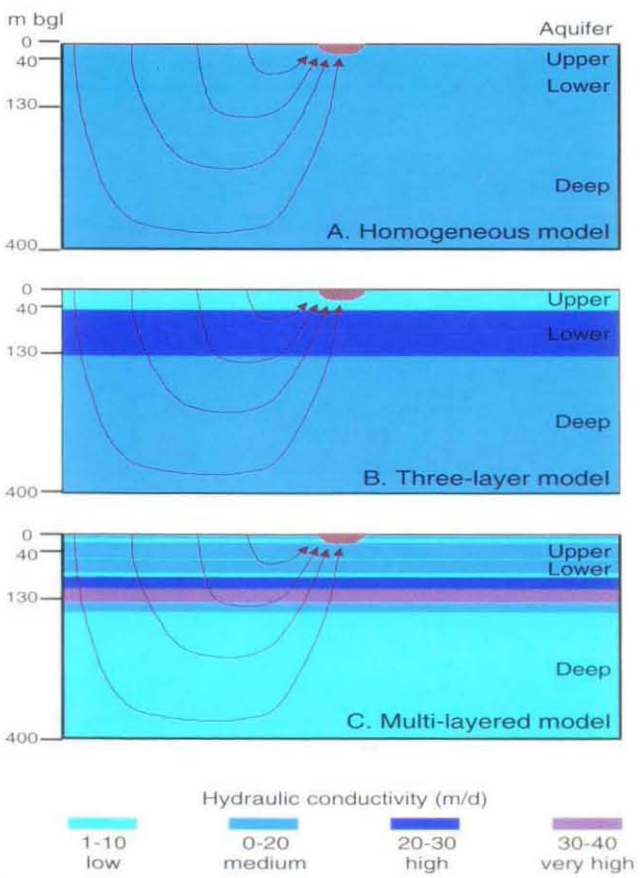

Figure 5.3. Layering used in the vertical slice model.

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5.3.1 Outline geology and hydrogeology

The Special Study Area of Faridpur was chosen as an example area for determining groundwater flows in a relatively well-defined hydrogeological setting. The geology of the Faridpur area is described in Section 3.3.4. The general geological features of the area are:

- the *upazila* is crossed by a recently-incised river channel which was active at the last glacial maximum (about 15 ka to 20 ka ago);
- this channel which is about 4 km wide sits on top of a 12 km main channel which contains meanders which predate the last interglacial more than 120 ka ago;
- subsidence since the main channel was formed has led to the stacking of channel deposits. There has been subsidence of about 60 m during the last 120 ka at a rate of about 0.5 mm a^{-1} (Figure 3.12);
- the *upazila* lies in a possible subduction zone – the Faridpur trough which runs north-west towards the Sylhet Basin.

The sediments consist of two partly upwardly-fining sequences. The lower one is a transgressive tract which fines from coarse sands and gravels to medium to fine sands. The upper one shows a sudden change in lithology from silt to fine to medium sands and finer. This could be caused by channel switching with the recently-incised channel being a distributary of the main channel, or the smaller channel may have been captured by the main channel.

5.3.2 Methodology

The simple vertical-slice model described in Section 5.2 was modified to incorporate a more realistic representation of the geology as observed in the borehole log of the Faridpur cored borehole (Figure 3.13). This log showed that there was a high degree of layering within the aquifer. The complexity of the model was therefore increased from the homogeneous aquifer through a simple 3-layer block model to one based more closely on the actual geological log of the borehole. This progression from homogenous model to a complex layered model is illustrated in Figure 5.3. The model had the following features and assumptions:

- steady state model;
- the River Kumar was assumed to be the only outflow;
- recharge was assumed to be 0.3 mm d^{-1} over the whole area;
- the initial hydraulic conductivity was 15 m d^{-1};
- the aquifer was 400 m thick.

Starting with a uniform hydraulic conductivity model, the layering within the model was developed through three further simulations:

- VS1: uniform hydraulic conductivity;
- VS2: 3-layer model; transmissivity the same as VS1 (see Table 5.5) with the hydraulic conductivities representative of the appropriate values for each hydrogeological layer; fine sand/silt for layer 1, medium sand for layer 2 and silty clay for layer 3;
- VS3: 3-layer model using hydraulic conductivities based on the observed and simplified lithologies of each layer with standard values for each lithology based on permeameter tests and pumping test analysis (Barker et al., 1989);
- VS4: 16-layer model derived from the detailed borehole log and typical hydraulic conductivity values (see Table 4.10 in Section 4.4) used for VS3 (see Table 5.6).

5.3.3 Effect of increasing complexity

The flow through the three different horizons was assessed by counting the number of particles that passed through a particular horizon. These horizons are based on the 3-layer model presented in Table 5.5. Accounting for the flows in this way meant that all the particles travelled through the top horizon (100%), but that decreasing numbers of particles were tracked through the middle and lower horizons. The percentage of the total flow associated with each horizon was then calculated from the proportion

Table 5.5. Hydraulic conductivity values used in the various simulations

Layer	Depth (m)	Lithology/ Geology	Hydraulic conductivity (m d^{-1})	
			VS2	VS3
Shallow	0–40	Fine/medium sand (highstand)	15	16
Medium	41–130	Medium/coarse sand (lowstand)	45	33
Deep	131–400	Fine sand (Pleistocene)	5	3

Table 5.6. Layering based on the lithological log of the Faridpur borehole and used in the VS4 simulation

Lithology	Model Layer	Top Depth (m)	Bottom depth (m)	Thick -ness (m)	Hydr. Cond. (m d^{-1})
Silt	1	0	2	2	1
Fine sand	2	2	4	2	8
Silt/fine sand	3	4	12	8	4
Fine sand	4	12	20	8	12
Fine sand/silt	5	20	40	20	8
Fine sand	6	40	44	4	12
Silt	7	44	46	2	1
Fine /medium sand	8	46	72	26	17
Silt/fine sand	9	72	80	8	4
Medium sand	10	80	104	24	25
Medium/coarse sand	11	104	110	6	34
Coarse sand	12	110	122	12	46
Coarse sand	13	122	134	12	46
Fine/medium sand	14	134	145	11	17
Fine sand	15	145	155	10	12
Silt to fine sand	16	155	400	245	4

Table 5.7. Effect of various representations of the lithological stratification on the steady state flow at various depths

		Percentage of overall flow at given depths							
		Flow from surface through layer				Flow with deepest extent in layer			
Layer	**Depth (m)**	**VS1**	**VS2**	**VS3**	**VS4**	**VS1**	**VS2**	**VS3**	**VS4**
Upper shallow	0–40	100	100	100	100	48	36	40	32
Lower shallow	40–130	52	64	60	68	28	56	56	56
Deep	>130	24	8	4	12	24	8	4	12

of particles passing through each horizon. The results for the four simulations (VS1 to VS4) are given in Table 5.7.

The results show that for the uniform hydraulic conductivity example (VS1) the upper and lower shallow aquifer layers receive one half and one quarter of the flow, respectively (Table 5.7). The basic 3-layer model (VS2) defines the upper layer as significantly less permeable than the middle layer (Table 5.7). This is reflected in an increase in flow to the middle layer from 52% for the uniform hydraulic conductivity model to 64% in the 3-layer model. In contrast, relatively little flow (<10%) reaches the deeper part of the system, the Pleistocene deposits, in this simulation. This flow pattern is confirmed by the 3-layer model using the hydraulic conductivities estimated from the simplified lithology used in earlier work (VS3). Table 5.7 shows that the main difference is that less flow reaches the deeper aquifer, half as much as in the uniform aquifer model.

When the layering is based on the more complex geology derived from the Faridpur borehole log, there is no significant change in the pattern of flow to the main aquifer (Table 5.7) but flow to the deeper part of the system has increased from 4% to 12%. This is due to the sequence of coarse sand at 110–134 m (Figure 3.13). The particle tracking shows that significant flow occurs through this layer in contrast to that based on the simpler 3-layer models. This high hydraulic conductivity layer draws water deeper into the aquifer as illustrated in Figure 5.4.

Additional simulations were undertaken to address the uncertainty in the recharge rate and the role of the coarse sand layer. Doubling or halving the recharge rate had little or no effect on the overall flow pattern, but increasing the

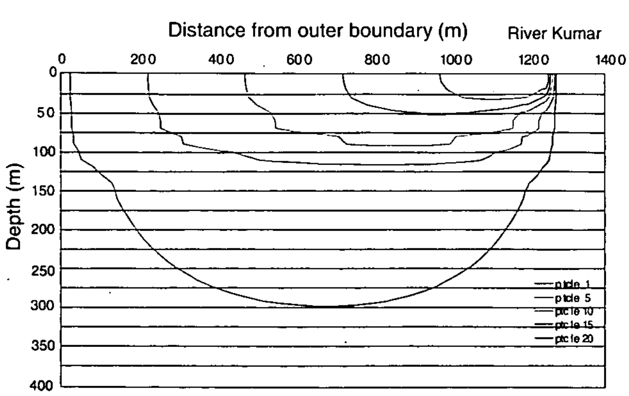


Figure 5.4. Flowlines for the base case model. Flow travels from the left to a discharge point on the right.

recharge rate did increase the depth to which flow occurred. Similarly, doubling or halving the thickness of the coarse sand layer produced little or no difference to the overall flow pattern.

A conclusion from these simulations is that, perhaps not surprisingly, the way that the inherent stratification in the aquifer is represented is important, particularly with regard to the possible flows to the deep aquifer. Since the VS4 simulation comes closest to geological reality, then the assumption of a uniform hydraulic conductivity (VS1) is clearly a poor representation of the flow through the system as a whole. The remaining representations all give a similar flow through the middle layer, the main aquifer, but the amount of flow to the deeper aquifer varies significantly.

While all simulations predict that only a small percentage of the overall flow passes through the deep aquifer under natural flow conditions, this varies from 4% to 12%, a factor of three. Therefore although flow through the deep aquifer is relatively small, it could be significant in the long term as these sediments will have been subject to groundwater flow for a long period of time, e.g. many thousands of years.

It would also be expected that the converse would apply. Low hydraulic conductivity layers should have the opposite effect to high hydraulic conductivity layers. This is confirmed by work undertaken with the generic model presented in Section 5.2. This demonstrated that relatively impermeable horizons will significantly reduce flow to deeper horizons. In practice, these low hydraulic conductivity horizons are not laterally extensive and this will also impact on the overall flow patterns. In particular, groundwater flow will tend to bypass localised low permeability horizons. This is significant because of the generally high positive correlation between the arsenic content and texture, i.e. fine-grained horizons with a low permeability tend to contain more arsenic than coarse-grained horizons (Chapter 11). Therefore, where discrete, these high-arsenic zones will tend to be protected to some extent from flushing.

5.3.4 Effect of abstraction

The work presented above has examined the patterns of groundwater flow under natural flow conditions. However, there is obviously concern that a presently uncontaminated well may become contaminated with arsenic as a result of the movement of groundwater induced by pumping. Clearly the likelihood of this depends on the distribution of arsenic within the aquifer and the nature of the groundwater flow induced by pumping. This itself depends on the nature of groundwater abstraction.

As discussed in Chapter 4, groundwater abstraction in Bangladesh is based on a number of different technologies:

- hand pump tubewells (HTWs) for village supply purposes;
- shallow tubewells (STWs) with motorised pumps for irrigation;
- deep tubewells (DTWs) with motorised pumps, also for irrigation;
- public water supply (PWS) wells used for town and city water supply.

Each type of well has a different abstraction pattern over time. Hand-pump tubewells and PWS wells operate throughout the year, whereas irrigation wells are used for 2–3 months during the dry season and only when required by the climatic conditions. In order to determine the likely effect of abstraction on groundwater flow, a long-term average abstraction rate was used in conjunction with a steady state groundwater model. This is a simple first step in assessing the possible impact of abstraction on the vertical distribution of groundwater flows.

Annual average abstraction was estimated and applied to the VS4 case used for the Faridpur vertical-slice model. The occasional use of tubewells for irrigation in Bangladesh means that it is difficult to obtain accurate estimates of abstraction rates by irrigation wells. For the purposes of the modelling described in this section, these were obtained from an estimate of the regional coverage of wells and their individual abstraction rates (DPHE/BGS/MML, 1999). These were then converted to give a combined outflow for the modelled area. Sixteen shallow tubewells (STWs) and 2 deep tubewells (DTWs) were used to represent the pumping from the modelled area.

The total abstraction was based on an equivalent recharge calculation using the total for the whole of Faridpur *upazila* (55.5 $Mm^3\ a^{-1}$ for STWs and 6.5 $Mm^3\ a^{-1}$ for DTWs).

There are now believed to be some 6–11 million hand-pump tubewells in Bangladesh. Although, in contrast to irrigation wells, these are operated throughout the year for domestic water supply, many are only for a single household. Individually, therefore they use very low volumes of water, mainly from the upper part of the shallow aquifer, and are widely distributed throughout the country. While

Table 5.8. Types of wells used and their abstraction

Well	Depth of well screen (m)	Total modelled abstraction ($m^3\ d^{-1}$)
STW	65 – 75	100
DTW & PWS	110 – 135	15

Total abstraction is based on an equivalent recharge calculation using the total for Faridpur *upazila* (55.5 $Mm^3\ a^{-1}$ for STWs and 6.5 $Mm^3\ a^{-1}$ for DTWs).

the total groundwater used for domestic purposes may be significant, the impact upon the groundwater system is likely to be small and is not taken into account in the model. Table 5.8 gives details of the depths and assumed flow rates for each set of wells. In summary, the following conditions have been assumed:

- the overall abstraction rate was made equivalent to the estimated average for Faridpur *upazila* (62 $Mm^3\ a^{-1}$);
- typical irrigation abstractions for shallow tubewells (STW) and 'deep' tubewells (DTW) together with public water supply (PWS) boreholes were assumed (Table 5.8);
- STWs were set at 65–75 m depth;
- DTWs and PWS wells were set at 110–130 m depth.

Note that the distinction between 'shallow' and 'deep' tubewells used here is based on that used in previous drilling and well construction programmes undertaken in Bangladesh. In Faridpur, the 'deep' aquifer is at a shallower depth than in other parts of Bangladesh and can also be called the lower shallow aquifer since it is not separated from the upper shallow aquifer by a thick clay layer.

Not surprisingly, introducing abstraction markedly changes the pattern of groundwater flow compared with the natural flow pattern. Groundwater flow in the pumped system is illustrated in Figures 5.5 and 5.6 and should be compared with the natural groundwater flow pattern in Figure 5.4. Figure 5.5 demonstrates the pattern of flow to the STWs and Figure 5.6 illustrates the groundwater flow to the DTWs from the river.

Comparing the simulations with and without abstraction demonstrates that with abstraction:

- with abstraction, water flows from the river to the aquifer;
- there is a reversal of the local hydraulic gradient compared with the natural base case;
- there is an increase in vertical gradients;

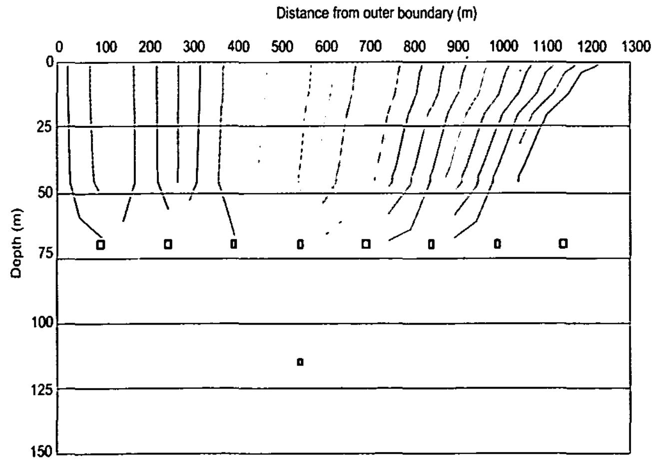


Figure 5.5. Flowlines from the surface to STWs for the base case when pumping is included. Flow travels downwards.

Table 5.9. Distribution of flow in the aquifer under natural and pumped conditions

		Percentage of overall flow at given depths							
		Flow from surface through layer				Flow with deepest extent in layer			
		Average recharge		High recharge		Average recharge		High recharge	
Layer	**Depth (m)**	**No pumping**	**Pumping**	**No pumping**	**Pumping**	**No pumping**	**Pumping**	**No pumping**	**Pumping**
Upper shallow	0–40	100	100	100	100	32	0	40	20
Lower shallow	40–130	68	100	60	80	56	100	48	76
Deep	>130	12	0	12	4	12	0	12	4

- the flow paths are very steep vertically and the lateral extent from each STW is small (about 100 m) implying a narrow distribution of travel times.

In the scenario outlined above, flow to the wells requires more water than is available from recharge when the same rate of recharge is used as in the unpumped model. This leads to the local gradient of the groundwater reversing. Groundwater is drawn from the rivers, i.e. the river becomes influent and acts as a recharge zone rather than a discharge zone. In practice, there will be some additional recharge from the irrigation returns.

In order to illustrate this effect in more detail, the results of two model runs are given below assuming either 'average' recharge rates (0.3 mm d^{-1}) or 'high' recharge rates (0.6 mm d^{-1}). Table 5.9 shows that, as before, the flow to the wells is predominantly through the middle layer but that with pumping a greater percentage of the recharge passes though the middle layer especially under the average recharge conditions. In the average recharge scenario, flow through the middle layer accounts for all of the natural recharge at the surface as well as any induced recharge from the river to the aquifer. This has the effect of reducing flow to the deeper part of the groundwater system either completely, as in the average recharge case, or to an extremely small value as in the high recharge case. In the high recharge case, abstraction produces the following effects:

- water now flows from the aquifer to the river, i.e. there is no longer any induced recharge from the river. Recharge is greater than abstraction;
- pumping still causes a reduction in the regional hydraulic gradient;
- there is an increased flow to the middle layer at the expense of both the upper and lower layers.

Placing the wells in the middle layer has reduced flow through the other layers and in this respect the wells act as interceptor wells, protecting the deeper aquifer from any contamination that might be derived from the shallower horizons.

It is possible to use particle tracking techniques to estimate the time of travel of groundwater from the water table to the well screen. Assuming a porosity of 20%, the resulting travel times vary from 40 to 300 years (Table 5.10). The contrast between the unpumped and pumped situations is illustrated in Table 5.11. This demonstrates that 50% of the flow to the river takes more than 225 years, whereas 50% of the flow to the STWs takes either 86 years for the average recharge case or 47 years for the high recharge case.

This situation is reversed for the time taken for less

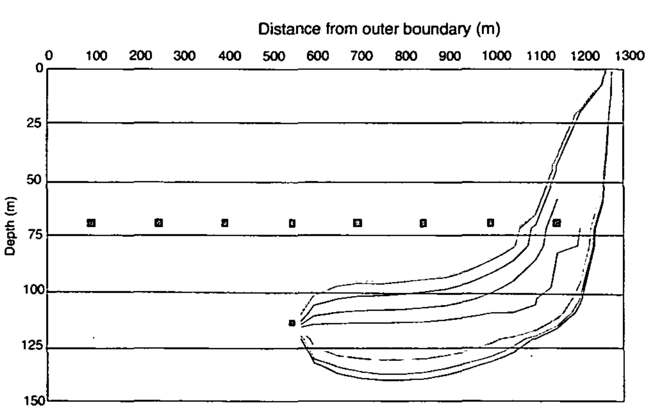


Figure 5.6. Flowlines to a DTW for the basecase model with pumping included.

Table 5.10. Approximate times of travel from the water table in the well catchment area to the various targets with pumping

Target	Approximate distance travelled (m)	Time of travel (years)	
		Average recharge	High recharge
River	800–-1000	—	2000
STW	75–100	40–50	40–70
DTW/PWS	150	300–700	200–300

Table 5.11. Distribution of flows by time of travel from the water table to the well screen

Percentage of flow	Time taken for groundwater to flow from the water table to the discharge point (years)		
	Natural	Pumped scenario	
	River	STWs under avge recharge	STWs under high recharge
5	2500	158	80
25	390	103	70
50	225	86	47
75	95	75	42
95	28	55	41

than 95% of the flow to reach a particular target. For the unpumped case, less than 95% of the flow takes 28 years to move from the water table to the well screen. This compares with 55 and 41 years under average and high recharge conditions, respectively, for the STWs. This is a direct result of the geometry of the two situations. The distance between the water table and the river is smaller near the river than the distance between the water table and the STWs.

For the upper shallow aquifer, assuming well screens at 65–75 m below the water table, it was estimated that 50% of the flow from the water table took less than 50 years to reach the well (Table 5.11). However, this is highly dependent on the recharge rate: the higher the rate, the shorter the travel time. The approximate maximum lateral distance of flow from the water table to the STWs was estimated to be around 50–125 m.

For the lower shallow aquifer, assuming a well screen at 110–135 m below the water table, the travel time under pumped conditions was estimated to be in excess of 200 years from a lateral distance of approximately 500 m. Under natural (unpumped) conditions, flow to the same depths was estimated to take in excess of 300 years, with a lateral movement of 1000 m. These travel-time estimates are consistent with the observed presence of tritium in the upper part of the shallow aquifer and its absence from the deep aquifer (see Chapter 7).

These travel times indicate that presently uncontaminated wells could start to show evidence of contamination over a timescale of decades. In practice, the actual timescale will also depend strongly on the distribution of arsenic and the retardation due to sorption processes (see Chapter 12).

The overall conclusion is that irrigation wells with realistic abstraction rates significantly affect the flow patterns within the groundwater system. They tend to draw water more quickly through the main aquifer. In this way, the wells are acting as interceptor wells and could protect the deeper parts of the aquifer system from arsenic contamination, particularly under average recharge conditions. The depth of placement of the well screen is therefore an important factor controlling the movement of potentially contaminated water.

5.4 GROUNDWATER FLOW NEAR TO A MEANDERING RIVER

5.4.1 Background to the problem and objectives

Rivers of various sizes are extremely common in Bangladesh. Therefore the interactions between rivers and groundwater are likely to have an important influence on local groundwater flow and ultimately on the arsenic distribution.

In our Phase I report (DPHE/BGS/MML, 1999), a modelling study of the Chapai Nawabganj Special Study Area showed an area of low groundwater flow velocities in the locality of Nawabganj town. This town is situated inside a meander of the River Mahananda and is the location of unusually high groundwater arsenic concentrations. A maximum arsenic concentration of 2400 $\mu g\ L^{-1}$ was found in the town during the present project and the average arsenic concentration found inside the meander was 455 $\mu g\ L^{-1}$. This compares with an average concentration of 144 $\mu g\ L^{-1}$ for the *upazila* as a whole.

Several explanations can be proposed for such a highly variable distribution of arsenic in this *upazila*. One hypothesis focuses on variations in the concentration of arsenic present in the original sediments (the source term), another focuses on variations in the processes leading to the mobilisation of arsenic from the sediments, e.g. variations in redox conditions, while a third focuses on the post-depositional flushing of arsenic from the aquifer. The reality of course is that all three sources of variation are likely to be important, although to differing extents in different circumstances. Here, we examine factors affecting the third hypothesis, namely the degree of flushing of the aquifer. In particular, we investigate the impact of variations in river geometry on groundwater movement and consequently on the degree of flushing. This has been inspired in part at least by the Chapai Nawabganj 'hot spot' but also by the known occurrence of some other hot spots near major rivers. A cluster of high arsenic wells was also found close to the Wabda river in the village survey of Mandari (see Chapter 8).

The aim of the work, therefore, was to examine groundwater flow around a river meander, and to determine to what extent this influences the rates of groundwater movement close to the meander.

5.4.2 Water movement near to a river meander

Two series of models were developed for this study:

- a generic model – developed to investigate groundwater flow patterns around an idealised river;
- a site-specific model – used to investigate the distribution of groundwater velocities in the vicinity of the River Mahananda as it flows around Chapai Town.

Both of these models were single-layer, steady-state groundwater models. In order to make the transition between the simple, generic model and the site-specific model based on the hydrogeology of Nawabganj *upazila*, the following steps were undertaken:

- increase the complexity of the distribution of transmissivity;
- create a distribution of recharge;
- impose a gradient in river stage;
- reproduce the shape of the river system.

Simplifications made include the assumption that the Barind Tract could be treated as a vertically homogeneous layer, and the omission of streams flowing across the Barind Tract. The rivers were modelled as having constant stage values whereas in reality, seasonal variations in river stage and groundwater levels are also important in determining groundwater flow. River flows and levels, together with groundwater levels, are highly seasonal, driven by the monsoon rains and tides.

The main aim, however, of this exercise was to investigate the possible influence of river meanders on local groundwater flow. It was necessary, therefore, to simplify the problem significantly. Seasonal changes in both river and groundwater flows were therefore not included in the models described below. This has the advantage that the effects of the geometry of river meanders could be thoroughly investigated without the additional complications of seasonal changes in river and groundwater levels and their interactions.

5.4.3 Generic meander model

Methodology

The generic model was developed as follows:

- circular meanders, no river stage gradient (PM1);
- circular meanders, river stage gradient (PM2);
- elliptical meanders, river stage gradient (PM3).

For each model, the groundwater gradient perpendicular to the river was examined. Particle tracking was also used to determine the pattern of flow close to the river.

Description of the initial model

A simple model was first developed to provide a baseline groundwater velocity distribution without having to deal with the complexities of building a detailed model of the Chapai Nawabganj area. This simple model consisted of a single layer with constant aquifer geometry and property values. The boundaries were set as no-flow to avoid the complication of any regional flow. All the recharge therefore flowed to the river, which was the only outflow. The position of the river and boundaries are illustrated in Figure 5.7.

The aquifer geometry and properties were based on those used for the Phase I modelling study of the Chapai Nawabganj area (DPHE/BGS/MML, 1999). The aquifer was assumed to be 50 m thick, had an annual average recharge (taking into account the effects of evapotranspiration and surface runoff) of 0.1 mm d^{-1}, and a hydraulic conductivity of 5 m d^{-1}. The low value of recharge results from the small difference between long-term average infiltration and long-term average evaporation. A river with three semi-circular meanders was positioned with the river axis running north-south halfway across the model grid. In this way, an equal amount of recharge was input on each side of the river.

Results from the generic meander model (PM1)

Attention was focused on the central meander as this was assumed to be independent of boundary effects. The head contours were found to be markedly different on the inside and outside of this meander, with a much wider spacing on the inside of the meander. This observation was quantified by plotting west-east profiles of head gradient, in particular a profile across the apex of the central meander (Figure 5.8). This showed that the groundwater velocity outside the meander, which ranged from 5 mm d^{-1} to 20 mm d^{-1} was up to 4 times greater than the velocity inside the meander, 1 mm d^{-1} to 5 mm d^{-1}. These results demonstrate that groundwater flow velocities are significantly lower inside the river meander. This is further illustrated by a velocity plot (Figure 5.9)

Particle tracking was used as a form of flow visualisation to determine the distribution of flows around the meander. This also illustrated the differing nature of flow inside and outside the meander. Groundwater flow from outside the meander converged towards the apex of the river, whereas flow from the inside of the meander was divergent (Figure 5.10). Particle counting showed that 90% of the baseflow into this stretch of river originated from the outside of the meander.

Effect of introducing gradient in river stage (PM2)

The previous model, PM1, was further developed by putting a gradient on the stage of the river so that the river sloped from north to south. Although this did affect

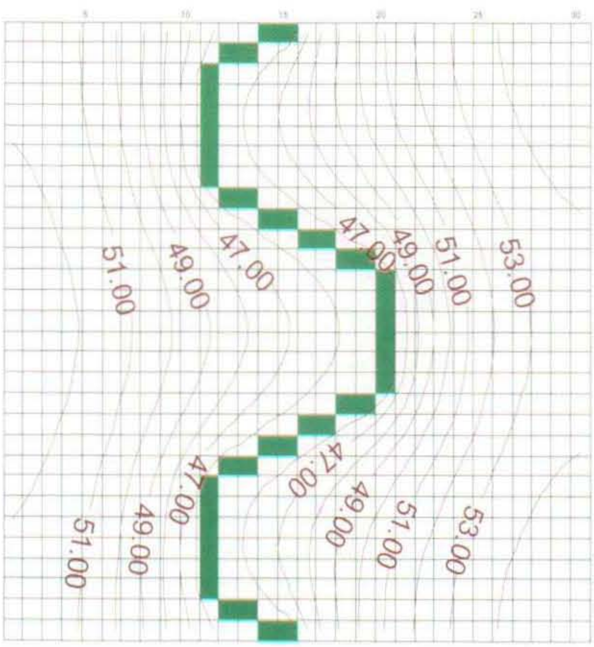


Figure 5.7. Generic meander model. Contours of head in metres.

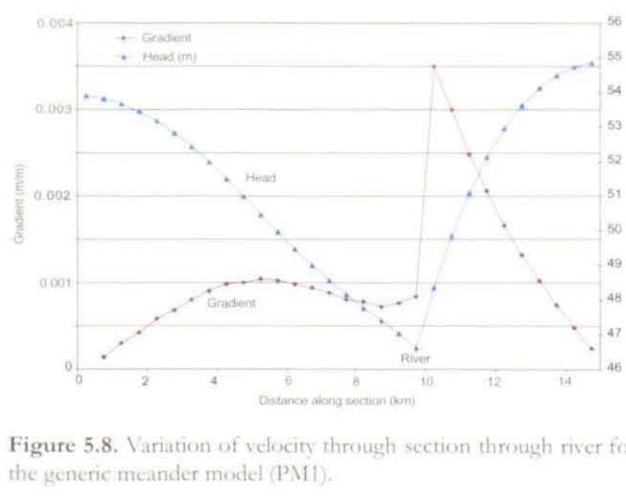


Figure 5.8. Variation of velocity through section through river for the generic meander model (PM1).

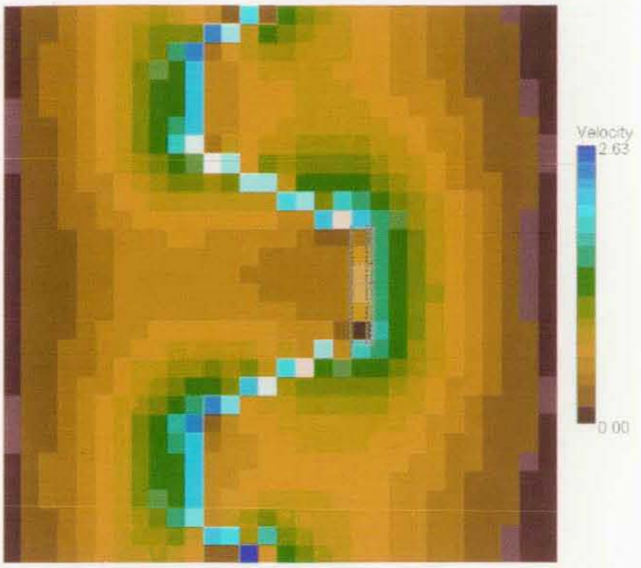


Figure 5.9. Groundwater flow velocity around an idealised meandering river (PM1). Velocity in units of m d^{-1}.

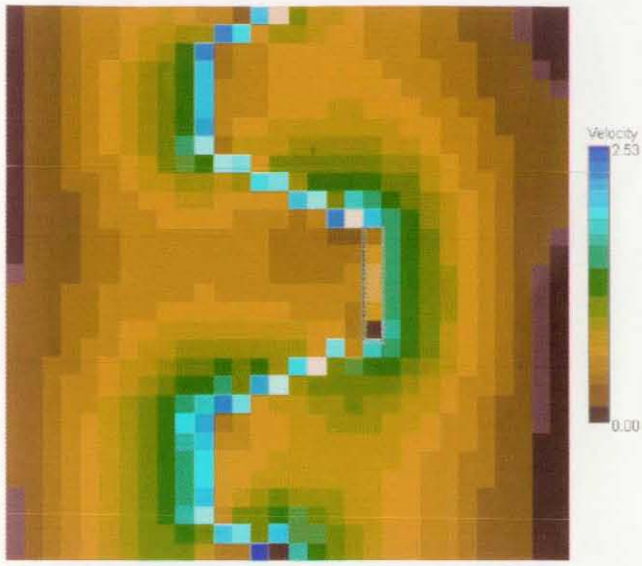


Figure 5.11. Groundwater flow velocity around an idealised meandering river with gradient in stage (PM2). Velocity in units of m d^{-1}.

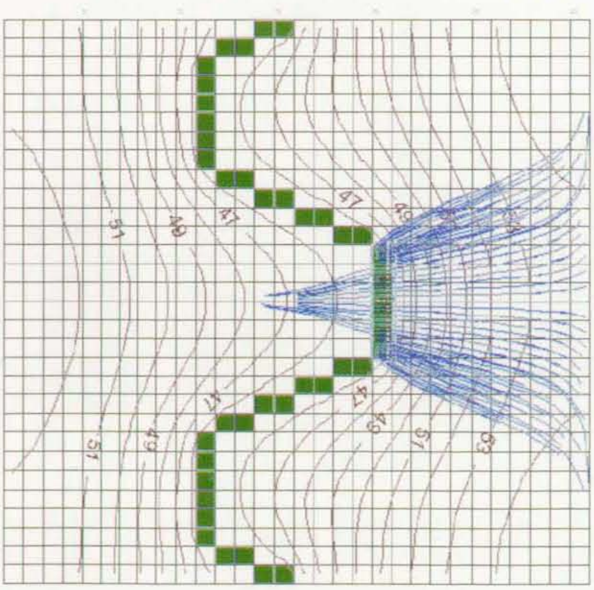


Figure 5.10. Reverse particle tracking demonstrating the divergent flow of groundwater inside the meander and convergent flow outside (PM1). Contours of head in metres.

heads, there was little change in the velocity distribution. The low velocity area inside the meander was reduced in size, however, being confined more to the northern (upstream) part of the meander (Figure 5.11).

Effect of changing meander shape (PM3)

This run (PM3) was based on the basic model described above (PM1), but the river meanders were made more oval in shape so that they more closely resembled the actual river geometry. However, the river remained symmetrical about its axis, which was again positioned halfway across the model. As well as more closely resembling the true situation, this model enabled the effect of meander shape to be assessed by comparison with the previous results.

Compared to the results from the basic model (PM1), the head gradients were lower on both sides of the river in simulation PM3. This is because there were more river cells for groundwater to receive the discharge, but the difference in gradients on each side was more marked. The groundwater velocity on the outside of the meander ranged from 2.5 mm d^{-1} to 10 mm d^{-1}, while on the inside of the meander it was 0.5 mm d^{-1} to 2 mm d^{-1}, i.e. a factor of five different. These results indicate that the curvature of the meanders controls their impact on local groundwater flow velocities.

Particle tracking showed the same pattern of convergent flow from the outside of the meander to the river with divergent flow inside the meander. The flow to the apex of the river meander from each side of the river was estimated and again showed that 90% of baseflow to the river came from the outside of the meander.

5.4.4 Site-specific meander model: Chapai Nawabganj

The geology of Chapai Nawabganj has been summarised in Section 3.3.3.

The Chapai Nawabganj meander model (PM4)

The geology of the Chapai Nawabganj area was simplified for modelling purposes. The upper aquifer was assumed to be a single horizontal layer with a uniform thickness of 50 m and an elevation of 20 m above MSL. The cell dimensions (500 m by 500 m), grid size (60 cells by 65 cells), and the positions of no-flow cells (around the edge

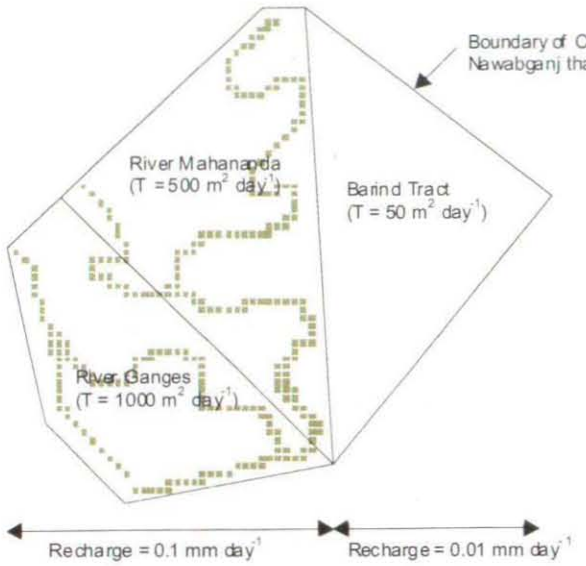


Figure 5.12. Conceptual model of Chapai Nawabganj *upazila*.

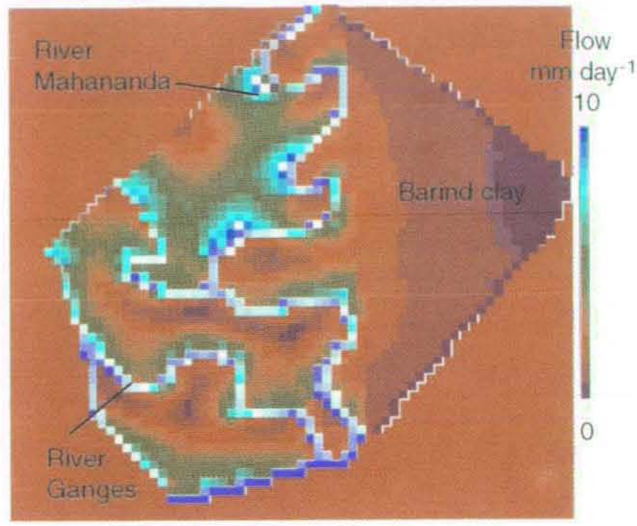


Figure 5.13. Groundwater flow velocity in Chapai Nawabganj.

of the model) and river cells, were based on the previous model of the area (DPHE/BGS/MML, 1999), and are shown in Figure 5.12. A no-flow boundary was chosen for the same reasons detailed in Section 5.3. The steps in river stage that were present in the Phase I model were smoothed to provide a more realistic representation of the river.

The transmissivity (T) was defined in three zones (Figure 5.12). An average value was used for the central floodplain area, which is dominated by alluvial deposits associated with the River Mahananda. This was determined from the lithological description given in the log of the project test borehole in the study area combined with the associated hydraulic parameters. The Mahananda floodplain was classified as Zone 1 with $T = 500\ m^2\,d^{-1}$. The Barind Tract, to the east, is made up from less permeable strata and the transmissivity was assumed to be an order of magnitude smaller than that of the Mahananda floodplain. The T of this Zone 2 was set to $50\ m^2\,d^{-1}$. The western area (Zone 3) made up from thicker and more highly permeable River Ganges deposits was given a transmissivity value of twice that of Zone 1, i.e. $1000\ m^2\,d^{-1}$.

Initially, the recharge over the entire model was set equal to that used in the simple models, namely an annual-averaged value of $0.1\ mm\,d^{-1}$. However, this produced unrealistically high head gradients over the Barind Tract. Further examination of the geology and topography of the Barind Tract showed that very little of the rainfall ever enters the underlying strata due to the extremely low permeability of the surface deposits. Furthermore, the topography slopes to the east in the Barind tract, so most of the runoff will not enter the Mahananda/Ganges floodplain. These factors were not taken into account by MODFLOW which placed all recharge directly into the surface layer. This problem was tackled by reducing the net recharge over the Barind to a tenth of that over the rest of the model, i.e. to $0.01\ mm\,d^{-1}$).

Results

The groundwater flow velocity distribution obtained from this model (PM4) is shown in Figure 5.13. The effects of a meandering river on groundwater velocity that were observed in the simple models (PM1 to 3) described above are also shown in this model. The groundwater velocity outside the meander was $10\ mm\,d^{-1}$ compared with a velocity of $0.6\ mm\,d^{-1}$ on the inside the meander. As expected, the low velocity area inside the central meander, where the high arsenic concentrations have been observed, is focused on the northern side due to the gradient in river stage.

However, this area of low velocity groundwater flow within the meander does not correspond exactly with the observed distribution of arsenic in the area and so there are clearly other factors involved – for example, the variation of iron oxide content of the sediments could also be a significant factor. Besides the possible factors mentioned above, the instability of the river systems means that the position of meanders will change with time. On a timescale of thousands of years, this will tend to even out the effects described above and is one factor which might explain why there is not a simple correlation between present-day river geometry and groundwater arsenic concentrations. It may be that the areas with high arsenic concentrations are found where the river systems have been particularly stable.

Nevertheless, the impact that river geometry might have on local flow velocities – a factor of five was estimated here – could be significant given the relatively young age of many Bangladesh sediments in relation to the estimated flushing times of the aquifers (Chapter 4). In more mature aquifer systems, these differences will become less significant.

The results of the sensitivity analyses were also normalised by dividing the change in head (Δh) by the change in parameter value (ΔP) expressed as a fraction of the original value ($\Delta P/P$) (Figure 5.15). This normalisation enabled the response to changes in different parameters to be compared directly. In general, the head was considerably more sensitive to changes in river gradient than to changes in either recharge or transmissivity. For example, a $\Delta P/P$ of –0.5 (halving the parameter value) in river gradient had 3–7 times more effect on the head in a cell in the area around Chapai Town than the same relative change in recharge or transmissivity. However, the same change in parameter values has a different effect in a cell in the north-west of the area where the change in river gradient had the least impact. Recharge there had over 16 times more effect and transmissivity had over 7 times the effect.

5.5 SUMMARY AND CONCLUSIONS

5.5.1 Vertical-slice model

Investigations using the generic vertical-slice model shows that in order to achieve the low groundwater gradients observed, the aquifers have to have a high transmissivity coupled with a low recharge. Rivers also need to be spaced regularly, to provide outflows to the groundwater system. Sensitivity analyses showed that:

- realistic variations in the amount of recharge have little or no effect on the overall pattern of groundwater flow;
- changing the thickness of the aquifer makes a small difference to the overall pattern of flow; increasing the thickness of the aquifer decreases the flow in the upper layer;
- introducing a low hydraulic conductivity layer dramatically reduces flow below this layer.

Three modelling scenarios were investigated: homogeneous (single-layer) model, 3-layer model and a complex layered model based on the BGS Faridpur test borehole log (16 layers). It was found that increasing the complexity of the hydrogeological layering changed the path of flow to the deep aquifer markedly. It decreased the amount of flow from recharge to the river via the deep aquifer from 24% for the homogenous case to 4% for the 3-layer model. Adopting the 16-layer discretisation increases the flow to the deeper part of the system to 12%, an increase by a factor of three.

There is therefore a significant variation in flow pattern depending on the conceptual model of the system chosen. Therefore in order to characterise the flows in the system with greater precision will require a good understanding of the layering within the aquifer system, and any lateral variation. This may ultimately limit the confidence that can be placed on groundwater flow estimates to the deep aquifer.

When the STWs and DTWs typical of those used for irrigation were put into the vertical-slice model, the following were estimated for the pumped flow conditions:

- for the upper shallow aquifer, assuming well screens placed 65–75 m below the water table, it was estimated that 50% of the flow took less than 50 years to reach the well from the surface;
- for the lower shallow aquifer, assuming a well screen at 110–135 m below the water table, the travel time to the well screen under pumped conditions was estimated to be in excess of 200 years from a lateral distance of approximately 500 m.

These results are highly dependent on the recharge rate: the higher the rate, the shorter the travel time. The main implications for arsenic contamination at wells are:

- Irrigation wells with realistic abstraction rates significantly affect the flow patterns within the groundwater system;
- significant flow from surface layers could arrive at wells could over the time-scale of decades;
- retardation due to sorption will be an important mechanism controlling the rate at which any changes in arsenic concentration take place.

The wells draw water more quickly from the shallow aquifer. This has two important consequences. Wells positioned in the shallow aquifer act as interceptor wells and could protect the deeper parts of the system from arsenic contamination. However, siting wells in the deep aquifer will eventually draw water from the more contaminated shallow aquifer and increase arsenic concentrations in the deeper part of the system, though not necessarily significantly. It is not yet clear over what timescale these effects will take place.

5.5.2 Groundwater flow near to river meander

Modelling studies have demonstrated the effect of a river meander on local groundwater flow patterns. Groundwater velocities were estimated to vary from 1 mm d^{-1} on the inside of a meander to 5 mm d^{-1} on the outside of the meander. When a specific river geometry was introduced, based on the River Mahananda at Chapai Nawabganj, the velocity variation ranged from 0.6 mm d^{-1} to 10 mm d^{-1}. The effect on groundwater velocity was not limited to meanders but was also observed when an area of the aquifer was surrounded by a river on three sides. Being at least partially surrounded by a river imposes a low hydraulic gradient in the interior – a kind of 'moat' effect.

While we have concentrated here on the role of meanders in controlling the local rates of water movement, this is only one factor in controlling the overall distribution of arsenic in groundwater. There are clearly others which also have an important role. For example, there may be accumulations of fine-grained material, including iron oxides, on the insides of meanders and these could lead to a greater-than-average source of arsenic in that region.

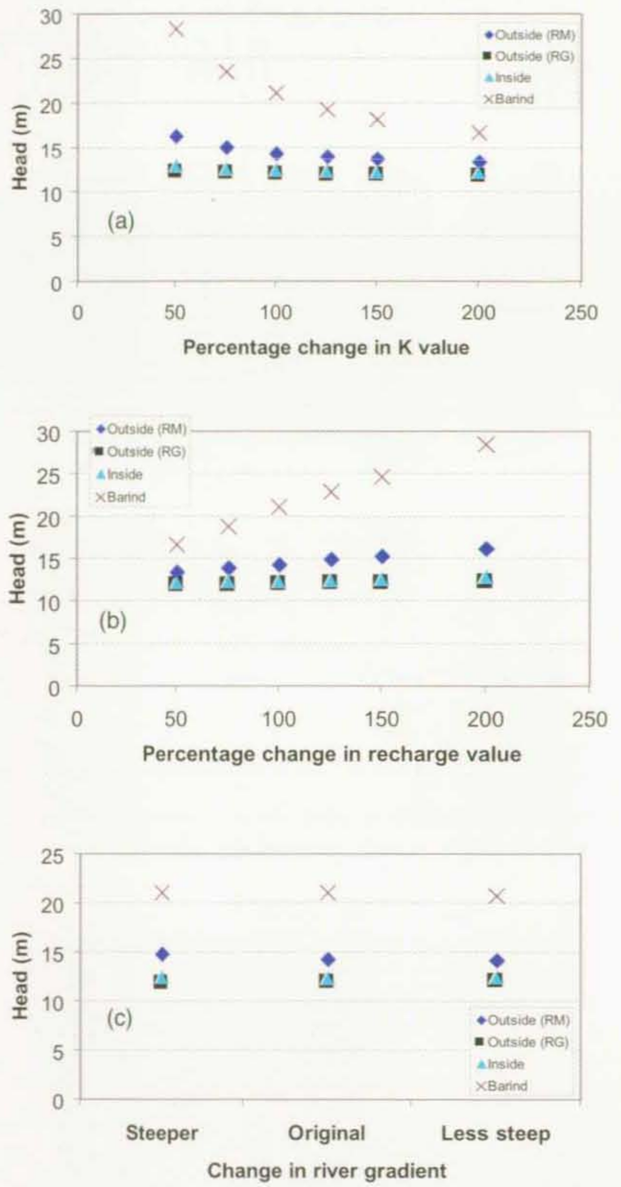


Figure 5.14. Sensitivity of groundwater head to changes in parameters. Variation with changes in (a) transmissivity, (b) recharge and (c) river gradient. Key to Legend: Outside (RM) = Outside of Meander, in River Mahananda T zone; Outside (RG) = Outside of Meander, in River Ganges T zone; Inside = Inside meander of interest; Barind = Barind Tract.

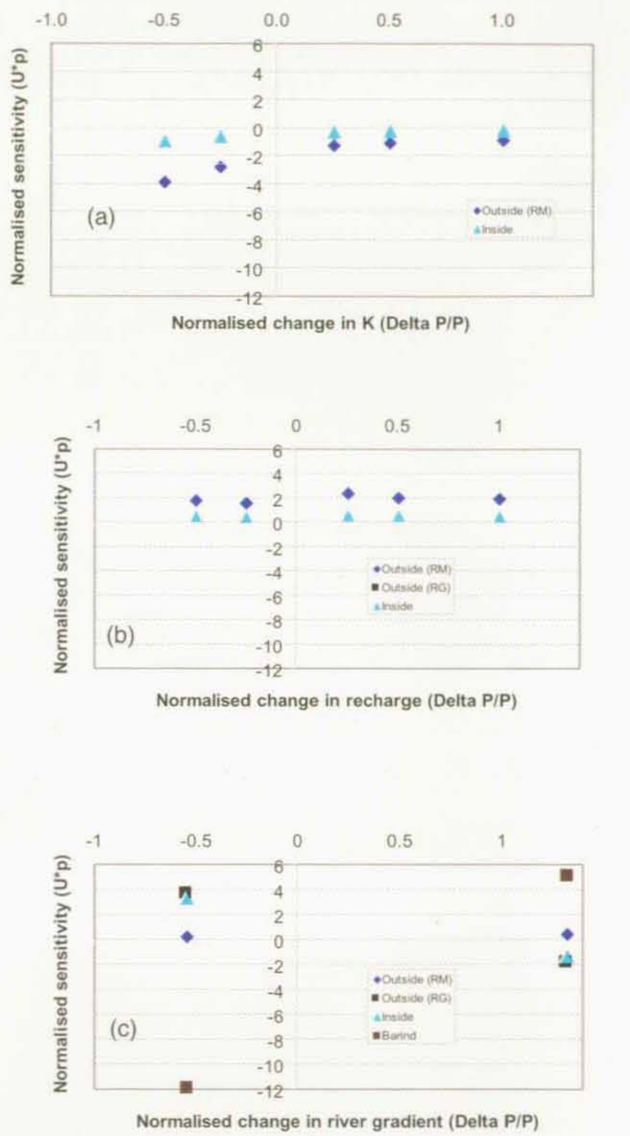


Figure 5.15. Normalised sensitivity of groundwater head to changes in parameters. Variation with changes in (a) transmissivity, (b) recharge and (c) river gradient.

Sensitivity

Model runs were also undertaken with PM4 to assess the sensitivity of groundwater head to changes in various parameters. Figure 5.14 shows that varying recharge and transmissivity (between 50% and 200% of the original values) had very little effect on heads near the rivers, with the effect tending to decrease close to the rivers. This was expected as the stage in the river cells was a constant, hence the river controls the head in its vicinity.

Since the area of high arsenic groundwaters in Chapai Nawabganj is on the inside of the meander and therefore close to a river, groundwater heads and flows in these areas are not sensitive to changes in recharge or transmissivity. These findings do not affect the conclusions reached, and therefore uncertainties in recharge and transmissivity are not of concern. However, as the areas of the model furthest from the river (most notably the Barind Tract) are most sensitive to changes in these parameters, improvements to the accuracy of the model in these areas would need a more detailed assessment of the appropriate values for these parameters.

The sensitivity of simulated heads to changes in the river gradient was also evaluated. Steepening the river gradient caused the low velocity zone to shrink, becoming more restricted in the northern part of the meander. A shallower river gradient had the opposite effect (Figure 5.14).

6 The National Hydrochemical Survey

6.1 INTRODUCTION

There have been various surveys of water quality in Bangladesh. Each of these have had different objectives, regional coverages, sample densities and determinand suites. Until around 1997, no surveys included arsenic as one of the measured elements. Most also did not include accurate geo-referencing of sampling points making mapping difficult. Nonetheless, the various surveys provided useful data that gave a broad indication of the major element groundwater quality in Bangladesh.

Since the alarm was first raised in Bangladesh about excessive arsenic concentrations in groundwater in the mid 1990's, there have been a number of arsenic surveys in Bangladesh. However, none of these was sufficiently comprehensive or had a sufficient dense sample density to give a reliable national picture of groundwater quality. This chapter gives an account of the results from the DPHE/BGS National Hydrochemical Survey (NHS) carried out within this project. This has provided the first comprehensive groundwater quality survey of Bangladesh. Where appropriate, we compare our results with earlier surveys.

6.2 EARLIER WATER-QUALITY SURVEYS

Halcrow and DHV (1995) carried out a survey of baseline groundwater quality in Bangladesh, concentrating particularly on heavily cropped areas of the country and the effects of pesticide and fertiliser use. They concluded from the 78 groundwater samples collected that, apart from coastal areas, groundwater was fresh and 'generally suitable for drinking ... and irrigation'. Ionic charge balances for most samples were however poor and so the major-element results are considered with caution. Halcrow and DHV (1995) identified high concentrations of iron and ammonium in many samples, high phosphorus in some and uniformly low fluoride concentrations ($\leq$0.8 mg L^{-1}). They also found that most were not contaminated with pesticide residues, although low concentrations of DDT and heptachlor (up to 1.5 μg L^{-1} and 1.02 μg L^{-1}, respectively) were detected in a few samples. Arsenic was not measured in the survey.

Davies (1994) investigated groundwater quality in the Dhamrai area of north-central Bangladesh, covering part of the Jamuna Valley (Holocene alluvium) and the Madhupur Tract (Dupi Tila Formation). Differences were identifiable between groundwaters from the two aquifers, with higher HCO_3, Mn, Ca, Mg, K concentrations and some high phosphorus concentrations in the former. Arsenic was not measured in the survey. Indeed, the Jamuna Valley was not recognised as a problem area with respect to arsenic until a few years later (DPHE/UNICEF field-test kit and DCH/SOES surveys).

NRECA (1997) surveyed around 570 tubewells for arsenic and ferrous iron as well as a subset for other determinands including dissolved oxygen, phosphate, sulphate and chloride. Sample sites were in clusters spaced about 25–50 km apart and spread around the country. The survey identified the highest average arsenic concentrations in Chandpur, Faridpur and Feni. Arsenic was also identified (>50 μg L^{-1}) in isolated pockets west of Rajshahi and in Bhola, Bogra, Phulbar, Kishoreganj, Jamalpur and east of Sylhet. Redox potentials were found to be highest in northern Bangladesh, especially the Madhupur and Barind Tracts and the Tista fan area. Spatial distributions of iron were variable but salinity indicators and phosphate were generally higher in the coastal area. They concluded that in general, high arsenic concentrations correlated with low redox potential, electrical conductance greater than 700 μS cm^{-1}, low dissolved oxygen, total iron above 10 mg L^{-1}, phosphate (as PO_4) above 4.5 mg L^{-1} and chloride above 25 mg L^{-1}. They found low SO_4 concentrations (typically 1–2 mg L^{-1} or less) in groundwater from almost all areas.

BUET analysed around 1200 samples from irrigation wells in north-east Bangladesh for arsenic using the SDDC method. They found around 33% exceeded the Bangladesh standard for arsenic and 60% exceeded the WHO guideline value. The worst-affected districts appeared to be Moulvibazar and Sunamganj.

DCH/SOES have reportedly carried out extensive surveys of arsenic in around 22,000 wells across Bangladesh over the last five years (e.g. DCH, 1997; SOES/DCH, 2000). Their surveys have identified severe arsenic contamination in many areas, including northern Bangladesh and the group have reported contamination in 43 out of 64 districts in Bangladesh. The affected populations were estimated to be 51 million drinking water with >10 μg L^{-1} and 25 million drinking water with >50 μg L^{-1} As. Their well-selection strategy is not clear and much of the sampling appears to have been governed by the location of patients with arsenic-related health problems. In this sense, the sampling is likely to have been biased rather than randomised and may therefore be an overestimate.

In addition to these large-scale surveys, more localised water-quality investigations have been carried out at various times by a number of organisations. Nickson (1997) collected around 30 groundwater samples from various locations in the Holocene alluvial aquifer and 17 from Dhaka deep wells. High concentrations of iron, manganese and bicarbonate and often low nitrate and sulphate concentrations were found in the groundwaters from the Holocene aquifers. Dhaka deep wells had uniformly low arsenic concentrations (<0.1–2 μg L^{-1}) as well as much lower iron, manganese and bicarbonate.

Safiullah (1998) analysed over 500 samples in Faridpur Municipality and reported that around 70% of the samples collected were contaminated with arsenic (i.e. >50 μg L^{-1})

and displayed considerable spatial variability. Lack of correlation between dissolved arsenic and iron was also noted. Various other local arsenic investigations have also been carried out by DANIDA, BWDB, Rajshahi University and the Asian Arsenic Network (AAN).

Since the instigation of the National Hydrochemical Survey, a number of other more recent local groundwater investigations have been carried out, including studies by Harvard University, USA, USGS/Geological Survey of Bangladesh, AAN and various MSc students. Large-scale arsenic surveys have also been carried out by NIPSOM-UNDP, DPHE-UNICEF and BAMWSP. Comparison between these larger surveys and the National Hydrochemical Survey is given in Section 6.15.

6.3 AIMS OF THE NATIONAL HYDROCHEMICAL SURVEY

In light of the patchiness of previously existing (pre-1998) analyses of arsenic and other elements, common lack of geo-referencing, the limitations of field-test kits and sometimes bias in choice of sampling locations for whatever reason, a national survey of arsenic and a range of other diagnostic elements in the groundwaters was carried out during this project. The aims of the survey were: (i) to produce maps showing the regional distribution of arsenic and other elements in the groundwaters and (ii) to provide estimates of the percentage of wells exceeding various limits for arsenic and other elements.

Production of maps is relatively straightforward, but obtaining unbiased statistics is much more demanding. When the survey was originally planned, it was thought that there were some 2–3 million tubewells in Bangladesh and so it was obvious that only a small proportion of all available wells could be sampled. Our original intention was that 1500–2500 wells should be sampled from what were then (early 1998) thought to be the worst-affected areas. This translated to about 8 samples per *upazila* since there were about 250 *upazilas* in the chosen area. The earlier extensive arsenic survey of well waters by DPHE staff using field-test kits was used for selecting what were then believed to be the worst-affected districts.

The ideal sought was for some form of randomised sampling but this was difficult to achieve for various reasons: (i) there was no register of available wells or even maps of their locations; (ii) there was no local experience of carrying out randomised surveys (or even an appreciation of their importance); (iii) the sampling had to be carried out quite rapidly which meant that most wells had to be close to a road, and (iv) we wanted to have reliable data for the date of construction of the well and its depth and so the majority of wells selected were government-constructed (DPHE) wells. There are not believed to be any systematic differences between Government and private wells in Bangladesh in part because the same drillers are often involved. The depth of wells in a given area is largely governed by the so-called 'depth book' which is kept in the local DPHE *upazila* office. This reassurance was of critical importance in selecting predominantly DPHE-constructed wells for the regional survey.

Apart from the above points, every attempt was made to ensure that the sampling strategy was as close to being random as possible. In particular, no knowledge of the arsenic concentration of the wells was used when selecting wells. We also wanted the spatial coverage to be as uniform as possible and we therefore attempted to stratify spatially.

The survey was carried out in two phases: the first phase (March–June 1998) covered what were at the time believed to be the worst-affected southern and eastern districts of Bangladesh while the second phase (May–July 1999) completed the remainder of Bangladesh apart from the three districts of the Chittagong Hill Tracts (CHT). The CHTs were excluded because their sediments were thought to not give rise to high arsenic groundwaters, groundwater is used less in the area and existing wells are relatively sparse and often have difficult access. Including the CHTs at this stage would have detracted from what were known to be areas of higher priority elsewhere and we were well aware that our chosen sample density was in any case low in relation to the likely scales of variation.

A collaborative microbiological study of the tubewell water quality was carried out by Hoque (1998) during the 1998 (southern) survey. Samples were rapidly transported to the ICDDR,B laboratory in Dhaka for faecal coliform and ammonia analysis.

6.4 SURVEY METHODOLOGY

6.4.1 Site selection and sampling

Details of the planning and organisation of the sampling are described in detail in the Phase I report (DPHE/BGS/MML, 1999). A similar approach was adopted for the second phase of sampling. Briefly, the sampling was organised on a district and *upazila* basis. At any one time, there were up to five active sampling teams (two for the second phase of sampling) and a timetable was devised on the basis that each team would sample one *upazila* per day. Sampling was completed district-wise. DPHE is organised regionally and there are five main DPHE Circles. A meeting of all DPHE Executive Engineers (XENs) for a given DPHE Circle was held at the office of the Circle Superintending Engineer at the start of the survey. The Project Director and Team Leader or Deputy Team Leader outlined the aims of the survey and the approach to be adopted. A sampling timetable for the Circle was agreed. A week or two prior to the sampling, the XEN would organise a meeting between the Team Leader and the local DPHE Sub Assistant Engineers (SAEs) to outline the aims of the survey and the sampling strategy. The desired 'randomness' of the survey was emphasised ('we are looking for high arsenic areas, medium arsenic areas and low arsenic areas, i.e. we want to sample everywhere as uniformly as possible'). The SAEs would then prepare a list of wells to be sampled. The XEN would also make local arrangements for accommodation for the sample team.

Each sample team consisted of a sampler (either a junior Hydrogeologist from DPHE R&D Division or a graduate from the Geology Department of Dhaka University recruited for the project), a local DPHE SAE as guide and helper, and a driver. Each team also had a four-wheel drive vehicle for transport and in most cases, a hand-held GPS for locating the wells. Some wells from Rajshahi and Nawabganj districts were sampled without access to a GPS and so their locations were estimated from the 1:50,000 LGED *upazila* maps.

Well selection was made using the following strategy: (i) a 3 × 3 grid was pencilled on the *upazila* map to divide the *upazila* into approximately nine equal-area cells; (ii) a route was planned between the cells; (iii) at least one well was selected from each cell ensuring that there was at least 2 km between samples from adjacent wells – normally about 10–12 wells were initially selected by the SAEs in this way; (iv) the final selection of the wells was made by the sampling team leader while on the road. Normally one or two were dropped from the initial list. Preference was given to DPHE-constructed wells.

In a few instances, strong pressure was brought upon the sample team leader to sample more than the required number of wells. Normally this was resisted but in a couple of cases, extra samples were taken, e.g. in the Khulna area. A note was taken of the extra wells selected. A retrospective analysis of these samples suggested that the extra wells were not significantly different from the original set and so they have been retained in the final data set.

In most of Bangladesh, the wells are predominantly in the shallow aquifer – usually in the range 15–70 m depth. Enquiries were also made about the existence of 'deep' wells in the area and where possible extra samples were taken from these even if they were close to a sampled shallow well. In practice, the number of deep wells in existence was small outside of the southern coastal area, affected by salinity and the north-east region, where the shallow aquifer is sometimes poor. Details of each well were recorded on a proforma during the visit. A total of 326 samples were collected from the deep aquifers.

Most of the wells sampled were fitted with a standard Bangladesh number 6 hand pump. Each well was purged prior to sampling by pumping one stroke per foot of well depth. The water was filtered through a 0.2 μm Millipore filter into a plastic 30 ml Sterilin tube and acidified with 'a few drops' (instructions were 10 drops) of concentrated Analytical Grade nitric acid. Nitric acid was used so that the samples could if necessary be analysed by ICP-MS (chloride from hydrochloric acid would interfere with the arsenic determination). Samples were periodically air-freighted to the UK and stored there at 5°C before and after analysis.

Upazila names were based on the 1991 census names with a few more recent amendments. This gave a total of 496 *upazilas* in Bangladesh. Many of the thirty or so new *upazilas* since the 1981 census have arisen from the subdivision of the larger metropolitan areas.

6.4.2 Analytical procedures

Details of the analytical procedures are given in the Phase I report. The initial aim of the project was for all of the arsenic analyses to be carried out in one of the four DPHE Zonal laboratories using 250 ml samples and for a 1:10 check to be made with the BGS laboratories. Separate, smaller acidified samples were collected for this. All samples were duplicated in this way and shipped to the UK as a contingency.

In the event, the DPHE results proved to be insufficiently reliable and so all Phase I samples were eventually reanalysed in the UK. The reasons for the problems with the DPHE results were never completely resolved but were probably in part due to poor sample preservation (not enough acid added for the volume of sample taken) and in part due to poor laboratory procedures. A number of recommendations for improving the DPHE procedures were made in the Phase I report and many of these have since been adopted, in part with UNICEF assistance. For example, the laboratories are now converting to a borohydride method for arsenic analysis which should overcome the problem of obtaining high-quality zinc.

Most of the samples were analysed for arsenic by hydride generation-atomic fluorescence spectrometry (HG-AFS) but some of the early samples collected in the Phase I survey were analysed by hydride generation-ICP-AES. Agreement between the two methods was good. The detection limit for the AFS determination was generally 0.25 or 0.5 μg L^{-1} (depending on the calibration range chosen) whereas for the HG-ICP-AES method it was about 6 g L^{-1} (6σ).

Additional elements were measured on the survey samples by ICP-AES and in a few cases by ICP-MS. Further details of ICP-AES and ICP-MS analytical procedures are given in Chapter 7. As with the samples from the Special Study Areas, the NHS samples were periodically interspersed with standard reference materials. Average results for 60 determinations of NIST standard 1643d were accurate for most certified elements to within 5% of the certified value (12% for Mo). Average results of 46 determinations of the Canadian NWRI standard TM23 gave values accurate to within 10% of certified values where determinands were above detection limits (except for Zn, 35%).

6.4.3 Verification of data and databasing

In a large survey such as this, there is plenty of scope for errors to creep in. Aside from the usual analytical problems, we had problems of samples presented without any location, samples with the wrong location, mis-numbered bottles, broken or leaky bottles, incorrectly typed site details, mismatch of *upazila* names and location, and incorrect and mismatching GIS coverages. Hopefully we have corrected or removed most of the errors but some may remain. We therefore caution against the over-interpretation of single values in the datasets. If the conclusion from a single data value is very important, the same or a similar well should be resampled and reanalysed to confirm its value. GIS coverage was obtained from the WARPO/EGIS database distributed on CD-ROM by EGIS. We have endeavoured to produce maps that are as accurate as possible but their accuracy cannot in all cases be guaranteed.

All the data were entered into the BGS (Wallingford) laboratory database which is maintained using the Microsoft Access database system as a front-end to an Oracle database server. The ICP-AES data were imported directly from the instrument after data processing and quality-control checks. Other data had to be entered manually. Aside from the usual QA checks, we have attempted to find aberrant values based on various consistency checks, where possible, by (i) comparing the results from two independent methods of analysis; (ii) calculating the charge balance where a complete set of major components was available; (iii) double checking apparent anomalies shown up by the mapping, and (iv) using geochemical experience to highlight possible inconsistencies. If inconsistencies were found, these were checked carefully but values were only removed from the dataset if there were good grounds for suspecting that a mistake had been made.

6.4.4 Presentation of data

The national hydrogeochemical data have been analysed using summary statistics, making various cross tabulations and cross plots, preparing maps and in a limited number of cases, undertaking detailed geostatistical analysis. The summary presented here focuses on the groundwater arsenic issue. We hope that the database will provide a source of data for a broad range of future investigations.

The statistical analyses were either made using a standard spreadsheet (Excel) or with the Genstat statistical package. One of the important features of the results is the well-to-well variation in water quality. This has been studied using classical statistical techniques (analysis of variance) and geostatistical techniques. Results of these studies are given in the Chapter 9.

The maps were prepared either with a standard GIS system (ArcView) or with a scientific plotting program (CoPlot). Most of the maps are also included in the accompanying *Hydrochemical atlas*. The atlas should be consulted for a wider range of maps.

A number of decisions had to be made when preparing these maps and these decisions can significantly affect the visual impact of the maps, e.g. the extent of data processing (interpolation and smoothing), choice of the number of class intervals and their values, size of map, symbols and colours used, the order of printing different colours and the display medium (e.g. VDU, paper, transparency).

In most of the following national maps, class intervals were chosen on the basis of rounded quartiles. The inset in these maps shows the actual percentage frequency of each of the indicated class intervals (the bar colours correspond with those of the map symbols).

6.5 SITE CHARACTERISTICS

6.5.1 Distribution of sampled wells

A total of 2039 sites were sampled in the 1998 Phase I survey and 1495 in the 1999 Phase II survey, giving 3534 sites overall. This amounts to a sample density of approximately one per 37 km^2 or an average site-to-site separation of about 6 km. The distribution of sample sites can be seen in Figure 6.1. The areas of low sample density are those where access is particularly difficult, for example the Sundarbans region in the south-west, the flooded *haor* regions in Sunamganj to the north-east and in the Atrai basin to the west.

The distribution of sample sites based on the six administrative divisions is given in Table 6.1 and the distribution based on districts is given in Table 6.2. Sixty one of the sixty four districts were sampled, the remaining districts being in the CHTs. On average, there were 58 sam-

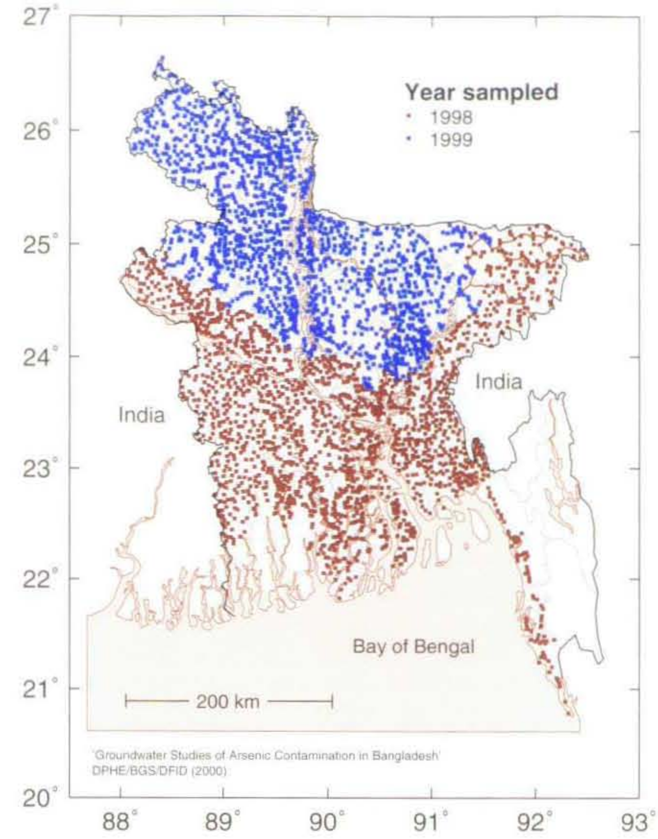


Figure 6.1. Distribution of well sites and year sampled for the DPHE/BGS National Hydrochemical Survey.

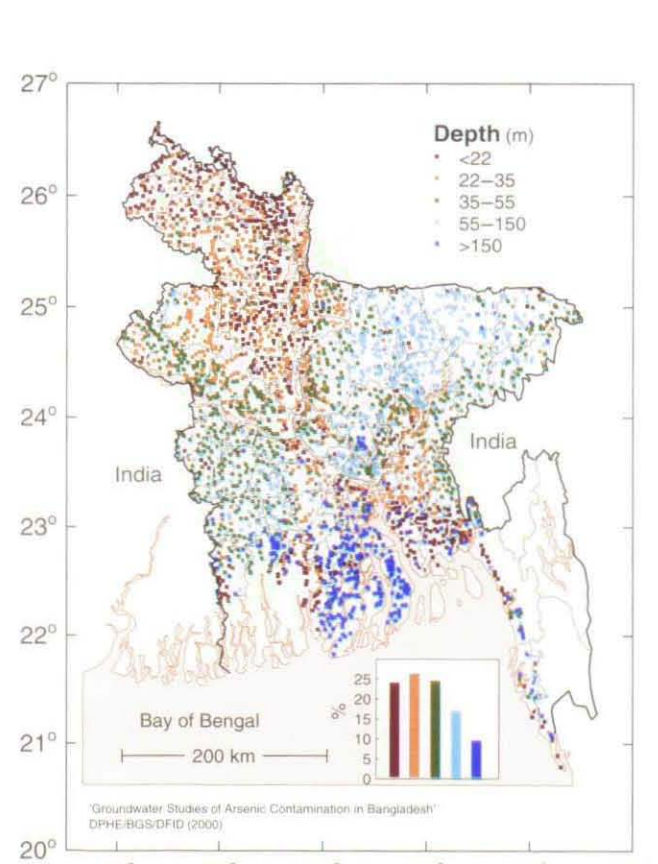


Figure 6.2. The depth distribution of wells sampled in the National Hydrochemical Survey.

Table 6.1. Number of districts visited and wells sampled in each division

Division	Number of districts visited	Number of wells sampled
Barisal	6	295
Chittagong	8	445
Dhaka	17	988
Khulna	10	474
Rajshahi	16	1072
Sylhet	4	260
All	61	3534

ples per district. Of the 496 *upazilas*, 433 were sampled, giving an average of about 8 samples per *upazila*.

6.5.2 Depth of sampled wells

The depth distribution of wells is shown in Figure 6.2 and classified in Table 6.3. Of the sampled wells, 69% were in the depth interval 15–60 m. As can be seen there is a distinct geographical distribution which is largely based on the minimum depth needed to obtain water of acceptable yield and quality (notably salinity). In the southern coastal region, mangrove swamps of the Sundarbans in the west mean that there are few people or wells present there. Further east, the wells either need to be very deep (greater than 150 m) as in the Barisal-Patuakhali region or very shallow, as in the Lakshmipur-Noakhali region further to the east, in order to avoid salinity. Relatively deep wells are also found in the Sunamganj-Sylhet region where shallow aquifers are poor or non-existent. Very shallow wells are also found in north-western Bangladesh where there is little or no overlying silt or clay layer. The cluster of deep wells in central Bangladesh corresponds with the deep wells of the city of Dhaka where extensive drawdown (and pollution) of the shallow aquifer necessitates the use of deep wells.

6.5.3 Age of sampled wells

The age distribution of wells is given in Tables 6.4 and 6.5. The tables illustrate the considerable growth in the number of installed tubewells in recent years. 41% of the sampled wells have been installed since 1995 and 68% (two thirds) since 1990. We could not find comparable statistics for other large-scale surveys and no national statistics for the age distribution of wells yet exist. Comparisons with such statistics as they become available will be an important test of the representativeness of our sampled wells. There are regional variations in the age distribution with the greatest percentage of 'old' (pre-1980) wells sampled in the Khulna area and the smallest percentage in the Rajshahi area.

6.6 ARSENIC

6.6.1 Overall statistics

A very large range in arsenic concentrations was found.

Table 6.2. Number of *upazilas* visited and wells sampled in each sampled district

District	Number of *upazilas* visited	Number of wells sampled
Bagerhat	9	62
Barguna	5	33
Barisal	10	92
Bhola	6	48
Bogra	11	94
Brahamanbaria	7	53
Chandpur	7	59
Chittagong	10	44
Chuadanga	4	34
Comilla	12	110
Cox's Bazar	6	43
Dhaka	6	45
Dinajpur	13	94
Faridpur	8	63
Feni	6	53
Gaibandha	7	71
Gazipur	5	44
Gopalganj	5	42
Habiganj	8	59
Jaipurhat	5	40
Jamalpur	7	63
Jessore	8	69
Jhalakati	4	33
Jhenaidah	6	54
Khulna	9	76
Kishoreganj	13	107
Kurigram	9	77
Kushtia	6	47
Lakshmipur	4	34
Lalmonirhat	5	39
Madaripur	4	36
Magura	4	32
Manikganj	7	47
Moulvibazar	6	53
Meherpur	2	15
Munshiganj	6	46
Mymensingh	12	108
Naogaon	11	92
Narail	3	24
Narayanganj	7	30
Narsingdi	6	56
Natore	6	51
Nawabganj	5	45
Netrokona	10	76
Nilphamari	6	53
Noakhali	5	49
Pabna	9	78
Panchagarh	5	39
Patuakhali	6	42
Pirojpur	7	47
Rajbari	4	34
Rajshahi	9	78
Rangpur	8	86
Satkhira	7	61
Shariatpur	6	49
Sherpur	5	51
Sirajganj	9	89
Sunamganj	10	71
Sylhet	11	77
Tangail	11	91
Thakurgaon	5	46

Table 6.3. Percentage of wells in each division classified by well depth and division

	Well depth interval (m							
Division	**<15**	**15–30**	**30–60**	**60–90**	**90–150**	**150–200**	**>200**	**All**
Barisal	7	23	3	0	1	1	66	100
Chittagong	18	39	27	3	4	2	7	100
Dhaka	4	26	41	21	4	1	3	100
Khulna	4	15	59	7	6	2	7	100
Rajshahi	11	55	31	1	1	0	0	100
Sylhet	2	7	42	19	26	3	<1	100
All	8	33	36	9	5	1	8	100

Table 6.4. The number of wells sampled, classified by age and division

	Year well constructed								
Division	**Not known**	**before 1970**	**1970–74**	**1975–79**	**1980–84**	**1985–89**	**1990–94**	**1995 or later**	**All**
Barisal	2	10	10	8	26	26	100	113	295
Chittagong	1	9	19	21	37	63	134	161	445
Dhaka	19	18	23	59	82	116	253	418	988
Khulna	4	10	15	45	55	74	112	159	474
Rajshahi	13	5	13	64	63	115	295	504	1072
Sylhet	3	6	8	14	22	44	64	99	260
All	42	58	88	211	285	438	958	1454	3534

Table 6.5. The percentage of wells sampled, classified by age and division

	Year well constructed								
Division	**Not known**	**before 1970**	**1970–74**	**1975–79**	**1980–84**	**1985–89**	**1990–94**	**1995 or later**	**All**
Barisal	1	3	3	3	9	9	34	38	100
Chittagong	0	2	4	5	8	14	30	36	100
Dhaka	2	2	2	6	8	12	26	42	100
Khulna	1	2	3	9	12	16	24	34	100
Rajshahi	1	0	1	6	6	11	28	47	100
Sylhet	1	2	3	5	8	17	25	38	100
All	1	2	2.	6	8	12	27	41	100

The minimum concentration found was less than 0.25 μg L^{-1} and the maximum found was 1670 μg L^{-1}, a range of four orders of magnitude. Only two samples (0.06% of all samples) exceeded 1000 μg L^{-1}. 850 samples (24% or one quarter of all samples) fell below the instrumental detection limit which was normally 0.25 or 0.5 μg L^{-1}. It is likely that the lowest concentrations were actually a few ng L^{-1} or lower. It is therefore quite possible that the true range could be as large as six orders of magnitude or more when the low concentrations in the Dupi Tila aquifer are eventually quantified.

The large proportion of 'less than' values complicates the calculation of many statistical parameters, e.g. means and variances. No attempt was made to deal with this using the various statistically-based substitution methods that are available. Rather we have chosen to use non-parametric methods wherever possible and where a value was required, we have used half the detection limit as the substituted value.

Tables 6.6 and 6.7 summarise the results in terms of percentiles. The median concentration was 4.0 μg L^{-1}. 42% of all samples exceeded 10 μg L^{-1} (the WHO guideline value for drinking water) and 25% (one quarter) exceeded 50 μg L^{-1} (the Bangladesh standard). If only shallow wells (<150 m) are considered, the percentages increase to 46% and 27%, respectively. 9% of samples exceeded 200 μg L^{-1}. The maximum reported groundwater As concentration in Bangladesh is about 4 mg L^{-1} from Chatkhil, Noakhali district in SE Bangladesh.

Clearly the groundwater arsenic problem is very serious in terms of both the number of exceedances and the scale of the exceedances. The average concentration was approximately 55 μg L^{-1}. Average concentrations are related to the average dose of arsenic taken in with drinking water and are therefore important from the health point of view.

Below, we examine the distribution of arsenic as a function of various features such as well location and well depth and age. Care should be taken in interpreting these data both in terms of the statistics derived (we cannot guarantee that a truly random distribution of wells was sampled) and even qualitatively in terms of the trends observed. The concentration of arsenic in groundwater depends on many factors, not all of which are adequately

Table 6.6. Distribution of arsenic concentrations in the complete dataset expressed as percentiles (n=3534)

Percentile	Arsenic concentration ($\mu g\ L^{-1}$)
10	<1
20	<1
30	<1
40	1.6
50	4.0
60	13
70	31
80	73
90	181
95	302
99	558
99.9	891

Table 6.7. Percentage of samples below or exceeding various concentration thresholds (n=3534)

Arsenic concentration ($\mu g\ L^{-1}$)	Percentage of samples exceeding threshold concentration	Percentage of samples below threshold concentration
5	48	52
10	42	58
20	35	65
30	31	69
40	27	73
50	25	75
100	16	84
200	9	91
300	5.1	94.9
500	1.79	98.21
1000	0.06	99.94

represented in our database. Statistically significant correlations may therefore result from the operation of other unseen but correlated variables.

It may be significant that the two sampling campaigns for our national survey were carried both out at the end of the dry season and so, if as some initial observations indicate, As concentrations are measurably greater during the wet season than during the dry season, then our regional survey of As must be viewed as being somewhat conservative, i.e. if anything, low.

6.6.2 Geographical distribution of arsenic

There is a distinct geographical distribution of arsenic with the greatest concentrations in the south and south-east and the smallest concentrations in the north and north-west of Bangladesh. This can be seen in a map of the point-source data (Figure 6.3) but the regional trends are more clearly seen in the smoothed map (Figure 6.4). In the arsenic point source map, and other similar maps shown in this Chapter, the lowest concentration class symbols have been plotted first, then the symbols for the next lowest class, and so on. Therefore where there is some overlap of symbols, the higher concentration symbol will fall on top of the lower symbol and will tend to dominate the map.

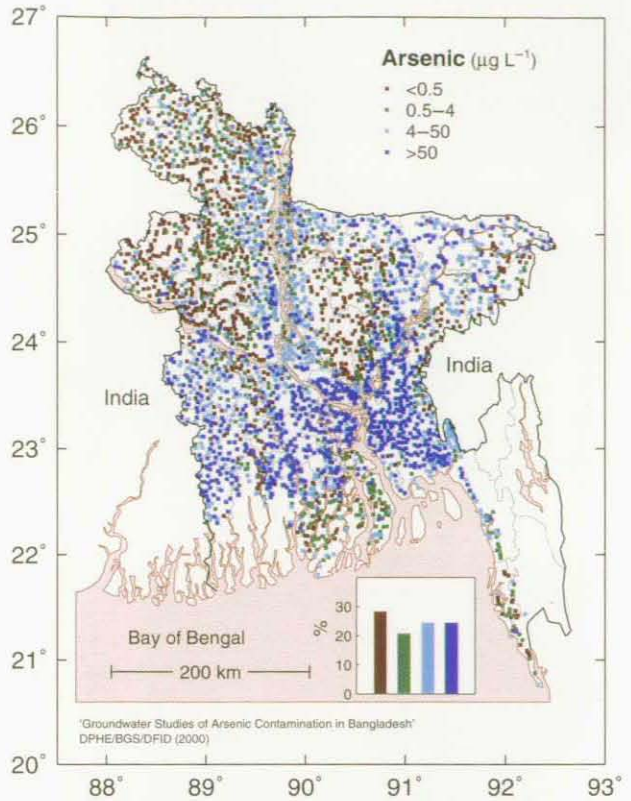


Figure 6.3. Map of point-source arsenic concentrations observed in groundwaters in the National Hydrochemical Survey. Inset shows the percentage frequency of each of the indicated class intervals (bar colours match those of the map symbols).

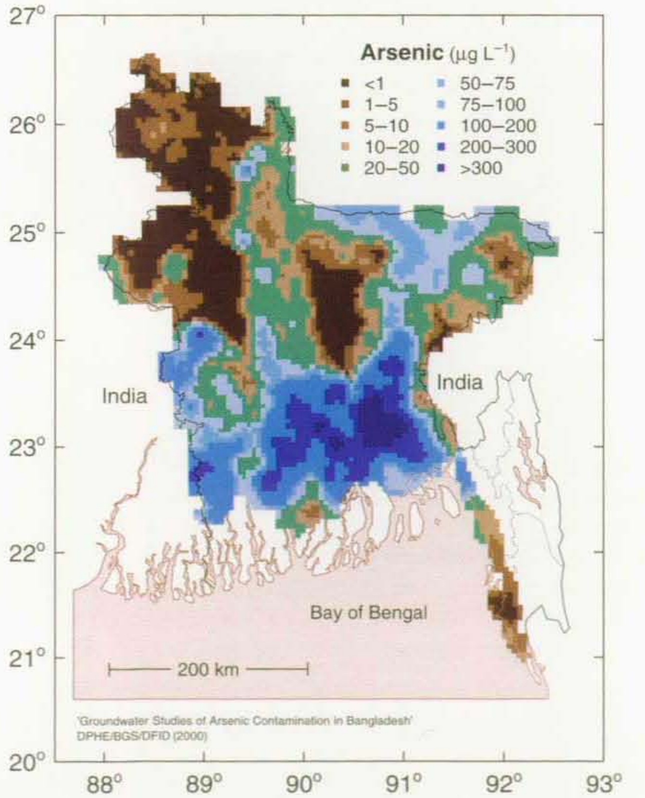


Figure 6.4. Map of smoothed groundwater arsenic concentrations from the National Hydrochemical Survey. Smoothing was carried out by disjunctive kriging.

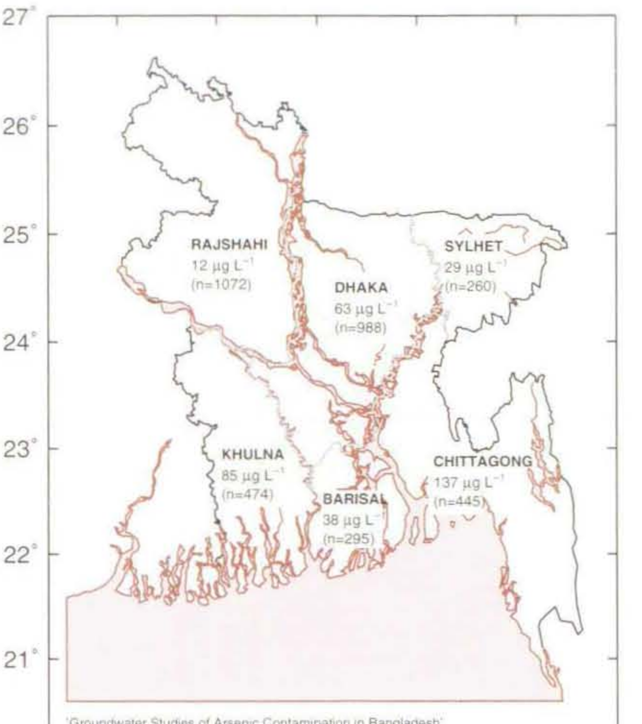


Figure 6.5. Average concentration of arsenic in wells from each of the six administrative divisions. Note that the Chittagong division includes the area east of Dhaka as well as the narrow strip of land sampled along the SE coast of Bangladesh. No wells were sampled in the Chittagong Hill Tracts.

There is a large variation in the average arsenic concentration found in each administrative division (Figure 6.5). This varies from 12 µg L^{-1} in Rajshahi Division to 137 µg L^{-1} in Chittagong Division (which includes the highly contaminated district of Chandpur). All divisions contain at least one well which exceeds the Bangladesh standard, as do 53 of the 61 districts (Table 6.8). 249 or 58% of the 433 sampled *upazilas* contained at least one well exceeding the Bangladesh standard.

The most contaminated district was found to be Chandpur with 90% of the sampled wells exceeding the Bangladesh standard and with an average arsenic concentration of 366 µg L^{-1} (Table 6.9). The remaining 11 most-contaminated districts had 60% or more of their sampled wells above the Bangladesh standard and average As concentrations exceeding 100 µg L^{-1}. In most districts, there were at least some wells with As concentrations less than 10 µg L^{-1} especially in the occasional deep well. A broad north-south band of low As wells is found in SE Bangladesh. This follows the Gorai-Bhairab valleys and may reflect a palaeochannel (Chapter 3).

The most-contaminated districts contrast sharply with the least-contaminated districts (Table 6.10). Only one district, Thakurgaon in the extreme north-west of Bangladesh, had no sampled wells exceeding the WHO guideline value. Eight districts had no sampled wells exceeding the Bangladesh standard. These were either southern coastal districts which are dominated by deep wells or north-western districts where contamination is regionally lower. Perhaps more significant is the contrast in average arsenic concentration which exceeds 100 µg L^{-1} in the most-contaminated districts to just a few µg L^{-1} in the least-contaminated districts.

Table 6.8. Number of administrative areas with at least one sampled well exceeding a drinking-water standard

	Number of administrative areas				
	Bangladesh standard (50 µg L^{-1})		WHO guideline value (10 µg L^{-1})		
	Below	Above	Below	Above	Total
Divisions	0	6	1	5	6
Districts	8	53	1	60	61
Upazilas	184	249	39	394	433

This emphasises the need to identify the worst-contaminated regions for priority action. However, there are some seriously contaminated wells even in the least-contaminated districts (Table 6.10) and so the mitigation strategy must also find these wells. The town of Chapai Nawabganj is one such 'hot spot' which appears to be about 5 × 3 km in size. The sample density of our national survey was insufficient to ensure that all hot spots were detected and indeed the Chapai Nawabganj hot spot was only identified by more detailed sampling. A number of other hot spots have been detected in northern Bangladesh by patient identification and field testing. While such hot spots undoubtedly present a serious situation, they are atypical and should not disproportionately detract the mitigation programme from the more extensive contamination in southern and south-eastern parts of the country.

6.6.3 Arsenic concentration versus well depth

Perhaps the most important distinction in arsenic concentrations is between shallow and deep wells (Figure 6.6). The situation is even clearer if the results are cross-tabulated (Table 6.11). Wells deeper than 150 m–200 m show a sharp reduction in their average arsenic concentration and in the percentage of wells that exceed both the WHO guideline value and the Bangladesh standard (Table 6.12). The 'cut-off' depth depends on geographic location. Even though only 4% of sampled wells in the 100–150 m depth range, 37% of them exceeded 50 µg L^{-1}. Therefore, in many areas it appears that it would not be sufficient to drill just a little deeper for low-As water but wells would need to exceed at least 150 m to provide low-As water.

It is interesting to note that there appears to be a 'bell-shaped' depth profile for the average As concentration, with the maximum average contamination being found in the 15–30 m interval. This trend is upset by the relatively large percentage of wells in the 90–150 m interval that are contaminated but this probably reflects the peculiar aquifer conditions in the Sylhet region from where most of these samples were derived. A broadly similar bell-shaped depth trend has long been known in West Bengal where the aquifer has traditionally been divided into three units with the middle unit, Unit 2, being described as the 'arseniferous' unit (PHED, 1991; Bhattacharya et al.,

Table 6.9. Arsenic statistics for the twelve most contaminated districts

District	Number of wells sampled	Average As concentration (μg L⁻¹)	Minimum As concentration deep/shallow (μg L⁻¹)	%age of wells in given As concentration class (μg L⁻¹)				%age of wells exceeding 50 μg L⁻¹
				<10	10–50	50–200	>200	
Chandpur	59	366	2/51	8	2	10	80	90
Madaripur	36	191	1/<1	31	0	31	39	69
Munshiganj	46	189	3/2	9	9	41	41	83
Gopalganj	42	187	21/<1	17	5	43	36	79
Lakshmipur	34	179	2/<1	24	21	26	29	56
Noakhali	49	162	4/2	16	14	37	33	69
Bagerhat	62	156	<1/<1	19	21	31	29	60
Shariatpur	49	151	2/<1	24	10	35	31	65
Comilla	110	142	<1/<1	29	5	37	28	65
Faridpur	63	140	<1/5	24	11	35	30	65
Satkhira	61	133	2/<1	18	15	41	26	67
Meherpur	15	116	<1/-	7	33	40	20	60

Table 6.10. Arsenic statistics for the twelve least-contaminated districts

District	Number of wells sampled	Average As concentration (μg L⁻¹)	Maximum As concentration (μg L⁻¹)	%age of wells in given As concentration class (μg L⁻¹)				%age of wells exceeding 50 μg L⁻¹
				<10	10–50	50–200	>200	
Thakurgaon	46	1	6	100	0	0	0	0
Natore	51	1	18	96	4	0	0	0
Barguna	33	1	11	97	3	0	0	0
Jaipurhat	40	1	13	98	3	0	0	0
Lalmonirhat	39	1	16	97	3	0	0	0
Nilphamari	53	2	23	94	6	0	0	0
Panchagarh	39	3	34	95	5	0	0	0
Patuakhali	42	3	17	93	7	0	0	0
Dinajpur	94	3	54	95	3	2	0	2
Cox's Bazar	43	3	70	95	2	2	0	2
Gazipur	44	4	155	98	0	2	0	2
Naogaon	92	6	244	95	3	1	1	2

Table 6.11. Two-way classification of tubewells according to their arsenic concentration and depth

Depth range (m)	%age of wells in a given depth range that are in a given arsenic concentration range — As concentration range (μg L⁻¹)							
	<10	10–50	50–100	100–150	150–200	200–300	>300	Total%
<25	53	17	9	5	3	4	8	100
25-50	57	16	9	4	3	5	6	100
50-100	55	22	10	5	3	3	2	100
100-150	26	37	27	5	2	3	0	100
150-200	78	19	3	0	0	0	0	100
>200	97	2	0	0	0	0	0	100

1997). Chowdhury et al. (1999) have also noted a very similar distribution of contaminated wells in West Bengal to that observed here.

It is important to appreciate the geographical spread of shallow and deep wells in our surveys since, as discussed above, this is far from uniform (Table 6.3). Broadly, many of the sampled wells in the 150–200 m depth interval are from the Sylhet region, while those with depths greater than 200 m are mostly from the southern coastal region. Very few deep wells were found or sampled in the rest of Bangladesh. Therefore, it is not possible to extrapolate the results from the relatively few deep wells sampled here to those other parts of Bangladesh that are not well represented by the current samples.

Of the few deep groundwaters investigated in Faridpur as part of our investigations in the Special Study Areas, a few exceedances above 10 μg L⁻¹ were noted (Chapter 7). In addition, some relatively high concentrations have been

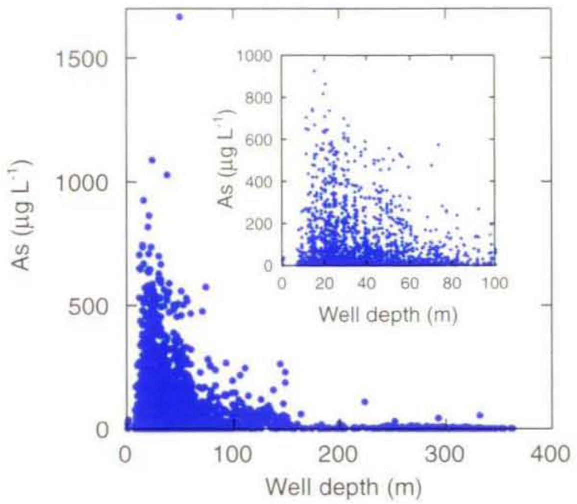


Figure 6.6. Concentration of arsenic plotted against well depth for all sampled wells.

Table 6.12. Average concentration of arsenic in wells as a function of well depth

Depth interval (m)	Number of wells	% of wells	Average As concentration ($\mu g\ L^{-1}$)	% of wells with $>50\ \mu g\ L^{-1}$
<15	287	8	58	25
15–30	1180	33	76	31
30–60	1258	36	56	26
60–90	317	9	33	21
90–150	165	5	45	35
150–200	32	1	7	1
>200	295	8	3	1
All	3534	100	55	25

found in groundwaters from 'deep' tubewells recently installed by DPHE with UNICEF assistance throughout the As-affected areas of Bangladesh. Of 170 'deep' tubewells drilled to assess the presence of, and water quality in, the deep aquifer, 95% were below the Bangladesh arsenic standard. The exceptions were wells at 700 ft in Faridpur which contain As just above the standard. Additional wells are being installed nearby to test whether this a problem of well construction or reflects contamination of the deep aquifer. The issue of the development of the deep aquifer is discussed in more detail in the Chapter 13.

6.6.4 Arsenic versus geology

Each of the sampled wells was assigned to a geological unit based on the Geological Survey of Bangladesh classification as given by the most recent geological map of Bangladesh (Alam et al. 1990). This allocation was based on the GPS measured well position and a digital form of the geological map given in the WARPO/EGIS database. This procedure is susceptible to errors and approximations aris-

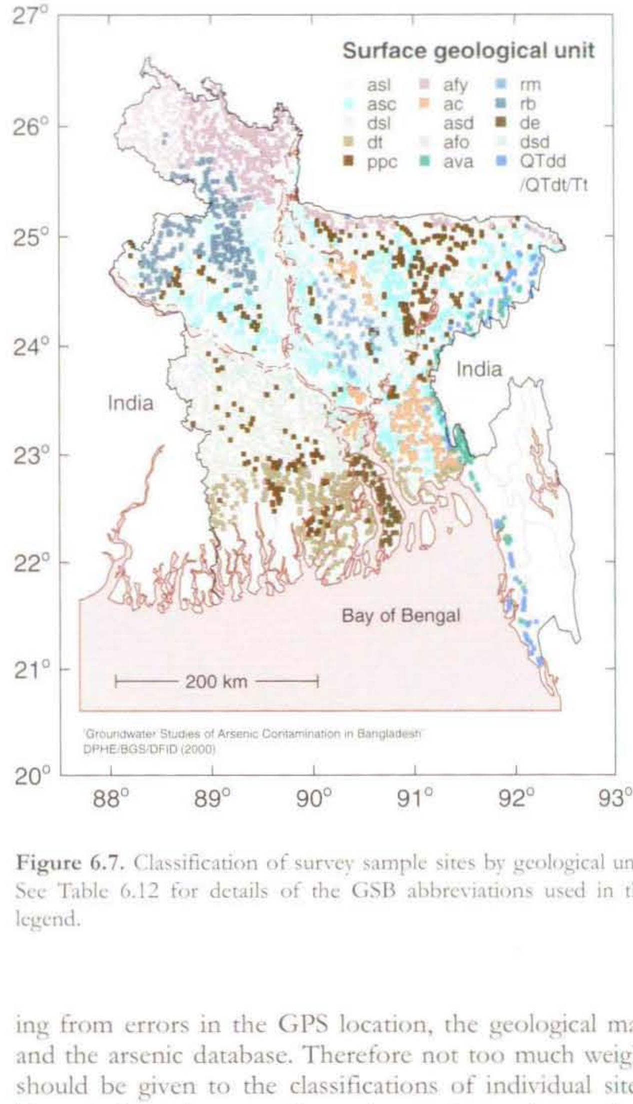


Figure 6.7. Classification of survey sample sites by geological unit. See Table 6.12 for details of the GSB abbreviations used in the legend.

ing from errors in the GPS location, the geological map and the arsenic database. Therefore not too much weight should be given to the classifications of individual sites. Nevertheless, the overall trends are interesting and of greater reliability. It should also be remembered that this geological classification is only based on the surface geology, and in that respect can only be expected to have a direct influence on the behaviour of the underlying aquifer where there is a close relationship between surface geology and subsurface geology. As the depth of the well increases, this relationship is likely to become weaker.

The classification of sites by surface geological unit (Figure 6.7) and by average arsenic concentration within each unit (Table 6.13) shows that the highest arsenic concentrations are found in the recent deltaic and alluvial deposits. These are also the most abundant deposits. The lowest concentrations are consistently found beneath the older Tertiary and Quaternary deposits including the Barind and Madhupur Clay. Interestingly, the 'old gravelly sand' unit, and to a lesser extent the 'young gravelly sand' unit, have low concentrations. These form part of the Tista Fan in north-western Bangladesh. The highest average concentrations are found beneath the Chandina alluvium and Deltaic silt and sand. As always, care must be taken when interpreting such differences since arsenic concentrations in groundwater reflect many factors of which surface geology is just one. The most significant observation is that high arsenic concentrations are confined to recent (Holocene) sediments – conversely, the older sediments

Table 6.13. Classification of sample sites (n=3534) and average arsenic concentrations based on the estimated geological unit (sorted by decreasing average arsenic concentration)

Geological unit	GSB code	No. of wells	% of wells in unit	Average As (μg L⁻¹)
Chandina alluvium	ac	183	5.2	162
Deltaic silt	dsl	428	12.1	105
Deltaic sand	dsd	57	1.6	99
Alluvial sand	asd	117	3.3	67
Tidal deltaic deposits	dt	352	10.0	64
Alluvial silt and clay	asc	476	13.5	61
Marsh clay and peat	ppc	345	9.8	52
Alluvial silt	asl	599	17.0	43
Estuarine deposits	de	68	1.9	38
Valley alluvium & colluvium	ava	83	2.3	23
Beach and dune sand	csd	22	0.6	20
Young gravelly sand	afy	326	9.2	17
Barail Formation	Tba	1	<0.1	14
Dupi Tila Formation	QTdt	14	0.4	6
Dihing & Dupi Tila undiv.	QTdd	42	1.2	6
Tidal mud	dm	2	0.1	4
Old gravelly sand	afo	111	3.1	2
Boka Bil Formation	Tbb	5	0.1	2
Tipam Sandstone Formation	Tt	19	0.5	2
Girujan clay	QTg	4	0.1	1
Barind clay residuum	rb	205	5.8	<1
Madhupur clay residuum	rm	73	2.1	<1
Mangrove swamp	dsw	1	<0.1	<1
Dihing Formation	Qtdi	1	<0.1	<1

are essentially arsenic-free.

6.6.5 Arsenic versus year of construction of sampled wells

The data for the shallow wells (<150 m deep) were divided into six 'arsenic' classes (<10, 10–50, 50–100, 100–200, 200–300 and >300 μg L⁻¹) and seven 'Year constructed' classes (before 1970, 1970–74, 1975–79, 1980–84, 1985–89, 1990–1994 and since 1995). Deep wells were excluded because most of the arsenic concentrations were very low, frequently below the detection limit, and it is reasonable to expect that any relationship between arsenic concentration and age of well would vary with well depth. The number of sampled wells in each class is shown in Table 6.14. The large number of wells that exceed the Bangladesh standard and which were constructed since 1990 is striking. This reflects the large number of wells constructed in recent years, even after awareness of the arsenic problems in Bangladesh was raised.

It is more revealing to express the numbers in terms of percentages (Table 6.15). There is a distinct trend for the older wells to be more contaminated than the younger wells. It is tempting to deduce from this that the shallow wells become more contaminated with time. This may be true but these data do not by themselves prove this to be the case. There could be other correlated variables that may account for the trend. For example, we have already demonstrated (Table 6.5) that proportionately more wells have been drilled recently in the Rajshahi Division and this is a generally low-arsenic area. The only sure way of dem-

Table 6.14. Number of shallow wells (less than 150 m deep) in given arsenic and 'Year constructed' classes and exceeding water-quality standards

	Number of wells in arsenic concentration (μg L⁻¹) class							Bangladesh standard	WHO guideline value
Year constructed	<10	10–50	50–100	100–200	200–300	>300	All	n>50 μg L⁻¹	n>10 μg L⁻¹
Before 1970	12	9	10	10	2	5	48	27	36
1970–75	25	19	14	8	7	10	83	39	58
1975–80	87	42	26	17	20	13	205	76	118
1980–85	130	54	37	21	13	13	268	84	138
1985–90	200	78	42	33	22	33	408	130	208
1990–95	464	153	76	78	36	59	866	249	402
Since 1995	797	230	108	79	36	46	1296	269	499
All years	1715	585	313	246	136	179	3174	874	1459

Table 6.15. Percentage of shallow wells in given arsenic and 'Year constructed' classes

	% of total wells in arsenic concentration (μg L⁻¹)class							Bangladesh standard	WHO guideline value
Year constructed	<10	10–50	50–100	100–200	200–300	>300	All	%>50 μg L⁻¹	%>10 μg L⁻¹
Before 1970	25	19	21	21	4	10	100	0.9	1.1
1970–74	30	23	17	10	8	12	100	1.2	1.8
1975–79	42	20	13	8	10	6	100	2.4	3.7
1980–84	49	20	14	8	5	5	100	2.6	4.3
1985–89	49	19	10	8	5	8	100	4.1	6.6
1990–94	54	18	9	9	4	7	100	7.8	12.7
Since 1995	61	18	8	6	3	4	100	8.5	15.7
All years	54	18	10	8	4	6	100	27.5	46.0

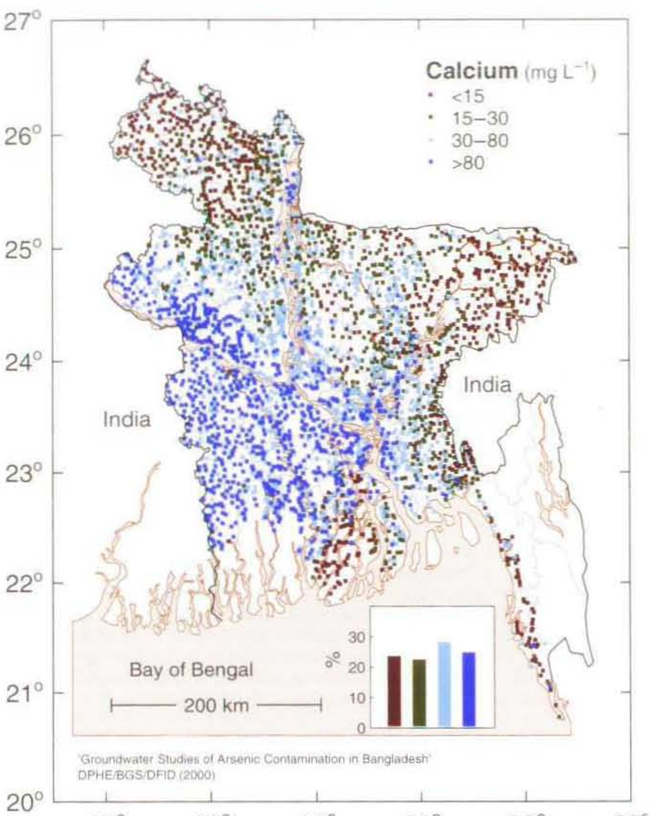


Figure 6.8. Spatial distribution in calcium from the National Hydrochemical Survey.

onstrating changes with time is to monitor these changes in a systematic way. This makes it difficult to quantify changes that take place over more than a few years. As better models for the evolution of the arsenic-rich groundwaters are developed, then a better insight into possible long-term changes should emerge.

6.7 MAGNESIUM, CALCIUM, STRONTIUM AND BARIUM

The groundwater chemistry can sometimes give clues indirectly to the probable composition of aquifer sediments without the benefit of a sediment analysis. This is particularly true for the alkaline earth elements since their concentrations in groundwater are often controlled by carbonate minerals which usually equilibrate rapidly with groundwater. The absence of pH and bicarbonate data from the National Hydrochemical Survey dataset means that saturation indices for these minerals cannot be calculated but data from the Special Study Areas where these data are available suggests that there is both calcite and dolomite saturation (even slight supersaturation) in the samples from all three areas.

The regional distribution of Ca in the Bangladesh groundwaters is shown in Figure 6.8 and maps for Mg, Sr and Ba are given in the *Hydrochemical atlas*. It is clear from the maps that the three alkaline earth cations, Mg^{2+}, Ca^{2+} and Sr^{2+}, are quite variable in concentration, yet the maps show similar spatial patterns. They also show the highest inter-element correlations (after log-transforming the data). Barium is also correlated with this group but less strongly so. This correlation probably reflects the distribution of free carbonates in the original sediments with the high concentrations of Ca in the groundwater reflecting their presence and relatively low concentrations reflecting their absence. The most probable carbonate minerals are calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$). Mg^{2+} and Sr^{2+} readily substitute for Ca^{2+} in calcite but Ba^{2+} does so much less readily because of its substantially larger ionic radius. It must be remembered that such inferences are likely to reflect most strongly the aquifer sediments from where the water has been pumped (i.e. older sediments at depth rather than recently-deposited surface sediments) and that in very old sediments, there is the possibility that some of the original, more soluble minerals may have been completely flushed away.

It appears from the maps that the Holocene sediments derived from the River Ganges (south-western and south-central Bangladesh) probably contain free calcium-magnesium carbonates. Soils developed on the sediments in this region are also defined as carbonate-rich (Brammer, 1996). In contrast, the Holocene sediments of the Tista Fan (north-west) and the north-east *haor* region, as well as the older Quaternary and Tertiary sediments of the Chittagong area probably do not. Concentrations of Ca in these latter groundwaters are less than 15 mg L^{-1}. This is also true for the deep groundwaters from the southern coastal region. In western and central Bangladesh, the distinctive boundary of the high-Ca groundwaters corresponds with the limit of the Holocene sediments of the Atrai Floodplain.

These alkaline earth elements are also derived from other minerals which reduces the overall correlations. Where there has been a substantial inundation of old seawater, some Mg may remain from this source: for every 8.3 mg L^{-1} of Na derived from seawater, there will be about 1 mg L^{-1} Mg and negligible amounts of Ca (0.3 mg L^{-1}), Sr (6 μg L^{-1}) and Ba (2 μg L^{-1}). The effects of ion exchange will cloud this simple relationship to some extent.

6.8 IRON AND MANGANESE

Maps of the distributions of Fe and Mn are given in Figures 6.9 and 6.10. Concentrations of iron and manganese are high in most of the groundwaters of Bangladesh as a result of the predominance of reducing conditions in the aquifers. The distribution of Fe shows some relationship with As, although the overall correlation is weak in some areas. Despite the fact that both Fe and Mn are redox-controlled, the spatial patterns of each differ and indicate the differing behaviour of the two elements as the sediments and groundwaters undergo reduction.

Iron is released by reductive dissolution of iron oxides and weathering of mafic minerals (e.g. biotite). Manganese is released by reductive dissolution of manganese oxides. The differences between iron and manganese distributions are related to their different positions in the redox sequence – as the redox potential is lowered (environment becomes reducing), Mn(IV) will tend to be reduced before Fe(III) but after the dissolved oxygen and nitrate have been consumed. At the near-neutral pH values of most Bangladesh groundwaters, Mn(II) is also much more

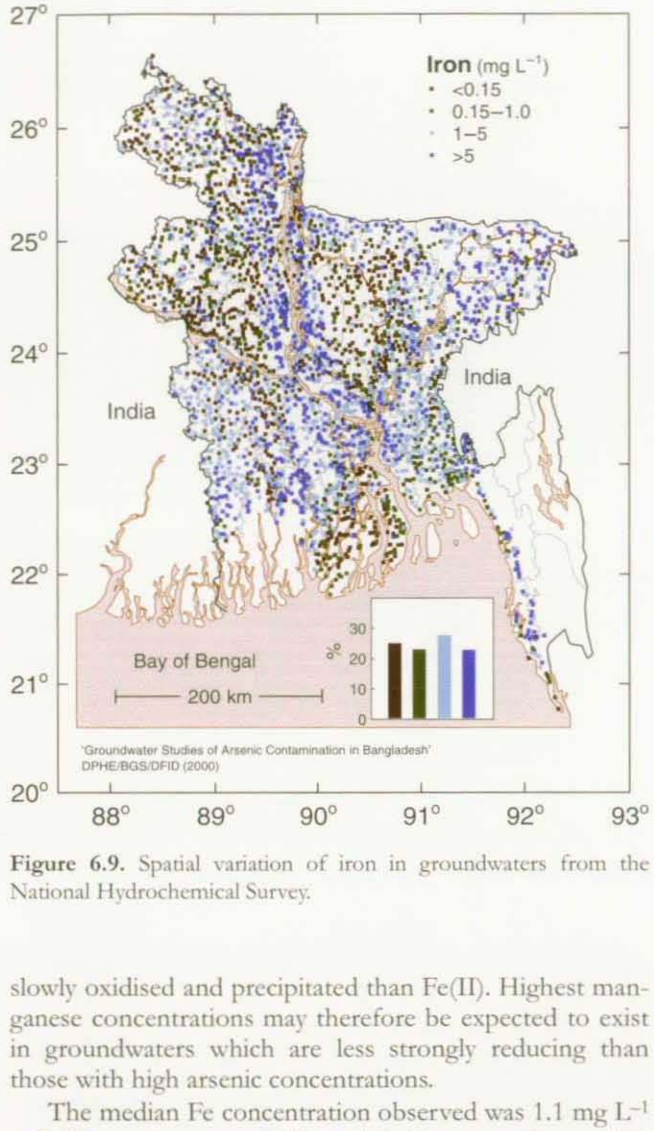


Figure 6.9. Spatial variation of iron in groundwaters from the National Hydrochemical Survey.

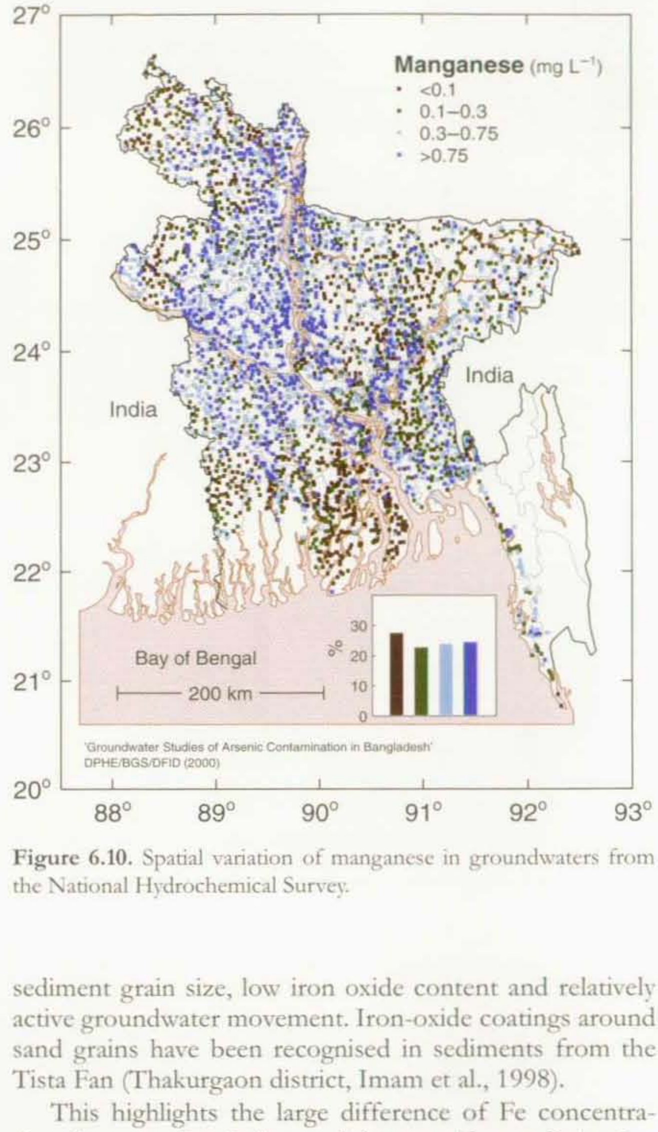


Figure 6.10. Spatial variation of manganese in groundwaters from the National Hydrochemical Survey.

slowly oxidised and precipitated than Fe(II). Highest manganese concentrations may therefore be expected to exist in groundwaters which are less strongly reducing than those with high arsenic concentrations.

The median Fe concentration observed was 1.1 mg L^{-1} and the maximum was 61 mg L^{-1}. Concentrations of Fe are high but patchy in southern Bangladesh (south of the River Ganges) and in the north-east (Sylhet Basin). The proportion of wells with high iron concentrations and the absolute concentrations are particularly high in the Jamuna Valley, with many wells exceeding 10 mg L^{-1} Fe. The median concentration of Fe in As-contaminated (>50 μg L^{-1}) shallow groundwaters is 4 mg L^{-1}.

Lowest overall Fe concentrations are found in the groundwaters from the Barind and Madhupur Tracts, the deep groundwaters of Barisal region and in north-western parts of the Tista Fan. The Dupi Tila aquifers of the Barind and Madhupur Tracts and the deep aquifers of Barisal are older (Plio-Pleistocene) sediments with longer histories of groundwater flow and sediment diagenesis. The sediments of the Barind and the Madhupur Tracts are commonly brown or yellowish brown in colour and reflect past episodes of oxidation. The iron oxides in these sediments may therefore be less labile (more oxidised, more crystalline) than that associated with the younger Holocene deposits. A band of relatively low-iron waters also follows the Gorai-Bhairab feature observed in the arsenic map.

In the Tista Fan, the low Fe concentrations probably relate to the occurrence of relatively oxidising conditions (and the presence of oxidised sands in the aquifers), coarse sediment grain size, low iron oxide content and relatively active groundwater movement. Iron-oxide coatings around sand grains have been recognised in sediments from the Tista Fan (Thakurgaon district, Imam et al., 1998).

This highlights the large difference of Fe concentrations between the shallow and deep aquifers, a distinction also seen with arsenic. Concentrations are highest in the Holocene aquifers from Rajshahi–Pabna area (Ganges, Atrai Floodplains), the Jamuna Valley and the eastern part of the Tista Fan (Young Gravelly Sand Unit of Alam et al. (1990)). The higher concentrations are believed to reflect the distribution of groundwaters which are less reducing than those found in the lower parts of the Bengal delta.

Maps have also been prepared of the distribution of manganese concentrations based on health-related class boundaries (see the *Hydrochemical atlas*) and also for the relationship between manganese and arsenic (Figure 6.11). The Bangladesh standard for Mn on both health and aesthetic grounds is 0.1 mg L^{-1}. 74% of groundwater samples collected in the survey exceeded this value and 35% exceeded the WHO guideline value of 0.5 mg L^{-1}.

Arsenic and manganese are the two elements for which the water quality standards are most commonly exceeded in Bangladesh. Some waters exceed one of these standards while others pass that standard yet fail the other standard. The correlation is important for assessing the overall distribution of risk. The joint arsenic and manganese map highlights the poor spatial correlation between the two elements. Many groundwaters from north-western Bangladesh in particular have low arsenic but high manganese

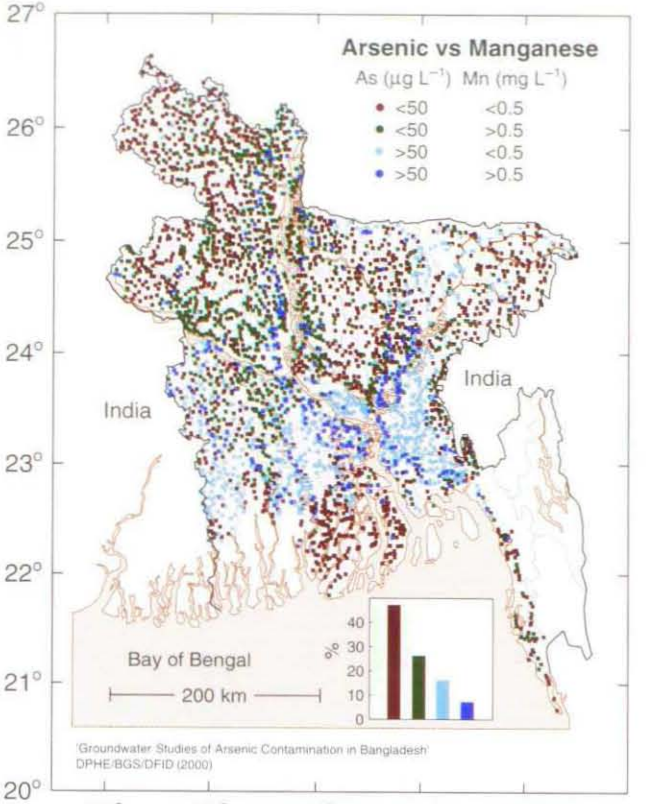


Figure 6.11. Combination distribution of arsenic and manganese in groundwaters from the National Hydrochemical Survey.

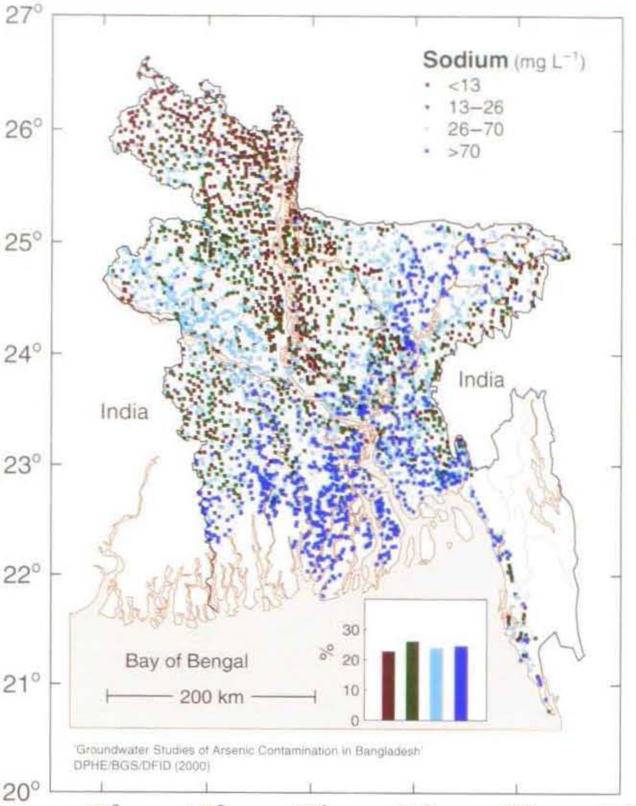


Figure 6.12. Spatial variation of sodium in groundwaters from the National Hydrochemical Survey.

concentrations. The survey showed that 8% of samples exceeded both 50 µg As L^{-1} and 0.5 mg Mn L^{-1}, while only 48% of samples were below both these criteria.

In other words, while approximately 25% of all sampled wells failed acceptability for drinking water because of their high arsenic concentrations (i.e. they exceed the Bangladesh standard), a further 55% will fail because they exceed the Bangladesh manganese standard. 27% of the samples which had arsenic concentrations below 50 µg L^{-1} had manganese concentrations above 0.1 mg L^{-1}. 62% of samples failed one or other of the two WHO guideline values. Groundwater from the Barind and Madhupur Tracts, the deep aquifer in the southern coastal region of Bangladesh and Sylhet (and Dhaka) and from the coarser sediments of north-western Bangladesh tended to comply on both counts.

There is a significant difference between the scale of exceedances in shallow and deep wells. 39% of shallow wells exceeded the WHO guideline value for Mn and 67% exceeded one or other of the As and Mn WHO guideline values. 86% exceeded one or other of the Bangladesh standards. Corresponding figures for deep wells were 7% and 23%, respectively. Therefore most deep wells comply with the WHO guideline values for both As and Mn.

6.9 SODIUM, POTASSIUM AND BORON

These elements are indicators of groundwater salinity and reflect relict seawater influences either by marine inundation of low-lying areas or saline intrusion of near-coastal aquifers. Potassium in particular also has an important relationship with mineral reactions (weathering of clays, ion exchange) and so although the distribution of K concentrations has some relationship to those with Na and B, some notable differences also occur (Figures 6.12, 6.13 and 6.14.

Concentrations of Na, K and B are in general greater in the deep groundwaters sampled in the National Hydrochemical Survey, although this is because a large proportion of these were collected from the Barisal region of southern (coastal) Bangladesh, as well as from the Sylhet region. Electrical conductivity logs of deep boreholes from the southern coastal region show a great deal of variability of salinity with depth. Very fresh water can often be found at considerable depth in the region (e.g. usually at depths greater than 250 m), as found in the 275 m tubewell in the DPHE compound at the Lakshmipur piezometer monitoring site (Chapter 10). However, in practice, somewhat shallower (but still 'deep') and slightly more saline aquifers are commonly exploited.

Figures 6.12, 6.13 and 6.14 show that the highest concentrations of Na, K and B are mainly found in the south and south-eastern parts of Bangladesh and in the low-lying haor region of the north-east. Occasional, locally high Na and B (though not K) concentrations are also found in the Atrai basin in western Bangladesh just north of the Ganges floodplain. Following the last glacial period, rising sea levels resulted in marine inundation of these areas between around 6500–4000 years ago (Chapter 3). 5.3% of samples exceeded the WHO guideline value for B (0.5 mg L^{-1}) and 9.1% exceeded the former guideline value of 0.3 mg L^{-1}.

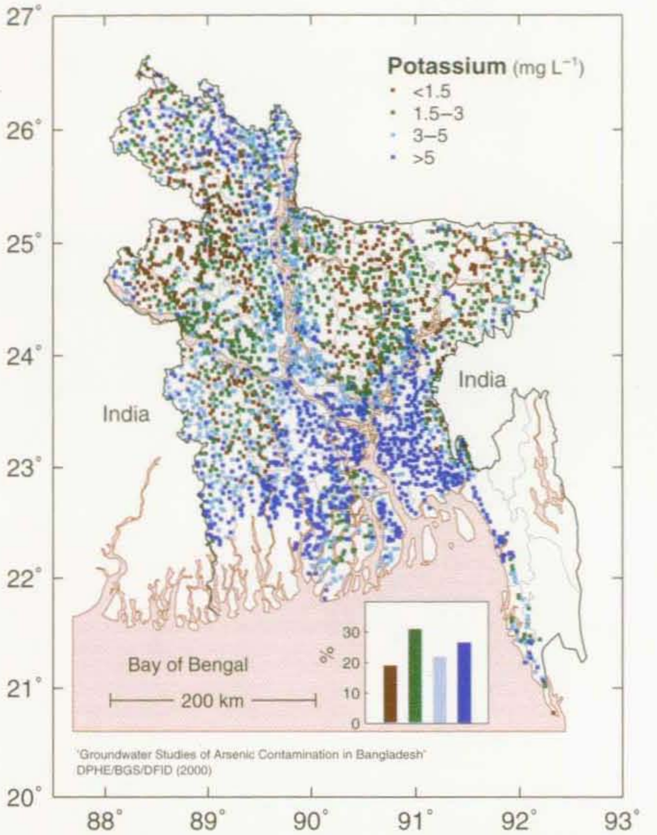


Figure 6.13. Spatial variation of potassium in groundwaters from the National Hydrochemical Survey.

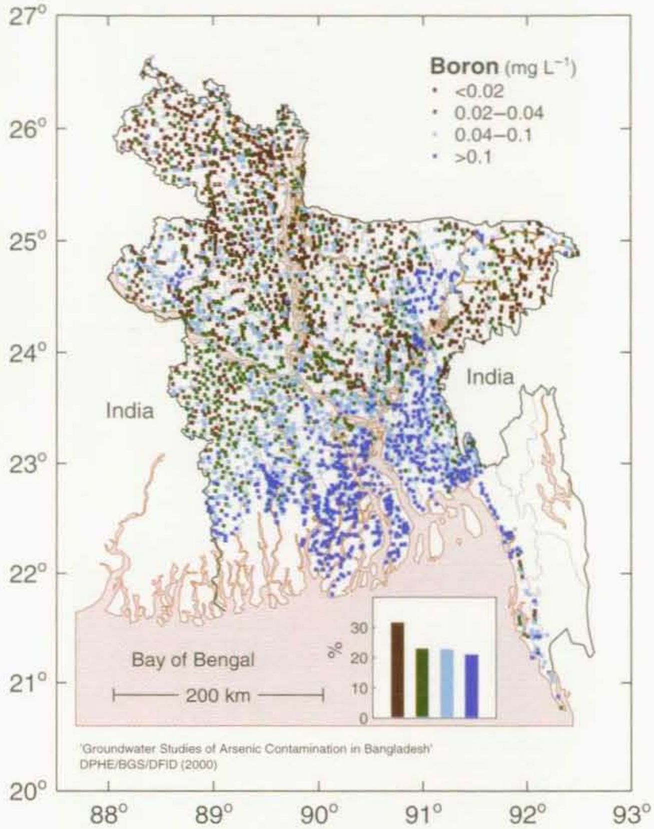


Figure 6.14. Spatial variation of boron in groundwaters from the National Hydrochemical Survey.

Relatively low concentrations of Na and B are found in the comparatively high ground of the Madhupur and Barind Tracts, the Sylhet Hills (Dihing and Dupi Tila outcrops) on the eastern border and the Tista Fan region in the north, as well as along the Jamuna Valley. In these areas, concentrations of these elements will be determined by the concentrations present in the recharge water (which will ultimately be determined by the sea-salt content of the rainfall and the extent of evapotranspiration), and by rock-water interactions, e.g. weathering of feldspars and clay minerals. Concentrations of K are correspondingly low in the Barind and Madhupur aquifers but are somewhat higher in the groundwaters from the Jamuna Valley and parts of the Tista Fan. This is believed to be due to weathering reactions.

The regional distribution of salinity in the deep aquifer is not known but DPHE has recently found some deep groundwaters to be saline as far north as Munshiganj and Manikganj.

6.10 Sulphate

Sulphate concentrations are mainly very low in Bangladesh groundwaters. Concentrations from the National Survey range between <0.2 mg L^{-1} and 753 mg L^{-1} in the shallow groundwaters and between <0.2 mg L^{-1} and 96 mg L^{-1} in the deep groundwaters. Although the maximum values are high, the median values in both the shallow and deep groundwaters are low at <1 mg L^{-1}.

Figure 6.15 shows that concentrations are generally lowest in the south-west and southern parts of Bangladesh as well as in the Sylhet region of the north-east. The deep groundwaters from the southern coastal region also have mostly low concentrations (<4 mg L^{-1}). Concentrations are typically higher (>4 mg L^{-1}) in the north, particularly in groundwaters from the Tista Fan, the Jamuna Valley and the Rajshahi–Pabna area (Ganges and Atrai Floodplains).

The low concentrations of sulphate (around 1 mg L^{-1} or less) occur under strongly reducing conditions and often occur in areas affected by residual seawater (southern Bangladesh, Sylhet Basin). This would be expected to increase sulphate concentrations as a result of the high concentrations found in seawater (around 2700 mg L^{-1}). The low concentrations suggest that bacterial sulphate reduction has occurred. This is supported (Chapter 7) by limited $\delta^{34}S$ isotopic data from the Special Study Areas and low SO_4/Cl ratios relative to seawater in the more saline groundwaters of Lakshmipur *upazila*, indicating sulphate loss from solution. Sulphate reduction appears to have been an important process in both the shallow and deep aquifers. Sulphate reduction is indicative of highly reducing conditions since it tends to occur after Fe(III) reduction in the sequence of microbially-mediated redox reactions.

The SO_4 map shows that higher concentrations are found in shallow groundwaters from the northern Ganges Floodplain, The Jamuna Valley and the Tista Fan aquifers and from parts of the Barind Tract (although Madhupur Tract groundwaters appear to have low concentrations,

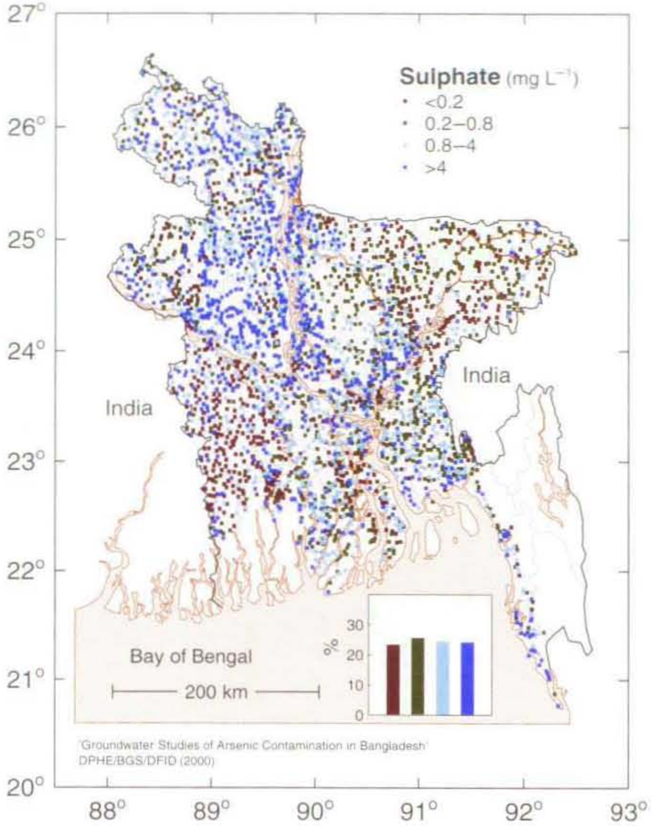


Figure 6.15. Spatial variation of sulphate in groundwaters from the National Hydrochemical Survey.

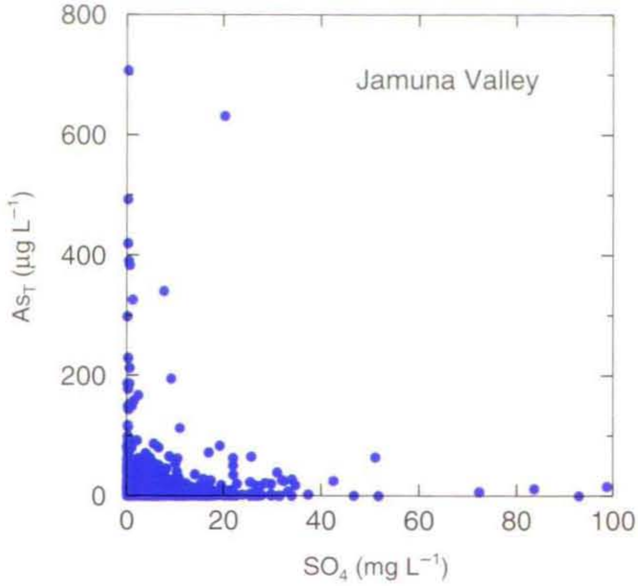


Figure 6.16. Arsenic concentrations plotted against sulphate concentrations in groundwaters from the Jamuna Valley based on data from the NHS.

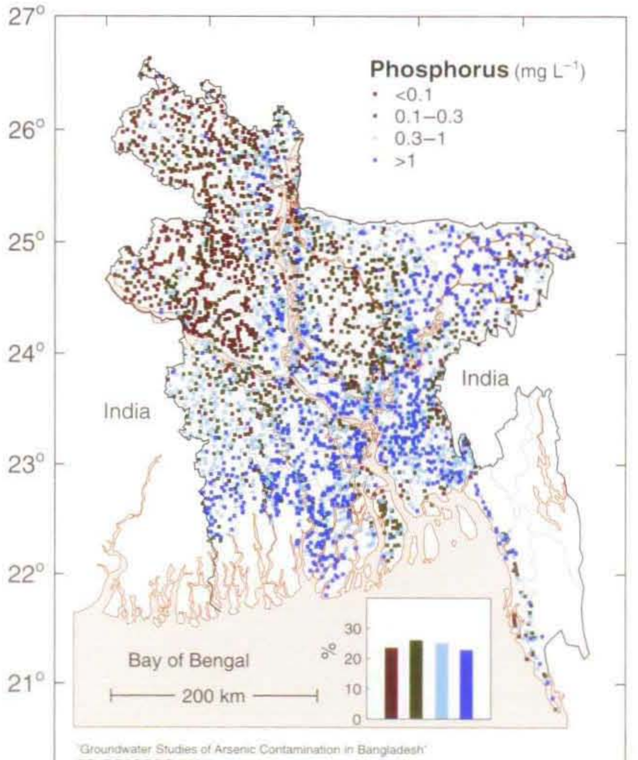


Figure 6.17. Spatial variation of phosphorus in groundwaters from the National Hydrochemical Survey.

typically <1 mg L^{-1}). These are considered to be more oxidising groundwaters than those in the lower parts of the delta. The sulphate present may either be derived from recharge (following concentration by evapotranspiration), or surface pollution (many of the groundwaters from the Jamuna Valley in particular are abstracted from shallow depths), or derived from oxidation of sulphide minerals (e.g. pyrite) in the aquifers. These processes are difficult to distinguish using the available geochemical data. In any case, if the relatively high sulphate concentrations are derived by oxidation of pyrite, this appears not to be a mechanism for arsenic release into the groundwaters as these high-sulphate waters have typically low arsenic concentrations. In the high-As tubewells of the Jamuna Valley, the groundwaters usually have low SO_4 concentrations (Figure 6.16). This suggests that even in this area, some sulphate reduction has taken place and that the reduction process has been accompanied by As mobilisation.

6.11 PHOSPHORUS

Phosphorus concentrations are quite variable in Bangladesh groundwaters. The P map shows some similarity to the As map. The concentration ranges found in the groundwaters are high by world standards: <0.1–19 mg L^{-1} in the shallow groundwaters and <0.1–6.1 mg L^{-1} in the deep groundwaters. Figure 6.17 shows that highest concentrations (>1 mg L^{-1}) are mainly found in groundwaters from south-eastern and north-eastern Bangladesh and along the Jamuna Valley. The distribution shows many similarities with that of arsenic, although in contrast to arsenic, many of the deep groundwaters of the southern coastal region have relatively high concentrations (often >1 mg L^{-1} P). The median concentration of P

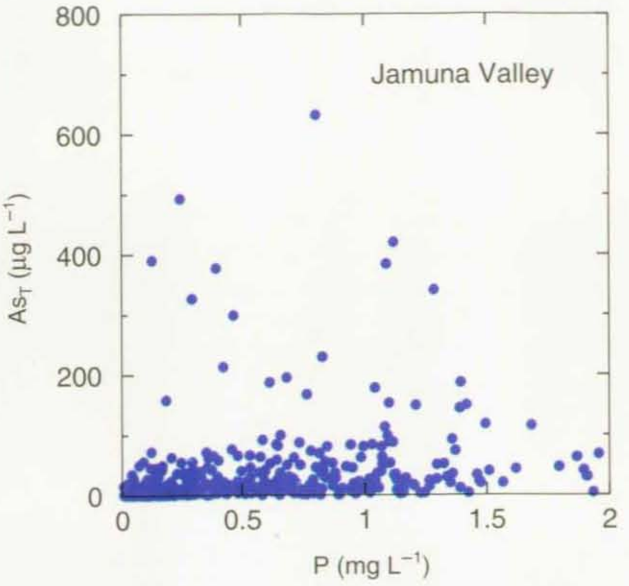


Figure 6.18. Arsenic concentrations plotted against phosphorus concentrations in groundwaters from the Jamuna Valley based on data from the NHS.

in As-contaminated (>50 μg L^{-1}) shallow groundwaters is 1.1 mg L^{-1}.

Some workers have attributed the high P concentrations to leaching of excess fertilisers from overlying soils (e.g. Acharyya et al., 1999, 2000). In view of the fact that high concentrations of P (>1 mg L^{-1}) are found in many groundwaters from both the shallow and deep aquifer, this is considered unlikely. Retardation of P by sediments is to be expected and P travel times to the deep aquifers should be significantly longer than the groundwater travel time itself. Dating of groundwaters from parts of the deep aquifer (Chapter 7) shows that these are 'old' groundwaters, of the order of thousands of years, hence they significantly predate fertiliser use. It is unlikely that fertilisers are a major source of P even in the shallow groundwaters.

Phosphorus in the groundwaters is believed to be derived mainly by desorption from, and dissolution of, iron oxides, although some is also probably derived from the oxidation of organic matter and from the dissolution of detrital apatite.

Dissolved P is likely to compete with dissolved arsenic species (arsenite, arsenate) for adsorption sites on iron and other oxides and the high observed phosphorus concentrations may be an additional factor responsible for the extensive arsenic mobilisation in Bangladesh groundwaters. However, the generally poor correlation between As and P in the groundwaters of the National Hydrochemical Survey and the presence of high phosphorus concentrations in many of the deep groundwaters which have low arsenic concentrations indicate that the geochemical processes are complex and that a number of factors are involved in arsenic release to the groundwater. The relationship between As and P is shown for one area, the Jamuna Valley, in Figure 6.18.

Table 6.16. Statistical summary and exceedances above WHO guideline values (GV) for groundwaters from the National Hydrochemical Survey analysed by ICP-MS

	Min	Max	Median	n	WHO GV	Exceed-ances	
	μg L^{-1}	μg L^{-1}	μg L^{-1}		μg L^{-1}	n	%
Al	4	27	8	16			
Be	<0.05	<0.05	<0.05	18			
Cd	<0.02	0.51	0.035	18	3	0	0
Ce	<0.005	0.587	0.0215	18			
Co	0.4	34.6	1.32	18			
Cr	<0.5	1.4	<0.5	16	50	0	0
Cs	<0.05	0.19	<0.05	18			
Cu	<1	8	<1	18	2000	0	0
Li	2	25	2.8	18			
Mo	<0.1	9.4	1.9	18	70	0	0
Ni	2.4	132	3.6	17	20	2	12
Pb	0.09	10.8	0.3	18	10	1	6
Rb	<0.1	10.2	0.45	18			
Sb	<0.02	0.16	0.03	18	5	0	0
Sn	<0.1	0.6	<0.1	18			
Tb	<0.005	0.01	<0.005	18			
Tl	<0.01	<0.01	<0.01	18			
U	0.03	11.6	2.365	18	2	10	56
V	<0.2	4.2	1.45	18			
Y	0.017	0.32	0.062	18			
Yb	<0.008	0.029	<0.008	18			
Zn	3	94	9.5	18			

6.12 Trace elements: ICP-MS data

In addition to the major and minor elements discussed above, a selection of trace elements were also measured in 18 samples from the National Hydrochemical Survey. The samples were selected on the basis of high Fe and Mn concentrations determined previously by ICP-AES. The data are therefore biased, but give an indication of water quality in the most metal-enriched groundwaters. Statistical summaries and exceedances with respect to WHO guideline values are given in Table 6.16 The results indicate that even in these samples, concentrations of most analysed trace metals are below recommended guideline values. The worst exceedances were for U, where 10 samples (56%) exceeded 2 μg L^{-1}. Two samples also exceeded the value for Ni and one sample exceeded for Pb, though the maximum Pb value was only 10.8 μg L^{-1}. The results indicate that few other trace metals in the ICP-MS range of analytes (with the possible exception of U) are likely to be of significant health concern.

6.13 BWDB Water-Quality Monitoring Network

Alongside the National Hydrochemical Survey, a survey of groundwater quality has also been carried out from the 113 tubewells in the BWDB Water-Quality Monitoring Network. This is a national network with sites located in all districts except the three districts of the Chittagong Hill

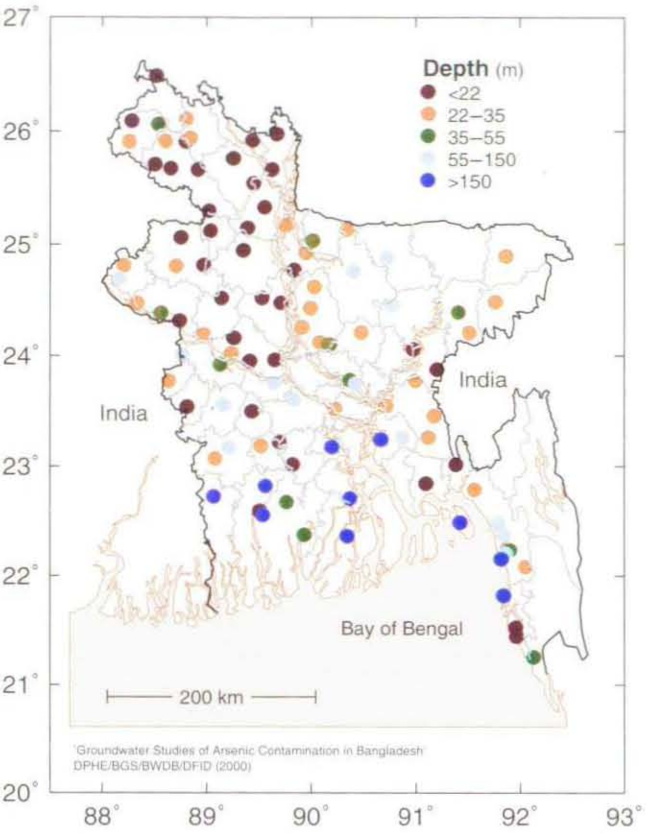


Figure 6.19. Distribution of well depths in the BWDB Water-Quality Monitoring Network survey.

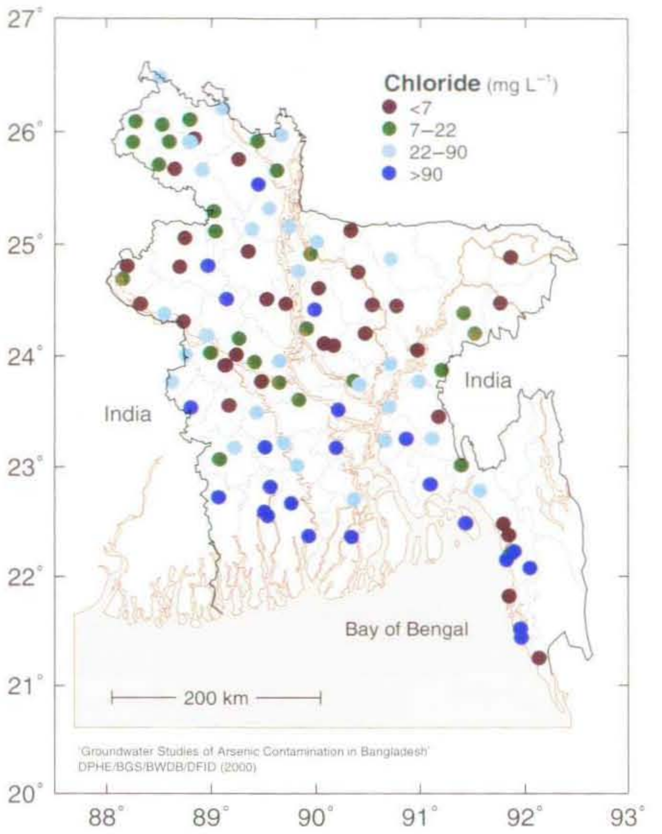


Figure 6.20. Chloride distribution in groundwaters from the BWDB Water-Quality Monitoring Network survey.

Tracts and Sunamganj in the north-east. The tubewells in the network are monitored by BWDB approximately bi-annually for water levels and a range of other chemical constituents. Sampling for this project was carried out during May–July 1998, except for 11 samples from the north-east which were collected in June 1999 due to inaccessibility problems the previous year. Analysis of major and trace elements was by ICP-AES and ICP-MS. Alkalinity was measured by titration with H_2SO_4 in the laboratory. In addition, chloride, fluoride and iodide were measured by AutoAnalyser.

The network includes wells with a large range of depths (7–610 m). The deepest tubewells are located mainly in the south, in Chittagong, Khulna and Barisal districts. Tubewells in the north-west are mainly shallow (<22 m). Some tubewells in Chittagong are also shallow. The range of well depths in the network are shown in Figure 6.19.

Elements measured in both the National Hydrochemical Survey and the BWDB Water-Quality Monitoring Network Survey include arsenic, calcium, magnesium, iron, manganese, boron, barium, strontium, sodium, silicon, phosphorus, potassium and sulphate. The spatial distributions of these elements have been plotted (see the *Hydrochemical atlas*). These parameters show general agreement with the distributions and concentration ranges seen from the National Hydrochemical Survey, except that the much lower sampling density fails to identify some patterns shown clearly by the National Hydrochemical Survey data. Maps for additional constituents measured in the BWDB Water-Quality Monitoring Network Survey (alkalinity, antimony, chloride, fluoride, iodide, lead, molybdenum, nickel, tin and zinc) are also given in the *Hydrochemical atlas*. The spatial distributions of some of these are discussed below.

6.13.1 Alkalinity

Alkalinity data based on BGS laboratory determinations have been included although we were aware that there was carbonate precipitation in some cases which may not have been fully included in the titration. Charge balances (excluding nitrate and ammonium) were sometimes poor as a result (9% of samples had a charge imbalance exceeding 1 meq L^{-1}). An approximate correction was applied to these samples by assuming that the charge imbalance reflected calcium carbonate precipitation. Despite uncertainties with the data quality, alkalinity (HCO_3) variations show some distinct regional patterns (see the *Hydrochemical atlas)* which closely follow the distributions of Ca, Mg, Sr and hardness. Highest alkalinities (HCO_3 >250 mg L^{-1}) are mainly found in the south-west. Intermediate values (125–250 mg L^{-1}) are found in the north-east and Jamuna Valley. Low alkalinities (<125 mg L^{-1}) are most typically found in the north-west (Tista Fan). As with the cations, the highest alkalinities are thought to reflect the presence of free carbonates in the soils and sediments.

6.13.2 Chloride

Concentrations of chloride in the surveyed samples have a

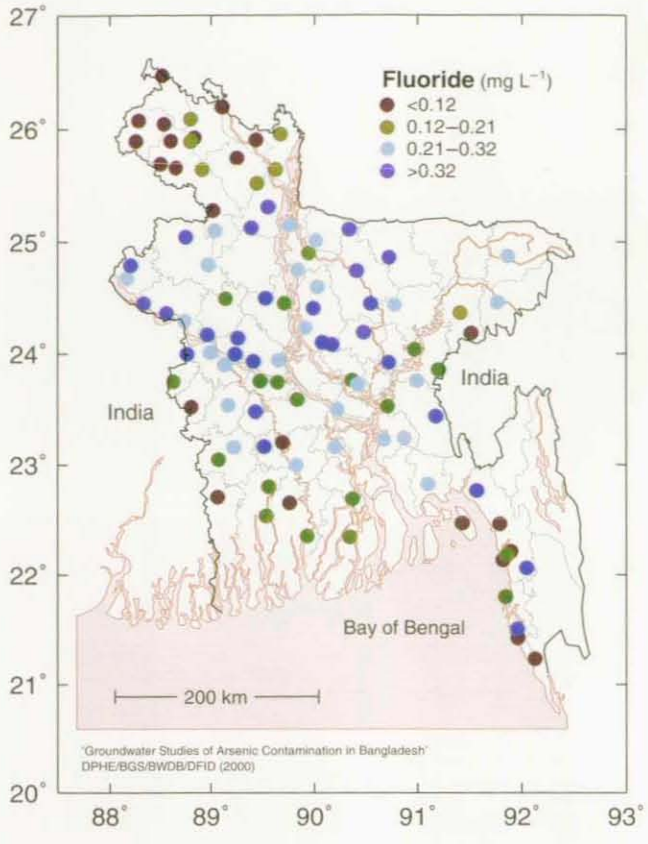


Figure 6.21. Fluoride distribution in groundwaters from the BWDB Water-Quality Monitoring Network survey.

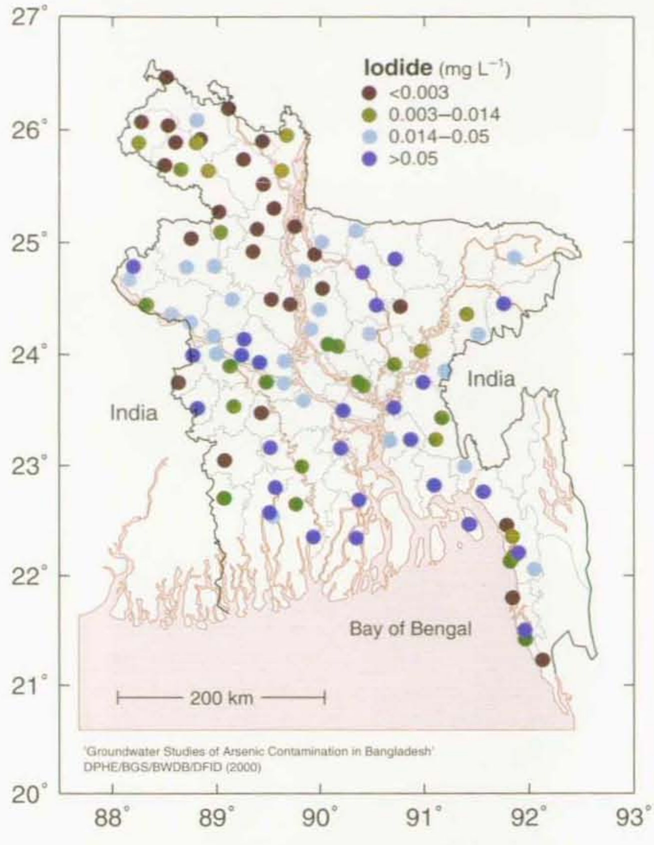


Figure 6.22. Iodide distribution in groundwaters from the BWDB Water-Quality Monitoring Network survey.

large range of 1.3–9140 mg L^{-1}. The distribution generally follows that of sodium with highest concentrations in the south of Bangladesh (both shallow and deep groundwaters), being indicative of salinity and marine intrusion (Figure 6.20).

6.13.3 Fluoride

Concentrations of fluoride in the groundwaters range between 0.01–0.73 mg L^{-1}. All these values are relatively low but the lowest concentrations are found mainly in north-west Bangladesh and the Chittagong coastal region (Figure 6.21). None of the samples exceeds the WHO guideline value for fluoride in drinking water of 1.5 mg L^{-1}. Indeed, many of the groundwaters are in the range where fluoride deficiency may become a problem without other forms of dietary fluoride. The low concentrations generally relate to the fact that groundwaters are dominantly of calcium-bicarbonate type and hence concentrations will be limited by fluorite solubility.

6.13.4 Iodide

Concentrations of iodide range between 0.4 μg L^{-1} and 5840 μg L^{-1}. Highest concentrations are scattered throughout the country but are typically high in southern Bangladesh where salinity is higher (Figure 6.22).

Iodine is an essential element for health and deficiency in the diet can lead to iodine-deficiency disorders (IDDs), the most common of which is goitre. Drinking water is only one source of dietary iodine, and is in most cases subordinate to that obtained from food. However, low iodine concentrations in drinking water may be indicative of low concentrations in the local environment in general (soils, local food crops) and may give a warning of the locations of IDD-prone areas. No WHO guideline value exists for iodide in drinking water as such guidelines represent maximum rather than minimum recommended values. However, in practice, endemic IDDs have been found in areas in developing countries where the drinking waters are typically less than 3–5 μg L^{-1}. In Bangladesh, only groundwaters from the north-west have such low concentrations (Figure 6.22). These areas may be susceptible to IDDs. Other parts of Bangladesh are considered to be less at risk from IDDs.

6.13.5 Trace metals: antimony, lead, molybdenum, nickel, uranium and zinc

All these elements show a considerable amount of spatial variability (see the *Hydrochemical atlas*). Among the more noteworthy variations are:

Sb: little discernible regional trend;

Pb: relatively low concentrations (<0.3 μg L^{-1}) in western Bangladesh, along the course of the Ganges (Nawabganj–Rajshahi–Pabna) and sporadic highs in Chittagong and the Tista Fan region;

Mo: relatively low (<0.1 μg L^{-1}) in north-west Bangladesh,

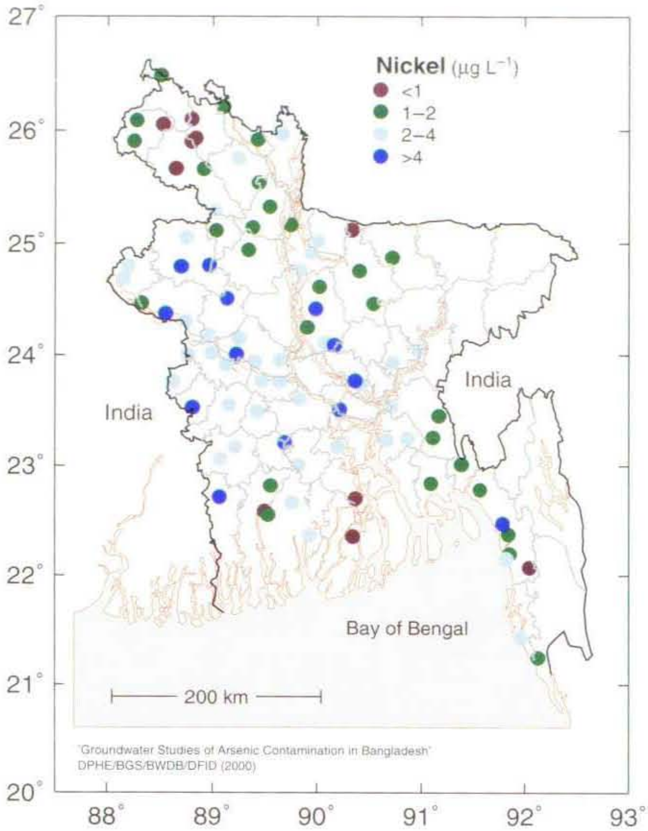


Figure 6.23. Nickel distribution in groundwaters from the BWDB Water-Quality Monitoring Network survey.

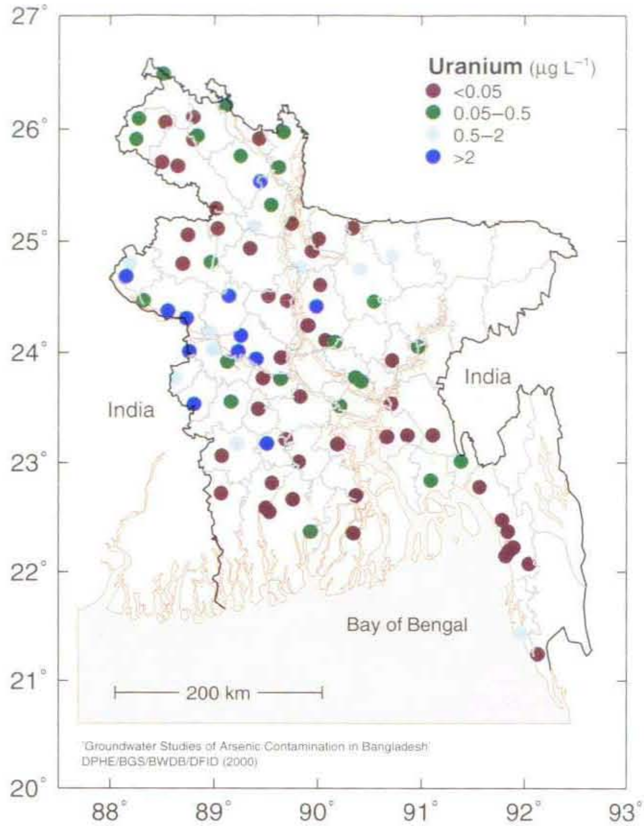


Figure 6.24. Uranium distribution observed in groundwaters from the BWDB Water-Quality Monitoring Network survey.

particularly the western part of the Tista Fan, variable elsewhere;

Ni: low concentrations ($<2\ \mu g\ L^{-1}$) in the north-west (Tista Fan) and sporadically in the southern coastal area (Figure 6.23);

U: highest concentrations ($>2\ \mu g\ L^{-1}$) in western Bangladesh (Ganges Floodplain and border districts) with usually low concentrations ($<2\ \mu g\ L^{-1}$) elsewhere (Figure 6.24);

Zn: low concentrations ($<10\ \mu g\ L^{-1}$) are most commonly found in south-western Bangladesh (Figure 6.25);

The low density of sampling in most cases precludes detailed interpretation of these trends. However, the distribution of Mo, with relatively low concentrations in north-west Bangladesh, to some extent reflects the distribution of As. As seen from the investigations in the Special Study Areas, Mo behaves in a similar way to As in the aquifers and often correlates with As. The variations observed in U concentrations in the BWDB Water-Quality Monitoring Network samples also mirror to some extent those from the Special Study Areas, where a greater proportion of high-U concentrations was found in groundwaters from Chapai Nawabganj. Many of the regional variations in these trace elements are also likely to reflect mineralogical (and hence trace-element) variations in the sediments as a result of varying sedimentation patterns and sediment provenance.

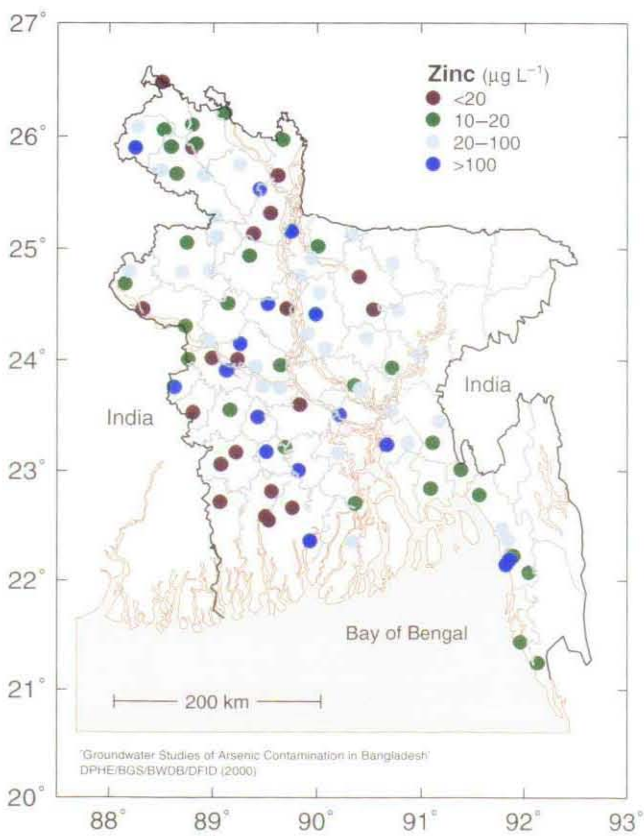


Figure 6.25. Zinc distribution in groundwaters from the BWDB Water-Quality Monitoring Network survey.

Table 6.17. Chemical data for groundwaters from deep tubewells in Dhaka city

Sample / Field code	Units	991545 RIP7501	991546 RIP7502	991547 RIP7503	991548 RIP7504	991549 RIP7505	991550 RIP7506	991551 RIP7507
Latitude		23.7497	23.726	23.7606	23.8017	23.7985	23.7405	23.7149
Longitude		90.3888	90.3852	90.3637	90.3597	90.4066	90.4072	90.4287
Location		Well S170A	Azimpur colony (pump 7)	Muhammadpur (pump 8)	Inside BIBM compound	Banani Pump (pump 5)	Circuit House	Bay Edabad
Ca	mg L^{-1}	31.4	50.7	24.3	15.4	15.4	16.5	59.2
Mg	mg L^{-1}	15.4	16.6	8.82	5.23	5.02	6.78	22.6
Na	mg L^{-1}	23	43	22	16	18	18	41
K	mg L^{-1}	2.0	5.6	1.8	2.3	1.7	1.7	2.5
SO_4	mg L^{-1}	11.5	31.6	2.8	0.6	1.2	6.4	34.6
As_T	µg L^{-1}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Fe	mg L^{-1}	0.171	0.021	0.232	0.248	0.024	0.097	0.041
Mn	mg L^{-1}	0.674	0.027	0.017	0.066	0.021	0.058	0.223
Si	mg L^{-1}	38.8	25.4	35.7	40	37.9	38.9	37.2
B	mg L^{-1}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ba	µg L^{-1}	39	52	41	18	11	13	23
Sr	µg L^{-1}	189	482	179	118	110	107	377
P	mg L^{-1}	<0.1	<0.1	<0.1	0.1	0.1	<0.1	0.1
Al	µg L^{-1}	3	5	23	5	4	4	3
Li	µg L^{-1}	15.3	6	5.8	9.9	8.4	9.4	9.5
Be	µg L^{-1}	0.02	<0.01	0.01	0.05	0.01	0.03	0.02
Cd	µg L^{-1}	0.09	0.04	0.06	0.03	0.03	0.02	0.04
Co	µg L^{-1}	1.53	0.3	0.17	0.2	0.09	0.21	0.65
Cr	µg L^{-1}	<0.5	2.4	0.7	8.6	3.1	3.2	1
Zn	µg L^{-1}	13	20	5	97	13	6	6
Cu	µg L^{-1}	1	1	<1	2	2	1	11
Ni	µg L^{-1}	2.3	2.1	0.9	1.1	0.6	1	1.8
Pb	µg L^{-1}	0.21	0.28	0.37	0.23	0.2	0.17	0.42
Mo	µg L^{-1}	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sb	µg L^{-1}	<0.01	0.01	0.02	0.06	<0.01	0.01	0.02
U	µg L^{-1}	0.3	0.42	0.16	0.02	0.03	0.04	0.97
Rb	µg L^{-1}	0.4	0.7	0.5	0.6	0.5	0.5	0.7
Cs	µg L^{-1}	0.005	<0.005	<0.005	0.005	<0.005	<0.005	<0.005
La	µg L^{-1}	0.006	0.012	0.013	<0.005	0.015	0.006	0.007
Ce	µg L^{-1}	0.015	0.022	0.02	0.007	0.023	0.008	0.009
Pr	µg L^{-1}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nd	µg L^{-1}	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Sm	µg L^{-1}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Eu	µg L^{-1}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Gd	µg L^{-1}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tb	µg L^{-1}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Dy	µg L^{-1}	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Ho	µg L^{-1}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Er	µg L^{-1}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Yb	µg L^{-1}	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lu	µg L^{-1}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sn	µg L^{-1}	0.2	<0.1	<0.1	<0.1	<0.1	0.3	0.2
Th	µg L^{-1}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tl	µg L^{-1}	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Tm	µg L^{-1}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
V	µg L^{-1}	1.8	1.2	1.5	1.1	1.5	1.3	1.2
Y	µg L^{-1}	0.03	0.07	0.02	0.01	<0.01	<0.01	0.03

6.14 Detailed chemistry of Dhaka deep tubewells

In addition to these regional surveys, 7 groundwater samples were collected from the deep (Dupi Tila) aquifer of Dhaka city. The depths of the wells are unknown but are likely to exceed 100 m. Samples were collected in December 1999 and treated in the same way as the other samples, i.e. filtered and split into acidified and unacidified samples. Samples of the acidified aliquots were analysed by ICP-AES and ICP-MS and the results are given in Table 6.17.

The results indicate that these deep groundwaters are of low salinity (Na <50 mg L^{-1}; B <0.1 mg L^{-1}; SO_4 0.6–35 mg L^{-1}) and have overall excellent inorganic quality. Concentrations of most trace elements are low to very low. In particular, As concentrations are all <0.5 µg L^{-1}. Iron concentrations are correspondingly low (<0.25 mg L^{-1}). Of the elements with WHO health-based guideline values, only Mn has any exceedances: one sample has a Mn concentration of 0.67 mg L^{-1} (Table 6.17). All other elements are substantially lower than the WHO guideline values. Concentrations of P are also uniformly very low (0.1 mg L^{-1} or less). Iron concentrations are generally much lower than in typical shallow Bangladesh groundwaters. There is no evidence of significant contamination with heavy metals.

As with evidence from elsewhere, the quality of groundwaters from the Dupi Tila aquifer is significantly better than that from the younger Holocene sediments of Bangladesh, despite the likelihood that a proportion of the groundwater from the Dhaka aquifers contains infiltrated river water.

In the deep Dupi Tila aquifer of Dhaka, potentially toxic trace elements are apparently not easily leached into solution (i.e. are not labile). Indeed, to some extent they are likely to already have been leached out due to a longer history of aquifer flushing and water-rock interaction. There are no signs in the trace-element data of serious contamination from the overlying, shallow aquifer which is heavily polluted in some parts of Dhaka. The most likely signs of possible early pollution are the relatively high Zn and Cr concentrations in the BIBM compound well. This appears to be the most reducing water on account of its relatively low SO4 and high Fe concentrations. Some of the low SO_4 concentrations may be due to sulphate reduction.

6.15 Comparison of the arsenic results with those from other large data sets

6.15.1 Background

Although we are aware that a large number of studies of arsenic contamination of groundwater have recently been undertaken in various places in Bangladesh, the results of these studies have either not been published, or the size of the surveys or the criteria for site selection do not make them suitable for comparison with the NHS database. The best surveys for such a comparison are therefore the large-scale screening surveys that have been, or are being, undertaken by NIPSOM-UNDP, NIPSOM-Columbia University, DPHE-UNICEF and BAMWSP. These surveys have been, or are being, mostly carried out using field-test kits either on 'randomly' selected wells or on a comprehensive (all well) basis.

The large number and high density of samples in these surveys tends to overcome the large amount of short-range variation present and compensates to some extent for the relative lack of precision of the test kits. Therefore the trends revealed from these surveys are expected to be quite reliable, especially for the more contaminated areas which are well above the detection limit of the kit being used. Indeed the use of field-test kits to establish such trends is an appropriate use of the kits. Establishing

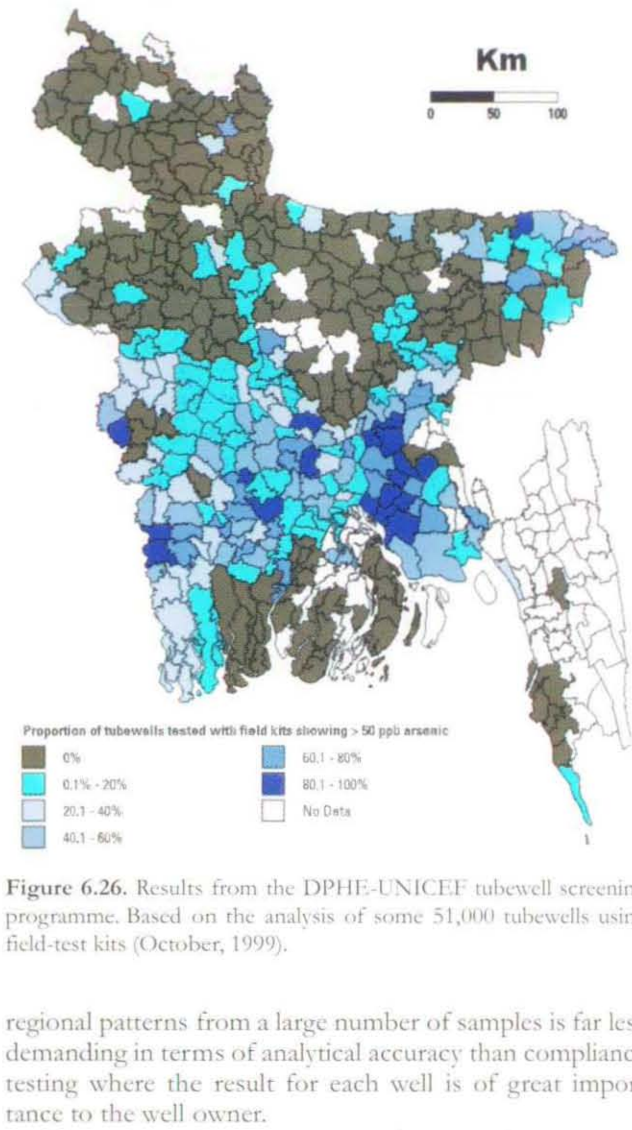


Figure 6.26. Results from the DPHE-UNICEF tubewell screening programme. Based on the analysis of some 51,000 tubewells using field-test kits (October, 1999).

regional patterns from a large number of samples is far less demanding in terms of analytical accuracy than compliance testing where the result for each well is of great importance to the well owner.

Discussion of the comparison between these surveys and the DPHE/BGS National Hydrochemical Survey follows. The results of the 500 village NIPSOM-UNDP survey are not readily available and so cannot be analysed.

6.15.2 DPHE-UNICEF nationwide survey

The most comprehensive nationwide survey to date is that carried out by DPHE-UNICEF. The resultant map (Figure 6.26), based on the results of 51,000 analyses to October 1999, shows the percentage of wells exceeding 50 µg L^{-1} on a *upazila* basis. Aggregating data on a *upazila* basis imposes an implicit smoothing of the data and so it is best compared with either the NHS 50 µg L^{-1} probability map (Chapter 9, Figure 9.10(c)) or with the NHS smoothed arsenic map (Figure 6.4), both for shallow wells only. Even with the large number of wells sampled in the DPHE-UNICEF survey, this still represents only a small fraction of the total number of existing wells and so the representativeness of the resulting statistics and spatial patterns depend strongly on the quality of the randomisation.

The spatial patterns revealed in the DPHE-UNICEF map bear a close resemblance to the NHS As maps, with a concentration of highly-affected areas in south-east Bangladesh and sporadic highly-affected upazilas in south-cen-

Table 6.18. Summary results of the 1999 NESP six *upazila* survey

Upazila, District	All wells			Deep wells		
	Tested	Arsenic-free	Arsenic-contaminated	Tested	Arsenic-free	Arsenic-contaminated
Government wells						
Uzirpur, Barisal	1141	102	773	1103	1025	21
Hajiganj, Chandpur	1272	40	1042	45	24	2
Gop. Sadar, Gopalganj	1824	61	1627	5	2	3
Bheramara, Khulna	807	539	246	3	2	1
Ishwardi, Pabna	907	767	102	19	18	0
Golapganj, Sylhet	671	559	88	90	69	17
Total	6622	2068	3878	1265	1140	44
Non-Government wells						
Uzirpur, Barisal	5039	344	4054	210	191	9
Hajiganj, Chandpur	8596	131	7999	13	5	8
Gop. Sadar, Gopalganj	5909	283	5349	7	0	7
Bheramara, Khulna	6249	4603	1590	33	20	9
Ishwardi, Pabna	8988	7876	987	24	19	2
Golapganj, Sylhet	7884	6917	745	524	359	107
Total	42665	20154	20724	811	594	142

Table 6.19. Extent of contamination of wells in the 1999 NESP survey of six *upazilas*

Upazila	Number of wells						% contaminated
	inoperative	operative	arsenic-free	<0.1 mg L^{-1}	0.1–1.0 mg L^{-1}	>1.0 mg L^{-1}	
Uzirpur	1032	6535	1666	686	4042	141	74.5
Hajiganj	792	9394	203	34	8861	296	97.8
Gop. Sadar	440	7354	353	508	6440	53	95.2
Bheramara	137	7392	5455	921	959	57	26.2
Ishwardi	197	9906	8797	298	785	26	11.2
Golapganj	320	9016	8048	602	365	1	10.7
Total	2918	49597	24522	3049	21452	574	Average 53%

Table 6.20. Percentage of wells contaminated according to owner and well type

Upazila	Government				Non-Government			
	Shallow wells		Deep wells		Shallow wells		Deep wells	
	Tested	% contam.	Tested	% contam.	Tested	% contam.	Tested	% contam.
Uzirpur	38	88	1103	2	4829	92	210	5
Hajiganj	1227	96	45	8	8583	98	13	62
Gopalganj Sadar	1819	96	5	60	5902	95	7	100
Bheramara	804	31	3	33	6216	26	33	31
Ishwardi	888	12	19	0	8964	11	24	10
Golapganj	581	14	90	20	7360	10	524	23
Total	5357	6622	1265	Average 4%	41854	42665	811	Average 19%

Sylhet district having a depth of greater than 150 m was contaminated, in that case quite severely (157 μg L^{-1}; 137 m depth). While the other four 'deep' wells were not contaminated at the 50 μg L^{-1} level, they all exceeded the 10 μg L^{-1} level. This contrasts with the NHS deep tubewell statistics from Barisal district: out of 50 deep tubewell samples in Barisal, only one exceeded 50 μg L^{-1} (54 μg L^{-1}; 331 m depth) and just a further two samples exceeded 10 μg L^{-1}. These results therefore point to systematic differences in the extent and nature of arsenic contamination of deep tubewells in different parts of the country. This probably reflects basic differences in the nature of the aquifers between the southern coastal region and the Sylhet region. The wells in Sylhet while 'deep' in terms of our defined depth interval (>150 m) actually tap the shallowest aquifer available. In the coastal region, the 'deep' wells tap a deep aquifer that is distinctly separate from the shallow aquifer in that area.

tral Bangladesh (south-west of Dhaka) and on the western border with West Bengal.

Most of northern Bangladesh is shown to be relatively uncontaminated or not contaminated. Since the specified 'detection limit' of the field-test kits was 50 μg L^{-1} (and may have been somewhat greater in practice), the DPHE-UNICEF survey shows little resolution in northern Bangladesh. The NHS survey shows some variation across northern Bangladesh, albeit frequently below the 50 μg L^{-1} level, and indicates elevated concentrations in the low-lying parts of the Jamuna and northern Meghna valleys. The DPHE-UNICEF map indicates a greater density of contamination in the extreme north-eastern part of Greater Sylhet.

The greater sensitivity of the laboratory analyses used in the NHS also highlights the groundwaters from the older sediments of the Madhupur and Barind Tracts and the Tista Fan deposits of north-western Bangladesh as being significantly lower than those from the younger alluvial sediments of the Jamuna Valley. This is not so clear on the DPHE-UNICEF map.

6.15.3 BAMWSP (NESP) six *upazila* Phase I surveys

Phase I of the BAMWSP National Emergency Screening Programme (NESP) began in October 1999 by undertaking a comprehensive survey of wells in the following six *upazilas* (district in parentheses): Ishwardi (Pabna), Bheramara (Kushtia), Uzirpur (Barisal), Gopalganj Sadar (Gopalganj), Golapganj (Sylhet) and Hajiganj (Chandpur). The location of these *upazilas* is shown in Figure 6.27. The criteria for selecting these *upazilas* is not known. Hajiganj had already been comprehensively surveyed by BRAC. Plans for Phase II were initially to sample a further 60 *upazilas* but this is currently under review and is likely to be significantly reduced.

Some 49,000 wells from the six Phase I *upazilas* were tested using Merck field-test kits. Ownership (Government or non-Government) and well type (shallow and deep) were reported as well as whether they were contaminated or not (Table 6.18). There were just over six times as many non-Government wells as Government wells, showing the relative abundance and importance of private wells. On average, 5.6% of wells were not working at the time of sampling although the percentage varied from *upazila* to *upazila* (Table 6.19). The variation was from 13.6% in Uzirpur to 1.8% in Bheramara.

The number of contaminated wells varied from 10.7% to 97.8% and averaged about 50% (Table 6.19). There were deep tubewells in all *upazilas* but, as expected, they were concentrated in Uzirpur (Barisal) and Golapganj (Sylhet). The percentage of shallow tubewells contaminated did not differ much between Government and non-Government wells (Table 6.20) which is important since Government (DPHE) tubewells were mainly sampled in our NHS survey on the assumption that this was the case.

However, the NESP survey shows that there is a significant difference in the degree of contamination of Government and non-Government deep tubewells in some of the *upazilas*. On average, 4% of Government deep tubewells were contaminated against 22% of non-Government deep tubewells. This difference is greatest in Hajiganj (Chandpur) where 8% of Government deep and 62% of non-Government wells were found to be contaminated. This suggests that the construction of the two types of well may have been different (different depths, for example). Hajiganj is at the centre of the area where the shallow aquifer is highly contaminated, as seen from the statistics for the shallow wells (more than 95% contaminated). Perhaps the non-Government wells are actually shallower than the Government wells and situated in the deeper part of the shallow aquifer rather than in the 'deep' aquifer which is quite distinct in this part of Bangladesh. A similar conclusion can be drawn from the results for Gopalganj *upazila*. Lessons should be learned from these differences.

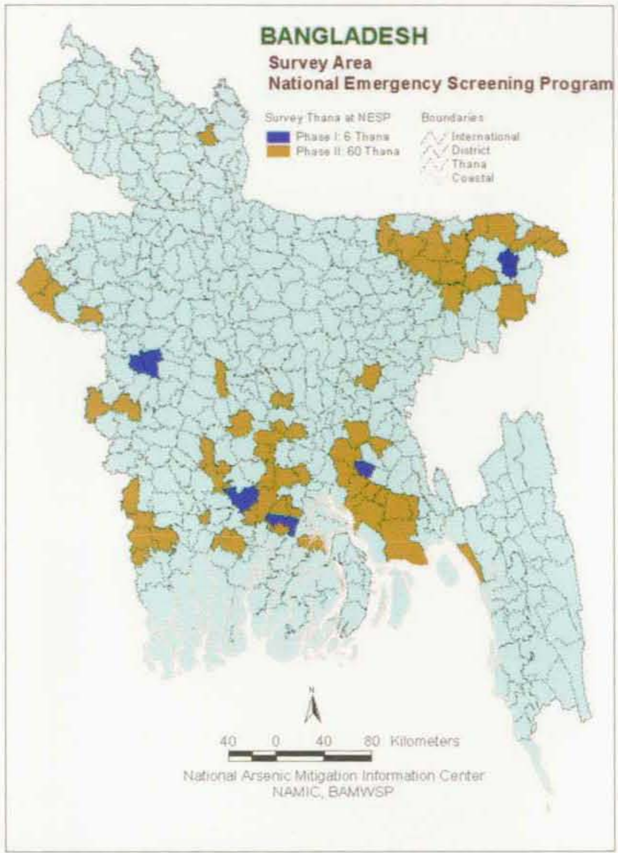


Figure 6.27. Location of the *upazilas* selected for comprehensive screening in Phases I and II of the BAMWSP National Emergency Screening Programme (NESP).

The majority of wells sampled in Uzirpur *upazila* (Barisal), which is in the southern coastal region of Bangladesh, were deep wells because of the presence of salinity in shallower horizons. Only 2% of these wells were reported as contaminated even though the shallow wells were mostly contaminated. This agrees with the results of the NHS where most of the deep wells sampled were from that region and showed a similarly low level of contamination. Some 20% of deep wells in Golapganj *upazila* in Sylhet district, both Government wells and non-Government wells, were contaminated. This is an area with a relatively low level of contamination in the shallow wells (10-14%) and so appears to reflect genuine contamination of the deep aquifer.

The NHS showed that one of the five wells from the

6.15.4 DPHE-UNICEF five *upazila* Community-Based Action Research Project surveys

As part of the DPHE-UNICEF Community-Based Action Research Project (CBARP), five *upazilas* were screened comprehensively for arsenic. The five *upazilas* (Districts in parentheses) were: Bera (Pabna), Jhikargacha (Jessore), Kachua (Chandpur), Sonargaon (Narayanganj) Manikganj sadar (Manikganj). This involved the testing of some 105,000 wells. The results for Manikganj were not available at the time of writing this report. The project began in March 1999 and involved the screening of some 788 villages in the four *upazilas*. The results for four *upazilas* are given in Table 6.21 and compared with those obtained by the NHS results in terms of the percentage of wells contaminated at the 50 μg L^{-1} level.

Plans are in place to tackle another 15 *upazilas* concentrated in southern Bangladesh.

6.15.5 Relationship with the numbers of arsenic patients identified

The large-scale screening surveys have also recorded the number of people showing symptoms of arsenic poisoning. In the DPHE-UNICEF four *upazila* survey, village health workers/community volunteers did the initial screening and physicians made the final diagnosis. A comparison of the results of such surveys with the arsenic concentrations in the tubewell water is obviously of great importance. It is commonly said in Bangladesh that 'the two maps do not agree'. Specifically, that relatively few patients have been identified from the highly contaminated region of south-east Bangladesh.

While such comparisons are best done on an individual household basis, the raw data were not available to us and so the only comparisons that could be made were based on the aggregated data.

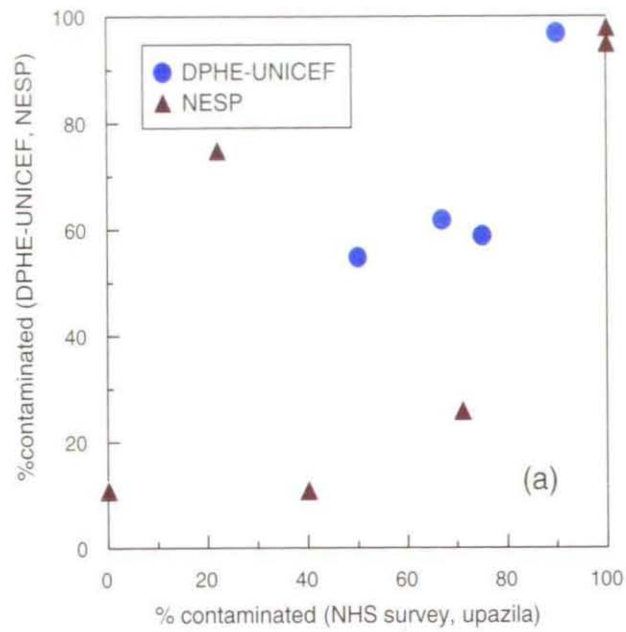
Table 6.21 shows the results from the six *upazila* NESP survey and the four *upazila* DPHE-UNICEF survey. In the NHS survey, only 8 wells were sampled in these *upazilas* on average. This will inevitably lead to a relatively large uncertainty in the calculated percentage contamination and other statistics. On average, 68 tubewells were analysed from each district in the *upazilas* covered by these two surveys. Therefore district-wise statistics are also given. There is a compromise between aggregating enough samples to obtain reasonably reliable statistics and losing the spatial resolution required, especially when cross-correlating with epidemiological data.

The *upazila* by *upazila* comparisons for the DPHE-UNICEF survey are good (Figure 6.28) and better than when district-wise averages are used for the NHS results. The selected *upazilas* in this survey appear to be relatively high-arsenic areas within each of the given districts, except for Chandpur where the level of contamination appears uniformly high (given the definition of 'contaminated' used). This is also reflected in the *upazila*- and district-wise average As concentrations. The correlation between the NESP survey and the NHS survey (*upazila*- or district-based results) are not so good.

There is a poor correlation between the percentage of contaminated groundwaters and the density of patients (Figure 6.28). The most striking difference between the DPHE-UNICEF and NESP surveys is in the number of patients identified in Chandpur district, a district identified as highly contaminated in both surveys. The DPHE-UNICEF survey in Kachua *upazila* observed only 0.1 patient per 10,000 people while the NESP survey in neighbouring Hajiganj *upazila* found 62.1 patients per 10,000 population. The reasons for this dramatic difference need to be explored and raise doubts about the sampling methodology used for the various surveys. The differences may give some indication of why there is often a poor correlation between the number of patients observed and the level of groundwater contamination.

Table 6.21. Results from four *upazilas* from the DPHE-UNICEF CBARP survey, and the NESP six-*upazila* survey, including the number of patients identified with arsenic-related symptoms and relation to the arsenic contamination of the tubewell water

				% contaminated			Average concentration (μg L^{-1})	
Upazila	**District**	**Population (1999 est)**	**Patients per 10,000 people**	**DPHE-UNICEF**	**NHS (upazila)**	**NHS (district)**	**NHS (upazila)**	**NHS (district)**
DPHE-UNICEF CBARP survey								
Bera	Pabna	237,000	4.3	55	50	17	50	32
Jhikarghacha	Jessore	267,000	3.6	59	75	48	91	72
Kachua	Chandpur	333,000	0.1	97	90	90	267	360
Sonargaon	Narayanganj	301,000	7.1	62	67	23	172	35
NESP 6-upazila survey								
Uzirpur	Barisal	489,000	6.3	75	22	32	41	90
Hajiganj	Chandpur	300,000	62.1	98	100	90	413	360
Sadar	Gopalganj	344,000	9.0	95	100	79	275	183
Bheramara	Kushtia	170,000	23.5	26	71	28	303	111
Ishwardi	Pabna	280,000	8.0	11	40	17	128	29
Golapganj	Sylhet	270,000	0.4	11	0	18	3	27



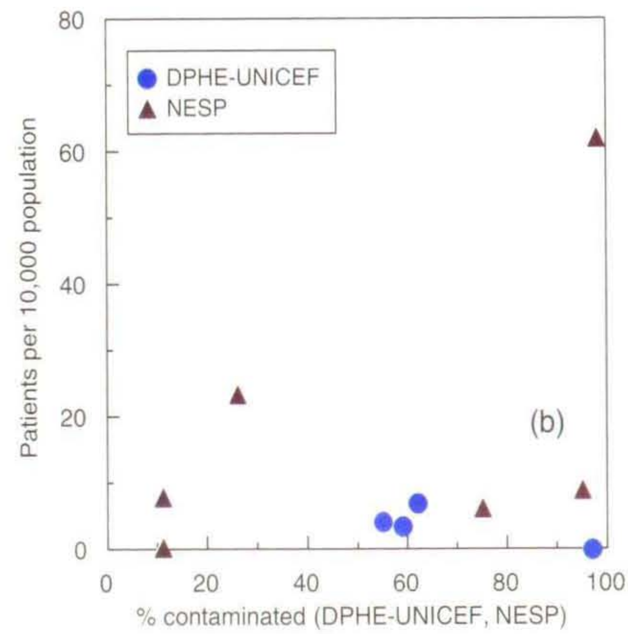


Figure 6.28. Relationships between observations of different surveys (a) level of contamination in the selected *upazila* between the NHS survey and the DPHE-UNICEF and NESP surveys, and (b) level of contamination in the DPHE-UNICEF and NESP surveys and the number of patients observed.

6.16 MICROBIOLOGICAL QUALITY

The parallel bacteriological water quality survey carried out on 1922 of the tubewells sampled in our 1998 survey showed that the the bacterial quality was not always adequate. Some 54% of samples failed the WHO guideline value for faecal coliforms, i.e. contained detectable coliforms (Hoque, 1998). The most significant causes of coliform contamination were found to be proximity of pit latrines and ditches. Well depth was found not to be a significant factor. Coliforms were detected in some of the deep groundwaters. The mechanism by which the deep wells become contaminated is not certain.

Ammonia-N was also found to be high in many samples with a median concentration of 1.0 mg L^{-1} ($n = 1922$) and a maximum of 7.5 mg L^{-1}. The ammonia concentrations tended to be high in the wells from southern Bangladesh including the deep tubewells from Barisal (Hoque, 1998).

6.17 SUMMARY

High As concentrations are almost entirely restricted to groundwaters from the shallow aquifers (<150 m) which are composed of Holocene alluvial and deltaic sediments and are the dominant aquifers in Bangladesh. Groundwater As concentrations have a considerable range from <0.25 μg L^{-1} to 1670 μg L^{-1} and show some distinctive spatial trends, with the highest average values in the south and south-east. Some high concentrations are also recognised in groundwaters from the Holocene sediments of the Jamuna Valley. Localised hot spots are also identified in some generally low-As areas (e.g. Chapai Nawabganj, western Bangladesh). Of the shallow groundwaters from Holocene sediments, the north-west region (Tista Fan) has the most consistently low As concentrations.

Of the groundwaters investigated in the survey, 42% had As concentrations >10 μg L^{-1}, 25% >50 μg l^{-1}, 16% >100 μg L^{-1} and 0.06% >1 mg L^{-1}. Considering the shallow wells (≤150 m) alone, 46% exceeded 10 μg L^{-1} and 27% exceeded 50 μg L^{-1}.

In the shallow aquifers, considerable variations also exist in As concentrations with depth. Some of the shallowest groundwaters (<10 m) typically have low As concentrations probably as a result of more oxidising conditions.

Where sampled, deep groundwaters from 'deep' wells (>150 m depth) almost always have low As concentrations (95% <10 μg L^{-1}, 99% <50 μg L^{-1}, 3 samples out of 326 sampled being in excess of 50 μg L^{-1}). However, these deep wells were mainly from the southern coastal region and Sylhet in the north-east, and so are not necessarily representative of deep wells elsewhere in Bangladesh. The deep wells in Sylhet appear to contain more As than those from the southern coastal regions.

Phosphorus concentrations in Bangladesh groundwaters are high by world standards: <0.1–19 mg L^{-1} in the shallow groundwaters and <0.1–6.1 mg L^{-1} in the deep groundwaters. The highest concentrations (>1 mg L^{-1}) are mainly found in groundwaters from south-eastern and north-eastern Bangladesh and along the Jamuna Valley. The distribution shows many similarities with that of arsenic, although in contrast to arsenic, many of the deep groundwaters of the southern coastal region have relatively high concentrations (often >1 mg L^{-1} P).

Groundwaters from the Barind and Madhupur Tracts (Dupi Tila aquifer) have uniformly low As concentrations. These include the deep groundwaters from Dhaka city. Analysis of seven Dhaka WASA wells showed that all had <0.5 μg L^{-1} As. Deep wells from Dhaka city also had low concentrations of most other analysed trace elements. Concentrations of Cd, Cr, Pb, Ni, Sb and U were all substantially below WHO health-based guideline values. Only

Mn exceeded the guideline value (0.5 mg L^{-1}), with one sample having 0.67 mg L^{-1}.

The spatial pattern of As concentrations in the Holocene aquifer is believed to reflect a complex interrelationship between the redox characteristics, lithology of the aquifer and overlying sediments and history of groundwater flow. High concentrations in the south and south-east reflect the strongly reducing conditions in the aquifers in this area, poor permeability of overlying sediments, higher proportions of finer-grained material and iron oxides, slow rates of groundwater movement and lack of aquifer flushing.

In the north-central Jamuna Valley, groundwaters have very high concentrations of Fe (often greater than 10 mg L^{-1}) and Mn (up to 10 mg L^{-1}) relative to most of Bangladesh, and many have high SO_4 concentrations compared to the high-As groundwaters further south. The young sediments of the Jamuna Valley are thought to be undergoing active reduction but have not achieved such strongly reducing conditions overall as in the high-As areas of southern Bangladesh. This may be for a number of reasons: less fine-grained sediment at surface and hence less restriction of recharge and dissolved oxygen to the aquifers, shallow well depths and a relatively deep unsaturated zone compared to further south, and perhaps more active groundwater flow. Some of the higher SO_4 concentrations may be related to sulphide oxidation. However, if this is happening, it has not resulted in As mobilisation as As concentrations are low in the high-SO_4 groundwaters. By contrast, the high-As groundwaters (>50 µg L^{-1}) from the area have very low SO_4 concentrations, typically 1 mg L^{-1} or less, and indicate that these are more strongly reducing. This association of high As with low SO_4, as elsewhere in Bangladesh, precludes sulphide oxidation as the dominant cause of arsenic mobilisation, although groundwaters from a few tubewells may have been affected by this process.

Low As concentrations in groundwaters from the Tista Fan deposits of northern Bangladesh occur in generally relatively oxidising conditions with low overall Fe concentrations. These redox characteristics probably reflect the coarser grain-size of the Tista Fan sediments and lack of impermeable sediment cover, as well as more active flushing of the aquifer in this region.

The regional distributions of Fe and Mn in the groundwaters also strongly reflect redox controls. The Fe distribution shows some relationship with that of As, though it is weak in some places. Despite the strong redox control of Fe and Mn concentrations, these two elements have differing regional distributions reflecting differing redox potentials at which the respective reactions take place.

Distributions of Na, B and K largely reflect seawater influences, with greatest contributions from old seawater in southern Bangladesh (shallow and deep aquifers), the Sylhet Basin and the Atrai Floodplain north of the River Ganges. Potassium is also derived from mineral weathering reactions.

Distributions of Ca, Mg, Sr and to some extent Ba, reflect the distributions of free carbonates in the aquifer sediments and soils. Concentrations are generally highest in south-west Bangladesh.

Other elements of potential health concern besides As include Mn and in some more saline samples, B. In a small subset of National Hydrochemical Survey samples analysed for a wider suite of trace metals, U exceeded the WHO guideline value most frequently (10 samples, 56%). Nickel and Pb exceedances above guideline values were noted in a small percentage of samples, with maxima of 132 µg L^{-1} and 10.8 µg L^{-1} respectively.

Comparisons between the National Hydrochemical Survey and other surveys generally show good agreement in the regional patterns. Some differences exist in northern Bangladesh where the more sensitive analyses of the National Hydrochemical Survey reveals patterns with a low level of contamination which are not shown in the mass screening programmes.

The geographical distribution of patients so far identified does not appear to be closely related to the groundwater arsenic maps. The reasons for this are not clear and need further study.

7 Hydrogeochemistry of three Special Study Areas

7.1 INTRODUCTION

Chemical data collected for groundwaters from the Bangladesh National Hydrochemical Survey give useful information about the inorganic groundwater quality and the regional variations but interpretation is limited by the range of determinands analysed. More detailed analysis of the national survey samples, including anion, trace-element and isotopic analysis, was beyond the scope of the project. However, these parameters are of great potential value in assessing hydrogeochemical processes in the aquifers and for this reason, three Special Study Areas were chosen in which to carry out more detailed groundwater chemical analysis. These study areas were also the focus of mineralogical and sediment chemistry investigations, groundwater monitoring and flow modelling. The areas chosen were the headquarter (sadar) *upazilas* of the Districts of Lakshmipur, Faridpur and Nawabganj (Figure 7.1). Samples were also collected from Shibganj, the neighbouring *upazila* to Chapai Nawabganj headquarter *upazila* (Nawabganj District) and Chatkhil (neighbouring *upazila* to Lakshmipur headquarter *upazila*). The areas were selected as they have recognised arsenic problems, are distributed widely across the alluvial and deltaic plain of Bangladesh in different sections of the Bengal drainage system and have differing geological and hydrogeological characteristics. This Chapter describes the results of the groundwater chemical investigations. Groundwater flow modelling results are presented in Chapter 5 and mineralogical and sediment chemistry results in Chapter 11.

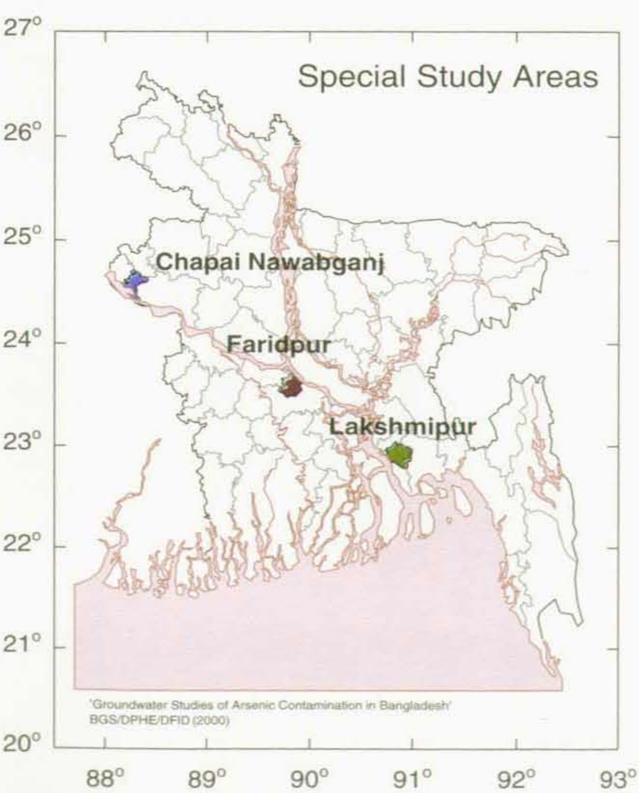


Figure 7.1. Sketch map of Bangladesh showing the major river systems and the locations of the three Special Study Areas.

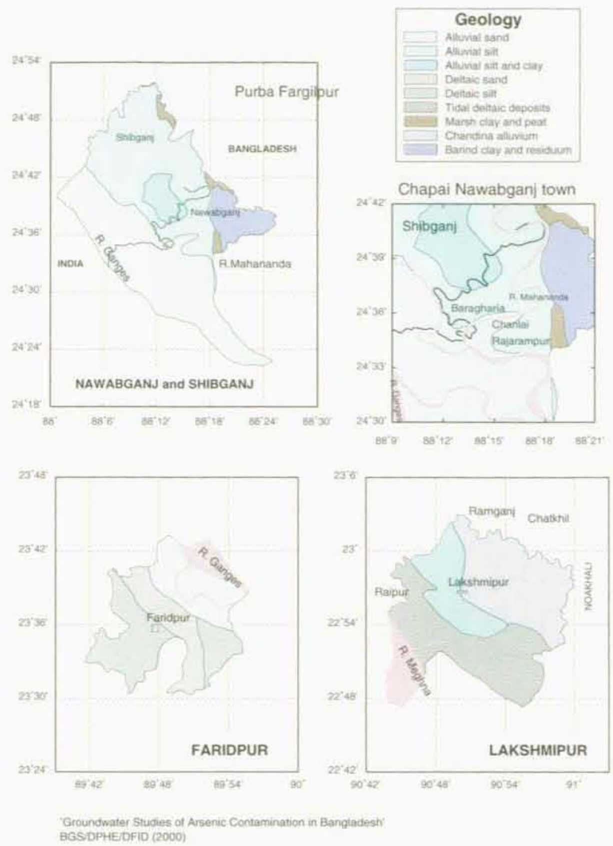


Figure 7.2. Maps of the three study areas showing surface geology (taken from Alam et al., 1990). The inset map for Chapai Nawabganj shows the municipal area.

7.2 LOCAL GEOLOGY AND HYDROGEOLOGY

7.2.1 Lakshmipur

Lakshmipur *upazila* is situated in the coastal belt of south-eastern Bangladesh, close to the present course of the Meghna river system and downstream of its confluence with the Jamuna and Ganges rivers. The surface geology comprises in the south, alluvial silt and clay and tidal deltaic deposits which are part of the active Meghna floodplain, and in the north, Chandina Alluvium (Figure 7.2). The Chandina Alluvium is composed of yellow-brown (partly oxidised) or grey silt and clay and is more consolidated than the active floodplain sediments. The surface is elevated relative to the active floodplain and radiocarbon dating suggests that its deposition ceased during the middle Holocene (Alam et al., 1990). MMI (1992) proposed a two-fold division of the Chandina Formation based on borehole records. They defined an upper unit, including ca. 3 m of surface clay (Chandina Alluvium), underlain by ca. 30 m of grey micaceous sand with occasional thin peat beds. Some boreholes from this horizon discharge methane (Ahmed et al., 1998). MMI (1992) also described a lower unit of dark grey micaceous sandy silt containing brackish groundwater. These are underlain by further sandy deposits of unknown age.

In the southern part of the *upazila*, alluvial and deltaic sediments of the active Meghna floodplain are composed predominantly of inter-layered grey to yellowish-grey fine micaceous sand and grey clay and silt. Surface horizons are usually of silt or clay. Three main aquifer units have been described in the sequence: an upper unit extending down to about 80 m depth, a second unit between about 100 m and 130 m and a lower unit at greater than ca. 250 m, extending to ca. 350 m (DPHE/BGS/MML, 1999). All are separated by clay and silt layers. The lower unit is believed to be the Dupi Tila Formation, but the stratigraphy at this depth has not been well-characterised. The subsurface relationship between the sediments of the active floodplain and the Chandina Formation is also not well understood.

Sediments recovered from the cored log of alluvial sediments at Lakshmipur (LPW6, Chapter 3) reveal a large degree of vertical sediment heterogeneity, particularly at shallow depths (<60 m; Figure 3.15). Interbedded layers of silt and fine sand typically just a few centimetres thick occur in this interval and must give rise to considerable heterogeneity of groundwater flow on a local scale. Silts and fine sands (grey and brownish grey) predominate in the core profile down to around 85 m depth with a coarser sandy interval at 60–70 m. Radiocarbon analysis (Chapter 3) suggests that sediments down to around 70 m depth are generally around 10,000 years BP or less. Peat occurs at around 76–77 m depth (radiocarbon age >40,000 years BP). Between 85–150 m, sediments are more commonly grey medium and coarse sands. Below this, grey silts occur down to the base of the profile at 153 m (Figure 3.15). Radiocarbon data are difficult to interpret in the lowermost part of the profile: sediments at around 80 m depth give radiocarbon ages of around 35,000–38,000 years BP whilst in the depth interval 92–138 m, the age dates (3 samples) are less than 13,000 BP. The profile does not penetrate as far as the deep aquifer used for groundwater abstraction and so age relationships of the deeper lithologies remain unknown.

Groundwater is abstracted from sandy sediments in the Chandina Formation and the alluvial/deltaic sequences of the active floodplain, as well as from the deep lower aquifer. Groundwater levels in both deep and shallow tubewells are generally shallow, just a metre or two below ground level. Groundwater quality is significantly impacted by salinity and the salinity variation with depth is complex (Jensenius and Rahman, 1997). However, abstraction is principally from two distinct depth ranges: <20 m and >170 m. Few tubewells abstract from the intermediate depth range because of the presence of brackish or saline

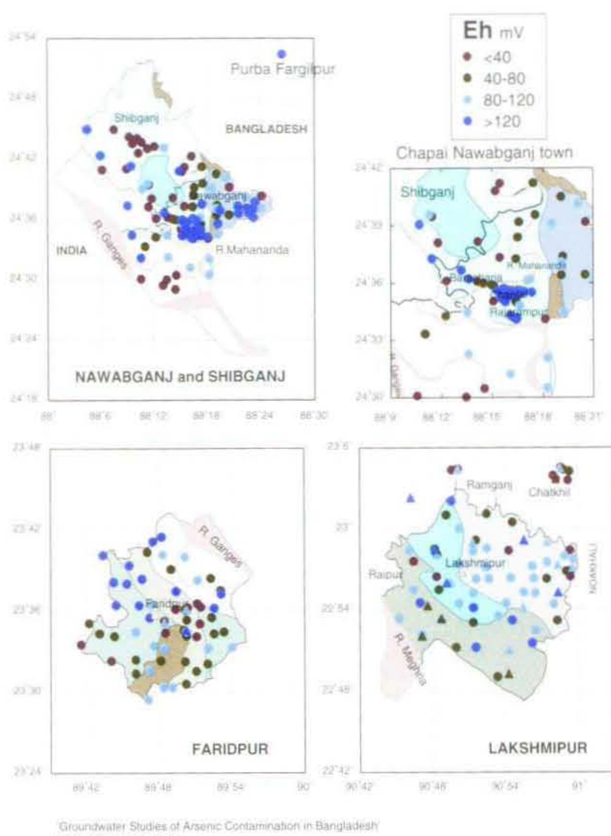


Figure 7.3. Maps of the three Special Study Areas showing the distribution of Eh. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

groundwater in this interval. The depth of the groundwaters from the upper aquifer is shallower than in the other Special Study Areas. There is thus a large depth difference between the shallow and deep aquifers under investigation in Lakshmipur and there is unlikely to be hydraulic connection between the two.

7.2.2 Faridpur

Faridpur *upazila* is situated downstream of the confluence of the Ganges and Jamuna river systems (Figure 7.1). The surface geology of the *upazila* comprises alluvial sand in the northern part and deltaic sand and silt in the south. A small area of marsh clay and peat also crops out in the south (Figure 7.3). The alluvial sand is part of the active floodplain of the River Ganges (channel, bar and levée deposits) and oversteps the deltaic sand and silt deposits (Older Ganges sediments) which crop out further south. The alluvial sands are grey to brownish-grey with dominant quartz and abundant mica (biotite and muscovite). The deltaic sands and silts are grey to yellow-grey deposits, mainly deposited in flood events as point bars, channel bars and levées.

As noted in Chapter 3, the sediments of Faridpur show considerable heterogeneity of sediment type and texture with depth. Lithological information from the Faridpur log (Figure 3.13) indicates that the sediments are complex sequences of micaceous sands, silts and clays, often fining upwards. Most are grey in colour, although several horizons are brown or brownish-grey. These occur particularly in the top 4 m, at various horizons down to 20 m and between 132 m and the base of the borehole at 155 m depth. A thin layer of clayey silt and peat occurs at 45 m depth. Sandy sediments predominate at greater than 45 m depth and coarsest sands occur at between 103 m and 133 m depth, with gravel fractions being important in the interval 110–132 m (Figure 3.13). Radiocarbon evidence suggests that sediments in the top 10 m are mainly less than 1000 years old. Sediment at 45 m depth gave an age of around 8000 years BP (Chapter 3) and that at 92 m depth gave a maximum age of 23,000 years BP. As with the Lakshmipur profile, age relationships with depth are highly complex and in the case of some old radiocarbon dates, may represent reworked (older) carbon.

Of significance from a hydrogeological point of view, neither the Faridpur lithological profile (Figure 3.13) nor correlated logs from across the region show major thicknesses of fine-grained poorly-permeable sediments that could effectively separate the shallow and deeper aquifers. The implication is therefore that potential exists for some cross-formational flow in this area. Groundwater is abstracted for domestic use largely from the shallow aquifer at less than around 100 m depth, although some irrigation wells abstract from >100 m.

7.2.3 Chapai Nawabganj

Chapai Nawabganj *upazila* is situated close to the present course of the River Ganges, adjacent to the national border with West Bengal. The surface geology comprises mainly alluvial sand of the active Ganges floodplain in the south and alluvial silt and clay in the north. The north-eastern part of the *upazila* investigated forms part of the fault-bounded Barind Tract, which has been uplifted by some 50 m relative to the neighbouring Holocene alluvium (Ahmed and Burgess, 1995). The contact of the Barind Tract with the younger alluvial sediments is not well understood but is thought to be steeply dipping and fault-bounded. The surface expression of the Barind Tract is the Barind Clay (Figure 7.2), which is of Pleistocene age and composed of around 30 m of fine-grained deposits, mainly of red-brown structureless fine silt and clay with less abundant sand. The sand fraction is dominantly quartz and mica, with accessory plagioclase and minor orthoclase; the clay is mainly illite with subordinate kaolinite (Alam et al., 1990). The formation includes relict palaeosol material.

The Barind Clay in Chapai Nawabganj is underlain by red-brown silty sands, sands and gravels of the Pliocene Dupi Tila aquifer, which is the source for groundwater supply in the north-eastern part of the *upazila*. The typical red-brown coloration of the Dupi Tila sediments indicates that constituent iron minerals are oxidised. The aquifer is confined by the overlying Barind Clay.

As noted in Chapter 3, the DPHE/Project cored borehole at Chapai Nawabganj (CPW5, located at Chanlai in the Chapai Nawabganj municipal area) is shallower than the boreholes from the other two study areas because of the known predominance of grey clay below 50 m depth, as identified from pre-existing logs. Vertical variations in lithology are large, with thin layers of alternating micaceous sand, silt and clay. Sediment colour is mixed brown, olive-brown and grey. Sediments in the top 26 m of the profile give radiocarbon dates up to 5000 years BP (Chapter 3). A thin layer (ca. 0.6 m) of dark red-brown platey ferricrete occurs at 37 m depth and is believed to represent a palaeosol horizon. Below this, light yellow and yellow-brown clay and silty clay predominates down to 45 m, and between 45 m and the base of the borehole at 50 m, grey and brown silts and clayey silts predominate (Figure 3.9). The palaeosol surface is thought to be the top erosion surface of the Barind Clay and underlying sediments are therefore considered to be much older Barind sediments.

Groundwaters in Chapai Nawabganj are mostly abstracted from shallow depths (<60 m) in either the Holocene alluvial sediments or, in the east, from the Dupi Tila aquifer confined beneath the outcropping Barind Clay. Most drinking-water supplies are abstracted with suction hand pumps but as groundwater levels have a tendency to be deeper than in the other two study areas, a greater proportion of water (around 20%) is abstracted with Tara pumps (DPHE/BGS/MML, 1999). A greater proportion of irrigation water (30%) is also derived from deep tubewells (DPHE/BGS/MML, 1999) than in the other study areas. Groundwater is relied upon heavily for irrigation in the dry season. A few hand-dug wells are present in the Holocene alluvium, extending to around 10 m depth, but these have been largely superseded by hand-pump tubewells. Hand-dug wells also exist in the Barind area (Ahmed and Burgess, 1995).

7.3 SAMPLING AND ANALYTICAL METHODS

7.3.1 Sampling

Groundwater samples were collected from 83 tubewell sources in Lakshmipur and neighbouring Chatkhil, 65 tubewells in Faridpur and 90 tubewells in Chapai Nawabganj and neighbouring Shibganj. Samples were also collected from 5 hand-dug wells in Chapai Nawabganj. Results are also considered from a previous British Geological Survey sampling campaign of 27 tubewells and 2 shallow dug wells in Chapai Nawabganj during February 1997. Sampling in each area was carried out at a density of around 1 tubewell per 7 km^2. Where possible, samples were collected from tubewells having a range of depths. Sampling density was greater in the earlier 1997 survey of the Chapai Nawabganj municipal area. Extra sampling around Chatkhil (Lakshmipur area) was carried out to allow comparison of groundwater-chemistry data with sediment-chemistry data (West Latifpur and Bhimpur sediments, Chatkhil) as discussed later (Chapter 11). Sample locations were fixed using GPS equipment.

Groundwater samples were collected whilst pumping from tubewells installed with hand or electric pumps. Dug wells were sampled by bailing. On-site analysis included pH, dissolved oxygen and redox potential (Eh), monitored in anaerobic flow cells until stable readings were obtained from flowing water where possible. On-site analysis also included specific electrical conductance (SEC), alkalinity and temperature. In addition, samples were collected for subsequent chemical and isotopic analysis. Samples for major- and trace-element analysis were filtered through 0.2 μm acetate filters and collected in acid-washed polyethylene bottles. Aliquots for analysis of cations and SO_4 were acidified to 1% (w/v) with pure concentrated nitric acid. Aliquots for As(III) were acidified to pH 4 using pure hydrochloric acid and total As was measured from these aliquots after acidification to 2% (w/v) with pure HCl. Unacidified aliquots were also collected for anion analysis. Further unfiltered samples were collected in glass bottles for analysis of $\delta^{18}O$, δ^2H and $\delta^{13}C$. Samples for $\delta^{13}C$ collected during 1998 were preserved using sodium azide, as recommended by Clark and Fritz (1997). However, analytical results produced following this method of preservation (as reported in our Phase I Report) were found to be questionable. Clark and Fritz subsequently issued an erratum to their 1997 volume (see www.science.uottawa.ca/~eih/errors.htm) retracting the recommendation of using sodium azide as a preservative due to analytical complications. Affected samples were therefore subsequently reanalysed using the aliquot originally collected for $\delta^{18}O$ analysis. Since these samples had not had preservative added specifically for ^{13}C analysis, the delay before reanalysis may have had an impact on the quality of the data.

Samples were also collected in 1- or 5-L polyethylene bottles at selected sites for analysis of $\delta^{34}S$, after preconcentration of S by addition of $BaCl_2$ under acidic conditions (HNO_3) and consequent precipitation of $BaSO_4$.

Dissolved gases were measured in 24 pumped groundwater samples selected from each of the three study areas. Samples were collected in-line in steel bombs.

Detailed sampling of groundwater from the piezometer sets installed for the project in each of the three study areas was also carried out to investigate water-quality relationships with depth. The piezometers are described more fully in Chapter 2 and monitoring data are described in Chapter 11. Piezometers installed at Chanlai Primary School, Chapai Nawabganj (24°35.37' N 88°15.50' E) were completed at depths of 10, 20, 30 and 40 m. Those from Aliabad Union Parishad Compound, Faridpur (23°35.22' N 89°51.69' E) were completed at depths of 10, 20, 30, 40, 50 and 150 m depth. Those from the DPHE Compound, Lakshmipur (22°56.47' N 90°50.60' E) were also completed at depths of 10, 20, 30, 40, 50 and 150 m. Sampling of these piezometers was carried out during November and December 1999 and included pumping of each piezometer to obtain measurements of Eh, dissolved oxygen, SEC, temperature and alkalinity as with the other samples. Extra samples were also collected for tritium (1-L polyethylene) and radiocarbon (1-L glass) during this campaign from both the piezometers and from other tubewells and dug wells in the vicinity of the piezometers. The 10 m piezometer at Faridpur was consistently dry and no sampling at this depth was therefore possible.

Depth samples were collected from a deep borehole in Lakshmipur (Kamarchat Bazar, 22°55.31' N 90°58.28' E) using an electric stainless-steel depth sampler equipped with 100 m of cable. Filtered samples were collected for chemical analysis, as with other samples and on-site analysis included pH, alkalinity, dissolved oxygen and SEC.

Pore waters were recovered from sandy core samples from two boreholes (DW1 and DW2) drilled in 1998 by BWDB as part of an earlier UNICEF-sponsored project in Chapai Nawabganj. Borehole DW1 was drilled at Rajarampur [24°34.5' N 88°16' E] and DW2 at Chanlai [24°35' N 88°16' E]. Each borehole was drilled to a total depth of 150 m by reverse circulation and core material was recovered over a 2-ft interval at every 10 ft (ca. 3 m) by spooning without use of drilling fluid. Details of the core material and drilling method are given in Khan et al. (1998). Sub-samples of core material were sealed on site with wax in PVC liners and freighted to the UK for chemical analysis. Pore waters were recovered by centrifugation using screw-topped centrifuge cups in a high-speed centrifuge. Analysis of these was carried out as for the pumped groundwater samples.

7.3.2 Analytical procedures

Major cations, SO_4 and minor elements were analysed by ICP-AES. Samples collected in 1997 and 1998 were measured using an ARL3400C optical emission spectrometer. Those collected during 1999 were measured using a Perkin Elmer Optima 3300 Dual-View machine. Selected trace elements were also analysed by ICP-MS. Analysis by both methods was carried out in BGS laboratories. ICP-AES and ICP-MS analyses were drift- and blank-corrected and ICP-MS measurements were made using In and Pt or In and Bi internal standards. Samples were interspersed with standard reference materials (NIST, USA standard 1643d and NWRI, Canada standard TM23) and other quality-control standards. During the course of ICP-AES analysis, average values of 8 determinations of 1643d measured were usually accurate to within 3% or less (Li 6%, K 5%). Five replicate analyses of standard TM23 gave values for detectable elements measured by ICP-AES generally within 10% (the poorer accuracy reflecting lower concentrations of many of the elements in this standard). Quality-control standards analysed during ICP-MS analysis were also checked against accepted values. Analysed values were typically within 10% of long-term means.

Chloride, total oxidised nitrogen (TON), NO_2-N, NH_4-N, F and I were measured by automated colorimetry. Bromide was also measured colorimetrically except where concentrations exceeded 25 μg L^{-1}, in which case, they were measured by ion chromatography. During the course of analysis, the average concentration of a 3.90 mg L^{-1} NH_4-N standard was 3.86 mg L^{-1} (two analyses, RSD 1.10%) and six determinations of NWRI reference standard ION96 gave average values of 70.9 mg L^{-1} (RSD 1.20%) for Cl (certified value 72.1 mg L^{-1}) and 4.60 mg L^{-1} (RSD 3.71%) for TON (certified value 4.69 mg L^{-1}). Results of total oxidised nitrogen in this study are quoted as nitrate (NO_3-N).

Arsenic(III) and As_T were determined in samples collected in 1997 and 1998 by ICP-AES with hydride generation following the method described by Smedley et al. (1996). As_T here and throughout the following discussion refers to total dissolved As (i.e. filtered). Analytical precision was usually good: duplicate analyses of 44 samples from these batches were mostly reproducible to within 10%, samples with concentrations less than 10 μg L^{-1} being reproducible to within 2 μg L^{-1}. The quality of replicate analyses between two BGS laboratories was also reasonable, with 20 duplicate samples differing by 10% or less, samples less than 10 μg L^{-1} agreeing to within 3 μg L^{-1}. Samples collected for As(III) and As_T in 1999 were analysed by atomic fluorescence spectrometry (AFS) with hydride generation. Samples for As_T analysis were pre-reduced using a solution of 10% KI/1% ascorbic acid and left at room temperature for more than 2 hours before analysis. Selenium was also measured in 20 selected samples by AFS with hydride generation, using KBr as reductant and heating at 70°C for 40 minutes before analysis. For overall analyses, electrical charge imbalances were usually less than 6% and in most samples (90%) less than 4%.

Stable-isotopic analysis was carried out by mass spectrometry. Measurements of $\delta^{34}S$ were made on $BaSO_4$ powders by Geochron Laboratories, USA. No measurements were made of $\delta^{18}O$ in SO_4. Results for $\delta^{18}O$ and $\delta^{2}H$ in groundwaters are reported relative to SMOW, $\delta^{13}C$ relative to PDB and $\delta^{34}S$ relative to CDT. Tritium samples were analysed by scintillation counting with electrolytic enrichment at the University of Witwatersrand, South Africa. Precision of analyses was within 0.4 TU. Radiocarbon analysis of groundwaters was carried out by accelerator mass spectrometry at the University of Arizona, USA with sample preparation by the NERC Radiocarbon Laboratory, East Kilbride, UK. Samples were filtered (0.7 μm) and CO_2 was produced from dissolved inorganic carbon (DIC) by hydrolysis with H_3PO_4. Carbon was preserved as graphite and sent to USA for analysis.

Dissolved gases were measured by gas chromatography following extraction using a carrier gas. Chromatographic separation of O_2 and Ar peaks is not possible by this method and so results give the sum of these two determinands. However, O_2 has been estimated approximately by assuming that Ar is a fixed proportion of the N_2 concentration.

7.4 REGIONAL GROUNDWATER CHEMISTRY

7.4.1 Common chemical characteristics

Representative analyses for selected groundwater samples are given in Table 7.1 and summary statistics for chemical and isotopic data from the three study areas, divided by aquifer, are given in Tables 7.2–7.5.

Chemical compositions of the groundwaters vary both regionally and between aquifers. Nonetheless, some common characteristics are observed. The most notable feature of the tubewell groundwaters is their predominantly reducing condition. Almost all samples investigated have low redox potentials (88% with Eh values less than 150 mV, 30% with values less than 50 mV) and negligible concentrations of dissolved oxygen (Tables 7.1 and 7.2). As a result, concentrations of Fe and Mn are high in many samples. Numerous samples investigated have Fe concentrations >1 mg L^{-1} and Mn concentrations >0.5 mg L^{-1}.

Concentrations of NO_3-N are low or not detectable in most samples and conversely, concentrations of NH_4-N are often high, typically in excess of 1 mg L^{-1}.

Concentrations of SO_4 are variable, but also usually very low, at 1 mg L^{-1} or less (Table 7.1, total S values, given as SO_4). All groundwaters are greatly undersaturated with respect to gypsum, log SI values being in the range –1 to –5 (all are also significantly undersaturated for jarosite and alunite). H_2S was rarely smelt at the well head.

Typical concentrations of dissolved organic carbon (DOC) are in the range 1–3 mg L^{-1} (Tables 7.1 and 7.2) but some higher concentrations occur (up to 14 mg L^{-1}).

Analysed groundwaters from the three areas are predominantly fresh with a SEC typically less than 1000 μS cm^{-1} and of Ca-HCO_3 type, although salinity is higher in many of the samples from Lakshmipur where a greater proportion of Na-Ca-Mg-HCO_3-Cl waters are present as a result of seawater influence close to the coast (Section 7.4.2).

The groundwaters have near-neutral pHs (most being in the range 6.5–7.6). Partial pressure of CO_2 is also high in most of the groundwaters (log pCO_2 values –0.1 to –3.0, but mostly more positive than –2.0). Compositions vary from being undersaturated to supersaturated with respect to calcite and dolomite (log SI values for calcite range between –1.3 and +0.7 and for dolomite between –2.7 and +1.6). Those with the highest pHs (7.3–7.6) are the most supersaturated with respect to these minerals. High HCO_3 concentrations are also a typical feature of many of these groundwaters (up to 1140 mg L^{-1}; Table 7.2). The groundwaters are usually saturated or supersaturated with respect to siderite, although this mineral has not been identified in thin section. The degree of saturation has a direct correlation with the dissolved Fe concentration.

Other notable features include the high concentrations of dissolved P in some groundwaters, concentrations frequently exceeding 1 mg L^{-1} (Tables 7.1 and 7.2). Calculated saturation indices indicate that the Fe phosphate mineral vivianite is saturated in many of the groundwaters, although this has also not been identified mineralogically.

Silicon concentrations range between 6–42 mg L^{-1} (Table 7.2). Concentrations appear to be greater in the deeper groundwaters, probably as a result of longer residence times and increased water-rock interaction relative to the shallow waters. Increasing temperature in response to the geothermal gradient may also have had an effect. The groundwaters are saturated with respect to quartz and chalcedony and undersaturated with respect to Si gel and amorphous SiO_2. Saturation indices for cristobalite are variable: shallow groundwaters may be either undersaturated or saturated. Deep groundwaters from Lakshmipur are more commonly saturated with respect to cristobalite.

The Bangladesh groundwaters have characteristic trace-element compositions which reflect their reducing nature. Concentrations of Cu, Ni and Pb are universally low in the groundwaters, probably as a result of their stabilisation in sulphide minerals. Most samples (90%) have Cu concentrations less than 1 μg L^{-1}, Ni concentrations less than 4 μg L^{-1} and Pb concentrations less than 0.4 μg L^{-1} (Table 7.3). Concentrations of Zn are typically less than 40 μg L^{-1} although occasionally concentrations in excess of 200 μg L^{-1} are found. Extremely high concentrations (up to 6 mg L^{-1}, Table 7.3) may be due to local contamination from pipework rather than natural reactions in the aquifer. Copper, Ni, Pb and Zn form cations in aqueous solution and will hence behave differently in groundwater from As, which is present as oxyanion species. Concentrations of Se analysed in a subset of 20 selected samples all had low values (<0.5 μg L^{-1}) as a result of reduction to Se metal or adsorption onto iron-oxide surfaces. Mercury was not measured and hence the distribution of Hg concentrations is unknown.

Table 7.1. Analyses of representative groundwater samples from the three Special Study Areas

Sample		990409	980733	980750	980725	980701	980742	980758	980761	980706	980734	990416	980704	980727	980826	980821	980776	980830
Locality		Fakhrul Alam	Madna Primary School	Char Mondal	Pratabganj School	Char Ramani Mohan	Mandari High School	Dalal Bazar High School	Chandipur	Lakshmipur School	Farashganj Bazar	Jagatbar	Shakchar	Kamarchat Bazar	Decreer Char	Bhabukdia	Fursa	Mahmud-pur
Upazila		Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Lakshmipur	Faridpur	Faridpur	Faridpur	Faridpur
Aquifer		Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Deep	Deep	Deep	Deep	Shallow	Shallow	Shallow	Shallow
Latitude	°N	22.9075	22.8592	22.9598	22.9408	22.8705	22.9397	22.9683	23.0722	22.9408	22.8515	22.8890	22.9050	22.9218	23.6248	23.5718	23.5057	23.5740
Longitude	°E	90.9650	90.9357	90.7738	90.9885	90.7840	90.9067	90.8055	90.8258	90.8052	90.9035	90.8113	90.7925	90.9713	89.8853	89.7173	89.8062	89.8380
Well depth	m	8	8	8	9	11	11	14	14	17	183	224	229	262	14	18	26	32
Temp	°C	26.1	26.6	25.1	26.0	27.4	26.3	26.6	25.4	24.9	27.7	27.9	25.7	26.3	26.9	26.6	26.4	26.0
pH		6.79	7.03	7.04	7.55	7.20	7.20	6.86	7.21	7.28	7.13	6.87	6.92	6.53	6.73	7.01	6.86	6.38
Eh	mV	87	150	35	28	119	81	57	36	25	81	61	78	128	77	47	98	91
DO	mg L^{-1}	<0.1	<0.1	<0.1	<0.1	1.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
SEC	µS cm^{-1}	887	4640	958	894	1440	883	597	1630	2490	424	408	490	2000	1100	785	764	622
Ca	mg L^{-1}	67.6	81.0	72.8	20.0	49.6	34.8	74.1	69.4	58.6	27.9	25.0	26.9	111.0	190.0	122.0	123.0	67.9
Mg	mg L^{-1}	66.0	124.0	41.8	27.7	32.7	38.7	30.2	43.5	58.2	16.9	16.1	18.7	75.8	51.0	27.5	28.0	44.0
Na	mg L^{-1}	62	1090	79.2	153	211	97.9	18.1	277	453	43.8	49.0	46.1	201	14.4	17.6	28.0	18.6
K	mg L^{-1}	9.93	30.2	7.29	11.5	11.1	11.7	5.01	10.7	14.0	5.95	4.91	4.06	6.94	7.63	3.31	4.84	4.17
HCO_3	mg L^{-1}	310	1140	546	519	629	463	422	597	1110	271	248	251	125	841	534	607	485
Cl	mg L^{-1}	195	1290	82.5	72.1	148	64.3	6.2	414	360	24.7	17.6	37.1	637	2	7.5	3.6	12.7
SO_4	mg L^{-1}	12.9	265	<0.2	<0.2	1.2	6.3	0.4	0.4	0.5	<0.2	<0.2	<0.2	4.9	2.1	<0.2	0.2	0.5
NO_3-N	mg L^{-1}	<0.5	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.5	<0.3	<0.3	<0.3	<0.3	3.7	<0.3
NO_2-N	µg L^{-1}	6	<2	<4	<2	5	<4	<4	4470	<2	<2	<4	3	<2	<4	<4	3420	<4
NH_4-N	mg L^{-1}	1.25	2.05	6.99	3.97	1.98	3.37	1.93	14.7	7.41	<0.06	1.31	0.34	0.34	0.45	0.61	<0.06	3.63
DOC	mg L^{-1}	0.41	3.8	5.7	3		2.9	2.5	9.8	10	2.5	<0.1	5.2	4.2	1.1	0.1	2.9	7.9
Si	mg L^{-1}	25.1	10.3	16.2	8.4	12.2	13.8	18.6	10.3	10.8	21.4	29.7	24.0	27.2	11.3	14.4	16.9	41.9
P	mg L^{-1}	0.3	0.5	2.9	1.7	0.7	0.6	2.8	1.6	3.4	0.2	0.7	0.3	0.3	0.3	1.1	2.1	2.7
As_T	µg L^{-1}	73	<6	276	262	13	62	194	702	364	<6	2.13	<6	8	<6	132	278	24
As(III)	µg L^{-1}	61	<6	188	206	<6	50	50	455	88	<6	<1	<6	<6	<6	41	192	16
Fe	mg L^{-1}	3.9	0.59	6.84	0.767	1.17	0.621	7.03	10.0	6.78	0.716	2.23	2.36	9.46	0.294	5.57	9.34	18.4
Mn	mg L^{-1}	1.55	1.17	0.577	0.199	0.624	0.442	1.28	0.253	0.21	0.051	0.132	0.123	0.294	1.71	0.651	0.21	0.246
F	µg L^{-1}	140	110	180	450	250	240	160	290	270	170	190	170	180	20	80	120	140
B	µg L^{-1}	<100	820	150	260	270	160	60	210	650	50	<100	40	30	30	30	40	50
δ^2H	‰	−13	−18	−35	−11	−38	−24	−20	−26	−23	6	−21	−14	−23	−28	−18	−24	−17
$\delta^{18}O$	‰	−1.2	−2.4	−4.8	−2.3	−5.3	−4.3	−2.9	−4.5	−4.8	−1.8	−3.3	−3.2	−4	−4.6	−2.8	−3.3	−2.8
$\delta^{13}C$	‰	−18.1	−14.2		−19.6	−16.7	−15.9	−16.6	−7.9	−18.3	−12.8	−15.6	−17.5	−13.7	−17.1	−11.8	−5.8	−9.3
Cr	µg L^{-1}	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.9
Co	µg L^{-1}	0.68	0.63	1.11	0.18	0.39	0.43	0.64	1.41	0.77	0.08	0.09	0.08	0.32	0.85	0.42	0.42	1.51
Ni	µg L^{-1}	3.6	2.9	2.1	0.8	1.7	1.2	3.5	5.1	1.9	0.8	0.7	0.9	6.6	4.7	2.7	2.8	5.0
Zn	µg L^{-1}	>461	41	27	6	48	23	20	5	3	3	14	5	63	4	7	8	28
Cu	µg L^{-1}	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	7	<1	2
Mo	µg L^{-1}	0.7	1.7	3.5	3.5	5.6	4.6	2.2	6.1	20.0	<0.1	<0.1	<0.1	<0.1	0.1	2.5	2.5	0.2
Cd	µg L^{-1}	0.09	0.03	<0.02	<0.02	0.03	<0.02	<0.02	0.11	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sb	µg L^{-1}	0.04	0.06	0.04	0.02	0.05	0.03	0.04	0.23	0.04	<0.02	<0.02	<0.02	0.03	0.05	0.03	<0.02	0.24
Pb	µg L^{-1}	9.23	0.14	0.09	0.09	0.27	0.47	0.10	0.13	0.17	0.20	0.07	0.05	0.06	0.12	0.29	0.18	0.94
U	µg L^{-1}	0.21	17.3	<0.01	0.55	0.93	0.36	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	29.6	0.06	<0.01	0.01

Table 7.1. Analyses of representative groundwater samples from the three Special Study Areas (Continued)

Sample	Units	980809	980794	980833	980903	980914	980862	980879	980905	990360	980855	980856	980875	980889	980900	990378	990390
Locality		Betbaria	River Research Institute	Old water works compound	Rajarampur, dug well	Anupnagar, dug well	Atohar	Nadhai-krishnapur School	Jhilim	Munimul Haque	Rahaichar	Sakerbati	Mohespur	Taherpur	Goalpara	Kalaban	Rajarampur
Upazila		Faridpur	Faridpur	Faridpur	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj	Nawabganj
Aquifer		Shallow	Deep	Deep	Shallow	Shallow	Dupi Tila	Dupi Tila	Dupi Tila	Dupi Tila	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow	Shallow
Latitude	°N	23.5382	23.5762	23.6020	24.5712	24.5083	24.6177	24.6747	24.6382	24.6180	24.5928	24.5728	24.6590	24.6250	24.5928	24.7347	24.5712
Longitude	°E	89.8027	89.8375	89.8378	88.2680	88.3037	88.3183	88.3180	88.4027	88.3750	88.2548	88.2528	88.2923	88.2903	88.2692	88.1692	88.2680
Well depth	m	88	165	185	8	4	35	29	43	52	28	32	20	27	40	39	21
Temp	°C	27.0	25.5	27.2	25.3	25.4	27.5	26.7	27.1	27.8	27.2	27.2	27.0	26.8	27.9	27.1	27.6
pH		6.95	6.98	6.88	7.25			6.61	7.00	6.92	6.98	7.01	6.74	6.69	7.02	6.76	7.30
Eh	mV	52	39	101	76	90	100	60	34	278	81	155	46	138	59	-65	167
DO	mg L^{-1}	<0.1	<0.1	<0.1	4.1	0.7	0.6	<0.1	0.9	0.2	<0.1	<0.1	<0.1	0.9	0.5	<0.1	0.5
SEC	µS cm^{-1}	653	990	951	1270	1060	588	535	713	647	771	575	495	331	752	906	762
Ca	mg L^{-1}	99.4	77.3	106.0	155.0	163.0	67.4	54.0	66.8	78.2	140.0	90.5	69.7	36.6	119.0	118.7	122.3
Mg	mg L^{-1}	37.3	43.5	41.1	45.5	42.0	21.9	10.5	23.9	24.5	34.2	16.5	13.0	10.3	24.2	39.2	26.7
Na	mg L^{-1}	21.5	100	108	82.1	24.0	44.1	52.9	70.6	42.7	17.4	18.4	26.4	19.6	14.7	46.9	15.9
K	mg L^{-1}	4.27	7.06	4.56	12.4	6.71	0.98	0.75	0.74	1.36	5.26	4.96	0.62	0.50	5.12	2.18	5.12
HCO_3	mg L^{-1}	556	607	668	603	614	395	302	489	448	622	377	312	199	507	618	506
Cl	mg L^{-1}	3.8	79.8	78.2	105	64.3	3.2	25.1	4.7	2.9	14.9	18.2	6.7	2.6	3.4	3.8	8.9
SO_4	mg L^{-1}	< 0.2	0.2	< 0.2	74.5	26.3	0.5	9.7	1.4	0.7	< 0.2	< 0.2	8.1	0.7	< 0.2	9.2	2.3
NO_3-N	mg L^{-1}	<0.3	<0.3	<0.3	9.5	<0.3	<0.3	<0.3	<0.3	0.9	<0.3	<0.3	<0.3	0.5	<0.3	<0.5	<0.5
NO_2-N	µg L^{-1}	7	<4	390	184	16	<4	7	<4	12	5	910	<4	<4	<4	<4	<4
NH_4-N	mg L^{-1}	2.71	3.84	0.36	0.02	0.3	<0.06	<0.06	<0.01	<0.01	2.03	0.54	<0.06	<0.06	0.67	<0.01	1.05
DOC	mg L^{-1}		5.4		1.4	1.3	0.8	0.8	1.3	0.42	1.9	2.2	0.8	1.2	1.7	1.32	1.52
Si	mg L^{-1}	16.9	16.4	19.7	11.2	12.8	16.0	20.8	16.2	19.9	13.4	14.0	11.2	20.2	15.0	20.7	15.7
P	mg L^{-1}	1.7	1.8	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	0.1	<0.2	<0.2	<0.2	<0.2	0.2	<0.1	0.2
As_T	µg L^{-1}	191	20	9	13	8	<6	<6	<6	<1	742	51	<6	<6	234	<1	2342
As(III)	µg L^{-1}	82	<6	<6	<6	<6	<6	<6	<6	<1	<6	<6	<6	<6	53	<1	2208
Fe	mg L^{-1}	6.99	8.47	3.53	0.007	0.341	0.014	5.46	0.135	0.050	0.696	0.242	0.250	0.270	0.678	0.082	0.167
Mn	mg L^{-1}	0.2	0.243	0.581	0.384	1.68	0.082	0.082	0.018	0.097	2.1	0.755	0.079	0.022	1.17	0.888	1.04
F	µg L^{-1}	140	150	150	180	90	450	370	690	480	200	150	380	440	120	300	310
B	µg L^{-1}	40	80	70	70	30	40	20	60	<100	30	20	10	10	10	<100	<100
δ^2H	‰	-28	-39	-42	-36		-26	-28	-24	-30	-38	-27	-18	-23	-31	-31	-38
$\delta^{18}O$	‰	-4.6	-5.6	-5.3	-5.8		-4.7	-4	-3.5	-4.2	-5.7	-4	-2.8	-4.3	-5.2	-3.8	-5
$\delta^{13}C$	‰	-7.9	-11.4	-13.2	-6.3		-14.5	-12.7	-12.3	-7.8	-14.3	-12.2	-13.4	-12.0	-11.9	-10.5	-15.7
Cr	µg L^{-1}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Co	µg L^{-1}	0.32	0.65	1.27	0.62	0.63	0.20	0.30	0.21	0.18	0.57	0.44	0.24	0.23	0.13	0.69	0.32
Ni	µg L^{-1}	2.5	2.1	3.7	4.8	4.7	2.0	2.0	1.9	1.5	4.0	2.7	2.3	1.5	1.2	2.3	2.4
Zn	µg L^{-1}	3	10	>508	6	8	11	32	4	10	11	2	5	3	<1	2	26
Cu	µg L^{-1}	<1	<1	<1	1	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mo	µg L^{-1}	1.8	2.1	1.5	0.8	0.4	0.3	0.2	0.3	0.3	3.9	2.4	0.2	0.1	2.3	0.2	9.8
Cd	µg L^{-1}	<0.02	<0.02	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02
Sb	µg L^{-1}	<0.02	<0.02	<0.02	0.09	0.31	<0.02	0.03	<0.02	<0.02	0.03	0.03	<0.02	0.06	0.02	<0.02	0.05
Pb	µg L^{-1}	0.07	0.08	28.6	0.03	0.03	0.30	0.06	0.09	0.09	0.13	0.09	<0.01	<0.01	<0.01	0.07	0.17
U	µg L^{-1}	<0.01	0.01	0.09	20.4	7.83	1.76	0.91	3.30	2.30	0.68	0.31	1.23	0.44	0.19	4.57	0.49

Table 7.2. Summary statistics for field determinands and major elements in groundwaters from the three Special Study Areas

	Depth	Temp	pH	Eh	DO	SEC	Ca	Mg	Na	K	HCO_3	Cl	SO_4	NO_3-N	NO_2-N	NH_4-N	DOC	Si
	m	°C		mV	mg L^{-1}	µS cm^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	µg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}
Lakshmipur shallow (<150m)																		
Min	4	24.3	6.66	-105	<0.1	384	16.6	13.9	7.9	3.5	262	4.9	<0.2	<0.5	<4	<0.01	0.4	7.0
10th percentile	8	24.6	6.86	27	<0.1	442	25.9	23.0	17.6	5.4	277	6.3	<0.2	<0.5	<4	<0.06	1.3	10.7
Median	11	25.9	7.18	82	<0.1	886	47.9	42.6	79.2	11.0	463	67.7	0.7	<0.5	<4	1.84	3.1	14.5
Mean	11	25.8	7.14	75		1200	55.2	50.1	176	12.7	497	222	18				4.0	15.0
90th percentile	14	26.9	7.37	120	0.1	2242	102	84.9	478	22.5	729	767	40	2.2	2290	6.35	8.7	19
Max	36	27.4	7.59	160	1.4	4640	186	154	1090	41.3	1140	1550	265	29.4	6210	17.8	14.0	25.1
n	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	57	59
Lakshmipur deep (>150m)																		
Min	171	25.3	6.53	18	<0.1	264	20.2	12.0	20.4	2.2	125	1.7	<0.2	<0.3	<2	<0.01	0.2	20.4
10th percentile	183	25.6	6.55	62	<0.1	396	23.8	16.1	28.5	3.5	171	2.8	<0.2	<0.5	<4	<0.06	0.7	22.0
Median	244	26.8	6.84	99	<0.1	506	34.1	20.5	52.1	4.5	210	57.7	<0.2	<0.3	<4	0.31	1.8	25.8
Mean	241	27.2	6.83	100		750	46.5	30.5	77.6	5.1	215	168	3.6			0.39	2.3	27
90th percentile	304	29.3	7.08	129	0.6	1179	79.0	51.5	124	7.6	268	323	3.0	<0.5	<4	1.05	4.7	31.4
Max	375	31.1	7.22	158	2.1	2200	153	95.3	432	9.4	285	1050	68	<0.5	161	1.31	6.2	40.3
n	22	22.0	22	22	22	22	22	22	22	22	22	22	22	22	22	22	21	22
Faridpur shallow (<100m)																		
Min	14	25.4	6.38	18	<0.1	344	34.8	8.9	5.1	2.6	200	1.8	<0.2	<0.3	<4	<0.06	0.1	6.3
10th percentile	18	25.7	6.61	49	<0.1	533	56.0	21.5	9.8	3.5	380	2.6	<0.2	<0.3	<4	<0.06	0.4	11.6
Median	29	26.2	6.94	101	<0.1	749	101	31.0	18.6	4.7	536	9.3	<0.2	<0.3	<4	1.02	1.9	16.0
Mean	35	26.3	6.90	111		758	104	32	30.0	5.0	534	17.3	4.5			2.46	2.7	17.3
90th percentile	53	27.0	7.09	165	<0.1	1012	156	43.7	53.7	6.8	690	41.3	13	<0.3	7	5.90	6.5	23.8
Max	88	28.1	7.35	309	1.4	1400	190	59.5	175	8.7	848	127	64	4.9	4800	17.6	13.0	41.9
n	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	48	59.0
Faridpur deep (>100m)																		
Min	137	25.5	6.75	22	<0.1	951	67.2	28.4	67.3	3.4	607	78	<0.2	<0.3	<4	0.07	1.4	10.2
10th percentile	148	26.1	6.80	29	<0.1	967	71.2	33.5	80.4	3.9	608	79	<0.2	<0.3	<4	0.17	1.4	12.7
Median	185	27.2	6.93	95	<0.1	1030	106	43.5	108	5.1	612	93	0.2	<0.3	<4	0.36	2.2	17.3
Mean	181	27.0	6.95	80		1190	99	41.8	112	5.1	630	112	<0.2			1.45	2.8	16.6
90th percentile	209	27.7	7.12	126	<0.1	1544	123	48.2	144	6.4	662	163	0.3	<0.3	236	3.4	4.6	19.7
Max	213	28.1	7.22	143	<0.1	1760	125	49.1	148	7.1	668	195	0.4	<0.3	390	3.8	5.4	19.7
n	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5

Table 7.2. Summary statistics for field determinands and major elements in groundwaters from the three Special Study Areas (Continued)

	Depth	Temp	pH	Eh	DO	SEC	Ca	Mg	Na	K	HCO_3	Cl	SO_4	NO_3-N	NO_2-N	NH_4-N	DOC	Si
	m	°C		mV	mg L^{-1}	µS cm^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	µg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}
Chapai Nawabganj Holocene																		
Min	6	25.7	5.90	−102	<0.1	331	36.6	9.0	5.2	0.5	199	1.0	<0.2	<0.3	<4	<0.01	0.2	7.4
10th percentile	20	26.3	6.74	−18	<0.1	492	72	13.5	8.7	1.2	298	2.4	<0.2	<0.5	<4	<0.1	0.5	9.7
Median	29	27.0	6.99	60	<0.1	726	104	24.6	18.4	4.0	464	6.9	7.4	<0.5	<4	0.02	1.3	14.8
Mean	28	27.0	6.94			740	108	26	27.7	4.2	477	13.2	16				1.5	15
90th percentile	37	27.9	7.15	158	0.4	1040	148	39	59.8	6.5	659	33.5	46	<0.5	5	1.0	2.2	20
Max	41	28.8	7.32	341	0.9	1370	218	49.2	95.1	18.7	826	70	115	12.6	910	2.0	9.4	22.3
n	67	69	65	68	69	69	69	69	69	69	69	68	69	69	69	69	68	69
Chapai Nawabganj Dupi Tila																		
Min	26	26.1	6.55	22	<0.1	374	47.2	10.5	22.4	0.7	241	2.4	<0.2	<0.3	<4	<0.01	0.3	15.0
10th percentile	29	26.6	6.63	51	<0.1	560	65.5	18.2	30.3	0.7	370	2.9	0.5	<0.5	<4	<0.06	0.5	15.5
Median	38	27.2	6.88	103	0.3	633	75.0	23.9	44.5	1.1	437	7.9	1.3	<0.5	<4	<0.06	0.9	17.1
Mean	38	27.2	6.86	123		679	83.1	26.5	48.2	1.2	425	25.2	8.0				1.3	17.9
90th percentile	46	27.7	7.02	257	1.4	765	87.3	27.4	62.0	1.4	491	25.7	9.8	1.8	21	<0.06	2.4	20.9
Max	52	27.8	7.04	278	1.9	1590	259	97.0	98.5	3.2	530	328	109	68.0	55	0.02	4.0	22.6
n	20	20	12	20	20	20	20	20	20	20	20	20	20	20	20	20	19	20
Chapai Nawabganj dug wells																		
Min	4.0	24.0	7.06	76	0.7	1060	115	32.1	24.0	2.9	603	51	19	<0.3	<4	<0.01	0.6	11.2
10th percentile	5.6	24.5	7.07	82	1.0	1068	131	35.4	47.2	4.4	607	56	22	0.5	<4	<0.01	0.9	11.6
Median	8.9	25.4	7.13	122	1.9	1270	163	42.0	104	6.7	640	95	74	6.0	16	0.02	1.4	12.8
Mean	7.8	25.1	7.15	157	2.3	1325	170	52.4	96.2	7.7	640	108	109				1.4	12.8
90th percentile	9.1	25.5	7.23	262	3.9	1636	210	79.4	136	11.3	676	176	238	20.7	118	0.22	1.9	14.2
Max	9.2	25.5	7.25	315	4.1	1744	213	102	138	12.4	695	223	335	28.1	184	0.30	2.2	14.9
n	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Table 7.3. Summary statistics for trace elements in groundwaters from the three Special Study Areas

	P$_T$	As$_T$	As(III)	Sr	Ba	Fe$_T$	Mn	B	I	Br	F	Li	Be	Al	V	Cr	Co	Ni	Zn	Cu
	mg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	mg L^{-1}	mg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}
Lakshmipur shallow (<150 m)																				
Min	<0.2	<1	<1	108	4.8	0.122	0.121	39	15	21	80	1.7	<0.05	<1	<0.2	<0.5	<0.05	<0.40	3.5	<1
10th percentile	0.23	29	3	172	9.4	0.344	0.268	52	25	61	140	2.1	<0.05	1.6	<0.2	<0.5	0.22	0.89	5.4	<1
Median	0.68	89	57	293	19.7	1.710	0.577	156	78	235	230	3.3	<0.05	3.9	<0.2	<0.5	0.43	1.65	19	<1
Mean	1.2	159	93	357	36.9	3.00	0.759	219	172	853	234	4.0							39	
90th percentile	2.2	369	213	759	74	6.79	1.28	520	413	2720	352	7.7	<0.05	10.9	0.32	<0.5	1.01	3.48	66	1
Max	3.4	986	501	1065	272	24.8	3.83	818	1240	5600	450	10.6	0.09	93	2.78	1.32	2.27	6.84	82.2	3
n	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Lakshmipur deep (>150 m)																				
Min	<0.2	<1	<1	124	28	0.53	0.051	29	1	18	150	2.5	<0.05	<1	<0.2	<0.5	0.05	0.59	2.4	<1
10th percentile	<0.2	<1	<1	189	68	0.85	0.077	39	2	25	161	3.4	<0.05	<1	<0.2	<0.5	0.08	0.80	3.4	<1
Median	0.29	<6	<6	267	116	2.47	0.102	48	7	255	190	5.9	<0.05	2.85	<0.2	<0.5	0.14	1.36	7.9	<1
Mean				369	164	3.85	0.160	48	13	683	202	7.2					0.24	1.86	33	
90th percentile	0.39	4.5	2.3	589	323	9.30	0.332	60	26	1283	259	12.1	<0.05	6.58	<0.2	<0.5	0.33	3.16	39	<1
Max	0.65	8.2	4.7	1258	657	12.00	0.399	67	59	3970	320	18.7	<0.05	12.0	1.32	<0.5	1.44	6.63	456	1
n	18	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Faridpur shallow (<100 m)																				
Min	<0.2	<6	<6	148	49	0.052	0.041	10	2	<25	20	1.2	<0.05	1.3	<0.2	<0.5	0.14	1.09	2.13	<1
10th percentile	<0.2	<6	<6	271	91	0.28	0.086	18	4	13	40	1.7	<0.05	2.2	<0.2	<0.5	0.26	1.86	3.41	<1
Median	1.5	39	9.2	377	159	5.57	0.48	32	18	49	110	2.7	<0.05	3.5	<0.2	<0.5	0.47	2.85	6.9	<1
Mean		102		404	169	5.76	0.69	39	32		120	3.6		7.1			0.59	3.29	13.8	
90th percentile	2.7	205	105	552	259	11.34	1.47	71	97	135	200	6.3	<0.05	11.5	0.34	<0.5	0.95	4.99	25	<1
Max	5.0	1460	990	769	439	19.60	4.23	105	130	671	400	8.8	<0.05	93	1.77	0.87	2.10	18.85	205	7
n	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Faridpur deep (>100 m)																				
Min	<0.2	<6	<6	353	123	1.73	0.101	0.054	52	351	100	8.3	<0.05	3.0	<0.2	<0.5	0.4	2.1	7.0	<1
10th percentile	<0.2	<6	<6	388	150	1.78	0.114	0.059	60	358	116	8.4	<0.05	3.3	<0.2	<0.5	0.5	2.5	8.2	<1
Median	0.4	9.0	<6	494	200	3.53	0.243	76	75	451	150	9.2	<0.05	3.7	<0.2	<0.5	0.9	3.1	216	<1
Mean		17.8	<6	497	202	4.26	0.286	76	76	478	140	10.3		11.9			0.9	3.1	1408	
90th percentile	1.3	39.2	6.1	602	253	7.38	0.497	95	92	640	156	12.9	<0.05	26.3	0.08	<0.5	1.2	3.6	3980	<1
Max	1.8	52	6.5	617	269	8.47	0.581	104	101	765	160	14.1	<0.05	33.7	0.26	<0.5	1.3	3.7	6270	<1
n	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Table 7.3. Summary statistics for trace elements in groundwaters from the three Special Study Areas (Continued)

	P_T	As_T	As(III)	Sr	Ba	Fe_T	Mn	B	I	Br	F	Li	Be	Al	V	Cr	Co	Ni	Zn	Cu
	mg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	mg L^{-1}	mg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}
Chapai Nawabganj Holocene																				
Min	<0.2	<1	<1	97	28.1	0.021	0.020	10	<0.8	<1.0	40	0.8	<0.05	<1	<0.2	<0.5	0.09	1.0	<1	<1
10th percentile	<0.2	<1	<1	208	64	0.043	0.29	12	2.1	<25	70	1.6	<0.05	1.5	<0.2	<0.5	0.22	1.7	2	<1
Median	<0.2	3.9	1	364	125	0.455	0.76	25	8.3	26	160	2.8	<0.05	4.7	<0.2	<0.5	0.37	2.5	5	<1
Mean				365	133	1.30	0.86	32			253	4.6					0.45	2.6		
90th percentile	0.5	136	46	544	201	3.39	1.44	67	100	89	482	11.1	<0.05	17.1	1.89	<0.5	0.80	3.3	35	<1
Max	1.14	2342	2208	666	442	9.79	4.36	102	270	182	1280	17.8	<0.05	98.1	2.55	<0.5	1.88	6.7	195	2
n	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
Chapai Nawabganj Dupi Tila																				
Min	<0.2	<1	<1	192	30	0.014	0.001	16	17	<25	330	3.6	<0.05	1.2	0.4	<0.5	0.13	1.4	4	<1
10th percentile	<0.2	<1	<1	286	38	0.016	0.007	21	19	12	367	4.5	<0.05	1.8	1.0	<0.5	0.14	1.5	7	<1
Median	<0.2	<1	<1	359	60	0.050	0.036	48	37	30	480	8.4	<0.05	3.8	1.6	<0.5	0.24	2.1	28	<1
Mean				412	59	0.48	0.101	51	43		489	8.6		3.9	1.6		0.33	2.4	36	
90th percentile	0.1	<1	1.3	535	83	1.07	0.409	84	70	111	620	12.5	<0.05	5.5	2.3	<0.5	0.77	2.9	56	<1
Max	0.2	6.8	2.63	1400	92	5.46	0.477	91	82	500	690	13.3	0.14	11.5	2.9	1.3	0.91	8.7	189	4
n	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Chapai Nawabganj dug wells																				
Min	<0.2	<3	<1	405	112	0.007	0.184	23	<0.5	59	10	2.9	<0.1	2.5	0.4	<0.5	0.4	3.5	6.3	<1
10th percentile	<0.2	<3	<1	467	118	0.020	0.197	24	<0.8	80	42	3.4	<0.1	3.3	0.7	<0.5	0.4	3.7	7.1	<1
Median	<0.2	7.6	2.05	578	182	0.041	0.384	57	1.1	118	180	4.5	<0.1	15.9	2.4	<0.5	0.5	4.7	9.7	1
Mean				591	170	0.102	0.705	55		122	232	5.3		16.6	2.7		0.5	4.3	15.9	
90th percentile	0.2	13.4	4.46	723	217	0.238	1.43	87	12.6	166	484	7.5	<0.1	32.7	5.0	<0.5	0.6	4.8	30.4	1
Max	0.3	14.0	5.70	793	226	0.341	1.68	100	16.5	190	660	7.8	<0.1	43.5	5.7	<0.5	0.6	4.8	41.4	1
n	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Table 7.4. Summary statistics for trace elements in groundwaters from the three Special Study Areas

	Rb	Y	Mo	Cd	Sn	Sb	Cs	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu
	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}	μg L^{-1}
Lakshmipur sh*allow (<150 m)*																					
Min	0.99	0.006	<0.1	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
10th percentile	1.52	0.019	1.04	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Median	2.74	0.035	2.95	<0.02	<0.1	0.036	<0.05	0.007	0.012	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Mean	3.22	0.042																			
90th percentile	5.82	0.087	8.15	0.04	0.28	0.13	<0.05	0.022	0.039	<0.005	0.024	<0.01	0.006	<0.005	<0.01	0.012	<0.005	0.012	<0.005	0.010	<0.005
Max	9.53	0.13	20.0	0.13	0.48	1.18	0.091	0.100	0.125	0.012	0.038	0.018	0.010	<0.005	0.017	0.018	0.007	0.033	0.005	0.013	<0.005
n	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Lakshmipur deep (>150 m)																					
Min	1.99	<0.005	<0.1	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
10th percentile	3.09	<0.005	<0.1	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Median	4.48	0.010	<0.1	<0.02	<0.1	<0.02	<0.05	0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Mean	4.72																				
90th percentile	7.23	0.019	0.20	<0.02	<0.1	0.15	0.064	0.012	0.019	<0.005	<0.01	<0.01	0.010	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Max	9.49	0.032	2.89	0.04	0.40	0.34	0.083	0.020	0.040	0.005	0.019	0.013	0.023	<0.005	<0.01	<0.01	<0.005	0.011	<0.005	<0.008	<0.005
n	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22	22
Faridpur shallow (<100 m)																					
Min	0.28	0.011	<0.1	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
10th percentile	0.70	0.014	0.24	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Median	3.06	0.030	1.34	<0.02	<0.1	<0.02	<0.05	0.008	0.009	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Mean	3.54	0.043																			
90th percentile	6.68	0.092	2.58	<0.02	<0.1	0.08	0.125	0.023	0.040	0.005	0.020	<0.01	0.011	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	0.008	<0.005
Max	10.59	0.155	20.46	0.16	0.26	0.37	0.256	0.053	0.101	0.012	0.053	0.019	0.017	<0.005	0.019	0.019	0.006	0.018	<0.005	0.013	<0.005
n	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59	59
Faridpur deep (*>100 m*)																					
Min	0.33	0.016	0.26	<0.02	<0.1	<0.02	<0.05	0.006	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
10th percentile	3.09	0.018	0.74	<0.02	<0.1	<0.02	0.013	0.006	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Median	7.35	0.028	1.47	<0.02	<0.1	<0.02	0.187	0.012	0.015	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Mean	7.02	0.039	1.49					0.016													
90th percentile	10.20	0.072	2.12	0.088	<0.1	0.04	0.322	0.030	0.070	0.003	0.024	0.005	0.007	<0.005	0.003	0.005	<0.005	0.008	<0.005	0.014	<0.005
Max	10.58	0.098	2.15	0.10	<0.1	0.04	0.377	0.039	0.099	0.008	0.033	0.015	0.008	<0.005	0.011	0.015	<0.005	0.019	<0.005	0.018	<0.005
n	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Table 7.4. Summary statistics for trace elements in groundwaters from the three Special Study Areas (Continued)

	Rb	Y	Mo	Cd	Sn	Sb	Cs	La	Ce	Pr	Nd	Sm	Eu	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu
	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}	µg L^{-1}
Chapai Nawabganj *Holocene*																					
Min	<0.10	<0.01	0.13	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.010	<0.005	<0.008	<0.005
10th percentile	0.15	0.021	0.25	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.010	<0.005	<0.008	<0.005
Median	1.16	0.043	0.82	<0.02	<0.1	0.02	<0.05	0.009	0.013	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.010	<0.005	<0.008	<0.005
Mean			1.23																		
90th percentile	2.75	0.108	2.35	0.021	0.38	0.06	<0.05	0.020	0.036	<0.005	0.019	<0.01	0.009	<0.005	<0.010	0.011	<0.005	<0.010	<0.005	0.009	<0.005
Max	8.11	0.447	9.77	0.128	0.70	0.15	0.10	0.125	0.193	0.030	0.117	0.037	0.037	0.007	0.026	0.042	0.009	0.032	<0.005	0.037	0.005
n	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69	69
Chapai Nawabganj *Dupi Tila*																					
Min	0.13	0.012	0.14	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
10th percentile	0.15	0.025	0.18	<0.02	<0.1	<0.02	<0.05	<0.005	<0.005	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Median	0.24	0.091	0.33	<0.02	<0.1	<0.02	<0.05	0.006	0.008	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Mean	0.26	0.094	0.35																		
90th percentile	0.38	0.174	0.56	0.026	0.44	0.03	<0.05	0.011	0.013	<0.005	0.010	<0.01	0.008	<0.005	<0.01	<0.01	0.005	0.014	<0.005	0.014	<0.005
Max	0.74	0.233	0.61	0.071	0.64	0.08	<0.05	0.032	0.015	0.007	0.033	<0.01	0.017	<0.005	0.011	0.015	0.006	0.017	<0.005	0.028	<0.005
n	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Chapai Nawabganj dug wells																					
Min	1.67	0.02	0.42	<0.02	<0.1	0.06	<0.05	<0.01	<0.01	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
10th percentile	2.06	0.02	0.45	<0.02	<0.1	0.07	<0.05	<0.01	<0.01	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Median	3.19	0.04	0.64	<0.02	<0.1	0.09	<0.05	0.011	0.01	<0.005	<0.01	<0.01	<0.006	<0.005	<0.01	<0.01	<0.005	<0.01	<0.005	<0.008	<0.005
Mean	3.04	0.05	0.70			0.14															
90th percentile																					
Max	3.97	0.07	1.02	0.025	0.24	0.25	<0.05	0.021	0.04	0.001	0.019	<0.01	0.004	<0.005	0.004	<0.01	<0.005	0.005	<0.005	<0.008	<0.005
n	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

Table 7.5. Summary statistics for trace-element and stable isotopic data in groundwaters from the three Special Study Areas

	Tl µg L⁻¹	Pb µg L⁻¹	U µg L⁻¹	δ^2H ‰	$\delta^{18}O$ ‰	$\delta^{13}C$ ‰	$\delta^{34}S$ ‰
Lakshmipur shallow (<150 m)							
Min	<0.01	0.038	<0.01	-64	-9.6	-23.6	13.8
10th percentile							
Median	<0.01	0.069	<0.01	-32	-4.7	-20.6	14.4
Mean		0.40			-3.4	-16.8	16.9
90th percentile	<0.01	0.63	3.67	-15	-1.7	-12.7	19.3
Max	<0.01	9.2	17.3	-11	-0.7	-7.1	19.9
n	59	59	59	59	59	56	2
Lakshmipur deep (>150 m)							
Min	<0.01	0.048	<0.01	-23	-4.2	-17.5	39.5
10th percentile	<0.01	0.064	<0.01	-20	-3.5	-16.1	39.5
Median	<0.01	0.11	<0.01	-15	-3.0	-13.5	39.5
Mean		0.15					39.5
90th percentile	<0.01	0.31	0.012	-9.3	-2.0	-12.3	39.5
Max	<0.01	0.41	0.207	-8.0	-1.8	-9.1	39.5
n	22	22	22	22	22	21	1
Faridpur shallow (<100 m)							
Min	<0.01	0.024	<0.01	-52	-7.5	-18.3	-0.9
10th percentile	<0.01	0.056	<0.01	-38	-5.5	-15.9	-0.9
Median	<0.01	0.12	0.013	-27	-4.2	-12.9	-0.9
Mean		0.15					
90th percentile	<0.01	0.28	7.19	-18	-3.2	-6.4	-0.9
Max	0.019	0.95	29.6	-14	-2.6	0.6	-0.9
n	59	59	59	22	22	21	1
Faridpur deep (>100 m)							
Min	<0.01	0.058	<0.01	-42	-6.6	-14.4	
10th percentile	<0.01	0.066	<0.01	-42	-6.4	-14.3	
Median	0.012	0.13	0.09	-40	-5.6	-13.2	
Mean		5.89					
90th percentile	0.043	17.4	0.56	-35	-5.3	-10.5	
Max	0.056	28.6	0.82	-32	-5.3	-9.9	
n	5	5	5	5	5	5	

Table 7.5. Summary statistics for trace-element and stable isotopic data in groundwaters from the three Special Study Areas (Continued)

	Tl	Pb	U	δ^{2}H	δ^{18}O	δ^{13}C	δ^{34}S
	μg L^{-1}	μg L^{-1}	μg L^{-1}	‰	‰	‰	‰
Chapai Nawabganj Holocene alluvium							
Min	<0.01	<0.01	<0.01	-52	-8	-18.1	-0.1
10th percentile	<0.01	<0.01	0.07	-48	-7	-15.6	0.2
Median	<0.01	0.064	1.6	-38	-5	-12.2	1.2
Mean							
90th percentile	<0.01	0.24	7.8	-28	-4	-8.8	9.2
Max	0.014	1.19	31.7	-18	-2	-6.8	11.2
n	69	69	69	65	65	64	3
Chapai Nawabganj Dupi Tila							
Min	<0.01	<0.01	0.5	-31	-4.7	-14.5	6.6
10th percentile	<0.01	0.022	1.5	-30	-4.3	-13.1	6.6
Median	<0.01	0.28	2.5	-26	-3.8	-11.1	6.6
Mean			3.9				6.6
90th percentile	<0.01	1.43	3.7	-21	-2.9	-7.2	6.6
Max	<0.01	8.36	32.4	-20	-2.2	-5.4	6.6
n	20	20	20	20	20	15	1
Chapai Nawabganj dug wells							
Min	<0.01	<0.01	4.2	-47	-6.3	-16.6	
10th percentile	<0.01	0.004	5.7	-46	-6.3	-16.2	
Median	<0.01	0.029	20.4	-41	-6.0	-13.7	
Mean			24.2				
90th percentile	0.002	0.071	44.8	-36	-4.5	-8.0	
Max	0.010	0.091	47.1	-36	-4.0	-6.3	
n	5	5	5	4	4	4	

Concentrations of other transition and heavy metals are usually also low in the Bangladesh groundwaters. These include V (90% being 0.8 μg L^{-1} or less), Cr (90% being less than the detection limit of 0.5 μg L^{-1}), Co (90% being 0.9 μg L^{-1} or less), Mo (90% being 4 μg L^{-1} or less), Sb (90% having 0.1 μg L^{-1} or less), Sn (90% having less than 0.3 μg L^{-1}) and Cd (90% having 0.03 μg L^{-1} or less; Table 7.2–7.5). Rare-earth elements (REE) are usually low, with La and Ce being just above the detection limit in some samples but most of the MREE (middle) and HREE (heavy) being undetectable by the ICP-MS method used.

One heavy metal worthy of note is U (Section 7.4.2). Concentrations range between <0.01 μg L^{-1} and 47 μg L^{-1}, although most are above the detection limit (Table 7.5) and are relatively high by world groundwater standards. Uranium is strongly redox-controlled and occurs in natural waters in two oxidation states: 4+ and 6+. The 6+ species are considerably more soluble then the 4+ species which tend to be more strongly adsorbed or precipitate as uraninite. In the Bangladesh groundwaters, the U is likely to be stabilised in solution as uranyl carbonate complexes (mainly $UO_2(CO_3)_2^{2-}$, $UO_2(CO_3)_3^{4-}$), aided by the high alkalinity of many of the groundwaters. Uranium carbonate species are poorly adsorbed by iron oxides (Langmuir, 1997). The groundwaters are significantly undersaturated with respect to uraninite.

Some of the most important distinctions in chemical composition are between groundwaters from the shallow Holocene alluvial aquifers and from the older aquifers (at greater depth in Lakshmipur and Faridpur and below the Barind Tract in Chapai Nawabganj). These are discussed more fully below.

7.4.2 Regional and depth variations in groundwater chemistry

A summary map indicating the surface geology of the three study areas is given in Figure 7.2 and regional maps of selected chemical constituents are presented and discussed below. The maps indicate a high degree of spatial variability in many of the determinands, both within and between regions and with abstraction depth. Whatever the causes of the variations of individual constituents, the high degree of spatial variation observed indicates that groundwater mixing has generally been poor and that aquifer horizons are likely to be in poor hydraulic connection. Such conditions are likely given the recognised high degree of variability in sediment texture and hence permeability over small distances, as recognised in numerous lithological logs from the study areas, and the historically small hydraulic gradients.

Lakshmipur

As noted in Section 7.2.1, groundwaters in Lakshmipur are abstracted from either the shallow aquifer at mostly less than 20 m depth or from the deep aquifer at 170 m or greater, with little abstraction from the intervening horizons. A depth of 150 m has been used here to distinguish shallow and deep groundwaters. Many similarities exist in the groundwaters from both aquifers investigated. Most notably, these include the chemical characteristics brought about by reducing conditions and the relatively high salinity of groundwater from both as a result of the *upazila's* near-coastal position. However, the large depth difference between the two aquifers and resultant likely hydraulic separation has generated some clear chemical distinctions.

Reducing conditions in both shallow and deep aquifers are demonstrated by the low Eh values. Although there is little discernible difference between the median values (Table 7.2), the lowest Ehs detected are from the shallow aquifer (down to −105 mV). Figure 7.3 shows the regional distribution of Eh in Lakshmipur. The spatial variation is great in both shallow and deep groundwaters, but a high proportion of samples with very low redox potentials (<40 mV) appears to be present in the north and north-eastern areas (Ramganj and Chatkhil).

Other evidence of the reducing conditions is given by very low or no detectable dissolved oxygen (Table 7.2), low concentrations of NO_3-N (mostly below 0.5 mg L^{-1}) and often high NH_4-N concentrations. The ranges of NH_4-N concentrations are one of the major differences between the two aquifers. The median value for NH_4-N in the shallow groundwaters is 1.84 mg L^{-1}, but is just 0.31 mg L^{-1} in the deep groundwaters (Table 7.2). The spatial distribution of NH_4-N concentrations is highly variable (Figure 7.4). Concentrations of NO_2-N are usually low but are increased (up to 6210 μg L^{-1}) in a few of the shallow groundwaters, possibly as a result of pollution.

Iron has a large range in both shallow and deep groundwaters, reaching up to 25 mg L^{-1} and 12 mg L^{-1}

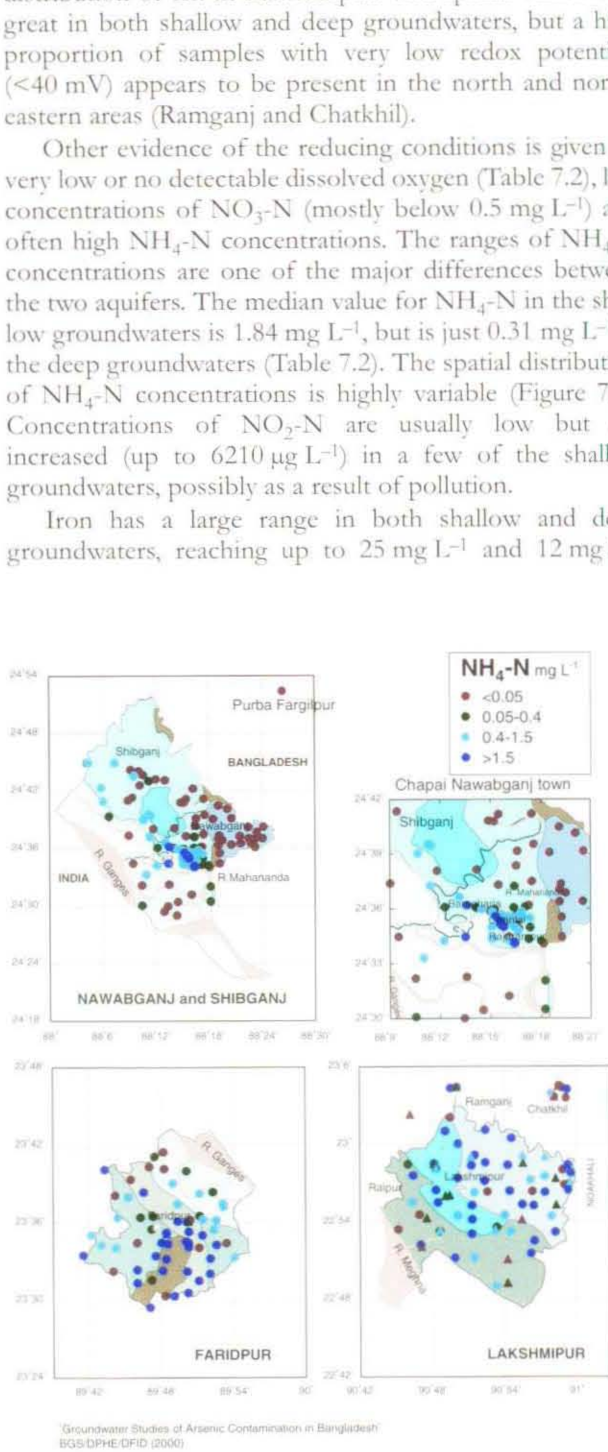


Figure 7.4. Maps of the three Special Study Areas showing the distribution of ammonium. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

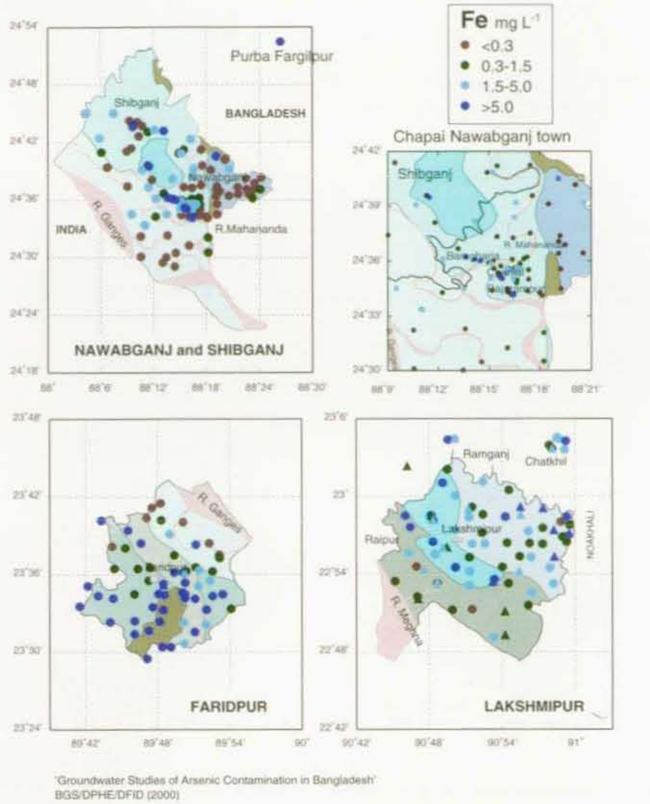


Figure 7.5. Maps of the three Special Study Areas showing the distribution of Fe. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

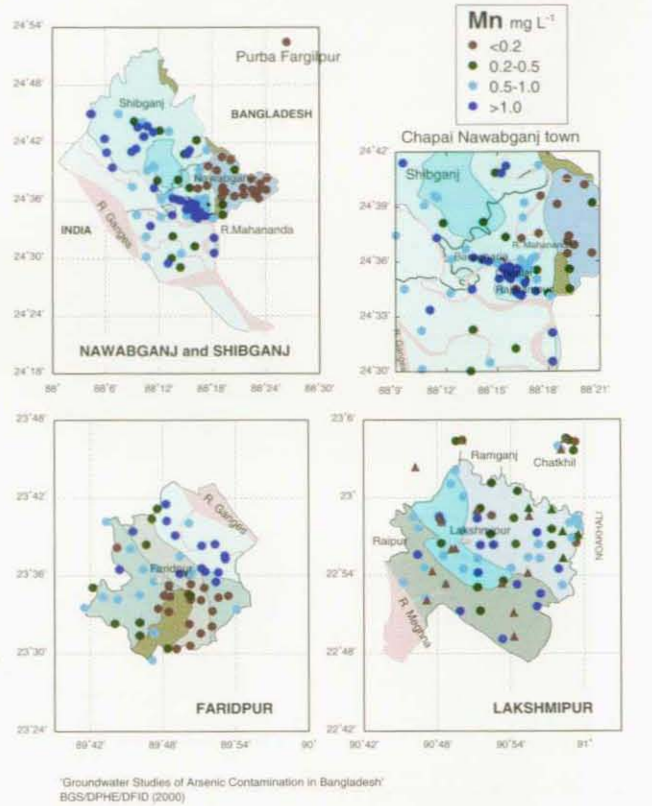


Figure 7.6. Maps of the three Special Study Areas showing the distribution of Mn. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

respectively (Table 7.3). Concentrations appear to be generally higher in the north-eastern part of the study area, including Ramganj and Chatkhil where Eh is correspondingly lower. The surface geology comprises the Chandina alluvium in these areas (Figure 7.5).

Manganese is another constituent showing notable differences between shallow and deep groundwaters, concentrations being typically much higher at shallow depths. The median and maximum concentrations respectively are 0.58 mg L^{-1} and 3.8 mg L^{-1} in the shallow groundwaters and 0.10 mg L^{-1} and 0.4 mg L^{-1} in the deep groundwaters. As with many other constituents, there is little discernible spatial pattern in the distribution (Figure 7.6).

The groundwaters also have some high concentrations of dissolved organic carbon (DOC). Some of the highest are present in groundwaters from the shallow aquifer (up to 14 mg L^{-1}; Table 7.2). DOC sometimes shows some spatial pattern locally (Faridpur) and appears to be generally greater in Lakshmipur (median 3.1 mg L^{-1}) than in the other two areas (Figure 7.7 and Table 7.1).

The effects of saline intrusion and residual seawater on Lakshmipur groundwater quality are seen in both the shallow and deep groundwaters, seawater with relatively high SEC values and high concentrations of Na, Cl, Mg, K, B, Sr and Br typical (Tables 7.2, 7.3). Regional distributions of Na and Cl are shown in Figures 7.8 and 7.9. Concentrations of each element are spatially variable, but samples from Chatkhil appear to have amongst the lowest concentrations in both aquifers.

Despite the increased salinity, concentrations of SO_4 are often low and commonly below detection limit. Median values are 0.7 mg L^{-1} in the shallow and <0.5 mg L^{-1} in the deep groundwaters (Table 7.2). Molar Na/Cl ratios of the brackish groundwaters (e.g. with Cl concentrations >1000 mg L^{-1}) are comparable to seawater values at around 0.9. Corresponding molar Cl/SO_4 ratios having seawater influence should be around 19. Where SO_4 concentrations are high in the shallow aquifer (e.g. above 100 mg L^{-1}), Cl/SO_4 ratios are close to the seawater value. However, the fact that ratios are usually higher than this (83% of samples analysed have molar Cl/SO_4 ratios greater than 19 and usually significantly so). Taking an average groundwater Cl concentration of 220 mg L^{-1} for the shallow Lakshmipur aquifer, the expected seawater sulphate concentration would be around 32 mg L^{-1}. The observed average value is 18 mg L^{-1} (Table 7.2). This indicates that some loss of SO_4 has taken place, most likely because of bacterial sulphate reduction.

The distribution of SO_4 in the Lakshmipur groundwaters is shown in Figure 7.10. Although there is little spatial trend, low concentrations are found consistently in both shallow and deep groundwaters in the northern areas (Ramganj, Chatkhil).

Although salinity is higher in samples from Lakshmipur than from the other study areas, only the most saline samples are of Na-Cl type. Groundwaters are generally of mixed-cation-HCO_3 type. Groundwaters from the shallow aquifer generally have higher HCO_3 concentrations than

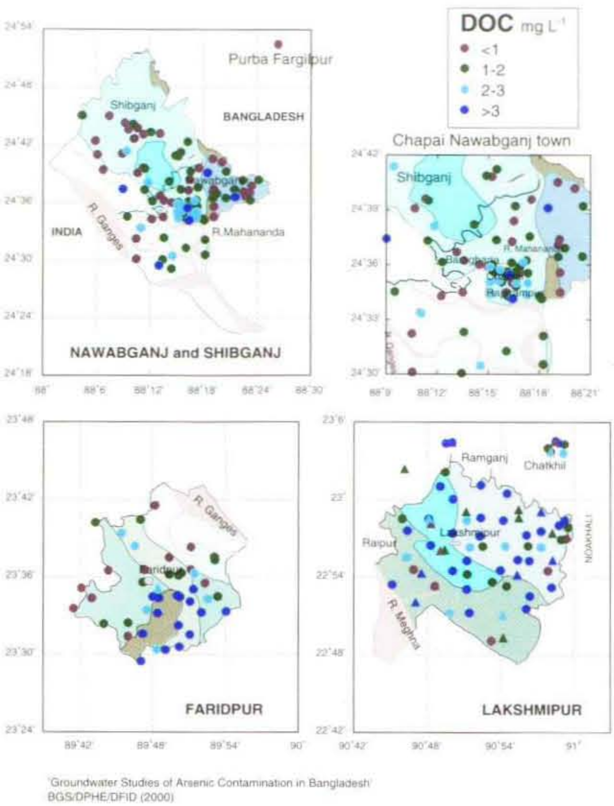


Figure 7.7. Maps of the three Special Study Areas showing the distribution of dissolved organic carbon. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

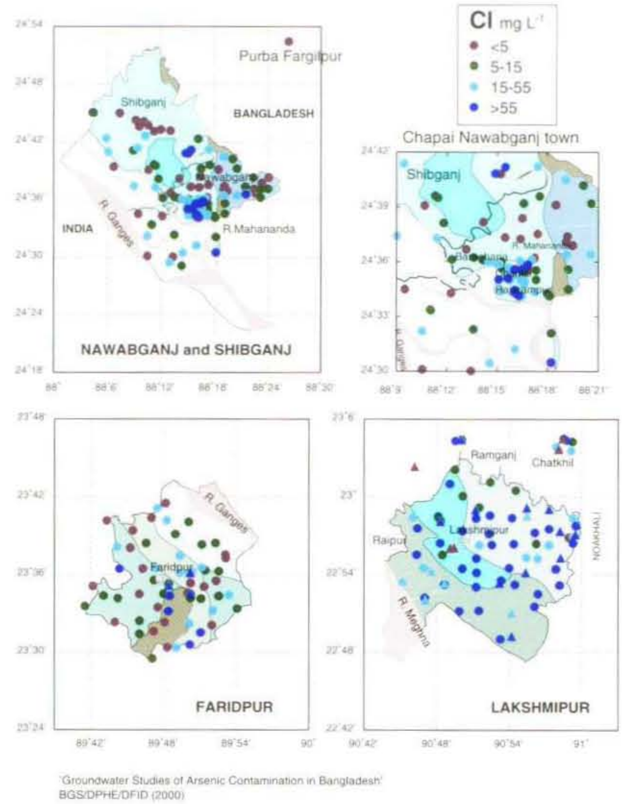


Figure 7.9. Maps of the three Special Study Areas showing the distribution of chloride. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

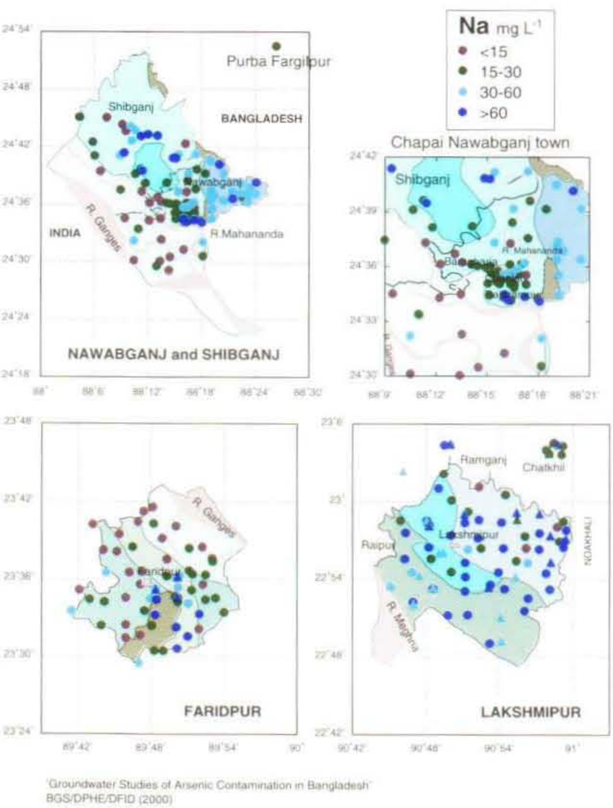


Figure 7.8. Maps of the three Special Study Areas showing the distribution of sodium. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

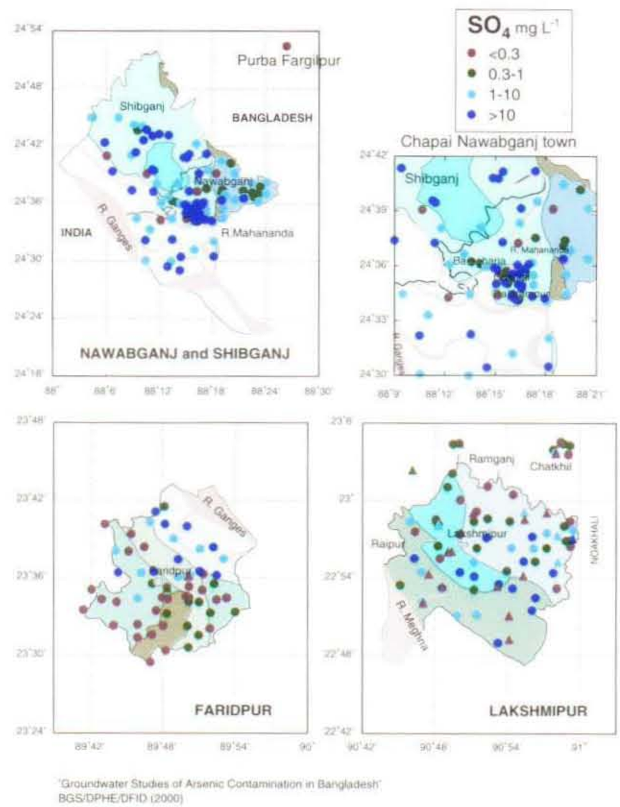


Figure 7.10. Maps of the three Special Study Areas showing the distribution of sulphate. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

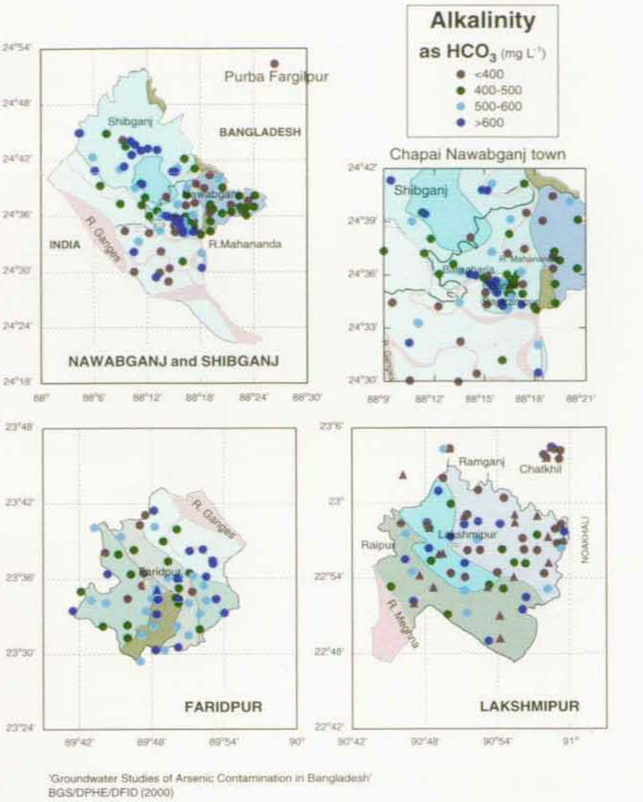


Figure 7.11. Maps of the three Special Study Areas showing the distribution of bicarbonate. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

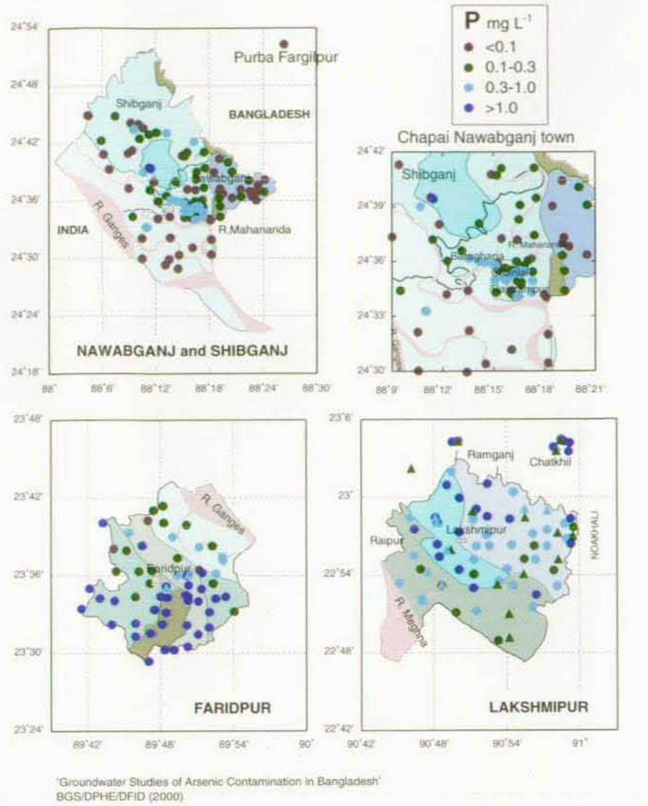


Figure 7.12. Maps of the three Special Study Areas showing the distribution of total phosphorus. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

deep groundwaters (median values 463 mg L^{-1} in the shallow groundwaters with a maximum up to 1140 mg L^{-1}; median value 210 mg L^{-1} in the deep groundwaters; Table 7.2). Like many other determinands, the regional pattern of HCO_3 is variable (Figure 7.11). Calcium concentrations are lower in Lakshmipur than in the groundwaters from the other study areas (many having <60 mg L^{-1}). As a result, Lakshmipur has a greater proportion of samples which are undersaturated with respect to calcite. This reflects the source of the sediments which have been derived from the generally calcite-free Meghna sediments of north-east Bangladesh.

Among the trace elements, As is one of the most diagnostic elements to distinguish the deep and shallow groundwaters. The differences are discussed further in Section 7.4.3. Notable differences between the aquifers are also seen in concentrations of P, B, I, Mo, U and Ba. In all cases except Ba, concentrations are much higher in the shallow groundwaters. These have P concentrations up to 3.4 mg L^{-1}, B up to 818 μg L^{-1}, I up to 1240 μg L^{-1}, Mo up to 20 μg L^{-1} and U up to 17.3 μg L^{-1} (Tables 7.3, 7.4, 7.5).

Regional distributions of P are variable, but some of the highest values are found in groundwaters from the north and north-east of the study area (Figure 7.12). The higher concentrations of B in the groundwaters compared to the other study areas is demonstrated in Figure 7.13, although no spatial trend can be detected from the concentration ranges chosen. Molybdenum also shows considerable spatial variability (Figure 7.14). The low

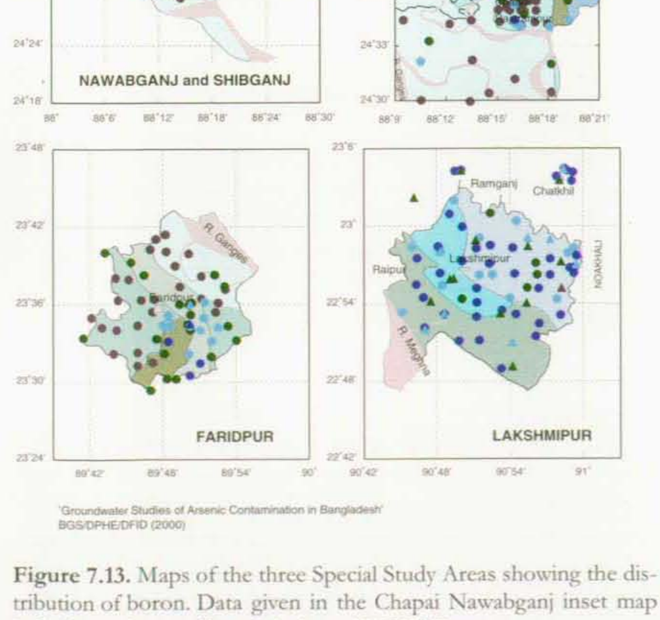


Figure 7.13. Maps of the three Special Study Areas showing the distribution of boron. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

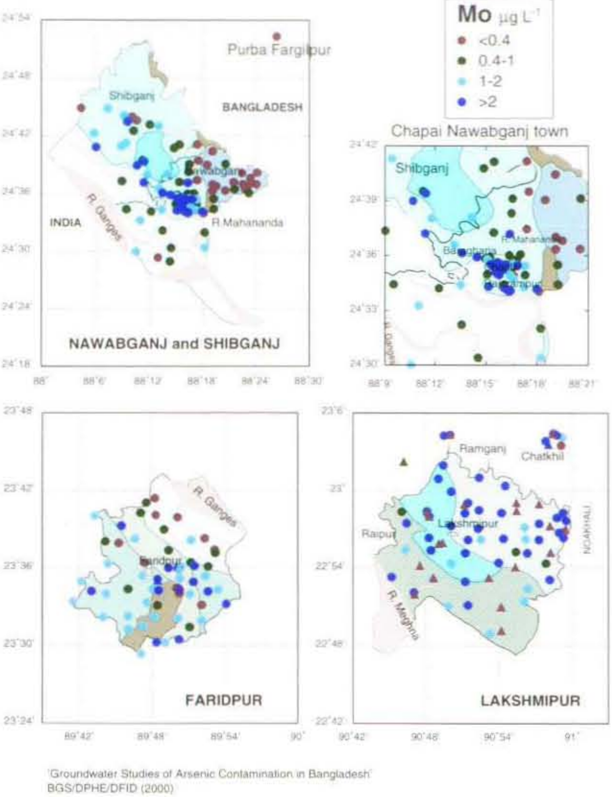


Figure 7.14. Maps of the three Special Study Areas showing the distribution of molybdenum. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

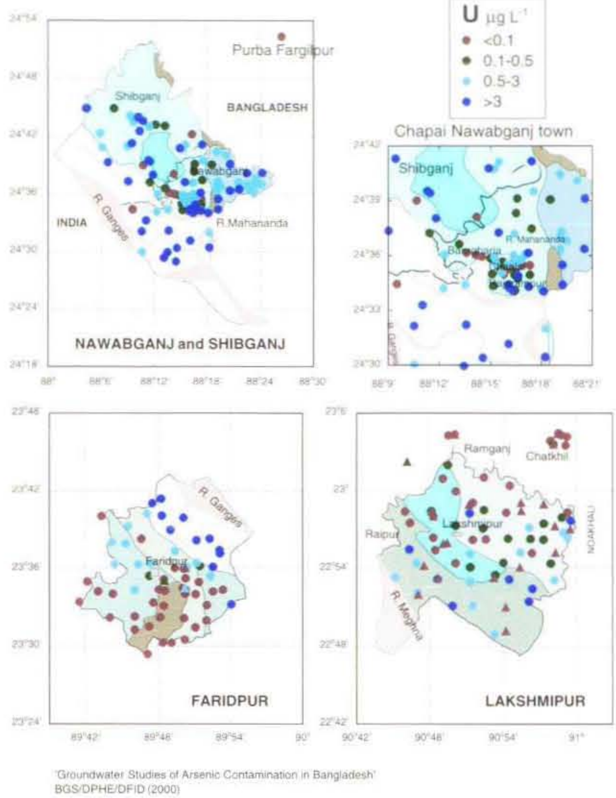


Figure 7.15. Maps of the three Special Study Areas showing the distribution of uranium. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

concentrations of U in deep groundwaters are highlighted in Figure 7.15 (<0.5 µg L^{-1}) and contrast with values found in the shallow groundwaters. These are patchy but tend to be higher in groundwaters from the south-west, relatively close to the River Meghna where the surface geology is of tidal deltaic deposits. Shallow groundwaters from the north-east areas (Chatkhil) have low U concentrations (Figure 7.15). Uranium shows a weak positive correlation with both Eh and HCO_3. The associations suggest that mobilisation in solution is achieved under less reducing conditions and with stabilisation of uranyl-carbonate species (Section 7.4.1).

Concentrations of Ba are generally lower than in the other study areas. All samples are undersaturated with respect to barite as a result of the low SO_4 concentrations. Nickel also appears to have lower concentrations in Lakshmipur groundwaters than in the other areas, although the regional distribution is variable in both aquifers.

Faridpur

Shallow and deep groundwaters from Faridpur do not have such a large depth distinction as in Lakshmipur. A depth distinction between the aquifers for Faridpur has been taken as 100 m. Table 7.2 shows that shallow groundwaters investigated are from tubewells with a depth range of 14–88 m while deep groundwaters have a defined depth range of 137–213 m. While intervening sediments are commonly poorly permeable and suggest a degree of separation of the aquifers, the distinction is not as great as at Lakshmipur and this may have implications for the isolation of the two aquifers. Only five samples were collected from the deep aquifer and these were from a limited area in the central part of Faridpur *upazila*. These factors must be borne in mind when considering the hydrochemical conclusions for this aquifer.

As with the other study areas, reducing conditions control many of the water-quality characteristics of the aquifers. Redox potentials (Ehs) have a large range in both shallow and deep groundwaters but, from the overall statistics, are not generally distinguishable (median Eh values for the shallow and deep aquifer being 111 mV and 95 mV, respectively; Table 7.2). The distribution of Eh across the aquifer is variable, but higher values appear to be more prevalent in the northern part (Figure 7.3). This may be associated with the modern floodplain of the Ganges where the surface geology is alluvial sand. In such areas, more oxidising conditions may be favoured locally by greater permeability of the topmost sediments. More active groundwater flow adjacent to the major river may also be responsible for generating slightly more oxidising conditions than elsewhere in the area.

Most groundwater samples from Faridpur have no detectable dissolved oxygen. Very few from the shallow aquifer, and none from the deep aquifer, have detectable NO_3-N. Ammonium concentrations are high in many and are predominantly highest in the south, where conditions are largely more reducing (Figure 7.3). The distributions of Fe (Figure 7.4) and DOC (Figure 7.7) have many similarities with those of NH_4-N.

As with Lakshmipur, Mn concentrations are high and notably higher in the shallow aquifer than the deep aquifer. Shallow groundwaters have a range of 0.04–4.2 mg L^{-1} while deep groundwaters have a range of 0.10–0.58 mg L^{-1} (Table 7.3). Higher Mn concentrations occur in the northern part of the *upazila*, particularly in the zone of the modern Ganges floodplain. This distribution indicates differing behaviour of Fe and Mn in solution. A similar observation was made from the National Hydrochemical Survey data, where Fe and Mn often do not correlate well spatially. The distinctions indicate different mobilisation behaviour and likely transport rates of the two elements. It is likely that mobilisation of Mn has occurred under more oxidising conditions than Fe, as expected from the thermodynamically predicted sequence of redox reactions in aquifers (Stumm and Morgan, 1995).

Concentrations of SO_4, though low, have a notable spatial trend, with lower concentrations found in the southern half of the study area (Figure 7.10). Concentrations are highest close to the Ganges floodplain (up to 64 mg L^{-1}; Table 7.2), believed to result from the occurrence of more oxidising conditions in this area and to increased localised groundwater flow induced by the river.

The Faridpur groundwaters are dominantly of Ca-HCO_3 or Ca-Mg-HCO_3 type and salinity is lower than in Lakshmipur, with lower concentrations of Na and Cl (Figures 7.8, 7.9). The deep groundwaters are generally more saline than the shallow groundwaters, although as they were collected from a limited area, the regional salinity variations are not known. Shallow groundwaters are slightly more saline in the central and southern parts of the *upazila* (shown by Na and Cl plots, Figures 7.8, 7.9), which includes the area from where the deep groundwaters were sampled. The correlation of higher salinity in shallow and deep groundwaters in this central area may indicate some hydraulic connection between the two aquifers, although multi-level screening of the deep tubewells within both shallow and deep aquifers adds an extra complication that could account for the chemical similarities.

Most of the groundwaters are saturated with respect to calcite, many are saturated with respect to dolomite and most saturated or supersaturated with respect to siderite, the degree of saturation rising with Fe concentration. pCO_2 values are high in both shallow and deep groundwaters (range –0.8 to –1.4 in the shallow; –1.0 to –1.4 in the deep groundwaters).

Bicarbonate concentrations are high in both the shallow and deep groundwaters with median values being higher in the deep aquifer (HCO_3 being 536 mg L^{-1} in the shallow groundwaters; 612 mg L^{-1} in the deep groundwaters). Alkalinity of the deep groundwaters is much greater than in the deep groundwaters from Lakshmipur.

As in Lakshmipur, a number of trace elements have distinctive concentration ranges in each aquifer. Concentrations of Mn, P, As and U are on average higher in the shallow aquifer (with maxima of 4.2 mg L^{-1}, 5.0 mg L^{-1}, 990 µg L^{-1} and 30 µg L^{-1} respectively; Tables 7.3–7.5). Concentrations of I, Br and Li are generally higher in the deep groundwaters, reflecting their higher salinity, although the concentration ranges of these elements generally overlap in the two depth intervals.

Chapai Nawabganj

Conditions differ in Chapai Nawabganj from the other two study areas in that no viable deep aquifer occurs below the Holocene alluvium and so groundwater is abstracted from depths shallower than around 50 m. In the east, groundwater is abstracted from the Dupi Tila aquifer beneath the Barind Clay (Figure 7.2). Summary statistics for the groundwater chemistry from tubewells in the shallow Holocene alluvium, from dug wells, and from the Dupi Tila aquifer are given in Tables 7.2–7.5. The statistics exclude the earlier batch of samples collected during the February 1997 BGS survey because these were of a reconnaissance nature and included sites where known As-related health problems existed. They were therefore not collected on a random basis. The data are included however, on the Chapai Nawabganj hydrogeochemical maps to highlight local spatial variations. Although all groundwaters are dominantly reducing, the local maps and summary statistics indicate some distinctive chemical differences between the Holocene alluvial and Dupi Tila aquifers.

Shallow Holocene tubewell waters: shallow groundwaters from Chapai Nawabganj have Eh values mostly <158 mV and low concentrations of dissolved oxygen (Table 7.2). Ehs are mostly low in the Shibganj area (Figure 7.3) and variable elsewhere. Concentrations of NH_4-N, Fe and DOC are highest in the Chapai Nawabganj urban area (Figures 7.4, 7.5, 7.7, insets) where more samples were collected during the 1997 survey. Manganese concentrations are relatively high throughout most of the aquifer (Figure 7.6).

Concentrations of SO_4 are typically higher in Chapai Nawabganj than the other two areas (Figure 7.10). Exceptions occur in the high-As groundwaters (mainly found in the town of Chapai Nawabganj), where SO_4 concentrations are more commonly 1 mg L^{-1} or less.

Most groundwaters are calcite-saturated and many also saturated with respect to dolomite. As elsewhere, alkalinities are high (199–826 mg L^{-1} as HCO_3). Ca and HCO_3 are generally the dominant ions. More of the groundwaters are undersaturated with respect to siderite than in the other two areas as a result of lower Fe concentrations.

Concentrations of P, B, Mo are highest in the Chapai Nawabganj urban area (Figures 7.12–7.14). Uranium concentrations in the groundwaters are also high, with a maximum of 32 µg L^{-1} (Table 7.5; Figure 7.15).

Dug-well waters: the small number of sampled waters from shallow dug wells (commonly around 10 m deep) in Chapai Nawabganj are distinctive from the tubewell waters, with chemical compositions apparently showing the effects of oxidation, evaporation or surface pollution. These sources are difficult to distinguish with most chemical determinands. In the groundwaters from the dug wells, SEC values are typically higher than from tubewell sources, at greater than 1000 µS cm^{-1}. Conditions are slightly oxidising with dissolved-oxygen concentrations being low but nonetheless detectable and usually present at a few milligrams per litre. Concentrations of SO_4 (up to 335 mg L^{-1}), Cl (up to 223 mg L^{-1}), NO_3-N (up to 28 mg L^{-1}), K (up to 12.4 mg L^{-1}) and occasionally B (up to 100 µg L^{-1}) are also high relative to the more typical anaerobic tubewell waters (e.g. Table 7.2, 7.3). Alkalinities are also high (603–695 mg L^{-1} as HCO_3) although not distinctive from the tubewell waters.

Increased SO_4 concentrations could be either related to surface pollution (agricultural inputs, latrines) or evaporation or sulphide (pyrite) oxidation. Similarly, NO_3-N could be derived from any of these processes, including oxidation of reduced NH_4-N, although given the maximum concentrations of dissolved NH_4-N in the reducing groundwaters of around 1–2 mg L^{-1} (Table 7.2), oxidation could only account for around 1–2 mg L^{-1} of NO_3-N. Oxidation of adsorbed NH_4 could account for some additional nitrate. However, the highest NO_3-N concentrations are likely to represent local pollution or evaporation. The higher concentrations of K and B may also be evaporation- or pollution-derived, but interaction with clay and silt which occur in greater proportion at shallow depths may also be at least partly responsible. The presence of increased Cl concentrations can only be due to evaporation or pollution as this is not derived from oxidation reactions. By contrast, the high alkalinities of the dug-well waters (>600 mg L^{-1} HCO_3) suggest that oxidation, in this case of organic matter, has taken place. Log pCO_2 values are high, ranging between −1.5 and -1.2. In practice, groundwater from the dug wells is likely to represent a mixture of both recently infiltrated and polluted surface recharge and older groundwater which has undergone a degree of oxidation in the zone of water-table fluctuation, particularly in the vicinity of the dug wells which have ready air access. The relative influence of each is likely to be variable between sampling sites.

One important observation from the dug-well waters is the high U concentrations (up to 47 µg L^{-1} with a median value of 20 µg L^{-1}; Table 7.5). Such concentrations are the highest found in the Bangladesh groundwaters and are believed to be derived by desorption from iron oxides under the comparatively oxidising conditions and correspondingly high bicarbonate concentrations around the open dug wells.

The dug-well waters are super-saturated with respect to calcite and dolomite and undersaturated with respect to siderite and vivianite.

Dupi Tila aquifer

Dupi Tila groundwaters are shown in Figures 7.3–7.17 as those below the Barind Tract. One sample from further north-east (Purba Fargilpur, Gomastapur *upazila*) is also from the Dupi Tila aquifer and has similar chemical characteristics to those from the Dupi Tila in Chapai Nawabganj.

Dupi Tila groundwaters are also reducing, although apparently less so than the shallow Holocene groundwaters. Most have low NO_3-N concentrations. Redox potentials are mostly <278 mV but are amongst the highest observed in the area (Figure 7.3). Dissolved-oxygen concentrations are also low (<2 mg L^{-1}) but sometimes detectable. Concentrations of NH_4-N, Fe and Mn are uniformly low and DOC is usually low relative to the shallow Holocene aquifer (Figures 7.4–7.7).

The groundwaters are of Ca-HCO_3 type but have relatively high Na concentrations compared to the shallow Holocene aquifer (Figure 7.8; Table 7.3). Concentrations of SO_4 are mostly in the range 0.5–10 mg L^{-1} (Figure 7.10; Table 7.3). These relatively high concentrations suggest that SO_4 reduction has been less influential than in the other study areas. Bicarbonate concentrations are lower than in the shallow Holocene groundwaters (Figure 7.11).

Among the other trace elements, P, Ba, Rb and Mo (Figure 7.14) as well as As (Figure 7.16) are notably lower than in the shallow Holocene aquifer (Tables 7.3–7.5). Concentrations of U are relatively high compared to aquifers in the other study areas (Figure 7.15), presumably as a result of the relatively oxidising conditions.

7.4.3 Arsenic

Regional and depth variations

Results of As analysis for selected samples are given in Table 7.1 and summary statistics for the three study areas are given in Table 7.3. Concentrations of As_T span almost four orders of magnitude, from <0.5 µg L^{-1} to in excess of 2300 µg L^{-1}. Although almost all analyses were of filtered samples, both filtered and unfiltered aliquots were measured in a sub-set of 29 samples from Chapai Nawabganj. Results generally compared well (most within 20%) and so it is considered that the As in the groundwaters is predominantly present in dissolved form.

Cumulative-frequency distributions for the three areas (depths not distinguished) are given in Figure 7.16 The distributions indicate that concentrations are consistently higher in Lakshmipur than in the other areas. In Lakshmipur, 55% of samples (shallow and deep) analysed exceeded the Bangladesh standard (50 µg L^{-1}) and 70% exceeded the WHO guideline value (10 µg L^{-1}). In Faridpur, 41% exceeded 50 µg L^{-1} and 69% exceeded 10 µg L^{-1} and in Chapai Nawabganj, although some high concentrations were found, only 25% exceeded 50 µg L^{-1} and 35% exceeded 10 µg L^{-1}.

Variations in As_T concentration with depth and aquifer type are shown in Figure 7.17. The distribution demon-

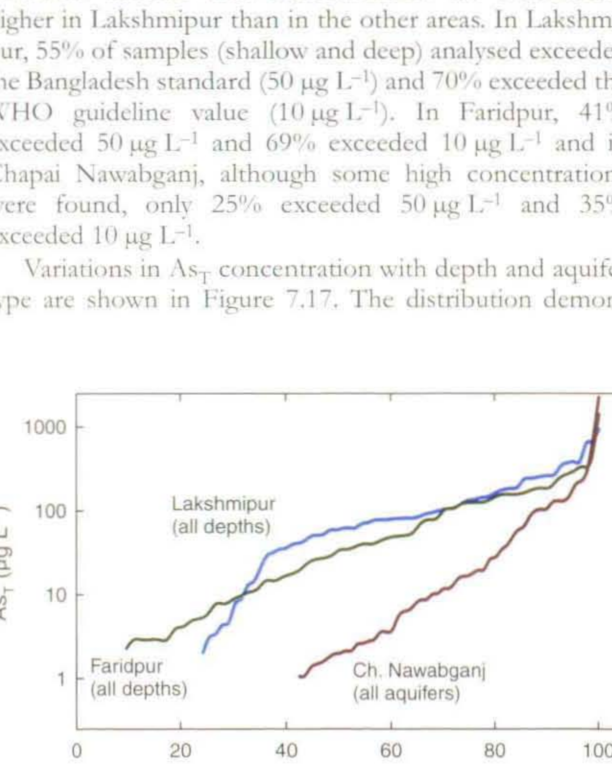


Figure 7.16. Cumulative frequency distributions of total arsenic in the Special Study Areas (aquifer depths not divided).

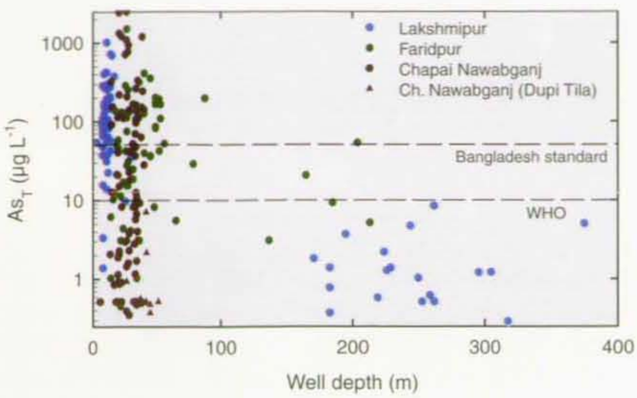


Figure 7.17. Variation of total arsenic with depth.

strates that in the three areas, the serious arsenic problems are restricted to the shallow Holocene alluvial aquifers.

Considering the shallow Holocene alluvial aquifer alone, maximum observed As_T concentrations in Lakshmipur, Faridpur and Chapai Nawabganj respectively were 986 μg L^{-1}, 1460 μg L^{-1} and 2342 μg L^{-1}. Groundwaters from the shallow aquifer at Lakshmipur are consistently higher than from the shallow aquifer in the other areas, with 95% exceeding the WHO guideline value and 80% exceeding the Bangladesh standard. In Faridpur, 71% of shallow groundwaters exceed the WHO guideline value and 42% exceed the Bangladesh standard (Table 7.6). These results indicate better quality with respect to arsenic than found by Safiullah (1998), who reported up to 70% of shallow groundwaters from Faridpur municipality exceeding the Bangladesh standard. Chapai Nawabganj has better overall statistics for As in the shallow alluvial aquifer, with 42% above the WHO guideline value and 23% above the Bangladesh standard (Table 7.6).

Lakshmipur

Shallow groundwaters from Lakshmipur (<150 m) have spatially variable As concentrations but with generally highest values in the northern area where surface geology comprises Chandina alluvium or alluvial silt and clay (Figure 7.18). Concentrations in shallow groundwaters from the southern part of the *upazila*, with a surface cover of tidal deltaic deposits, were mostly lower. However, distributions of As in the south are patchy, with a few samples having in excess of 100 μg L^{-1} (Figure 7.18).

Lakshmipur deep groundwaters (>150 m) have uniformly low As concentrations with a maximum of 8.2 μg L^{-1} out of 22 analysed samples.

Selected chemical results from depth sampling (bailing) of groundwaters from a deep hand-pump tubewell from Kamarchat Bazar in Lakshmipur are shown in Table 7.7. The tubewell is 262 m deep and is constructed with a long cased section, down to 7 m above its base with a 4 m slotted screen below. Sampling depth was restricted by the length of the bailer cable and hence all samples (down to 94 m) were from the cased section. The results reveal very

Table 7.6. Percentage exceedances above the Bangladesh standard and the WHO guideline value for As in groundwaters (distinguished by aquifer) from the three study areas

	Shallow alluvial aquifer			Deep aquifer/Dupi Tila (Chapai Nawabganj) aquifer		
Location	Number	% >50 μg L^{-1}	% >10 μg L^{-1}	Number	% >50 μg L^{-1}	% >10 μg L^{-1}
Lakshmipur	59	80	95	22	0	0
Faridpur	59	42	71	5	20	40
Chapai Nawabganj	69	23	42	20	0	0

Table 7.7. Variations in groundwater quality with depth in a 262 m deep borehole in Lakshmipur (Kamarchat Bazar, 22°55.31'N 90°58.28'E) Samples were bailed from discrete depths at 10 m intervals and are compared with one pumped sample from the screened section of the borehole. All samples were filtered (0.2 μm)

Sample depth	As_T	pH	Ca	HCO_3	Fe_T	P_T
m	μg L^{-1}		mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}
4	1.9	6.67	117	134	9.70	0.12
14	<1	6.70	116	137	9.04	0.16
24	<1	6.69	116	141	8.90	0.19
34	<1	6.66	117	139	8.65	0.19
44	<1	6.68	117	146	8.93	0.20
54	<1	6.67	118	149	8.21	0.18
64	<1	6.68	116	151	7.84	0.16
74	<1	6.65	118	139	6.65	0.11
84	<1	6.66	116	141	8.63	0.23
94	<1	6.67	116	122	8.27	0.19
Pumped	8.2	6.53	111	125	9.46	0.30

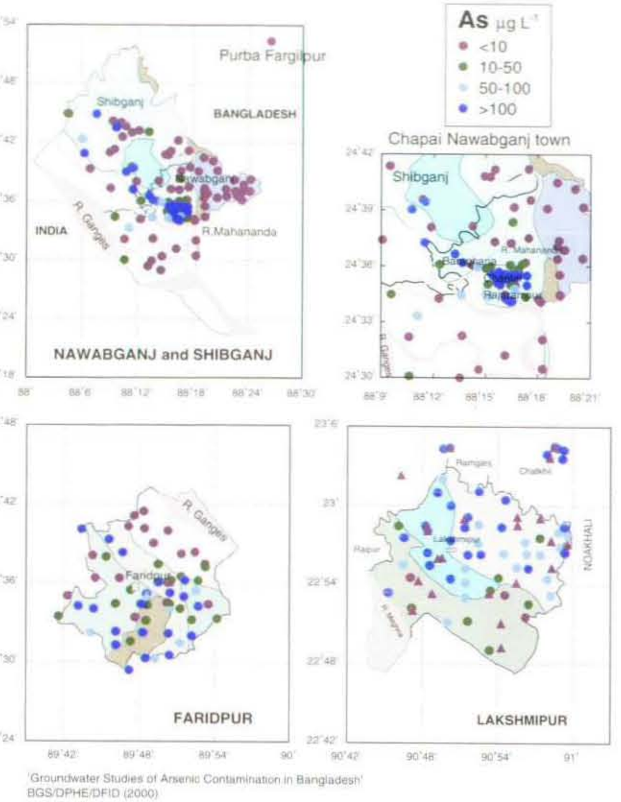


Figure 7.18. Maps of the Special Study Areas showing the distribution of total arsenic. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

little chemical variation with depth and uniformly low As_T concentrations (1.9 µg L^{-1} or less). The concentrations are lower than that of groundwater pumped from the screened section of the borehole, which is itself low at just 8.2 µg L^{-1}. Other determinands, including pH, Fe and alkalinity have notable similarities between the depth samples and the pumped sample. The data indicate a dominance of groundwater flow up the borehole from the screened section without leakage of high-As groundwater into the borehole from the shallow horizons. This is also supported by the concentration of other elements in the groundwaters which show very little variation with depth (Table 7.7) and have low concentrations of HCO_3 (around 150 mg L^{-1}), P (around 0.2 mg L^{-1}) and Mn (around 0.3 mg L^{-1}).

Faridpur

Shallow groundwaters (<100 m): despite much variability, shallow groundwaters from Faridpur *upazila* appear to show some local trends in As concentrations, with highest values largely being found in groundwaters where the surface geology is deltaic sand or silt and marsh clay/peat. Concentrations in groundwaters from below alluvial sand in the northern part of the *upazila* are all <50 µg L^{-1} (Figure 7.18). As with other redox-controlled constituents, this distribution is likely to be because of locally high permeability in the surface sediments of the modern Ganges floodplain and more active groundwater flow adjacent to the river bed.

Deep groundwaters (>100 m): these have much lower As concentrations than the shallower groundwaters. However, the highest values observed in the deep groundwaters are notably higher than found in Lakshmipur. Two samples out of the five investigated exceeded the WHO guideline value and one exceeded the Bangladesh standard (Figure 7.18), though only just (52 µg L^{-1}; Table 7.3). This high-As tubewell is located within a few metres of another tubewell of similar depth which had a much lower As concentration (5 µg L^{-1}). There is a possibility that the tubewell containing groundwater with 52 µg L^{-1} As is multi-screened and hence the water quality represents a mix between shallow and deep groundwaters. However, this has not been confirmed. There is also a possibility of drawdown of water from shallow aquifer since there is no substantial intervening clay layer at Faridpur. However, the range of As concentrations observed suggests that the deeper aquifer around Faridpur is of much better quality than the shallow aquifer with respect to As. Further investigation of the deep aquifer at Faridpur is needed to identify whether the high As values observed have been developed in situ.

Chapai Nawabganj

Shallow tubewell waters: not surprisingly, the shallow Holocene groundwaters collected from Chapai Nawabganj from our 1998–1999 surveys yield a smaller proportion of samples exceeding guideline values than from the 1997 survey. However, the concentrations show an enormous spatial variability (and the water-quality data contrast strongly with results from an earlier BGS survey of Chapai Nawabganj municipal area). In the earlier 1997 batch of samples, a much larger proportion exceeded the Bangladesh standard for As in drinking water with several having very high concentrations, some in excess of 1 mg L^{-1}. The variability indicates that the groundwater As is concentrated in a localised zone or 'hot spot', some 5 × 3 km in areal extent, which occurs close to Chapai Nawabganj town centre (Rajarampur, Chanlai, Rahaichar and Baragharia especially) and is centred in an interfluve of a meander of the Mahananda River (Figure 7.18, inset). Concentrations in excess of 100 µg L^{-1} extend beyond this area, north-westwards into neighbouring Shibganj *upazila*, but not the extremely high concentrations of >1 mg L^{-1} observed in the municipal area. Similar observations of a localised 'hot spot' of As were made in Samta village, Jessore (Biswas et al., 1998; AAN, 2000). Groundwaters from similar depths in other parts of the study area have much lower concentrations.

As in Faridpur, As concentrations appear to be lower in the shallow Holocene groundwaters in the south of Chapai Nawabganj *upazila* along the banks of the River Ganges, where surface geology comprises alluvial sand (Figure 7.18). This is likely to be for similar reasons, namely more oxidising conditions allowed by coarser-grained surface sediment and more active shallow groundwater flow close to the main river.

Dug wells: by contrast, As_T concentrations in groundwater from shallow dug wells in the Holocene alluvial aquifers

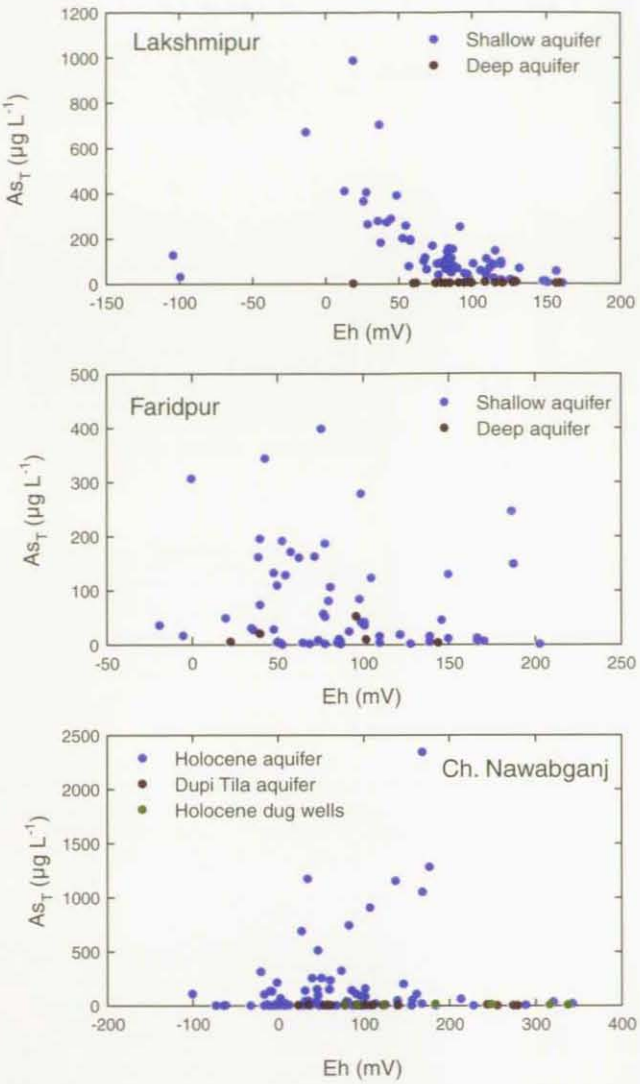


Figure 7.19. Variation of total arsenic with redox potential (Eh) in groundwaters from the Special Study Areas.

are usually low and often below detection limits. Summary statistics for As_T in dug-well waters from Chapai Nawabganj indicate a range in concentrations for 5 samples of <3–14 µg L^{-1}. Two of the samples exceed the WHO guideline value of 10 µg L^{-1} but the median is below, at 7.6 µg L^{-1} (Table 7.3). As discussed above, the shallow well waters are likely to represent a mixture between polluted and aerated surface recharge and slightly older groundwater that has been oxidised by aeration in the zone of water-table fluctuation and close to the open wells. The maintenance of low As concentrations compared to the deeper tubewell waters probably results from the combination of:

- lack of opportunity for recently recharged, polluted waters to interact with host sediments and for reducing conditions to develop;
- oxidation of groundwaters present in the aquifer (by air, dissolved oxygen and NO_3-N in the recently recharged polluted waters) and hence oxidation of Fe(II) and As(III) present with resultant increase in adsorption onto oxide minerals;

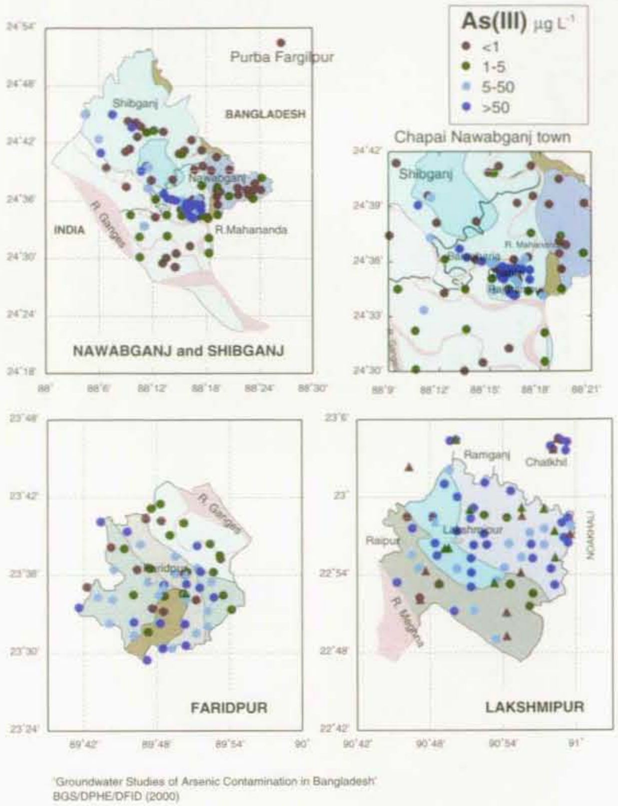


Figure 7.20. Maps of the three Special Study Areas showing the distribution of As(III). Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

- most active flushing of the shallowest parts of the aquifer by seasonal recharge and pumping.

Dupi Tila aquifer: As concentrations are also uniformly low (all <10 µg L^{-1}) in groundwaters from the older Dupi Tila aquifer beneath the Barind Clay in the east of the area (Figure 7.18).

Arsenic mobilisation and speciation

The presence of reducing conditions in the Bangladesh aquifers appears to have a strong control on the As mobilisation. Although there is much variation locally, some relationship exists between total As (As_T) concentrations and Eh values in the groundwaters, at least in Lakshmipur and Chapai Nawabganj (Figure 7.19). In Lakshmipur, the highest As_T concentrations are found in groundwaters with Ehs of –20 to +100 mV (though interestingly not in the groundwaters with lowest observed Eh values, around –100 mV). In Chapai Nawabganj, highest As_T concentrations are in groundwaters with Ehs between 0–170 mV. In this region too, groundwaters with the lowest Ehs (<0 mV) have lower As_T concentrations (Figure 7.19). Groundwaters from Faridpur do not show much relationship between As_T and Eh.

Under the reducing conditions, As(III) is an important component of the dissolved As_T. Figure 7.20 shows the regional distributions of As(III) in the three study areas. Local variations largely follow those observed in the As_T concentrations.

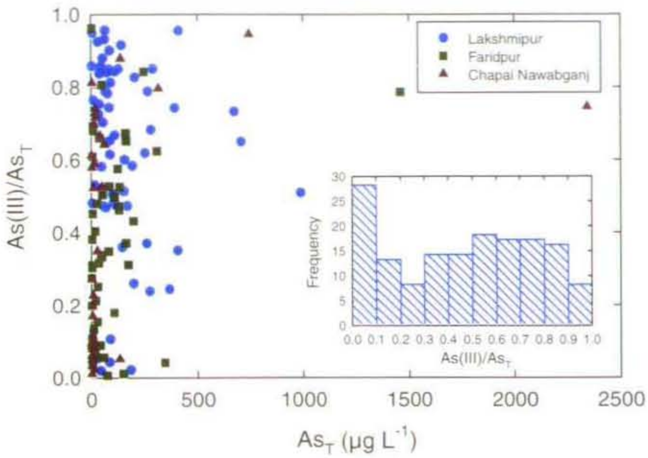


Figure 7.21. As(III)/As$_T$ ratio against As$_T$ concentration in each of the Special Study Areas.

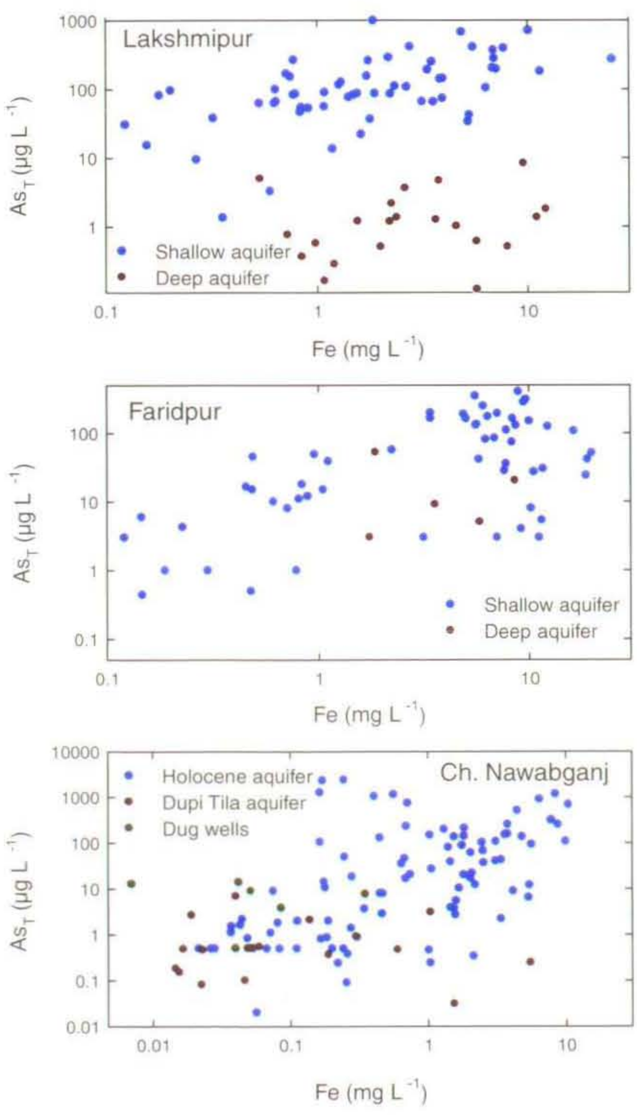


Figure 7.22. Variation of total arsenic with total dissolved Fe concentration.

Although dominance of As(III) would be predicted in the reducing groundwaters from thermodynamic considerations, the observed As(III)/As$_T$ ratio is highly variable. This may reflect mixed groundwater samples rather than lack of thermodynamic equilibrium in the aquifer. The sediments are highly variable, sometimes on a centimetre scale (e.g. Figure 3.16), and this may be reflected in their local redox status. Species other than As(III) were not measured but experience of As speciation elsewhere (e.g. Chen et al., 1995; Das et al., 1996) suggests that the inorganic forms are overwhelmingly dominant in groundwaters. Organic forms (MMAA, DMAA) are therefore considered to be negligible.

Although the modal and median ratios of As(III)/As$_T$ are 0.5, the range is from <0.1 to >0.9 (i.e. the proportion of As present as As(III) varies widely). As(III)/As$_T$ ratios in the samples with highest As concentrations are mainly in the range 0.6–0.7 (Figure 7.21). Such variable As(III)/As$_T$ ratios have been reported in groundwaters elsewhere in the Bengal Basin. Safiullah (1998) found ratios ranging between 0 and 0.93 in groundwaters from Faridpur. Large

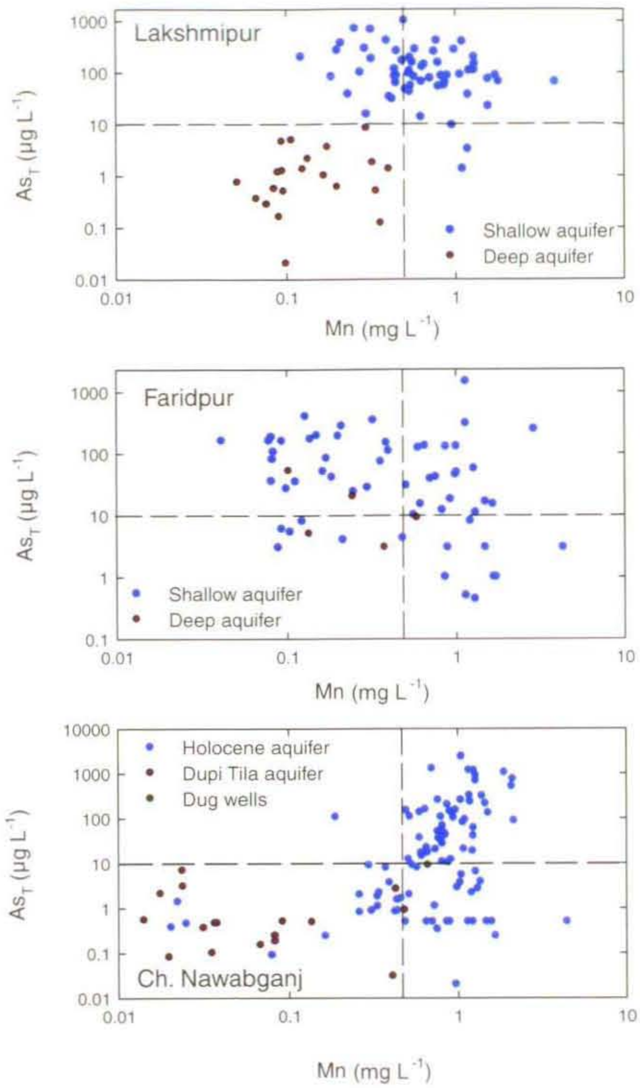


Figure 7.23. Variation of total arsenic with total dissolved manganese concentration.

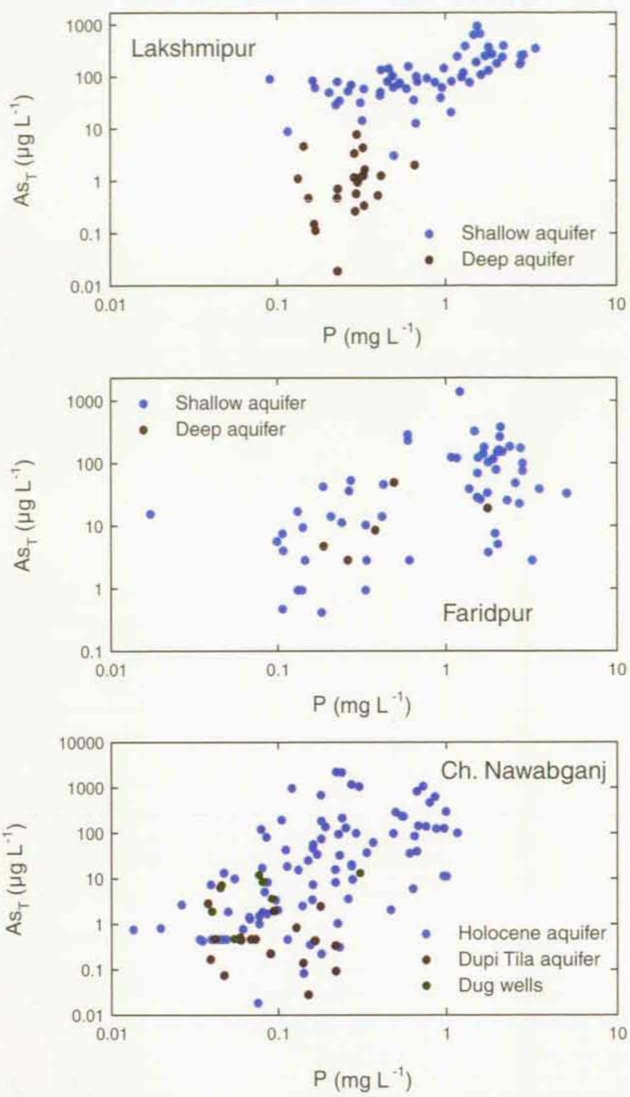


Figure 7.24. Variation of total arsenic with total phosphorus concentration.

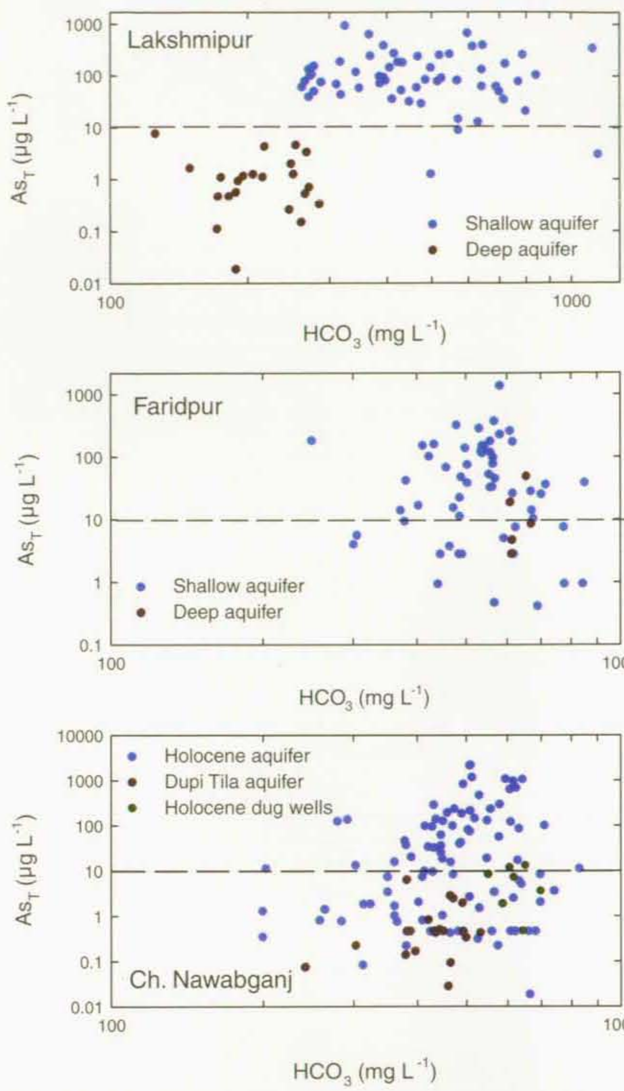


Figure 7.25. Variation of total arsenic with alkalinity (HCO_3) concentration.

ranges were also found in groundwaters from West Bengal (e.g. Das et al., 1995; Acharyya, 1997).

Relation between arsenic and other ions

Relationships between As and other chemical parameters are shown (log scales) in Figures 7.22–7.28. One of the most diagnostic associations is that with Fe and this has often been taken to indicate a mineral source for the As (e.g. Matisoff et al., 1982). Congruent dissolution of Fe oxides and the associated release of As under the reducing conditions would be one mechanism expected to generate a positive correlation between Fe and As (assuring all of the oxides contained the same amount of As). The variation between As and Fe shows some positive trend, particularly in Lakshmipur, but the correlations are generally rather poor (Figure 7.22). Lack of correlation between As and Fe has also been noted in other studies of groundwaters in Bangladesh (e.g. NRECA, 1997; Safiullah, 1998).

Some general relationships are established between As_T and Mn, P and HCO_3 (Figures 7.23–7.25). As noted from the statistical summaries and regional maps, all four parameters are typically high in the shallow Holocene alluvial groundwaters, although the correlations between them within the aquifer are not strong.

One of the elements most strongly correlated with As_T is Mo (Figure 7.26). This is also a redox-sensitive element with oxidation states in natural waters of 4+ or 6+. Like As, these also form oxyanions in solution although concentrations can be limited in strongly reducing conditions by precipitation of molybdenite. In all three areas, high As_T is reflected in high Mo and suggests that the two may be derived from similar sources. Like As, Mo strongly adsorbs to Fe oxides and is incorporated into sulphide minerals. Molybdenum also forms oxyanion species in solution and is therefore expected to behave in a similar way to As.

Variation between As_T and SO_4 is also potentially diagnostic in determining the mineral source(s) of the As. Derivation by oxidation of pyrite in the aquifer would be expected to produce dissolved SO_4 and hence result in a general positive correlation between As and SO_4 in the Bangladesh groundwaters. This is clearly not the case (Figure 7.27). The correlations between As_T and SO_4 are gen-

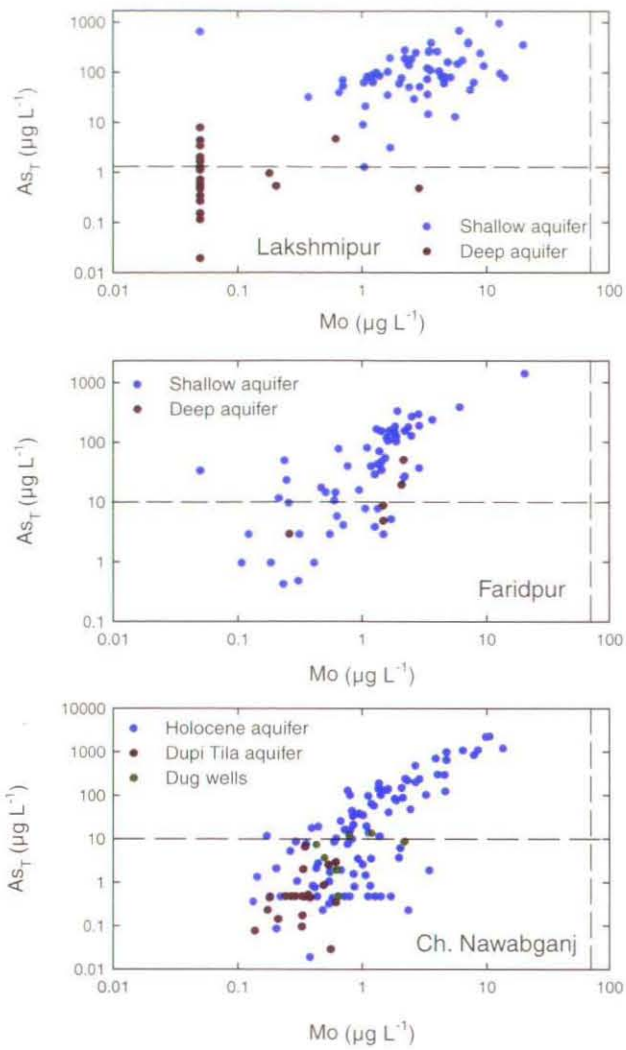


Figure 7.26. Variation of total arsenic with molybdenum concentration.

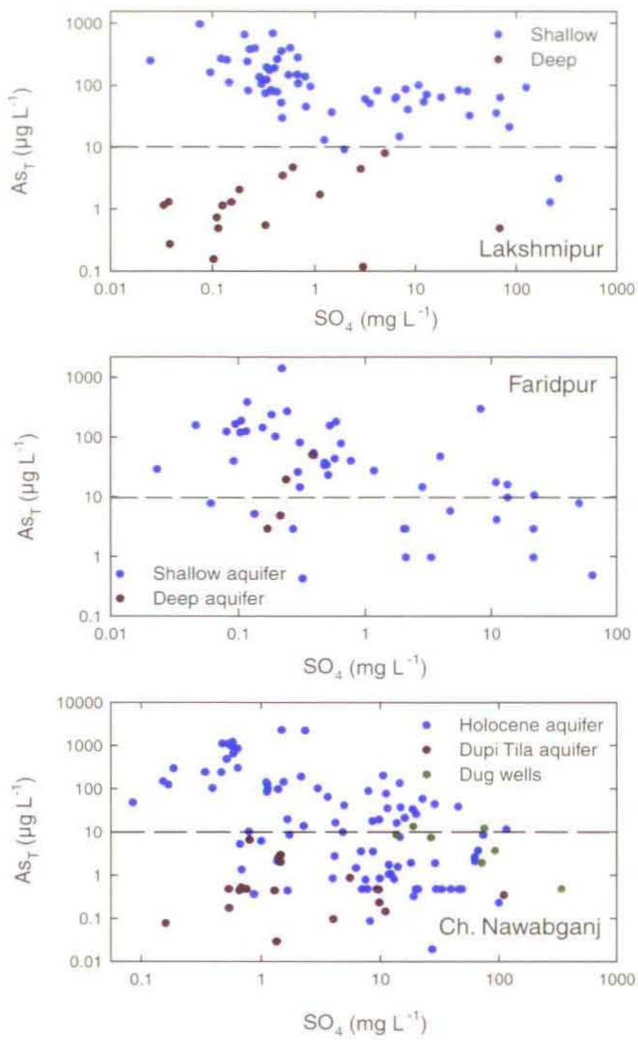


Figure 7.27. Variation of total arsenic with sulphate concentration.

erally poor, and in all areas, show a negative, rather than positive, relationship. This is supported by the regional trends in As_T and SO_4 concentrations (Figures 7.10, 7.18) which indicate that the distributions of high concentrations of the two parameters are completely different. The relationships between As_T and SO_4 suggest that in areas where high concentrations of As exist, the waters have also undergone sulphate reduction. Mobilisation of As has therefore apparently been under highly reducing aquifer conditions, rather than by widespread oxidation of sulphide minerals. This general negative association between As and SO_4 has also been seen in the groundwaters from the National Hydrochemical Survey (Chapter 6).

A generalised negative relationship is also observed between As_T and U (Figure 7.28). As with SO_4, the trends are considered to reflect the ambient redox conditions, with highest U and lowest As being found in the more oxidising groundwaters. The negative correlation is seen most strongly in the Lakshmipur shallow groundwaters (Figure 7.28). Concentrations of U are relatively high (>2 µg L^{-1}) in many of the groundwaters.

Although some general relationships are highlighted between As_T and numerous other chemical parameters, none of the relationships are reliable enough to be used in a predictive sense to determine As concentrations where they have not been measured directly.

7.4.4 Dissolved gases

Results for dissolved gases in groundwater are given for a representative set of samples in Table 7.8, together with average percentages of each of the gases relative to air-saturated water. Well depths are also given to distinguish the aquifers. The results indicate the depletion in O_2 gas relative to air-saturated values, in line with the observed low dissolved-oxygen concentrations measured in the field and the anaerobic condition of the groundwaters.

Concentrations of N_2 and Ar (the latter calculated) are similar to air-saturated water concentrations. In contrast, significant enrichment is observed in CO_2 and CH_4 and indicates that groundwater evolution has involved generation of these gases since recharge. Concentrations of CH_4 are up to 14 mg L^{-1} (Table 7.8). The presence of methane was also observed by Ahmed et al. (1998) in some groundwaters from shallow tubewells in the south-eastern coastal part of Bangladesh.

Table 7.8. Concentrations of dissolved gases in selected groundwater samples from the three study areas
These are compared to theoretical values in air-saturated water (calculated at 1 atm. pressure, 25°C using the Ostwald coefficients given)

Sample	Temp °C	Depth m	Field DO mg L⁻¹	O_2 calc mg L⁻¹	Ar calc mg L⁻¹	O_2+Ar mg L⁻¹	N_2 mg L⁻¹	CO_2 mg L⁻¹	CH_4 mg L⁻¹	C_2H_6 mg L⁻¹	N_2O mg L⁻¹
Ostwald coefficient* (cc mL⁻¹)				0.03111	0.03407		0.01588	0.82800	0.03395	0.04530	0.10000
Atmospheric concentration (%)				20.95	0.93		78.1	0.0365	0.00018	0.00001	3.20×10^{-5}
Air-saturated water (cc L⁻¹)				6.52	0.32		12.4	0.30	6.04×10^{-5}	4.5×10^{-6}	0.000032
Air-saturated water (mg L⁻¹)				9.3	0.6	9.9	15.5	0.6	0.00005	0.00001	0.0001
Lakshmipur											
980701	27.4	11	1.3	0.55	0.45	1.00	12.6	85.6	0.021	<0.00013	0.0187
980713	25.3	11	<0.1	0.24	0.60	0.85	16.9	42.9	0.149	<0.00013	<0.0001
980717	24.3	8	<0.1	<0.34	0.20	<0.14	5.7	45.4	0.016	<0.00013	<0.0001
980721	25.1	12	<0.1	2.39	0.27	2.66	7.7	34.3	14.806	0.00018	<0.0001
980756	25.7	14	<0.1	0.52	0.51	1.04	14.4	44.3	0.003	<0.00013	<0.0001
980761	25.4	14	<0.1	4.19	0.52	4.71	14.6	5.0	5.544	0.00007	<0.0001
980768	26.3	37	<0.1	0.95	0.57	1.53	16.1	82.2	0.219	<0.00013	<0.0001
980775	25.4	50	<0.1	<0.73	0.60	<0.12	16.9	121.6	10.075	0.00027	<0.0001
980785	26.4	24	<0.1	<0.01	0.71	0.71	20.0	32.2	0.004	<0.00013	0.0005
980723	26.4	183	<0.1	0.39	0.38	0.77	10.6	58.2	10.200	<0.00013	<0.0001
980754	25.3	250	<0.1	0.98	0.42	1.39	11.7	17.0	4.204	<0.00013	<0.0001
Faridpur											
980793	27.4	79	<0.1	3.87	0.68	4.55	19.0	9.9	0.441	<0.00013	<0.0001
980803	26.4	28	<0.1	3.31	0.61	3.92	17.1	33.5	2.393	<0.00003	<0.0001
980817	27.0	27	1.4	3.26	1.00	4.25	27.9	151.1	0.012	<0.00013	<0.0001
980828	26.2	27	<0.1	0.22	0.32	0.54	8.8	111.1	14.570	0.00040	<0.0001
980858	26.8	43	<0.1	0.27	0.71	0.98	19.9	90.4	0.002	<0.00013	<0.0001
980863	27.6	34	<0.1	0.02	0.72	0.75	20.3	84.0	0.001	<0.00013	<0.0001
980870	27.9	29	0.2	2.40	0.68	3.08	19.1	107.3	0.019	<0.00013	<0.0001
980794	25.5	165	<0.1	1.61	0.49	2.10	13.8	38.8	7.401	0.00026	<0.0001
Chapai Nawabganj											
Shallow alluvial aquifer											
980878	27.0	29	<0.1	0.38	0.82	1.20	23.0	52.7	0.252	<0.00013	<0.0001
980896	28.8	41	0.2	<0.02	0.61	0.59	17.1	51.1	4.478	<0.00013	<0.0001
980899	28.1	41	<0.1	3.87	0.68	4.55	19.0	68.1	0.029	<0.00013	<0.0001
Dupi Tila aquifer											
980881	26.1	38	0.2	2.82	1.04	3.85	29.1	85.5	0.004	<0.00013	<0.0001
980884	27.8	34	<0.1	0.44	0.59	1.03	16.7	62.0	0.854	<0.00013	<0.0001

* Ostwald partition coefficients at 1 atm., 25°C from Wilhelm et al. (1977).

other areas. Deep groundwaters are at the enriched end of the compositional range, though not outside the range observed for the shallow groundwaters.

The most depleted sample found ($\delta^{18}O$ −9.6 ‰, δ^2H −64 ‰) was also from Lakshmipur. This was from a shallow tubewell (14 m) in the northern part of the *upazila*, below Chandina alluvium (Figures 7.30, 7.31). The reason for the depletion is not clear but is thought not to be related to local recharge since it is distinct from other groundwater compositions locally. The site is not obviously close to a major river system, but its depleted isotopic composition may reflect a significant contribution deriving from river recharge, since water in the major river systems originating in the Himalayan foothills and uplands is likely to be isotopically depleted. Navada and Rao (1991) found $\delta^{18}O$ compositions as depleted as −10 ‰ in River Ganges water. Although several kilometres away from the main course of the composite Ganges-Brahmaputra-Meghna River course, the groundwater sample may reflect inputs to the aquifer from the river during flood times.

The range of compositions in Faridpur is the narrowest observed (Figure 7.30). Although spatial trends are variable, compositions of the shallow groundwaters are generally most depleted close to the floodplain of the River Ganges and slightly more enriched in the south and westerly parts of the *upazila*. The trends do not closely reflect the salinity of the groundwaters. Depleted compositions close to the river may reflect an increasing influence of river recharge locally. Compositions of the deep groundwaters from Faridpur are within the range of the shallow groundwater compositions, but at the depleted end of the range.

Groundwaters from Chapai Nawabganj also show some spatial variation (Figure 7.30, 7.31) with the most depleted compositions in the Holocene aquifer, like Faridpur, being found within the modern Ganges floodplain and possibly also relating to increased inputs of river recharge locally. Groundwaters from the older Dupi Tila aquifer are at the enriched end of the compositional range (Figure 7.29), though again not distinctive from the range for groundwaters from the Holocene aquifer. The range for Dupi Tila groundwaters is smaller than that given by

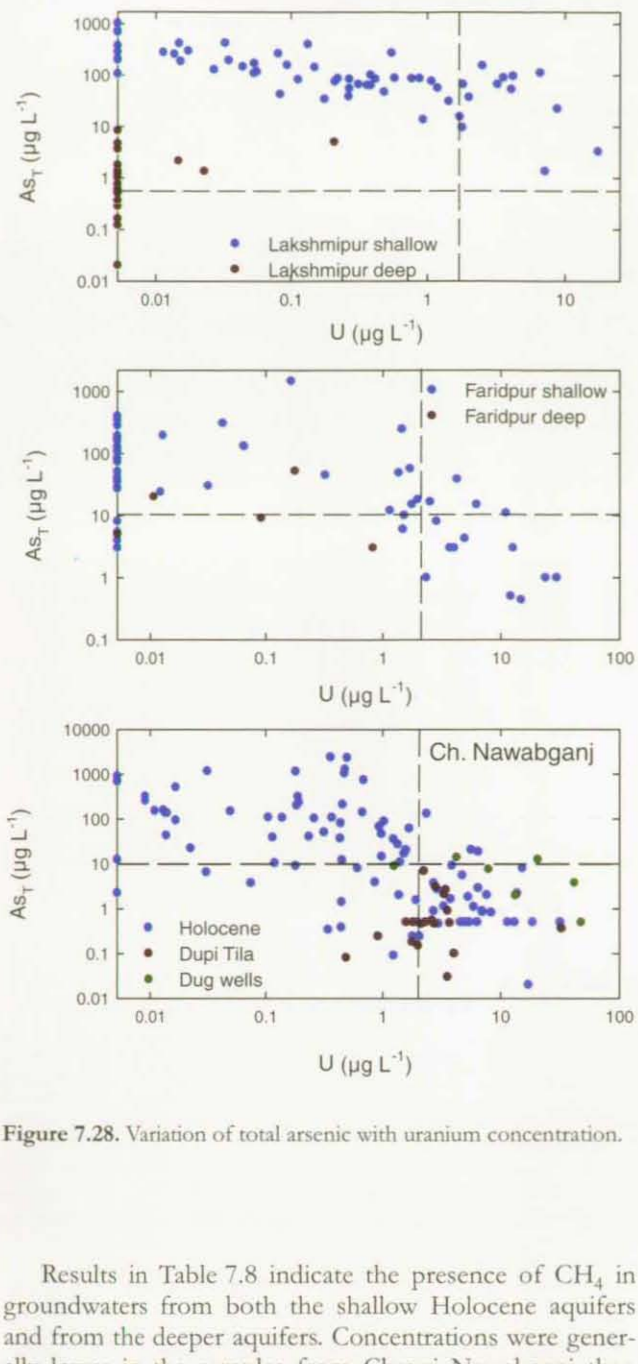


Figure 7.28. Variation of total arsenic with uranium concentration.

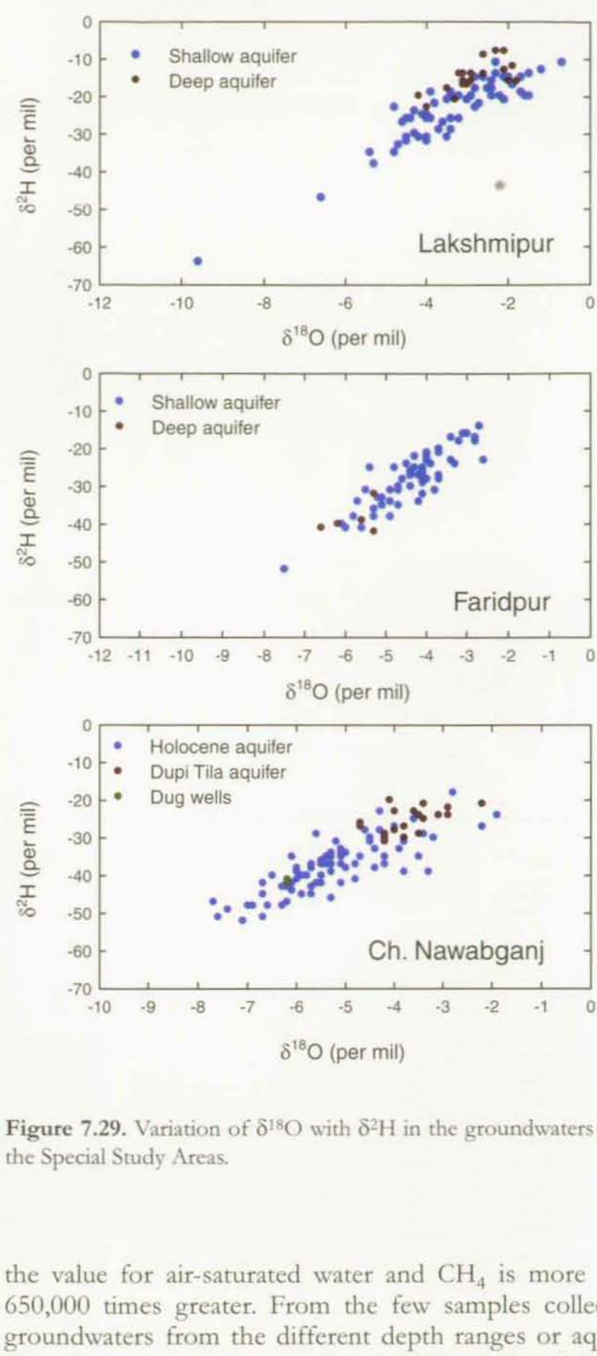


Figure 7.29. Variation of $\delta^{18}O$ with δ^2H in the groundwaters from the Special Study Areas.

Results in Table 7.8 indicate the presence of CH_4 in groundwaters from both the shallow Holocene aquifers and from the deeper aquifers. Concentrations were generally lower in the samples from Chapai Nawabganj than from the other two areas. Concentrations of dissolved ethane (C_2H_6) are almost always low, although they are slightly above detection limit where CH_4 concentrations are correspondingly high.

Concentrations of N_2O are usually below detection limit, but are detectable in a few samples. Nitrous oxide is an intermediate product of denitrification and it is likely that the N_2O observed is generated in this way. However, if denitrification has been an important process, it appears that such intermediary products no longer remain significantly in the system. This is not surprising given the likely long timescales involved.

In summary, results for dissolved gases show, on average, significant depletions in O_2 relative to air-saturated water, values close to air-saturated water for N_2 and Ar and significant relative enrichments for CO_2 and CH_4. Concentrations of CO_2 average more than 100 times greater than the value for air-saturated water and CH_4 is more than 650,000 times greater. From the few samples collected, groundwaters from the different depth ranges or aquifer types (Holocene aquifer versus Dupi Tila in Chapai Nawabganj) are indistinguishable in their dissolved-gas compositions (Table 7.8). Arsine gas was not measured, but may be expected to be present in some groundwaters given the high concentrations of aqueous As present and the reducing nature of the groundwater.

7.4.5 Isotopic compositions

Oxygen-18 and deuterium

Summary statistics for $\delta^{18}O$ and δ^2H are given in Table 7.5. These isotopes are plotted against each other in Figure 7.29 and as maps in Figures 7.30 and 7.31. The compositions show a large range in each of the study areas, the greatest being observed in Lakshmipur. Many of the samples from Lakshmipur have the most enriched compositions, in line with their increased salinity relative to the

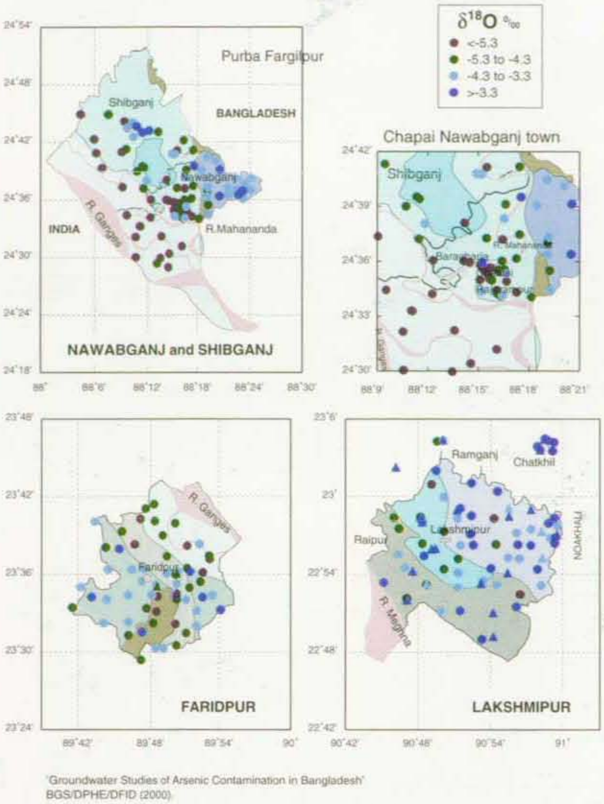


Figure 7.30. Maps of the three Special Study Areas showing the distribution of $\delta^{18}O$. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

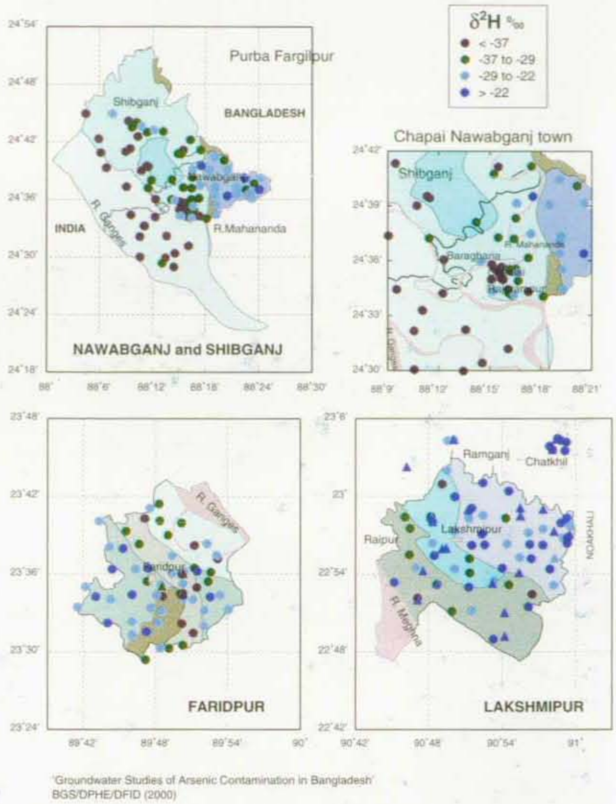


Figure 7.31. Maps of the three Special Study Areas showing the distribution of $\delta^{2}H$. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

Ahmed and Burgess (1995) who plotted values around –6 to +2‰ and –10 to –50‰ for $\delta^{18}O$ and $\delta^{2}H$ respectively. Our data for the Dupi Tila groundwaters from Chapai Nawabganj are also distinct from (more enriched than) the composition obtained for one groundwater sample from the Dupi Tila aquifer below Dhaka, which had a $\delta^{18}O$ value of –5.4‰ and $\delta^{2}H$ of –32‰.

There is little consistency in the $\delta^{18}O$ and $\delta^{2}H$ compositions from the shallow and deep aquifers between regions. In Lakshmipur, groundwaters from the deep aquifer are within the range of the shallow groundwater compositions, but towards the enriched end of the range (Figure 7.29). In Faridpur, the few samples available from the deep aquifer have comparatively depleted isotopic compositions. In Chapai Nawabganj as in Lakshmipur, the groundwaters from the Dupi Tila aquifer are among the most enriched of the samples collected from that area. The isotopic distinctions in any given area suggest some segregation of groundwaters from the different aquifers and may indicate different ages of recharge. However, it is not possible to delineate distinct 'groundwater ages' from the different aquifers or aquifer depths based solely on their stable isotopic composition.

It is reasonable to suggest that the deep groundwaters from Lakshmipur represent an older generation of groundwaters than the shallow groundwaters from the same area. However, these groundwaters are isotopically distinct from the deep groundwaters of Faridpur. The Lakshmipur deep groundwaters are from 170–375 m depth, whereas the Faridpur deep groundwaters are from a comparatively shallow range of 140–213 m depth. Groundwaters from the two aquifers are therefore likely to have been recharged at different periods and may not be directly comparable. This is to some extent confirmed by radiocarbon data for groundwaters from piezometers in these areas (Section 7.4.6).

Carbon-13

Results for $\delta^{13}C$ in DIC are summarised in Table 7.5 and plotted as maps in Figure 7.32. Values for $\delta^{13}C$ show a range between –22‰ and 0.6‰ and compositions in each area are variable.

Derivation of DIC in groundwaters by oxidation of organic matter should produce $\delta^{13}C$-depleted (light) compositions, while dissolution of carbonate minerals in the aquifer and mixing with marine waters, would both be expected to produce groundwaters with more enriched DIC compositions. No measurements have been made of $\delta^{13}C$ in carbonate minerals from Bangladesh, but from literature values, the compositions are expected to be close to 0‰.

The large $\delta^{13}C$ variations observed in the Bangladesh groundwaters reflect derivation of the DIC from these multiple sources (soil-zone CO_2, oxidation of organic matter potential oxidation of CH_4, dissolution of carbonate

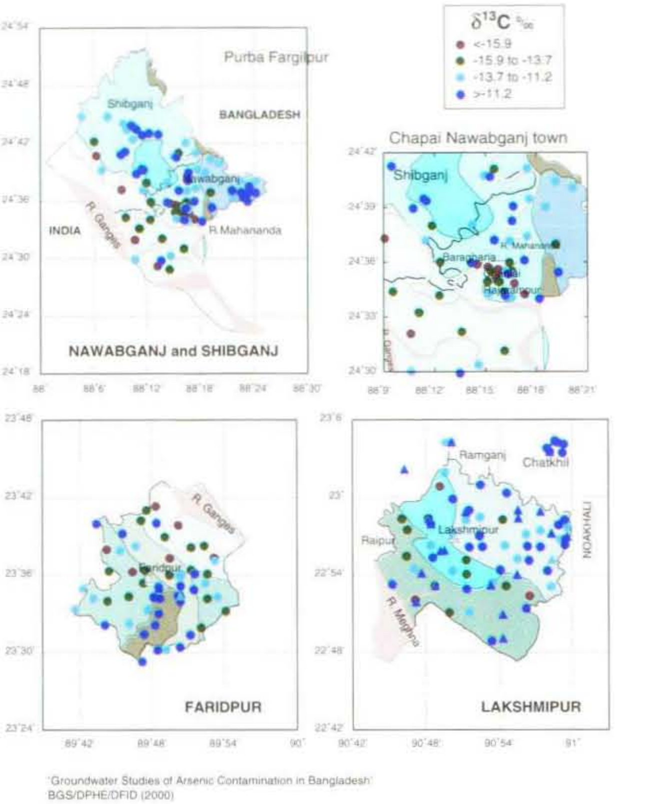


Figure 7.32. Maps of the three Special Study Areas showing the distribution of $\delta^{13}C$. Data given in the Chapai Nawabganj inset map includes analyses collected during a 1997 BGS survey.

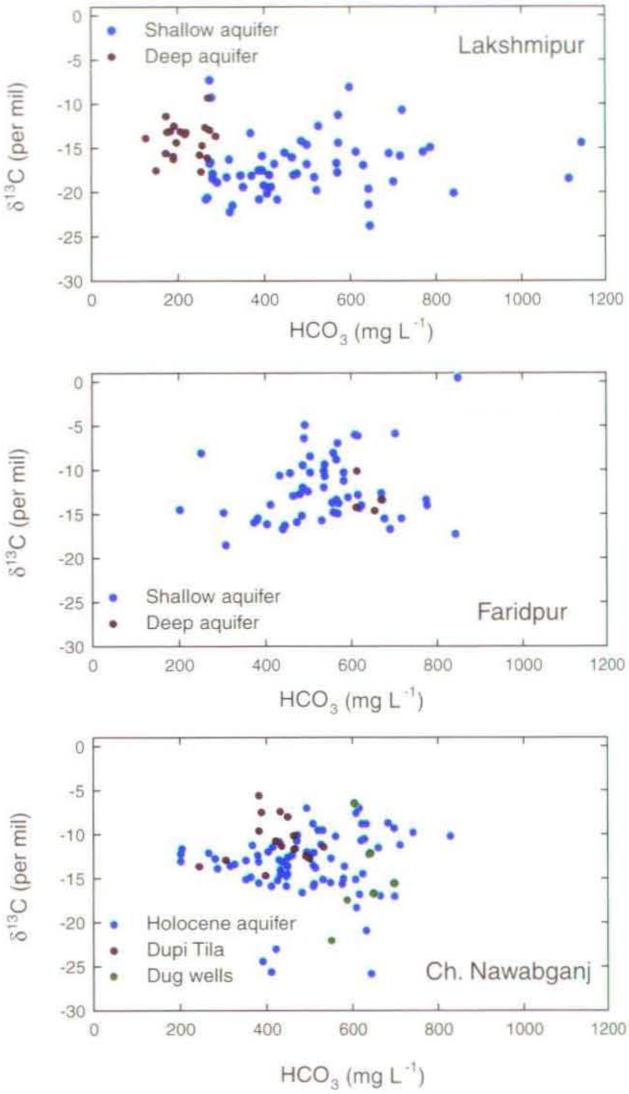


Figure 7.33. Variation of $\delta^{13}C$ with alkalinity (HCO_3) concentration.

minerals, particularly calcite, and in places, mixing with seawater). The depleted isotopic compositions of many of the samples suggest that a proportion of the DIC in some has originated from oxidation of organic matter in the aquifer (and groundwater). However, the enriched compositions of many also suggest that reaction of carbonate minerals has been important. Compositions of groundwaters in Lakshmipur are also expected to reflect inputs of enriched water from saline intrusion.

Variations in $\delta^{13}C$ composition with alkalinity (DIC) are also shown for each of the study areas in Figure 7.33. The fact that correlations between these parameters are poor suggests that many of these ^{13}C-fractionating processes have been active in the aquifers and that the isotopic evolution of the dissolved carbon has been complex.

In Lakshmipur, despite the large range of compositions observed and the overlapping ranges of groundwaters from shallow and deep aquifers, many of the shallow groundwaters appear to be slightly depleted in $\delta^{13}C$ (median –17.4‰) relative to the deeper groundwaters (median –13.5‰; Table 7.5). This may reflect a slightly greater degree of oxidation of recent organic matter in the shallow aquifer. The most striking feature of the distribution in Lakshmipur is the higher HCO_3 concentrations of the shallow groundwaters which are thought to be derived predominantly by oxidation of organic matter, and less by carbonate dissolution.

Carbon-isotopic compositions in the Faridpur groundwaters are slightly less variable than Lakshmipur and no distinction can be found between the shallow and deep groundwaters. Compositions are less depleted than Lakshmipur, although HCO_3 concentrations are of a similar range. Spatial trends to some extent reflect groundwater salinity (Figures 7.8 & 7.32) with more enriched compositions in the high-Na waters in the south. Relatively depleted compositions occur along the Ganges floodplain.

Most groundwaters from Chapai Nawabganj have $\delta^{13}C$ compositions between –5 and –16‰ (Figure 7.33). Compositions along the Ganges floodplain are largely in the range –16 to –13‰ (Figure 7.32), i.e. relatively depleted but not at the extreme end of the compositional range. A few shallow groundwaters from the Holocene alluvial aquifer have very depleted compositions of less than –20‰. These are particularly from the hot spot area of central Chapai Nawabganj. The values are believed to reflect a greater degree of organic-matter oxidation (leading to the generation of highly reducing conditions) in this localised area. This is believed to be an important factor in the release of As to groundwater in the hot spot.

Interestingly, $\delta^{13}C$ compositions of dug-well waters from Chapai Nawabganj (Figure 7.33) are also relatively depleted, with several samples having $\delta^{13}C$ less than −15 ‰. This also indicates that oxidation of organic matter has been important and is supported by the relatively high DIC (HCO_3) concentrations (Section 7.4.22).

Compositions of groundwaters from the Dupi Tila aquifer in Chapai Nawabganj are relatively enriched compared to other samples from the region, in the range −5 to −15‰, with many greater than −10‰ (Figure 7.33). These samples appear to show a greater influence of reaction with carbonate minerals than many of the groundwaters. The $\delta^{13}C$ compositions of the Dupi Tila groundwaters are distinct from that for one sample from the Dupi Tila below Dhaka, which had a measured $\delta^{13}C$ composition of −17.5‰. As observed from the ^{18}O and ^{2}H results, the data suggest that the Dupi Tila groundwaters from the Barind area are distinctive from groundwaters from the Dupi Tila of the Madhupur Tract. The sediments of the Madhupur Tract are believed to be considerably older than those of the Barind Tract.

There is little apparent correlation in the groundwaters between $\delta^{13}C$ of DIC and dissolved methane. Some of the most depleted $\delta^{13}C$ compositions (from Lakshmipur) appear in low-CH_4 groundwaters but the values are variable. Most of the high-methane groundwaters have $\delta^{13}C$ compositions of around −10 ‰ to −14 ‰.

Sulphur-34

Sulphur-34 is a potentially useful diagnostic isotopic tool given that sulphur isotopes are strongly fractionated by redox processes which are an important factor in the groundwater chemistry of Bangladesh. The role of microbes in fractionating $\delta^{34}S$ compositions is known to be particularly important (e.g. Clark and Fritz, 1997). Bacterial sulphate reduction, by preferential removal of the lighter sulphur (^{32}S), leaves residual dissolved sulphate which is significantly enriched in $\delta^{34}S$ relative to the initial composition (by some 5–46‰; Habicht and Canfield, 1997). The degree of fractionation depends on a number of environmental factors, particularly the rate of reduction, and to a lesser extent SO_4 concentration and temperature (Kaplan and Rittenberg, 1964; Habicht and Canfield, 1997; Bottrell and Raiswell, 2000). Reduction of SO_4 is linked to the oxidation of fresh organic matter:

$$2CH_2O + SO_4^{2-} \rightarrow 2HCO_3^- + H_2S$$

The above reaction can proceed by the activity of bacteria such as *Desulfovibrio desulfuricans*, with resultant production of sulphide and alkalinity. In a similar way, oxidation of sulphide minerals can fractionate sulphur-isotopic compositions, leading to a depletion of derived SO_4, although the degree of fractionation is less than with sulphate reduction (Clark and Fritz, 1997). Sulphur-isotopic compositions of sedimentary sulphide minerals are highly variable, but typically depleted with often negative $\delta^{34}S$ values. Evidence of sulphide oxidation would be expected to produce groundwaters with high sulphate and depleted $\delta^{34}S$ compositions, while sulphate reduction should result in low SO_4, enriched $\delta^{34}S$ compositions and increased HCO_3 concentrations.

A small subset of groundwater samples was analysed for $\delta^{34}S$ from the Special Study Areas. The most notable observation was that most of the groundwaters sampled contained insufficient dissolved SO_4 to make an isotopic measurement without collection of very large sample volumes. Analyses were therefore biased towards samples with detectable SO_4 (strictly, dissolved sulphur quoted as SO_4) concentrations. The range of compositions found is plotted against SO_4 in Figure 7.34. Only three samples were analysed from Lakshmipur, two from the shallow aquifer and one from the deep aquifer. The deep sample had the lowest SO_4 concentration and the most enriched $\delta^{34}S$ composition (39.5‰). This enriched composition suggests that the dissolved SO_4 measured is likely to be residual after sulphate reduction. The isotopic value, along with low SO_4 concentrations of the deep groundwaters in general, suggest that sulphate reduction has been an active process in the deep aquifer at Lakshmipur.

Sulphate reduction is also concluded to have been important from the observed low SO_4 concentrations in shallow groundwaters from Lakshmipur. Where higher SO_4 concentrations exist (say >200 mg L^{-1}), evidence from two samples suggests that the SO_4 has been derived predominantly from seawater during past saline intrusion as the samples have $\delta^{34}S$ compositions close to the value for modern seawater (21‰; Figure 7.34). The limited data therefore suggest that the high SO_4 concentrations in the shallow groundwaters are not derived from oxidation of pyrite within the aquifer.

One sample of shallow groundwater from Faridpur had a composition of −0.9‰ and shallow alluvial groundwaters from Chapai Nawabganj showed a large range in $\delta^{34}S$ from −0.1 to 24.5‰. One sample from the Dupi Tila aquifer at Chapai Nawabganj had a composition of 6.6‰. The large range of isotopic compositions for these groundwaters do not determine unequivocally the origin of the SO_4 but some of the most enriched compositions point towards sulphate reduction as an important factor.

Limited $\delta^{34}S$ data for dissolved SO_4 in reducing groundwaters from West Bengal showed similar characteristics, with low-SO_4 waters having enriched compositions (up to 9.5‰) relative to groundwaters with higher SO_4 concentrations (CGWB, 1999). In more saline groundwater from southern West Bengal, $\delta^{34}S$ compositions have

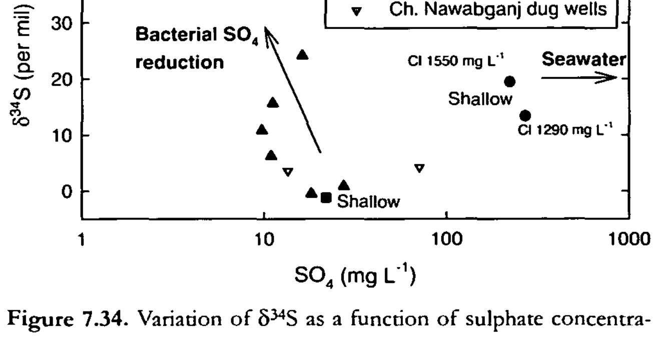


Figure 7.34. Variation of $\delta^{34}S$ as a function of sulphate concentration.

Table 7.9. Summary of chemical compositions of groundwaters from the piezometers at Chapai Nawabganj, Faridpur and Lakshmipur, December 1999

Sample	Piezo-meter	Well depth	Water level	Temp	pH	Eh	DO	Ca	Mg	Na	K	HCO_3	Cl	SO_4	As_T	Fe	Mn	P
		m	m	°C		mV	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}	µg L^{-1}	mg L^{-1}	mg L^{-1}	mg L^{-1}
Chapai Nawabganj																		
991506	CPW1	10	2.77	26.4	6.92	100		149	40.8	49.1	7.24	675	36.8	11.7	16.9	8.16	1.15	0.53
991507	CPW2	20	3.05	27.0	7.01	31		139	32.3	30.2	6.13	573	51.8	2.53	398	14.7	1.02	0.15
991508	CPW3	30	3.05	27.3	7.06	108	0.1	158	35.5	23.1	5.18	631	41.5	0.05	329	2.44	1.86	0.12
991509	CPW4	40	3.03	27.7	7.04	29	<0.1	140	32.2	36.4	4.91	583	35.0	<0.07	361	6.32	0.94	0.93
Faridpur																		
991521	FPW2	20	3.85	26.4	7.16	18.7	<0.2	118	32.0	21.1	4.72	578	3.0	0.06	291	5.80	1.09	1.93
991522	FPW3	30	4.00	26.6	7.15	34	<0.3	88.4	24.9	29.7	3.65	444	3.1	1.10	231	3.84	0.367	1.91
991523	FPW4	40	3.88	26.5	7.32	40	<0.4	56.4	18.8	24.4	3.30	312	3.2	0.09	212	2.08	0.249	2.66
991524	FPW5	50	3.81	26.8	7.13	35	<0.5	55.2	22.1	24.1	4.97	339	3.8	6.88	173	3.22	0.165	2.00
991525	FPW6	150	3.91	26.7	6.96	155	<0.6	112	39.5	212	3.96	551	298	0.04	2.44	0.45	0.75	0.18
991526	FPW6	150	3.91	26.7	7.00	152	<0.7	111	38.3	204	3.92	551	294	4.83	2.73	0.15	0.77	0.16
Lakshmipur																		
991533	LPW1	10		26.5	7.44	4	<0.8	31.3	34.3	280	10.9	472	311	0.27	137	2.41	0.414	1.21
991534	LPW2	20		26.6	7.14	-10	<0.9	181	141	721	28.1	646	290	0.80	508	20.0	0.509	1.84
991535	LPW3	30		26.7	7.11	21	<0.1	189	108	932	20.2	663	1410	1.94	651	16.1	0.305	2.03
991536	LPW4	40		26.6	7.10	2	<0.1	184	119	1013	22.0	597	1930	3.47	555	16.6	0.414	2.21
991537	LPW6	150		27.3	6.82	95	<0.1	408	439		71.0	226	7200	430	<0.5	7.53	0.95	0.16

also been found with seawater signatures (around 20‰; CGWB, 1999).

Two groundwater samples from dug wells in Chapai Nawabganj have $\delta^{34}S$ compositions of 3.9 and 4.6‰ (Figure 7.34). It is not possible from the data to determine whether the SO_4 in these samples has been derived by in-situ oxidation of sulphide minerals by aeration in the shallowest parts of the aquifer, or whether the compositions result from pollution inputs at the surface. Isotopic compositions of pyrite and pollutants (sewage, fertilisers) have a large but often overlapping range and do not allow a distinction between these possibilities to be made without further isotopic study of the potential sources. Nonetheless, as described earlier, other chemical data from these samples suggest that these shallow groundwaters are polluted (high Cl and NO_3-N concentrations in particular) and this may be a significant source of the derived SO_4.

7.4.6 Variations in chemical composition with depth: piezometer investigations

Chemical variations

The piezometers give potentially important information about geochemical processes over distinct depth ranges since they are within a very small area in each *upazila* and have been completed with careful sealing to ensure lack of vertical mixing via the piezometer conduits. Important chemical components of groundwaters from the piezometers in the three study areas are summarised in Table 7.9 and profiles for selected constituents are shown for each area in Figures 7.35–7.37.

In the Chapai Nawabganj piezometers (Figure 7.35), groundwater levels at the time of sampling were around 3 m below surface. Observed variations in water quality with depth are relatively small as expected over a depth interval of just 30 m. Temperatures increase slightly with depth (26.4°C at 10 m to 27.7°C at 40 m). Salinity is relatively high with SEC values in the samples mostly >1000 µS cm^{-1} although values decrease slightly with depth, perhaps as a result of decreasing influence of evaporation or pollution. Conditions are highly reducing, as evidenced by Eh values in the range 29–108 mV and absence of detectable dissolved oxygen. Alkalinity values are high at typically around 600 mg L^{-1} (HCO_3). Iron and Mn concentrations are relatively high throughout the piezometer profile (2–15 mg L^{-1} and 1.0–1.9 mg L^{-1} respectively) as a result of the reducing conditions. Dissolved P concentrations are variable but also moderately high (up to 1 mg L^{-1}). Arsenic concentrations are low in the topmost piezometer at 10 m depth but relatively uniform with depth at 20 m, 30 m and 40 m, with concentrations of around 400 µg L^{-1} (Figure 7.35). The As profile shows an inverse relationship with SO_4. Sulphate is greater in the 10 m piezometer, either as a result of oxidation of sulphide minerals in the shallowest part of the aquifer, or due to other factors such as evaporation or pollution. Lack of significant increase in Cl in the shallowest piezometer relative to values at 20–40 m at the time of sampling suggests that sulphide oxidation may be a more likely cause. If so, loss of As from solution (by adsorption) appears to have accompanied the oxidation process.

In the Faridpur piezometers, groundwater levels at the time of sampling were around 3.8 m below surface. Groundwaters in the depth range 20–50 m are of lower salinity than at Chapai Nawabganj, with SEC values of less than 700 µS cm^{-1}. As with Chapai Nawabganj, Eh values are very low in the shallowest piezometers (40 mV or less) and dissolved oxygen was not detectable. Alkalinity values are high, though generally lower than in Chapai Nawabganj. Groundwater from the deeper piezometer at 150 m depth in Faridpur has a distinctive chemistry from the

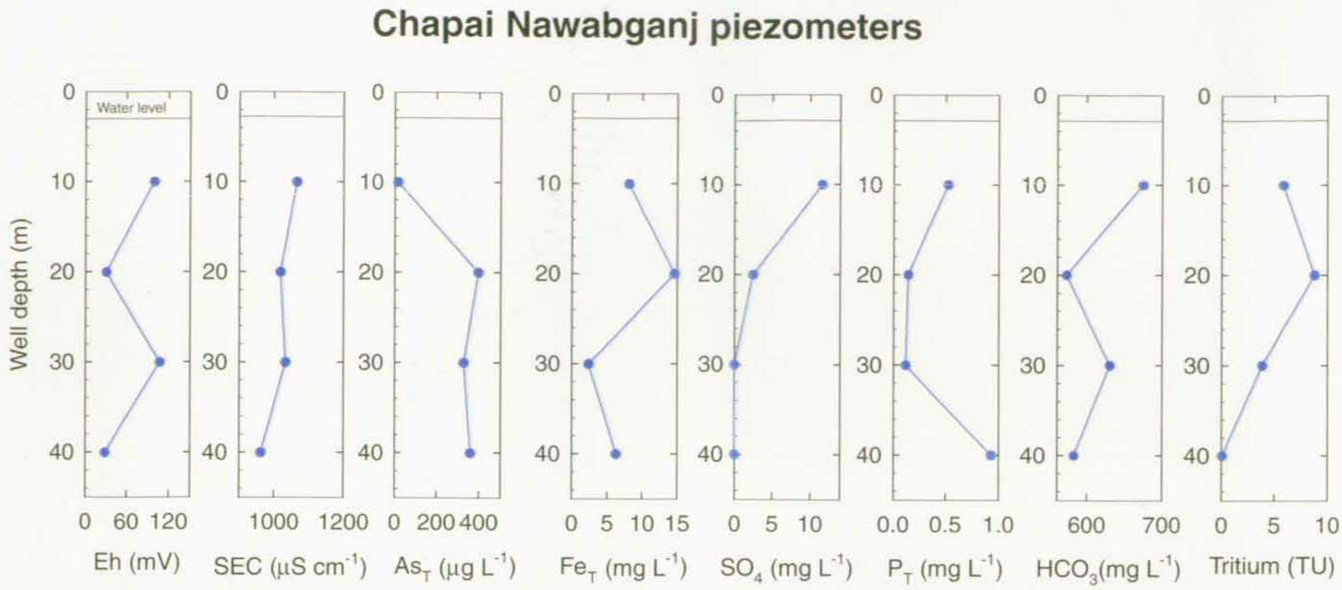


Figure 7.35. Chemical variation with depth in groundwater from piezometers, Chapai Nawabganj sampled on 1/12/99.

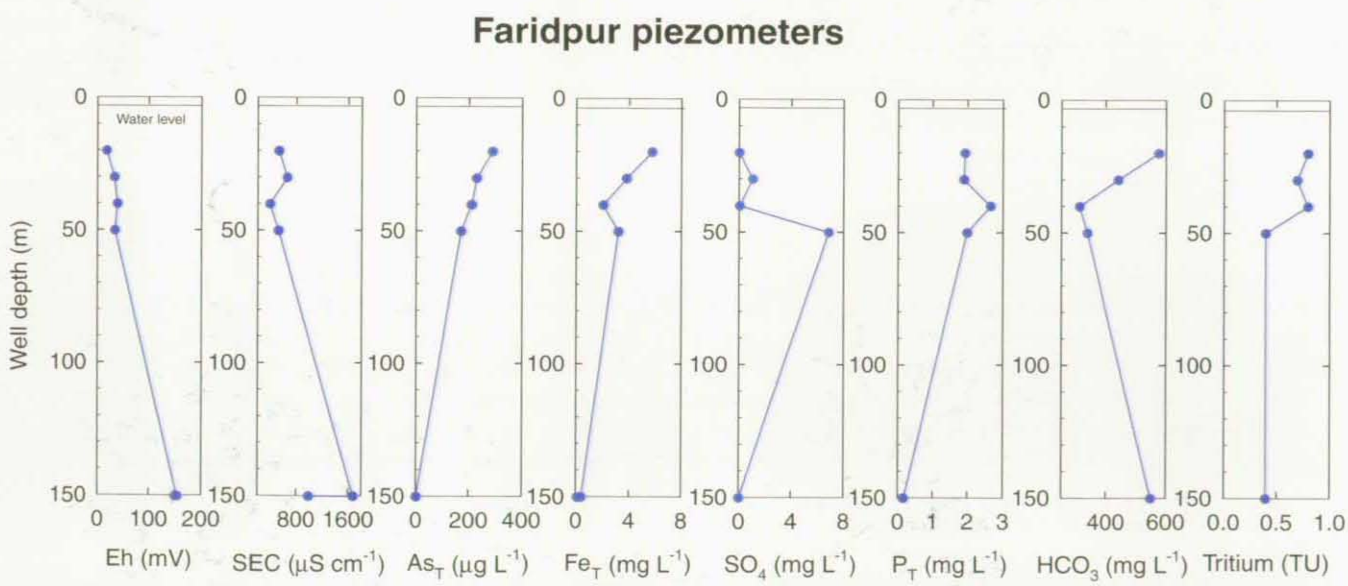


Figure 7.36. Chemical variation with depth in groundwater from piezometers, Faridpur sampled on 9/12/99.

shallower groundwaters. SEC values are higher (around 1682 μS cm^{-1} and 995 μS cm^{-1} measured on two separate days), and reflected by higher concentrations of Na, Cl, Mg, B and Sr. Groundwater pH is slightly lower (average 7.0 in the deep samples compared to 7.1–7.3 at 20–50 m depth) and Eh is notably higher than the shallower groundwaters (155 mV; Figure 7.36; Table 7.9). Arsenic concentrations are high at <50 m depth (around 200 μg L^{-1}) but <3 μg L^{-1} at 150 m. Concentrations of Fe and P are also notably higher at shallow depths (Figure 7.36). Sulphate concentrations are low (<7 mg L^{-1}) in all samples, the highest observed value being at 50 m depth. Presence of very low SO_4 concentrations in the shallowest groundwaters indicates that sulphide oxidation is not a major influence in the vicinity of the piezometers and is not a cause of the high As concentrations.

In the Lakshmipur piezometers, water levels were relatively shallow, 1.5 m below ground level at the time of sampling. Groundwaters here are also highly reducing with low Eh (21 mV or less) and no detectable dissolved oxygen. Alkalinity is similarly high. Higher salinity is a notable feature of these groundwaters compared to the other areas. SEC values for the shallower depths (10–50 m) are in the range 1240–4400 μS cm^{-1}. Groundwater from the deeper piezometer at 150 m depth is notably different. SEC is much higher at 19800 μS cm^{-1}, and major elements are correspondingly high (e.g. Cl 7200 mg L^{-1}).

Redox potential is appreciably higher (95 mV;

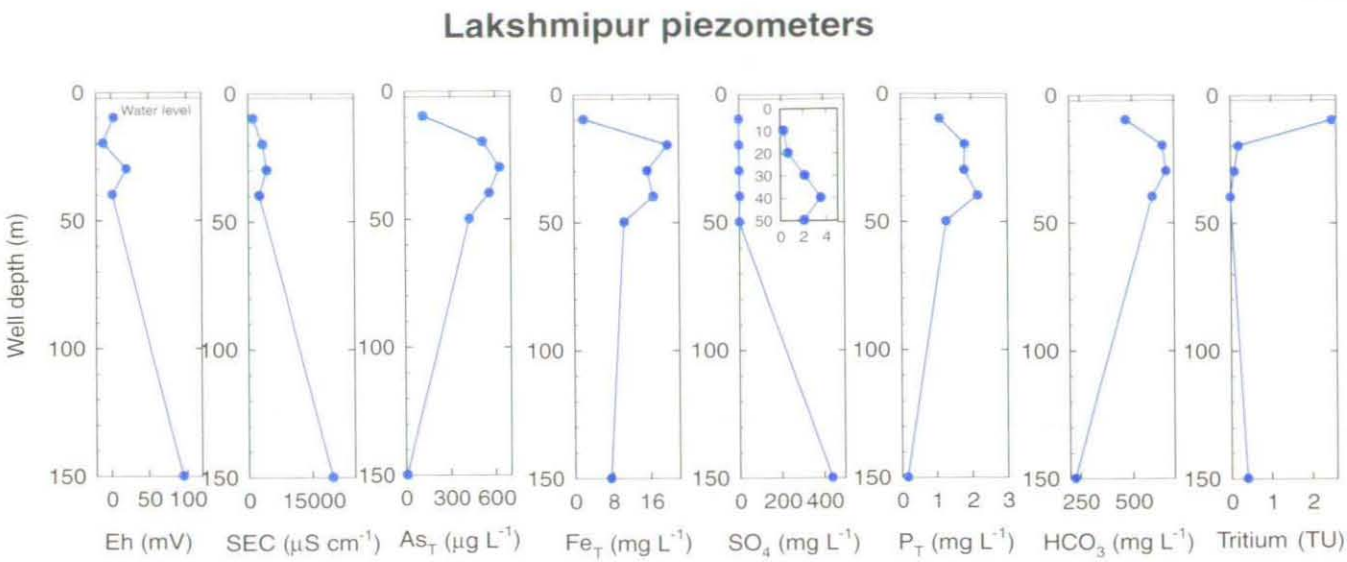


Figure 7.37. Chemical variation with depth in groundwater from piezometers, Lakshmipur sampled on 20/11/99.

Figure 7.37) in the deep piezometer, though is still indicative of reducing conditions. Alkalinity is also much lower with an HCO_3 concentration of just 226 mg L^{-1} (Table 7.9). Sulphate concentrations are low (<3.5 mg L^{-1}) in the shallow aquifer and particularly low at 10–20 m depth (<1 mg L^{-1}; Figure 7.37). As with Faridpur, this indicates that sulphide oxidation has not been important in the shallow parts of the saturated zone. Arsenic and Fe concentrations are relatively low in the topmost (10 m) piezometer, high in the 20–50 m piezometers, and low in the 150 m piezometer (<0.5 μg L^{-1} and 7.5 mg L^{-1} respectively; Figure 7.37). The low concentrations at 10 m are not thought to be due to significant oxidation because redox potentials are still low and SO_4 concentrations very low (Figure 7.37). The low values may be due to more active flushing of the shallowest depths by recent recharge than has occurred at greater (20–50 m) depths.

Concentrations of P are relatively high in the shallow groundwaters, being highest in the 20–40 m piezometers. The bell-shaped profile for P (Figure 7.37) is somewhat similar to that for As and suggests strongly that P is not derived from agricultural pollutants as this would be expected to give the greatest concentrations at the shallowest depths.

An adjacent deep well LHTW7 (286 m depth, screen at 275 m) at Lakshmipur, some 30 m from the piezometer cluster, gives high-quality water with low salinity and a low As concentration. The fact that the deeper piezometers in both Faridpur and Lakshmipur display distinctive chemistry from shallower samples is significant as it suggests that there has been little mixing of groundwaters between the two depth ranges.

For Lakshmipur, this is consistent with the evidence from the survey of the groundwaters in the *upazila*. However, for Faridpur, although groundwater chemistries were also distinctive, the survey showed the potential for a degree of mixing between the shallow and deeper groundwaters. This may be either due to paucity of intervening aquicludes or to multi-level screening of some tubewells in both aquifers. The piezometers are not heavily pumped and so no major drawdown is expected locally. They are also well sealed at the prescribed depths. These factors may explain why there are discrepancies in groundwater As concentrations from the deep piezometer and the tubewells.

The redox variations also indicate that (at least in the vicinity of the piezometers) conditions are more reducing in the shallow aquifers than in the deeper aquifers. This may be a reflection of the amounts of fresh organic matter in the more recent sediments. The high alkalinity values in the shallow groundwaters are also an indication that the oxidation of organic matter may have been an important process. The solid organic carbon concentration in the deeper aquifer may be lower or it may have had longer reaction times with flowing groundwater to have allowed preferential removal of the most labile organic detritus.

Tritium

Results of the tritium analysis of the piezometer groundwaters and of samples collected in the vicinity of the piezometers are given in Table 7.10. The results indicate that groundwaters from Chapai Nawabganj have higher tritium concentrations than those from Faridpur and Lakshmipur areas. The tritiated waters with relatively high values of typically 2.5–8.8 TU around Chapai Nawabganj indicate that a significant proportion of the water is post-1960s in origin. The groundwater from the deepest piezometer (40 m) has a lower value of 0.1 ± 0.2 TU and suggests that less, modern tritiated water has infiltrated to a great depth in the Holocene alluvial aquifer and hence the average residence time of groundwater at this depth is likely to have been longer.

In Faridpur, tritium concentrations are mostly low at all depths (maximum 0.8 TU) and suggest that groundwaters are dominated by pre-1960s recharge. Only three of the samples collected from Faridpur have tritium greater than 1 TU (Table 7.10).

Table 7.10. Results of tritium analysis from piezometers and other nearby wells in the three study areas

Sample	Location	Latitude	Longitude	Well depth	Arsenic	Tritium
		°N	°E	m	µg L^{-1}	TU
Chapai Nawabganj						
CNP1	Chanlai Primary School	24.5887	88.2554	10	16.9	5.9±0.3
CNP2	Chanlai Primary School	24.5887	88.2554	20	398	8.8±0.4
CNP3	Chanlai Primary School	24.5887	88.2554	30	329	3.9±0.3
CNP4	Chanlai Primary School	24.5887	88.2554	40	361	0.1±0.2
CHTW1	Chanlai Primary School	24.5887	88.2554	33.5		2.5±0.3
CHTW2	Chanlai	24.5908	88.2592	19.5		4.9±0.3
CHTW3	Chanlai	24.5930	88.2568	15.2		7.2±0.4
CHTW4	Chanlai	24.5874	88.2528	30		0.8±0.2
CHTW5	Chanlai	24.5904	88.2587	33.5		6.7±0.4
CHTW6	Chanlai	24.5878	88.2535	21.3		9.6±0.5
CHTW7	Chanlai	24.5906	88.2592	27.4		4.9±0.3
CHDW1	Chanlai	24.5918	88.2409	8.0		7.2±0.4
CHDW2	Chanlai	24.5905	88.2578	9.1		8.9±0.4
CHDW3	Chanlai	24.5865	88.2541	8.0		5.8±0.3
Faridpur						
FPW2	Aliabad Union Parishad	23.5870	89.0738	20	291	0.3±0.2
FPW3	Aliabad Union Parishad	23.5870	89.0738	30	231	0.8±0.2
FPW4	Aliabad Union Parishad	23.5870	89.0738	40	212	0.7±0.2
FPW5	Aliabad Union Parishad	23.5870	89.0738	50	173	0.8±0.2
FPW6	Aliabad Union Parishad	23.5870	89.0738	150	2.58	0.4±0.2
FHTW1	Aliabad Union Parishad	23.5876	89.8610	40.8		0.4±0.2
FHTW2	Md. Alef Mondal	23.5866	89.8623	24.4		0.4±0.2
FHTW3	Md. Haider Chukder	23.5871	89.8623	45.7		0.7±0.2
FHTW4	Aliabad Union Health Centre	23.5876	89.8612	24.4		1.7±0.2
FHTW5	Md. Lokman Mollah	23.5869	89.8590	17.1		7.3±0.4
FHTW6	Md. Sekander Ali Pattader	23.5881	89.8601	26		1.1±0.2
Lakshmipur						
LPW1	DPHE Compound	22.9412	90.8433	10	137	2.5±0.2
LPW2	DPHE Compound	22.9412	90.8433	20	508	0.2±0.2
LPW3	DPHE Compound	22.9412	90.8433	30	651	0.1±0.2
LPW4	DPHE Compound	22.9412	90.8433	40	555	0.0±0.2
LPW6	DPHE Compound	22.9412	90.8433	150	<0.5	0.4±0.2
LHTW7	DPHE deep HTW	22.9412	90.8436	275 (286)	1.7	0.6±0.2

In Lakshmipur, tritium is high in the shallowest piezometer sample (2.5 ± 0.2 TU, 10 m) but is much lower at greater depth, indicating a degree of flushing with modern water at the shallowest depth, but much slower flow at deeper levels. The deep groundwaters (150 m and 275 m) also have low tritium concentrations of 0.4 and 0.6 TU, respectively. Aggarwal et al. (2000) also sampled our 150 m piezometer and obtained an identical tritium value of 0.4 TU. The low tritium values in the deep Lakshmipur samples indicate the presence of predominantly older (pre-1960s) water at depth.

The finding of very low tritium concentrations (<1 TU) at depth (e.g. 40 m) at the three sites, which are geographically diverse, while at the same time finding high concentrations of arsenic (>200 µg L^{-1}) at these depths is a strong indication that the arsenic release predates the 1960's. Indeed, it seems probable that the initial release occurred shortly after sediment burial several thousand years ago. Therefore, the tritium data is consistent with the other geochemical data presented here and provides support for the idea that the arsenic release is *not* related to recent changes in the management of water resources such as increased use of groundwater for irrigation or the building of the Farakka barrage on the Ganges.

Stable isotopes

Data for $\delta^{18}O$ and $\delta^{2}H$ in piezometers and a few other tubewells nearby are given in Table 7.11. Variations in the $\delta^{18}O$ and $\delta^{2}H$ compositions of the piezometer waters broadly follow the trends observed from the regional isotopic surveys of the three study areas. Piezometer waters from Chapai Nawabganj (10 m and 40 m) are within, but on the depleted side, of the range observed for shallow Holocene groundwaters elsewhere in the *upazila*.

Piezometer waters from Faridpur show distinctive isotopic signatures in shallow and deep groundwaters, with a relatively depleted composition at 150 m depth.

As with the regional survey samples, groundwaters from the Lakshmipur piezometers have the greatest range of $\delta^{18}O$ and $\delta^{2}H$ compositions and values are distinctly more enriched in the deep groundwaters than those at shallow depths (Figure 7.29). The stable-isotopic data support other chemical evidence that the two aquifers are dis-

Table 7.11. Radiocarbon and stable-isotope data for groundwater samples from the piezometers and from neighbouring tubewells

Lab number	Piezometer/ well	Depth (m)	$\delta^{18}O$ (‰)	$\delta^{2}H$ (‰)	$\delta^{13}C$ (‰)	^{14}C enrichment (pmc)
Chapai Nawabganj						
AA37721	CNP1	10	–6.7	–35	–17.0	105.38
AA37722	CNP4	40	–6.8	–33	–12.9	82.96
Faridpur						
AA37723	FPW2	20	–6.0	–32	–5.8	91.11
AA37724	FPW3	30	–6.7	–33	–5.1	87.60
AA37725	FPW4	40	–4.7	–35	–4.6	78.37
AA37726	FPW5	50	–4.2	–27	–6.3	88.44
AA37727	FPW6	150	–6.7	–42	–16.6	51.28
Lakshmipur						
AA37728	LPW1	10	–2.8	–22	–20.0	94.81
AA37729	LPW2	20	–8.1	–54	–11.8	77.42
AA37730	LPW3	30	–7.1	–49	–5.9	67.52
AA37731	LPW4	40	–6.7	–51	–5.7	65.04
AA37732	LPW5	50			–5.3	66.98
AA37733	LPW6	150	–3.6	–23	–25.6	28.42
AA37734	LHTW7	275	–2.5	–9	–8.4	25.36
AA37735	M122	259	–2.1	–9	–10.0	19.13
AA37736	M123	9.1			–20.2	95.06
AA37737	M173	366	–2.3	–10	–11.9	18.97
AA37738	M511	259			–9.7	18.03

tinct and not likely to be hydraulically connected.

Aggarwal et al. (2000) duplicated the stable isotope analysis of our shallow piezometers from Lakshmipur and Faridpur and apparently found similar compositions to those reported here. However, the raw data were not given in their report.

Carbon-14

Results of radiocarbon analysis of groundwaters from the piezometers also given in Table 7.11. Groundwaters from 10 m and 40 m depth in Chapai Nawabganj have high ^{14}C activities (high pmc values) indicative of modern recharge. As noted above, the shallow 10 m piezometer also has a detectable tritium concentration which indicates the presence of modern (post-1960s) groundwater. Groundwater from 40 m depth is also modern from the radiocarbon evidence, although its low tritium concentration suggests the presence of a higher proportion of pre-1960s water.

Groundwaters from Faridpur shallow piezometers have high ^{14}C activities (78–91 pmc) and also indicate that they are modern, although from tritium evidence they are dominantly pre-1960s. The deeper groundwater from 150 m is however distinctive, with a lower ^{14}C activity of 51 pmc which is indicative of significantly older groundwater. Dating of the groundwaters is complicated by the numerous processes involving carbon exchange in the system (carbonate reactions, organic matter oxidation, sulphate reduction, methane oxidation and seawater inputs). However, the 150 m groundwater from the Faridpur piezometer gives an apparent model age of the order of 2,000 years, i.e. appreciably younger than the sediments.

Samples from the Lakshmipur piezometers have the greatest range of radiocarbon values. Groundwater at 10 m depth is modern recharge (95 pmc) as supported by the presence of tritium (2.5 TU). Groundwaters from 20–50 m are also apparently largely modern (although tritium-free and hence pre-1960s). These have ^{14}C activities of 65–77 pmc (Table 7.11). In contrast, deep groundwaters from Lakshmipur are notably older. The 150 m piezometer has a ^{14}C enrichment of 28 pmc, and that from the nearby 275 m tubewell, LHTW7, has a value of 25 pmc. Model ages for these are broadly in the range 2,000–12,000 years. For comparison, deep groundwaters from nearby Mandari also have low ^{14}C activities of around 18 pmc (Table 7.11). These give model ages of the order of 2,000–6,000 years. The results indicate that deep groundwaters from Lakshmipur are the oldest observed from the three areas. Even these however, contain some radiogenic carbon. The groundwaters from Lakshmipur show similar characteristics to deep groundwaters from southern West Bengal (South 24 Parganas) which have ^{14}C activities of around 20–22 pmc and apparent model ages in the range 5,000–13,000 years (CGWB, 1999).

The radiocarbon data indicate that deep groundwater from Faridpur (150 m) is older than the shallow groundwaters in the same area, but nonetheless distinct from the deep aquifer of Lakshmipur. This is also suggested by the distinct differences in $\delta^{18}O$ and $\delta^{2}H$ compositions. Several generations of groundwater therefore appear to be present in the Bangladesh aquifers reflecting the different flow paths and rates of flushing of the aquifers.

7.4.7 Groundwater potability and health

The large range of chemical data summarised in Tables 7.2–7.5 gives an indication of the other constituents present in the Bangladesh groundwaters which may potentially be of health concern. The data indicate that As is overwhelmingly the most important inorganic constituent detrimental to health, although consistently high concentrations of a few other determinands are worthy of note and high concentrations of a few other trace elements occur in some groundwaters, albeit sporadically. Only inorganic constituents have been investigated and so this account makes no reference to organic constituents, particularly pathogenic organisms, which may be present. It is expected that highest concentrations of these (e.g. *E. coli*) would be found in groundwaters from shallow hand-dug wells which have open access from the surface, and this should be borne in mind when considering the inorganic-chemistry data for dug-well sources.

Salinity. One of the chief criteria determining potability of Bangladesh groundwaters is salinity, which is very variable and controlled mainly by past and present seawater intrusions to the aquifers. The highest concentrations of Na are found in groundwaters from the southern coastal fringes and in low-lying areas which have been previously been inundated by seawater (e.g. Sunamganj). In the three Special Study Areas, the greatest range and highest observed salinities are found in shallow groundwaters from Lakshmipur (SEC range 97–4640 µS cm^{-1}). In practice, most groundwaters are rendered non-potable due to taste and acceptance problems before salinity becomes a health concern.

Hardness. Hard groundwaters (high Ca, Mg) are common features of parts of Bangladesh, especially in the south and eastern parts of the country and along the northern side of the River Ganges. Hardness does not pose a health threat and indeed, it may be a useful mitigating factor in protecting against cardiovascular disease. There are therefore no water-quality guidelines in place for hardness. Although there have been suggestions that hard waters have high As concentrations, this is not borne out by comparison of maps of hardness and As concentrations. Therefore, although many of the groundwaters are hard, they are not considered a health risk.

Arsenic. The enormous range of As concentrations in the groundwaters (<3–2300 µg L^{-1}) and large spatial variability indicate that broadscale random sampling of groundwaters cannot be used to test for the potability of groundwaters with respect to As but that As surveys need to be carried out to establish the suitability of individual wells for potable use. Of the measured determinands in the Bangladesh groundwaters, As has the most serious health consequences both in terms of the frequency of exceedances and the scale of those exceedances. Samples investigated from the three study areas indicate that arsenic speciation is also variable, with As(III) ranging from <10% to >90% of the total As present (averaging around 60%). It is often stated that As(III) is the most toxic of the arsenic species found in drinking water. However, it is likely that As reduction occurs rapidly *in vivo* and so the significance of the initial As speciation for human health is not clear. Evidently, As present in drinking water in any form is undesirable.

Iron. High Fe concentrations are typical of many of the groundwaters and reach up to 25 mg L^{-1} in some sources. Iron is an essential element for human health and is not detrimental in drinking water. Hence, there is no WHO health-based water-quality guideline for the element. Nonetheless, high Fe concentrations may lead to acceptability problems and may therefore be detrimental indirectly if groundwaters are abandoned in favour of other sources which have lower Fe concentrations but may be bacterially or otherwise unsafe. The WHO recommended limit for Fe in drinking water on acceptability grounds is 0.3 mg L^{-1}, but in practice a limit of 5 or even 10 mg L^{-1} is often used in Bangladesh. Quite a few of the groundwaters even exceed these values, some significantly.

Manganese. Like Fe, Mn concentrations are also high in the groundwaters as a result of the strongly reducing conditions. Manganese is an essential element for human health but can be detrimental at high concentrations. Few studies have been made of the health effects from drinking water, although occupational exposure to Mn is known to produce neurotoxic effects. The WHO health-based guideline value for Mn in drinking water is 0.5 mg L^{-1}. Concentrations in the three study areas often exceed this value and sometimes significantly so. Concentrations up to 4.4 mg L^{-1} have been found. The highest concentrations occur in groundwaters from the Holocene alluvial aquifers. Median concentrations for Mn exceed 0.5 mg L^{-1} in groundwaters from shallow tubewells in both Chapai Nawabganj and Lakshmipur and are just below (0.48 mg L^{-1}) in Faridpur. Concentration ranges are generally lower in the deeper aquifers and in the Dupi Tila aquifer from Chapai Nawabganj. These data compare with those from the National Survey which showed that of 3204 shallow groundwater samples, 39% exceeded the WHO guideline value, the maximum concentration being 10 mg L^{-1}. As with the Special Study Areas, highest concentrations were also observed in the shallow aquifer. Manganese can therefore be a significant extra problem in the groundwaters, both on acceptability and potential health grounds.

Nitrate. The WHO guideline value for nitrate in drinking water is 11.3 mg L^{-1} as NO_3-N. Almost all samples are well below this because of the reducing conditions. From the investigations of the Special Study Areas, only four samples had concentrations exceeding this value, the highest being 68 mg L^{-1}. All of these exceedances are thought to be due to localised pollution (latrines etc) as they are accompanied by high concentrations of SO_4, Cl, Br and often NO_2-N and relatively high SEC values.

Nitrite. Like nitrate, concentrations of nitrite are also mostly low, and usually less than the WHO guideline value of 0.91 mg L^{-1} as NO_2-N. From the three study areas, only 4% of samples investigated had concentrations in excess of the guideline value. These are mainly but not always in samples which are thought to be polluted.

Ammonium. Ammonium has no known health consequences and there is no WHO health-based guideline value for ammonium in drinking water. However, on acceptability grounds, the WHO recommended upper limit is 1.24 mg L^{-1} as NH_4-N. High concentrations occur naturally in reducing aquifers and locally as a result of direct pollution from domestic or agricultural sources. In the reducing conditions of the Bangladesh aquifers, many of the observed NH_4-N concentrations are significantly higher than 1.24 mg L^{-1}. Concentrations are particularly high in the shallow groundwaters from Lakshmipur (up to 17.8 mg L^{-1}, median 1.84 mg L^{-1}; Table 7.2) and Faridpur (up to 17.6 mg L^{-1}, median 1.02 mg L^{-1}). Concentrations are lower in groundwaters from the Dupi Tila aquifer of Chapai Nawabganj (maximum value 0.3 mg L^{-1}; Table 7.2).

Phosphorus. There is also no WHO health-based guideline for phosphorus in drinking water, although the EC maximum admissible concentration is 5 mg L^{-1} as P. Groundwaters from Bangladesh have some very high P concentrations in places. Highest values highlighted from the three study areas are in groundwaters from the shallow aquifers of Lakshmipur and Faridpur (up to 3.4 mg L^{-1} and 5.0 mg L^{-1} respectively; Table 7.3). Quite high concentrations are also found in some of the deeper groundwaters. Exceptions are found in the Dupi Tila aquifer of Chapai Nawabganj where concentrations were found to be uniformly low (up to only 0.2 mg L^{-1}). Concentrations in the dug wells from Chapai Nawabganj are also low (up to 0.3 mg L^{-1}; Table 7.3).

Fluoride. Fluoride has well-known health consequences as chronic exposure from drinking water can give rise to dental fluorosis, or in the worst cases, skeletal fluorosis. The WHO guideline value for F in drinking water is 1.5 mg L^{-1}. None of the samples investigated from the three study areas exceeds this value. The highest value obtained was 1.28 mg L^{-1} (Chapai Nawabganj groundwater from the Holocene alluvium). Fluoride concentrations are maintained at relatively low levels (despite its probable abundance in mineral phases such as biotite in the sediments) by the abundance of dissolved Ca, as equilibrium with fluorite (CaF_2) will limit F solubility. In fact, many of the groundwaters have low concentrations of F, median values from the different aquifers often being less than 0.2 mg L^{-1}. Similar observations were made for groundwaters from the BWDB monitoring network. Out of 113 BWDB samples, the maximum observed was only 0.73 mg L^{-1} and the median was 0.21 mg L^{-1} (Chapter 6). In this case, a low F intake is more of a concern than F excess and is likely to result in development of dental caries if other sources of dietary fluoride are not taken.

Iodide. Iodine is an essential element for health. Chronic dietary deficiency can lead to a number of iodine-deficiency disorders (IDDs), the most common of which is goitre. Although food is generally the most important source of I in the diet, regions where local drinking water has low I concentrations can be an indication that IDDs may be prevalent because concentrations in local waters usually reflect concentrations in soils, rocks and locally-grown food crops. No health-based guidelines exist for I in drinking water, but regions where drinking-water has generally less than around 3–5 μg L^{-1} are often found to have IDD prevalence. In tubewell waters from the three study areas, I concentrations are usually higher than 5 μg L^{-1} and median values were higher than this in the tubewell waters from all three areas, although minimum values were lower in some of the aquifers. Highest concentrations are found in the more saline waters of Lakshmipur as a result of marine influences (saline intrusion and possibly marine aerosols). Iodine concentrations are low in many of the waters from the dug wells in the Chapai Nawabganj area (median 1.1 μg L^{-1}; Table 7.3). In comparison, groundwaters from the BWDB monitoring network had a median I concentration of 13 μg L^{-1}. Of these groundwaters, 33% were below 5 μg L^{-1}, most of these being in the northern part of the country, furthest from potential marine influences.

Selenium. WHO has recommended a health-based guideline value for Se of 10 μg L^{-1}. Only 20 samples were analysed for Se from the study but all were found to be below the detection limit of 0.5 μg L^{-1}. The low values result from the reducing conditions in the aquifers. Selenium toxicity is therefore not an issue but human metabolism may be impacted by low Se concentrations and As toxicity may consequently be increased.

Aluminium. Evidence for adverse health effects from Al in drinking water is poor, despite suggestions that a link exists between chronic exposure to Al and development of Alzheimer's disease. WHO gives no health-based guideline value for Al but recommends an upper limit of 200 μg L^{-1} on aesthetic grounds. All samples investigated from the three study areas have concentrations significantly below this. The highest values are found in the groundwaters from the Holocene alluvium in all three areas and maximum values are around 100 μg L^{-1}.

Boron. WHO recently (1998) revised the guideline value provisionally for B in drinking water to 500 μg L^{-1} from its former value of 300 μg L^{-1}. In the three study areas, the only groundwaters with concentrations higher than this were from the shallow aquifer of Lakshmipur (up to 818 μg L^{-1}). In all other areas, B concentrations were around 100 μg L^{-1} or less. The high concentrations in Lakshmipur are related to the presence of residual seawater. In all, 2.5% of samples from the study areas exceed 500 μg L^{-1}. Boron concentrations in groundwaters from the National Hydrochemical Survey showed 187 samples (5.3%) exceeding the revised guideline value and 322 samples (9.1%) exceeding the former value. The maximum observed concentration was 2190 μg L^{-1}. Again the highest concentrations are found in the south of the country where saline influences have been greatest. Boron is therefore a potentially problematic element for the groundwaters in the south of Bangladesh.

Nickel. The WHO guideline value for Ni in drinking water is 20 μg L^{-1}. All samples analysed from the three study areas were below this value and mostly significantly so. The highest observed concentration was 18.8 μg L^{-1} (Faridpur shallow groundwater; Table 7.3). All other samples contained 2 μg L^{-1} or less, and most were below 1 μg L^{-1}. Similar observations were made from the National Survey data, where only one sample was found to contain Ni greater than 20 μg L^{-1} (samples from the Phase I survey are not considered as detection limits by the ICP-AES equipment used for the earlier survey were greater than the WHO guideline). The single exceedance value was 37 μg L^{-1}. Nickel is therefore not considered to be a significant health problem.

Lead. WHO revised its guideline value for Pb to 10 μg L^{-1} in 1993 as a result of new toxicological evidence for its potential detrimental effects to health. From the data for the three study areas, only one sample exceeded this value (28.6 μg L^{-1}, Faridpur deep groundwater; Table 7.5). The average value for all data from the three areas is 0.43 μg L^{-1}, well below the WHO recommendation. From the National Survey (Phase II data only), only one sample exceeded the detection limit (12 μg L^{-1}; 6σ) with a value of 31 μg L^{-1}. Lead is likely to be problematic in only a very small number of samples, and then not significantly above 10 μg L^{-1}. Lead is therefore not considered a major health risk in Bangladesh groundwaters.

Uranium. The 1998 revised WHO guidelines have recommended a provisional guideline value for U of 2 μg L^{-1} based on limited toxicological evidence. Of the samples from the three study areas, 30% exceed this low value and the maximum observed concentration was 47 μg L^{-1}. The average value for samples from the three study areas (undivided) was 2.8 μg L^{-1}. Concentrations are for the most part highest in the shallow alluvial aquifers, although the Dupi Tila groundwaters from Chapai Nawabganj also have some high values. Highest observed concentrations were from the shallow dug wells of Chapai Nawabganj (Table 7.5). The concentrations found in the Bangladesh groundwaters are relatively high compared to groundwaters elsewhere, although databases for U in groundwater are limited and comparisons therefore difficult. Given the WHO guideline value for U, uranium needs to be assessed further in Bangladesh groundwaters.

Antimony. The provisional WHO guideline value for Sb is 5 μg L^{-1}. All samples from the three study areas were significantly below this value. The highest observed concentration was 1.2 μg L^{-1} (Lakshmipur shallow groundwater; Table 7.4). Most groundwaters have less than 0.06 μg L^{-1}.

Other trace metals. The WHO guideline value for Mo in drinking water is 70 μg L^{-1}. All samples from the three study areas were significantly less than this and many were below detection limit (Table 7.4).

The WHO guideline value for Cd in drinking water is 3 μg L^{-1}. From the three study areas, all samples have concentrations significantly less than this. The highest observed concentration was 0.16 μg L^{-1} (Table 7.4). Similar observations were made from the National Survey data (Phase II data, determined by ICP-AES, 6σ detection limit 1 μg L^{-1}). In these, 15 samples exceeded the guideline value. These ranged between 3.0–4.4 μg L^{-1} and are therefore only just in excess.

No health-based guidelines exist for Co. Concentrations in the groundwaters from the three study areas are at most 2.3 μg L^{-1} and not considered high. The maximum from the Phase II National Survey was 9 μg L^{-1}.

There are insufficient data to allow definition of a guideline value for Be. Nonetheless, Be concentrations in the Bangladesh groundwaters are universally low, most being <0.05 μg L^{-1} with a maximum observed of 0.14 μg L^{-1}.

The WHO guideline value for Ba is 700 μg L^{-1}, on health grounds. All samples from the three study areas were less than this, the highest observed concentration being 657 μg L^{-1}. From the National Hydrochemical Survey, 10 samples (0.3%) exceeded the value, the highest being 1360 μg L^{-1}, or roughly double the guideline value.

The provisional WHO guideline value for Cr is 50 μg L^{-1}. Highest concentrations observed from the three study areas were around 1.3 μg L^{-1}. Similarly low values were found in the National Survey samples, with only one sample exceeding the value, and only just in excess at 51 μg L^{-1}. Chromium is therefore not considered a problem. No data for mercury concentrations are available.

The elements of greatest concern from a health perspective, beside As in the Bangladesh groundwaters are considered to be Mn and U. Of the shallower groundwaters from the Holocene aquifers from each area, the WHO guideline values for As, Mn and U were all exceeded in 14% (n=8) of samples from Lakshmipur, 7% (n=4) of samples from Faridpur and 4% (n=3) of samples from Chapai Nawabganj. One Chapai Nawabganj dug well also exceeded all three guideline values. No samples from the deep aquifer exceeded on all counts.

7.5 PORE WATER CHEMISTRY: RAJARAMPUR (CHAPAI NAWABGANJ)

Pore waters extracted from core sediments in DW1 (Rajarampur) showed evidence of oxidation before analysis and demonstrate the absolute need for care with sampling of such reducing sediments. Although the ends of the cores were waxed on site this was evidently insufficient to prevent oxidation. Results for selected elements are given in Table 7.12. Assuming that the original in-situ pore water chemistry was akin to that of analysed groundwaters (i.e. anaerobic), the data indicate that reduced species such as Fe, NH_4, Mn (not shown) and As have oxidised and have

Table 7.12. Chemistry of pore water (in mg L^{-1}) from DW1 (Rajarampur)

Depth	Lithology	Ca	Mg	Na	K	Cl	SO_4	HCO_3	NO_3-N	NH_4-N	P	Fe	As
10-12'	silt	74.1	19.9	128	4.30	77.2	113	375	0.2	0.05	5.6	0.042	nd
40-42'	mica sand	142.6	27.0	146	9.56	258	291	72	1.2	<0.01	<0.2	<0.006	<0.02
50-52'	mica sand	54.5	10.3	66.5	9.46	102	58	118	6.5	<0.01	<0.2	0.239	<0.02
70-72'	mica sand	69.2	15.3	73.1	6.69	145	95	83	0.8	<0.01	0.2	<0.006	<0.02
80-82'	mica sand	23.3	5.85	453	6.27	190	469	369	nd	<0.01	0.4	0.017	<0.02
90-92'	mica sand	74.5	19.1	63.5	8.76	148	40	196	0.4	0.64	4.3	0.094	<0.02
100-102'	mica sand	49.6	11.3	333.	7.43	177	431	250	nd	<0.01	<0.2	<0.006	<0.02
110-112'	mica sand	18.9	4.88	415	6.81	156	427	317	nd	<0.01	<0.2	<0.006	<0.02
140-142'	silt	25.9	9.85	72.1	1.95	51.8	28	179	3.7	<0.01	<0.2	0.027	<0.02

nd: not determined

been removed from solution. Concentrations of most of these are below detection limit. The As has probably co-precipitated with iron oxide or adsorbed onto its surfaces. Conversely, SO_4 has high concentrations, much higher than observed in the groundwaters. The SO_4 must be derived from oxidation of sulphide phases (adsorbed S or pyrite) in the sediment. The extent of oxidation will depend not only on the amount of these phases present but also on the permeability of the cored sediments to air.

Low concentrations of HCO_3 and Ca relative to local groundwaters suggest that calcite has precipitated from solution during processing due to degasing of CO_2. These results (and probably Mg) should therefore be viewed with caution. The results demonstrate the practical difficulties of maintaining the integrity of reducing pore waters during collection and processing.

Nonetheless, the data give a useful indication of likely chemical compositions of groundwaters following advanced sulphide oxidation in the aquifer: i.e. high SO_4, low Fe and very low As concentrations. The results give further evidence that sulphide oxidation is not the major process initiating As mobilisation in the Bangladesh groundwaters.

7.6 DISCUSSION

Arsenic concentrations in the three Special Study Areas clearly vary considerably. From the statistical data (percentage exceedances), the worst-affected of the areas appears to be Lakshmipur and the least-affected is Chapai Nawabganj. However, the highest absolute concentrations (up to 2400 $\mu g\ L^{-1}$) were observed in the localised hot spot of Chapai Nawabganj. This might go some way to explaining why reported arsenicosis cases have been more prevalent in Chapai Nawabganj as As doses will have been considerably higher from chronic use of such high-As drinking water. Variations in Fe(II) concentrations (higher values in Lakshmipur and Faridpur) may also be a factor if waters are left for a period to stand before drinking as this will have an influence on the amount of As removed by co-precipitation.

Our As data are principally measurements of dissolved concentrations (i.e. filtered through 0.2 μm filters). Limited comparisons between dissolved (filtered) and total (unfiltered) As indicate that most are very similar, i.e. that almost all of the As is dissolved. A similar conclusion was reached for the Mandari samples (Chapter 8). However, where groundwaters are visibly cloudy, total As may be considerably higher than dissolved concentrations. Ingestion of such waters will give a higher dose of As than indicated from our geochemical studies because of the added component of particulate As. Dissolved concentrations are more diagnostic and hence preferable in geochemical investigations but may not indicate the total dose in a few instances where particulate As is appreciable.

Arsenic concentrations in groundwaters from the Holocene alluvial aquifers show some relationship with lithology but the associations are variable and complex. It is therefore unlikely that lithological variations in the Holocene aquifer can be used to predict accurately the As concentrations in the groundwaters, as was suggested for example by Nickson et al. (1998). Perhaps relationships with lithology will emerge with further study but it is doubtful if the aquifers will ever be characterised well on a large scale as they are so spatially variable. Such complexity means that it will probably always be easier simply to measure As in the groundwaters than to attempt predictions of water quality from sediment lithology, which also requires the availability of detailed sediment logs.

Several workers (e.g. Das et al., 1996; Mandal et al., 1996) have suggested that the As problem of the Bengal Basin has been caused by recent 'over-abstraction' of groundwater by irrigation, such that aquifer dewatering has led to pyrite oxidation. Our data from the Special Study Areas do not support such a hypothesis as a major control on As mobilisation because of a lack of positive correlation (indeed, an observed negative correlation) between dissolved As and SO_4. Such trends suggest instead that removal of SO_4 from solution has occurred. The mechanism is most likely to be bacterial sulphate reduction under highly reducing conditions and this process is either coincident with, or precedes, As release. Enriched $\delta^{34}S$ ratios in a limited number of analysed low-SO_4 groundwaters support the suggestion that sulphate reduction has occurred and the low concentrations of many trace metals such as Cu, Zn, Pb, Ni and Co in the groundwaters suggest that these too have been removed from solution by precipitation or co-precipitation with sulphide minerals.

Positive correlations of As with Mo reflect the tendency of Mo to form oxyanion species in solution, unlike other trace metals such as Cd, Pb, Ni, Cu, Zn, and hence to behave in a similar way to As under the ambient conditions.

Authigenic pyrite has been observed, albeit rarely, in some sediments from Bangladesh. This is an expected end product of the sulphate reduction process. However, newly formed reaction products are expected to include finely-divided iron monosulphides which would be difficult to see in thin section. Without careful sample preservation, these readily oxidise once the sediment is removed from its natural (reducing) environment.

Proponents of the pyrite-oxidation hypothesis have suggested that the lack of observed increases in SO_4 in the groundwaters following oxidation are related to removal in secondary minerals, mainly gypsum. Gypsum is a highly soluble mineral and concentrations of dissolved Ca and SO_4 need to be very high in waters (SO_4 of around 3000 $mg\ L^{-1}$) in order to reach saturation. Saturation indices for the groundwaters from the Special Study Areas are substantially undersaturated with respect to gypsum (log values −1 to −5) and we have not detected the mineral in thin section. Moreover, concentrations of Ca are limited by calcite solubility. In the worst-affected aquifer of the Special Study Areas, Lakshmipur, groundwaters have typically lower Ca concentrations because of the salinity influence and greater abundance of Na. In such cases, saturation with gypsum is even less likely. The groundwaters are also substantially undersaturated with respect to other oxidation products such as jarosite and alunite. It is not inconceivable that gypsum and other sulphate minerals may be found in some Bangladesh sediments in support of the oxidation hypothesis, but care needs to be taken that the sediments have been preserved well (i.e. anaerobically) and that the grains are not simply artefacts of sample storage in aerated conditions. The mere presence of certain minerals in sediments is no guarantee of a significant role in arsenic release.

In addition, national patterns of irrigation and water-level fluctuation do not support the sulphide oxidation hypothesis as the dominant cause of As release. Irrigation is mainly concentrated in the northern parts of Bangladesh (Chapter 4) rather than in the worst-affected areas of the south-east. Irrigation drawdowns are therefore greatest in the north. Further south in the badly-affected Lakshmipur area, water levels are typically only 1–2 m below surface and seasonal fluctuations are much less than further north (Chapter 4).

It is likely that sulphide oxidation is an active process in parts of the Bengal aquifer, especially at shallow depths in the zone of water-table fluctuation and above the redox boundary. Any fine-grained authigenic iron monosulphide and pyrite produced under reducing conditions will be metastable and readily react under such oxidising conditions. Seasonal oxidation of sulphide minerals may occur but there is no evidence that this leads to a significant As release. It is likely that sulphate reduction will follow when the water table rises again. Data from relatively oxidising dug wells and from the shallowest (10 m) piezometers from Chapai Nawabganj and Lakshmipur indicate that As concentrations are low in such conditions because of the strong adsorbing capacity of iron oxides (which are partly produced by sulphide oxidation).

Some of the chemical data suggest that the deep aquifers of Faridpur and Lakshmipur as well as the Dupi Tila of Chapai Nawabganj are at least locally less reducing than the shallow Holocene aquifer. Nonetheless, SO_4 reduction appears to have occurred in all of the aquifers. The observed negative correlations between As_T and SO_4 in the shallow groundwaters suggest that generation of conditions sufficiently reducing for sulphate reduction is a key factor in facilitating the release of As into solution.

Conditions in the shallow aquifer at Chapai Nawabganj appear to be generally less reducing than at Faridpur and Lakshmipur. This is reflected by lower As concentrations in most shallow groundwaters, as well as higher SO_4 and relatively high U. Dissolved gases from Chapai Nawabganj also have lower CH_4 concentrations. Despite this, a local hot spot occurs at Chapai Nawabganj in the vicinity of a meander of the Mahananda River. Sluggish groundwater flow and an abundance of Fe-rich sediments in the region of the hot spot may contribute to these anomalous concentrations (Chapter 4).

High HCO_3 concentrations are also a feature of Bangladesh groundwaters, as well as most other high-As provinces both oxidising and reducing (Smedley et al., 2001b). Sulphate reduction as a result of the oxidation of organic matter produces dissolved HCO_3. Each mg L^{-1} of sulphate reduced produces 1.3 mg L^{-1} bicarbonate. Further HCO_3 is also produced by oxidation of organic matter by dissolved oxygen and nitrate and by diffusion of gaseous oxygen through the unsaturated zone. Additional carbonate is produced by reaction with carbonate minerals where present. Such processes have given rise to the high alkalinities (HCO_3) observed in the groundwaters. The generation of high alkalinity can lead to calcite and siderite precipitation.

High concentrations of dissolved P (typically 1 mg L^{-1}) are common in the shallow groundwaters. Some of this may be derived by desorption from iron oxides and from organic matter, but the weathering of apatite it also likely to have contributed further P to the groundwaters.

The dominant mechanism of As release into the groundwaters is considered to be by desorption from, and dissolution of, iron oxides. The extent of desorption is sensitive to many factors which are as yet poorly understood at a quantitative level. Initiation of strongly reducing conditions in the aquifers, with resultant reduction of As(V) present on oxide surfaces to As(III) may favour significant desorption relative to As(V). Competition for oxide exchange sites with other dissolved constituents, including P, Si, DOC and HCO_3 will further enhance desorption reactions while Ca^{2+} and Fe^{2+} may enhance it. Reductive dissolution of the iron oxides themselves can further add small amounts of As to solution. Diagenetic evolution of iron oxides in the aquifers under reducing conditions may with time lead to significant changes in the oxide surface area, and in its bulk and surface structure and thereby lead to substantial desorption of As. These processes are discussed further in Chapter 12.

7.7 CONCLUSIONS

- The Bangladesh groundwaters show a considerable degree of spatial variability in chemical compositions over short distances, as well as with depth. The variations mean that it is difficult to predict As concentrations in groundwaters with the required degree of accuracy within a village, for example, without actual measurement.

- Concentrations of As_T vary over at least four orders of magnitude, with observed ranges in Lakshmipur, Faridpur and Chapai Nawabganj being respectively <3–986 µg L^{-1}, <3–1460 µg L^{-1} and <3–2342 µg L^{-1}. In Lakshmipur, 55% of groundwaters exceed the Bangladesh standard of 50 µg L^{-1}, 41% exceed the value in Faridpur and 25% in Chapai Nawabganj. Exceedances above the WHO guideline value (10 µg L^{-1}) are 70%, 69%, and 35%, respectively, in Lakshmipur, Faridpur and Chapai Nawabganj. Although the greatest proportion of high-As concentrations occurs in Lakshmipur, the highest observed concentrations are found in a relatively small number of samples from Chapai Nawabganj. These high values, several exceeding 1 mg L^{-1}, are largely concentrated in the Chapai Nawabganj municipal area, in a local hot spot of around 5 x 3 km in areal extent.

- As observed from the National Hydrochemical Survey, groundwaters with high As concentrations invariably occur in the shallow Holocene alluvial aquifer. Concentrations in groundwaters from the deep aquifer of Lakshmipur, and from the Dupi Tila beneath the Barind Clay in Chapai Nawabganj, have low concentrations. In most of these, concentrations were significantly less than 10 µg L^{-1}. In Faridpur, deep groundwaters also have low As concentrations, although two samples exceeded the WHO guideline value. The highest value observed in the deep aquifer was 52 µg L^{-1}. It is not known whether this value is representative of the aquifer locally or whether the concentration reflects inputs of groundwater from the overlying aquifer through drawdown, faulty well seals or multi-level screening. Intermediate aquiclude sediments in Faridpur appear to be locally thin and suggest that some degree of hydraulic connection between the shallow and deep (>150 m) aquifers is possible in this area. Groundwater quality in the deep aquifer of Faridpur, as well as in other areas where intervening aquicludes are thin or non-existent (e.g. Kushtia, Jessore), deserve further investigation.

- The overriding feature of the groundwaters from the Special Study Areas is their reducing condition. This strong redox control has given rise to a characteristic set of water-quality features, including high concentrations of Fe, Mn and NH_4-N as well as As, and typically low concentrations of dissolved oxygen, NO_3-N, Cu, Ni, Zn, Pb, Co and Se. Low SO_4 concentrations in many point to SO_4 reduction as having been an important process. Highest As concentrations are found in some of the most reducing (low-SO_4) groundwaters and indicate that development of strongly reducing conditions is likely to be a major control on As mobilisation.
- Arsenic occurs in the groundwaters in both reduced (As(III)) and oxidised (As(V)) forms. The proportions of each vary significantly with As(III)/As_T ratios ranging between <0.1 and >0.9 in the three areas. Groundwaters from Lakshmipur have a higher proportion of samples with high ratios (i.e. As(III) is the major component). Hence, of the three areas studied, the Lakshmipur groundwaters are amongst the most reducing. This is also the area where arsenic contamination is greatest. Groundwaters with high concentrations (As_T >400 μg L^{-1}) in Chapai Nawabganj also have As(III)/As_T ratios exceeding 0.6 and in some cases exceeding 0.9. The results suggest that As_T is usually substantially present as reduced As(III) in areas where there has been significant mobilisation. However, since not all the As appears to be present in reduced form, simple reduction of As(V) to As(III) is probably not the only mechanism involved in generating the high As concentrations in groundwaters in Bangladesh. Other factors usually correlated with reducing conditions are likely to be involved. These include competition from other anions present (bicarbonate, phosphate, DOC and silicate) as well as possible diagenetic changes to the iron oxides.
- There is no convincing evidence for oxidation of sulphide minerals being an important process in the release of As in the three study areas. Arsenic shows a broad negative relationship with SO_4 (total S) concentrations in the groundwaters and suggests that sulphate reduction is a key process accompanying As release to groundwater. Enriched sulphur-isotopic compositions of the dissolved SO_4 in a limited number of groundwater samples also suggest that these represent residual sulphur after biogenic reduction of SO_4 to sulphide. High Cl/SO_4 ratios in the more saline groundwaters from Lakshmipur also suggest some SO_4 loss from solution by biogenic reduction. High SO_4 concentrations in groundwaters from Lakshmipur appear to be derived from residual seawater rather than from pyrite oxidation.
- As expected some sulphide oxidation may be occurring in the shallowest levels of the aquifer (near to the water table) but this is not responsible for the major As release to solution observed in Bangladesh groundwaters: indeed in places where this process is suspected, As concentrations are usually low (e.g. dug wells and the shallow 10 m piezometer of Chapai Nawabganj).
- In all study areas, similarities between the young Holocene (shallow) aquifer and older (deeper or Dupi Tila) aquifer are observed, mainly as a result of the reducing conditions. However, some important distinctions are also highlighted, particularly in some trace elements. Concentrations of Mn, P, B, Mo, U (and I) are typically much higher in the shallow aquifer than the deep aquifer. Like As, this association is likely to be related to the young aquifer age, slow groundwater flow and the consequent short history of aquifer flushing since sediment deposition.
- Stable-isotopic data ($\delta^{18}O$, $\delta^{2}H$) for the groundwaters are variable both within and between aquifers. The greatest variation is seen in Lakshmipur where past marine intrusion is likely to be responsible for the most enriched compositions observed. Distinct isotopic differences are seen in each area between the shallow Holocene alluvial aquifer and the deeper or older (Dupi Tila) aquifer. There is also an apparent isotopic distinction between groundwater compositions of the Dupi Tila in the Barind and the Madhupur Tracts. The isotopic distinctions overall suggest that variations exist in the residence times of the groundwaters (i.e. groundwater 'ages') in each aquifer. Nonetheless, the differences are not consistent between areas.
- Tritium is largely detectable at a few TU in the shallowest groundwaters (a few metres below the water table) from each study area but deeper groundwaters have low concentrations, typically <0.4 TU. Such low concentrations are indicative of older groundwater, with a large proportion having been recharged before the 1960s. A greater number of tritiated waters were detected in the shallow aquifer in Chapai Nawabganj than in Lakshmipur and Faridpur. The observation suggests that Chapai Nawabganj groundwaters have a higher proportion of modern recharge at shallow levels. Depths of penetration of tritiated water appear to be greater in Chapai Nawabganj than in the other areas perhaps because of a greater unsaturated-zone thickness and greater seasonal fluctuations in water level. Modern abstractions may have induced increased flow in the shallow horizons of the aquifer in Chapai Nawabganj.
- The finding of very low tritium concentrations and high arsenic concentrations in the shallow aquifer (e.g. at 40 m depth) at all three sites provides strong evidence that the release of arsenic into the groundwater predates the 1960's. It is therefore not a modern phe-

nomenon related to irrigation or the building of the Farakka barrage. It probably began shortly after burial several thousand years ago.

- Radiocarbon data from piezometer sets in each study area show some distinctive compositions and suggest distinctive groundwater ages. Groundwater from 10–40 m at Chapai Nawabganj is 'modern' (83 pmc or higher) indicating an age of the order of decades, a conclusion supported by the presence of tritium in many of the groundwater samples. Shallow groundwaters from Faridpur are also modern in radiocarbon terms (78 pmc or higher), despite lower tritium concentrations. Groundwater from 150 m at Faridpur is notably older, with a ^{14}C activity of 51 pmc and a model age in the region of 2,000 years. Deep groundwaters from Lakshmipur are notably older than those from the Faridpur deep aquifer, with ^{14}C activities of 28 pmc or less, suggesting the presence of palaeowaters at depth in Lakshmipur, with model ages of the order of 2,000–12,000 years.
- Isotope data for Bangladesh groundwaters show some distinctive spatial patterns, both laterally and with depth. However, contrary to the claim made by Aggarwal et al. (2000), the interpretation of isotope data alone can be ambiguous and such data should not be used as alternatives to careful major- and trace-element analysis, and more specifically, arsenic analysis, for the evaluation of the regional hydrochemical conditions.
- The most plausible explanation for As release into Bangladesh groundwaters is desorption from oxide minerals (mainly iron oxides, but potentially also to a lesser extent from aluminium and manganese oxides and clays) in the aquifer sediments. This will be accompanied by some reductive dissolution of the iron oxides under the prevailing conditions. There is also a change in colour of the sediments to a grey colour which may, in part, reflect significant changes to the bulk and surface structure of the iron oxides with significant consequences for As mobilisation. It is likely that many of these redox reactions are microbially mediated.
- Of the inorganic constituents considered in the Bangladesh groundwaters, As represents by far the most serious health risk. Other potential problems also arise particularly from high concentrations of Mn and to a lesser extent B and U. From the data for the three study areas, 50% of samples were found to exceed the WHO guideline value for Mn in drinking water (0.5 mg L^{-1}). This compares to 35% of the samples from the National Hydrochemical Survey exceeding the value. Many were significantly higher than this WHO guideline value (maximum observed 10 mg L^{-1}). As with As, the highest Mn concentrations were found in groundwaters from the shallow alluvial aquifer. Boron showed 2.5% of samples from the three study areas exceeding the revised (1998) WHO guideline value of 500 $\mu g\ L^{-1}$. Around 30% of samples from the three study areas exceed the provisional WHO guideline value for U of 2 $\mu g\ L^{-1}$, particularly those from the shallow aquifer. Uranium concentrations were particularly high in groundwaters from shallow dug wells of Chapai Nawabganj (up to 47 $\mu g\ L^{-1}$). The health consequences of U at this low concentration are not well established.
- Occasional exceedances are also observed for a much smaller number of samples in Pb, Ba, NO_2-N and NO_3-N. Other potentially toxic elements such as Cd, Ni, Cr and Mo were not found in excessive concentrations in the three Special Study Areas.
- Constituents considered troublesome on aesthetic grounds include high salinity, Fe and NH_4-N. Salinity is highest in groundwaters from the southern part of Bangladesh where seawater influences have been greatest, as evidenced by high Na and Cl concentrations (in particular) in Lakshmipur. Iron and NH_4-N are often present in very high concentrations (up to 11 mg L^{-1} and 17.8 mg L^{-1} respectively) in the reducing conditions of the aquifers.
- Only inorganic constituents have been considered in this study and hence no indication is given of the bacteriological quality of the groundwaters or the presence of particulate matter. Occasional high concentrations of observed NO_3-N together with NO_2-N, Cl, SO_4 and high SEC values, suggest that pollution of some tubewells and dug wells may occur, especially at shallow depths. Hence the bacterial quality of some of these groundwaters may be impaired.
- The three Special Study Areas investigated lie in different parts of the Ganges-Brahmaputra-Meghna river systems and hence have geographically distinct upland catchment areas. All have As problems and so the As cannot be derived from distinct and isolated bedrock provinces. The sediments are also likely to be derived by reworking of pre-existing sediments. The arsenic source is considered to be disseminated in the aquifer sediments. The sediments appear to be typical alluvial and deltaic sediments. The As problem in the three Special Study Areas and other parts of Bangladesh is related to the special geochemical and hydrogeological conditions favouring As release and mobilisation, rather than to unusually high-As mineral sources.

8 A village survey: Mandari, Lakshmipur District

8.1 INTRODUCTION

A rapid hydrochemical survey of the *mouza* (village) of Mandari, Lakshmipur District was carried out during 22–27 November 1999. The purpose of the survey was two-fold: (i) to see how groundwater chemistry, including that of arsenic, varied at the village scale, and (ii) to establish the feasibility of carrying out rapid village-level surveys for arsenic using the Arsenator, a portable, sensitive and precise instrument capable of measuring arsenic accurately at the 50 $\mu g\ L^{-1}$ level and below.

There is much anecdotal evidence in Bangladesh of the well-to-well variability of arsenic concentrations. This has been borne out by our own experience during the National Hydrochemical Survey and our *upazila*-based surveys in the three Special Study Areas. Yet where detailed surveys had been undertaken at the village scale, as for example with the studies in Samta village, Jessore by the Asian Arsenic Network (AAN, 2000), there was also evidence of some spatial pattern at the village scale. If more was understood about the nature of this variation it may be possible to develop rules of thumb for deciding where to locate new wells, or where not to, based on an analysis of the pattern shown by existing nearby wells, or of some other readily-observed natural feature. How useful are neighbouring wells for estimating arsenic concentrations when they are 10 m, 50 m or 200 m apart? How important is depth? Geostatistics can in principle provide an answer to these questions but requires a large body of data to establish reliably the nature of the spatial variation. Alternatively, it may turn out that other surface features such as the proximity to a major river or low-lying ground may prove to be useful.

An important aspect of our approach was to prepare reasonably accurate maps. This means locating the position of each sampled well as accurately as possible. It is traditional in Bangladesh to record the location of a well by the name of the *mouza*, the name of the owner and the owner's father's name. This is of little value for computerised mapping and geostatistical analysis. The 1:50,000 LGED *upazila* maps available in Bangladesh are not at a scale or level of detail to be of use in locating individual wells in a village where recording to ten metres or better is desirable. The existing cadastral and village maps are detailed but are not accurately to scale, and have no absolute latitude and longitude coordinates. This lack of accurate village-scale maps hinders the development of a detailed local or national database of wells. EGIS (EGIS, 1998) and others, through BAMWSP, have been experimenting with how to provide accurate village-scale maps for the arsenic screening programme. The obvious way forward is to use GPS. This should now enable locations in Bangladesh to be recorded to within 10 m or better using a simple-to-use handheld device.

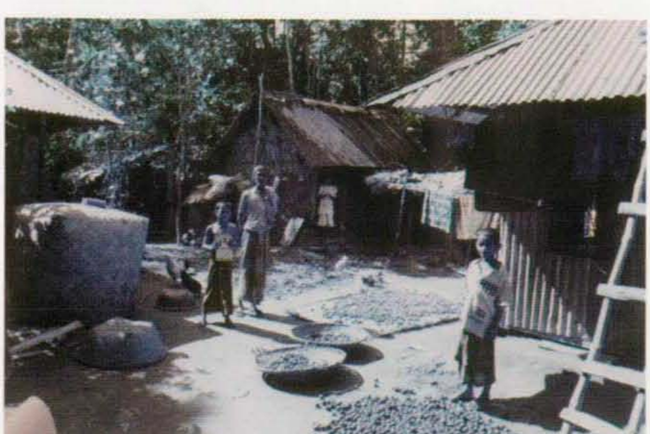


Figure 8.1. Village life: inside one of the *paras*.

Figure 8.2. Work in the fields.

Mandari is situated near the centre of the sadar *upazila* of Lakshmipur district and the *upazila* was extensively surveyed as one of our three Special Study Areas. A detailed discussion of the hydrogeochemistry of the *upazila* can therefore be found in Chapter 7. Mandari was selected by DPHE as a village in which there had been no prior arsenic testing and in which a number of deep wells had recently been drilled.

8.2 THE VILLAGE

Mandari is the principal *mouza* or village in Mandari Union in the sadar *upazila* of Lakshmipur District. Mandari *mouza* consists of a number of *paras* dispersed throughout the *mouza* (Figure 8.1). *Paras* are clusters of houses often belonging to a single extended family. Mandari Union covers about 6 km^2. It is about 3 km from the bazar in the

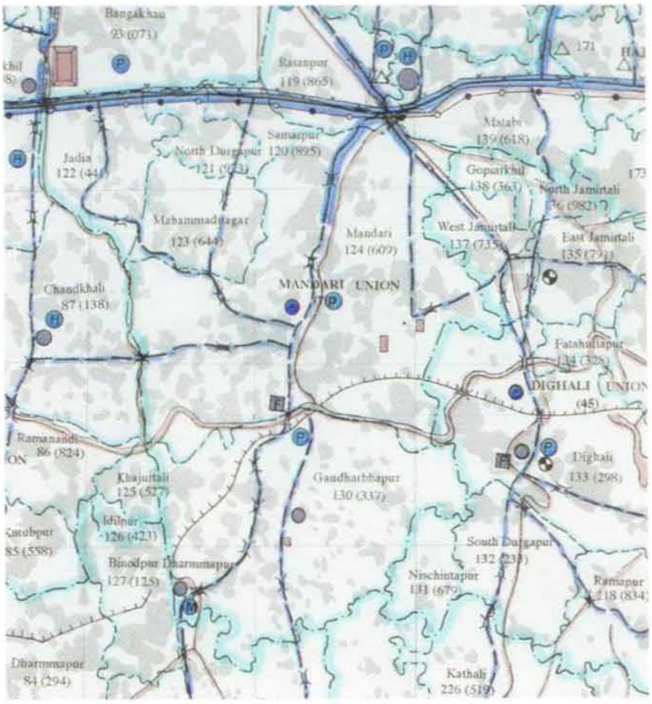


Figure 8.3. Part of the LGED *upazila* map of Lakshmipur showing the location of Mandari.

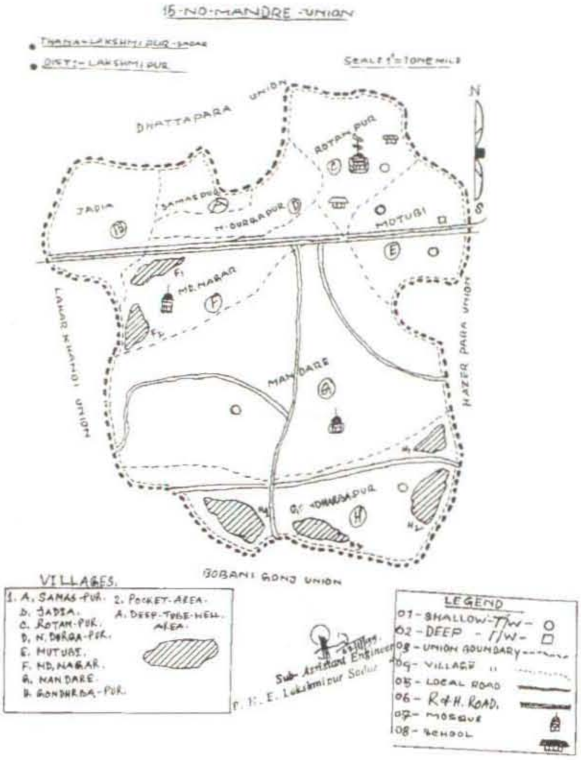


Figure 8.4. Sketch map of Mandari prepared by the local DPHE staff.

north to the southern boundary on the River Wabda to the south. The population is not known accurately but is believed to be about 10,000. It was estimated that there are about 1250 tubewells in the union. Mandari is located on the Noakhali-Lakshmipur main road, about 25 km from Noakhali and 8 km from Lakshmipur. As for most of Bangladesh, cultivation of the fields is a key feature of village life (Figure 8.2).

The *upazila* map shows only the major features and is not useful for mapping at the village scale (Figure 8.3). A sketch map of Mandari was also available from the local DPHE office (Figure 8.4) but this was also not suitable for the detailed mapping to be undertaken since it was not accurately to scale.

In the absence of accurate village-scale maps, we requested the Bangladesh Space Research and Remote Sensing Organisation (SPARRSO) to provide a range of images of Mandari to aid us in site location. They provided us with a 24" × 21" 1:50,000 coloured TM (transverse Mercator) print covering bands 2, 3 and 4 of the area taken on 14 February 1998, a black and white 1:50,000 SPOT image taken on 17 December 1988, and an interpreted map of the union showing the location of fields and *paras*. The *paras* could be identified from satellite images by the location of trees which were always present for shade and shelter near the houses. We had insufficient time to make full use of these maps before the survey but they proved useful during the survey and afterwards when producing the final map. The SPOT image was the most useful (Figure 8.5).

We also obtained a set of 5 detailed maps of Mandari from the Union Council Chairman. These were probably copies of the Department of Land Records Survey (DLRS) *mouza* map, were very detailed and of course, were written in Bangla. They were very old, however, made in about 1914, and much had changed since then (Figure 8.6). We did not fully succeed in joining them together to make a

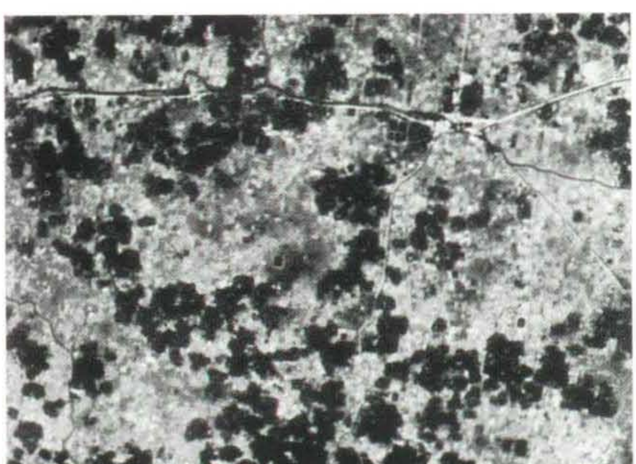


Figure 8.5. SPOT image of Mandari village. The main Lakshmipur to Noakhali road can be seen to the north (top) and the River Wabda to the south (bottom).

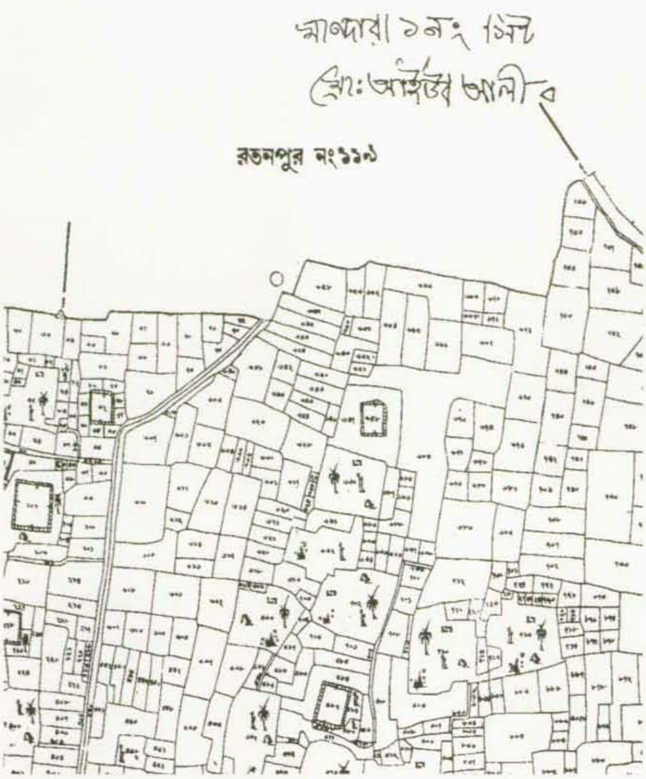


Figure 8.6. Part of the hand-drawn DLRS map of Mandari given to us by the Union Council Chairman.

Figure 8.7. A typical hand-pumped tubewell (HTW) in Mandari. Note the iron staining from the iron-rich water.

complete map of Mandari. The lack of a detailed map of Mandari before the survey began made the planning of the survey and the actual sample collection considerably more difficult than it would have been if a map had been available.

During the survey, all wells were located with GPS but because of the degradation of the signal at the time of the survey, this was only accurate to 50–100 m (the degradation of the signal was turned off on 1 May 2000, after the survey had been completed). The GPS data were supplemented by notes from visual observation in the field to give the relative positions of closely-spaced wells. As the survey progressed, a hand-made map was prepared on a large piece of graph paper to show as accurately as possible the location of the sampled sites and other features such as roads and tracks. This is not a trivial task!

The aim of the survey was to obtain a reasonably uniform spatial coverage of wells while at the same time trying to obtain some idea of the very short-range variation (within 50 m). We were aware that we would only be able to sample and analyse about 1 in 5 of the wells and so there had to be some site selection. Therefore, often only one or two wells were sampled in a *para* and some *paras* were missed completely. We sampled as many deep wells as possible since the deep aquifer was generally believed to be arsenic-free and this needed confirmation. Within these constraints, selection of the sample sites was essentially random. We had little prior information about the expected arsenic concentrations in the well waters other than the general feeling from DPHE staff that the concentrations in the shallow wells would be high with many above the Bangladesh standard. Our own less detailed sampling of the *upazila* as part of the investigation of the Special Study Areas had also provided some information about the *upazila*. Drinking water in Mandari is now almost entirely obtained from tubewells. Most wells are fitted with a cast-iron Bangladesh No. 6 hand-pump (Figure 8.7).

8.3 SAMPLING AND ANALYSIS

Arrangements for sampling access were made by the local DPHE staff. The survey team visited the village Chairman before the survey to discuss the aims of the survey. The Chairman kindly made available for our use the Union Council Headquarters office and provided us with staff to help with the sampling.

The survey team consisted of a Team Leader from BGS, three officers from the R&D DPHE Division in Dhaka, Professor Walter Kosmus (Karl Franzens University, Graz, Austria) and four local officers of Mandari Union Council. Initially we had planned to include a medical worker in the team to diagnose any arsenic-related symptoms but this proved not to be possible. We were not aware of any arsenic-affected patients having been diagnosed in Mandari and no patients were presented to us during the survey.

We also had available two 4-wheel drive vehicles. The survey had to be carried out largely on foot and by rickshaw as the village tracks were not sufficiently wide for the vehicles. The Union Council officers provided the necessary local knowledge and painted with white paint survey numbers (e.g. DPHE 141) close to each sampled well to identify it. This was usually done on the wall of the adjacent house rather than on the well in order to protect it from the weather.

As the survey was a new experience for us and there were many unknowns, the logistics of the survey were largely decided 'on the fly'. We planned to spend 5 days on the survey and hoped to be able to sample about 200 wells. In the event, we sampled 239 wells. The survey team was split into two parties for sampling. Each had 12 1-litre plastic bottles for sampling the water. These were carried around in large plastic buckets and ferried back to the field 'laboratory' for analysis usually in batches of 6. The bottles were constantly reused. The two sampling parties were assigned parts of the village to cover and then visited the various *paras* by whatever means was appropriate. Once in a *para*, the DPHE staff located a well to sample, obtained permission to sample it and then held a short interview with the owner to determine their name, father's name, depth of well, age of well, number of users, etc. These details were recorded on a proforma. DPHE staff also distributed a coloured arsenic-awareness leaflet (in Bangla) that described the nature of the arsenic problem and simple ways of minimising its effects. The villagers were always keen to help us and often assisted by showing us to the next well and by carrying the samples

The shallow wells in Mandari are at a fairly uniform depth – mostly in the 30–36 ft (9–11 m) range. This tends to avoid the excessive salinity which is found at somewhat greater depths (but not in the deep aquifer) as seen from the study of Lakshmipur *upazila* in general (see Chapter 7). The wells were pumped for a minimum of about 5 minutes while the interview was taking place and then two samples taken, a 1-litre unfiltered sample for field arsenic analysis and a 30 mL, 0.2 µm-filtered sample for additional analyses by ICP-AES in the UK. This latter sample was subsequently acidified with high grade concentrated nitric acid to give a final concentration of 1% HNO_3. The 1-litre plastic bottle was thoroughly rinsed with the well water before the final sample was taken.

When sufficient samples had accumulated, they were taken back to the 'laboratory' along with the set of proformas each marked clearly with the well identity and bottle number. The quantity of water used depended on the anticipated arsenic concentration. If the original guess was wrong, then the analysis was repeated with a different sample volume. Each analysis took about 7 min to complete. Once the analysis was complete and the result recorded both on the proforma and in a separate log book, the 1-litre bottles were emptied and returned to the sampling party.

During the course of the survey, three temporary 'laboratories' were set up at various points in the village. These were at the Union Council Offices in the centre of Mandari, at the Chairman's house to the north and in the primary school at Amin Bazar to the south (Figure 8.8). Professor Kosmus was responsible for all of the arsenic analyses and organised the sample collection accordingly. He used an Arsenator 3000, an instrument of his own design, for the arsenic analysis (the design of the instrument has since been improved – the electronics are now contained in a smaller, hand-held device with little loss of sensitivity over the original, larger instrument). This proved reliable throughout. It ran from a rechargeable battery which was recharged at night or during the day when possible. Deep well water from Mandari or water from Dhaka was used as arsenic-free water for diluting samples where necessary. This water was checked for its arsenic-free status before use as dilution water.

Each party was able to collect around 15–30 samples per day. We sampled a total of 239 wells as part of the survey. Even with three locations for the laboratories, the distances that needed to be covered were considerable. The greatest logistical problem occurred because of the delay in transporting the first samples of the day to the 'laboratory'. This meant a slow analytical start and a prolonged end to each analytical day! Two full-day hartals (politically-motivated strikes) also hampered the survey.

As the sampling and analysis were taking place, we attempted to keep track of sample locations using our rapidly-prepared map, and organised later sampling trips accordingly.

At the end of the survey, we provided the Chairman of the Union Council and the local Executive Engineer of DPHE, Lakshmipur district with a list of all the wells sampled and the results, and asked them to communicate the results to the well owners. We suspect that the results were not as bad as perhaps they had feared, but they were nevertheless disturbing. We suggested that they paint all of the wells below 50 $\mu g\ L^{-1}$ with green paint and all of the wells with greater than 200 $\mu g\ L^{-1}$ with red paint. Those in between could be left unpainted for the time being until a full-scale mitigation effort was underway. The red wells were highlighted on our list. We suggested that those with red-painted wells should be advised to seek neighbouring unpainted and preferably green-painted wells for their drinking and cooking water. This was a pragmatic response to an emergency situation but ultimately the decision on the course of action to take lay with DPHE and the village officials.

We provided the Union Council Chairman and DPHE with red and green paint, brushes and turpentine and suggested that they do the painting immediately while the location of the wells was fresh in their minds. When we returned a week later, no wells had been painted.

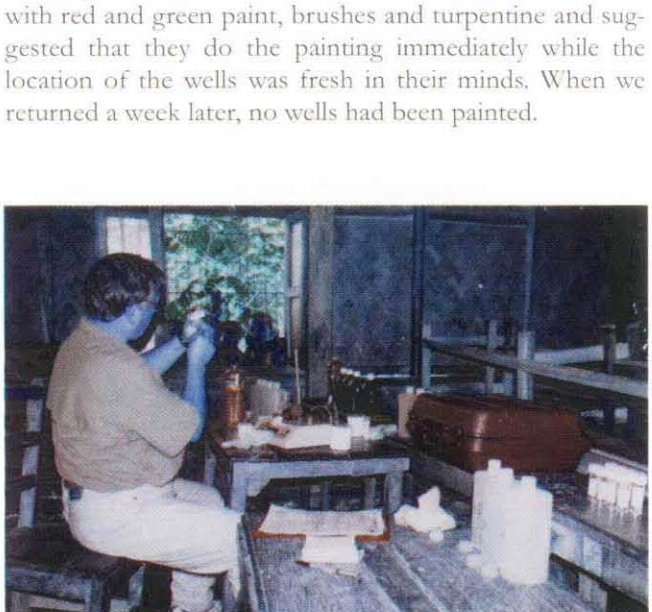


Figure 8.8. Walter Kosmus operating the Arsenator in the primary school at Amin Bazar.

Table 8.1. Distribution of sampled tubewells with depth in Mandari

Depth interval	Number	Percentage
Less than 7 m	0	0
7-8 m	96	40
8-9 m	6	2
9-10 m	52	22
10-12 m	43	18
12-22 m	28	12
22-150 m	0	0
>150 m	12	5
Unknown	2	1
All	239	100

Table 8.2. Distribution of sampled tubewells in Mandari classified by the year installed and depth

Year installed	Number of shallow wells	Number of deep wells	Total number	Total percentage
Before 1970	1	0	1	0
1970-1979	13	0	13	5
1980-1989	35	0	35	15
1990-1995	85	0	85	36
1996-1997	60	3	63	26
1998-1999	32	8	40	17
Unknown	1	1	2	1
Total	227	12	239	100

8.4 Well statistics

A total of 239 wells were sampled for arsenic. Samples for three of these (M116, M225, M226) did not have accurate locational or ICP-AES data as they were brought in by hand and therefore could not be mapped or filtered on site. However, they were included in the overall statistics where appropriate. This gave 236 samples with both arsenic data and locational data. There were 227 shallow tubewells at an average depth of 32 ft (9.7 m) and 12 deep tubewells at an average well depth of 829 ft (253 m). The most common well depth was 26 ft (7.9 m) (Table 8.1), i.e. very shallow by Bangladesh standards. 64% of wells were 10 m deep or less. There were no wells in the depth interval 22–150 m because of unacceptable salinity.

With deep wells, the screened interval is often placed in the most productive zone somewhat above the maximum depth drilled but this depth was generally not available. Therefore the 'depth' data for the deep wells needs to be interpreted with some caution. Most of the wells are completed with PVC pipework and with either one (for shallow wells) or two (for deep wells) 6 ft lengths of PVC screen. In most cases, the wells were fitted with a standard Bangladesh hand pump since the water table is always just a few metres below ground level. Only in the case of one of the sampled deep wells was there an electric submersible pump fitted. This had been installed by DPHE but was located in a private house. 184 (77%) of the sampled wells were classified as private and 54 (23%) were classified as Government (i.e. DPHE). One was classified as owned by an NGO.

If our survey is representative of Mandari as a whole, it is clear that a large number of tubewells has been installed recently, more than 40% since 1996 and 79% since 1990 or later (Table 8.2). All of the deep tubewells sampled had been installed since 1996 – four of the twelve in 1996–7, the remainder after that. Of the 92 shallow tubewells that had been installed since 1996, 91 have known ownership of which 77 (85%) were private, 13 (14%) were Government and 1 (1%) was NGO.

A full range of hydrochemical maps can be found in the *Hydrochemical atlas*. Only selected maps are included in the discussion given below. The class limits have mostly been selected by using rounded quartiles based on the Mandari data set. The class limits for the arsenic map are based on the Bangladesh arsenic standard and higher, rounded limits.

8.5 Water quality

8.5.1 Arsenic

It was not the intention of this survey to 'check' the Arsenator's results but some checks were possible as the ICP-AES analysis on the small filtered and acidified subsample returned to the UK also incidentally gave an arsenic result at no extra cost. However, because hydride generation was not used with the ICP-AES, the sensitivity was low and readings less than about 30 μg L^{-1} are unreliable. Nevertheless there were sufficient high-As samples to make a comparison worthwhile (Figure 8.9).

While there is some scatter in the results, the comparisons are satisfactory in all but a couple of cases. There is no evidence of any systematic differences between the two

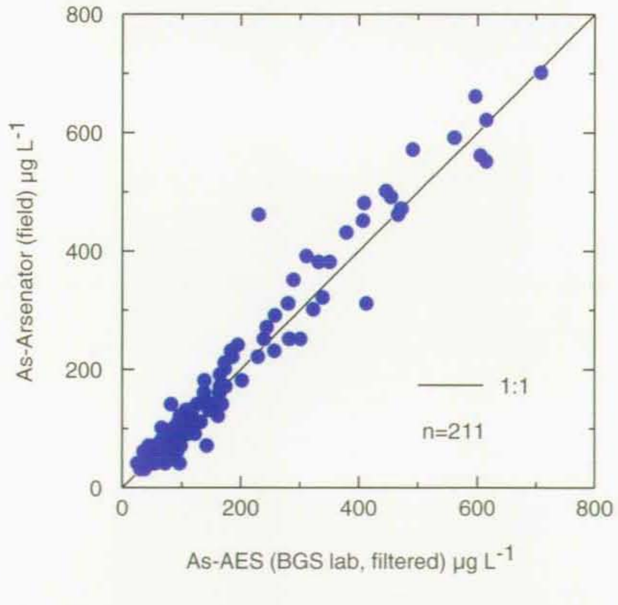


Figure 8.9. Plot showing the comparison of arsenic analyses by the Arsenator (unfiltered sample, field analysis) and direct aspiration ICP-AES (filtered sample, BGS laboratory).

methods which provides indirect support for the Arsenator results. It also suggests that filtering does not have a large effect on the arsenic results since the laboratory results were based on filtered samples while the Arsenator results were based on unfiltered samples.

The distribution of arsenic found is shown in Figure 8.10. As can be seen from the map, there is a rather patchy distribution of arsenic although a general trend of low-As well waters can be seen in the centre of Mandari. There is one well sample in this area with high As (M232) that deserves checking. High-As areas exists in the south-west corner near the Mosque and to a lesser extent in the north-west. There appears to be a concentration of high-As waters along the River Wabda on the southern boundary of Mandari. 77% of the shallow tubewells contained more than 50 µg L^{-1} and 99.5% (all but one) contained more than 10 µg L^{-1}. All 12 of the deep tubewells contained less than 2.5 µg L^{-1} and 9 of them contained less than 0.5 µg L^{-1}, the detection limit of the analytical method.

The distribution of arsenic contamination with depth is shown in numerical terms in Table 8.3 and in percentage terms in Table 8.4. There was a slight trend for the deeper shallow wells to contain more As than the shallowest wells (Table 8.4), especially in terms of the highest levels of contamination.

The maximum arsenic concentration found was 707 µg L^{-1} and the next highest concentration was 614 µg L^{-1} (two wells). Fortunately the 707 µg L^{-1} well and one of the 614 µg L^{-1} wells were not being used for drinking water because of their high iron content (10 mg L^{-1} and 19 mg L^{-1}, respectively).

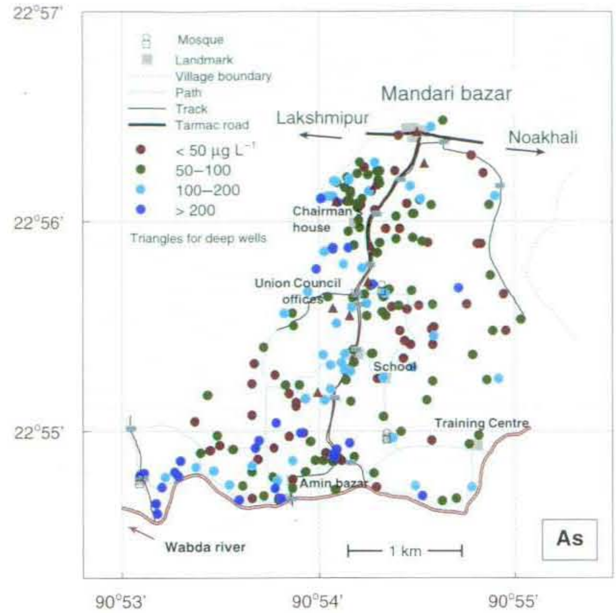


Figure 8.10. Map showing the distribution of arsenic in Mandari well waters.

Table 8.3. Number of wells classified by both depth and arsenic concentration

	Numbers of samples from each depth interval Arsenic concentration classes (µg L^{-1})						
Depth interval (m)	<10	10–50	50–100	100–200	200–300	>300	All
Unknown	—	—	—	—	—	2	2
7–8 m	1	24	44	22	3	2	96
8–9 m	—	2	2	2	—	—	6
9–10 m	—	14	19	10	2	7	52
10–12 m	—	8	15	10	3	7	43
12–22 m	—	2	13	7	2	4	28
>150 m	12	—	—	—	—	—	12
All depths	13	50	93	51	10	22	239

Table 8.4. Classification of wells by depth and arsenic concentration, expressed as a percentage of the number of wells within a given depth interval

	Percentage of samples from each depth interval Arsenic concentration classes (µg L^{-1})						
Depth interval (m)	<10	10–50	50–100	100–200	200–300	>300	All
Unknown	0	0	0	0	0	100	100
7–8 m	1	25	46	23	3	2	100
8–9 m	0	33	33	33	0	0	100
9–10 m	0	27	37	19	4	13	100
10–12 m	0	19	35	23	7	16	100
12–22 m	0	7	46	25	7	14	100
>150 m	100	0	0	0	0	0	100
All depths	5	21	39	21	4	9	100

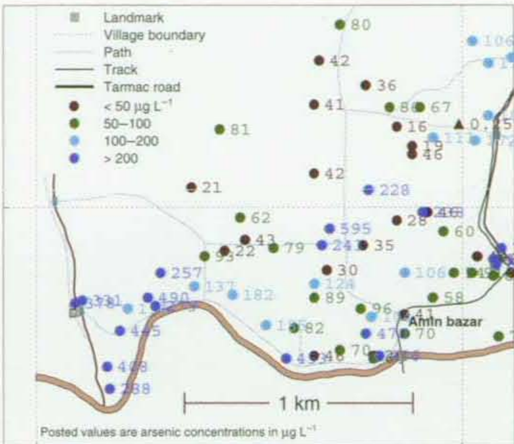


Figure 8.11. Map showing a close-up view of the distribution of arsenic in SW Mandari well waters. Figures given are the well water arsenic concentrations in $\mu g\ L^{-1}$.

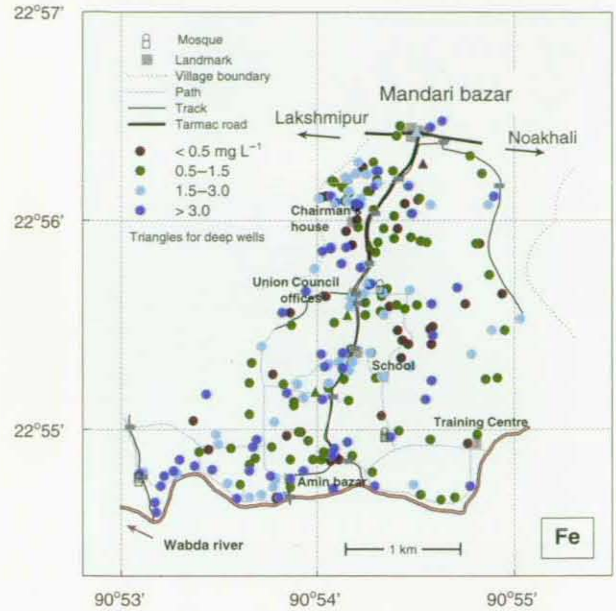


Figure 8.12. Map showing the distribution of iron in Mandari well waters.

The extreme spatial variability in As concentrations in well waters is shown by a close-up map of the As concentrations in south-west Mandari (Figure 8.11). Geostatistical analysis of the entire dataset showed that there was very little spatial dependency in the data, i.e. the variogram showed no structure and the variance could all be ascribed to the nugget variance (see Chapter 9). This undoubtedly reflects the lack of a high degree of short-range spatial dependency but the inherent error in the recorded sample co-ordinates (as determined by GPS) will tend to blur any spatial dependence for separations of less than 100 m or so. More precise map co-ordinates are desirable, and indeed are now possible. There do seem to be distinct patterns in the arsenic distribution and a greater density of sampling and better locational data is likely to reveal these patterns better.

8.5.2 Iron

Iron concentrations were generally high with the median concentrations of iron in the shallow and deep wells both being 1.5 mg L^{-1}. This is similar to the median concentration found in the shallow wells in the NHS (1.4 mg L^{-1}) but appreciably greater than the median Fe concentration in the deep wells from the NHS (0.17 mg L^{-1}). The maximum concentration of Fe found in the shallow wells in Mandari was 39.8 mg L^{-1} (n=226) compared with 8.0 mg L^{-1} in the deep wells (n=10). Twenty nine (13%) of shallow wells exceeded 5 mg L^{-1} and 7 (3%) exceeded 10 mg L^{-1}. These figures are somewhat lower than those found in the Lakshmipur Special Study Area survey (20% and 8%, respectively) and in the NHS (25% and 10%, respectively) indicating that Mandari does not have as many high-Fe wells as in Bangladesh as a whole. Only one (9%) of the deep wells exceeded 5 mg L^{-1} and none exceeded 10 mg L^{-1}. Nevertheless, the deep wells in Mandari seem to contain more Fe than the deep wells in the other areas sampled (notably the southern coastal region and the Sylhet region).

As with arsenic, the spatial distribution of Fe also shows a high density of high-Fe wells close to the River Wabda, especially in the south-west of Mandari but there are also clusters of high Fe wells west of the girl's school and north of the Council offices, as well as being scattered throughout most of Mandari (Figure 8.12). In other words, given the density of samples available, the Fe map does not show a definite spatial pattern.

The correlation between Fe and As is generally poor (r^2=0.138, n=225, Figure 8.13) with high As concentrations often being associated with relatively 'low' Fe concentrations (but nevertheless high by world standards), and

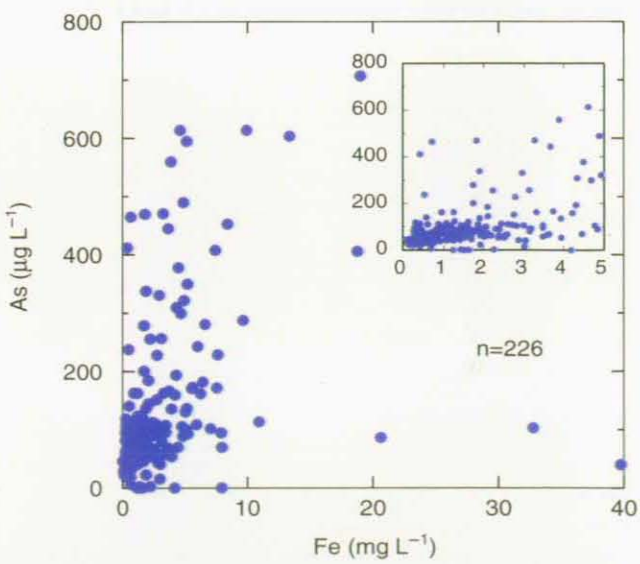


Figure 8.13. Plot of arsenic concentration versus iron concentration in Mandari well waters. The inset is a close-up of the low iron region.

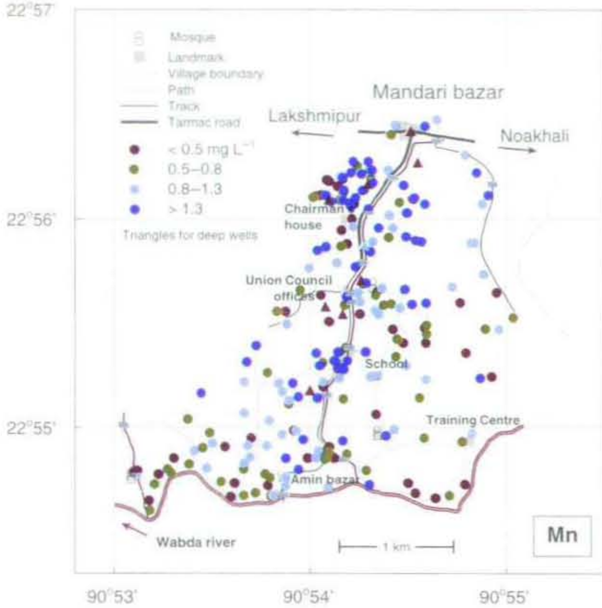


Figure 8.14. Map showing the distribution of manganese in Mandari well waters.

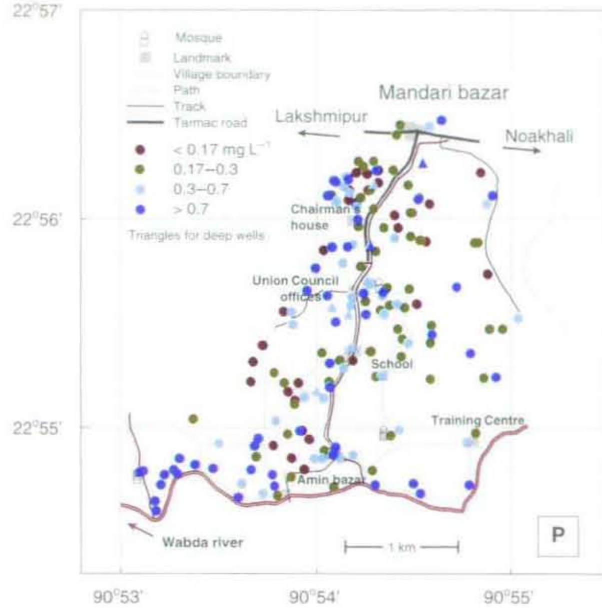


Figure 8.15. Map showing the distribution of phosphorus in Mandari well waters.

vice versa. Iron cannot therefore provide a good predictor of As concentrations. The highest Fe sample contained only 40 μg As L^{-1}. On the other hand, three of the four highest As samples contained 10 mg L^{-1} Fe or greater and the fourth contained nearly 5 mg L^{-1}.

8.5.3 Manganese

The distribution of Mn is quite different from that of both Fe and As with the greatest concentrations being found in the north of the village (Figure 8.14). There was a poor correlation (r^2=0.042, n=225) between Fe and Mn concentrations for shallow wells, as well as for deep wells.

It is likely that the Mn concentrations reflect the present redox status of the groundwaters and their evolution. While the Eh was not measured, the reasonable positive correlation with SO_4 (r^2=0.24, n=225) for the shallow wells suggests that the high Mn concentrations relate to reducing, but not strongly reducing, groundwaters. A similar observation was made in the NHS. Low Mn concentrations are found close to the River Wabda in the south-west of Mandari where generally low SO_4 and high Fe and As concentrations are also found. This suggests that this area is more strongly reducing than elsewhere in the area.

78% of the samples from the shallow tubewells exceeded the WHO guideline value of 0.5 mg L^{-1} for Mn, while only one (9%) of the deep wells did so (although two more deep tubewells were very close to exceeding the guideline). 99% of shallow wells and 45% of deep wells exceeded the Bangladesh Mn standard of 0.1 mg L^{-1}. The shallow wells therefore appear to be distinctly more susceptible to high Mn concentrations than the deep wells. This was also observed in the groundwaters from the Special Study Areas.

8.5.4 Phosphorus

The median phosphate-P concentration in the shallow well waters was 0.31 mg L^{-1} whereas in the deep wells it was somewhat lower at 0.19 mg L^{-1}. Corresponding figures from the NHS for Bangladesh as a whole are 0.29 mg L^{-1} and 0.33 mg L^{-1}, respectively. Therefore the deep well waters in Mandari are somewhat lower in phosphorus than in the southern coastal (Barisal) region from where most of the deep wells in the NHS were derived.

Of all the elements, the map for phosphorus in Mandari (Figure 8.15) shows the closest similarity to that of arsenic (r^2=0.27). The high-As areas in the south-west corner of Mandari and along the River Wabda also have relatively high P concentrations (>0.7 mg L^{-1}). The highest P concentration was 4.06 mg L^{-1} in a sample with a very low Ca concentration (5.4 mg L^{-1}) suggesting that the dissolution of some calcium-phosphate mineral may be playing a role in controlling P concentrations and that some other reaction or process is limiting the Ca concentration. However, as discussed elsewhere, it is likely that P has been derived from several sources including mineral solubility, oxide desorption and organic matter decomposition.

8.5.5 Sulphate

Sulphate concentrations in the well waters show a considerable variation from <0.5 mg L^{-1} up to 137 mg L^{-1}. Median concentrations were 2.8 and <0.5 mg L^{-1} for the shallow and deep aquifers, respectively. The deep aquifer appears to be uniformly low in sulphate, whereas the shallow aquifer is more variable. The sulphate concentration is probably a good indicator of redox status of the aquifer with the lowest concentrations reflecting strongly reduced conditions and the higher concentrations reflecting

8.5.8 Potassium

While the K map (not shown) does not show any strong spatial pattern, potassium concentrations are significantly higher in the shallow wells (median=9.4 mg L^{-1}) than in the deep wells (median=4.3 mg L^{-1}), reflecting the unusually high potassium concentrations in the shallow tubewells from this part of Bangladesh. This probably reflects the high mica and clay content of the sediments. Potassium is likely to be released from the weathering of micaceous minerals, including biotite, chlorite and muscovite, as well as K feldspars.

8.5.9 Boron and silicon

Mandari, as for Lakshmipur *upazila* as a whole, generally has quite high B concentrations compared with the rest of Bangladesh. The maximum concentrations in the shallow and deep wells were 0.71 and 0.31 mg L^{-1}, respectively. Five (2%) of the shallow wells exceeded 0.5 mg L^{-1}, the revised WHO guideline value. These all had Na concentrations exceeding 200 mg L^{-1}. Diluted seawater containing 200 mg L^{-1} Na would provide 0.08 mg L^{-1} B and so, while B often appears to be closely related to Na, there tends to be an excess of B indicating that some of the seawater Na may have been lost or that some of the B has been derived from some other source. Nevertheless, the boron map shows a strong similarity to the Na map, confirming the importance of seawater as a source of boron.

The silicon concentrations varied from 10–30 mg L^{-1} in the shallow wells and from 19–37 mg L^{-1} in the deep wells. The median concentration in the deep wells was 34.7 mg L^{-1} in contrast with 20.6 mg L^{-1} for the shallow wells, suggesting that the deep wells generally had higher Si concentrations. This is supported by the broader survey of Lakshmipur *upazila* but does not appear to be true in the other Special Study Areas or in the southern coastal region from where most of the deep well waters from the NHS were derived. High Si concentrations are more characteristic of the Pleistocene terraces of northern Bangladesh and are sometimes associated with 'older' groundwaters. However, while the deep well waters in Lakshmipur are undoubtedly relatively 'old', other factors are also likely to be involved in controlling Si concentrations.

8.5.10 Other parameters

Four of the wells (three deep and one shallow) from Mandari were included in the ^{14}C survey and are discussed elsewhere (see Chapter 7). The deep well samples were the 'oldest' waters in terms of percent modern carbon sampled during this project.

8.6 CONCLUSIONS

The following conclusions can be drawn from the Mandari survey:

- 239 wells from a 6 km^2 area in Lakshmipur were successfully sampled and analysed in one week using on-site arsenic analysis with an Arsenator.
- As elsewhere in Lakshmipur and the surrounding area, salinity at intermediate depths means that the 'shallow' wells were mostly very shallow, 64% less than 10 m deep, while most of the deep wells exceeded 230 m.
- 77% of the sampled wells were private and 79% of the sampled wells had been installed in 1990 or later.
- Only fifty-one (23%) of the 227 shallow wells sampled fell at or below the 50 µg L^{-1} Bangladesh standard for arsenic, i.e. 77% exceeded the standard.
- Only one shallow tubewell fell below the WHO guideline value for arsenic of 10 µg L^{-1}.
- All of the 12 deep tubewells sampled had As concentrations at or below 2.5 µg L^{-1} and most were less than the detection limit of 0.5 µg L^{-1}.
- Both shallow and deep tubewells gave iron-rich groundwaters.
- Maps for other elements showed some spatial patterns but there was a great deal of short-range spatial variation which means that it is difficult to predict tubewell water quality from the results of neighbouring wells.
- In the future, the availability of the more accurate GPS signals that are are now available should enable the nature of the spatial dependency to be determined down to distances of ten metres or so.
- After being in a beautiful rural setting for a week and sampling more than 200 wells giving clear, flowing water, even we found it difficult to believe that the water contained a 'natural' poison. But the analyses are unambiguous. Something needs to be done rapidly.

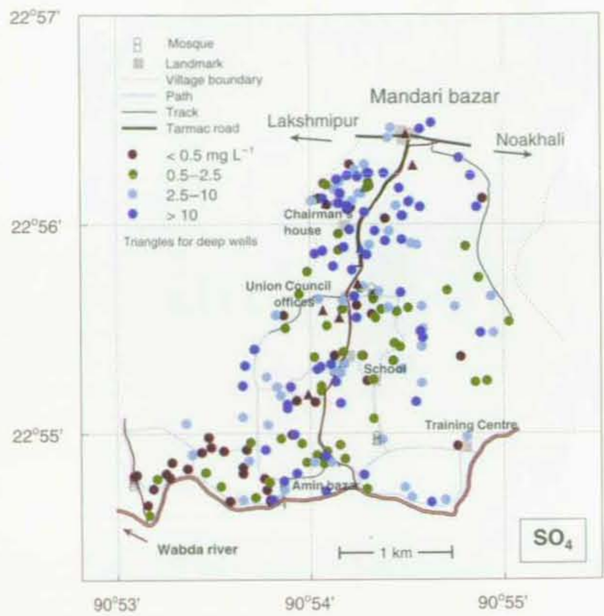


Figure 8.16. Map showing the distribution of sulphate in Mandari wells waters.

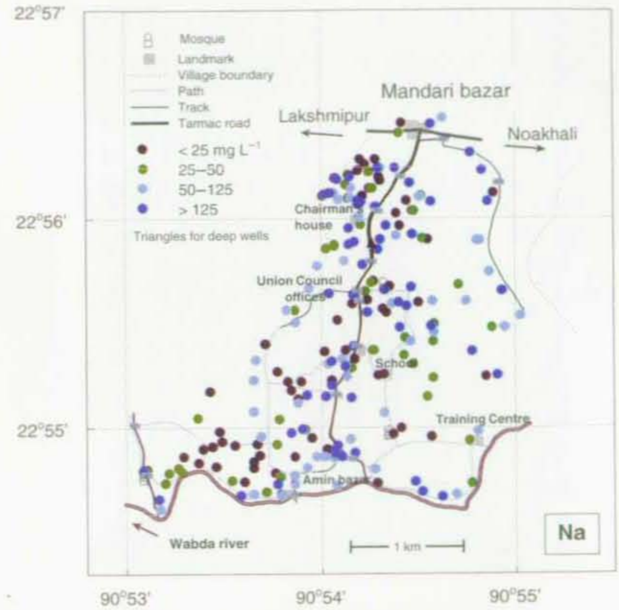


Figure 8.17. Map showing the distribution of sodium in Mandari well waters.

reduced, but not strongly reducing, conditions.

While the spatial patterns were not very clear (Figure 8.16), an area of low-SO_4 waters is concentrated in the south-west of Mandari alongside the River Wabda. This was the area of generally high-As waters and confirms the conclusions reached elsewhere in this study (Chapters 6 and 7) that high-arsenic waters are generally associated with low-SO_4 waters. There was also an area of high-sulphate waters in the north close to the Chairman's house. This was an area of relatively low As concentrations. These features point away from mineral sulphide (pyrite) oxidation being the major cause of arsenic release in this area.

8.5.6 Sodium

The Na map (Figure 8.17) shows relatively little coherent pattern with a wide range of concentrations reflecting a highly variable marine influence. It is remarkable how wells in such a small area, many of which were drilled to a narrow range of depths (normally 26–35 feet or 8–10 m), have such different chemistries. However, Mandari is close to the present-day deltaic-alluvial boundary and this can be expected to have moved laterally in the recent past, leaving a record of highly variable salinity in the sediments of this area. The high degree of lithological stratification found within this depth range in the Lakshmipur test borehole (LPW6, Figure 3.15) confirms the extreme vertical variability of the lithological facies in this area.

The median Na concentration in the shallow aquifer is 47 mg L^{-1} with minimum and maximum values of 8.9 and 1320 mg L^{-1}, respectively. The median concentration in the deep wells was 31 mg L^{-1} and all but one of the 11 deep wells sampled and analysed lay in the range 20–50 mg L^{-1}. 16% of the shallow well samples exceeded 200 mg L^{-1}; one of the 11 deep wells (M143, located near the Chairman's house) did. The depth of this Government well was unknown although it was recorded as 'deep'.

Relatively low Na concentrations are scattered throughout the village although there appears to be a higher density of low Na areas in the south-west corner of the village but not along the river (Figure 8.17).

8.5.7 The alkaline earths: calcium, magnesium, strontium and barium

Not surprisingly, the maps for these four elements (see the *Hydrochemical atlas*) show generally good correlations with each other, especially Mg vs Sr, Ca vs Mg and Ca vs Sr where in each case, the correlation coefficient for the datasets exceeds 0.9 (n=226).

Nevertheless, the maps show a great deal of short-range variation and there is little evidence of a strong local pattern. This probably reflects the great variability in the carbonate mineral content of the sediments and small differences in the well depth. As shown in Chapter 7, Lakshmipur *upazila* has substantially lower Ca concentrations than the other two Special Study Areas. Sediments are likely to have been derived from both the carbonate-poor sediments of the Meghna basin as well as the carbonate-rich sediments from the River Ganges. Calcium concentrations are generally high immediately north-west of Amin Bazar and low east of the girl's primary school but the variability elsewhere is large.

In the higher-Na (exceeding 200 mg L^{-1}) and the higher-SO_4 (exceeding 10 mg L^{-1}) waters, there is quite a good correlation between Na and Mg, indicating that seawater also contributes to the magnesium load of these waters. Seawater does not contribute significant quantities of the other alkaline earth cations.

9.2.1 Approach

Basic statistical analysis

Basic statistical parameters were estimated for both the whole of Bangladesh and on a district basis. The frequency distributions for both the original data and the log transformed data were calculated. A major difficulty in analysing the data is that 24% of the recorded arsenic values were below the instrumental detection limit. As a result, the data distribution shows a large number of values near the lower limit that cannot be resolved further. The censored values also present a problem when attempting to calculate basic statistics. Where necessary, we have substituted half the detection limit value when calculating such statistics. Transformation of the measured arsenic concentrations to their logarithms (base 10) brings the distribution closer to normal but does not remove the peak at low concentrations. An analysis of variance (ANOVA) based on districts was carried out to estimate the within-district variance as well as the overall variance in As concentrations.

Spatial dependency

The spatial dependence of a regionalised variable is represented by the variogram. The variogram is both a theoretical function relating the magnitude of variation to the separation in space in one, two or three dimensions, and it can also be an estimate of this variation based on observed data – this is often called the experimental variogram. The variogram is calculated from the data using the formula:

$$\gamma(h)=\frac{1}{2n(h)}\sum_{i=1}^{n(h)}\left(z(x_i)-z(x_i+h)\right)^2$$

where $z(x)$ and $z(x_i+h)$ are the measured values at x_i and x_i+h and h is the lag, $n(h)$ is the number of pairs $(x, x+h)$ separated by the vector h, and $\gamma(h)$ is the calculated semi-variance at that lag. If the variation is isotropic, then the calculated values are averages over all directions.

The experimental variogram consists of an ordered set of estimates for a chosen set of lags. The true variogram is a continuous function of h. It can be approximated from the experimental variogram by fitting a theoretically acceptable equation or model. Depending on the complexity of the variation, this can be a single model such as an exponential or spherical model which is bounded, or a power function or a more complex model in which two or more simple models are combined and which may or may not be bounded, e.g. bounded linear, double spherical and double exponential models. The more complex models usually fit better than simple models and the Akaike Information Criterion (Webster and McBratney, 1989) based on the residuals can be used to determine the most appropriate, i.e. the best compromise between simplicity and goodness of fit.

Predictions using kriging

Kriging is a technique that enables estimates of the As concentration to be made at points where no observations are available. It can also be applied to blocks of land. At its simplest, kriging is a method of local-weighted averaging of the observed values. Weights are allocated to the sample data with their magnitude depending on the correlation structure of the data, i.e. the variogram of the variable, the configuration of the sampling sites and its relation to the target point or area. Using the variogram and the data, the concentration of As and the kriging variance can be estimated using ordinary kriging. However, one is often interested not only in the estimated As value at a certain point, but also in the probability, given the data, that the As concentration exceeds a certain threshold value at that point, e.g. a drinking water standard. The technique of disjunctive kriging is appropriate for such situations and was applied to our dataset. Rivoirard (1994) describes disjunctive kriging in detail, and an application of this technique is described in Webster (1991).

With disjunctive kriging, the original data are transformed to a Gaussian (normal) distribution using Hermite polynomials and then the variogram of the transformed variable is calculated and modelled. Using the variogram, the concentration of As and the indicators for each of the thresholds can then be estimated. Estimates for these indicators are given by the estimated probabilities that the concentrations exceed the value associated with each indicator (5 μg L^{-1}, 10 μg L^{-1}, 50 μg L^{-1} and 150 μg L^{-1}, respectively, in our case).

9.2.2 Basic statistics and the data distribution

The data were split into two sets: those for shallow wells and those for deep wells. A depth of 150 m was used for making this split. These two datasets were treated separately. Data for the shallow wells (3208 sites) were analysed using both basic statistics and also geostatistics. Only the basic statistical analysis was carried out on the deep wells.

Summary statistics for As for both datasets are given in Table 9.1. The probability distributions of the As concen-

Table 9.1. Summary statistics for deep wells (>150 m) and shallow wells (<150 m)

	Shallow wells (<150 m)	**Deep wells (>150 m)**
Number of observations	3208	326
Mean (μg L^{-1})	60.52	2.95
Standard deviation (μg L^{-1})	123.11	8.29
Variance (μg $L^{-1})^2$	15155.9	68.7
Geometric mean (μg L^{-1})	5.47	1.06
Geometric variance (μg $L^{-1})^2$	22.77	2.08
Percentiles (μg L^{-1})		
10	0.1	0.25
20	0.2	0.25
30	0.6	0.25
40	2.0	0.75
50 (Median)	6.1	1.04
60	16.6	1.56
70	40.4	2.07
80	83.4	3.17
90	199.7	5.29
95	320.0	9.39
99	570.7	42.85

9 Scales of variation

9.1 Introduction

One of the recurring comments heard in Bangladesh when discussing the groundwater arsenic problem is of the great variability in groundwater arsenic concentrations found. It is often said that the arsenic concentrations in adjacent wells bear very little resemblance to one another. This makes mapping the spatial variation in arsenic concentrations within a village very difficult. Indeed it is usually inferred from such observations that each and every well needs to be analysed. This may indeed be the case for compliance testing but the problem with such statements is that they tend to promote the attitude that there is little or no spatial dependence in the data and that we should just accept that we are dealing with a hopelessly spatially variable environment. In reality, this is far from the case, especially on the regional scale, and we can use the spatial patterns to aid the setting of priority areas for emergency testing, and perhaps in the future, to help guide a national water resources strategy.

In this Chapter, we explore this spatial dependence quantitatively. We focus mainly on the regional hydrochemical dataset for arsenic but a similar approach could also be adopted for the other parameters. We concentrate on the regional dataset since this is at present the most complete dataset in terms of spatial coverage. However, there are many scales of variation in arsenic concentrations and with more data, it would be useful to explore other scales. In particular, the village scale of variation deserves more attention from a quantitative point of view.

These scales of variation range from the molecular to the regional (Figure 9.1) with some scales having more significance for some processes and objectives than others. For example, total arsenic concentrations in bulk sediments from Bangladesh are typically in the range 1–10 mg kg^{-1} but within these sediments there may be minerals containing essentially no As while in other minerals in the same sediment the concentration may exceed 1000 mg kg^{-1}. Different particles of the same mineral may also have a different origin and may contain different As concentrations, and even within an individual mineral particle there may be zonation due to a changing environment during particle growth or to later diagenesis or weathering.

These spatially highly variable sediment concentrations which are seen at the microscopic scale will tend to be reflected to some extent in variations in the concentration of As in the surrounding water, and ultimately in some of the variation seen in well waters at the field scale. From a practical point of view, recognising this variability is also important when investigating the geochemical processes involved, and when reporting and interpreting the As concentration of sediments and minerals.

9.2 Country and district level

The arsenic data have been analysed using both classical statistics and geostatistics. Geostatistics is a branch of statistics that deals specifically with spatially-variable data. The mathematical background of the technique is described in standard geostatistics textbooks (Kitanidis, 1997; Webster & Oliver, 2001). The application of geostatistic involved three steps based on the assumption that the arsenic concentration could be treated as a 'regionalised variable': (i) computation and modelling of the variogram; (ii) prediction of concentrations by kriging, and (iii) an analysis of the errors. Kriging is superior to simple interpolation in that it uses knowledge of the spatial structure gained from the data, it interpolates exactly and provides an estimate of the error in such interpolations (kriging variance). Such an analysis can therefore lead to an insight into the spatial variance of the data. We have also used kriging to estimate the groundwater As concentration in shallow groundwaters on a 5-km grid for the whole of the sampled region of Bangladesh and to estimate the probabilities that the As concentration exceeds a specified threshold value. The following thresholds were chosen: 5 µg L^{-1}, 10 µg L^{-1} (the WHO guideline value) and 50 µg L^{-1} (the Bangladesh standard). A 150 µg L^{-1} threshold was also included.

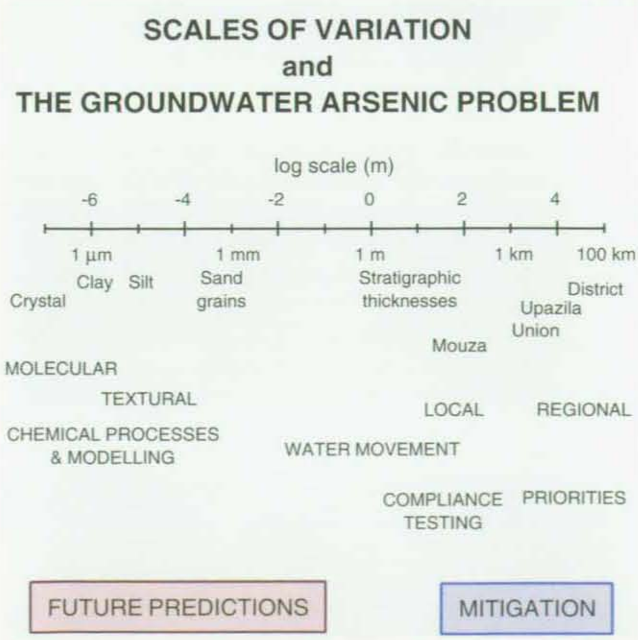


Figure 9.1. Different scales of variation and their relevance to different processes and objectives.

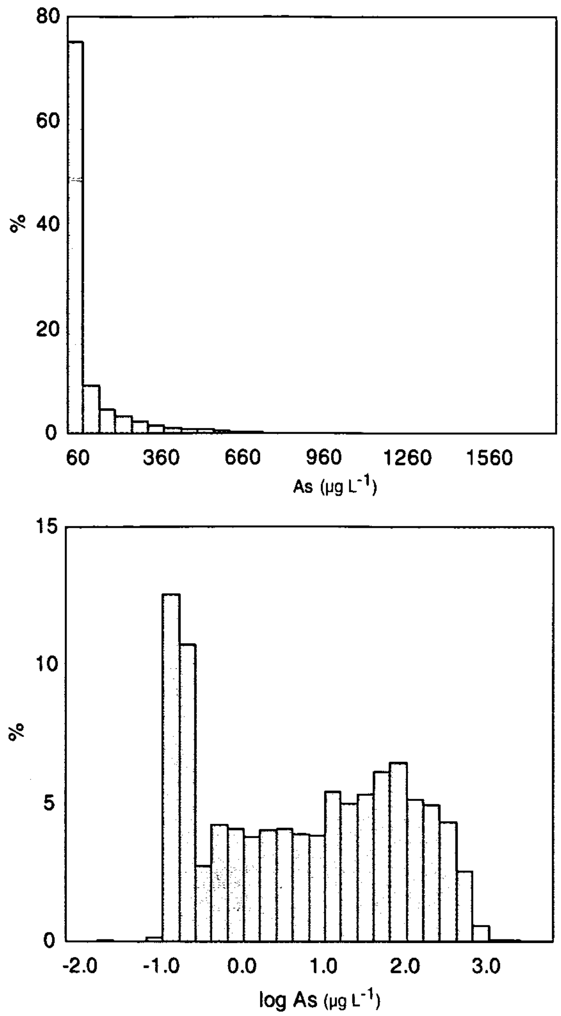


Figure 9.2. Histograms of the arsenic and log arsenic data (n=3534)

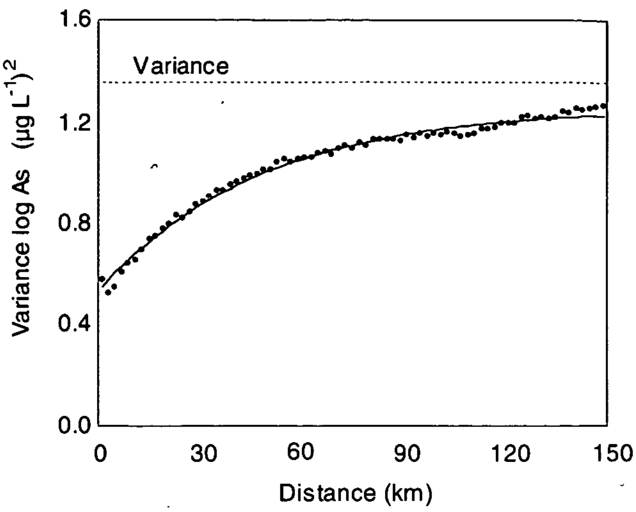


Figure 9.3. Variogram of the log As-data.

trations, and the log As concentrations of the shallow wells, are given in Figure 9.2.

Shallow wells

Whole country. The mean As concentration in the shallow wells is 60.5 µg L^{-1} with a maximum of 1670 µg L^{-1} and a minimum of less than the detection limit (usually less than 0.5 or 0.25 µg L^{-1}). The distribution is strongly skewed with almost 80% of the samples in the lowest class. Only three samples were greater than 1000 µg L^{-1}. The median concentration of 6.1 µg L^{-1} is much smaller than the mean value which reflects the skewed nature of the distribution. The variance of the distribution is large leading to a standard deviation of 123 µg L^{-1} which is 203% of the mean value. The As concentrations were transformed to their logarithms (base 10) in order to attempt to normalise this long-tailed distribution. The skewness is reduced, but the fact that many samples were close to or below the detection limit leaves many values in the lower classes (–1.0 to –0.6). Also, after log transformation the distribution is still far from normal.

Districts. The analysis of variance (ANOVA) based on the As concentrations in each of the 61 sampled districts are given in Table 9.2. The variance ratio from the mean squares is approximately 30 in the case of the untransformed data and 41 in the case of the log transformed data. This points to a large variation in the means between districts, i.e. it confirms a significant regional pattern.

Deep wells

For the deep wells the As concentrations are much lower. The mean concentration is about 3 µg L^{-1}, the median concentration is 1 µg L^{-1}, the minimum is less than the detection limit and the maximum is 108 µg L^{-1}. The standard deviation is also very large, 8.3 µg L^{-1}, which is 277% of the mean value. These statistics are strongly influenced by the large number of censored data values.

Table 9.2. District-wise analysis of variance (ANOVA) for the As measurements from the shallow wells

Source of variation	Degrees of freedom	Sum of squares	Mean square	Variance ratio
		Untransformed As measurements		
Between districts	60	18016773	300280	30.88
Within districts	3146	30587459	9273	
Total	3206	48604232		
		Log transformed As measurements		
Between districts	60	1918.98	31.98	41.35
Within districts	3146	2433.50	0.77	
Total	3206	4352.48		

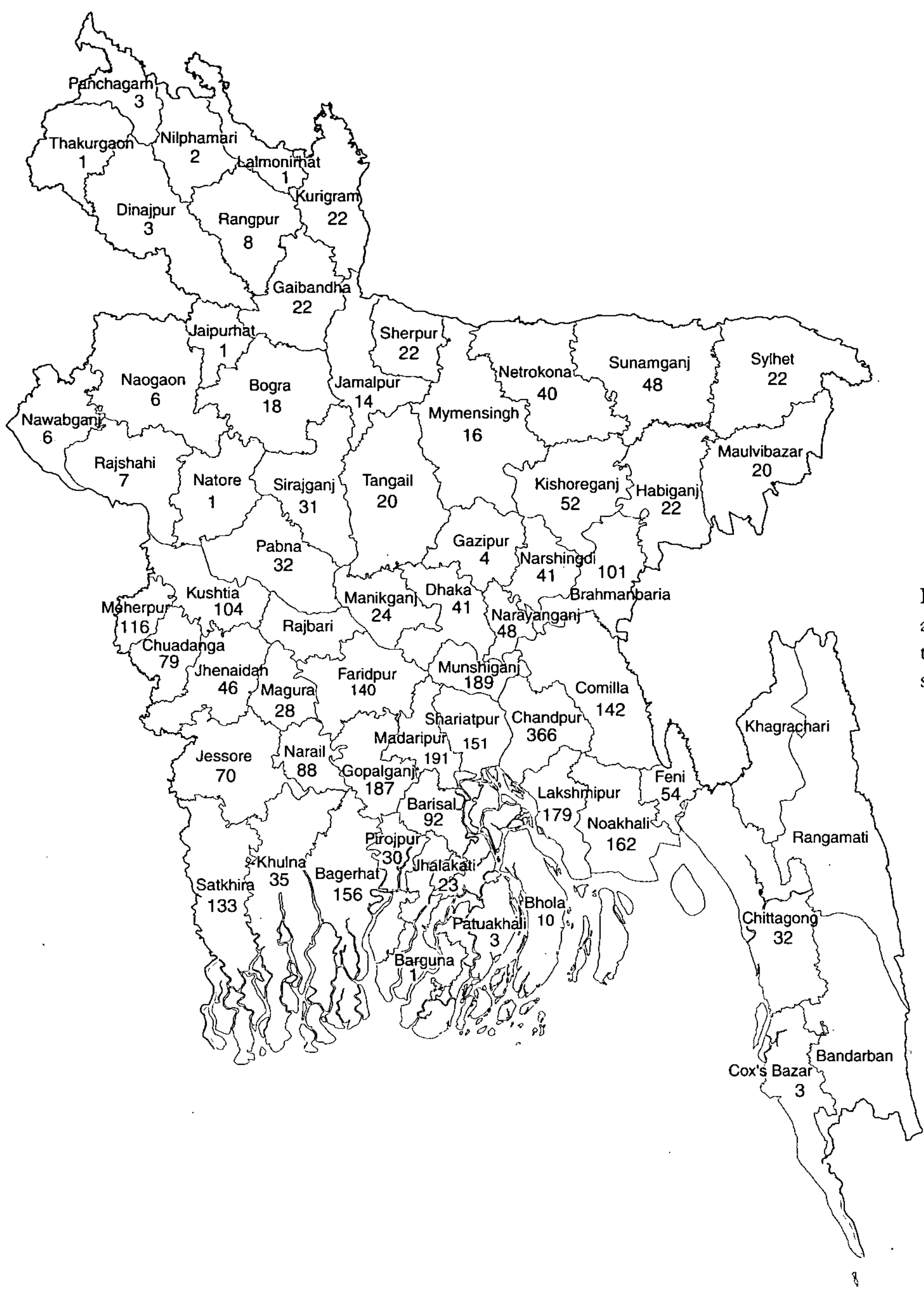


Figure 9.4. Map of the district-mean arsenic concentrations (in µg L^{-1}) found in the DPHE/BGS National Hydrochemical survey.

9.2.3 Spatial analysis

Whole country

The variogram for the $\log_{10}$-transformed As concentrations in the shallow wells (Figure 9.3) was computed up to a maximum lag distance of 150 km at intervals of 2 km. The horizontal line on the graph indicates the overall variance. The experimental variogram was fitted to an isotropic, exponential model:

$$\gamma(h) = c_0 + c\left(1 - e^{-h/a}\right)$$

where c_0 represents the nugget variance, c is the sill variance and a is the distance parameter. The optimal parameter values based on a minimisation of the sum of squares of the residuals were: c_0=0.5335 (µg $L^{-1})^2$, c=0.724 (µg $L^{-1})^2$ and a=48100 m.

The nugget variance, which is the intercept of the function on the ordinate, is large. It represents the variation in As concentrations over distances smaller than a couple of km interval plus any measurement error. This nugget variance is equivalent to some 42% of the overall variance observed in the data for the whole country. The sampling strategy deliberately avoided closely-spaced samples and so it is not surprising that little is known about the spatial dependence over short distances.

It was decided that a maximum of 20 data points would be used for making the kriged estimates and so a maximum lag distance of 150 km was chosen. Given the sample density of the data, it is unlikely that the maximum lag distance required to achieve this would often exceed 150 km. With increasing lag distances, the variance increased steadily. Even at the maximum lag distance, the sill value (being a constant variance not dependent on the lag distance) was not reached. This reflects the long-range component in the As concentrations. Figure 9.4 shows that in general As

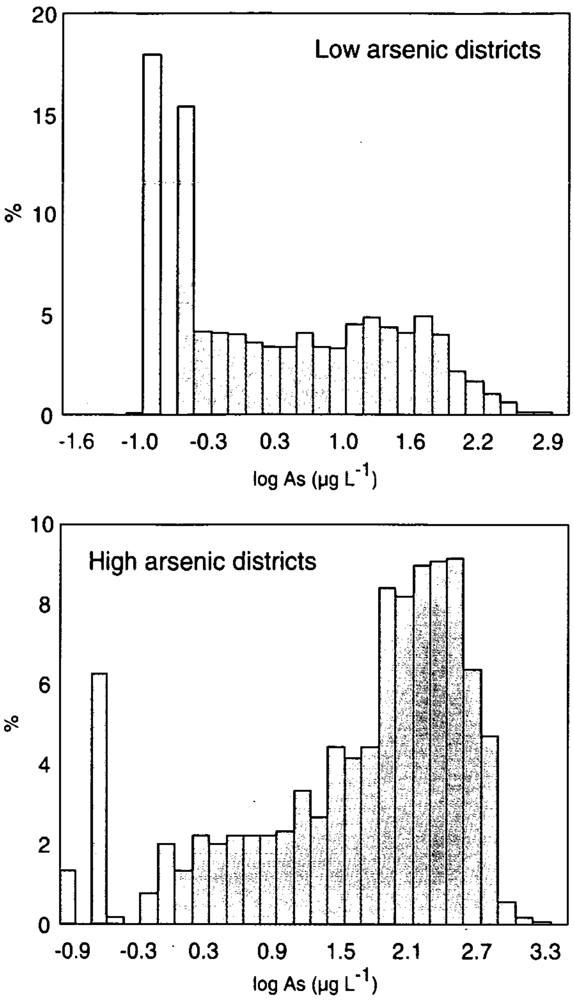


Figure 9.5. Histograms of the districts with a mean arsenic concentration of below 50 µg L^{-1} and those with a mean arsenic concentration of over 50 µg L^{-1}.

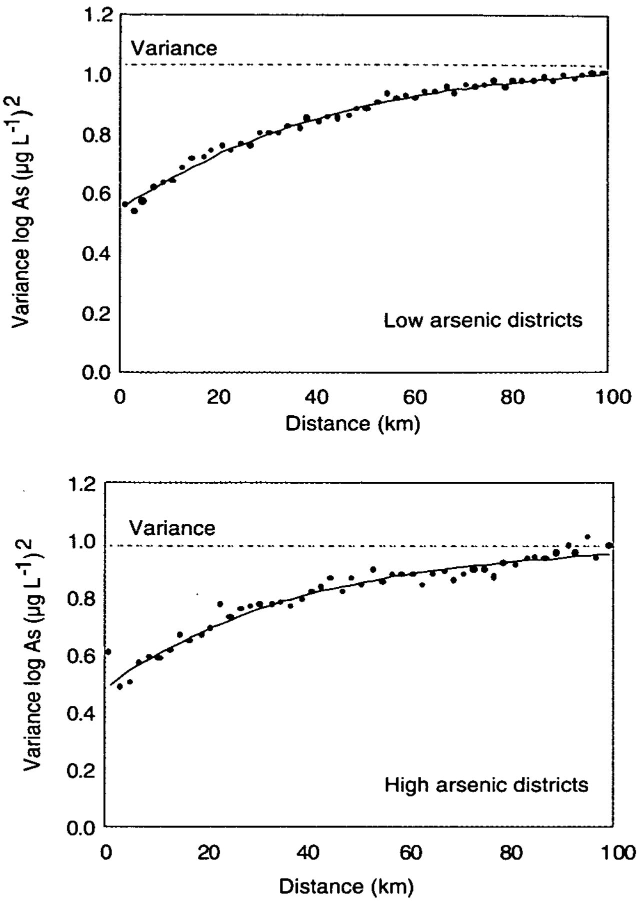


Figure 9.6. Variograms of the districts with a mean arsenic concentration of below 50 µg L^{-1} and those with a mean arsenic concentration of over 50 µg L^{-1}.

concentrations in the south of Bangladesh tend to be much greater than in the north. District-mean As concentrations vary by more than two orders of magnitude.

Districts

In order to see if the spatial variation depended on the mean As concentration in a district, a distinction was made between districts having a mean As concentration of less than 50 µg L^{-1} (SET 1) and districts with a mean As concentration greater than 50 µg L^{-1} (SET 2).

The two sets of data were then analysed separately. The frequency distributions for both sets are given in Figure 9.5 and their variograms given in Figure 9.6. In both sets of data, there are many values close to or less than the detection limit although the influence of these values on the resulting distribution is less important for the districts with high As concentrations. The variograms for the two sets of data are remarkably similar. The nugget variance is only slightly smaller for SET 1 than for SET 2 and both values are similar to the nugget variance of the combined data. Also, the overall variances of the two datasets are similar. Both experimental variograms fitted an exponential model well. The similarity between the variograms implies that the spatial variation of As concentrations in SET 2 is not essentially different from that of SET 1 and that the variance does not correlate with the As concentrations. This means that for the kriging, the overall variogram can be used for the whole of Bangladesh and that no distinction has to be made between areas with small and large As concentrations.

9.2.4 Predicting arsenic concentrations and the probability that a threshold level has been exceeded

Kriging and disjunctive kriging calculations

In the first instance, ordinary punctual kriging was carried out with the log-transformed As concentrations. Kriged estimates and kriging variances were calculated on a 5-km grid for the whole of Bangladesh. The kriged estimates were calculated for the centre point of each grid cell. The parameters used for the kriging are given in Table 9.3. Since the kriging was carried out on the log-transformed As concentrations, the estimates derived must be transformed back to the original scale taking into account the estimated kriging variance:

$$z = \exp\left(y \ln 10 + 0.5\sigma^2 (\ln 10)^2\right)$$

Table 9.3. Parameters used for ordinary and disjunctive kriging

Parameter	Ordinary kriging	Disjunctive kriging
Type of kriging	punctual	punctual
Max number of data for any one estimate	20	20
Interval between estimates in the X and Y-direction	5 km	5 km
Variogram model	exponential log-transformed variable	exponential Hermite-transformed variable
Distance parameter (m)	48096	60957
Nugget variance ($\{\log_{10}$ (μg L^{-1})$\}^2$)	0.5335	0.3284
Sill variance ($\{\log_{10}$ (μg L^{-1})$\}^2$)	0.7240	0.4852
Number of terms in the Hermite expansion	—	7
Number of terms in the least squares fit	—	7
Number of terms in the Hermite integration	—	5

where z is the estimated As concentration in μg L^{-1}, y is the estimated $\log_{10}$ As concentration and σ^2 is the kriging variance in terms of $\{\log_{10}$ (μg L^{-1})$\}^2$. In order to check the reliability of the results, both ordinary punctual kriging and block kriging using the original variable were also carried out.

Subsequently, disjunctive kriging (von Steiger et al., 1996; Webster, 1991) was carried out on the original As concentrations. The Hermite transformation of the original data to a standard normal variable is presented in Figure 9.7(a). The large deviation from a linear function for the transformation function indicates the strong skewness of the original data. If the original data were normally distributed then the transformation function would be linear.

Looking at the distribution of the Hermite-transformed As concentrations (Figure 9.7(b)), it is clear that although the transformed variable is closer to a normal distribution than the original variable, the distribution is still not normal. It is assumed that the large proportion of values close to the detection limit makes it impossible for a Hermite transformation to give a normal distribution. Therefore one of the conditions for disjunctive kriging is not fulfilled. This means that the disjunctive-kriged estimates, their variances and the estimated threshold probabilities have to be treated with caution. An alternative approach to overcome the non-normality of the distribution would be to apply indicator kriging (Goovaerts, 1997). No assumptions concerning the distribution of the kriged variable are made with indicator kriging and the deviation from normality would not pose a problem. However, indicator kriging is time-consuming and could not be carried out within this project.

The variogram for the Hermite-transformed As concentrations is shown in Figure 9.7(c). It was fitted to an exponential model. Disjunctive punctual kriging was used to calculate arsenic concentrations and their variances and also the probabilities that the As concentration exceeded the 5, 10, 50 and 150 μg L^{-1} thresholds. These estimates, variances and probabilities were calculated for a 5 km grid. The parameters used in these calculations are given in Table 9.3.

The representative sample interval (which is the area for which one sample is representative – in this case, this could be interpreted as the area of the depression cone of a sampled well) is in this case smaller than the grid area used for the estimates (25 km^2 for a 5 km grid). In geostatistical terms, the estimates have been calculated for a scale greater than the scale of the 'support'. In order to overcome this problem, which might affect the estimated probabilities, Webster (1991) describes how disjunctive block kriging can be used to increase the scale of the support. However, because of time constraints, this approach could not be tested.

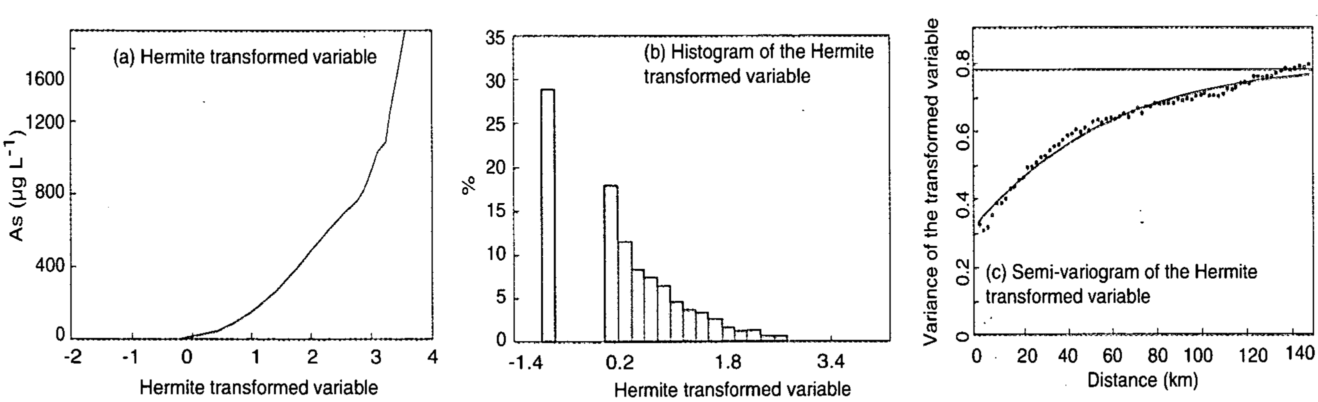


Figure 9.7. Behaviour of the Hermite-transformed variable for disjunctive kriging of arsenic concentrations. (a) The transform function between the original and the Hermite-transformed variable; (b) the distribution of the Hermite-transformed concentrations, and (c) the variogram of the Hermite-transformed variable.

9.2.5 Analysis of the results

Comparison of disjunctive kriging and ordinary kriging

In order to compare the As estimates obtained by disjunctive kriging and ordinary kriging, the two estimates have been plotted against each other for each point on the 5 km grid. In Figure 9.8(a), the disjunctive kriged estimates are compared with the ordinary kriged estimates using the log-transformed variable, while in Figure 9.8(b) the disjunctive kriged estimates are compared with the ordinary kriged estimates using the original variable.

Ideally the points should plot on a straight line through the origin in both graphs. This is certainly not the case for ordinary kriging using the log-transformed variable (Figure 9.8(a)). The estimates obtained with ordinary kriging using the log-transformed As concentrations lead to far greater estimates (up to 6000 μg L^{-1} while the maximum value in the data was 1670 μg L^{-1}) than the estimates obtained with disjunctive kriging. The reason for this large discrepancy is not understood, and needs further investigation. The estimates obtained with ordinary kriging on the original variable agree well with the disjunctive kriging estimates. Most of the points which deviate considerably from the diagonal have a large kriging variance (and lie outside the Bangladesh borders) as can be seen from Figure 9.8(c) where points with a disjunctive kriging variance greater than 11,000 (μg $L^{-1})^2$ have been eliminated.

The large kriging variances lead to a great deal of scatter. This means that the estimates from ordinary kriging of the log-transformed variable are of dubious value. Because the distribution of the original arsenic concentration, on which ordinary kriging is based, was so skewed, preference was given to the disjunctively-kriged estimates which were based on Hermite-transformed concentrations. These are therefore the estimates which have been mapped.

Kriged arsenic concentrations and kriging variances

The map of the disjunctively-kriged estimates is shown in Figure 9.9. An arbitrary colour scale (a 'temperature' scale) was chosen to distinguish the concentrations. Kriged estimates having a kriging variance greater than 11,000 (μg $L^{-1})^2$ are not displayed because the error of the estimate would be too large. The maximum kriged estimate was 417 μg L^{-1} which is smaller than the maximum measured As concentration of 1670 μg L^{-1}. This illustrates the smoothing effect of kriging. Due to the high sampling density the kriging variances are not very informative. The kriging variances depend principally on the sampling density and since the sampling density was fairly homogeneous over the whole of Bangladesh (with the exception of the south-east and the islands), the map of the kriging variances (not shown) shows little variation within Bangladesh.

Probabilities for exceeding a threshold

A map of the probabilities was produced for each of the specified threshold concentrations (Figure 9.10). As before, a linear scale was used and probabilities with a kriging variance greater than 11000 (μg $L^{-1})^2$ were not dis-

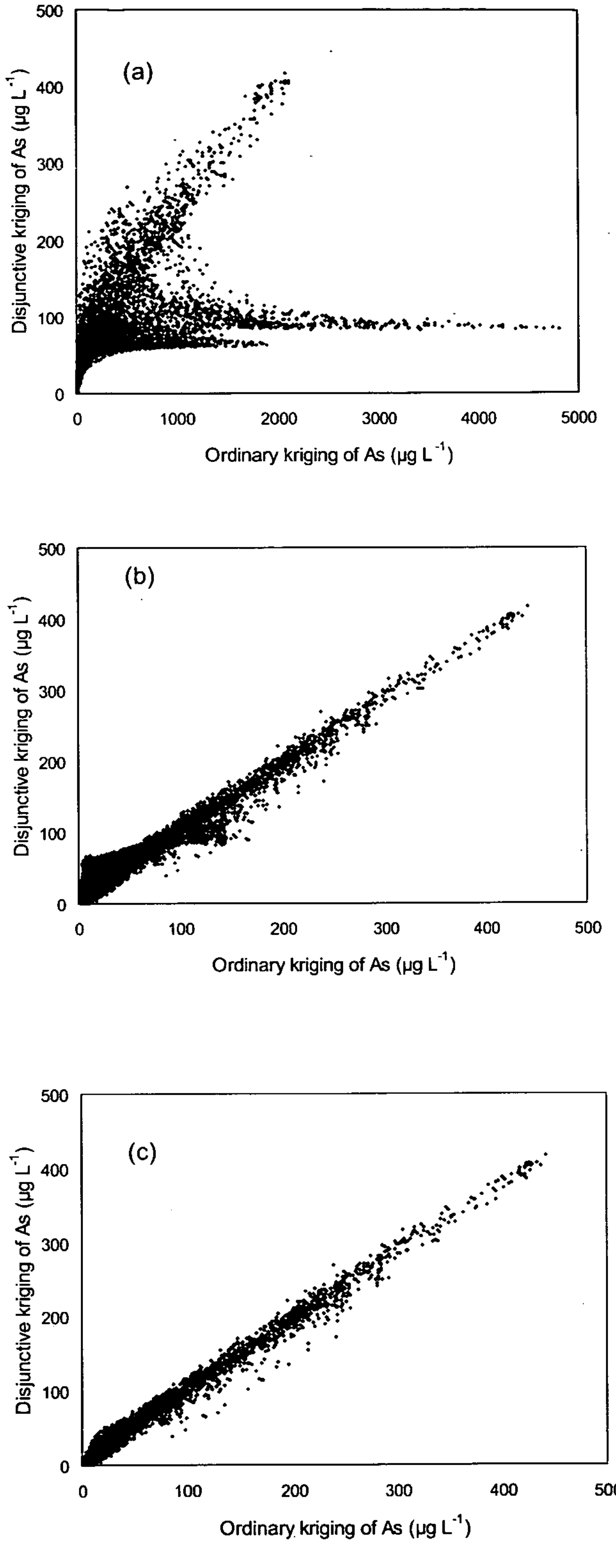


Figure 9.8. Comparison of estimated arsenic concentrations obtained by ordinary kriging and disjunctive kriging. (a) based on log-transformed concentrations for the ordinary kriging estimates and Hermite-transformed concentrations for the disjunctive kriging estimates; (b) ordinary kriging estimates based on untransformed concentrations; (c) as for (b) except that only points with a low disjunctive kriging variance have been retained.

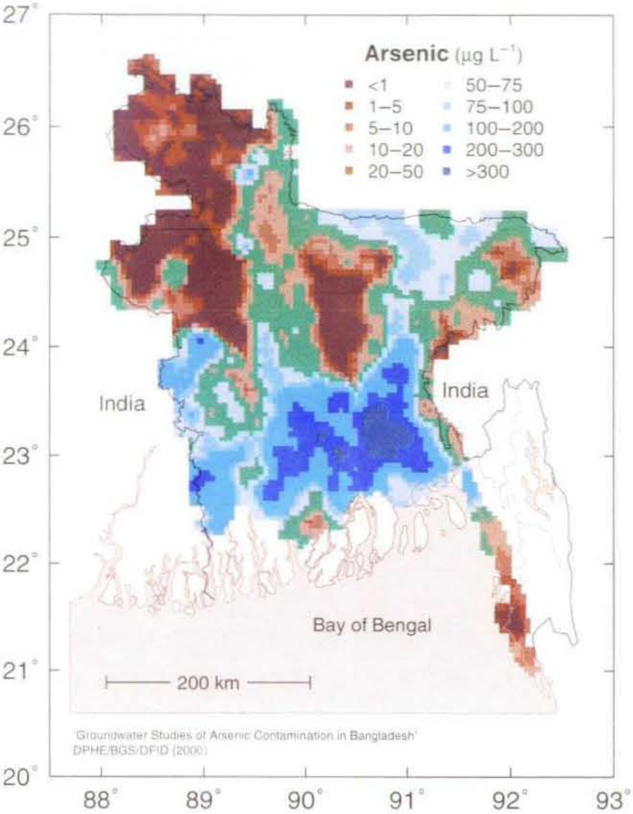


Figure 9.9. Smoothed map showing the estimated arsenic concentrations in shallow wells (<150 m) based on disjunctive kriging.

played because of the poor reliability of these estimates.

The estimated probabilities for each of the points has been plotted against the disjunctively-kriged estimates (Figure 9.11(a-d)). In most cases, the larger the estimated As concentration the greater the probability that the threshold will be exceeded. The farther away that the threshold was from the detection limit and the closer it was to the mean of the distribution, the more nearly linear was the relation between the estimates and their probabilities. This is clearly illustrated in Figure 9.11(c-d). For the 150 $\mu g\ L^{-1}$ threshold, an almost linear correlation exists between the two variables. Also the results for the 50 $\mu g\ L^{-1}$ threshold also suggests, but with more scatter, a linear relation. For the 10 $\mu g\ L^{-1}$ threshold and certainly for the 5 $\mu g\ L^{-1}$ threshold, the relationship seems to curve towards the probability axis indicating a greater range of probabilities for the same estimated As concentration. For these graphs, where the threshold value is much less than the mean value, many observations exceed the threshold value. The estimates might not be as reliable as the probabilities found for thresholds closer to the mean of the distribution.

An estimate of the number of people exposed to an As concentration greater than 50 $\mu g\ L^{-1}$ was calculated by combining the arsenic map with the *upazila*-based population map. The following approach was taken: (i) the 1991-based *upazila* populations were increased by 2.1% per year to give estimates of the 1999 *upazila* populations, i.e. the factor (1+0.021)^8=1.181 was used. This gave an estimated 1999 population of 125.5 million for the whole of Bangladesh; (ii) the population densities were calculated for each *upazila*; (iii) the population of each 5 km grid cell was estimated based on the area-weighted contribution of each *upazila* to the grid cell; (iv) this value was multiplied by the estimated probability for As exceedance of each grid cell to give the exposed population for that cell (a zero probability was assumed for unsampled *upazilas* principally from the Chittagong Hill Tracts), and (v) the total population was estimated by summing the exposed populations for all of the cells.

The following three factors were also taken into account in this calculation:

1. the *upazila* "Dhaka Metro" was excluded because the drinking water for most people in Dhaka city is derived from the deeper, uncontaminated aquifer;
2. the south east coastal part of the country, some of the islands and the Chittagong Hill Tracts were excluded because the kriging variances exceeded 13000 $(\mu g\ L^{-1})^2$ and the estimated probabilities were therefore deemed too unreliable (in practice, these are all believed to be areas of relatively low arsenic risk in part because the shallow groundwater is not primarily used for drinking water);
3. it was assumed that 97% of the population used well water for drinking (and cooking) water.

No explicit 'corrections' were made for large population centres such as Chittagong and Khulna where drinking water is supplied from a relatively small number of municipal wells. These are usually set deeper than many of the surrounding shallow tubewells and in the case of Khulna and Chittagong are believed to be low in As.

Bearing in mind these assumptions, this calculation leads to an estimated total number of people exposed to an As concentration of greater than 50 $\mu g\ L^{-1}$ of 35.2 million. Excluding the city of Khulna would reduce this number by approximately 0.7 million people. A map showing the exposed population densities obtained is given in Figure 9.12. Making the same calculation to estimate the number of people exposed to an As concentration exceeding 10 $\mu g\ L^{-1}$ gave an estimate of 56.7 million people.

Simpler calculations of the exposed population were also made using entirely *upazila*-based statistics. The percentage of wells in each *upazila* exceeding a given threshold was multiplied by the population of that *upazila* and then by the factor 0.97 since 97% of the rural population are assumed to use groundwater. Unsampled *upazilas* were assumed to contribute no exceedances. This gave estimates of the population exposed to greater than 50 $\mu g\ L^{-1}$ and 10 $\mu g\ L^{-1}$ as 28.1 million and 46.4 million people, respectively. The kriged estimates are significantly greater than the purely *upazila*-based estimates and in the absence of data to the contrary are believed to be more accurate. Both sets of calculations could be refined with higher resolution and more up-to-date population maps and with a greater density of sampled wells. Nevertheless, the figures clearly demonstrate the massive scale of the problem. Changing from the Bangladesh standard to the WHO guideline value would add approximately another 20 million people to the population 'exposed'.

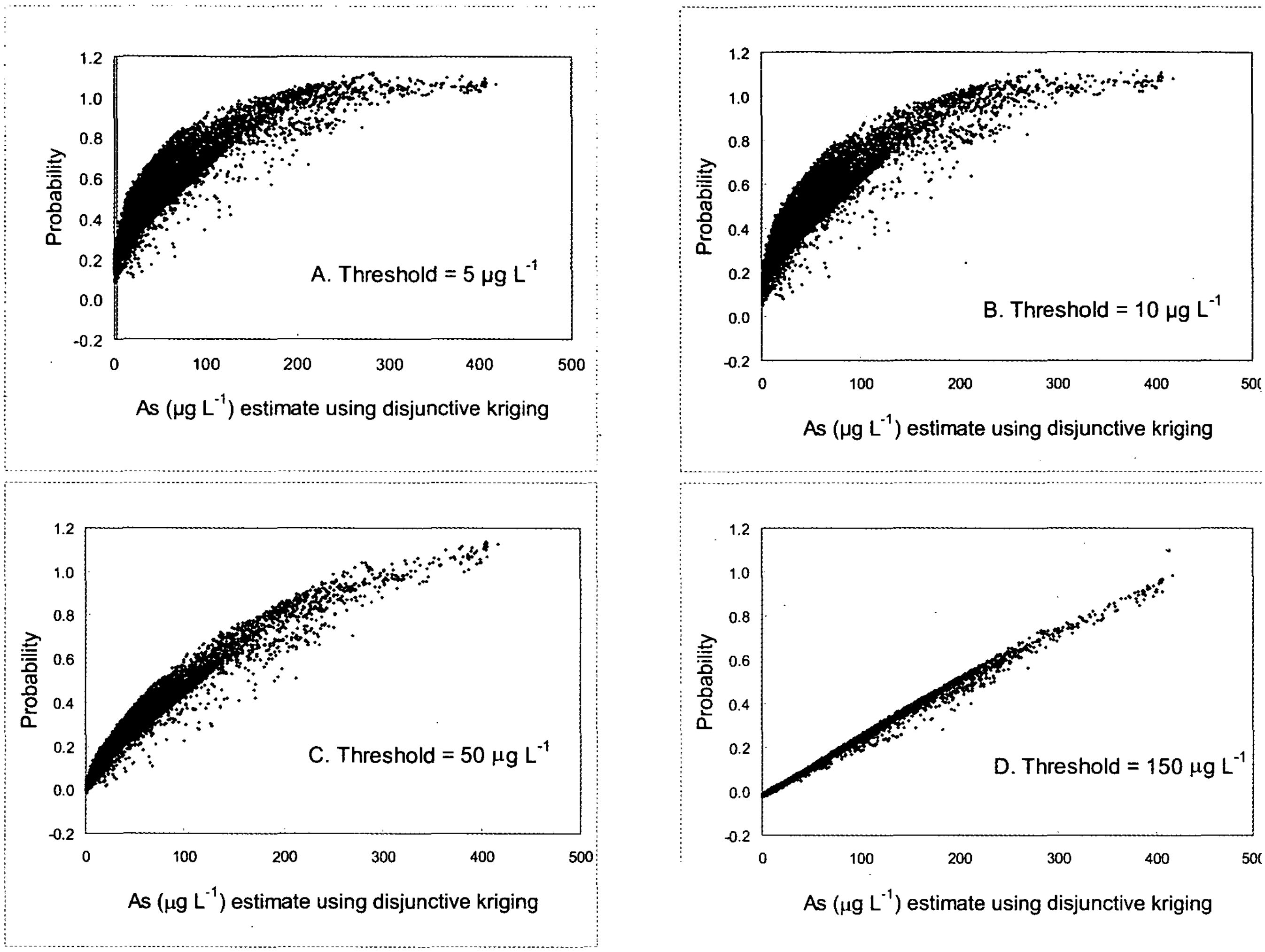


Figure 9.11. Scatter diagrams of the calculated probabilities for the arsenic concentration to exceed a defined threshold against calculated arsenic concentration using disjunctive kriging. (a) Threshold= 5 μg L^{-1}, (b) Threshold= 10 μg L^{-1}, (c) Threshold= 50 μg L^{-1}, (d) Threshold = 150 μg L^{-1}.

Table 9.4. Percentage of Bangladesh by area that exceeds a probability limit with respect to the 50 μg L^{-1} Bangladesh arsenic standard

Probability limit with respect to the Bangladesh Arsenic Standard (50 μg L^{-1})	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Percentage of the total area of Bangladesh exceeding the probability limit (in%)	62	47	35	25	17	13	9	6	3

Percentage of the total area of Bangladesh for which the probability was calculated = 92%.

It is unfortunate that many of the most-contaminated areas south-east of Dhaka are also areas of high population density. The percentage of Bangladesh by area that exceeds the 50 μg L^{-1} Bangladesh arsenic standard has also been calculated as a function of the associated probability (Table 9.4). For example, there is a 90% probability of finding a well to be contaminated in only 3% of Bangladesh and a 50:50 chance of finding a well to be contaminated in 17%, or about one-sixth, of Bangladesh.

9.3 LOCAL VARIATION

Lakshmipur upazila

The Lakshmipur dataset from the Special Study Area survey (Chapter 7) (59 observations, Table 9.5) was selected for further statistical analysis. All samples selected were obtained from a well depth of less than 150 m. The mean As concentration of 159 μg L^{-1} is considerably higher than the national average since Lakshmipur is located in the

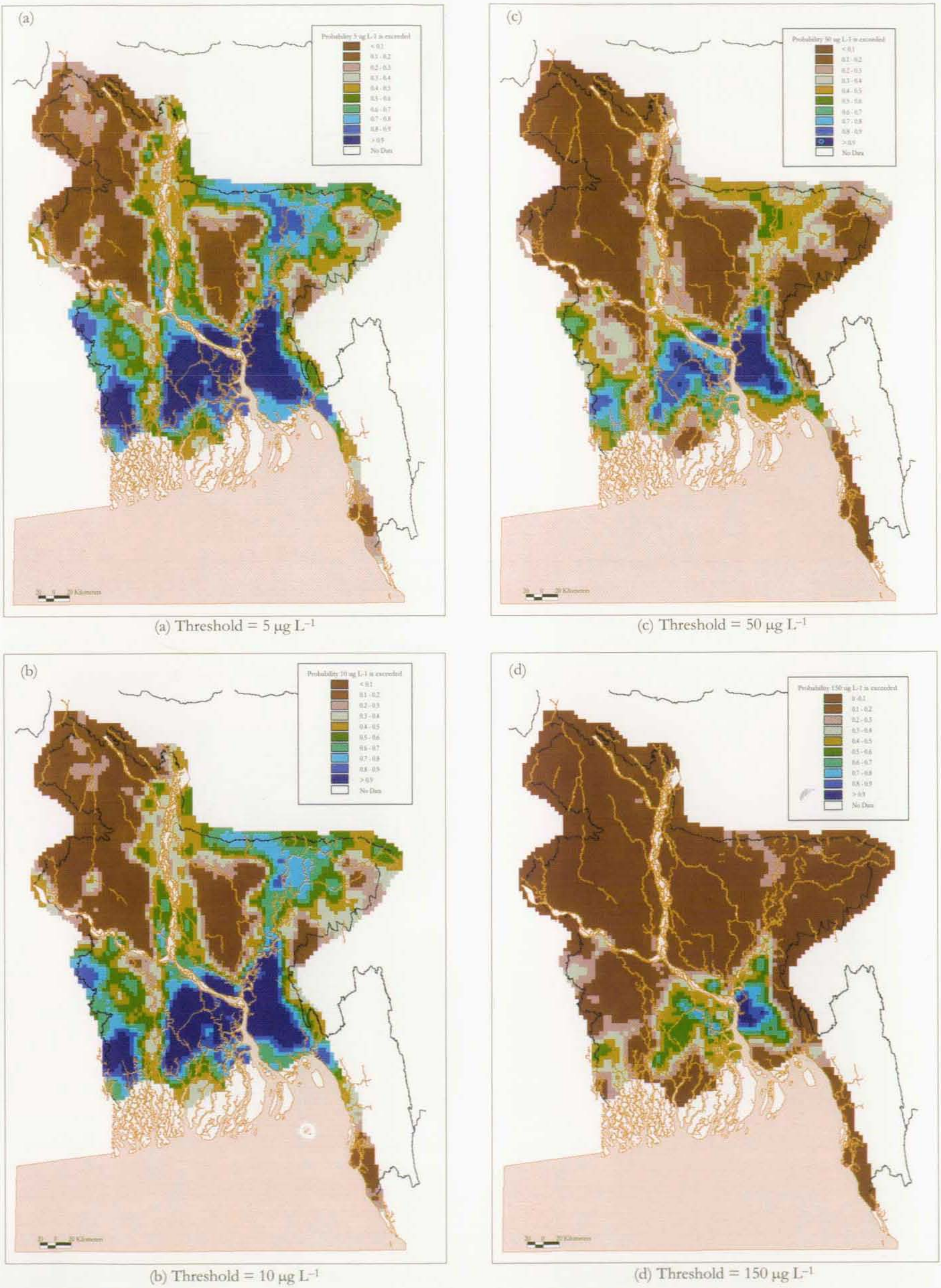


Figure 9.10. Probabilities, calculated using disjunctive kriging, that the arsenic-concentration exceeds specified thresholds. **(a)** 5 μg L^{-1} **(b)** 10 μg L^{-1} **(c)** 50 μg L^{-1} **(d)** 150 μg L^{-1}.

Table 9.6. Summary statistics for the deep wells (>150 m) and the shallow wells (<150 m) in Mandari

	Shallow Wells (<150 m)	Deep Wells (>150 m)
Number of observations	228	10
Minimum ($\mu g\ L^{-1}$)	11.71	0.03
Mean ($\mu g\ L^{-1}$)	125.04	5.43
Maximum ($\mu g\ L^{-1}$)	701.95	16.00
Standard deviation ($\mu g\ L^{-1}$)	132.56	6.10
Variance ($\mu g\ L^{-1})^2$	17572.00	37.26
Geometric mean ($\mu g\ L^{-1}$)	86.31	1.51
Geometric variance ($\mu g\ L^{-1})^2$	1.34	9.84
Percentiles ($\mu g\ L^{-1}$)		
10	37.79	0.04
20	45.14	0.40
30	60.25	0.92
40	67.68	1.69
50 (median)	77.92	2.53
60	92.25	4.45
70	110.07	7.93
80	138.33	11.54
90	300.18	14.20
95	465.75	15.10
99	610.77	15.82

of which 227 are for tubewells shallower than 150 m. The mean As concentration of the shallow tubewells is 122.4 $\mu g\ L^{-1}$ with a maximum of 707 $\mu g\ L^{-1}$. The mean concentration is again considerably larger than the overall mean As concentration in the country. The standard deviation is 132.6 $\mu g\ L^{-1}$, which is 106% of the mean. The frequency distribution (Figure 9.14(a,b)) of the As concentrations is strongly skewed. Taking logarithms eliminates much of the skewness.

The experimental variogram of the log-As concentrations of the shallow wells is shown in Figure 9.14(c). The interval between the calculated points is 100 m. The calculated values show a large scatter and are situated close to the overall sample variance. This indicates that the experimental variogram consists of pure nugget variance indicating that there is no spatial dependence in the dataset. The accuracy of the GPS measurements of the map coordinates will affect the variogram because of the small distance between many of the wells. The nugget variance of the Mandari variogram is approximately the same as the nugget variance for the Lakshmipur data (0.091) and about 5 times less than for the national dataset.

9.4 CONCLUSIONS

Classical statistics and geostatistics have been used to analyse the spatial variability of some of the water quality data collected during this project, principally the arsenic data from the National Hydrochemical Survey.

The NHS groundwater data were divided into those from shallow wells (<150 m) and those from deep wells (>150 m) since there was a clear difference in their chemistries, particularly in terms of their arsenic concentrations. Shallow wells (n=3208) had a mean arsenic concentration of 60 $\mu g\ L^{-1}$ whereas deep wells (n=326) had a mean concentration of 3.0 $\mu g\ L^{-1}$. The frequency distribution in both shallow and deep wells was strongly skewed. For example, the coefficient of variation of arsenic concentrations in the shallow wells was 203%. More than 30% of the samples were below 1 $\mu g\ L^{-1}$, and 24% were below the instrumental detection limit (normally 0.25 or 0.5 $\mu g\ L^{-1}$). The maximum As concentration was 1670 $\mu g\ L^{-1}$.

Log transforming the data reduced the skewness in the distribution to some extent but there are indications of two (or more) populations. Again the large number of samples below the instrumental detection limit makes a detailed analysis difficult. The geometric mean arsenic concentration in the shallow groundwaters was 5.5 $\mu g\ L^{-1}$, an order of magnitude lower than the arithmetic mean.

Variogram analysis was performed on the log-transformed data. The data fitted well to an isotropic exponential model. There was no evidence for significant anisotropy. The nugget variance, representing the variance for separations of less than about 2 km, was large – about 40% of the variance (in log terms) over the whole country. This reflects the local experience. It has been found to be extremely difficult to predict the concentration of arsenic in unsampled wells at the village scale.

There is also a long range component reflecting the variation in the major geological units at the national scale. Even at separations of 150 km, the variance had not reached the sample variance.

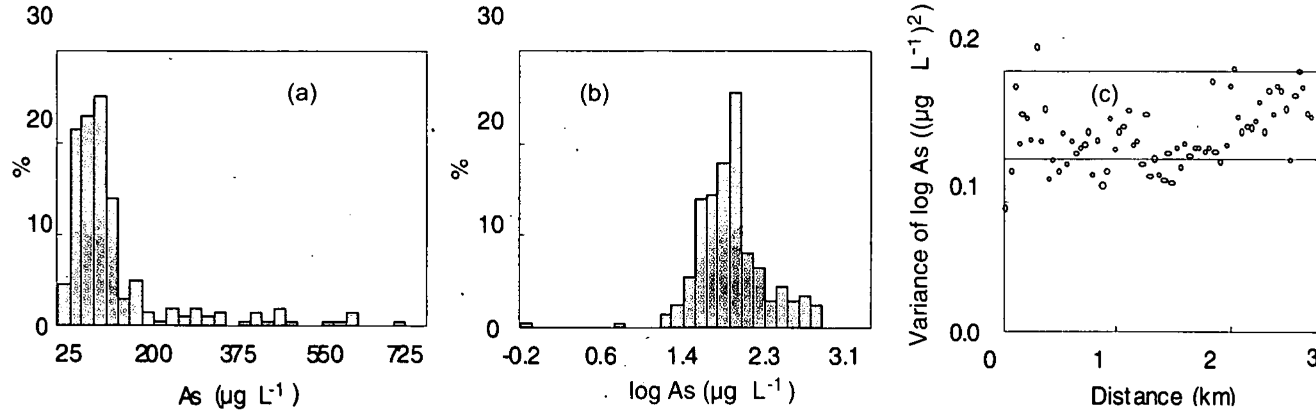


Figure 9.14. Histogram of (a) normal (b) log-transformed (b) data from Mandari. (c) shows the variogram for arsenic.

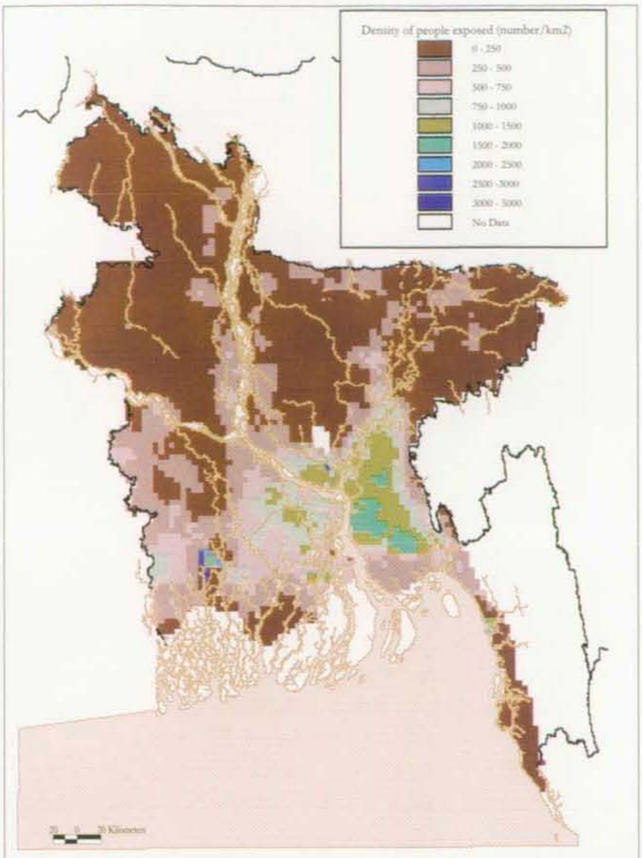


Figure 9.12. Number of people exposed to arsenic-concentrations above 50 μg L^{-1} using the calculated probabilities and the population density.

high-As region of Bangladesh. The maximum concentration is 986 μg L^{-1} and the standard deviation is 181.5 μg L^{-1}, 114% of the mean concentration. The frequency distributions are discontinuous because of the small number of samples (Figure 9.13(a,b)).

The experimental variogram of the log As concentrations is shown in Fig 9.13(c). The interval between the calculated points is 500 m with a maximum lag of 20 km. Although the experimental variogram is scattered, a trend

Table 9.5. Summary statistics for the Lakshmipur wells

	Shallow Wells (<150 m)*
Number of observations	59
Minimum (μg L^{-1})	1.3
Mean (μg L^{-1})	159.0
Maximum (μg L^{-1})	986.0
Standard deviation (μg L^{-1})	181.5
Variance (μg $L^{-1})^2$	32945.2
Geometric mean (μg L^{-1})	91.8
Geometric variance (μg $L^{-1})^2$	1.9
Percentiles (μg L^{-1})	
10	21.8
20	46.2
30	64.5
40	81.8
50 (Median)	88.7
60	114.0
70	165.0
80	256.0
90	390.0
95	669.5
99	986.0

*All wells are shallow wells

can be observed and a fit to an isotropic, exponential model was obtained:

$$\gamma(h) = c_0 + c\left(1 - e^{-h/a}\right)$$

where c_0 is the nugget variance, c is the sill variance and a is the distance parameter. The optimal parameters based on a minimisation of the sum of squares of the residuals were: c_0=0.0909, c=0.2951, and a=15800 m. The variogram indicates a significant reduction in the nugget variance for the Lakshmipur dataset compared with the nugget variance calculated from the national dataset (0.53). All variances have units of log (μg $L^{-1})^2$).

Mandari village

The Mandari dataset contains 337 observations (Table 9.6)

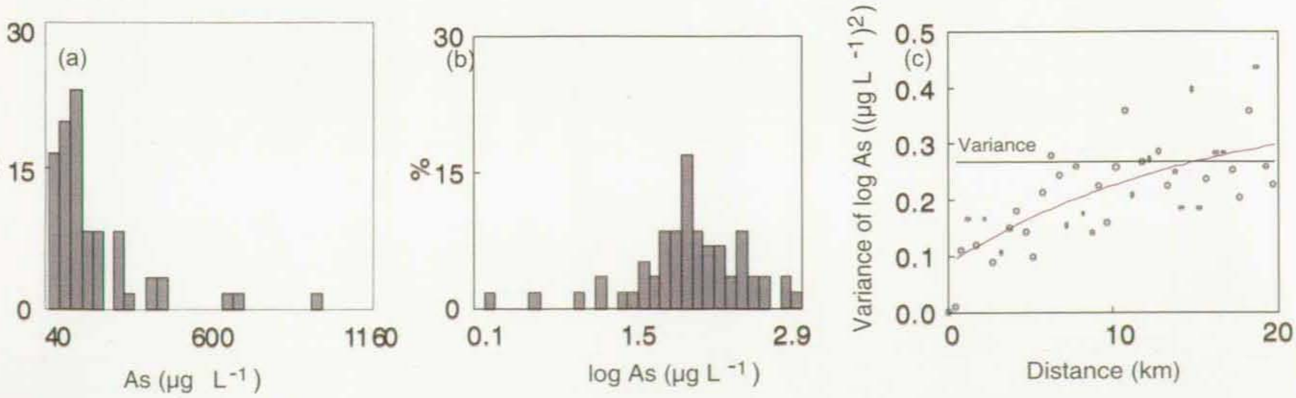


Figure 9.13. Histogram of (a) normal and (b) log-transformed arsenic data from Lakshmipur. (c) shows the corresponding variogram.

The average As concentration was calculated for each of the 61 sampled districts. The districts were divided into two sets: those with an average As concentration of <50 μg L^{-1} and those >50 μg L^{-1}. Separate variogram analysis of the two sets indicated that there was no significant difference between them. Therefore subsequent variogram analysis was carried out for the whole of Bangladesh using the single national data set.

Ordinary punctual kriging based on the raw data and the log-transformed data, and disjunctive kriging based on Hermite-transformed data, showed that the estimates from disjunctive kriging agreed best with those of the raw data. Back-transforming the log-transformed ordinary kriged estimates to the original scale gave some very high, and probably unrealistic, concentrations (greater than 5000 μg L^{-1}).

Disjunctive kriging was used to produce a smoothed As map based on a 5 km grid and it also gave a series of maps which indicated the probability that a particular threshold As concentration (5, 10, 50, 150 μg L^{-1}) would be exceeded. These maps highlighted the high arsenic areas in the south of Bangladesh and the low arsenic areas in much of northern Bangladesh including the Pleistocene Tracts.

Estimates of the population exposed to arsenic contaminated water were made by overlaying the maps of the arsenic distribution and the estimated *upazila*-based populations. Two methods of estimation were used depending on how the discretisation was accomplished. When the arsenic statistics were based on average percentage exceedances (at the 50 μg L^{-1} level) over whole *upazilas*, an exposed population of 28 million was estimated. When the arsenic statistics were based on interpolated estimates on a 5-km grid using disjunctive kriging (the 'smoothed arsenic map'), the estimate was 35 million. If the more stringent WHO guideline value of 10 μg L^{-1} is used, then these figures increase to 46 million and 57 million, respectively. In the absence of any data to the contrary, we assume that the kriged estimates (larger figures) are more reliable. It is uncertain what the errors associated with these figures are but clearly the exposed population is very large. There is a 50:50 chance of a shallow well being contaminated in 17%, or about one-sixth, of Bangladesh.

We had insufficient short-range data (i.e. pairs of wells with separations of less than 2 km) to calculate a reliable variogram for short distances. However, an analysis of the available shallow tubewell data from Lakshmipur *upazila* (n=59) and Mandari village (n=228) suggests that there is an approximately 5-fold reduction in the nugget variance in the more localised data sets compared with the national data set. We found no significant spatial structure in the Mandari data set.

10 Changes with time: groundwater monitoring

10.1 Introduction

The regional surveys of groundwater in Bangladesh have established significant variations in water quality both laterally and with depth. A further critical factor is the potential variation that can occur with time. Such variations may occur over very different timescales as a result of differing underlying controls. Short-term fluctuations in a given well, over periods of hours or days for example, may occur as a result of factors such as diurnal variations in pumping rate and duration. Variations over periods of months may result from the seasonal input of monsoon rainfall and changes in groundwater flow, for example. Monitoring in West Bengal has indicated that arsenic concentrations in tubewells are lowest during the months August-September (CGWB, 1999). Long-term variation over years or decades may result from factors such as a change in climate, land-use, abstraction rates or geochemical reaction. These differing scales of temporal variation have important implications for the screening and mitigation programmes and should be monitored carefully. The true variation also need to be separated from 'noise' resulting from sampling and analytical errors.

Scant reporting, much of it anecdotal, has so far concluded that temporal changes in arsenic concentrations have occurred in groundwaters from West Bengal and Bangladesh. Some reports (e.g. SOES/DCH, 2000) have suggested that 'deep' wells that were once arsenic-free are now arsenic-contaminated. What is not clear, is the nature of the variation (causes and timescales) and specifically, the amplitude of the variations. Some of the variation might feasibly be expected to be within the analytical error of the arsenic measurements. Monitoring requires high precision measurements if 'real' variations are to be distinguished from this noise. Furthermore, two situations have to be distinguished: (i) natural flow conditions (not influenced by abstractions), and (ii) pumped conditions where the abstraction of groundwater significantly changes the groundwater flow pattern.

One objective of the current project was to carry out a monitoring exercise of water levels and water quality in selected wells to assess the chemical variations with time and depth. As part of the detailed investigations in the selected three Special Study Areas, piezometers were installed to a range of depths in each of the three areas (Lakshmipur, Faridpur, Chapai Nawabganj) (Chapter 3). These, along with a selection of existing wells in the vicinity, have been sampled at approximately fortnightly intervals and provide time-series data for up to one year. This is a very short interval for assessment of temporal changes in water quality but provides a start to a process that should become a long-term investigation.

10.2 Sampling and analysis

In all, 32 wells have been sampled in the Special Study Areas (Table 10.1). These included 15 piezometers, 14 other hand-pump tubewells and 3 dug wells.

10.2.1 Sampling and analytical protocol

Each well was sampled at approximately fortnightly intervals by DPHE R&D staff from Dhaka. Monitoring began after piezometer completion (from April 1999 in Chapai Nawabganj and Faridpur and June 1999 in Lakshmipur) and continued up until March 2000.

At each time of sampling, the wells were purged. This was reasonably straightforward for the shallow wells (around one pump stroke per foot of piezometer depth) but was much more difficult to achieve for the deep wells, although best efforts were made by hand pumping. Water levels were recorded in all the piezometers and dug wells but measurement was not routinely possible in the other tubewells due to lack of access via the well head.

At all sites, filtered samples (0.2 μm) were collected in 30 ml plastic bottles for chemical analysis. Each sample comprised two aliquots, one acidified (1% HNO_3) for analysis of As and other elements, and one unacidified for Cl analysis. During the early stages of monitoring, additional on-site investigation included measurement of SEC (specific electrical conductance) and water temperature. Water samples were returned to Dhaka and freighted to the UK in batches for analysis.

Analysis of As was initially by both ICP-AES (direct aspiration) and AFS with hydride generation. AFS analysis was carried out as for samples from the National Hydrochemical Survey and surveys in the Special Study Areas (Chapters 6 and 7). Cross-checks were made between the two As data sets and results for samples with high concentrations (>100 $\mu g\ L^{-1}$) were generally good (within 11% and mostly within 5%). Once the initial concentrations of As were determined for each well, subsequent analysis by AFS with hydride generation was only carried out where concentrations were expected to be low (in practice below around 100 $\mu g\ L^{-1}$) in order to cut costs.

Analysis of major cations, SO_4 and a range of trace elements was also made by ICP-AES. Chloride was determined by automated colorimetry.

During December 1999, an additional sampling of the piezometers and other monitoring wells was carried out for a wider range of chemical parameters, including redox measurements, stable isotopes, tritium and radiocarbon. Results of these investigations are reported separately in Chapter 7.

In the event, the Faridpur 10 m piezometer was found to be consistently dry and so no data have been produced for that depth. Yield of groundwater from the 50 m pie-

Table 10.1. Site details of monitored wells

Well name	Latitude	Longitude	Year constructed	Well type	Well depth (m)	Well location/owner
Chapai Nawabganj						
CPW1	24.5887	88.2554	1999	Piezometer	10	DPHE/Project
CPW2	24.5887	88.2554	1999	Piezometer	20	DPHE/Project
CPW3	24.5887	88.2554	1999	Piezometer	30	DPHE/Project
CPW4	24.5887	88.2554	1999	Piezometer	40	DPHE/Project
CHTW1	24.5887	88.2554	1989	Hand-pump tubewell	34	Primary School
CHTW2	24.5908	88.2592	1999	Hand-pump tubewell	20	Md. Sazzad Ali
CHTW3	24.5930	88.2568	1994	Hand-pump tubewell	15	Md. Sabed Ali
CHTW4	24.5874	88.2528	1992	Hand-pump tubewell	38	Alhaj Bashir Ali
CHTW5	24.5904	88.2587	1980	Hand-pump tubewell	34	Jam-e-Masjid
CHTW6	24.5878	88.2535	1984	Hand-pump tubewell	21	Md. Khorshed Ali
CHTW7	24.5906	88.2592	1997	Hand-pump tubewell	27	Md. Ashraful Islam
CDW1	24.5918	88.2409	1999	Dug well	8	Md. Dhulur Rahman
CDW2	24.5905	88.2578	1933	Dug well	9.1	Md. Ekramul Hoque Biswas
CDW3	24.5865	88.2541	1984	Dug well	8	Md. Mainul Islam
Faridpur						
FPW2	23.5870	89.8615	1999	Piezometer	20	DPHE/Project
FPW3	23.5870	89.8615	1999	Piezometer	30	DPHE/Project
FPW4	23.5870	89.8615	1999	Piezometer	40	DPHE/Project
FPW5	23.5870	89.8615	1999	Piezometer	50	DPHE/Project
FPW6	23.5870	89.8615	1999	Piezometer	150	DPHE/Project
FHTW1	23.5876	89.8610	1994	Hand-pump tubewell	41	Chairman
FHTW2	23.5866	89.8623	1996	Hand-pump tubewell	24	Md. Alef Mondal
FHTW3	23.5871	89.8623	1993	Hand-pump tubewell	46	Md. Haider Chukder
FHTW4	23.5876	89.8612	1999	Hand-pump tubewell	24	Health Centre
FHTW5	23.5869	89.8590	1996	Hand-pump tubewell	17	Md. Lokman Mollah
FHTW6	23.5881	89.8601	1998	Hand-pump tubewell	26	Md. Sekander Ali Pattader
Lakshmipur						
LPW1	22.9412	90.8433	1999	Piezometer	10	DPHE/Project
LPW2	22.9412	90.8433	1999	Piezometer	20	DPHE/Project
LPW3	22.9412	90.8433	1999	Piezometer	30	DPHE/Project
LPW4	22.9412	90.8433	1999	Piezometer	40	DPHE/Project
LPW5	22.9412	90.8433	1999	Piezometer	50	DPHE/Project
LPW6	22.9412	90.8433	1999	Piezometer	150	DPHE/Project
LHTW7	22.9412	90.8436	1999	Hand-pump tubewell	275	DPHE

zometer at Lakshmipur was also found to be very poor and variable. Hence results from that piezometer are to be viewed with caution.

10.2.2 QA problems

Monitoring of a large number of wells at regular intervals involves some significant logistical problems with sampling, labelling, recording, freighting, analysis and databasing. There is considerable scope for entry of errors throughout the procedure. Collection of monitoring data for the individual wells has highlighted some significant errors arising at all stages. While every effort has been made to remove obvious errors from our database, finding all of these is difficult and time-consuming and the data are not guaranteed to be error-free. Some of the following graphs of chemical data show incomplete time-series as a result of deletion of some of the glaring errors. Our experience indicates the absolute requirement for meticulous care with sampling, analysis, recording and reporting.

10.3 WATER LEVELS

Monsoon rainfall affects Bangladesh usually during the period July–September and this is the interval when most groundwater recharge occurs. Groundwater levels in the three study areas have varying responses to the monsoon, with the greatest impact being seen in Chapai Nawabganj and the least in Lakshmipur. The piezometers are not pumped between sampling periods and hence groundwater levels are essentially rest-water levels. The other wells in the monitoring network are used at other times, although all are hand-pump tubewells or dug wells and pumping rates are therefore minor.

10.3.1 Chapai Nawabganj

The hydrographs for the four Chapai Nawabganj piezometers (10–40 m depth) show a large seasonal fluctuation, with water levels ranging between around 1 m below ground level at the end of the monsoon period to around

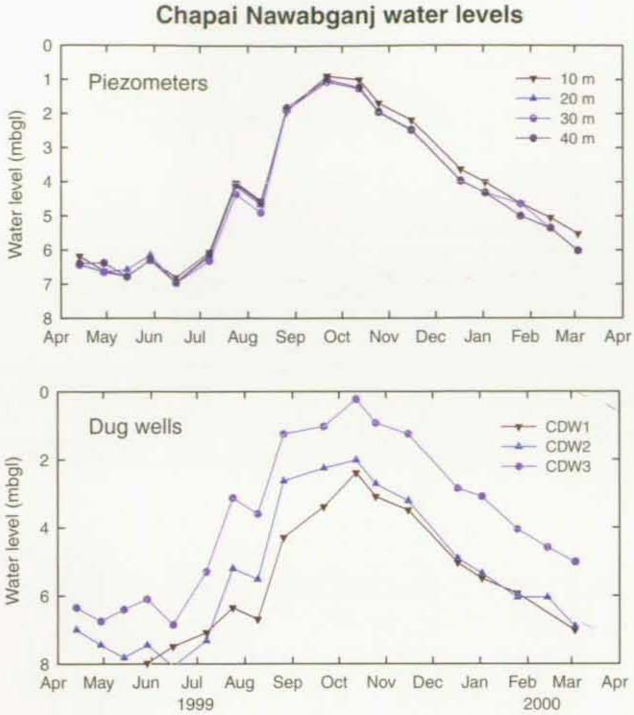


Figure 10.1. Temporal variation in water level (metres below ground level) at the Chapai Nawabganj monitoring sites.

7 m below ground level during the dry season. The seasonal amplitude of the fluctuation is therefore around 6 m. All piezometers have very similar responses which suggests close hydraulic connection between the sediment strata at the depths of abstraction (Figure 10.1). It is not thought likely that there is connection via the piezometer conduits themselves as care was taken during construction to ensure good sealing.

Groundwater levels in the Chapai Nawabganj dug wells showed very similar responses to the piezometers during the monitoring period (Figure 10.1) with amplitudes of variation also of the order of 6 m (groundwater-level range 0.2–8 m below surface). Absolute water levels are more disparate in the dug wells because of their greater spatial separation. Although all are less than 1 km apart, the distances are considerably greater than the spacing of the piezometers (typically within 3 m).

10.3.2 Faridpur

Water levels in the Faridpur shallow piezometers (20–50 m) also show a notable response to seasonal monsoon recharge, with rising groundwater levels during the period May 1999 to September 1999, a peak during September to November 1999 and recession thereafter (Figure 10.2). Water levels vary between around 2–6 m (amplitude 4 m). Hence the variation is less than for Chapai Nawabganj. The responses of all shallow piezometers are very similar, again suggesting hydraulic connection between the sediment strata over this depth range.

The trend in groundwater level in the deep 150 m piezometer at Faridpur (Figure 10.2) is notably similar to those from the shallow set (Figure 10.2). This suggests that there may be a hydraulic connection between the shallow and 'deep' aquifers, although as discussed below and in Chapter 7, groundwater chemistry is notably different between the 20–50 m set and the 150 m piezometer.

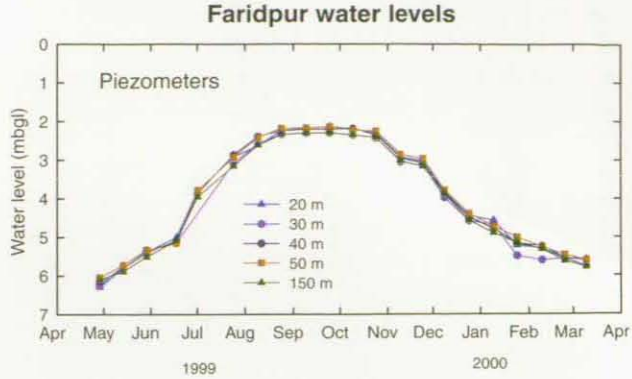


Figure 10.2. Temporal variation in water level (metres below ground level) at the Faridpur monitoring sites.

The existing water-level data for the 150 m piezometer, like the shallow groundwaters, shows an apparent response to seasonal recharge. Radiocarbon data (Chapter 7) suggests that groundwater at this depth is significantly older than the shallow groundwaters (^{14}C in DIC of 51 pmc, with an apparent model age of around 2000 years). Hence, significant response to rainfall is not expected. This is a discrepancy which requires further investigation.

10.3.3 Lakshmipur

Groundwater levels in the piezometers from Lakshmipur are shallow, 1–2 m below ground level in the shallow groundwaters (10–50 m depth) and show a much smaller seasonal variation (Figure 10.3). Monitoring at Lakshmipur began later in the year (June 1999) than for the other two areas as these were the last piezometers to be drilled. Hence the pre-monsoon part of the hydrograph was not captured for 1999. However water levels were rising from June 1999 to September 1999. Groundwater level recessions appear to have begun around December 1999. The amplitude of the variation is typically about 1 m, albeit

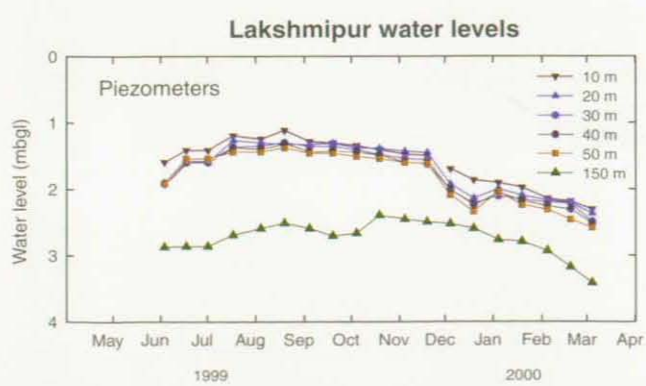


Figure 10.3. Temporal variation in water level (metres below ground level) measured at the Lakshmipur monitoring sites.

with only a 9-month period of monitoring.

Unlike Faridpur, the deep piezometer is very distinct from those at shallower levels and suggests hydraulic segregation between the shallow (10–50 m) and deep (150 m) aquifers. However, although absolute depths differ, the shapes of the respective profiles are quite similar and the deep piezometer shows a potential groundwater recession during November 1999 to March 2000. This may indicate some groundwater recharge, although a longer period of monitoring is required to be certain of the trends. Isotopic dating suggests that groundwater from this deep piezometer is largely 'old' water (^{14}C=28 pmc; Chapter 7) and does not contain significant modern recharge.

The lower absolute level of groundwater in the deep piezometer (around 3 m below ground level) was typically around 1.5–2 m below those in the shallow piezometers (Figure 10.3). This suggests that some downward leakage of groundwater to the lower (150 m) aquifer will occur if intervening sediments are sufficiently permeable. It must be remembered however, that the deep tubewells in Lakshmipur *upazila* were typically much deeper than 150 m and that this conclusion does not necessarily hold for greater depths. Indeed, notable variations in groundwater salinity with depth in Lakshmipur area suggest that strong groundwater stratification and poor hydraulic connectivity is more typical.

10.4 Arsenic

Results of the well monitoring in each of the three study areas are presented in Figures 10.4–10.6. As mentioned above, data for some sampling dates are missing because of suspicions about the quality of the data.

10.4.1 Chapai Nawabganj

As shown in Chapter 7, As concentrations in the groundwaters from the Chapai Nawabganj piezometers are relatively low at the shallowest depth (10 m), being generally <30 µg L^{-1}. They are much higher (250–350 µg L^{-1}) and comparable in the depth range 20–40 m (Figure 10.4). The low As concentrations in the shallowest piezometer probably reflect relatively oxidising conditions which facilitate adsorption onto precipitated iron oxides. The concentrations in the groundwaters from 20–40 m are high, but much lower than the extremes seen elsewhere in Chanlai, given that the piezometers are located in the heart of the Chapai Nawabganj 'hot spot'.

Neither the shallow (10 m) piezometer nor the deeper (20–40 m) piezometers showed any notable temporal trend in As concentrations during the period of monitoring. Concentrations were relatively low during the sampling in late August 1999 (at all depths) but this does not show an obvious trend with water level (Figure 10.4).

The shallowest piezometer with the lowest As concentrations showed no evidence of an increase with time during the sampling period, and all measurements were well below 50 µg L^{-1} (expanded graph, Figure 10.4).

Other monitored hand-pump tubewells from Chapai Nawabganj had variable absolute concentrations from 40–800 µg L^{-1}. The highest As concentrations were found in tubewells CHTW1 and CHTW4 which have well depths

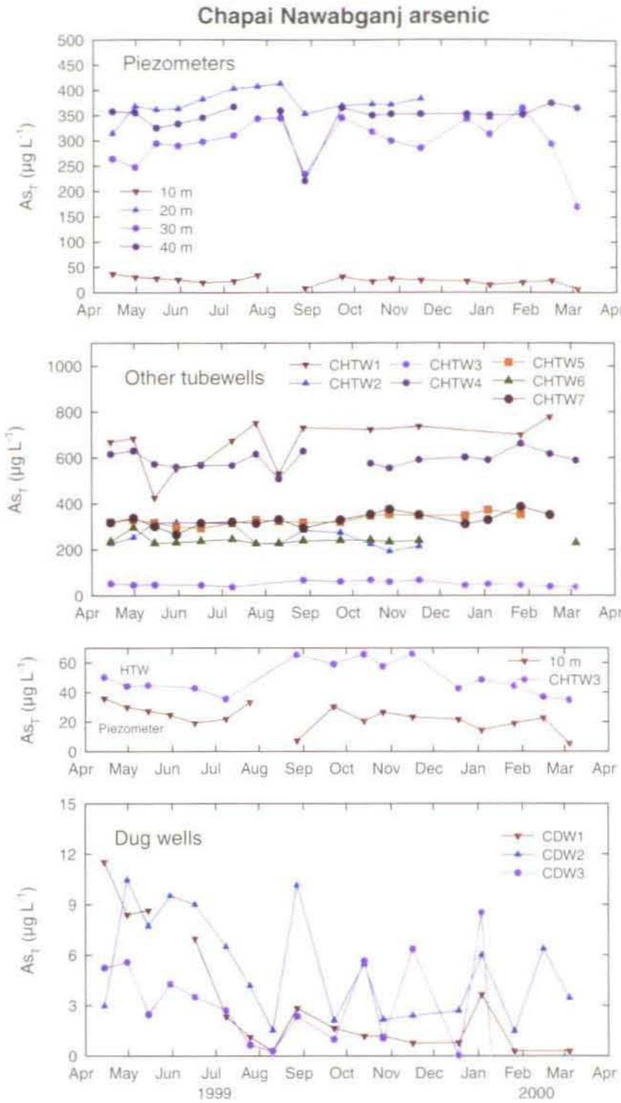


Figure 10.4. Temporal variation in As at the Chapai Nawabganj monitoring sites.

of 34 m and 38 m respectively. The other CHTW wells which are shallower than these have lower As concentrations, though only CHTW3 (15 m depth) has concentrations close to or less than 50 µg L^{-1}. The arsenic concentration at a given depth is therefore not the same in different tubewells with the sample region.

None of the additional tubewells sampled showed convincing evidence of increases or decreases of As concentration with time and there is no evidence of any response to seasonal recharge inputs. The expanded graph for the tubewell with the lowest concentration (CHTW3, Figure 10.4) shows variation between 35 µg L^{-1} and 66 µg L^{-1} and does show some apparent increase during the monsoon period. The depth of this tubewell is shallow (15 m) and this is probably the reason for the apparent variation. Shallow groundwaters are likely to be much more susceptible to seasonal changes in chemistry as a result of more active groundwater movement. Changes in concentration are also more discernible at low absolute concentrations. The concentration range of As in CHTW3 fluctuates around

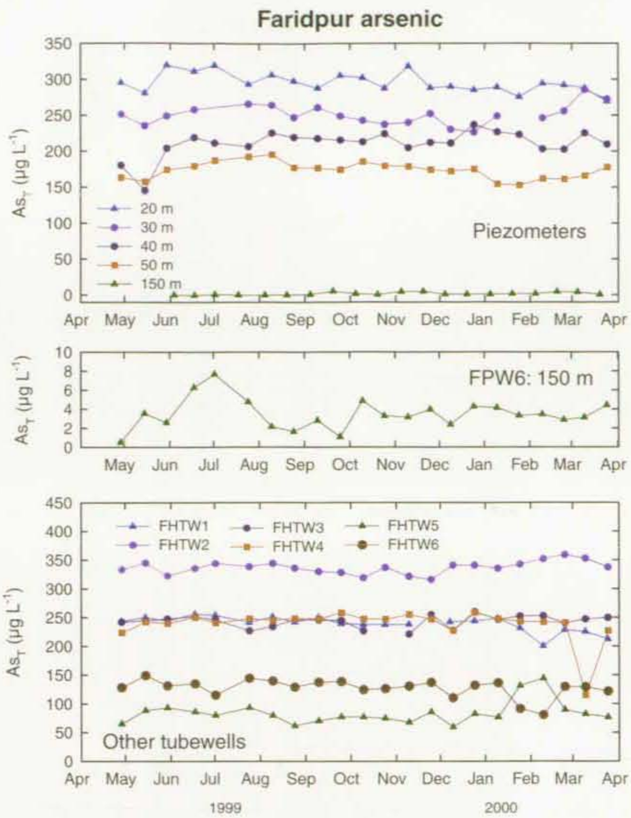


Figure 10.5. Temporal variation in As at the Faridpur monitoring sites.

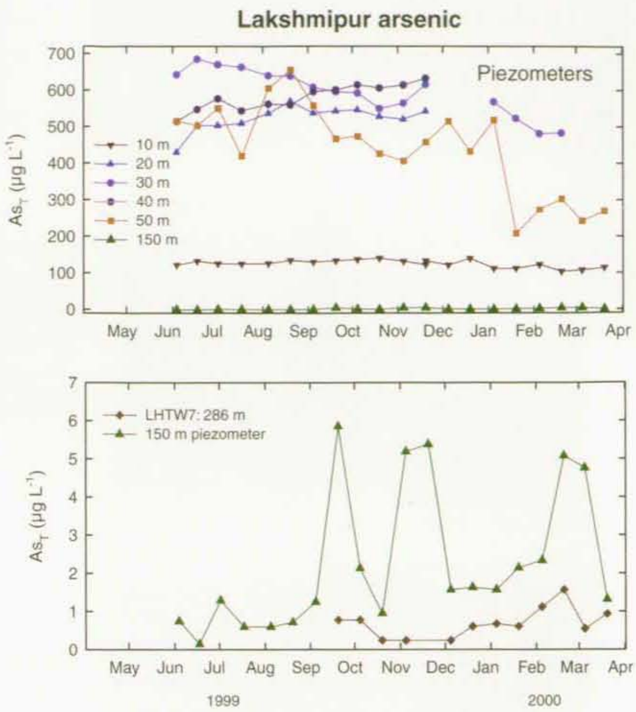


Figure 10.6. Temporal variation in As at the Lakshmipur monitoring sites.

50 µg L^{-1} (i.e. the national standard) and the variation serves to illustrate that some wells with concentrations close to the standard may be considered acceptable for drinking at some times but unacceptable at other times.

The three dug wells in the monitoring network at Chapai Nawabganj all have low As concentrations (Figure 10.4). Concentrations are very variable with 'spiky' temporal trends, although the range is only small 0.5–2 µg L^{-1}. Only 2 measurements exceeded the WHO guideline value of 10 µg L^{-1}. There is no evidence of As concentrations increasing with time, and no obvious evidence of a seasonal response to rainfall, despite the shallowness of these wells. One dug well had concentrations decreasing from April 1999 to July 1999 (pre-monsoon) but did not show any evidence of post-monsoon increase.

10.4.2 Faridpur

Arsenic concentrations in monitored wells from Faridpur were largely constant during the monitoring period (Figure 10.5). None of the shallow wells showed any seasonal response in As to rainfall. Concentrations were a little more variable during the early stages of sampling (May 1999) but this may be due to temporary disturbances in the groundwater chemistry following drilling.

In the shallow piezometers, As concentrations show a progressive decrease with depth, from maximum values at 20 m (ca. 300 µg L^{-1}) to minima at 50 m (ca. 160 µg L^{-1}). The profile may be explained in part at least by the occurrence of relatively high concentrations of oxalate-extractable As and Fe (denoting higher concentrations of labile As) at around 10 m depth (Figures 11.13 and 14, Chapter 11).

The 150 m piezometer had low overall concentrations during the monitored period (≤8 µg L^{-1}). The highest concentration was found during early July but the data are too limited to indicate whether or not this has any relation to the monsoon (Figure 10.5). Such rapid responses to monsoon recharge at this depth are considered unlikely.

Arsenic concentrations in the other hand-pump tubewells monitored at Faridpur were also largely constant (Figure 10.5). All are shallow wells and all exceed 50 µg L^{-1}. The highest As concentrations among these were found in tubewell FHTW2 (24 m depth) which had concentrations in excess of 300 µg L^{-1}.

10.4.3 Lakshmipur

The monitored set at Lakshmipur comprises the 6 piezometers and one adjacent deep hand-pump tubewell (286 m deep; screen at 275 m) nearby. As shown from the piezometer depth profiles (Chapter 7), groundwater from the 10 m piezometer has the lowest concentrations of the shallow set, with about 100 µg L^{-1} As. The temporal variation is minimal (Figure 10.6). Variations in the 20 m piezometer are also minimal, although concentrations exceed 500 µg L^{-1}. Variations are greater in the groundwaters from 30, 40 and 50 m depth. The 40 m piezometer appears to show a slightly increasing trend (around 19%) between June and November 1999, while the 30 m piezometer shows a decreasing trend (around 27%) over the period June 1999 to March 2000. Whether this variation is related to seasonal recharge effects or not is not known and requires further monitoring for proper assessment.

Variations in the 50 m piezometer are much greater with initially high concentrations of 400–650 μg L^{-1} (Figure 10.6) but with lower concentrations around 300 μg L^{-1} during February–April 2000. As noted above, this piezometer gives a very poor yield on pumping and the groundwater composition is therefore unlikely to be representative.

Figure 10.6 also shows an expanded plot of the deep 150 m piezometer which confirms its low As concentrations in the range 0.5–6 μg L^{-1}. High values were recorded in September and November 1999 and February–March 2000. The baseline concentration for this piezometer appears to be closer to <1–2 μg L^{-1}. A longer sequence of data is needed to indicate whether there are any seasonal or longer trends.

The 286 m deep hand-pump tubewell (Figure 10.6) also had uniformly low As concentrations of <2 μg L^{-1} during the period of monitoring.

10.5 Sodium and chloride

Only a limited number of other major and trace elements are discussed here. Sodium and chloride have been included as they provide important indicators of ground-

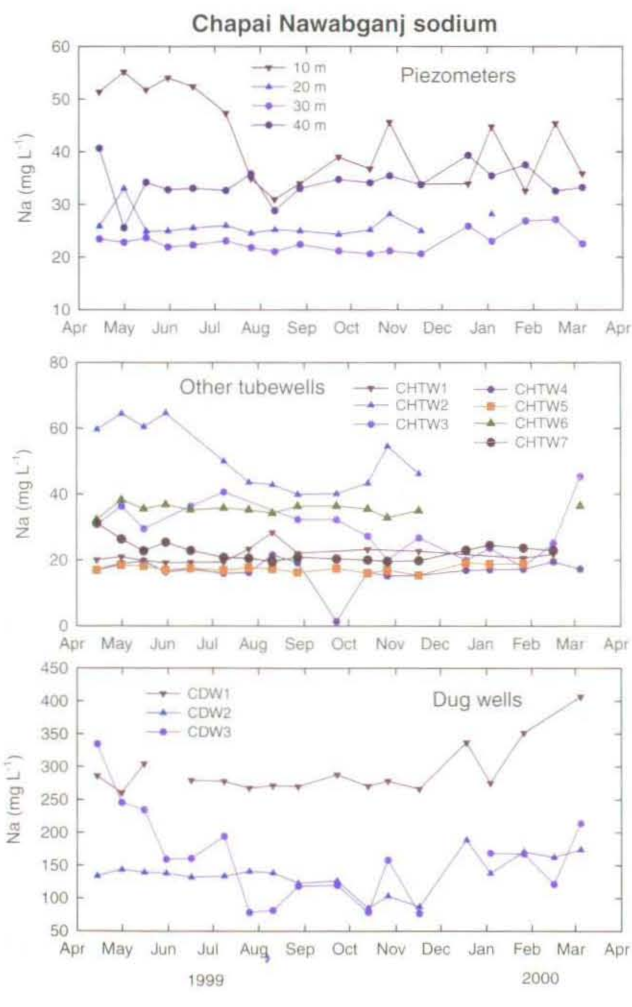


Figure 10.7. Temporal variation in Na at the Chapai Nawabganj monitoring sites.

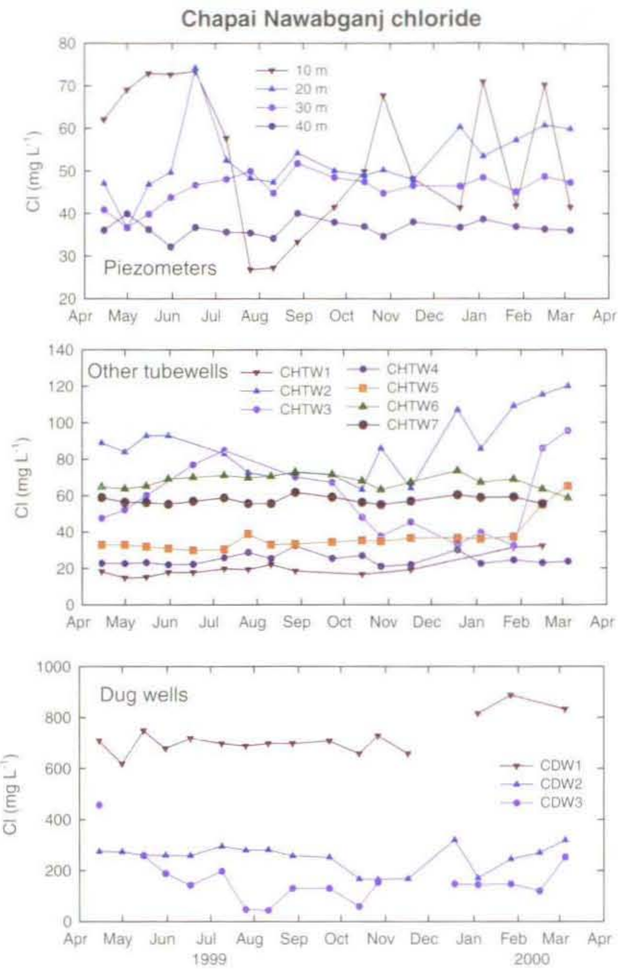


Figure 10.8. Temporal variation in Cl at the Chapai Nawabganj monitoring sites.

water salinity and its variation with time. Sodium may also be affected by mineral reactions including ion exchange.

10.5.1 Chapai Nawabganj

In all monitored groundwaters from Chapai Nawabganj, the greatest variations and, for the most part highest concentrations, were seen in the shallowest wells. These were the 10 m piezometer, tubewells CHTW2 (20 m) and CHTW6 (21 m) and all the dug wells. This reflects the greatest influence of surface processes at shallow depths. In the zone near the water table, groundwater movement is likely to be most active, impacts of groundwater recharge and pollution inputs more immediate, and effects of variations in evaporation greatest. These are all thought to be influential controls on the groundwater chemistry of the shallow groundwaters, although the variations in absolute concentrations in the tubewells are not large. Concentrations of Na in the tubewell waters vary largely between 20–60 mg L^{-1} and in Cl between 20–70 mg L^{-1} (Figures 10.7 and 10.8). By contrast, concentrations in the open dug wells are generally much higher (Na up to 400 mg L^{-1}; Cl up to 900 mg L^{-1}) and reflect a more pronounced effect of evaporation and/or pollution.

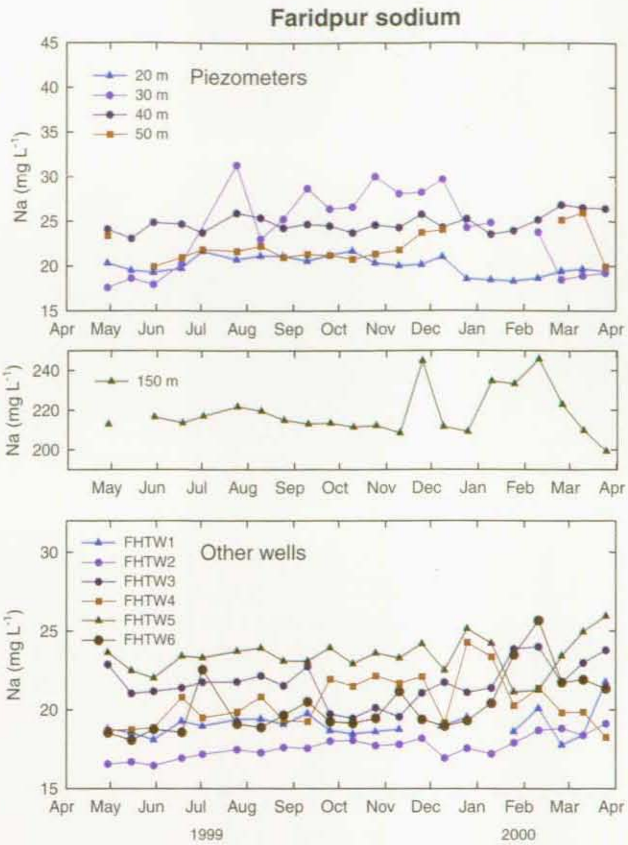


Figure 10.9. Temporal variation in Na at the Faridpur monitoring sites.

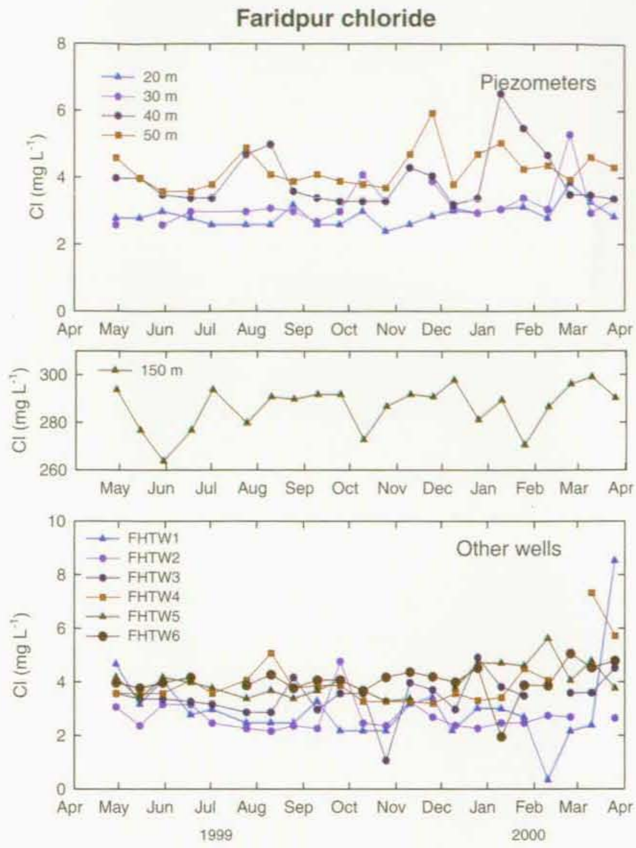


Figure 10.10. Temporal variation in Cl at the Faridpur monitoring sites.

10.5.2 Faridpur

Variations in Na and Cl in the Faridpur wells show some minor variations (Figures 10.9 and 10.10) but little or no evidence of seasonal trends. The only discrepancy is the slight increase in Na concentration in the 30 m piezometer over the period July–December 1999 (range 20–30 mg L^{-1}), although the Cl concentrations remained very low and stable (around 3 mg L^{-1}) over this interval. Concentrations in the deep 150 m piezometer showed no temporal trend, concentrations being in the range 200–250 mg L^{-1} for Na and 260–300 mg L^{-1} for Cl.

10.5.3 Lakshmipur

Concentrations of Na and Cl were remarkably constant in all monitored wells at Lakshmipur during the sampling period. In the shallow piezometers, concentrations generally showed a progressive increase with depth, reflecting the increasing salinity of the groundwaters at depths greater than about 20 m (and hence the dominance of tubewells of less than 20 m depth in the region; Chapter 7). There is no apparent seasonal effect relating to the monsoon. The trends for the deep tubewells reiterate the considerable salinity variations with depth at Lakshmipur, with high salinity in the 150 m piezometer, and remarkably fresh groundwater (Na around 35 mg L^{-1}, Cl around 10 mg L^{-1}) in the 286 m tubewell LHTW7 (Figures 10.11 and 10.12).

10.6 SULPHATE

Sulphate is discussed here in order to investigate the evidence for oxidation of sulphide minerals in the aquifer, particularly close to the water table, and its potential effects on the concentrations of, and variations in, As in the groundwaters.

10.6.1 Chapai Nawabganj

In all cases, highest concentrations of SO_4 in the Chapai Nawabganj groundwaters were found at shallow depths

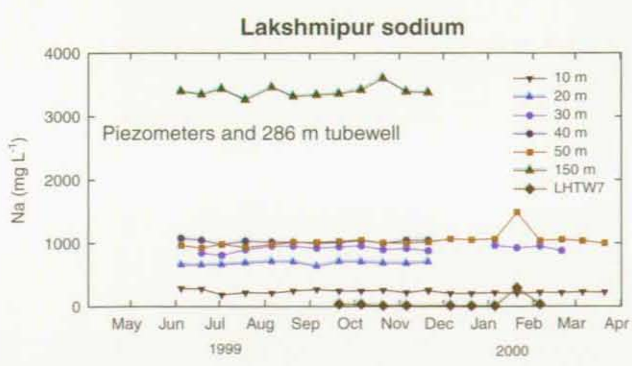


Figure 10.11. Temporal variation in Na at the Lakshmipur monitoring sites.

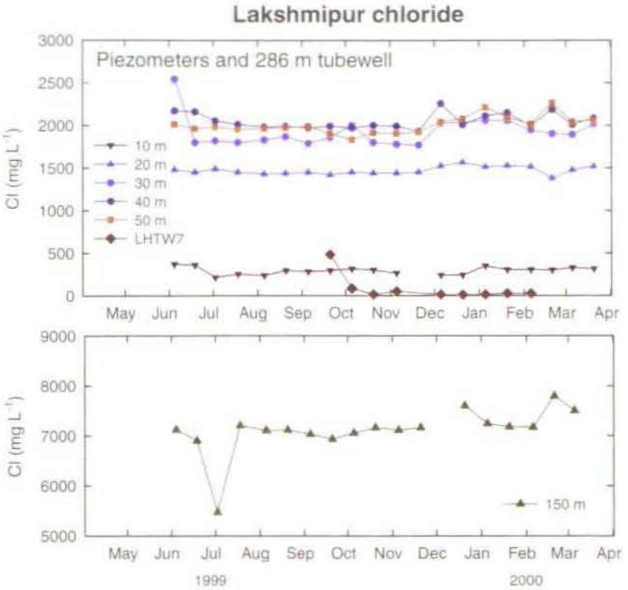


Figure 10.12. Temporal variation in Cl at the Lakshmipur monitoring sites.

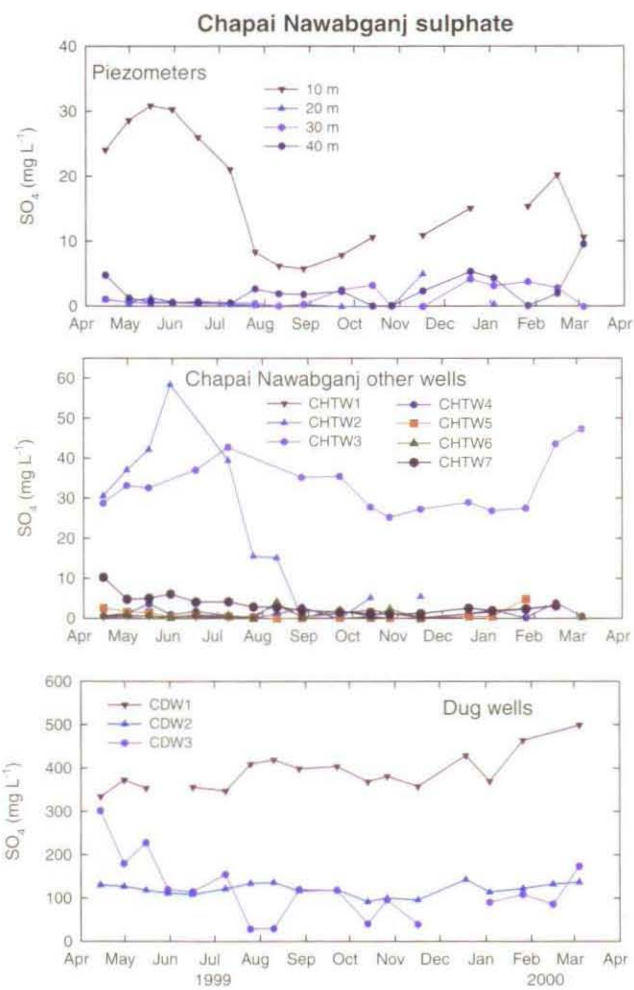


Figure 10.13. Temporal variation in SO_4 at the Chapai Nawabganj monitoring sites.

(Figure 10.13). Concentrations greater than 5 mg L^{-1} are largely restricted to the groundwaters from the 10 m piezometer, tubewells CHTW2 (20 m) and CHTW3 (15 m) and the dug wells. As noted in Chapter 7, the dug wells have by far the highest SO_4 concentrations, often in excess of 100 mg L^{-1}. These are also relatively oxidising with detectable dissolved oxygen. The shallow tubewells (and to some extent the dug wells) show pronounced seasonal trends which reflect variations in recharge, with minima around the period August–October 1999. This effect is probably the result of dilution from modern recharge. Sulphate present in the shallowest groundwaters during the dry periods is likely to be partly picked up from oxidation of sulphide minerals. As discussed in Section 10.5 and Chapter 7, the much higher concentrations in the dug wells probably reflect a combination of oxidation, pollution and evaporative concentration processes.

Concentrations of SO_4 in the 20–40 m piezometers and the other tubewells with depths greater than 20 m are typically much less than 5 mg L^{-1} (Figure 10.13). Concentrations in the piezometers at 30 m and 40 m rise slightly (to around 5 mg L^{-1}) over the period December 1999 to February 2000, possibly as a result of falling groundwater levels. Further monitoring is needed however, to assess whether this has any significance over the longer term.

The lack of correspondence between SO_4 and As concentrations in the Chapai Nawabganj groundwaters during the period monitored is significant and provides no support for the hypothesis that As release is related to pyrite oxidation.

10.6.2 Faridpur

Concentrations of SO_4 are low in the groundwaters from most of the Faridpur monitored wells, as concluded from the surveys outlined in Chapter 7. Concentrations <1 mg L^{-1} are typical. Values up to 10 mg L^{-1} were recorded in the 30 m piezometer (Figure 10.14), with a maximum during the beginning of the monsoon (July 1999) and a gradual decrease thereafter. Concentrations are most variable in the 50 m piezometer (up to 12 mg L^{-1}) with maxima in November 1999. Rising concentrations may correspond with the end of the monsoon and resulting recession of groundwater levels. The increase in SO_4 concentrations in the groundwater from this piezometer is not matched by increasing As concentrations.

Concentrations of SO_4 in the other monitored tubewells (FHTW wells; Figure 10.14) have low concentrations but very spiky trends. At such low concentrations, the extent of analytical error is uncertain. Certainly no seasonal trends can be discerned from the data.

10.6.3 Lakshmipur

The shallow groundwaters from the Lakshmipur piezometers have dominantly low SO_4 concentrations (<10 mg L^{-1}) and, as noted for other Lakshmipur groundwaters in Chapter 7, much lower than expected from equivalent Cl (and Na) concentrations. The low values reflect loss of SO_4 from solution by bacterially-mediated reduction reactions. Despite this dominant process, the SO_4 concentrations (as with other major elements in the

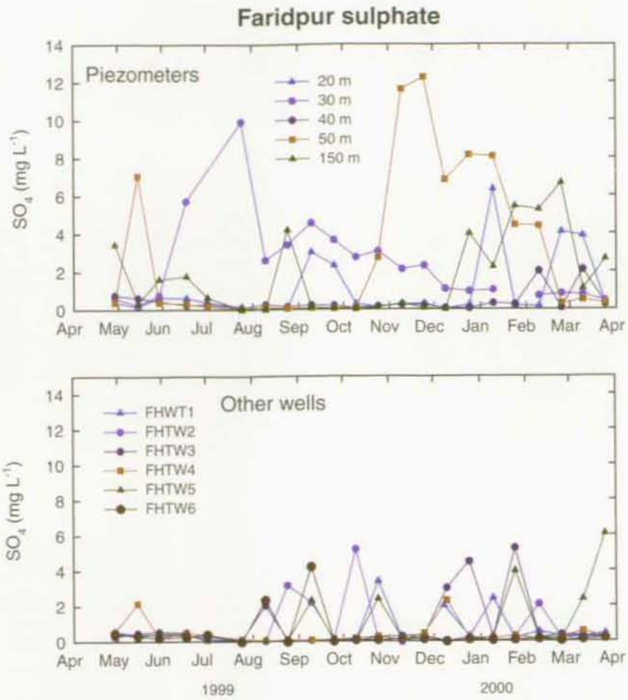


Figure 10.14. Temporal variation in SO_4 at the Faridpur monitoring sites.

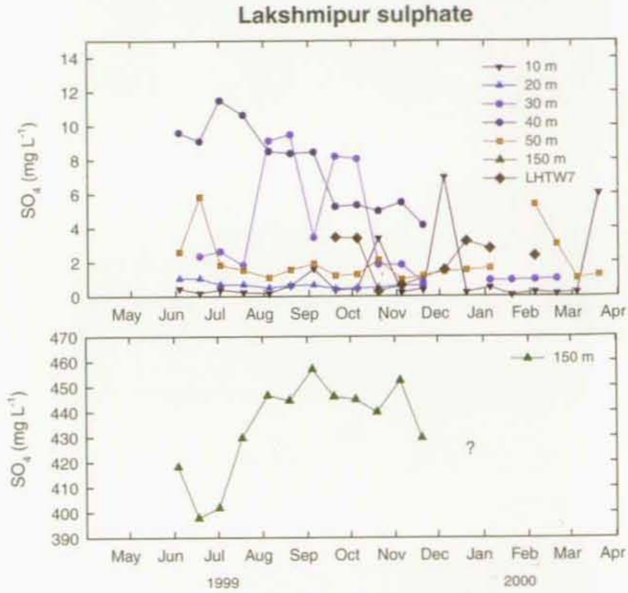


Figure 10.15. Temporal variation in SO_4 at the Faridpur monitoring sites.

Lakshmipur piezometers) reflect to some extent groundwater salinity. Concentrations increase progressively with depth going from 10 m to 40 m bgl.

Piezometers at 30 m and 40 m have apparent maxima over the monsoon period, though there is no apparent increase during this time in the shallowest piezometers. The reasons for these variations are not clear from the existing data and a longer period of monitoring is required to determine the main processes.

Sulphate concentrations in the 150 m piezometer lie in the range 400–600 mg L^{-1} range with a distinct increase during the monsoon period (Figure 10.15). The reason for this is not clear. It did not appear to be a simple consequence of ingress of sea water as Cl concentrations did not show a coincident increase.

10.7 Phosphate

Phosphate is discussed briefly here because of the potential diagnostic use of depth information in determining the significance of pollutants such as fertilisers in contributing P to the groundwaters.

10.7.1 Chapai Nawabganj

Concentrations of P in the monitored network at Chapai Nawabganj are considerably higher in the tubewell waters than the dug wells, with concentrations up to around 1 mg L^{-1} (Figure 10.16). Concentrations in the dug wells were mostly <0.2 mg L^{-1} and are not shown. Trends are somewhat spiky and some of the variation perhaps reflects unresolved sampling and analytical errors. However, in the early part of monitoring of the piezometers (April–August 1999), concentrations appeared to progressively decrease in the interval from 10–40 m depth. Later variations are less clearly stratified, with maximum concentrations observed in the 40 m piezometer. The trends do not provide convincing evidence for a pollutant source including a fertiliser source. The piezometers at Chapai Nawabganj are located at a Primary School in the centre of Chanlai where impacts of fertiliser from local fertiliser applications are expected to be minimal. Therefore, in this case, the leaching of fertiliser phosphate is unlikely to be a main driving force for the development of high arsenic groundwaters.

In the other monitored sites (CHTW wells), concentrations are variable between wells with no consistent depth relations. The shallowest wells have both the highest (CHTW6; 21 m) and lowest (CHTW3; 15 m) concentrations (Figure 10.16). The P data do not provide unequivocal evidence for the dominant sources of phosphate.

10.7.2 Faridpur

Concentrations of P in the monitored wells at Faridpur are generally high (often 1–3 mg L^{-1}; Figure 10.17). The profiles show no discernible temporal trend. Highest concentrations in the shallow piezometer set are found at the 40 m depth, lowest at 20 m. This does not suggest a surface-derived pollutant source since concentrations would be expected to decrease with depth. The highest concentrations among the other monitored wells are from FHTW1 (41 m depth). The deep 150 m piezometer has consistently low P concentrations (<0.2 mg L^{-1}; Figure 10.17).

10.7.3 Lakshmipur

Shallow groundwaters from the Lakshmipur piezometers have generally high P concentrations (1–2 mg L^{-1}) (Figure

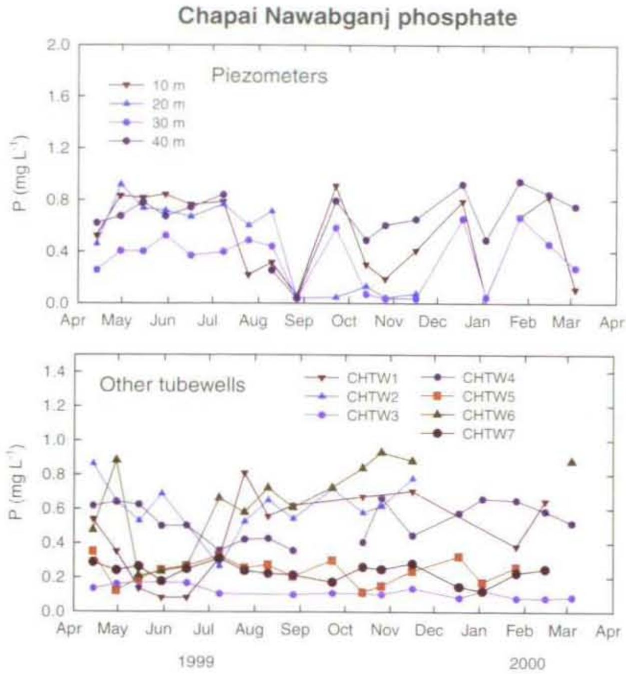


Figure 10.16. Temporal variation in P at the Chapai Nawabganj monitoring sites.

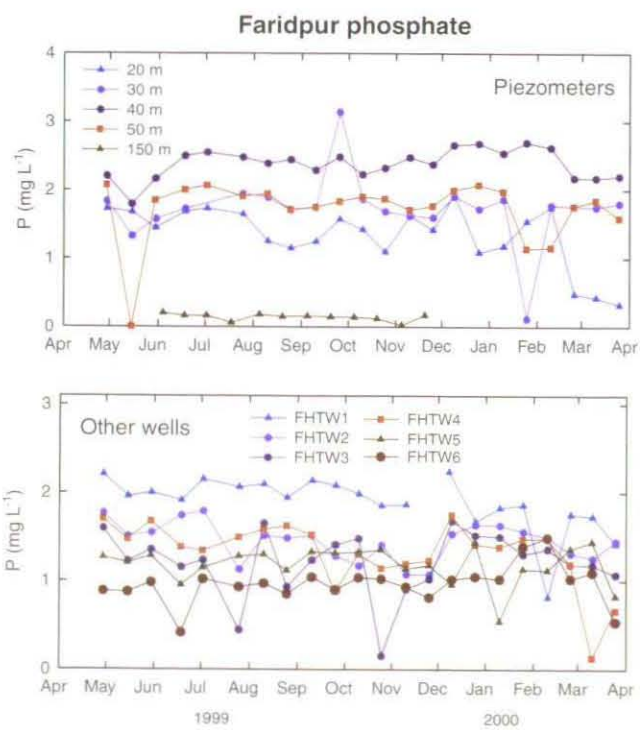


Figure 10.17. Temporal variation in phosphate-P at the Faridpur monitoring sites.

10.18), as reported in Chapter 7. Of these, the lowest and least variable concentrations are found in the 10 m piezometer. Highest concentrations overall are found in the groundwaters from 30–40 m depth. Groundwater from the 50 m poor-yielding piezometer shows the greatest variability with a maximum in July–August 1999. It is not clear how much of the initial variability in the P concentrations

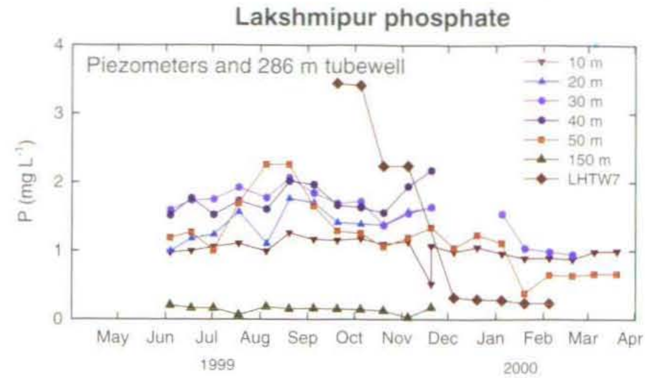


Figure 10.18. Temporal variation in phosphate-P at the Lakshmipur monitoring site.

in the piezometers is related to disturbance of the groundwater due to drilling.

The deep (150 m) piezometer has much lower P concentrations (typically <0.2 mg L^{-1}) and over the period where data are available showed little variation. Concentrations in the deeper (286 m) LHTW7 tubewell were also low in the period December 1999 to February 2000, but for reasons which are unclear, had dropped sharply in the 3-month interval previously, from an initial high of 3.3 mg L^{-1} (Figure 10.18). Continued monitoring would help to identify the causes, repeatability and significance of this trend.

10.8 CONCLUSIONS

- Groundwaters have been monitored over a period of up to 12 months in specially-drilled piezometers and a selection of existing tubewells and dug wells in the Special Study Areas.
- The tubewells were pumped before sampling but piezometers are not pumped between sample periods and the other tubewells are equipped with hand pumps for normal domestic use. The temporal variations in water level and chemistry therefore reflect changes in the aquifers without heavy pumping. Nonetheless, the conditions are representative of the real situation where most groundwater abstraction is from hand pumps.
- Water levels show varying responses to seasonal monsoon rainfall. The greatest variation and deepest levels are seen at Chapai Nawabganj and the least at Lakshmipur. Hydrographs of the shallow piezometers are similar at each location and suggest that good hydraulic connections exist within the shallow aquifer.
- At Faridpur, the hydrograph of the 150 m piezometer is similar to those at shallow depths, suggesting some hydraulic connection. Despite this, chemical compositions are very different in the two depth ranges.
- At Lakshmipur, the 150 m piezometer has a distinctive hydrograph with a much smaller seasonal variation, suggesting hydraulic separation between the shallow (≤ 50 m) and deep aquifers.

- Arsenic concentrations show little notable temporal variation in most of the monitored wells. Two shallow piezometers from Lakshmipur showed possible small trends, but while one increased, the other decreased and there was no consistent pattern among the piezometers. Concentrations of As were consistently lowest in the 10 m piezometers (Chapai Nawabganj, Lakshmipur), the dug wells (Chapai Nawabganj) and the deep tubewells (Faridpur and Lakshmipur). At Faridpur, concentrations decreased systematically with depth over the depth range 20–50 m.
- Sodium and Cl are indicators of the temporal and spatial variations in groundwater salinity. Concentrations are low in shallow tubewells from Faridpur and Chapai Nawabganj but much higher in the dug wells from Chapai Nawabganj as a result of evaporation and/or pollution, and the Lakshmipur tubewells as a result of a seawater component in the aquifer. Groundwater is notably fresh in the 286 m tubewell from Lakshmipur. Concentrations of Na and Cl often decreased during the monsoon period perhaps as a result of dilution by recharge. This effect was greatest at the shallowest depths.
- Sulphate concentrations, as reported elsewhere (Chapters 6, 7) were generally low. At shallow depths where concentrations were greatest, they also tended to decrease during the monsoon period. Concentrations increased with depth in the Lakshmipur piezometers as a result of increased salinity, but nonetheless showed evidence of significant loss (compared to Cl and Na concentrations) as a result of sulphate reduction.
- Concentrations of P were variable but often high (often > 1 mg L^{-1}). There was little consistent trend in absolute concentrations with depth. Trends showed some similarities, but also some differences, with those for As at each site.
- The monitoring period gives some preliminary information about temporal trends in water quality over a range of depths in the aquifers, but continued monitoring for a period of several more years is required to test the consistency of observed seasonal variations and record potential trends over longer timescales.
- The sampling interval used in this study reveals variations over periods of weeks, to months, to seasons but does not give any information over shorter timescales (hours or days). Some systematic monitoring at these timescales is required to explore this.
- We caution against reaching hasty conclusions about the expected long-term trends in water quality especially where substantial flow has been induced by pumping.

Table 11.1. Source of sediment samples

Site	Upazila, District	Latitude	Longitude	Stratigraphy	As-rich groundwaters	Source
Khitta	Gomastapur, Nawabganj	24°36.7'	88°22.5'	Dupi Tila	No	Barind Integrated Agricultural Development Project
Purba Fargilpur,	Gomastapur, Nawabganj	24°52.6'	88°26.6'	Dupi Tila	No	same as above
Rajarampur, DW1	Sadar, Nawabganj	24°34.67'	88°15.50'	Holocene	Yes	DPHE/BWDB/DU (UNICEF assisted)
Chanlai Primary School, DW2	Sadar, Nawabganj	24°35.37'	88°15.50'	Holocene	Yes	same as above
West Bilat Haripur, Kansat	Shibganj, Nawabganj	24°41.5'	88°12.0'	Holocene	No?	Barind Integrated Agricultural Development Project
Chanlai Primary School,	Sadar, Nawabganj	24°35.37'	88°15.50'	Holocene	Yes	Project piezometer, CPW5
Aliabad Union Parishad Compound	Sadar, Faridpur	23°35.22'	89°51.69'	Holocene and older	Yes	Project piezometer, FPW6
BWDB Compound	Sadar, Lakshmipur	22°56.47'	90°50.60'	Holocene and older	Yes	Project piezometer, LPW6
Bhimpur,	Chatkhil, Noakhali	24°3.9'	90°58.7'	Holocene	Yes	BWDB
West Latifpur	Sadar, Lakshmipur	22°57.5'	90°59.7'	Holocene	Yes	BWDB
Thakurgaon	Sadar, Thakurgaon	26°4'	88°20'	Holocene alluvial fan	No	BWDB
Pirgacha	Pirgacha, Rangpur	25°43'	88°22'	Holocene	Yes	BWDB
BWDB Compound	Dhaka city, Dhaka	23°45.2'	90°23.0'	Dupi Tila	No	BWDB

Details of the core material and drilling method are given in Khan et al. (1998). The main fraction of the core material was forwarded to Dhaka University for sedimentological investigation. A separate sub-sample was sealed on site with wax in PVC liners and freighted to the UK for analysis. Pore waters were recovered from the more sandy core samples from DW1 and DW2 by centrifugation using screw-topped centrifuge cups in a high-speed centrifuge but as reported in the Phase I report and Chapter 7, these showed evidence of oxidation and were all low in arsenic. They were therefore not thought to reflect the true in situ pore water chemistry. Nevertheless, the sediment provided samples for SEM analysis and chemical analysis.

A set of piezometers for water quality and water-level monitoring was drilled in each of the Special Study Areas. The piezometers were installed by BWDB during 1999. Two drilling rigs were used: one for the Chanlai (Chapai Nawabganj) set and one for the Faridpur and Lakshmipur sets. The sediment was extracted in a PVC liner and both ends sealed with wax to minimise, but not totally exclude, oxidation of the sediment. Although visible signs of oxidation were not always visible, there was evidence for oxidation in some samples when the cores were opened. This was seen in the form of a brown rim on the outside of the core with grey sediment in the centre. Oxidation of the sediments was seen to progress slowly as the storage time increased. The borehole logs are described in detail in Chapter 3.

As expected, clay was encountered below about 40 m at Chanlai, as in the earlier DW2 borehole (Figure 3.11), and so drilling was halted at 50 m. The 'deep' hole at Faridpur was 155 m deep and at Lakshmipur it was 153 m deep. Sediments from these three purpose-drilled deep boreholes were used as the principal samples in the subsequent mineralogical and geochemical investigations. The samples used were derived from the bulking of sediment over 0.3 or 0.6 m (1 or 2 ft) intervals.

Some sediment samples were also available from the BWDB. These included Thakurgaon in the extreme north-west of Bangladesh where the sediments are dominated by coarse sediments of the Tista Fan. It is also a region of low groundwater As concentrations. Pirgacha is also in the north-west but is a known As hot spot area. The Dhaka samples, from a borehole drilled on the main BWDB compound, are from the Dupi Tila aquifer. This aquifer has known low groundwater As concentrations.

A summary of the properties of the sediments used in this study is given in Table 11.1. Sediment samples from all boreholes were air-dried. Samples for determination of organic carbon and selective extraction using ammonium oxalate-oxalic acid and/or 6 M HNO_3 were gently disaggregated before extraction using a pestle and mortar. Organic carbon was determined using a Carlo Erba CNS analyser after initial dissolution in 10% HCl to remove inorganic carbon.

Representative samples of sediments were analysed using an acid ammonium oxalate extraction. The most detailed profiles were for the DW1 (Rajarampur) and DW2 (Chanlai) boreholes and for the three project piezometer boreholes. Sediment samples from these profiles were taken at 3 m intervals for extraction, where available, and at 1.5 m intervals for the top 15 m of the three piezometer boreholes. These extracts provided upper limits on the amount of labile elements present, especially of arsenic and iron. They also provided a standard basis for comparing sediments from various locations.

11 Mineralogy and sediment chemistry

11.1 Sediment samples available

Despite the large amount of drilling for tubewells that has been undertaken in Bangladesh, archives of well-catalogued and well-preserved sediment samples are relatively rare. This situation has been remedied recently to some extent by both DPHE and BWDB (with UNICEF assistance) undertaking a number of drilling programmes specifically aimed at retrieving core for investigations related to arsenic. Core recovery in early boreholes from these programmes was far from complete but as experience has accumulated, recovery has improved. However, in none of these programmes was core recovered without at least some oxidation of the pore water and sediment. This was also true during the drilling of the three boreholes carried out within this project. While this is clearly an important limitation for studies of sediment-water interactions in the reducing sediments of Bangladesh, it is not critical for many basic mineralogical studies and for those chemical analyses that are insensitive to the effects of oxidation, e.g. total arsenic contents. These and other archived sediments provide a valuable indication of the overall variability of sediment mineralogy. Undertaking sample collection with the necessary precautions to prevent oxidation must await more focused studies of the sediment chemistry.

Sediment samples were therefore collected from various sources for whole-rock examination and analysis, and for selective extraction. A map showing the location of the various sediment samples used in this study is given in Figure 11.1. Small amounts of archived sediments from three boreholes in and close to Nawabganj *upazila* were provided by the Barind Integrated Agricultural Development Project. Core material from these holes was obtained during drilling by the reverse-circulation method and samples had been stored in bags for several years. They will therefore have been at least partially oxidised. A limited amount of core material was also available from two other boreholes from the Dupi Tila aquifer in the Barind area. One borehole was located at Purba Fargilpur, some 25 km north of Chapai Nawabganj in Gomastpur *upazila* and the other at Khitta, 12 km east of Chapai Nawabganj. Core material was also available from a third borehole in the Recent alluvial sediments at West Bilat Haripur, in Shibganj *upazila*, around 15 km north-west of Chapai Nawabganj town.

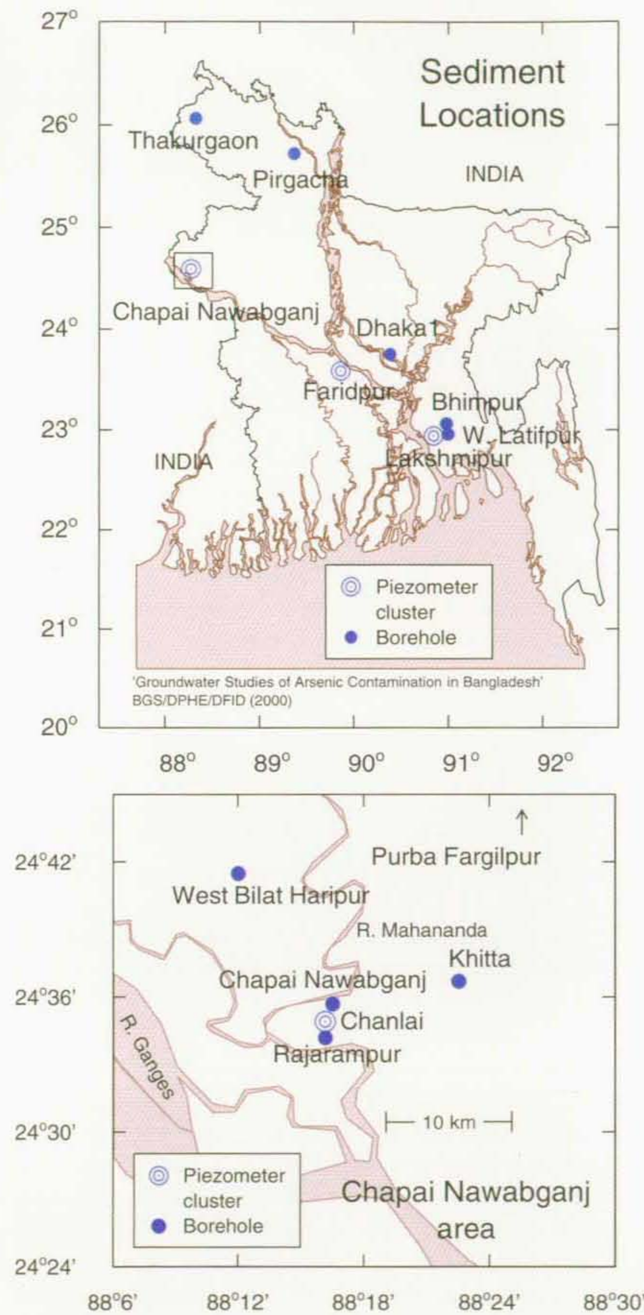


Figure 11.1. Location of the various sediment samples studied.

A number of additional sediment samples from northern and southern Bangladesh were also obtained from Dr. Aftab Alam Khan (DU) and Mizanur Rahman (BWDB). These had been obtained in separate studies of the sediments of Bangladesh as part of arsenic investigations by these organisations. In particular, sediments were analysed from two boreholes (DW1 and DW2) drilled by BWDB during January–March 1998. The results of these were reported in detail in the Phase I report and their logs are presented in Chapter 3. These holes were drilled into the aquifer in the region of the Chapai Nawabganj hot spot: DW1 at Rajarampur and DW2 at Chanlai. Each borehole was drilled to a total depth of 150 m by reverse circulation and core material was recovered from a 0.6 m interval every 3 m using a split spoon. No drilling fluid was used.

Table 11.2. Description of the twenty one samples used for detailed mineralogical and geochemical studies

No.	Location	Depth (ft)	Depth (m)	Description	Colour
1	Chapai Nawabganj	10–12	3.0–3.7	Very micaceous fine sand to **silt**	Dark to olive brown
2	Chapai Nawabganj	**90–92**	**27.4–28.0**	Micaceous fine sand	Light grey
3	Chapai Nawabganj	**120–122**	**36.6–37.2**	Micaceous medium to fine sand	Brown grey
4	Chapai Nawabganj	130–132	39.6–40.2	**Silty clay**	Light yellow brown
5	Chapai Nawabganj	158–160	48.2–48.8	**Clayey silt**	Grey brown
6	Faridpur	4–5	1.2–1.5	Micaceous **silty** fine sand	Brown
7	Faridpur	14–15	4.3–4.6	Fine sand and micaceous sandy silt	Brown
8	Faridpur	34–35	10.4–10.7	Clayey **silt** and micaceous fine sand	Grey brown
9	Faridpur	**59–60**	**18.0–18.3**	Fine to medium sand	Brown grey
10	Faridpur	**109–110**	**33.2–33.5**	Fine to very fine sand	Grey
11	Faridpur	**139–140**	**42.4–42.7**	Silty fine to medium sand	Grey
12	Faridpur	**181–182**	**55.2–55.5**	Micaceous fine sand	Grey
13	Faridpur	430–431	131.1–131.4	Coarse sand and gravel	Grey
14	Lakshmipur	5–6	1.5–1.8	**Silty** very fine sand	Brown grey
15	Lakshmipur	**30–31**	**9.1–9.4**	Micaceous fine sand	Grey
16	Lakshmipur	80–81	24.4–24.7	Medium to fine sand	Grey
17	Lakshmipur	110–111	33.5–33.8	Very fine to medium sand	Grey
18	Lakshmipur	150–151	45.7–46.0	Micaceous **silt** to fine sand	Brown grey
19	Lakshmipur	280–281	85.3–85.6	Micaceous fine to very fine sand	Grey
20	Lakshmipur	340–341	103.6–103.9	Coarse sand	Grey
21	Lakshmipur	420–421	128.0–128.3	Coarse to medium sand	Grey

Bold typeface in the Depth column signifies a significant aquifer horizon; **bold** typeface in the Description column indicates a fine-grained sediment identified from sieve analysis.

11.2 SAMPLES SELECTED FOR MINERALOGICAL ANALYSIS

Twenty one samples of core material from the three Special Study Areas were selected for detailed sedimentological and mineralogical analyses. These were chosen to include the main aquifer as well as representative samples from the various lithologies found in the boreholes. Details are given in Table 11.2 for the Faridpur (FPW6), Chapai Nawabganj (CPW5) and Lakshmipur (LPW6) boreholes. The log descriptions were made immediately upon opening the plastic liner and so the sediments should not have been extensively oxidised. The aims of the analyses were twofold: (a) to determine the concentration of As and other elements in specific size and heavy mineral fractions, and (b) to determine the principal sources of As and other elements within the sediments. The geochemical and heavy-mineral analyses also enable conclusions to be drawn about the sediment provenance.

11.3 METHODS

11.3.1 Sieve analysis, heavy mineral and magnetic separations

Sample splitting

A representative sub-split from each sample was taken either by riffle splitting (sand grade samples) or by cone and quartering (clay grade samples). This was ground by Tema mill for chemical analysis. The remainder was used as the active sub-sample (Figure 11.2).

Particle size fractions

The active sub-sample was split into several size fractions to obtain a suitably graded fraction for heavy liquid-separation (Figure 11.2). This was done using a combination of wet screening and hydrocycloning. The sample was wet screened on 500 and 63 μm stainless steel sieves. The <63 μm material was left in suspension and the <10 μm material was removed using a Pyrex bench-scale hydrocyclone. The 10–63 μm fraction was also dried and weighed and then combined with the 63–500 μm fraction to produce a 10–500 μm fraction for heavy-liquid separation. The data from the particle size fraction were used to produce particle-size frequency distributions (i.e. mass retained for each size fraction) and cumulative distributions (i.e. mass percentage less than a particular particle size).

Heavy-liquid separation

The 10–500 μm fraction was placed in a separating funnel containing bromoform (density 2.88 g cm^{-3}) and was separated into a light (<2.88 g cm^{-3}) and heavy fractions (>2.88 g cm^{-3}). Each fraction was filtered and washed several times with acetone to remove any trace of the bromoform. The fractions were then air dried and weighed.

Magnetic separation

The heavy fraction was separated by magnetic separation to produce five fractions of different magnetic susceptibility as follows: (1) highly magnetic; (2) strongly magnetic; (3) moderately magnetic; (4) weakly magnetic, and (5) non-

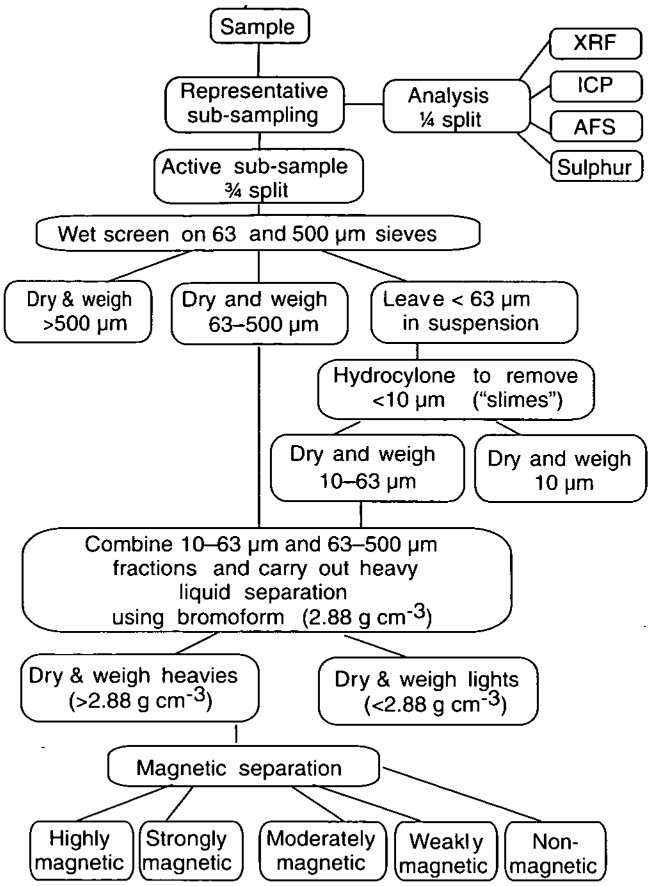


Figure 11.2. Scheme used for separation and analysis of sediment samples.

magnetic. A permanent 'horseshoe' magnet was used to separate the highly magnetic material, and an 'Eclipse' variable hand magnet was used to split the remainder into the other fractions. Magnetic susceptibility measurements were also made on all 21 samples by R. Reynolds (USGS).

11.3.2 Scanning electron microscopy (SEM)

Subsamples of various horizons from the DW1 (Rajarampur) and FPW6 (Faridpur piezometer) boreholes were examined by SEM. These subsamples were mounted on aluminium pin-type stubs using a graphite carbon cement and coated with a thin layer of carbon, approximately 25 nm thick by evaporation in an Emitech evaporation coater. All specimens were examined in a Leo 435VP SEM fitted with a four element solid-state backscattered electron detector. An Oxford Instruments Isis 300 energy-dispersive X-ray microanalysis (EDXA) instrument allowed routine mineral identification.

11.3.3 X-ray diffraction

In order to study the clay minerals present, a fine (<2 μm) fraction-oriented mount was prepared. A representative sub-sample of the <10 μm material was dispersed in 150 mL of deionised water by shaking overnight on a reciprocal shaker and subsequent treatment with ultrasound for approximately 3 minutes. The resultant suspensions were placed in a 250 mL measuring cylinder and allowed to stand. 1 mL of 0.1 M 'Calgon' (sodium hexametaphosphate) was added to the suspensions to prevent flocculation. After a period dictated by Stokes' Law, a nominal <2 μm fraction was removed and dried at 55°C. 100 mg of the <2 μm material were then re-suspended in a minimal amount of distilled water and pipetted onto a ceramic tile in a vacuum apparatus to produce an oriented mount. The clay mounts were then Ca-saturated using 2 mL 1M $CaCl_2$ solution and washed with distilled water twice to remove excess salt before being allowed to air-dry.

XRD analysis was carried out using a Philips PW1700 series diffractometer using Co-Kα radiation and operating at 45 kV and 40 mA. The oriented mounts were scanned over the range 1.5–32° 2θ in both air-dried and ethylene glycol-solvated states, and after heating at 550°C for 2 hours, at a scanning speed of 0.5° 2θ per minute. Diffraction data were analysed using the PC-based Philips X'Pert software coupled to an International Centre for Diffraction Data (ICDD) database.

11.3.4 Geochemistry

Major element chemistry by XRF

Major elements were determined by X-ray fluorescence (XRF) using a Philips PW 2400 X-ray fluorescence spectrophotometer. Approximately 5 g of sample was dried for 24 hours at 105°C. Loss on ignition (LOI) was calculated from the weight loss of 1 g of sample heated at 1050°C for one hour. Fused glass beads were prepared by fusing 0.9 g of sample with 9 g of dried lithium tetraborate ($Li_2B_4O_7$) flux at approximately 1200°C in a muffle furnace. The melt obtained was poured into a platinum casting dish. Lithium iodide was then added to all samples before fusion to act as a releasing agent. Subsequently, 14 major elements were calculated as oxides using a standard Philips calibration algorithm and theoretically generated alpha coefficient corrections. The LOI values obtained represent the loss of volatiles from the samples due to reactions such as carbonate and organic matter decomposition, sulphide oxidation and the loss of moisture and structural water.

Sulphur

Total sulphur was determined on all 21 samples but only one (F154, Lakshmipur 45.7–46.0 m) was found to contain an appreciable sulphur content (0.22 %S). A sample of this material was incrementally ignited from 350–650°C in air, and the sulphur content re-determined (0.19 %S). Very little if any sulphur was lost, indicating that this sample probably contained sulphate and not sulphide. The small difference in the values is much less than the errors inherent in the method.

Digested samples

Two digestions were made prior to analysis by ICP-AES. The first was a mixed acid attack using a combination of $HF/HClO_4/HNO_3$ acids and this was used to determine Sr, Ba, Fe, As Ti, Sc, Co, Rb, Cd, Pb and Bi. The second

Table 11.3. Fractionation of the Chapai Nawabganj sediments from test borehole CPW5 by sieve, heavy mineral and magnetic separation

Description	Chapai Nawabganj				
Depth (feet)	10–12	90–92	120–122	130–132	158–160
Depth (m)	3.0–3.7	27.4–28.0	36.6–37.2	39.6–40.2	48.0–48.6
Sample	1	2	3	4	5
Sample code	F145	F146	F147	F148	F149
Sieve					
>500 μm wt%	2.24	0.03	8.37	0.55	0.03
63–500 μm wt%	1.01	84.00	83.56	2.12	0.66
10–63 μm wt%	66.11	12.58	6.37	60.94	59.39
<10 μm wt%	30.65	3.39	1.71	36.39	39.92
Total wt%	100.00	100.00	100.00	100.00	100.00
Heavy minerals					
>500 μm wt%	2.25	0.03	8.39	0.56	0.03
10–500 μm lights wt%	66.94	94.39	88.65	62.44	59.71
Heavies wt%	<0.01	2.18	1.25	0.28	0.01
<10 μm wt%	30.81	3.40	1.72	36.72	40.24
Magnetic					
>500 μm wt%	2.25	0.03	8.39	0.56	0.03
10–500 μm lights wt%	66.94	94.45	88.68	62.62	59.71
1) highly magnetic wt%	<0.01	0.03	0.01		<0.01
2) strongly magnetic wt%	<0.01	0.50	0.22		<0.01
3) moderately magnetic wt%	<0.01	1.12	0.67		<0.01
4) weakly magnetic wt%	<0.01	0.19	0.07		<0.01
5) non-magnetic wt%	<0.01	0.29	0.24		<0.01

digestion involved the same mixed-acid attack followed by a fusion with NaOH and was used to determine REE, U, Th, Zr, Nb, Hf and Ta. Although the duplicate determinations for the fusions were not as reproducible as usual (i.e. differences sometimes greater than 10%) particularly for some of the more refractory elements, the data obtained for the CRMs was acceptable, suggesting that the cause was an inhomogeneous distribution of refractory minerals within the samples. Arsenic was determined by HG-AFS on the extracts from the mixed-acid attack without NaOH fusion.

11.3.5 Selective extraction using acid ammonium oxalate

Acid-ammonium-oxalate extracts were prepared (following the method of McKeague and Day, 1966). Samples were weighed (1.25 g) into acid-washed Oak Ridge centrifuge tubes and 25 ml of 0.2 M acid oxalate solution (700 mL ammonium oxalate plus 535 ml 0.2 M oxalic acid, adjusted to pH 3; i.e. Tamm's Reagent) added. Solutions were then shaken in the dark (to prevent photochemical reactions) for 4 hr, centrifuged and supernatants decanted ready for chemical analysis. Acid ammonium oxalate extracts arsenic associated with iron and aluminium oxides, with carbonates including iron carbonate (siderite), and to some extent with clays, and is expected to give a closer estimate of the 'labile pool' of arsenic than a 'total' dissolution which will tend to overestimate the pool, or with a water-soluble extraction which will tend to underestimate it. In aerobic environments, this extract has been widely used for estimating the amount of 'amorphous' iron oxides. With reducing sediments, the extraction is also likely to dissolve some crystalline iron oxides such as magnetite, akageneite, hematite and goethite (Heron et al., 1994; Kostka and Luther, 1994) and probably other mixed Fe(II)-Fe(III) oxides. It may also desorb As and other adsorbed solutes from a variety of minerals. The oxalate extracts were analysed for a wide range of elements by ICP-OES using matched standards and for As by HG-AFS as for the groundwaters.

11.4 MINERALOGY AND WHOLE ROCK GEOCHEMISTRY

11.4.1 Particle size, sedimentology and mineralogy

The results of the sieve and heavy-mineral separations are given in Tables 11.3–11.5. Both coarse-grained and fine-grained samples were analysed from the three Special Study Areas boreholes. The proportion of <63 μm (silt and clay) material provided a clear distinction between the two: the fine-grained sediments usually contained >90% of this fraction whereas the coarse-grained sediments usually contained <10%. In general, most samples in the Faridpur borehole (FPW6) were fine to medium sands. However, the fine-grained samples were distinguished by a higher clay and silt content. All samples contained conspicuous, coarse, sand-sized biotite. The mineralogy of the samples is dominated by quartz and feldspar, both plagioclase (albite and more Ca-rich compositions) and alkali feldspar. The proportion of <10 μm material varies in the Faridpur samples, from 38–46% in the fine-grained samples to typically less than 1% in the coarser-grained samples.

Table 11.4. Fractionation of the sediments from the Faridpur borehole FPW6 by sieve, heavy mineral and magnetic separation

Description	Faridpur							
Depth (feet)	4–5	14–15	34–35	59–60	109–110	139–140	181–182	430–431
Depth (m)	1.2–1.5	4.3–4.6	10.4–10.7	18.0–18.3	33.2–33.5	42.4–42.7	55.2–55.5	131.1–131.4
Sample	6	7	8	9	10	11	12	13
Sample code	F137	F138	F139	F140	F141	F142	F143	F144
Sieve								
>500 μm wt%	0.45	0.35	0.08	1.41	2.08	10.23	19.95	93.34
63–500 μm wt%	3.64	62.28	5.06	93.76	96.18	86.96	78.98	5.56
10–63 μm wt%	57.51	32.40	49.33	2.99	1.04	2.05	0.54	0.70
<10 μm wt%	38.40	4.97	45.53	1.85	0.69	0.77	0.54	0.39
Total wt%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Heavy minerals								
>500 μm wt%	0.46	0.35	0.08	1.41	2.09	10.25	19.98	93.46
10–500 μm lights wt%	60.96	92.83	54.03	91.26	89.73	80.85	73.47	5.60
Heavies wt%	0.07	1.84	0.02	5.48	7.49	8.13	6.00	0.54
<10 μm wt%	38.52	4.98	45.87	1.85	0.70	0.77	0.54	0.39
Magnetic								
>500 μm wt%	0.46	0.35	0.08	1.41	2.09	10.27	20.00	93.48
10–500 μm lights wt%	60.96	92.85	54.03	91.28	89.75	81.00	73.53	5.60
1) highly magnetic wt%	0.06	0.03	<0.01	0.23	0.29	0.22	0.20	0.02
2) strongly magnetic wt%	<0.01	0.42	0.01	0.33	1.02	1.55	0.81	0.16
3) moderately magnetic wt%	<0.01	1.05	<0.01	3.60	3.68	4.45	3.87	0.25
4) weakly magnetic wt%	<0.01	0.08	<0.01	0.42	1.38	0.92	0.46	0.03
5) non-magnetic wt%	<0.01	0.24	<0.01	0.87	1.09	0.81	0.58	0.05

Table 11.5. Fractionation of the sediments from Lakshmipur borehole LPW6 by sieve, heavy mineral and magnetic separation

Description	Lakshmipur							
Depth (feet)	5–6	30–31	80–81	110–111	150–151	280–281	340–341	420–421
Depth (m)	1.5–1.8	9.1–9.4	24.4–24.7	33.5–33.8	45.7–46.0	853–85.6	103.6–103.9	128.0–128.3
Sample	14	15	16	17	18	19	20	21
Sample code	F150	F151	F152	F153	F154	F155	F156	F157
Sieve								
>500 μm wt%	0.04	0.40	0.40	0.33	0.03	0.24	51.02	20.04
63–500 μm wt%	5.51	88.04	91.91	98.67	9.95	84.52	48.38	76.79
10–63 μm wt%	81.22	8.28	5.97	0.78	58.47	14.13	0.30	2.00
<10 μm wt%	13.23	3.29	1.72	0.22	31.55	1.11	0.30	1.16
Total wt%	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Heavy mineral								
>500 μm wt%	0.04	0.40	0.40	0.33	0.03	0.24	51.13	20.11
10–500 μm lights wt%	86.53	91.72	94.71	93.13	67.89	95.85	46.01	74.63
heavies wt%	0.11	4.58	3.16	6.32	<0.01	2.80	2.56	4.10
<10 μm wt%	13.32	3.30	1.73	0.22	32.07	1.11	0.30	1.16
Magnetic								
>500 μm wt%	0.04	0.40	0.40	0.33	0.03	0.24	51.14	20.12
10–500 μm lights wt%	86.59	91.79	94.75	93.16	67.89	95.88	46.02	74.67
1) highly magnetic wt%	0.01	0.06	0.05	0.17		0.04	0.04	0.05
2) strongly magnetic wt%	0.02	0.35	0.22	0.40		0.30	0.19	0.49
3) moderately magnetic wt%	0.01	2.65	2.18	4.18		1.61	1.69	2.54
4) weakly magnetic wt%	<0.01	0.84	0.27	0.70		0.16	0.20	0.39
5) non-magnetic wt%	<0.01	0.62	0.39	0.84		0.66	0.42	0.57
<10 μm wt%	13.33	3.30	1.73	0.22	32.07	1.11	0.30	1.16

In the Chapai Nawabganj samples, the proportion of <10 μm fraction varied from 31–40% in the fine-grained samples to typically less than 4% in the coarse-grained samples. In the Lakshmipur samples, the proportion of this fine fraction varied from 13–33% in the fine-grained samples to typically less than 4% in the coarse-grained samples. Heavy mineral concentrations varied up to 8% in the coarser, more gravel-rich Faridpur samples, up to 6%

maghemite. The highest MS values came from the Faridpur samples that contained abundant 'rust' (samples 9–12). Iron sulphides were uncommon. Some partly oxidised framboidal pyrite, a grain of pyrrhotite (probably detrital), pyrite in various associations, and one cluster of greigite were also observed.

11.4.3 Scanning electron microscopy (SEM)

Subsamples of sediments from the DW1 (Rajarampur), West Latifpur and Faridpur piezometer boreholes were analysed by SEM (Figures 11.4 and 11.5). The sediments appear to be typical of young alluvial sediments with abundant quartz, mica and feldspars and minor amounts of heavy minerals such as pyroxenes, magnetite, chromite, TiO_2, Fe_2O_3, and accessory minerals such as apatite (Figure 11.4a and b). The DW1 clay sample (Figure 11.4c) shows a clay matrix with various embedded lithic fragments. Authigenic pyrite was observed but was rare (Figure 11.4d–f). It occurs both as a replacement for other minerals within exfoliating biotites and as very rare framboidal aggregates. In one sample (Faridpur FPW6 borehole 33.2–33.5 m), extensive authigenic Fe($\pm$Mn) phosphate developed as massive to blocky, subhedral rhombohedral laths. This formed coarse aggregates which filled in the pore space and locally cemented detrital grains. These aggregates may be derived from the ferricrete horizon observed in the Faridpur borehole at approximately 44.2 m depth (10.7 m below this sample).

Three samples from the Faridpur borehole (samples 10.4–10.7 m, 33.2–33.5 m and 131.1–131.4 m) were examined in detail to assess the nature of the clay minerals, iron oxides and heavy minerals present. The coarse, >500 μm fraction, comprised composite aggregates of smaller particles that reflected the mineralogy of the finer fractions, i.e. the finer fractions are probably derived from the disaggregation of coarser aggregates. However, it was noted in the coarser fractions that distinct lithic fragments were present including fine-grained, light brown sandstone, grey micritic limestone and possible granite. SEM analysis indicated that many of the coarse lithic clasts are made up of predominantly coarse to fine sand-sized, angular quartz, feldspar (albite, plagioclase and minor K-feldspar) and mica (biotite and minor muscovite) grains in a silty clay matrix.

A minor but significant proportion of the grains from the Faridpur 131.1–131.4 m sample were rounded suggesting possible reworking of a sandstone source. Generally, the grains appeared fresh although slight corrosion was seen in some feldspar grains. Biotites had been altered and opened slightly along their basal cleavage planes. The clay matrix (Figure 11.5a) comprised smectite, illite and chlorite as irregular platelets which had often coalesced to form coarser aggregates. Authigenic calcite was occasionally found as small, rhombohedral crystals up to 10 μm in diameter (Figure 11.5b). Iron oxide developed as patchy irregular, void linings (Figure 11.5c) and formed coalescing masses of subhedral to euhedral, hexagonal, sub-micron platelets (Figure 11.5d). These iron oxide fragments may be artefacts resulting from oxidation of the sediment or may even have been derived from rusty drilling equipment and entrained in the sediment during drilling.

In the Faridpur 131.1–131.4 m sample, iron oxide developed as microbotryoidal aggregates (Figure 11.5e) which were mostly found as isolated occurrences attached to sand grain surfaces. However, some examples (Figure 11.5f) developed as moderately extensive linings to relatively large voids in sandstone lithic clasts.

11.4.4 X-ray diffraction

Examples of the X-ray diffactograms of the fine (clay) fractions are shown in Figure 11.6 and the overall results are summarised in Table 11.7. The samples contain a clay mineral assemblage consisting of smectite, illite (an undifferentiated and hydrated mica species giving a 10 Å basal spacing), chlorite and kaolinite, in varying proportions. Of these, kaolinite was generally the least abundant clay mineral and was absent from, or below detection, in some samples.

Smectite showed the most marked variation with two sub-groups showing a strong smectite-dominated assemblage (Table 11.7). In the Faridpur samples those from 18.0–18.3 m, 33.2–33.5 m, 42.4–42.7 m, 55.2–55.5 m and 131.1–131.4 m, and in the Lakshmipur samples those from 103.6–103.9 m and 128.0–128.3 m (Figure 11.6) consist of a smectite-dominated clay mineral assemblage. In the Faridpur samples, there is an abrupt change in clay mineralogy from a chlorite-mica-dominated assemblage to a smectite-dominated assemblage between 4.3–4.6 m and 10.4–10.7m.

In the Lakshmipur borehole, a more gradual change occurs with depth, with the shallowest sample (1.5–1.8 m) having a mica-dominated assemblage which changes to an assemblage containing major smectite between 85.3 and 103.6 m. The changes in clay mineral assemblage are not reflected in significant changes in whole rock geochemistry. However, when the Faridpur data are normalised to 100% SiO_2, significant increases occur in the Al_2O_3 (36% to 45%), Na_2O (3% to 9%) and K_2O (8% to 11%) concentrations at and above 10.7 m, compared to the deeper, smectite-dominated samples. In the Faridpur borehole, the smectite-dominated assemblages coincide with the coarse-grained samples.

The clay assemblages in the Chapai Nawabganj samples contain a much lower concentration of, but slightly more crystalline, smectite (Figure 11.6) relative to those of Lakshmipur or Faridpur. This may reflect the increased formation of smectite in the alluvial deposits downstream from Chapai Nawabganj or in the physical concentration of fine-grained particles in the lower part of the delta. Generally the coarser samples (i.e. aquifers) contained higher smectite concentrations.

11.4.5 Whole-rock geochemistry

Whole-rock major and trace-element analyses are presented in Tables 11.8–11.10 for the samples from Chapai Nawabganj CPW5, Faridpur FPW6 and Lakshmipur LPW6 respectively. The total As content of the 21 sediments varied from 0.4 to 10.3 mg kg^{-1} with averages of 5.9, 3.4 and 3.2 mg kg^{-1} for Chapai Nawabganj, Faridpur and Lakshmipur, respectively. These are within the typical range for soils and sediments even though the groundwaters from these areas are highly As-contaminated.

in the Lakshmipur samples and up to 2% in the Chapai Nawabganj samples which were generally slightly better sorted.

The magnetically-separated, heavy mineral fractions were very similar in all samples. The mineralogy changed gradually without distinct cut-offs between the different fractions. This is because the bulk of the heavy mineral populations were ferro-magnesian minerals including pyroxene (augite plus others), hornblende and other amphiboles and garnet. Other heavy minerals present in minor quantities included zircon in some of the less magnetic fractions and apatite in the least magnetic fractions. In the more magnetic fractions, a higher proportion of magnetite and possible hematite occurred. Pyrite was extremely rare and only observed in some of the less magnetic fractions.

11.4.2 Magnetic susceptibility

The results of magnetic susceptibility measurements are given in Table 11.6. They are based on bulk sediment samples of about 3 g. Values of the mass-normalised magnetic susceptibility ranged from 0.36×10^{-5} emu g^{-1} to 10.3×10^{-5} emu g^{-1}. This is normally a measure of the magnetite content, with the higher values reflecting greater magnetite contents. The greatest values are found in the sandy aquifer horizons from Faridpur (18–55 m).

Examination of grain mounts of 6 samples using reflected-light microscopy showed the presence of particles of detrital magnetite, the size of which corresponded reasonably well with the overall grain size of the sediment. The magnetite appears to be of plutonic origin (optically homogeneous for the most part) with minor Ti content indicating low Ti-magnetites. Many grains contained some pleonastic spinel. Most grains exhibited post-depositional dissolution that has removed some Fe leaving relict TiO_2 at the margins of the grains. There were indications that the deeper samples showed a higher degree of dissolution. No unusual authigenic, magnetic Fe minerals were observed. Less common were titanomagnetite (magnetite subdivided by ilmenite lamellae) and ilmenite-magnetite composite grains, and grains of ilmenite-hematite intergrowths. Most samples from the Faridpur and Lakshmipur cores contained moderate to abundant particles of Fe oxide that could have been derived from contamination with rusty scale from the drilling equipment. Many such particles contained relicts of α-iron, indicative of steel fragments (Figure 11.3). The 'rust' also contained some strongly magnetic phases, such as magnetite and

Table 11.6. Magnetic susceptibility (MS) measurements made on the subset of 21 samples from the three Special Study Areas

Sample	USGS sample no.	Lithology	Location	Mass normalised MS 10^{-5} emu g^{-1}
1	B99-1	mud	CN	2.44
2	B99-2	sand	CN	1.38
3	B99-3	sand	CN	0.36
4	B99-4	mud	CN	1.01
5	B99-5	mud	CN	2.23
6	B99-6	mud	F	5.28
7	B99-7	silty sand	F	2.59
8	B99-8	mud	F	2.52
9	B99-9	sand	F	9.17
10	B99-10	sand	F	10.3
11	B99-11	sand	F	7.63
12	B99-12	sand	F	8.75
13	B99-13	sand	F	1.72
14	B99-14	mud	L	1.17
15	B99-15	sand	L	4.29
16	B99-16	sand	L	2.24
17	B99-17	sand	L	4.97
18	B99-18	mud	L	1.70
19	B99-19	sand	L	2.69
20	B99-20	sand	L	0.51
21	B99-21	sand	L	2.17

Data kindly supplied by R. Reynolds, USGS.
Sample numbers from Table 11.2. Location key: CN=Chapai Nawabganj; F=Faridpur; L=Lakshmipur

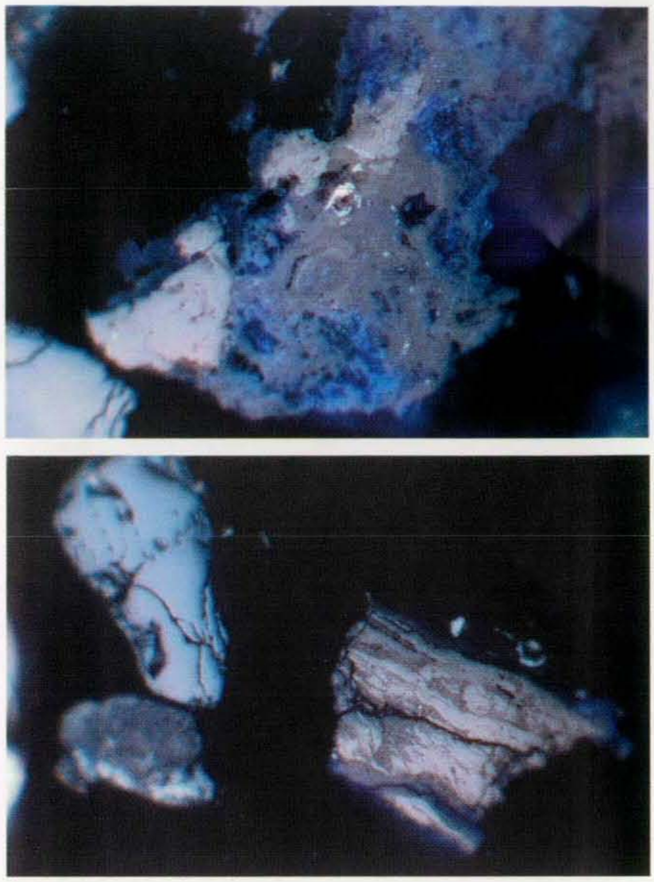
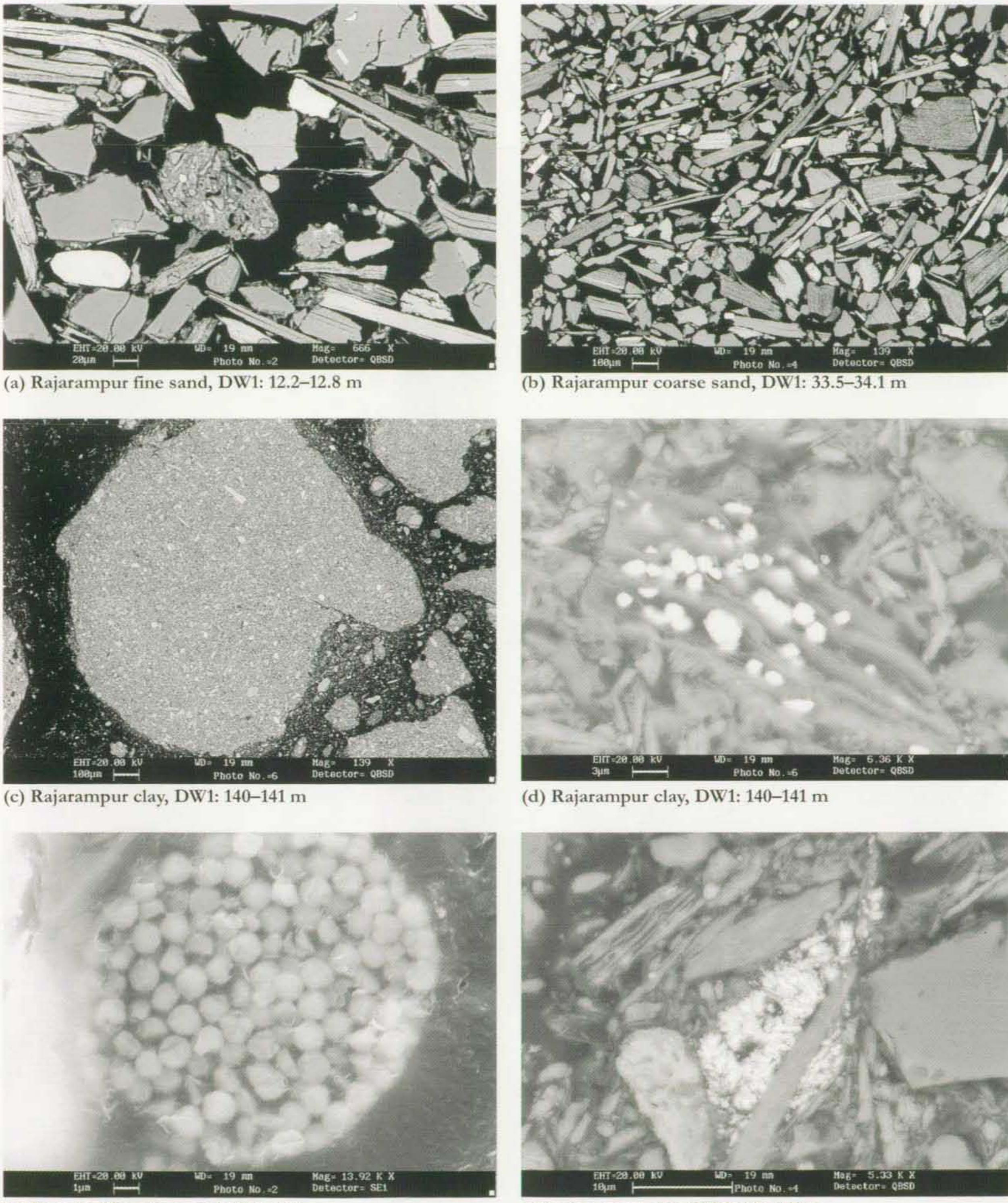


Figure 11.3. Photomicrographs of Faridpur sediment.
Top: 14–15 m. The massive grain is composed mainly of an intermixed iron oxide mineral. The most reflective (white) parts are probably maghemite. The remainder of the grain is a mixture of fine-grained hematite (reddish) and goethite (bluish grey). Bright flecks, mostly in the upper central region, appear to be α-iron.
Bottom: 59–60 m. The large grain on the right is a rust fragment composed of iron oxide minerals. The particle on the upper left is detrital magnetite. The particle on the lower left consists of various Fe-Ti oxide phases, perhaps ilmenorutile. The bright bottom edge is composed of titanium dioxide (rutile or anatase).
Photomicrographs kindly supplied by R. Reynolds (USGS).



(a) Rajarampur fine sand, DW1: 12.2–12.8 m

(b) Rajarampur coarse sand, DW1: 33.5–34.1 m

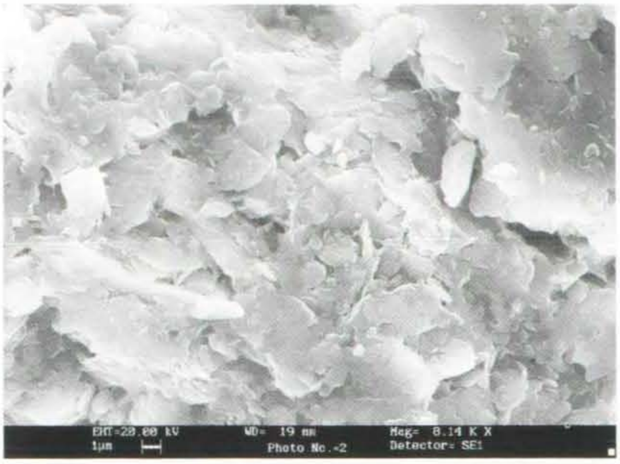
(c) Rajarampur clay, DW1: 140–141 m

(d) Rajarampur clay, DW1: 140–141 m

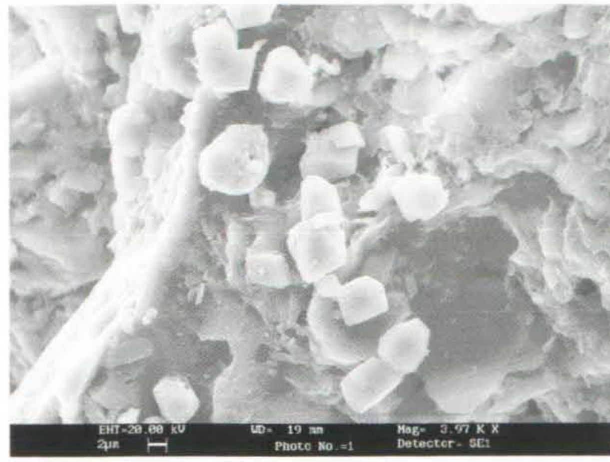
(e) West Latifpur fine sand, 12.2–12.8 m

(f) Rajarampur clay, DW1: 140–141 m

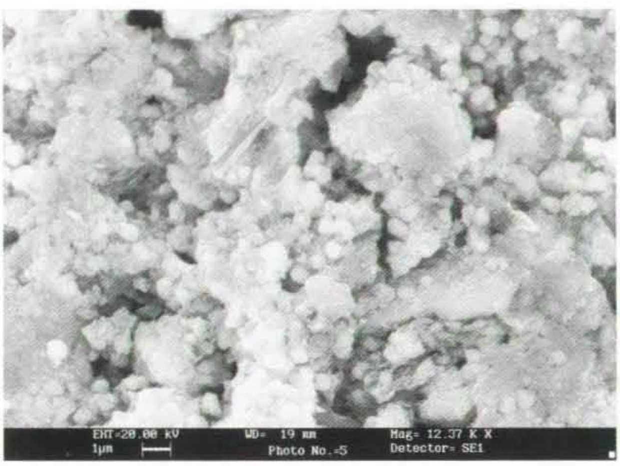
Figure 11.4. SEM photomicrographs of polished thin sections from the DW1 (Rajarampur) and West Latifpur boreholes. **(a)** DW1 (12–13 m, 40–42 ft, bar=20 μm) fine sand showing grains of quartz, sodium feldspar, biotite, apatite, zircon; **(b)** DW1 (33–34 m, 110–112 ft, bar=100 μm) coarse sand with abundant biotite and muscovite; **(c)** DW1 (140–141 m, 460–462 ft, bar=100 μm) grey clay showing aggregates; **(d)** close-up of (c) showing rare authigenic micron- to submicron-sized pyrite precipitating along the basal cleavage plane of an exfoliating mica (bar=3 μm); **(e)** West Latifpur (12–13 m, 40–42 ft, bar=1 μm) close-up of fine sand showing very rare authigenic framboidal pyrite, and **(f)** DW1 (140–141 m, 460–462 ft, bar=10 μm) rare authigenic pyrite replacing an earlier (ferro magnesian?) mineral.



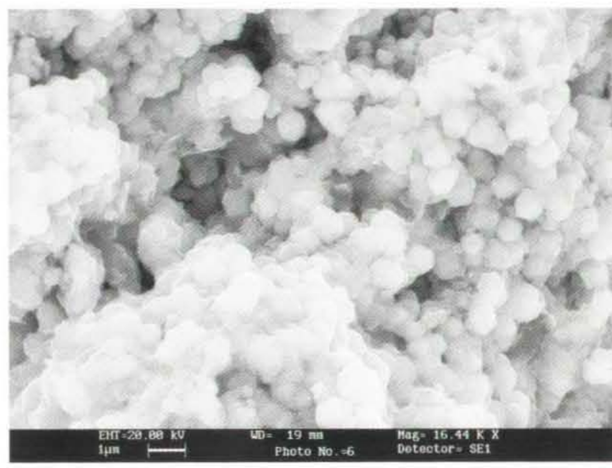
(a) **Faridpur: 10.4–10.7 m**



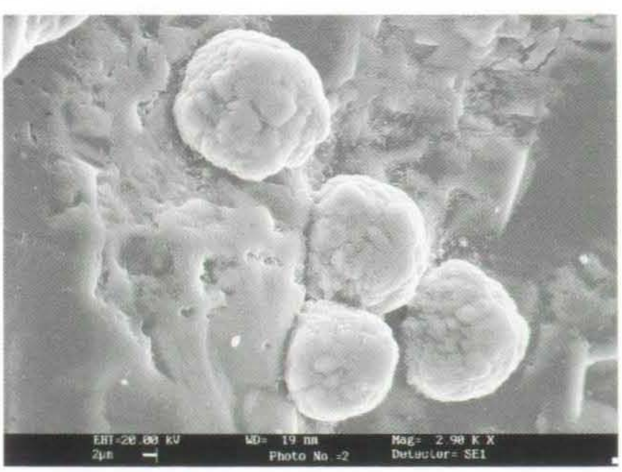
(b) **Faridpur: 10.4–10.7 m**



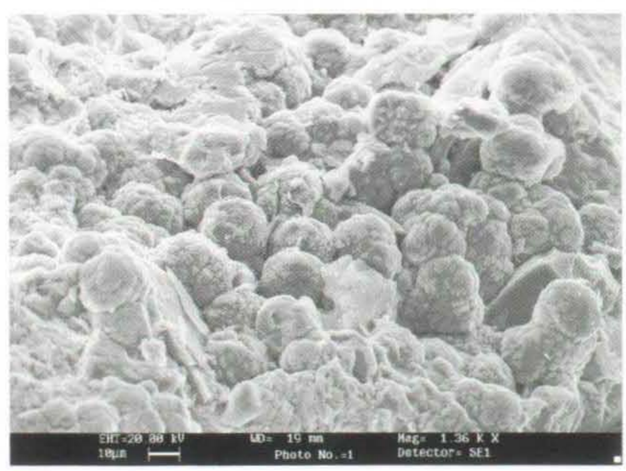
(c) **Faridpur: 33.2–33.5 m**



(d) **Faridpur: 33.2–33.5 m**



(e) **Faridpur: 131.1–131.4 m**



(f) **Faridpur: 131.1–131.4 m**

Figure 11.5. SEM photomicrographs of sediments from the Faridpur piezometer borehole (FPW6). **(a)** 10.4–10.7 m (34–35 ft). Clay matrix including smectite, illite and chlorite within a coarse lithic clast. This matrix is typical of that in all samples examined (bar= 1 μm); **(b)** 10.4–10.7 m (34–35 ft). Rare fine-grained authigenic calcite rhombohedra lining a void in a coarse lithic clast (bar=2 μm); **(c)** 33.2–33.5 m (109–110 ft). Typical view of patchy, earthy iron oxide lining a void in a lithic clast (bar=1 μm); **(d)** 33.2–33.5 m (109–110 ft). Detailed view of sub- to euhedral, sub-micron iron oxide platelets – possibly hematite (bar=1 μm); **(e)** 131.1–131.4 m (430–431 ft). Botryoidal iron oxide aggregates attached to a feldspar substrate (bar=2 μm), and **(f)** 131.1–131.4 m (430–431 ft). Microbotryoidal iron oxide lining a void in a sandstone lithic clast (bar=10 μm).

Table 11.7. Summary of the clay minerals identified by X-ray diffraction

Sample	Sample code	Location	Depth (ft)	Depth (m)	Major	Minor	Trace
1	F145**	Chapai Nawabganj	10–12	3.0–3.7	Smectite, illite	Chlorite	?Kaolinite
2	F146	Chapai Nawabganj	90–92	27.4–28.0	Illite	Chlorite, smectite	
3	F147	Chapai Nawabganj	120–122	36.6–37.2	Illite	Chlorite, smectite	
4	F148	Chapai Nawabganj	130–132	39.6–40.2	Smectite Illite	Chlorite	?Kaolinite
5	F149	Chapai Nawabganj	158–160	48.2–48.8	Illite, chlorite, smectite		?Kaolinite
6	F137	Faridpur	4–5	1.2–1.5	Illite	Smectite, chlorite	Kaolinite
7	F138	Faridpur	14–15	4.3–4.6	Smectite	Illite, kaolinite, chlorite	
8	F139	Faridpur	34–35	10.4–10.7	Smectite, illite	Chlorite, kaolinite	
9	**F140**	**Faridpur**	**59–60**	**18.0–18.3**	**Smectite***	**Illite, chlorite, kaolinite**	
10	**F141****	**Faridpur**	**109–110**	**33.2–33.5**	**Smectite***	**Illite, chlorite**	
11	**F142**	**Faridpur**	**139–140**	**42.4–42.7**	**Smectite***	**Illite, chlorite, kaolinite**	
12	**F143**	**Faridpur**	**181–182**	**55.2–55.5**	**Smectite***	**Illite, chlorite**	**Kaolinite**
13	**F144**	**Faridpur**	**430–431**	**131.1–131.4**	**Smectite***	**Illite, chlorite**	**?Kaolinite**
14	F150	Lakshmipur	5–6	1.5–1.8	Chlorite, smectite, illite		Kaolinite
15	F151	Lakshmipur	30–31	9.1–9.4	Smectite*	Chlorite, illite	
16	F152**	Lakshmipur	80–81	24.4–24.7	Illite, chlorite	Smectite	
17	F153	Lakshmipur	110–111	33.5–33.8	Smectite	Illite, chlorite	Kaolinite
18	F154	Lakshmipur	150–151	45.7–46.0	Illite, chlorite		Smectite, kaolinite
19	F155	Lakshmipur	280–281	85.3–85.6	Chlorite, illite,	Smectite	?Kaolinite
20	F156	**Lakshmipur**	**340–341**	**103.6–103.9**	**Smectite***	**Kaolinite, illite, chlorite**	
21	F157	**Lakshmipur**	**420–421**	**128.0–128.3**	**Smectite***	**Illite, chlorite, kaolinite**	

* dominant phase in the clay assemblage
** poor quality traces due to low amounts of material available for analysis
Bold text is used to highlight the marked changes in clay assemblage, from a smectite-mica-chlorite±kaolinite assemblages to a strongly smectite-dominated assemblage.

Arsenic was strongly positively correlated with many major elements (Fe, Mg, Mn, Ca, K, P and Cr) and with LOI. These correlations, although all greater than r^2=0.64, are probably in large part due to the SiO_2 dilution effect. This results from the dominance of SiO_2 which is relatively pure, largely occurring as quartz in these sediments, and so effectively dilutes the concentration of all other elements. Similarly, As was strongly positively correlated with the amount of the <10 μm fraction (r^2=0.79) since this contained proportionately more feldspars, heavy minerals, clay minerals and authigenic minerals than the coarser fraction which was dominated by quartz.

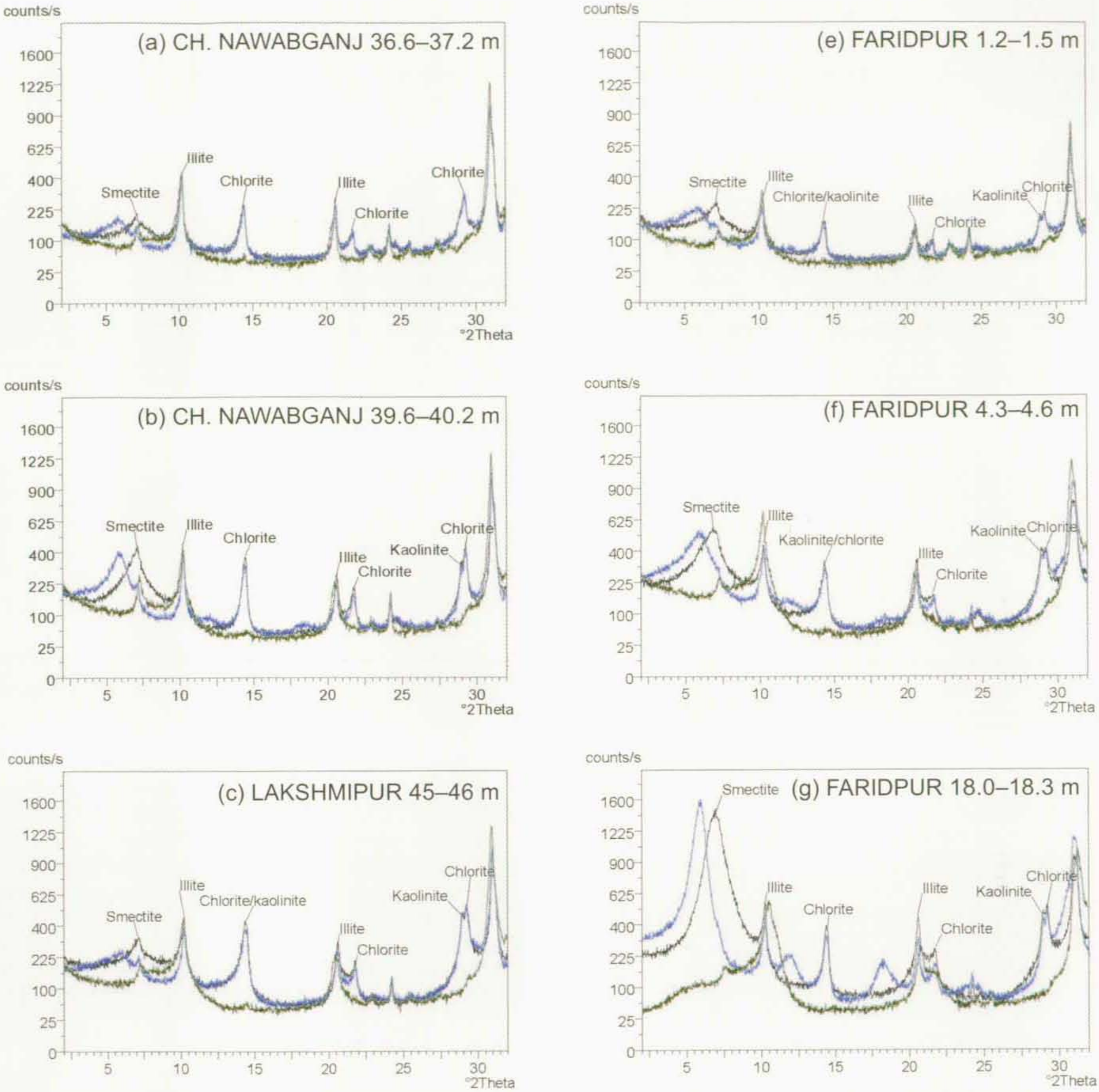
The As and Fe (total from XRF) depth profiles show very similar patterns for each of the three profiles (Figure 11.7) and the two elements are strongly correlated overall (Figure 11.8). The fitted regression equation is:

$$\text{As (mg kg}^{-1}) = -2.0 + 2.3\%\text{Fe} \qquad (r^2=0.79) \qquad (1)$$

The high-Fe and high-As sediments are generally the finer-grained sediments and the Fe is closely associated with a number of other elements including Mg, Al, Mn, Ti, Co and Sc. The good correlation between Fe and a wide range of trace metals in GBM sediments has already been noted (Datta and Subramanian, 1998). The relatively high As content of the clay underlying the shallow sand aquifer in Chapai Nawabganj is notable. However, this probably has no direct relation to the high-As groundwaters found there and it is below the zone from where groundwater is generally derived. At Faridpur, there is quite a distinct drop in sediment As concentration with depth. The As concentration is strongly related to the texture of the sediment with a zone of relatively high-As sediments in the fine-grained overbank deposits at the top of the three profiles.

There were a number of relatively strong correlations which tended to reflect the strong contrast between the Si-rich and minor-element poor sands and minor element-rich silts and clays which are also rich in Mg, Al and K. Multiple regression analysis (not shown) indicated that the size of the <10 μm fraction, and the concentrations of MgO and Fe_2O_3, and LOI together provided the best predictor of the sediment As concentration (R^2=0.90). This suggests that the As occurs principally in the fine (<10 μm) fraction and is associated with iron oxides and possibly smectite clay. In these samples, the LOI is likely to be associated with the clays. The generally low CaO contents indicate that while free carbonates are present in many of the sediments, they are only present as minor constituents. Calcite or dolomite are believed to be quite widely distributed in small amounts in Bangladesh sediments which is consistent with the finding that many Bangladesh groundwaters are saturated, or close to saturated, with these minerals. The Lakshmipur sediments have lower CaO concentrations than those from Faridpur and Chapai Nawabganj, indicating the importance of the carbonate-free Meghna Basin as a source of these sediments.

Factor analysis, a commonly-used multivariate statistical technique, showed that two factors accounted for 86% of the variance in the data. The first factor can be called the 'heavy-mineral' factor since high factor loadings were found for those trace and major elements known to be associated with heavy minerals (i.e. Y, Th, U, La, Zr, Ta, Ti,



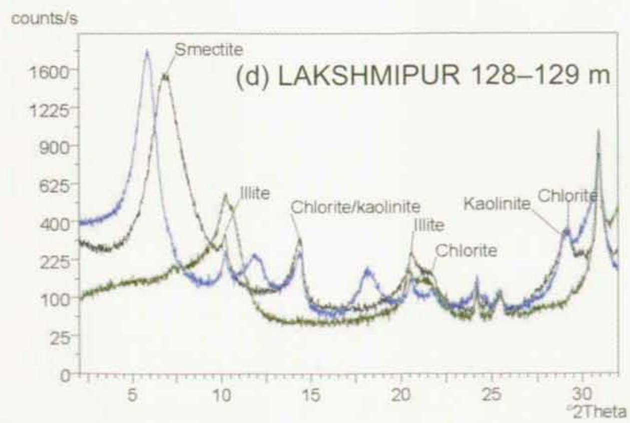


Figure 11.6. Examples of XRD traces of oriented <2 μm fractions from the test boreholes in the Special Study Areas highlighting variations in the proportions of smectite, mica and chlorite.
Left column: Chapai Nawabganj CPW5 (a) 36.6–37.2 m (120–122 ft); (b) 39.6–40.2 m (130–132 ft); Lakshmipur LPW6 (c) 45.7–46.0 m (150–151 ft); (d) 128.0–128.3 m (420–421 ft); Right column: Faridpur FPW6 (e) 1.2–1.5 m (4–5 ft); (f) 4.3–4.6 m (14–15 ft) and (g) 18.0–18.3 m (59–60 ft).

Table 11.8. Whole-rock geochemical data for the Chapai Nawabganj CPW5 samples

Description			**Chapai Nawabganj**		
Depth (feet)	10–12	90–92	120–122	130–132	158–160
Depth (m)	3.0–3.7	27.4–28.0	36.6–37.2	39.6–40.2	48.2–48.8
Sample	1	2	3	4	5
Sample code	F145	F146	F147	F148	F149
Description	brown fine sand	grey fine sand	brown grey med/fine sand	yellow brown silty clay	grey brown clayey silt
SiO_2%	59.71	79.40	81.60	57.11	55.22
TiO_2%	0.84	0.31	0.21	0.68	0.69
Al_2O_3%	16.37	7.86	8.65	13.98	14.46
Fe_2O_3t%	6.45	2.00	1.62	5.53	6.01
Mn_3O_4%	0.09	0.04	0.02	0.10	0.11
MgO%	2.57	0.91	0.65	2.67	2.89
CaO%	2.89	2.70	1.21	6.42	6.90
Na_2O%	1.14	1.48	1.58	1.14	1.17
K_2O%	3.43	1.99	2.46	3.02	3.19
P_2O_5%	0.12	0.08	0.04	0.14	0.18
Cr_2O_3%	0.02	0.01	0.01	0.02	0.02
SrO%	0.01	0.01	0.01	0.02	0.02
ZrO_2%	0.03	0.03	0.02	0.04	0.02
BaO%	0.07	0.04	0.04	0.06	0.06
LOI%	6.01	2.49	1.40	8.59	9.23
Total%	99.77	99.35	99.51	99.54	100.20
FeO%	0.98	0.56	0.39	1.12	2.46
As	6.17	1.74	1.31	10.13	10.34
Co	16.16	5.28	4.29	14.30	14.95
Sr	82.17	87.17	72.67	114.17	127.42
Ba	493.3	286.8	326.3	416.8	427.8
Fe	40455	13782	10481	35130	38921
Ti	4828	1812	1242	3822	4090
Sc	10.47	3.83	2.93	8.98	9.11
Rb	167.84	91.17	110.91	125.12	133.94
Pb	23.41	17.15	19.21	25.90	27.91
Bi	0.64	0.15	0.10	0.55	0.62
Y	23.41	16.38	9.31	20.94	18.20
Zr	133.60	173.30	72.01	164.44	86.89
Nb	15.91	7.08	5.76	14.02	13.76
La	36.38	22.06	12.69	28.93	26.45
Ce	80.02	48.96	28.09	61.29	54.55
Nd	32.30	20.08	11.27	26.14	23.95
Sm	6.40	3.97	2.26	5.11	4.80
Yb	2.46	1.66	0.87	2.16	1.87
Hf	3.66	4.70	1.94	4.37	2.34
Ta	1.50	0.80	0.52	1.14	1.15
Th	15.26	10.72	5.99	12.82	9.94
U	3.38	2.08	1.20	2.19	2.49

Units are mg kg^{-1} unless otherwise indicated. 'Fe_2O_3t' is the total Fe expressed as Fe_2O_3 and 'FeO' is the Fe(II) expressed as Fe, both from XRF. 'Fe' is the total Fe determined by ICP-AES after dissolution.

Nb, P). The second factor was the 'clay' factor which contained a high factor loading for As in association with LOI, the <10 μm fraction and the MgO content.

The As contents for the weight- and size-separated fractions of five selected samples (Table 11.11) indicated that the 'light sand' fraction and <10 μm size fraction dominated both the weight fraction and also the As load of the sediment. The heavy mineral fraction does not contribute significantly to the total As concentration. This is in agreement with the multivariate analyses described above which emphasise the importance of the fine fraction. In the samples analysed (Table 11.11), As concentrations in the fine fraction (<10 μm) varied between 10 and 45 mg kg^{-1}, significantly greater than the concentrations in the heavy-mineral fractions. The >500 μm fraction also tended to have quite high As concentrations.

Table 11.9. Whole-rock geochemical data for the Faridpur FPW6 samples

Description	**Faridpur**							
Depth (feet)	4–5	14–15	34–35	59–60	109–110	139–140	181–182	430–431
Depth (m)	1.2–1.5	4.3–4.6	10.4–10.7	18.0–18.3	33.2–33.5	42.4–42.7	55.2–55.5	131.1–131.4
Sample	6	7	8	9	10	11	12	13
MPG Code	F137	F138	F139	F140	F141	F142	F143	F144
Description	brown silty f sand	brown f sand & silt	grey brown clayey silt & f sand	brown grey f/m sand	grey f/vf sand	grey silt f/vf sand	grey f sand	Grey coarse sand & gravel
SiO_2%	59.55	70.90	56.30	78.73	77.30	77.63	77.51	89.56
TiO_2%	0.78	0.57	0.77	0.32	0.43	0.44	0.37	0.12
Al_2O_3%	14.30	10.64	15.75	9.08	9.71	9.76	10.35	4.57
Fe_2O_3t%	5.89	4.07	6.57	2.65	3.50	3:08	2.90	1.18
Mn_3O_4%	0.11	0.07	0.10	0.05	0.07	0.07	0.05	0.03
MgO%	2.53	1.70	2.70	0.87	1.00	1.03	1.00	0.35
CaO%	4.85	3.62	4.48	2.01	2.34	2.36	1.78	0.50
Na_2O%	1.14	1.53	0.99	1.80	1.87	1.91	2.04	0.83
K_2O%	3.06	2.46	3.18	2.12	2.18	2.16	2.43	1.25
P_2O_5%	0.12	0.11	0.13	0.08	0.13	0.12	0.07	0.03
Cr_2O_3%	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01
SrO%	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.01
ZrO_2%	0.03	0.03	0.02	0.02	0.04	0.04	0.02	0.02
BaO%	0.07	0.05	0.07	0.04	0.05	0.05	0.05	0.02
LOI%	7.21	4.07	8.24	1.53	1.29	1.34	1.03	0.75
Total%	99.69	99.86	99.35	99.33	99.95	100.03	99.63	99.23
FeO%	0.99	0.88	1.50	0.69	1.12	1.18	1.02	0.23
As	8.02	5.82	7.12	1.95	1.38	1.34	1.10	0.69
Co	15.04	11.88	17.92	5.22	6.89	7.18	7.51	2.11
Sr	102.17	106.67	99.67	131.17	137.17	141.67	149.67	63.17
Ba	453.3	357.8	467.3	314.8	310.3	312.8	349.8	180.8
Fe	37404	26664	42097	17625	23047	20471	19121	8052
Ti	4447	3245	4540	1885	2443	2596	2218	691
Sc	9.21	6.39	9.97	4.20	5.70	5.83	5.14	1.25
Rb	136.64	111.59	141.59	79.29	82.54	82.25	101.35	42.03
Pb	22.88	18.83	25.78	18.15	16.17	17.01	17.59	9.11
Bi	0.54	0.25	0.70	0.12	0.10	0.09	0.09	0.08
Y	26.11	22.02	24.23	15.90	22.04	21.50	15.46	5.99
Zr	195.56	209.67	147.01	155.92	199.98	237.29	155.66	33.72
Nb	15.08	11.78	14.62	6.95	8.15	9.00	7.41	2.68
La	32.86	29.00	30.52	20.15	29.22	28.36	22.50	11.91
Ce	75.29	65.98	69.46	45.94	62.73	69.30	51.24	24.68
Nd	30.74	27.64	29.05	19.79	25.20	27.05	19.29	9.57
Sm	6.18	5.49	5.78	3.87	4.81	5.24	3.72	1.70
Yb	2.70	2.31	2.48	1.71	2.40	2.43	1.75	0.71
Hf	5.38	5.84	3.98	4.17	5.46	6.67	4.27	0.89
Ta	1.51	1.25	1.38	0.65	0.75	0.91	0.68	0.10
Th	15.68	13.71	15.62	10.21	13.64	15.07	9.59	4.98
U	2.98	2.57	2.94	1.68	2.55	2.76	1.81	0.81

Units are mg kg^{-1} unless otherwise indicated. 'Fe_2O_3' is the total Fe expressed as Fe_2O_3 and 'FeO' is the Fe(II) expressed as Fe, both from XRF. 'Fe' is the total Fe determined by ICP-AES after dissolution

11.5 NATURE AND ORIGIN OF THE SEDIMENTS

Three lines of evidence can be used to make tentative suggestions about the provenance or origin of the sediments: the sediment chemistry, heavy-mineral assemblages and clay-mineral assemblages. However, the heavy-mineral assemblages from only three samples from the Faridpur borehole have been characterised and it is not known whether these findings can be extrapolated to the other samples within this borehole or to samples from Chapai Nawabganj and Lakshmipur.

The heavy-mineral fractions from the Faridpur sediments that were analysed by SEM contained varying amounts of magnetite (largely retained in the magnetic and strongly magnetic fractions), hematite, titanite, rutile and ilmenite in the strongly to moderately magnetic fractions as well as pyroxene, epidote, tourmaline(?), amphiboles including hornblende and garnet. Minor minerals included

Table 11.10. Whole rock geochemical data for the Lakshmipur LPW6 samples

Description	Lakshmipur							
Depth (feet)	5–6	30–31	80–81	110–111	150–151	280–281	340–341	420–421
Depth (m)	1.5–1.8	9.1–9.4	24.4–24.7	33.5–33.8	45.7–46.0	85.3–85.6	103.6–103.9	128.0–128.3
Description	brown grey silty vf sand	Grey f sand	grey med/f sand	grey vf/med sand	brown grey silt/f sand	grey f/vf sand	grey coarse sand	grey coarse/ med sand
Sample	14	15	16	17	18	19	20	21
MPG Code	F150	F151	F152	F153	F154	F155	F156	F157
SiO_2%	69.70	74.65	79.04	81.81	66.02	78.85	88.89	83.07
TiO_2%	0.76	0.53	0.28	0.30	0.78	0.48	0.15	0.26
Al_2O_3%	13.25	10.63	9.88	8.46	14.44	9.47	5.05	7.94
Fe_2O_3t%	5.15	4.36	2.41	2.19	5.81	3.22	1.14	2.00
Mn_3O_4%	0.09	0.07	0.04	0.05	0.10	0.06	0.03	0.05
MgO%	1.80	1.37	0.77	0.70	1.97	1.07	0.28	0.60
CaO%	1.53	1.75	1.29	1.57	1.12	1.66	0.67	1.23
Na_2O%	1.79	1.84	1.92	1.77	1.54	1.72	0.87	1.51
K_2O%	2.61	2.37	2.58	2.06	2.77	2.17	1.56	2.09
P_2O_5%	0.12	0.12	0.05	0.06	0.10	0.09	0.02	0.04
Cr_2O_3%	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01
SrO%	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.01
ZrO_2%	0.03	0.04	0.02	0.01	0.03	0.03	0.01	0.02
BaO%	0.06	0.05	0.05	0.04	0.05	0.05	0.03	0.04
LOI%	2.67	1.57	1.11	0.60	4.70	1.37	0.47	0.76
Total%	99.60	99.39	99.47	99.64	99.94	100.29	99.18	99.63
FeO%	0.98	1.28	0.60	0.68	2.04	0.94	0.27	0.59
As	3.84	5.89	2.10	1.27	8.20	2.71	0.41	1.27
Co	13.29	10.87	6.13	4.22	15.81	7.73	2.47	4.62
Sr	126.17	136.67	138.17	137.67	98.17	122.67	80.17	123.17
Ba	375.8	330.8	371.3	297.8	355.8	299.3	231.8	298.3
Fe	34393	28998	16007	14730	38880	20253	8072	13266
Ti	4449	3106	1655	1723	4653	2721	902	1485
Sc	8.82	6.68	3.55	4.11	9.48	5.60	1.25	4.35
Rb	124.18	98.04	103.26	68.67	133.41	86.68	54.94	75.65
Pb	19.54	20.90	24.66	18.23	29.15	17.42	12.22	18.38
Bi	0.29	0.16	0.09	0.09	0.45	0.13	0.03	0.07
Y	28.52	19.36	7.61	11.20	26.24	18.06	9.80	13.40
Zr	240.63	200.58	41.29	68.03	197.17	176.60	64.55	111.40
Nb	14.56	10.34	5.90	5.90	13.60	8.69	3.03	4.94
La	37.80	23.92	12.41	20.73	33.19	23.12	17.44	21.95
Ce	87.19	57.72	28.57	47.02	72.72	57.81	35.57	47.60
Nd	34.87	23.48	10.92	17.43	29.07	22.96	13.42	17.81
Sm	6.84	4.60	2.15	3.24	5.73	4.57	2.37	3.35
Yb	2.95	2.02	0.85	1.25	2.69	1.83	1.05	1.53
Hf	6.49	5.36	1.14	1.83	5.30	4.68	1.78	3.17
Ta	1.33	0.91	0.54	0.60	1.13	0.74	0.21	0.41
Th	16.80	11.69	5.56	8.17	14.72	11.28	7.10	9.40
U	3.31	2.15	1.04	1.41	3.08	1.97	0.90	1.41

Units are mg kg^{-1} unless otherwise indicated. 'Fe_2O_3' is the total Fe expressed as Fe_2O_3 and 'FeO' is the Fe(II) expressed as Fe, both from XRF. 'Fe' is the total Fe determined by ICP-AES after dissolution

zircons, apatite, sillimanite/kyanite/andalusite and xenotime. Pyrite was only observed very rarely.

This range of heavy minerals is comparable to that from the Miocene and younger sediments reported for the Bengal Basin (Uddin and Lundberg, 1998). The young alluvial sediments studied here sometimes contained significantly more heavy minerals as a proportion of the total rock than older sediments, up to 8.1% in the Faridpur 42.4–42.7 m (139–140 ft) sample (Table 11.4) but the proportion was highly variable. The heavy-mineral assemblage from the Plio-Pleistocene Dupi Tila sands are dominated by non-opaque minerals, mainly tourmaline, kyanite, epidote, garnet, pyroxene, hornblende, mica, chlorite and apatite. The opaque minerals made up to 11% of the total heavy-mineral fraction. Uddin and Lundberg (1998) suggested that the varied nature and types of heavy minerals in the younger sediments of the Bengal Basin indicate an orogenic source and reflect input from varied sources ranging from high-grade contact metamorphic rocks to acidic to ultramafic igneous suites. In the Bengal Basin, this reflects

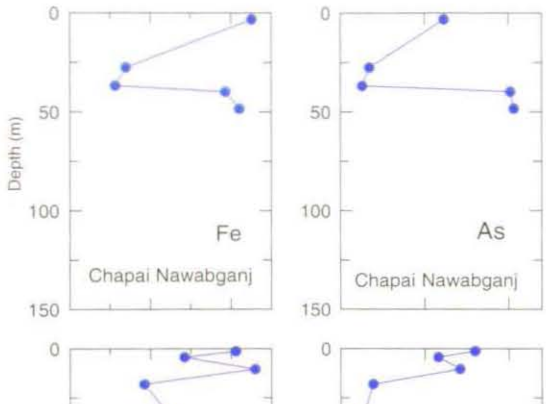


Figure 11.7. Variation of total As and Fe with depth for the three project boreholes.

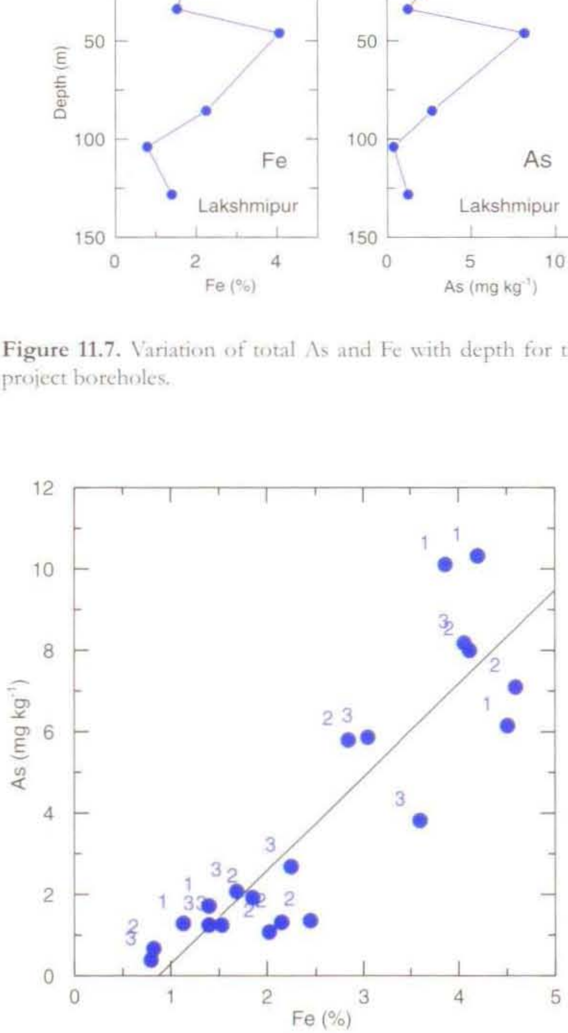


Figure 11.8. Relationship between total Fe and As in the 21 sediments from the three project exploration boreholes. Numbers refer to the borehole: 1=Chapai Nawabganj; 2=Faridpur and 3=Lakshmipur.

continued unroofing of the Himalayas and the alluvial samples investigated here represent the latest stages in this ongoing process. The abundant amphiboles (described in the Plio-Pleistocene Dupi Tila Sandstone as blue-green amphiboles) may reflect arc and ophiolitic sources as the deepest parts of the Himalayas were eroded.

The mineralogy of sediments currently being transported by the Ganges-Brahmaputra rivers is similar to that described here. Datta and Subramanian (1997) reported heavy-mineral concentrates dominated by amphibole, epidote, garnet and apatite with minor pyroxene, topaz, magnetite and trace amounts of rutile, kyanite, ilmenite, tourmaline, zircon and titanite. They found little variation across the basin in terms of heavy-mineral composition. The clay mineral fraction was dominated by illite and kaolinite, with minor chlorite and typically less than 10% smectite. The sediment as a whole was dominated by quartz and feldspars. Datta and Subramanian (1997) reported the mean As concentration in the Ganges sediments as 1.2–2.6 mg kg^{-1}, in the Brahmaputra sediments as 1.4–5.9 mg kg^{-1} and in the Meghna sediments as 1.3–5.6 mg kg^{-1}. These concentrations are generally somewhat lower than those obtained from many of the borehole samples analysed in this study but are not unrealistic.

The clay mineralogy of selected samples has been described above. At Chapai Nawabganj, the clay mineral assemblage is made up of smectite, mica, chlorite and possible trace kaolinite. Smectite is the major constituent at 3.0–3.7 m, 39.6–40.2 m and 48.2–49.4 m. In the Faridpur and Lakshmipur samples, two assemblages were recognised: a smectite-dominated assemblage and a mica-chlorite-dominated assemblage.

In the source rivers of the Bengal Basin, the clay mineral composition of the suspended sediments is dominated by illite with less than 20% kaolinite and chlorite (Naidu et al., 1985). Smectite was not present in these sediments. Chakrapani et al. (1995) and Sarin et al. (1989) indicated that the smectite content of the modern Ganges River increases downstream with both highland and lowland rivers being dominated by mica (illite). Kaolinite is the second most abundant mineral in the highland rivers and smectite the second most abundant in the lowland rivers. This change to a smectite-dominated assemblage was attributed to erosion of the altered basaltic Deccan Traps.

A measure of the degree of weathering can be obtained from the chemical index of alteration (CIA) which is defined by the following formula (Nesbitt and Young, 1982):

$$CIA = Al_2O_3/(Al_2O_3+CaO+Na_2O+K_2O) \times 100\% \quad (2)$$

where CaO^* is the amount of CaO corrected for the calcite content. The resultant value is a measure of the proportion of Al_2O_3 versus more labile elements. Al_2O_3 tends to accumulate in minerals such as gibbsite and kaolinite in highly weathered soils. Examples of typical CIA values are given in Table 11.12. CIA values for the Bangladesh sediments range from 45 to 65 with most between 50 and 55. This reflects the high proportion of unaltered feldspar, the generally low degree of weathering undergone by these immature sediments and their rapid deposition.

The K/Rb ratio can be used to indicate whether the

Table 11.11. Arsenic concentrations in individual separated fractions of five selected samples

Sample	Sample code	Location	Size fraction	Weight percentage %	As in separate mg kg^{-1} sep.	As in separate mg kg^{-1} sediment
1	F145	Chapai Nawabganj	>500 μm	2.3	3.53	0.08
		3.0–3.7 m	Lights	66.9	4.30	2.88
			<10 μm	20.8	10.2	2.12
4	F148	Chapai Nawabganj	>500 μm	0.6	7.76	0.05
		39.6–40.2 m	Lights	62.4	6.80	4.24
			<10 μm	36.7	17.0	6.24
6	F137	Faridpur	>500 μm	0.5	13.4	0.07
		1.2–1.5	Lights	61.0	4.43	2.70
			<10 μm	38.5	15.8	6.08
7	F138	Faridpur	>500 μm	0.4	14.4	0.06
		4.3–4.6 m	Lights	92.8	4.94	4.58
			<10 μm	5.0	23.8	1.19
			Heavies	1.8	3.66	0.07
15	F151	Lakshmipur	>500 μm	0.4	37.6	0.15
		9.1–9.4 m	Lights	91.7	4.11	3.77
			<10 μm	3.3	45.1	1.49
			MS 1&2	0.4	6.96	0.03
			MS3	2.6	10.9	0.28
			MS4	0.8	8.15	0.07
			MS5	0.6	4.54	0.03

sediments are derived from acidic or basic source rocks. The high values found for the Bangladesh samples suggest derivation from acidic to intermediate rock types. This includes the potential for reworking of earlier sedimentary sandstones which is suggested for at least some of the sediments due to the occurrence of subrounded to rounded grains (e.g. in the deepest Faridpur sample).

Our detailed studies of the sediments have shown that pyrite was occasionally found but in general was very rare. It is therefore unlikely to be the main source of As in these sediments. Acharyya et al. (1999) suggested that the primary source of As could be coal seams in the Rajmahal Basin or isolated sulphide outcrops in the Darjeeling Himalayas. Also, Saha (1997) reported that arsenopyrite grains were occasionally observed. These were not observed in the sediments studied here and are therefore considered unlikely to be major sources of As in Bangladesh.

Two clay assemblages have been determined in the sediments from the Faridpur, Chapai Nawabganj and Lakshmipur boreholes: an illite-chlorite-dominated assemblage and a smectite-dominated assemblage. Previous studies of sediment mineralogy in the region have focused on the Bay of Bengal where the clay mineralogy is made up of variable amounts of illite, chlorite, smectite and kaolinite. In the eastern parts of the basin, smectite is the dominant clay type and is typically used to infer a Deccan Traps provenance, whereas to the north and west, illite and chlorite are dominant clay types and are typically used to infer a Himalayan provenance (e.g. Rao, 1991; Segall and Kuehl, 1992; Raman, et al., 1995; Ramaswamy et al., 1997; Roonwal et al., 1997). Analysis of lithic grains has also identified the Himalayan gneissose, sedimentary and metasedimentary terranes as sediment sources in the northern Bengal Fan and the western Nicobar Fan in the Bay of Bengal (Ingersoll and Suczek, 1979).

However, France-Lanord et al. (1993) have suggested from oxygen and hydrogen isotopic analysis of the clay mineral assemblages in the Bengal Fan that the illite-chlorite and smectite assemblages were from the same source with the smectite-dominated assemblage reflecting a difference in alteration history. The $\delta^{18}O$ values of +20‰ and $\delta^{2}H$ values of –65‰ are consistent with alteration by meteoric water in the Indo-Gangetic plain at ca. 20°C (France-Lanord et al., 1993). They suggested that although some smectite could be derived from the Deccan, it does not represent an important component of this assemblage. They therefore concluded that the smectite is formed during transport in the Ganges-Brahmaputra River system by one or more of the following processes: alteration during

Table 11.12. Chemical index of alteration (CIA) values for a range of minerals and rocks

Mineral or rock	CIA index
Diopside	0
Basalt	30–45
Albite, anorthite, K feldspar	50
Granites and granodiorites	45–55
Muscovite	75
Shale	70–75
Montmorillonite	75–85
Kaolinite and chlorite	100

transport, deposition in a foreland basin followed by re-erosion under a warm climate, or alteration following sedimentation in the Indo-Gangetic Plain. France-Lanord et al. (1993) suggested that the ultimate source of these sediments is the High Himalayan Crystalline series.

High concentrations of smectite could reflect wetter and warmer periods when chemical weathering of soils was greater relative to physical erosion (Derry and France-Lanord, 1996; Colin et al., 1999). The smectite-rich assemblage of the sediments analysed in this study may reflect increased weathering alteration of source terranes and increased alteration in situ during warmer and wetter periods. However, the CIA indices do not support this. The generally low concentrations of smectite in modern river sediments (Datta and Subramanian, 1997) suggest that much of the smectite may have developed in situ.

The heavy-mineral assemblages, clay assemblages and sediment geochemistry therefore indicate that the sediments have been derived from metamorphic and sedimentary terranes of the Himalayas, including reworking of sandstones and alluvial deposits.

11.6 OXALATE EXTRACTIONS

11.6.1 General features

Acid ammonium oxalate releases elements by a combination of acid dissolution, ligand-promoted dissolution and desorption. It will release coprecipitated elements that are present in oxides and clays as solid solutions. It also dissolves other metal oxides especially aluminium oxides and partially dissolves clays. It could also release trace elements by promoting desorption from insoluble oxides. Not much is yet known about the typical ranges of oxalate-extractable trace elements in sediments, including for arsenic. If there is a large amount of Ca present, the extract forms insoluble Ca oxalate crystals and so the Ca data are unreliable. It appears that Mg oxalate is not normally precipitated or coprecipitated to the same extent and the amount of Mg extracted gives an indication of the clay content of the sediment. Some sulphur is also extracted. This represents sulphate derived from both interstitial water and adsorbed sulphate, and in the case of reduced sediments, from the oxidation of reduced mineral sulphur compounds such as pyrite.

Altogether 227 sediments and 7 soils were subjected to an acid ammonium oxalate extraction. These were from the various sources listed in Table 11.2. These included Holocene sediments as well as older Dupi Tila sediments, and included sites with arsenic-rich groundwaters as well as sites from northern Bangladesh where there are low-As groundwaters. For some sites, there were only a few samples available whereas at other sites there were sufficient samples to give detailed depth profiles. Many of the sediments investigated are from Chapai Nawabganj area as this is where our initial As investigations began and more material was available from this area. Details of the lithological logs from the project's three piezometers at Chapai Nawabganj, Faridpur and Lakshmipur are given in Chapter 3 (Figures 3.9, 3.13 and 3.15). Lithological logs of the other boreholes in Chapai Nawabganj and surrounds (DW1, DW2, West Bilat Haripur, Khitta and Purba Fargilpur) investigated here are given in Figure 3.11. Samples from other borehole locations were generally sparser and no lithological logs were available for these boreholes.

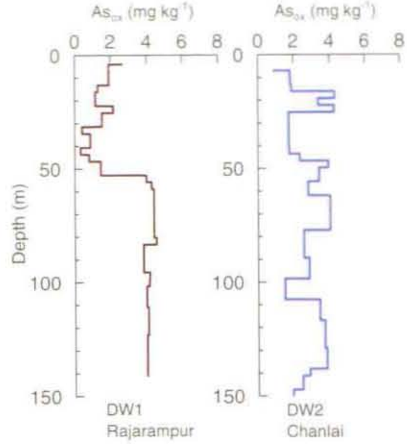


Figure 11.9. Depth profiles of oxalate-extractable arsenic from the DW1 and DW2 boreholes in Chapai Nawabganj.

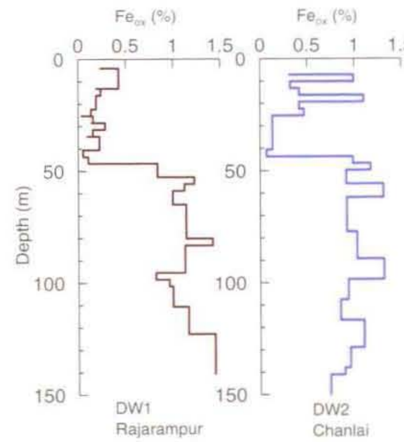


Figure 11.10. Depth profiles of oxalate-extractable iron from the DW1 and DW2 boreholes in Chapai Nawabganj.

11.6.2 Depth profiles from the BWDB-DU boreholes in the Chapai Nawabganj area

Three holes (DW1–3) drilled by BWDB-DU in the Chapai Nawabganj hot spot area during 1998 were designed to study the nature of the sediments and to investigate the possibility of finding As-free water in a deeper aquifer. However, a continuous grey clay was found from about 40 m depth down to the contract depth of 150 m (500 ft). Sand was subsequently discovered at about 168 m (550 ft).

The variation with depth of oxalate-extractable arsenic and iron for the DW1 and DW2 holes is shown in Figures 11.9 and 11.10, respectively. The change from the upper sandy horizons to the clay horizon is clearly seen in the sharp increase in As_{ox}, and especially Fe_{ox}, at about 50 m depth. This change occurs some 5–10 m below the sand-clay interface. At the interface, the clay horizon is relatively

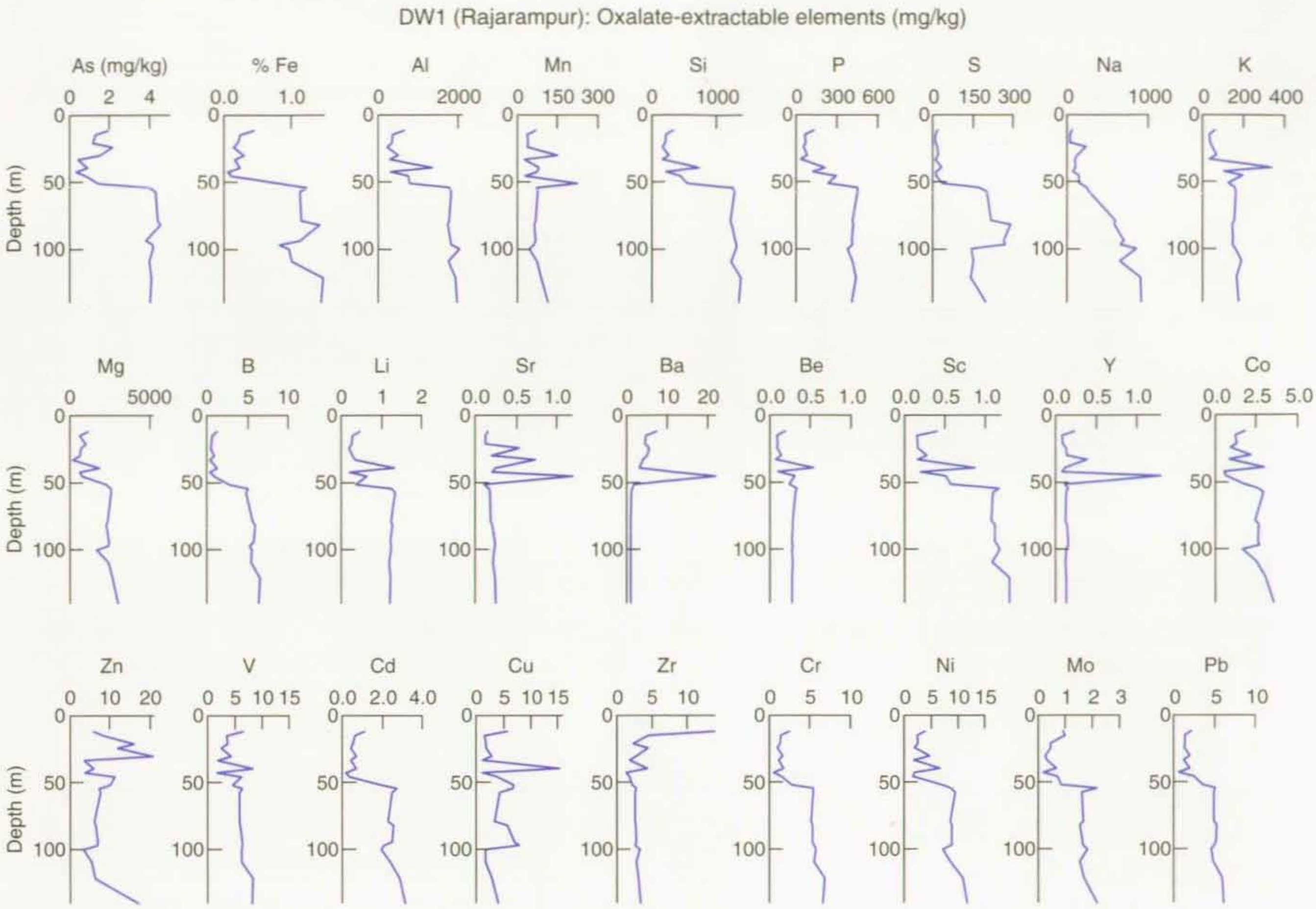


Figure 11.11. Oxalate-extractable elements derived from core material from the DW1 (Rajarampur) DPHE/DU borehole.

low in As_{ox} and Fe_{ox} and has a pale brown colour. It may represent a slightly more oxidised or more leached environment. Below this, the As_{ox} concentration maintains a steady value of about 4 mg kg^{-1} in the clay horizons of DW1 and fluctuates from 2–4 mg kg^{-1} in the clay horizons of DW2. As_{ox} in the contaminated sandy horizons is approximately 2 mg kg^{-1} with a peak reaching 4 mg kg^{-1} at about 20 m. It is clear from these profiles that the sediments from the groundwater-contaminated sandy horizons (10–50 m) are not particularly contaminated with As in relation to the rest of the sediments in the top 150 m, and on a purely mass basis, even have a somewhat lower average As concentration than the deeper sediments. There is no indication of a distinct layer of As-rich sediments that may have come from a mineralised area upstream: the Rajmahal Hills in Bihar, India have been proposed as a possible source.

The Fe_{ox} profiles reflect the dominant texture of the sediments (clay or sand) with a doubling or more of Fe concentrations in the grey clay sediments. Concentrations of Fe_{ox} has a range of about 0.2–0.5% in the sands and about 0.8–1.3% in the clays. These are not exceptional by the standards of normal soils and sediments (Cornell and Schwertmann, 1996).

The clay horizons also contained relatively high concentrations of oxalate-extractable Al, Mg, Si, B, P, S, Li, Sc, Cd, Cr, Ni, Mo and Pb (Figures 11.11 and 11.12). Free carbonates were present in the three DW1 samples tested. It was estimated on the basis of a cold nitric acid extraction of three DW1 sediments that between one-third and two-thirds of the total Fe present (as determined by XRF) was readily leached by acid and was probably present as free iron oxides.

11.6.3 Depth profiles from the BGS test boreholes

The variation of oxalate-extractable As and Fe with depth for the three project boreholes in Chapai Nawabganj (CPW5), Faridpur (FPW6) and Lakshmipur (LPW6) are shown in Figures 11.13 and 11.14, respectively. Summary statistics are given in Table 11.13. The piezometer cluster in Chapai Nawabganj was drilled close to the Chanlai (DW2) investigation borehole but only went as deep as the clay layer at 50 m.

The major features in the three boreholes tend to reflect changes in lithology with clay horizons having greater concentrations of As, Fe and many other elements than the sandy horizons. For example, as noted above for the DW1 and DW2 profiles, the sharp rise in As_{ox} and Fe_{ox} at the base of the Chapai Nawabganj profile is found when the sediments change from grey sands to a grey clay.

The Chapai Nawabganj profile is broadly similar to the DW1 and DW2 profiles but there are differences in detail that probably reflect the lateral variation in sediment com-

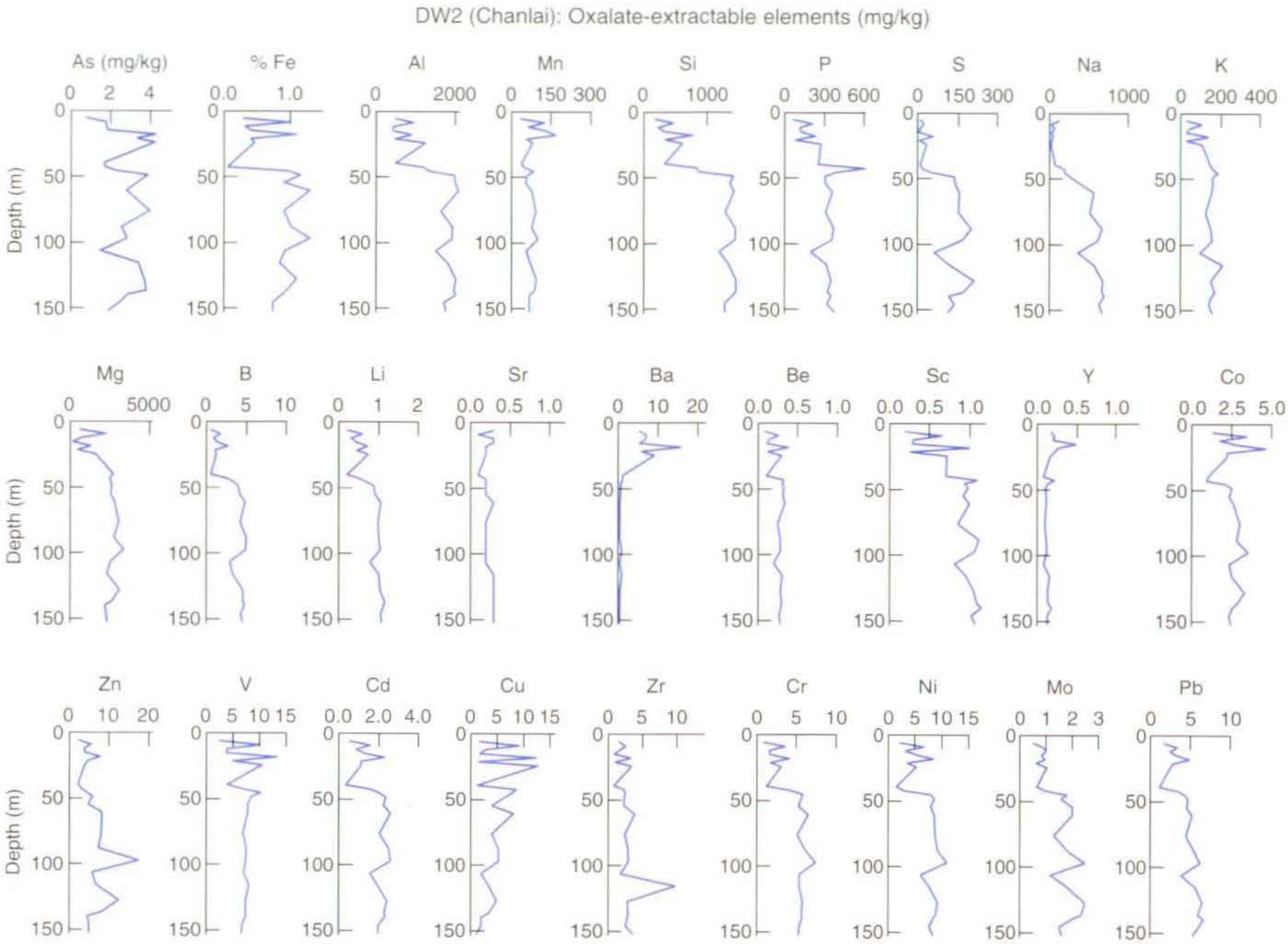


Figure 11.12. Oxalate-extractable elements derived from core material from the DW2 (Chanlai) DPHE/DU borehole.

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position within Chapai Nawabganj. However, there seems to be a consistent As-rich zone with 2–4 mg As_{ox} kg^{-1} at about 15–25 m in all three profiles. This is above the typical depth zone of the contaminated shallow tubewells in the Chapai Nawabganj area (median depth is 29 m, Chapter 7). Our 20 m and 30 m piezometers at Chanlai give an As concentration of about 400 μg L^{-1} while the seven hand-pump tubewells monitored in Chanlai show As concentrations in the range 50–750 μg L^{-1} (Chapter 10). The results from these wells suggest that the wells at 30 m depth or deeper tend to be more contaminated than those at around 20 m depth. This is not reflected in the sediment As profiles. Therefore, while the groundwater As concentration might be expected to be reflected in the arsenic composition of the sediments, this does not appear to be the case when examined in detail. Other factors also appear to be important. On the other hand, we show below that there appear to be significant differences in the overall sediment As concentrations between As-contaminated groundwater areas and As-free groundwater areas.

Table 11.13. Summary statistics for oxalate-extractable arsenic and iron from the sediments of the three project boreholes

Site	Depth range (m)	n	As_{ox} mg kg^{-1} min	mean	max	Fe_{ox} % min	mean	max
Chapai Nawabganj	0–48.7	22	0.56	1.79	5.8	0.026	0.23	0.96
Faridpur	0–131.2	51	0.08	0.84	5.29	0.002	0.19	0.78
Lakshmipur	0–137.3	49	0.08	2.13	6.09	0.008	0.46	1.16

The Faridpur As_{ox} profile shows a peak in the clay and silt horizons found in the top 10 m. Below that, As_{ox} remains fairly constant at about 0.7 mg kg^{-1} until below 70 m where it decreases to 0.1–0.2 mg kg^{-1}. Fe_{ox} shows a similar trend. Therefore the relatively uniform nature of Faridpur sediments observed in the lithological log (Figure 3.13) is reflected in the sediment chemistry.

In contrast, the chemistry of the Lakshmipur sediments varies greatly over short vertical distances (Figures 11.13 and 11.14) which reflects the large vertical lithological heterogeneity over scales of a few centimetres (Figures 3.15 and 3.16). However, the most noticeable feature of the Lakshmipur profiles are the high concentrations of As_{ox} and Fe_{ox}, especially in the top 60 m. The concentration of As_{ox} averaged over the whole length of

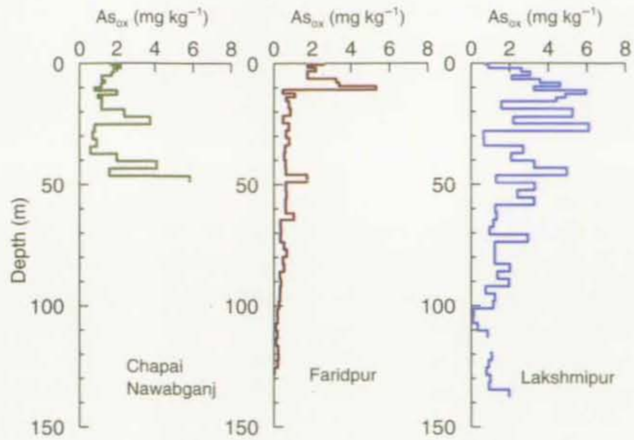

Figure 11.13. Depth profiles of oxalate-extractable arsenic from the three project boreholes.

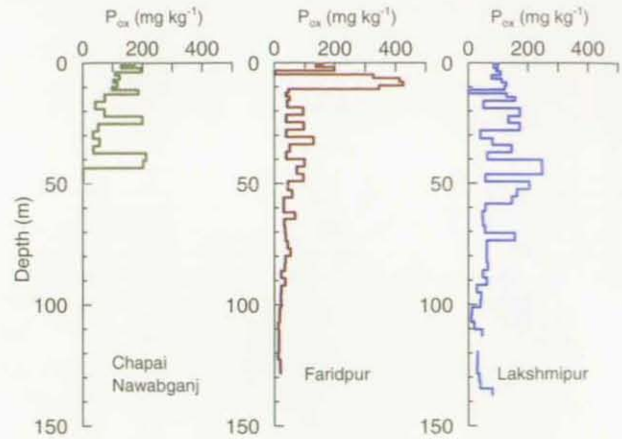

Figure 11.15. Depth profiles of oxalate-extractable phosphate-P from the three project boreholes.

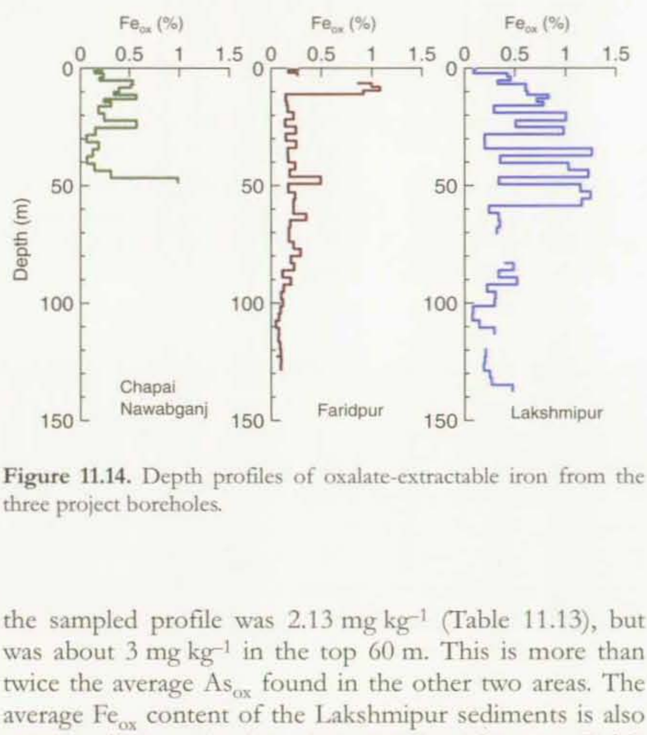

Figure 11.14. Depth profiles of oxalate-extractable iron from the three project boreholes.

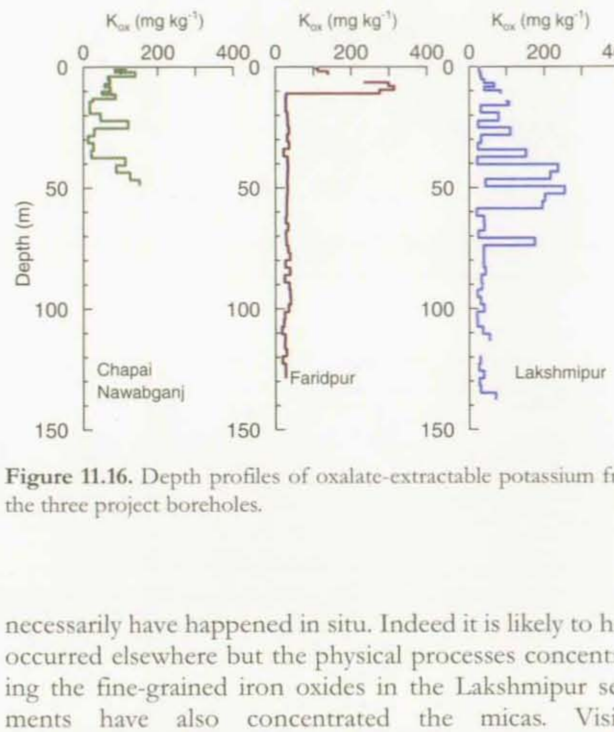

Figure 11.16. Depth profiles of oxalate-extractable potassium from the three project boreholes.

the sampled profile was 2.13 mg kg^{-1} (Table 11.13), but was about 3 mg kg^{-1} in the top 60 m. This is more than twice the average As_{ox} found in the other two areas. The average Fe_{ox} content of the Lakshmipur sediments is also twice as high as in the other two As-rich areas (Table 11.13, Figure 11.13). Again these differences reflect the nature of the sediments as revealed in the borehole logs. The upper 50 m of the Lakshmipur profile consists of a sequence of interbedded silts and fine sands (Chapter 3).

Other elements in the oxalate extracts also reveal important differences in the sediment chemistry of the three boreholes. Phosphate (Figure 11.15) profiles match those of As and Fe quite closely but there is about 70 times more phosphate-P extracted compared with As on a weight basis. The K profiles (Figure 11.16) also reflect the same features as shown by the other elements. Much of the K in these sediments is probably derived from weathering of the abundant micas. The high extractable K content of the Lakshmipur sediments therefore could support the idea that much of iron in these sediments is derived from the weathering/dissolution of micas, and that this is greatest in the Lakshmipur sediments. This weathering need not necessarily have happened in situ. Indeed it is likely to have occurred elsewhere but the physical processes concentrating the fine-grained iron oxides in the Lakshmipur sediments have also concentrated the micas. Visible examination of the sediments by SEM shows abundant fresh micas in the early stages of weathering with exfoliating edges (Section 11.4.3).

11.6.4 Regional variation

Overall, the oxalate-extractable As is quite highly correlated with the oxalate-extractable Fe (Figure 11.17, n=227, r^2=0.69) but the most striking feature of the plot is the separation between the low–As groundwater regions and the high–As groundwater regions. The low-As groundwaters normally have sediments with As_{ox} <1 mg kg^{-1} and especially Fe_{ox} <0.1%. There are three exceptions (two from West Bilat Haripur and one from Khitta) but these are all for clay horizons within these profiles. Grey (reduced) sediments tend to have larger oxalate-extractable concentrations of most elements including Fe and S than the brown sediments and the finer-grained sediments tend

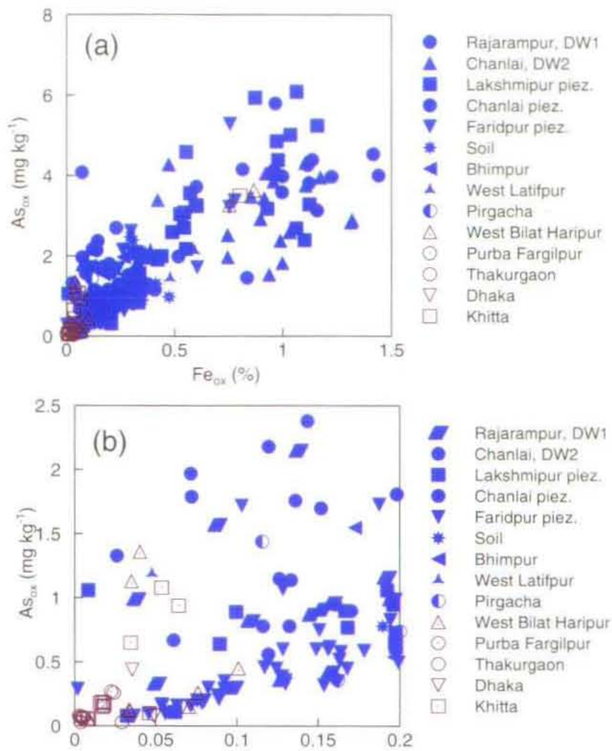

Figure 11.17. Relationship between arsenic and iron extracted by acid ammonium oxalate from Bangladesh sediments and soils. (a) all sediments and soils (n=227); (b) enlargement of low concentration region of (a). Blue symbols correspond to sediment from low groundwater As regions. Red symbols are for As-affected areas.

to have higher concentrations compared with the coarser-grained sands. It is likely that in the older and more oxidised sediments, a greater proportion of the free Fe oxides is present as more crystalline oxides such as goethite and haematite which are less readily extracted than the 'amorphous' and reduced Fe(II)-Fe(III) oxides.

Since the fine-grained sediments are often found both above and below the main horizons used for water abstraction by tubewells and since they tend to contain high concentrations of As and many other elements, it is useful to separate these sediments from the aquifer (sandy) sediments when considering summary statistics. Table 11.14 gives the average concentration of selected elements in the subset of sandy sediments from the studied sites. Sites having high-As groundwaters are highlighted in this table. It is clear from the table that the areas with high-As_{ox} groundwaters not only have sediments with relatively high As concentrations but also contain high concentrations of other elements including Fe, P, Cu, Al and Mg. These correlations probably reflect the relative abundance of colloidal material, including 'amorphous' iron oxides, even in these dominantly sandy sediments. The linear correlation between As_{ox} and Fe_{ox} is particularly strong (Figure 11.18). The correlation with SO_4 is poor. Multiple regression indicates that:

$$As_{ox} = 3.9\ \%Fe_{ox} + 0.00045\ Mg_{ox} \quad (R^2=0.990)$$

where oxalate-extractable concentrations of As and Mg are expressed in mg kg^{-1}. This points to an iron oxide and clay source for the As. Mg_{ox} may reflect the clay contribution.

On average, about 3/4 of the As_{ox} is predicted to be derived from the iron oxides. High-As groundwaters tend to be found where the average As_{ox} in sediments exceeds 0.5 mg kg^{-1} or Fe_{ox} exceeds 0.15%. The relatively low average values of As_{ox} and Fe_{ox} for the Faridpur piezometer site reflect the inclusion of a large number of sediment samples from the deeper parts of the aquifer which are relatively low in As and Fe (Figure 11.18). It is likely that groundwater from 70 m or deeper at Faridpur will contain less As than that from shallower horizons above this depth. There were not enough piezometers installed at the Faridpur site to confirm this in detail but the evidence from the available piezometers (Chapter 10) is consistent with such a decrease with depth.

Table 11.14. Average oxalate-extractable constituents in sedimentsderived from sandy horizons from various sources across Bangladesh*

Site	n	As	%Fe	Al	Mg	SO_4	P	Co	Zn	Cu
Chanlai DW2	8	2.53	0.516	783	1299	59	214	2.40	4.75	6.34
Lakshmipur piez.	49	2.13	0.461	571	850	197	109	1.72	4.01	4.27
West Latifpur	5	1.70	0.349	501	549	30	151	4.28	4.59	5.67
Ch. Nawabganj piez.	19	1.57	0.198	342	1464	12	100	1.04	1.77	2.82
Bhimpur	6	1.38	0.247	290	179	29	123	2.54	8.12	2.44
Rajarampur DW1	16	1.07	0.176	305	643	19	58	1.07	8.60	1.92
Pirgacha	3	0.85	0.159	246	131	192	90	0.57	3.39	4.13
Faridpur piez.	43	0.48	0.142	159	105	38	37	0.56	4.07	1.86
West Bilat Haripur	7	0.17	0.047	75	55	17	14	0.50	1.10	0.81
Dhaka	3	0.17	0.041	69	98	41	24	2.07	3.61	0.53
Thakurgaon	2	0.15	0.027	251	44	122	37	0.41	4.53	0.70
Khitta	8	0.13	0.019	61	72	7	14	0.46	2.00	0.31
Purba Fargilpur	7	0.06	0.004	24	29	5	6	0.86	1.87	0.28

*All chemical analyses are in units of mg kg^{-1} unless otherwise indicated; SO_4 is total sulphur expressed as sulphate. Data sorted by As_{ox}. Locations in **bold** are sites with known high concentrations of As in groundwater.

particularly strong in the south-east of Bangladesh which is where the high-As groundwaters are concentrated.

Although the grey clay sediments tend to contain the highest As concentrations (both total and oxalate-extractable), there is no evidence that these are the major source of As in the groundwaters. The abstracted groundwaters are mostly derived from sandy sediments and the fine-grained horizons will tend to be protected from leaching because of their lower permeabilities. Rather it appears sufficient at this stage to hypothesise that it is the concentration of fine-grained 'iron oxides' within the sandy horizons that are important. Oxalate-extractable iron appear to be a particularly important indicator. There must be some movement of recharge water and As through the shallow, fine-grained horizons, particularly during the monsoon season, but the evidence from the piezometer profiles suggests that these shallow horizons are not the major source of As. They may not be sufficiently strongly reducing to facilitate the release and transport of their labile As.

While from a classical mineralogical perspective the sediments from the As-rich areas appear to be 'typical alluvial sediments', they contain a relatively high concentration of oxalate-soluble As probably initially bound to iron oxides. When buried, these oxides contain significant amounts of adsorbed and coprecipitated As that can be subsequently released to the groundwater given appropriate geochemical conditions. The iron oxides themselves are probably extremely fine-grained and do not appear as major components when observed by classical mineralogical techniques such as light microscopy and SEM. The diameter of individual ferrihydrite particles can be as little as 50 nm. Iron oxides often form coatings on larger-sized minerals and such coatings have been observed in some Bangladesh sediments (Khan et al., 1998).

We have not been able to characterise the nature of the extracted iron oxides mineralogically and they probably do not have a typical Hfo or ferrihydrite structure. The sediments associated with the As-affected groundwaters are typically grey, not brown, and come from a strongly reducing environment. Therefore some solid state Fe(II) is likely and either a magnetite-like or green-rust structure is possible. This too may have an important bearing on the release of arsenic to the groundwater (Chapter 12).

11.7 ORGANIC CARBON CONTENT OF SEDIMENTS

The average organic carbon content of selected sediments from the DW1 (Rajarampur) and DW2 (Chanlai) boreholes in Chapai Nawabganj was 0.21% (n=20) (Table 11.15). The organic carbon content of the sandy sediments was often less than 0.1% but reached a maximum of 0.4% in one instance. The fine-grained, especially clay, horizons tended to have the greatest TOC contents. The grey clay underlying the sandy sediments had a consistent TOC content of about 0.25%.

While occasional thin, peaty horizons were observed in the three BGS test boreholes at Chapai Nawabganj, Faridpur and Laksmipur, this was the exception rather than the rule. It would be interesting to know the As content of this organic matter.

Table 11.15. Total organic carbon content of selected sediments

Borehole	Depth (m)	Colour and texture	%TOC
DW1	12.2–12.8	grey fine sand	0.08
Rajarampur	15.2–15.8	grey medium sand	0.05
	21.3–21.9	grey-brown fine sand	0.06
	24.4–25.0	grey medium sand	0.40
	33.5–34.1	grey coarse sand	0.05
	39.6–40.2	grey clay	0.68
	45.7–46.3	pale brown clay	0.10
	51.8–52.4	pale grey clay	0.17
	57.9–58.5	grey clay	0.27
	79.2–79.7	grey clay	0.25
DW2	6.1–6.7	grey brown coarse sand	0.06
Chanlai	9.1–9.8	grey brown coarse sand	0.35
	12.2–12.8	grey black medium sand	0.08
	18.3–18.9	grey brown silt	0.50
	21.3–21.9	grey coarse sand	0.05
	39.6–40.2	v pale brown clay	0.08
	45.7–46.3	grey clay	0.21
	61.0–61.6	grey clay	0.22
	115.8–116.4	grey clay	0.25
	137.2–137.8	grey clay	0.24

11.8 SUMMARY

Sediments from various locations across Bangladesh have been studied both mineralogically and geochemical. The most detailed investigations were carried out on the Holocene sediments from the three test boreholes at Chapai Nawabganj, Faridpur and Lakshmipur and nearby locations but sediments were also studied from the older Dupi Tila aquifer and from the Tista Fan region in the extreme north-west.

The sediments vary in texture from coarse sand and gravels in the Tista Fan region through to the sands that are associated with the extensively exploited aquifers of Bangladesh and to the silts and clays that are often found in superficial deposits and as confining layers at depth.

The major minerals found were quartz and feldspars, both plagioclase (albite and more Ca-rich compositions) and alkali feldspar. Lithic fragments consisting of aggregates of minerals were common. All samples contained conspicuous, coarse, sand-sized, biotite flakes. Pyrite was observed but only rarely and arsenopyrite was never observed. In general, the sediments are sulphur-poor.

Small amounts of rhombohedral calcite were seen. Calcite or dolomite are believed to be quite widely distributed in small amounts in Bangladesh sediments which is consistent with the finding that most Bangladesh groundwaters are saturated, or close to saturated, with these minerals. The clays consist of either a smectite-dominated assemblage or a smectite-mica-chlorite-dominated assemblage. A wide range of ferro-magnesian heavy minerals was identified including pyroxene (augite plus others), hornblende and other amphiboles, garnet and minor quantities of low-Ti magnetite, zircon, apatite and possibly hematite.

In many respects, the sediments appear to be typical

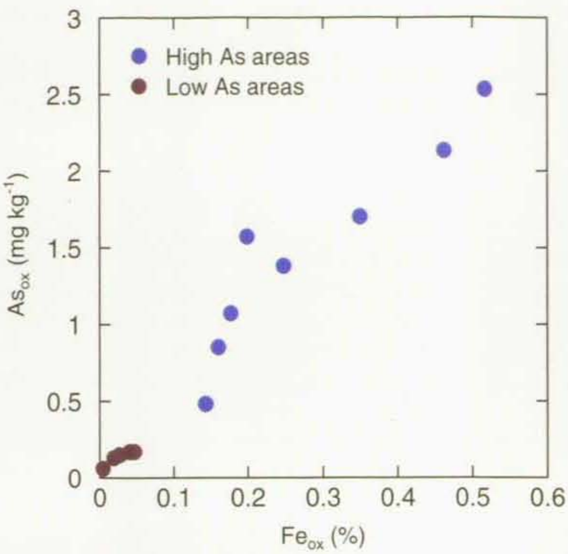

Figure 11.18. Relationship between oxalate-extractable arsenic and iron for a range of sandy sediments from across Bangladesh. Sediments from low groundwater arsenic areas are plotted with blue symbols whereas samples from contaminated areas are plotted with red symbols.

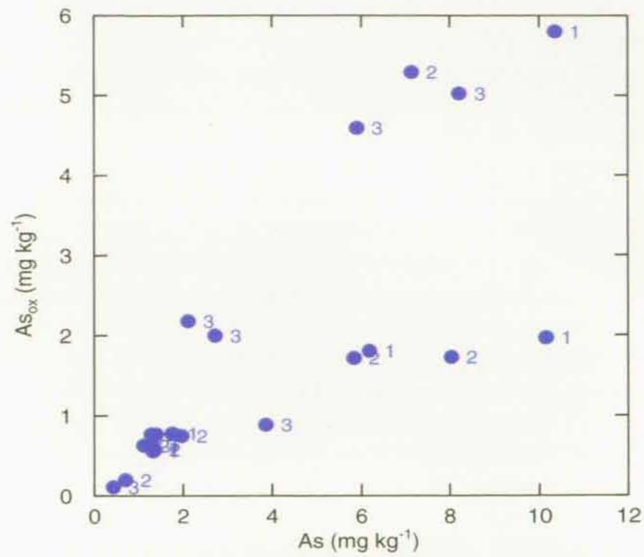

Figure 11.19. Relationship between arsenic extracted by acid ammonium oxalate and total arsenic determined by complete digestion of the sample followed by arsenic analysis by HG-AFS. Numbers refer to the borehole: 1=Chapai Nawabganj; 2=Faridpur and 3=Lakshmipur.

The highest average concentration of As extracted from the sediments (2.5 mg kg^{-1}) is from the Chanlai DW2 borehole. This is situated in the Chapai Nawabganj hot spot, the area with the highest groundwater As concentrations observed in this study. The nearby Chanlai piezometer borehole and the Rajarampur borehole have a lower average As$_{ox}$ concentration. It therefore appears that there is a useful correlation between oxalate-extractable As of sediments and the extent of As contamination of groundwaters in a given area. It was not possible to plot As (sediment) vs As (groundwater) for individual sediments because in most cases we did not have groundwater or reliable pore water data for the appropriate sediment horizons. However, while the separation into high- and low-As groundwaters is good (Table 11.14), there is no reason why the relationship should be strictly linear. The groundwater concentrations of As in the Dupi Tila aquifer, for example, are more than two orders of magnitude lower than in the contaminated aquifers, while the ratio of As$_{ox}$ and Fe$_{ox}$ is considerably less than this. Other factors, particularly the age of the sediments and their degree of oxidation, are also likely to be involved in producing low As groundwaters.

The SO_4 removed by the oxalate extract is probably mainly derived from the oxidation of sulphides during the extraction. The values in terms of mineral sulphides contents are very low (equivalent to <0.012% pyrite). While not all the pyrite will be oxidised during the extraction, the results point to the presence of only small quantities of mineral sulphides in the sediments. This agrees qualitatively with the sulphur determinations and the SEM observations made earlier.

Of the 21 sediments for which a sulphur determination was specifically undertaken, only one (Lakshmipur 45.7–46.0 m; 150–151 ft) contained appreciable sulphur, in this case 0.2%. As it happens, this sediment also gave the highest oxalate-SO_4 concentration out of the 227 sediments studied and is from a zone (45– 58 m; 150–190 ft) of sulphur-rich sandy to very fine sandy sediments. This concentration is equivalent to 2800 mg SO_4 kg^{-1} or 0.18% pyrite indicating almost complete extraction of the sulphur in this case. This probably reflects sulphur derived from residual seawater-sulphate since the Na concentrations in the oxalate extracts from this zone were also exceptionally high. Elsewhere, the highest concentrations of extracted sulphate tend to come from the clay horizons. The two Thakurgaon samples also gave quite high extractable-SO_4 concentrations (Table 11.14). In general, the conclusion seems to be that Bangladesh sediments are sulphur-poor and in many cases, iron-rich. Hence the abundance of high-Fe groundwaters.

Comparison of the oxalate-extractable As and the total As (from a total dissolution, Tables 11.8–11.10) in the 21 samples derived from the 3 piezometer profiles indicates that for many samples about half of the total As is oxalate-extractable (Figure 11.19). However, for some samples from Chapai Nawabganj and Faridpur, it is a substantially smaller proportion than this. A similar comparison for Fe shows a poor correlation since much of the Fe is bound in minerals such as biotite and will not be completely released by the oxalate extraction. The maximum proportion of Fe extracted by oxalate was about 30% but it was more typically only 10%.

The data therefore support the hypothesis that iron oxides are a primary source of As in Bangladesh groundwaters. Arsenic-rich groundwaters tend to be found in areas where high concentrations of extractable iron minerals with their adsorbed and coprecipitated As have accumulated in the sediments. This accumulation occurs as a result of natural sedimentological processes, including flocculation at the freshwater-seawater interface, and is young alluvial sediments. The total As content of the 21 sediments studied in detail varied from 0.4 to 10.3 mg kg^{-1} with averages of 5.9, 3.4 and 3.2 mg kg^{-1} for Chapai Nawabganj, Faridpur and Lakshmipur, respectively. These are in the typical range for soils and sediments even though the groundwaters from these areas are highly As-contaminated. The highest concentrations of most elements, including As, are found in the fine-grained, especially clay, sediments. Acid ammonium oxalate, which dissolves the more labile fraction of the sediments, gave average As contents of 1.6, 0.5 and 2.1 mg kg^{-1} for the sandy (potential aquifer) horizons from the Chapai Nawabganj, Faridpur and Lakshmipur boreholes, respectively. Corresponding extractable Fe contents were 0.20, 0.14 and 0.46%.

Extractable As was highly correlated with Fe and other elements including Mg. Grey (reduced) sediments tend to contain more extractable Fe and As than brown (less strongly reduced) sediments. Extractable As from areas of Bangladesh with As-free groundwaters had much lower oxalate extractable As (<0.2 mg kg^{-1}) and Fe (<0.05%) concentrations. Our data therefore support the hypothesis that iron oxides are a primary source of As in Bangladesh groundwaters. Arsenic-rich groundwaters tend to be found in areas where high concentrations of iron oxides with their adsorbed and coprecipitated As have accumulated in the sediments. This accumulation occurs as a result of natural sedimentological processes and is particularly strong in the south-east of Bangladesh where the high-As groundwaters are concentrated.

While occasional organic-rich horizons are found within the sandy sediments, this is the exception rather than the rule. The average organic carbon content of the upper sandy horizons at Chapa Nawabganj was 0.21%. It was frequently below 0.1%.

12 Sorption and transport

12.1 Evolution of the groundwater arsenic problem in the Bengal Basin

In this chapter we discuss the possible mechanisms by which the Bangladesh groundwater arsenic problem may have arisen. Central to this are the concepts of sorption and transport. There are many uncertainties and much of what is discussed below is speculation that needs to be tested. We begin by reviewing some of the more firmly established conclusions from our work and that of others.

12.1.1 Established background information

While it is too early to be able to say unequivocally how the high arsenic concentrations in groundwater in the Bengal Basin have evolved, enough is known to be able to speculate on the likely processes. The following observations are now reasonably well supported by data and can form a basis for such speculation.

- Arsenic is not that rare in the natural environment. It is found in all sediments, typically at total concentrations from a few mg kg^{-1} up to about 10–15 mg kg^{-1}. Bangladesh sediments do not appear to be exceptional in this respect. Furthermore, groundwaters with high As concentrations are now being found under broadly similar conditions to those of the Bengal Basin in many places in the world.
- Arsenic, especially As(V), is strongly sorbed by Fe(III) oxides – this is known from laboratory studies with pure oxides and can also be inferred from the analysis of iron oxides from Bangladesh sediments. There is often a good correlation between the iron and arsenic concentrations in the sediments, both in terms of 'total' concentrations and 'oxalate-extractable' concentrations. Limited sediment data suggest that areas of arsenic-contaminated groundwaters in Bangladesh tend to be found in areas with sediments containing relatively high concentrations of extractable Fe (and associated As).
- As(V) sorption by iron oxides is quite similar to that of phosphate and in the absence of other specifically adsorbed ions is characterised by a highly nonlinear sorption isotherm. This means that even at very low arsenic concentrations in solution, the loading of arsenic on the surface can be relatively high. This feature is responsible for maintaining the very low concentration of As usually found in natural waters. As a consequence of this, even a small disturbance to this equilibrium can release relatively large quantities of As to the surrounding water.
- High arsenic concentrations in groundwaters from the Bengal Basin are always associated with strongly reducing conditions and there is some evidence that the more reducing, the greater the concentration but the relationship is far from perfect and is of itself not good enough for predicting groundwater arsenic concentrations. The groundwaters also have relatively high concentrations of bicarbonate and of other redox-sensitive species such as iron, manganese, ammonium and nitrite. They also contain relatively low concentrations of sulphate and nitrate.
- High-arsenic groundwaters are often associated with high-iron groundwaters but the correlation is far from perfect and is not sufficiently good to be generally useful for predicting groundwater arsenic concentrations. Correlations with other water quality parameters such as bicarbonate, sulphate and phosphate may be locally significant but tend to be weaker than with iron.
- While some groundwaters do contain relatively high concentrations of sulphate, particularly in northern Bangladesh, these do not correlate with the high-As groundwaters. If sulphide oxidation were the main mechanism for As release, sulphate and arsenic concentrations would also be expected to be greatest in the more oxidised zone close to the soil surface. The results from our piezometers do not demonstrate this – arsenic concentrations tend to be somewhat smaller in the shallowest groundwaters. Therefore sulphide mineral oxidation is unlikely to be the source of the As in the high-As groundwaters.
- The low concentrations of sulphate, typically < 5 mg L^{-1} sulphate, tend to be associated with the strongly-reducing high-As groundwaters. There is evidence for the precipitation of iron sulphides in some sediments. Framboidal, authigenic pyrite is occasionally observed. This would account for the disappearance of residual seawater sulphate. Some As would have been scavenged from the pore water during the formation of these sulphide minerals.
- The range of As concentrations in Bangladesh groundwaters is large (more than four orders of magnitude). There is a good deal of short-range variation, for example within a village, but there are also very distinct regional patterns. The same can probably also be said about the sediments: much local variation but regional differences too.
- The depth of the well is very important which in turn may reflect the importance of the age of the sediment. Groundwater from deep wells usually has a low As concentration even in areas where the shallow wells are heavily contaminated. While the original deep well data was for only a relatively small region of Bangladesh, recent drilling in other areas (and in West Bengal) seems to confirm this observation more broadly.

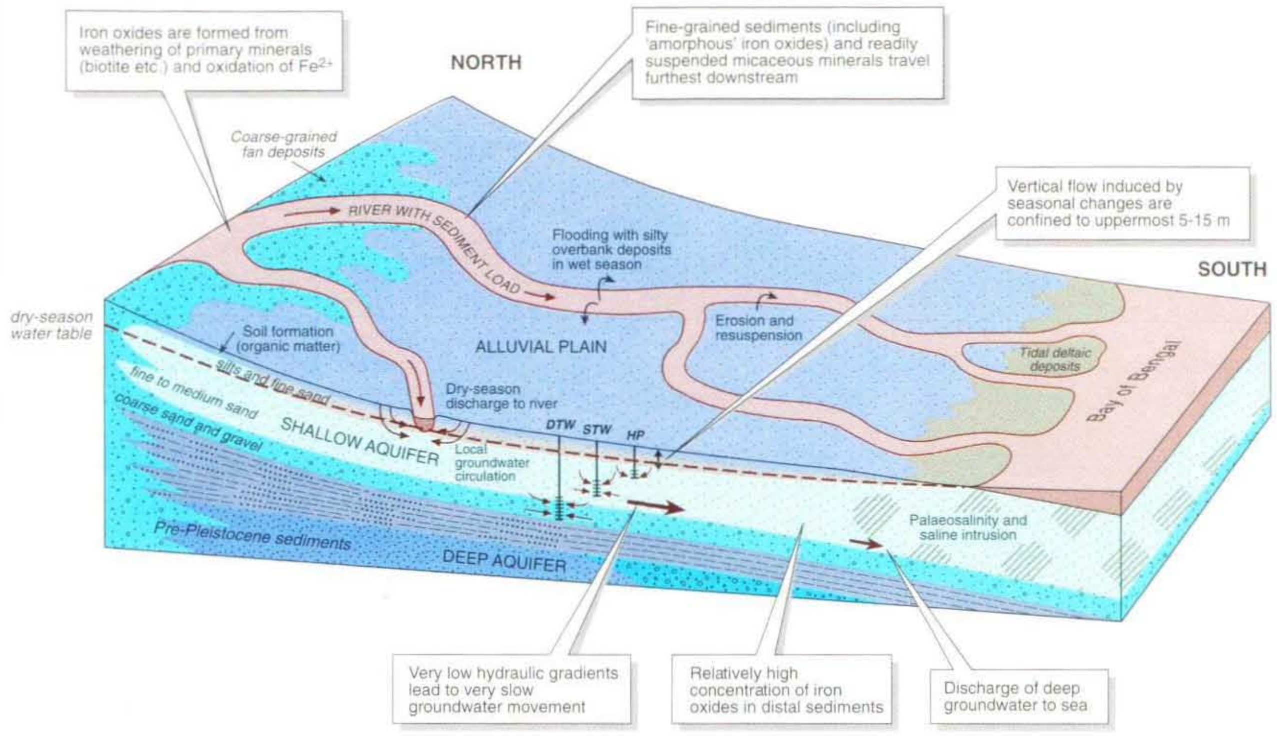

Figure 12.1. Block diagram showing the basic geology and hydrogeology of the Bengal Basin.

12.1.2 Source of the arsenic in Bangladesh groundwaters

Nature of the sediments

The following hypothesis provides a plausible explanation of many of the features observed in the groundwaters of the Bengal Basin. We stress that this is only a hypothesis and needs more data and more detailed studies to confirm it. The hydrogeological processes envisaged are shown in Figure 12.1 and the basic geochemical processes leading to arsenic release are summarised in Figure 12.2.

Others have speculated that the high concentrations of arsenic in the groundwaters of the Bengal Basin are due in some way to an exceptionally large source of As in the rocks somewhere upstream of the problem areas, but this does not appear to be the case. Indeed, the very large area affected, which includes sediments derived from all three of the major rivers of Bangladesh, indicates that there can be no single discrete source of the arsenic. The very large quantity of As involved also points away from a single source. It would have to be very large. Rather we believe that the sediments and their source rocks are typical of such alluvial and deltaic environments. There will of course be some source rocks, and particularly some minerals, with larger than average As contents, but this is normal and we can find no evidence that this is a critical factor in the development of high As groundwaters in the Bengal Basin (unlike the case in mining areas).

Indeed, no unusual high-arsenic source, such as a mineralised area, needs to be invoked since the release of only a small fraction of the arsenic from the solid phase to groundwater is sufficient to give rise to arsenic concentrations in excess of 50 μg L^{-1}. The primary attention should therefore be focused away from attempting to locate a unique, upstream source towards the geochemical and hydrogeological processes involved in the release of As from the sediments and the subsequent transport of As – or lack of it – within the aquifers. This will need to include a detailed characterisation of the nature of the labile As within these sediments including its sorption behaviour. The important sediment factors are likely to be rather more subtle than revealed by bulk chemical analyses.

The iron oxides are believed to be critical in Bangladesh. These are common secondary minerals formed by the weathering of iron-containing primary minerals. The large concentration of fresh biotite in many Bangladesh sediments provides a ready source of such iron. The rate of weathering of biotite is greatest under oxidising conditions since the mineral structure is destabilised by the oxidation of structural Fe^{2+}. The weathering in river sediments and soils is therefore likely to be particularly important for liberating iron.

may facilitate the development of strongly-reducing conditions, there is no evidence that such concentrated sources of organic matter are required in order to produce reducing conditions. Organic matter, albeit at low concentrations, is widely disseminated in Bangladesh sediments. Much of this is likely to be relatively young (on geological timescales) and reactive.

Fine-grained overbank deposits of at least several metres thickness are present over much of Bangladesh and these surficial deposits, combined with the generally high water table, limit the diffusion of oxygen to the underlying sediments. Strongly reducing conditions and As release appear to be established within 5–10 m of the redox boundary. While the exact location of the redox boundary is unknown, it is probably just below the water table which is a few metres below ground level (bgl) in southern Bangladesh to some 5–15 m bgl in northern Bangladesh. The redox boundary probably shifts seasonally in response to the change in water level.

When the sediments become reduced, a series of geochemical reactions occur that lead to the release of some of the arsenic into the groundwater. The exact processes involved are not yet well understood but are likely to involve one or more of the following: (i) reduction of strongly adsorbed As(V) to maybe less strongly bound As(III), leading to the overall release of arsenic; (ii) iron (III) oxides partially dissolve and release iron as well as coprecipitated and adsorbed arsenic (and phosphate); (iii) the iron(III) oxides undergo diagenetic changes leading to the desorption of adsorbed arsenic. We collectively describe these processes as the *iron oxide reduction hypothesis.* A more detailed discussion of these is given below.

While the dissimilatory reduction and dissolution of iron oxides undoubtedly releases some arsenic, the As/Fe ratio observed in tubewell water is frequently greater than that found in the solid phase implying either that the dissolution is incongruent or that other processes such as desorption of As or precipitation of an Fe-mineral are operating. Desorption releases arsenic without any concomitant release of iron while iron sulphide or iron carbonate precipitation will reduce the concentration of soluble iron. Movement of groundwater will also tend to uncorrelate the released As and Fe as a result of chromatographic separation. Therefore a combination of mineral dissolution, precipitation, desorption and transport can provide a wide range of As/Fe ratios in groundwater and it is difficult to deduce much simply from the As/Fe ratio in groundwater. It is also likely that the overall As/Fe ratio released will change as the extent of dissolution increases.

If the iron oxide reduction hypothesis is correct, then the greater the iron(III) oxide concentration in the original sediment, particularly of the more bioavailable Hfo-type, then the greater the potential for the later release of arsenic to groundwater will be. Young, iron-rich sediments are therefore expected to be the most likely to provide sources of high-arsenic groundwaters. However, these waters need not necessarily be high-iron groundwaters. It is possible for desorption of As to occur from iron oxides with little or no release of iron although some exchangeable Fe^{2+} may be released. The solubility of iron oxides is in turn controlled by their bioavailability and their solubility product rather than by the amount of iron oxide present.

Therefore reductive desorption is different from reductive dissolution in terms of the expected ratio of As/Fe released. This may account in part for the wide range of As/Fe ratios seen in Bangladesh groundwaters. In practice, under reducing conditions, dissolution and desorption are likely to occur simultaneously and a range of availability and solubility of the various forms of iron oxides means that the dissimilatory iron-reducing bacteria (DIRB) will utilise the most soluble (most amorphous) oxides first. These kinetic factors may also introduce some dependence of dissolution on the initial quantities of the various iron oxides present.

12.1.3 Why is the deep aquifer low in arsenic?

As well as the release of As in the shallow aquifer, we have to explain why the deeper aquifer is low in As, usually very low. This will become much clearer when detailed studies of the variation of pore water chemistry and the associated sediment chemistry at different depths become available. Two possible explanations are: (i) *non-flowing system*: there is an increase in the As sediment-groundwater partition coefficient for some reason (e.g. change in redox status, change in surface chemistry), such that some of the As in the pore water is either readsorbed or was never released in the first place. The total amount of As in the sediment plus pore water system does not change, just its partitioning; (ii) *flowing system*: As is steadily flushed from the aquifer by fresh (low-As) groundwater. The rate of flushing in the past is likely to have been greater than at present (see below). These two possibilities are not mutually exclusive.

The frequent observation of As peaks in ocean and lake sediment pore-water depth profiles (Smedley and Kinniburgh, 2001) suggests that there could be a process that reduces the As concentration in deeper, older sediments that is not related to pore water flushing since the hydraulic gradients in such situations are unlikely to be favourable for extensive flushing. Some kind of slow geochemical (e.g. redox) or diagenetic (mineral) reaction may be operating. At present, there are few indications to be more specific.

There is also the possibility that the Dupi Tila sediments never contained large amounts of organic matter and that in any case, as the sediments became older, their labile organic matter content decreased and they became less able to maintain strongly-reducing conditions.

It is therefore possible that the brown, oxidised sediments often found at depth may never have been strongly reduced and that desorption of arsenic due to the various reductive processes may not have occurred to a significant extent. In other words, the most important drivers for arsenic release seen in the Holocene sediments may have not been operating. There are grey (reduced) sediments at considerable depth that give low-arsenic groundwaters, as in our deep well (LHTW7) and 150 m deep piezometer (LPW6) in Lakshmipur. However, while this groundwater was still reducing, it was less strongly reducing than the shallow groundwaters.

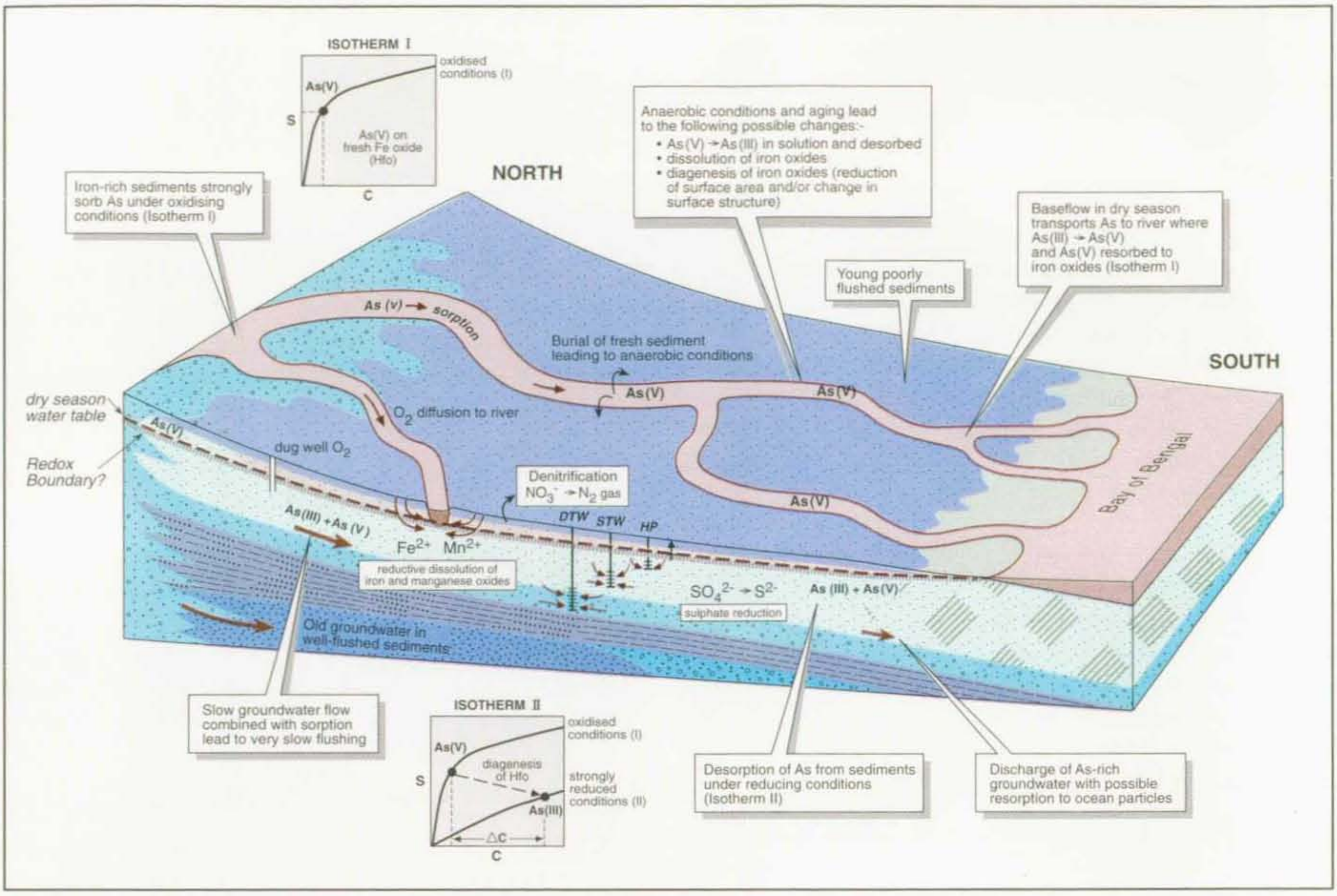

Figure 12.2. Block diagram showing the principal geochemical processes involved in the development of arsenic-contaminated groundwater in the Bengal Basin.

Iron oxides as a source of labile arsenic

'Labile As' is the As that can readily move reversibly from the sediment phase to the groundwater, and vice versa, given appropriate environmental conditions. It is distinct from 'non-labile As' found within the structure of minerals which has no possibility of being released rapidly because it requires the dissolution of the mineral or some very slow diagenetic reaction. This distinction is not 'black-and-white' but is nevertheless useful. Sorbed As tends to be labile because it is located at the mineral surface. Iron(III) oxides are a good source of labile As, because they often have a very large specific surface area and a high capacity and strong affinity for sorbing As. They are also unstable in reducing environments, in highly acidic environments and to a lesser extent, wherever there are large concentrations of chelating agents, particularly 'humic acids', which can lower the Fe^{3+} activity and promote dissolution.

Iron oxides in soils and river sediments scavenge arsenic from the soil solution and from river water building up a store of sorbed arsenic. The arsenic in river water is likely to be mostly present in its oxidised form, As(V), and in oxidising environments, this is very strongly sorbed by iron oxides. Typical concentrations of As in Bangladesh rivers and soil solutions are not known, but if they are typical of other areas in the world, can be expected to be of the order of 1 $\mu g\ L^{-1}$ (Smedley and Kinniburgh, 2001). Even with just 1 $\mu g\ L^{-1}$ As(V) in solution, the amount of arsenic sorbed by the iron oxides is relatively large. This can amount to several thousands of mg As kg^{-1} or ppm on an iron oxide basis.

The iron oxides are very fine-grained, colloidal in size, and are concentrated by the normal fluviatile processes in the fine-grained sediments. Natural sedimentological processes will mean that there will be some areas with higher-than-average concentrations of iron oxides than others, especially in those places where fine-grained deposits tend to have accumulated. Sometimes this will be in the predominantly sandy (aquifer) horizons. Relatively high concentrations of fine-grained sediments, including iron oxides, are deposited in the low energy part of the delta in south-eastern Bangladesh.

As the sediments are buried during the normal development of the delta, they rapidly become reducing owing to the microbial consumption of oxygen during the process of organic matter oxidation. This is facilitated by the presence of fresh organic matter from buried soils and the relatively high ambient temperature, about 28°C. Only small amounts of solid organic matter are required to reduce the available dissolved oxygen, nitrate and sulphate to trace concentrations. There is overwhelming evidence that most of the arsenic-affected Bangladesh groundwaters are reducing, and often strongly reducing. While occasional peat layers are found in Bangladesh sediments and these

12.2 Transport of arsenic in Bangladesh aquifers

12.2.1 Introduction

There must be a relationship between the concentration of arsenic in groundwater and the groundwater flow since it is not possible to maintain a high concentration in groundwater in the face of high flows over a long period.

While the principles of solute transport in aquifers are quite well understood, very little is known about how rapidly arsenic actually moves through Bangladesh aquifers, or indeed in most alluvial and deltaic aquifers elsewhere in the world. Historically, there has been little need for such detailed and difficult-to-obtain information. This highly variable sedimentology of the Bangladesh aquifers and the uncertainties in the way in which groundwater has moved through the aquifers in the past, and is doing so at present, add to the complexity (Chapter 5). There is also a general lack of understanding of how arsenic binds to alluvial sediments in anoxic environments. The rate of arsenic transport is a result of the combination of the rate of water movement and the retardation brought about by sorption.

The rate of water movement and flow patterns will be influenced to some extent by the amount of pumping, especially by large-capacity irrigation pumps (Chapter 5). Therefore present flow patterns are not necessarily a good guide to past flow patterns or future flow patterns. It is clear from the large vertical and lateral variations in water chemistry, including salinity, that mixing in the aquifers has been limited. Indeed, this is characteristic of many of the high-As aquifers in the world. This points to highly stratified aquifer properties and/or sluggish groundwater movement.

It is clear from the simple calculations of groundwater flow made earlier (Chapter 5) that under past flow conditions it could have taken some 2,000–6,000 years to move one pore volume of water through the most permeable parts of the shallow aquifer, and several times longer for less permeable horizons. This is on a similar timescale to the age of the sediments indicating that, at most, just a few pore volumes of water have already been flushed through the shallow aquifer. Certainly the normal processes of groundwater flow will tend to slowly flush the arsenic and other mobile solutes out of the aquifer. Salinity will be the first component to be flushed (the 'salt' front) followed by the weakly sorbed ions, and then the more strongly sorbed ions (the retarded fronts). Slowly, the dissolved oxygen and nitrate in the influent water will tend to oxidise the sediment and the groundwater will tend to become less reducing, and eventually even oxidising. Some of the arsenic will return to the river as baseflow and will be re-oxidised and readsorbed onto the iron(III) oxides in the sediments. The sediment will gradually move downstream with the sediment load of the river, and some of it will ultimately be buried in the Bay of Bengal. This gradual oxidation process may involve reoxidation of the sediment iron(II) and increased adsorption of dissolved arsenic in a reversal of the original desorption and dissolution process. This process is likely to take hundreds of thousands of years.

Other groundwater will take a deeper flow pattern and may be discharged directly into the Bay of Bengal. Over thousands of years, the arsenic will slowly be flushed away or readsorbed and the Bangladesh aquifers will become good sources of potable water. The flushing is particularly slow because of the low hydraulic gradients in the delta. The sealevel was much lower during the last glacial period several thousand years ago and so flow to the sea was then much faster. This will have helped to flush the arsenic out of the older and deeper sediments. The much longer history of flushing in the deep aquifer may explain why it is now practically arsenic-free in many places. These deeper, older sediments are often oxidised (brown in colour) especially the Dupi Tila sediments, and have been through this reduction-oxidation change perhaps shortly after deposition.

The rate of flushing of arsenic from the aquifers therefore depends on the extent of groundwater flow (present and historic), the chemistry of the recharge water and the strength of sorption of the arsenic to the sediments. This may change with time as a result of sediment diagenesis.

With much deeper and older sediments, the extent of flushing will have been correspondingly greater and may have been sufficient to have flushed significant amounts of arsenic from the aquifer. However, another important factor also comes into play. The sea level at present is as high now as it has been for the last 120,000 years. Only 20,000 years ago, during the maximum of the last glaciation, the sea level was some 130 m lower than at present. This would have led to much lower water tables, deeper unsaturated zones and greater hydraulic gradients. Therefore the rate of movement of groundwater would probably have been greater although the greater gradient must be offset against the drier climate then prevailing – the monsoon was not operating. The lower water table may have meant that the sediments never became strongly reducing.

The speed with which arsenic is flushed from the aquifer will depend in part on the arsenic sorption isotherm. Some detailed transport calculations for arsenic were carried out earlier (Volume S3, DPHE/BGS/MML, 1999) using various assumptions about the arsenic sorption isotherm. These calculations were indirectly based on the diffuse-layer model of Dzombak and Morel (1990) and were based on the assumption that some kind of iron oxide analogous to hydrous ferric oxide (Hfo) was present in the sediment. In fact, as discussed earlier, it is possible that the iron oxides present in the reduced sediments are significantly different from Hfo. However, the critical feature is the adsorption isotherm with its implied retardation.

A wide range of isotherms was used in these preliminary transport calculations (DPHE/BGS/MML, 1999) because low- and high-Fe sediments were considered as well as low and high groundwater phosphate concentrations. Phosphate was included as a competitor and it is quite likely that this overestimated the true competitive effect thereby compensating to some extent for the possible overestimation of sorption by the iron oxides. Retardation factors vary with concentration because of the nonlinearity of the isotherms but were typically estimated to be 5–100 L kg^{-1} for arsenite and 5–1000 L kg^{-1} for arsenate (DPHE/BGS/MML; 1999).

12.2.2 Sorption of arsenic by sediments

There is a considerable amount of information about the interaction of arsenic with iron(III) oxides and other model oxide compounds but it is not yet clear how this relates to Bangladesh sediments. The greatest uncertainties lie in the nature of the solid phases present in the sediments, and from a sorption point of view, the nature of the As sorption isotherm for these phases, and their sensitivity to variations in groundwater quality. The presence of other major and minor ions in groundwater can both increase and decrease As sorption but it is expected that the competitive interactions leading to a reduction in As sorption are most likely to predominate.

The amount of arsenic adsorbed is highly dependent on many aquifer and groundwater parameters. These need to be understood in order to provide reliable predictions. The necessary theory for the competitive sorption of anions such as $As(V)O_4^{3-}$, $As(III)O_3^{3-}$, PO_4^{3-}, and HCO_3^-, is complex and critical laboratory data need to be gathered and appropriate models and thermodynamic databases developed.

Two broad approaches aimed at achieving a better understanding of the transport of solutes such as arsenic in aquifers are possible: (i) *laboratory-based approaches* – the sorption isotherm is measured in the laboratory using batch equilibration or column breakthrough experiments and these results are combined with a water flow model to predict field-scale transport; (ii) *field-based approaches* – the movement of arsenic (and other solutes) is measured in the aquifer using tracer tests or some other form of monitoring and the results fitted to the appropriate transport equations. The first approach has the disadvantage that of itself it says nothing about groundwater movement (which is itself difficult to characterise); the second approach overcomes this problem to some extent, but usually requires highly accelerated flow rates to make the changes observable within a short timescale and it does not provide a fundamental insight into how the transport might change under different groundwater flow or quality conditions or with different sediment characteristics. The best strategy is probably therefore a combination of the two.

The laboratory approach is particularly difficult for Bangladesh sediments since the sediments are reducing and will significantly change their sorption (and hence transport) properties when oxidised on exposure to air. Sediments would therefore have to be protected from oxidation as soon as they are retrieved from the aquifer. Such techniques have been quite widely used elsewhere, for example when studying marine sediments, but it was not possible to adopt such techniques within the scope of this project. Others are presently carrying out such detailed studies in Bangladesh (Foster et al., 2000).

Therefore while the mineralogical studies undertaken on Bangladesh sediments within this study (Chapter 11) are of value in defining the overall mineralogy and chemical composition of the sediments, they do not provide a sound basis for establishing the sorption and transport properties of the sediments. The ammonium oxalate extracts of sediments described in Chapter 11 give some indication of the concentration of iron oxides and other relatively soluble minerals, and an upper limit on the amount of 'labile' arsenic present. These data are also far from ideal for sorption modelling but help to constrain the modelling to some extent.

12.3 MODELLING ARSENIC SORPTION BY IRON OXIDES

12.3.1 The sorption isotherm for iron oxides

The sorption isotherm describes the relation between the concentration of arsenic in the sediment and the concentration in the groundwater. It defines the extent to which the solid phase buffers dissolved solute concentrations and the slope of the isotherm is directly related to the retardation experienced by the solute during groundwater flow (Appelo and Postma, 1994). Judging from work on other sediments and pure minerals, particularly oxide minerals, the form of the isotherm is likely to depend on many factors including the nature of the sediments and the chemistry of the groundwater, including pH, arsenic concentration and speciation, and to a lesser extent the concentrations of phosphate, silicate, bicarbonate, calcium, magnesium and iron.

The classic and idealised sorption isotherm is the Langmuir isotherm. This is characterised by a linear isotherm at low concentrations where the probability of a solute adsorbing to the surface is directly related to its concentration in solution. At higher concentrations, there is a greater possibility of the solute hitting an already occupied surface site which leads to a reduced isotherm slope with an eventual flattening out as most sites become filled and the probability of hitting an empty site becomes very low. This plateau at high concentrations gives an estimate of the number of sorption sites. In practice, sorption of charged solutes (ions) on oxides normally does not follow this simple model because as the ions are adsorbed, they change the surface charge appreciably. Normally this makes further adsorption more difficult and results in an increase in the curvature (nonlinearity) of the isotherm. Electrostatic effects are very important for controlling the interaction of ions on oxide surfaces and describing these interactions forms the basis of most so-called 'surface complexation' models. Also, oxide surfaces can be intrinsically heterogeneous which will also lead to additional nonlinearity.

Iron oxides have a very strong and well-documented affinity for arsenic, particularly As(V), but at high pH (pH>9), As(III) sorption can exceed that of As(V). Indeed, the strong sorption of As(V) is the basis for many methods of removing arsenic in water treatment. In our earlier report (DPHE/BGS/MML, 1999), we estimated sorption isotherms for As(V) and As(III) based on the assumption that the arsenic was adsorbed to iron oxides which could be approximated by hydrous ferric oxide (Hfo). The iron oxide content of some Bangladesh sediments was estimated by an ammonium oxalate extraction. These hypothetical isotherms were then linked to a standard groundwater flow model to provide estimates of the rate of arsenic movement in typical Bangladesh aquifers subject to a range of constraints.

In modelling the sorption of As by Fe oxides, the type of iron oxide chosen is important. The iron oxides present in Bangladesh sediments have not yet been well characterised and while this could include Fe(III)-oxides such as Hfo, goethite (α-FeOOH) or hematite (α-Fe_2O_3), it is also likely to include various mixed-valence oxides such as magnetite (Fe_3O_4) and possibly a green rust (e.g. $Fe(III)_2Fe(II)_4(CO_3)(OH)_{12}.nH_2O$) (Taylor, 1980; Génin et al., 1998). In the laboratory, dissimilatory iron-reducing bacteria (DIRB) such as *Shewanella putrefaciens* have been shown to reduce Hfo to various Fe(II)-containing minerals including siderite ($FeCO_3$), vivianite ($Fe_3(PO_4)_2$), fine-grained magnetite and a green-rust type compound, depending on conditions (Frederickson et al., 1998). Sulphate-containing green rusts have been most widely studied (Hansen and Poulsen, 1999) but are not likely to be the dominant form in Bangladesh because of the generally low sulphate concentrations. Heron et al. (1994) found that most of the 0.5M HCl-extractable iron (= FeS, $FeCO_3$ and '$Fe(OH)_3$') in the sulphate-reducing part of a sandy aquifer in Denmark was present as Fe(II) not Fe(III).

The arsenic-affected sediments are often dark grey in colour (when wet) and the small amount of colloidal material sometimes found when filtering the groundwaters usually has a grey-green colour characteristic of reduced Fe minerals. Bicarbonate-stabilised green rusts are therefore a possibility. The surface chemical properties of such oxides are not known.

Most of the sorption data in the literature is for the Fe(III) oxide minerals: Hfo, goethite and hematite. There is very little information for magnetite, for example, although its point of zero charge is believed to be about pH 6.5, some 1.5–3 pH units lower than for the Fe(III) oxides.

It is a major exercise to characterise all the surface interactions of importance, especially for redox-sensitive minerals, and developing general chemical models of such interactions on oxides is an active area of research. The iron oxides found in Bangladesh may be very fine-grained (colloidal-sized) and may therefore not be easily visible or characterised by traditional mineralogical techniques. Many are probably present as coatings. Significantly, acid ammonium oxalate is known to partially extract non-Hfo forms of iron oxide (such as magnetite, akageneite and green rusts) and so there is necessarily much uncertainty as to the exact form of the iron oxides extracted (Heron et al., 1994; Kostka and Luther, 1994). It is also known that in reducing sediments, acid ammonium oxalate may be able to partially dissolved crystalline iron oxides since Fe^{2+} is known to catalyse the dissolution of these iron oxides (Heron et al., 1994). It will also displace exchangeable Fe^{2+} but this is expected to be relatively small. Judging by the amount of magnesium and aluminium dissolved (Chapter 11), it is also likely to dissolve some clays.

Nevertheless, since sorption reactions are likely to play a role in the groundwater arsenic problem in the Bengal Basin (and elsewhere), it is useful to explore at a semi-quantitative level some of the important features given our current level of understanding. We suspect that the iron oxides are the most important oxides in Bangladesh sediments because of their relative abundance and because the geochemical associations observed with arsenic tend to be stronger for iron than for manganese or aluminium.

12.3.2 Arsenic sorption by hydrous ferric oxide (Hfo)

Existing models

Below we use Hfo as a 'model' iron oxide for some example sorption calculations but we do not want to imply by this that Hfo is necessarily the only, or even the main, form of iron oxide in Bangladesh sediments. Hfo has the advantage that it has been widely studied and there is a readily-available thermodynamic database for many of the key reactions and so is easy to model (approximately). It is likely that many of the interactions shown by Hfo will also be shown by other oxides albeit to a quantitatively different extent.

Dzombak and Morel (1990) critically reviewed the sorption data for a wide variety of cations and anions by hydrous ferric oxide (Hfo) and fitted the results to a simple model, the diffuse layer model (DLM). More sophisticated models have also been proposed, of which the most successful is the CD-MUSIC model of Hiemstra and van Riemsdijk (1999). However, a comprehensive database of model parameters for the CD-MUSIC model is not yet available. Therefore while the DLM undoubtedly has limitations, especially when it comes to modelling competitive interactions, it is probably sufficiently accurate to provide a semi-quantitative insight into the scale of the interactions that are likely to be found.

The DLM and the accompanying database have been included in a number of general-purpose geochemical speciation programs including PHREEQC, the Geochemist's Workbench, ECOSAT and MINTEQA2. There was not much arsenic sorption data available for Hfo in 1990 when Dzombak and Morel published their compilation, and the data from the principal datasets available then showed some inconsistencies. However, subsequent measurements of As(V) and As(III) sorption by Hfo (Wilkie and Hering, 1996) have shown that the published database and model are reasonably reliable, and probably sufficiently good for making initial estimates of sorption by Hfo.

Therefore below we present some model calculations to demonstrate the basic features of As sorption by Hfo. We used PHREEQC (Parkhurst and Appelo, 1999) and ECOSAT (Keizer and van Riemsdijk, 1998) for our calculations. These calculations are for a pure Hfo-As system with a background electrolyte of approximately 0.01M NaCl. In the calculations, the concentration of Hfo is expressed in terms of the total Fe concentration in the system (1 mg L^{-1} Fe as Hfo is equivalent to 1.60 mg L^{-1} Hfo).

Since an Hfo-like compound is produced when Fe^{2+} is precipitated during air oxidation, the calculations below also give a guide to the possible efficiency of As removal by 'passive' oxidation of Fe-rich groundwaters. This will depend to some extent on the ratio of As(III) to As(V) and the pH and concentrations of other ions present.

pH dependence

Given an initial As(V) concentration of 100 μg L^{-1}, the expected sorption or 'removal' of As(V) depends strongly on the pH and the total amount of Fe (as Hfo) present (Figure 12.3). As(V) is very strongly sorbed below pH 7 and decreases quite rapidly above that pH. The pH of the

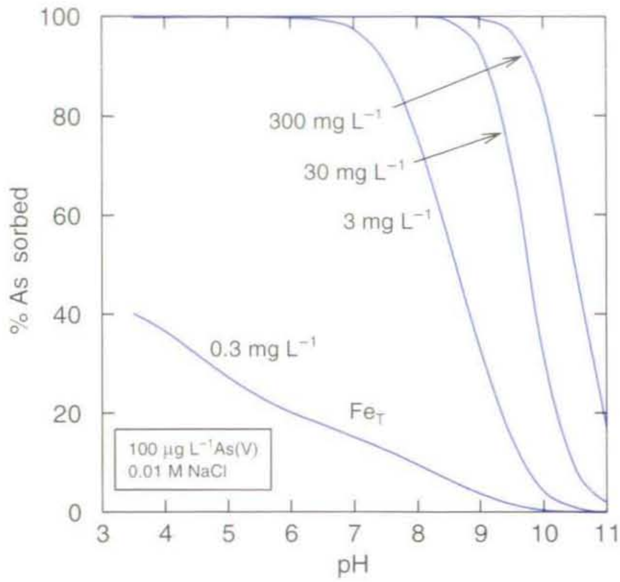

Figure 12.3. Calculated percentage of arsenic(V) sorbed by hydrous ferric oxide from a 100 μg As(V) L^{-1} solution as a function of the amount of Fe as Hfo present.

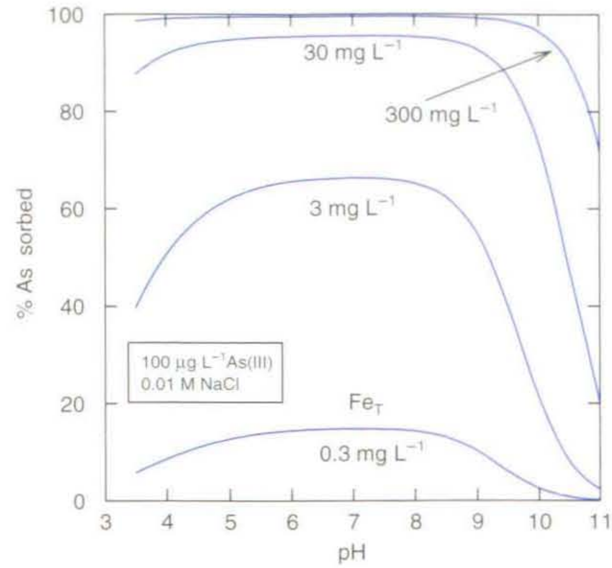

Figure 12.4. Calculated percentage of arsenic(III) sorbed by hydrous ferric oxide from a 100 μg As(III) L^{-1} solution as a function of the amount of Fe as Hfo present.

desorption edge depends quite strongly on the solid/solution ratio and so these pH's are not fixed – the higher the solid/solution ratio, the smaller the desorption at a given pH and the sorption edge shifts to a higher pH.

At the iron concentrations typical of Bangladesh groundwaters and used in arsenic removal plants (a few mg Fe L^{-1}), As(V) sorption decreases with increasing pH especially when the pH is above pH 7 and the As(V) concentrations are low. Therefore any upward shift in pH, especially above pH 7, could give rise to significant desorption of As from Hfo and in a closed system would result in an increase in As in solution. The magnitude of this shift depends on the solid/solution ratio. The position of the curves is also dependent on the total As concentration. The curves shift to a higher pH at lower As concentrations and are quite sensitive to uncertainties in the model parameters. However, at pH 7 and in the simple Fe-rich systems (those with more than 3 mg Fe L^{-1}), a significant amount of the As(V) should be sorbed on Hfo precipitated by the oxidation of the Fe(II).

The sorption behaviour of As(III) is quite different, especially the pH dependence (Figure 12.4). In particular, over the pH range 6–8, the sorption is independent of pH and depends primarily on the solid/solution ratio. At pH's and iron concentrations typical of Bangladesh groundwaters, As(III) sorption on Hfo precipitated during the oxidation of Fe^{2+} is likely to be only partial, and substantially less than for As(V). At high pH's (>pH 9), As(III) is more strongly sorbed than As(V). The sorption-pH curves have been calculated for 'simple' systems in the absence of other interacting ions. Strongly sorbed ions such as phosphate can have an important effect. This is shown in the adsorption isotherms at constant pH illustrated below.

Sorption isotherms at constant pH

Calculated As(V) adsorption isotherms at constant pH show that the isotherms depend strongly on the presence or absence of phosphate (Figure 12.5). In the absence of phosphate and above about 10^{-7} mol L^{-1} (7.5 μg As L^{-1}) As in solution, the isotherms at pH 6, 7 and 8 are approximately linear on a log-log scale with a slope of about 0.13. This indicates that the isotherms are very nonlinear (when plotted on a linear scale as sorbed amount against concentration) with the consequence that even at very low concentrations (a few μg L^{-1} or less) there is a considerable amount of arsenic adsorbed to the Hfo. For example, at pH 7 and an As(V) concentration of 10^{-9}M (equivalent to 0.075 μg As L^{-1}), the calculated amount of As sorbed is about 0.1 mol As kg^{-1} Hfo. This is equivalent to some 7500 mg kg^{-1} Hfo. At greater concentrations, the arsenic content of the Hfo is correspondingly greater. At pH 7–8, As(V) loadings can be as large as 1 mol kg^{-1} Hfo or some 75,000 mg kg^{-1}. Hfo therefore has both a large affinity and a large capacity for sorbing As(V) from natural waters. It should come as no surprise when iron oxide-rich sediments are found to contain large concentrations of arsenic.

The near-linearity of the isotherms on a log-log scale indicates that they can be approximated by a pH-dependent Freundlich isotherm. The high degree of non-linearity results from strong electrostatic interactions on the surface of the Hfo: as more and more As is adsorbed, the net negative charge of the oxide is increased, decreasing the surface potential (i.e. it becomes more negative) and leading to an increasingly unfavourable electrostatic environment for the sorption of more As.

The situation changes dramatically in the presence of phosphate. Phosphate competes very effectively with As(V) for sorption sites and reduces As(V) sorption greatly (Figure 12.5). The NHS showed that the median P concentration in As-contaminated shallow groundwaters

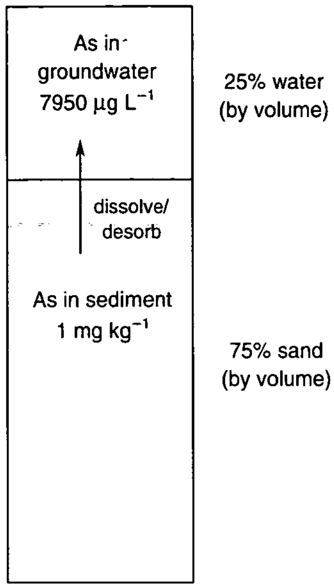

Figure 12.7. Schematic diagram showing how the consequences of a high solid/solution ratio on pore water arsenic concentrations. Complete dissolution of even small amounts of arsenic (1 mg kg^{-1} here) from a sandy Bangladesh aquifer sediment would give rise to extremely high concentrations of arsenic in the groundwater.

of dissolution/precipitation and sorption reactions. Clays may also be important.

Groundwater chemistry is particularly sensitive to any shifts in the sediment chemistry because of the very large solid/solution ratios found in aquifers (Figure 12.7). For example, assuming a porosity of 25% and a crystal density of the aquifer minerals of 2650 kg m^{-3} (typical of quartz) gives a solid/solution ratio of 7.95 kg L^{-1}; a porosity of 30% decreases this to 6.2 kg L^{-1} which is still very large. If an aquifer has a porosity of 25% and the sediment contains say 1 mg As kg^{-1} of labile As, the complete dissolution of that As would lead to a groundwater As concentration of 7950 µg As L^{-1}, far in excess of any drinking water standard. The oxalate-extractable As in Bangladesh sediments can exceed 1 mg kg^{-1} (see Table 11.14, Chapter 11) and while all, or even most, of this may not be labile, it demonstrates the sensitivity of the groundwater to changes in sorption. It only takes a small shift (less than 0.01 mg kg^{-1}) in the amount of labile As from the solid phase to the solution phase to give a significant groundwater As problem. These shifts are too small to be reflected accurately in 'total' sediment As determinations or even in oxalate-extractable determinations. Analysing sediments for total As is not necessarily a reliable indicator of a potential groundwater As problem.

From the calculations given above, groundwater pH increases in the presence of Hfo could provide one route for the formation of high As groundwaters. This is unlikely to be the driving force in Bangladesh since groundwater pH values are invariably near neutral. As discussed earlier, other processes giving rise to desorption of As are also possible (Table 12.1) and it is useful to explore some of these in a semi-quantitative way in order to estimate the magnitude of the changes expected and the relative sensitivity of these changes. The As-rich groundwaters frequently contain high phosphate concentrations and high bicarbonate concentrations, for example. It is often difficult to separate 'cause' from 'effect' since desorption reactions will result in the partial desorption (and increase in solution concentration) of many sorbed ions and so it can be difficult to identify the 'driving force' controlling the desorption reaction amongst the many correlated variables.

In order to make the calculations relevant to the Bangladesh situation, we assume the following scenario for the formation of high-As groundwaters. Many of the details are as yet unsubstantiated and so at present this is just a hypothesis but it is plausible and is consistent with existing data.

(i) Freshly-formed Hfo is formed in soils and in river sediments by the oxidative weathering of primary minerals such as biotite. As a result of soil erosion and the reworking of older sediments, this Hfo is slowly transported down the river. Formation of Hfo as opposed to the more crystalline iron oxides, will tend to be favoured because of numerous phases of precipitation and dissolution as a result of successive redox cycles following burial and exposure of the sediments. In this way, the iron oxides are constantly kept 'young' (McGeehan et al., 1998). Hfo tends to be most abundant in young soils and sediments and because it is colloidal in nature, will tend to be quite readily transported. It will therefore be concentrated in the lower parts of the delta, along with other fine-grained material.

(ii) While in the river bed, this Hfo sorbs As from the passing river water. We assume for the sake of the calculations that this As is present entirely as As(V) but this is unlikely to be strictly the case. As we have shown above, substantial amounts of As(V) can be accumulated on the sediment by sorption, even while the As concentration in the river water is small. This is a consequence of the high affinity of Hfo for As(V). The concentration of As in the river water will reflect the various As sources upstream, including mineralised areas, and the extent of adsorption by the upstream sediments. The river water will approach a steady state concentration of As. The pH of the river water will primarily depend on whether there are free calcium and magnesium carbonates in the sediments, on the effect of biological activity and the degree of reaeration. In Bangladesh, the river pH is probably about pH 7.5–8.0 (Datta and Subramanian, 1997) but could be lower in carbonate-free areas. The lower the pH, the greater the sorption of As(V) by the sediments is likely to be.

(iii) River sediment is continuously being deposited either as overbank deposits during times of flood or at the distal end of the delta as the delta advances. As soon as the sediment is buried, dissolved oxygen will be depleted from the pore water by microbial oxidation of the small amounts of fresh organic matter present in the sediments. When the sediment is buried beyond a certain depth, the rate of oxygen diffusion from the surface will be insufficient to maintain dissolved oxygen in the water and the pore water and sediments will become anaerobic. This change occurs at the redox boundary which in many natural environments is quite sharp. Further oxidation of

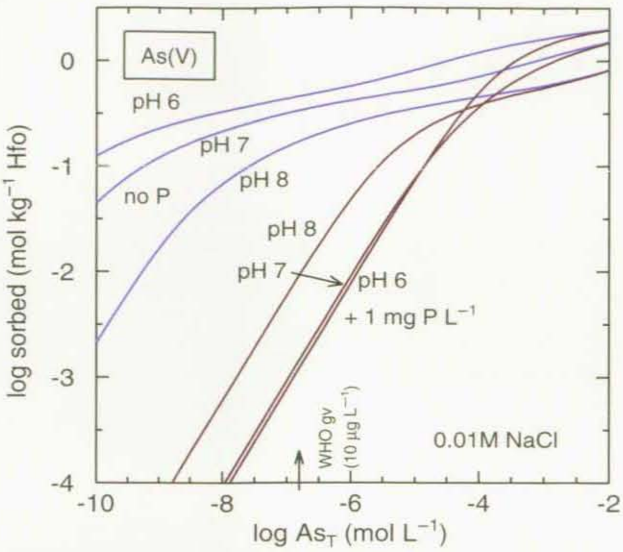

Figure 12.5. Calculated sorption of As(V) by Hfo as a function of As(V) concentration and pH in 0.01M NaCl background electrolyte. Calculated in the absence (red) and presence (blue) of an equilibrium dissolved phosphate-P concentration of 1 mg L^{-1}.

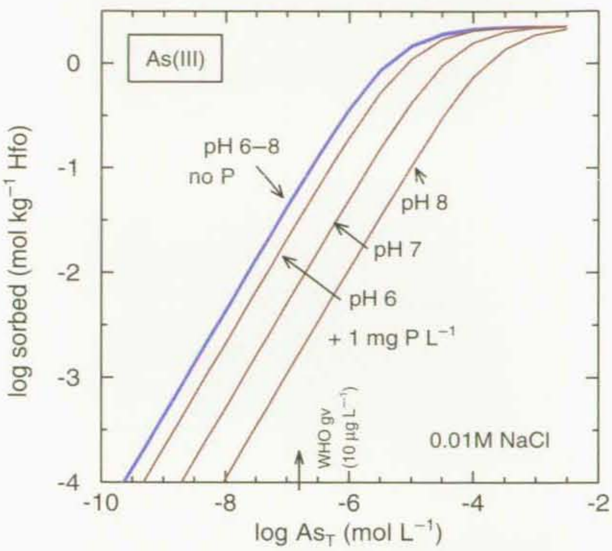

Figure 12.6. Calculated sorption of As(III) by Hfo as a function of As(III) concentration and pH in 0.01M NaCl background electrolyte. Calculated in the absence (red) and presence (blue) of an equilibrium dissolved phosphate-P concentration of 1 mg L^{-1}.

(greater than 50 µg As L^{-1}) was 1.1 mg P L^{-1}. We have therefore calculated the As(V) sorption isotherms for pH 6, 7 and 8 in the presence of an equilibrium (final) dissolved P concentration of 1 mg L^{-1} (3.23e-5 mol L^{-1}).

At low As(V) concentrations, the high As/P molar ratios mean that P outcompetes As very effectively and is calculated to reduce the sorption by one to three or more orders of magnitude (Figure 12.5). The isotherm is now linear at low As concentrations and is close to being a Langmuir isotherm overall. This is because the surface potential is now governed by the phosphate sorption and is essentially independent of the As(V) concentration over much of the isotherm. The pH dependence of the isotherms has been reversed from the no-P situation and there is a rather small pH dependence between pH 6–7. For typical groundwater As concentrations, increasing pH from 7 to 8 is calculated to increase As sorption slightly rather than decrease it.

As expected, the sorption isotherms for As(III) differ greatly from those for As(V) both in terms of the basic isotherms and the effect of phosphate (Figure 12.6). The plateau regions at near neutral pHs seen in Figure 12.4 (in the absence of phosphate) mean that As(III) sorption is essentially independent of pH in the region of interest for Bangladesh groundwaters, i.e. near neutral. This is confirmed in Figure 12.6 where the three isotherms are superimposed. The resulting pH-independent isotherm is nonlinear and conforms closely to a Langmuir isotherm. However, in the range of As concentrations relevant to most groundwaters, the isotherm has a slope of one on the log-log plot indicating a linear isotherm.

This difference in behaviour between As(V) and As(III) largely reflects differences in the importance of electrostatics. The dominant As(III) species in near-neutral pH solutions is the neutral H_3AsO_3 species and in the Dzombak and Morel (1990) model, this neutral species is the only form of As(III) sorbed. This sorption involves little change in surface charge. Hence, the conformity to the idealised Langmuir isotherm.

In the presence of 1 mg L^{-1} phosphate-P, the competitive effect is much less than for As(V) but As(III) sorption still decreases by up to an order of magnitude. The presence of phosphate has also induced some pH dependence with somewhat greater sorption at pH 6 than at pH 7 or 8. Comparing As(V) and As(III) sorption in the presence of 1 mg L^{-1} P, we can see that over the pH range of interest, As(III) is now calculated to sorb more strongly than As(V), the reverse of the situation in the absence of P. The situation is indeed complicated, and this is without considering HCO_3^-, SiO_4^{2-}, DOC, Ca^{2+}, Fe^{2+} and Mg^{2+}!

One interesting point suggested by this modelling is that in the presence of phosphate, the sorption isotherms for both As(V) and As(III) are essentially linear isotherms over the range of As concentrations typical of Bangladesh groundwaters (10^{-9} to 10^{-4} mol L^{-1}). If true, this greatly simplifies transport modelling since it implies that a simple 'Kd' or constant retardation factor approach can be used.

12.3.3 Desorption of arsenic from iron oxides and the formation of high-arsenic groundwaters

Anything that causes significant dissolution or precipitation of As-containing minerals or a change in the As sorption isotherm of the aquifer material will tend to be reflected by a mirror change in the As concentration of groundwater, i.e. desorption will lead to an increase in groundwater concentration, and *vice versa*. Both Fe(III) oxides and Fe(II) sulphide minerals are well-known scavengers of trace elements and so these are likely to be important minerals in this respect in Bangladesh in terms

Table 12.1. Geochemical processes that can cause an increase of the arsenic concentration in groundwaters

Process	Comments
Solution complexation	Recent data suggest that carbonate ions form stable complexes with As(III) and As(V) in solution. This will lower the activity of free arsenic ions in solution and will tend to increase the solubility of any As minerals and cause the desorption of As from oxides. Both of these mechanisms will tend to increase the concentration of As in groundwater. Bicarbonate concentrations in many As-affected groundwaters are relatively high (compared with surface waters) as a result of the oxidation of fresh organic matter and the dissolution of carbonate minerals and so while this mechanism of arsenic release might be correlated with sediment burial and reduction, it does not require such reduction and could also occur in high bicarbonate groundwaters in oxidising environments – there can be a good correlation between arsenic and bicarbonate in such oxidising environments (Smedley et al., 2001a).
Reductive dissolution of iron oxides	Reduction of Fe^{3+} leads to the (partial) dissolution of Fe(III) oxides and the release of Fe^{2+}. This will lead to the co-release of both adsorbed solutes (including As) and structural (solid solution) components. Details of the mechanisms involved are not well understood quantitatively but the amount of co-release by pure (congruent) dissolution should be proportional to the amount of dissolution, i.e. to the release of Fe^{2+}. Dissolution (and As release) will continue until all the oxide has dissolved, with the least crystalline oxides dissolving first. Some of the released Fe^{2+} is readsorbed on iron(III) oxide surfaces. Specialised dissimilatory iron-reducing bacteria have been identified.
Reductive desorption due to reduction of As(V) to As(III) in solution	Since As(III) is less strongly sorbed than As(V) by oxides under near neutral pH conditions (Figures 12.3 and 12.4), the reduction of As(V) to As(III) may lead to the release of As. For iron oxides, this is independent of any Fe released as a result of mineral dissolution. Reductive desorption can also occur on aluminium oxides and clays. Once the system has adjusted to the new redox conditions, there should be no further As release, i.e. it is essentially a one-off process. There is as yet little experimental evidence to support this hypothesis directly and calculations suggest that there can be a reversal in the presence of other specifically adsorbed ions such as phosphate. Some recent laboratory results (Langner and Inskeep, 2000) demonstrate that reductive desorption does not necessarily occur rapidly. A different type of reductive desorption could also occur through the change in oxidation state of the structural Fe(III) ions (see below).
Competitive desorption of As(III) and As(V)	Anything that leads to an increase in the concentration of strongly sorbed anions such as phosphate, silicate and bicarbonate could lead to the desorption of As(III) and As(V) through competitive sorption reactions. This also applies to AsO_4^{3-} and AsO_3^{3-} competition. The most likely competitor anions in Bangladesh groundwaters are phosphate, bicarbonate (example calculations by CAJ Appelo, personal communication, 2000; www.xs4all.nl/~appt/co2_hfo.html suggest that bicarbonate-induced desorption could be important), silicate and dissolved organic matter (humics). Unlike the reductive dissolution of iron oxides, there will be no corresponding release of large quantities of dissolved Fe. Weakly-bound ions such as chloride and nitrate have little effect. These competitive desorption effects will be counteracted to some extent by any specific adsorption of multivalent cations. Ca^{2+}, Fe^{2+} and Mg^{2+} are the most likely candidates in Bangladesh groundwaters. Oxidation of organic matter can lead to increased concentrations of bicarbonate and phosphate while mineral dissolution can lead to increased bicarbonate, silicate and phosphate concentrations.
pH changes	An increase in pH will tend to lead to the desorption of As(V). As(III) sorption is little affected by pH changes at the pH of most groundwaters. The presence of competing specifically adsorbed anions will affect the pH dependence of sorption and the nonlinearity of the As isotherm – it tends to decrease the nonlinearity of the isotherm.
Diagenesis of iron oxides	Freshly-precipitated iron oxides are unstable and tend to crystallise with time. This invariably leads to an increase in particle size and a reduction in specific surface area, and probably a reduction in the number of sorption sites per unit mass. This could lead to the desorption of adsorbed solutes including any sorbed As. However, some ions may be incorporated as a solid solution into the evolving structure which will reduce the impact on solution concentrations. There may also be a change in crystal structure, generally an increase in structural order or 'crystallinity' say from ferrihydrite to goethite. This will also change the mineral surface structure and alter the sorption isotherm – this could lead to an increase or decrease in sorption through its impact on the intrinsic binding affinities (log K's). Some of these diagenetic changes have been observed in Atlantic ocean pelagic sediments from below the sediment redox boundary (Haese *et al.*, 1998).
Reduction of solid phase Fe(III) to Fe(II)	Another form of diagenesis found under reducing conditions is that some of the Fe(III) in iron oxides and other Fe(III)-containing minerals will be reduced to Fe(II). With oxides, this leads to a change in coordination of the Fe and is a precursor to the detachment of Fe(II) as part of the reductive dissolution process (Stumm and Sulzberger, 1992). The change in oxidation state is therefore likely to lead to a change in the surface structure of the iron oxides and a consequent change in the sorption isotherm for the (partially) reduced surface. It could increase or decrease sorption but electrostatic considerations suggest that a decrease in sorption is more likely because of the reduction in positive charge in the solid phase. This is consistent with the change in the point of zero charge of oxidised iron oxides which varies from about pH 8.1 for Hfo to about 9.5 for goethite while that of magnetite is about pH 6.5. Therefore, all other things being equal, a change from Hfo to magnetite could lead to a more negatively-charged surface and desorption of both As(III) and As(V). Solid state diffusion of electrons is relatively fast and so reduction of deeper-placed structural Fe(III) could also take place leading to minerals with a magnetite or green-rust structure. Ultrafine-grained authigenic magnetite has been identified in recent sediments and soils (Maher and Taylor, 1988). Fe(III) in other minerals, such as phyllosilicates, could also be reduced. This may be accompanied by a colour change and can be very rapid. Vermiculite rapidly changes colour from a light brown to a steel grey when reduced. This too affects the layer charge.

Table 12.2. Arsenic and major element chemistry of some Bangladesh rivers

Sample no.	Description	Longitude	Latitude	Date sampled	As_T	Na	K	Ca	Mg	Si	Fe	Mn	SO_4	P
					µg L^{-1}	mg L^{-1}								
9901552	R. Wabda, Mandari, Lakshmipur (M203)	90.8932	22.9110	26/11/99	1.0	12.2	2.3	4.0	4.7	0.9	0.22	0.055	0.7	<0.2
9901553	R. Meghna near Meghna bridge	90.7110	23.5304	22/11/99	<0.5	6.0	2.0	7.2	3.7	6.4	0.11	0.028	2.3	<0.2
9901554	Jamuna R. near Bangabandhu bridge	88.7530	24.0004	3/12/99	0.7	4.0	2.4	25.4	5.9	6.6	0.03	0.002	13.4	<0.2
9901555	R. Ganges, Rajshahi	88.5705	24.3622	2/12/99	1.8	13.9	7.9	36.4	10.3	7.2	<0.01	0.014	13.8	<0.2
9901556	R. Mahananda at Chanlai bridge, Nawabganj	88.2565	24.5994	2/12/99	2.7	15.0	2.7	22.1	5.9	15.8	0.06	0.046	4.6	<0.2
9900389	R. Mahananda at Chanlai bridge, Nawabganj	88.2537	24.5993	22/3/99	29	22.9	4.5	22.9	14.9	16.5	0.04	0.153	4.7	<0.2
9900414	Wapda canal, Kamalpur, Lakshmipur	90.8422	22.9040	3/4/99	1.7	0.9	8.0	0.9	23.3	7.4	0.09	0.036	46.1	<0.2

organic matter will lead to the reduction of nitrate to nitrite and ultimately to nitrogen gas (denitrification), formation of ammonium, and eventually to the reduction of sulphate to sulphide. The reductive dissolution of manganese and iron oxides will also occur with iron being released more slowly than manganese (Williamson et al., 1994). As a result, Fe(II)-containing minerals such as siderite ($FeCO_3$) or iron sulphides may form. The most readily 'available' iron oxides will be reduced first. The pore water pH will tend to be stabilised close to pH 7.

This change to anaerobic conditions will lead to the reduction of As(V) to As(III) both in solution and in adsorbed forms. The kinetics of these reactions are slow on laboratory timescales but probably not on geological timescales. At present, opinions vary about the degree to which the As(III)–As(V) couple is in redox equilibrium in groundwaters. This reduction could lead to desorption of As since As(V) is often, but not always, more strongly sorbed than As(III). A decrease in pH, say from pH 8 (river) to pH 7 (buried sediment), may also affect the sorption of As(V).

12.4 MODELLING THE DEVELOPMENT OF ARSENIC-RICH GROUNDWATERS

12.4.1 Approach

While it is too early to model the evolution of the arsenic-rich groundwaters in Bangladesh with much confidence, it is possible to carry out some simple modelling to show what might happen if the sequence of events described above takes place. We concentrate on the dissolution and desorption of As by iron oxides but qualitatively similar arguments could be applied to other oxides and clays. The key reactions appear to be between arsenic species and oxides or oxide-like minerals. While manganese oxides are significant for arsenic sorption and release in some environments, we have not seen any data that suggest this is true in Bangladesh.

The following parameters are assumed to change in the groundwater and aquifer following sediment burial: (i) pH (pH 8 to pH 7); (ii) phosphate increases in concentration (0.03 to 1 mg P L^{-1}); (iii) redox potential (oxidising to reducing) with As(V) changing to As(III); (iv) reduction in specific surface area of iron oxide (600 to 300 $m^2 g^{-1}$ or less), and (v) reduction in As(III) binding affinity on the iron oxide (log K decreased by 1 or 2 units). The first three changes probably occur rapidly, the last two more slowly.

We have not attempted to model the entire evolution of the groundwaters at this stage. It is relatively straightforward to account for the development of the major-ion chemistry in terms of the oxidation of organic matter, reduction of sulphate, dissolution of carbonates, silicates etc. Rather we concentrate on how the As-rich groundwaters may have developed.

12.4.2 River water quality

Since we take as a starting point iron(III) oxide in equilibrium with river water, we need to know the average chemistry of Bangladesh river water. There are few As analyses of Bangladesh rivers but the indications and expectations are that it is generally low, especially in the major rivers. We analysed seven surface waters mainly collected from major Bangladesh rivers (including the Ganges, the Brahmaputra and the Meghna), mostly sampled during November–December 1999. This time of sampling corresponds to the early part of the dry season. The results (Table 12.2) show that, with one exception, the As concentration in the sampled river waters was less than 3 µg L^{-1} and in three cases was 1 µg L^{-1} or less. The most notable exception was for the River Mahananda which runs through the Chapai Nawabganj As hot spot area and in March 1999 had a concentration of 29 µg L^{-1}. However, a second sample taken from the same location in December 1999 gave an As concentration of only 2.7 µg L^{-1}, some ten times lower. It is not known why there was this large change, whether it is real or not, or in general how the surface water As concentration varies with river flow and time.

Most of the samples were from large rivers, some very large rivers, and had correspondingly large flows. Concentrations in small rivers and near-stagnant ponds may be different and more variable. The As speciation was not determined in the river water samples. We assume for the sake of the modelling a river water As concentration of 1 $\mu g\ L^{-1}$ and that all of this is present as As(V). We have not studied any modern river sediments in the laboratory.

12.4.3 Sorption of arsenic by river sediments

Calculated arsenic loading of the active river sediment

While the CD-MUSIC model of Hiemstra and van Riemsdijk (1999) is the most promising of the oxide adsorption models presently available, there is as yet no database for Hfo-cation and anion interactions available. The CD-MUSIC model is available in ECOSAT (Keizer and van Riemsdijk, 1998) and ORCHESTRA (Meeussen, 2000) but not in PHREEQC. Some preliminary calculations trying to fit the existing Hfo-As experimental data to CD-MUSIC were carried out but these brought up too many inconsistencies in the experimental data to make the results usable within the scope of this project.

In the following calculations, we assume that a fraction of the extractable iron in Bangladesh river sediments behaves like Hfo and that this fraction interacts with arsenic and other ions according to the Dzombak and Morel (1990) diffuse layer model. The model itself, and the way in which it accounts for competitive interactions (Wilkie and Hering, 1996), involve many important simplifications that have not been verified over the wide range of conditions required. Indeed it is likely that some of the assumptions will be subsequently be shown to be incorrect. The results must therefore be viewed with caution. The modelling has been carried out to give a first guide as to the order of magnitude of the interactions expected and to guide further modelling and data collection.

We assume that an average sediment has a crystal density of 2650 kg m^{-3}, a water-filled porosity of 25% and contains 0.2% Fe_{ox} (2 mg Fe_{ox} kg^{-1} sediment), an oxalate-extractable Fe content typical of that found in the Faridpur sediments (Figure 11.14). This is equivalent to 3.19 g Hfo kg^{-1} sediment or 25.4 g Hfo L^{-1} of groundwater. If we further assume that the river water has: a pH of 8.0; a dissolved phosphate-P concentration of 0.03 mg L^{-1}; a dissolved As(V) concentration of 1 $\mu g\ L^{-1}$ and an ionic strength of 0.05 mol L^{-1}, then using Dzombak and Morel's default parameter values, the Hfo will have an As(V) loading of 34 mmol kg^{-1} Hfo or 8.2 mg kg^{-1} sediment. This is about an order of magnitude greater than the observed As_{ox} concentrations of about 0.5–2 mg kg^{-1} in the depth range 15–50 m (Figure 11.13). The river PO_4–P concentration is probably less than 0.03 mg L^{-1} but this value compensates to some extent for the omission of bicarbonate and silicate competition (Swedlund and Webster, 1998).

We can reduce the calculated sediment loading with As by reducing either the sediment iron concentration or the river As concentration, or by converting some or all of the As(V) to As(III) or by increasing the river phosphate concentration. Here we assume that only 10% of the oxalate-extractable Fe is present as an Hfo-like oxide since it is known that oxalate overestimates Hfo-like material in reduced sediments. Clearly, this is an important and somewhat arbitrary assumption.

With this reduced Fe oxide concentration, the As loading of the sediment is reduced accordingly and is now plausible. More than 99.9% of the arsenic in the system (adsorbed plus solution) is adsorbed. The high value used here for the ionic strength (made up from NaCl) and throughout these simulations meant that small differences in ionic strength had little influence on the results. While changes in ionic strength do have some effect on As sorption, the effect is relatively small and should be included later when a more complete model of all the major changes in groundwater chemistry has been derived.

This river sediment with the above adsorbed arsenic load is assumed to be buried, after which various changes occur. Below we calculate the impact that these changes in the 'groundwater' and sediment may have on the arsenic concentration in the groundwater. These impacts are calculated sequentially and cumulatively in steps in order to show their separate impacts. In practice, they may not take place in the order given and probably will take place in parallel, at least to some extent. Calculations were made using PHREEQC (Parkhurst and Appelo, 1999) and ECOSAT (Keizer and van Riemsdijk, 1998). The calculations are meant to be demonstrative rather than definitive. Clearly others sets of assumptions would be equally valid.

Change in pH (Step 1)

There is likely to be a reduction in pH in going from river water to groundwater principally due to the increase in pCO_2. The median pH of Bangladesh groundwaters is close to pH 7 (Chapter 7, *Hydrogeochemistry of three Special Study Areas*). Therefore a pH change of one pH unit or more is possible, say from pH 8 to pH 7. In our simulations, the pH was adjusted by the addition of HCl since we did not want to simulate all proton reactions. Redox status was controlled by maintaining the partial pressure of oxygen at atmospheric levels.

In the presence of the baseline 0.03 mg L^{-1} dissolved P, the 'groundwater' As concentration actually increased by changing from 1 $\mu g\ L^{-1}$ to 1.5 $\mu g\ L^{-1}$ as the pH changed from pH 8 to pH 7. Phosphate was added to maintain the given dissolved P concentration. This change is the reverse of that expected in the absence of phosphate. This effect of P in reversing the pH dependence of As(V) sorption was noted earlier (Volume 4; DPHE/BGS/MML, 1999). This inversion in the pH dependence has not, to our knowledge, been demonstrated to take place in practice.

Competitive interactions: phosphate increase (Step 2)

Increasing the dissolved phosphate-P concentration to 1 mg L^{-1} at pH 7 by adding phosphate to the system increased the dissolved As concentration to 266 $\mu g\ L^{-1}$ due to species competition and electrostatic effects. Adding even more phosphate would further increase the groundwater As concentration. This P concentration is not excep-

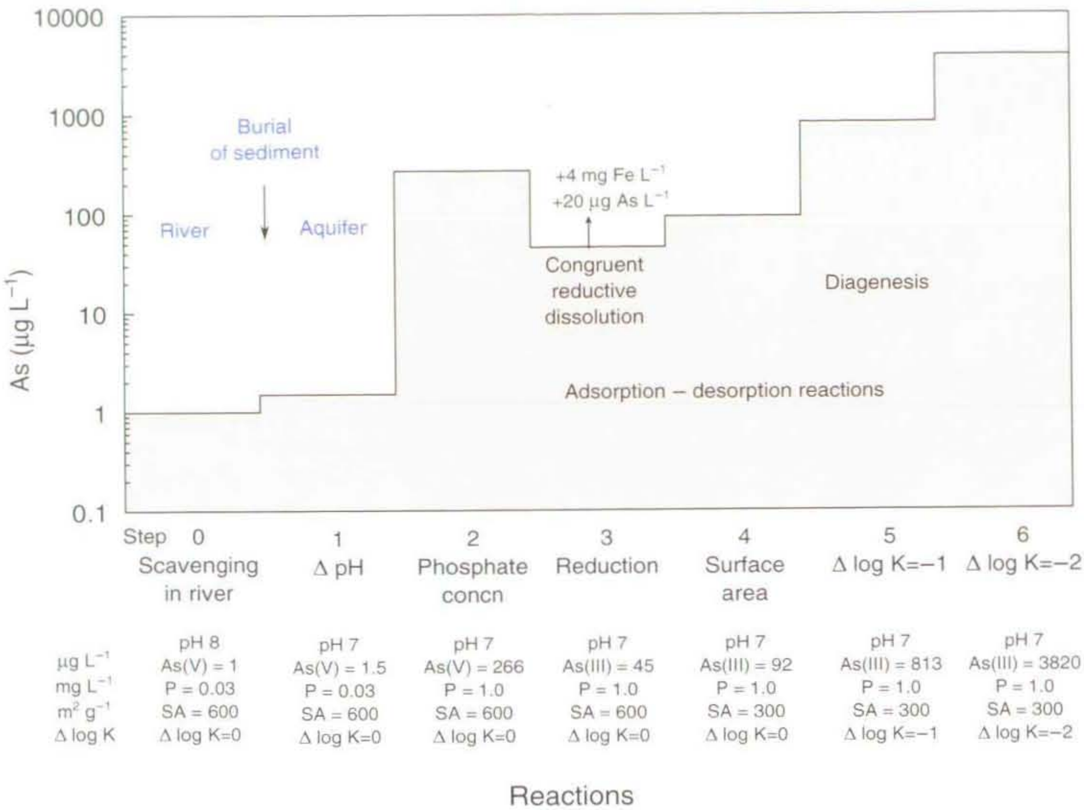

Figure 12.8. Change in the calculated arsenic concentration in groundwater as a result of changes in the amount of As adsorbed to iron oxides. The stepwise changes in groundwater chemistry or model parameters leading to this adsorption/desorption are indicated. The starting condition is river sediment with iron oxide in equilibrium with river water containing 1 µg L^{-1}. The changes are assumed to be sequential and cumulative from left to right. Δ log K is the change in the intrinsic As(III)-Hfo binding constant. All calculations are based on the Dzombak and Morel (1990) diffuse layer model and their default thermodynamic database for Hfo. The calculations indicate that the indicated adsorption/desorption reactions can 'magnify' the initial water concentration of 1 µg L^{-1} by more than three orders of magnitude.

tional for Bangladesh groundwaters. Weathering of phosphate minerals such as apatite, decomposition of organic matter, desorption of adsorbed P, fertilizers and even pollution could all increase P concentrations.

Redox changes (reduction) (Step 3)

Changing from oxidising to reducing conditions by reducing log pO_2 to −70 converts all of the As(V) to As(III). A constant total dissolved P concentration of 1 mg L^{-1} was maintained by adding phosphate to the system and a pH of 7 and ionic strength of 0.05 were maintained as before. The net effect of this redox change was to decrease the groundwater As concentration to 45 µg L^{-1}, a somewhat surprising result and again the reverse of the trend expected in the absence of phosphate. In other words, the presence of reductive desorption of As due to a change in arsenic speciation may depend on the phosphate concentration present. Phosphate is expected to be a better competitor for As(V) than As(III) (Figures 12.5 and 12.6). Again, whether this reflects reality remains to be seen. Anecdotal information suggests that the removal of As(III) by iron precipitation in Bangladesh groundwaters is less effective than might be 'expected' because of the presence of As(III) rather than As(V) which suggests that it might not be true (or is this simply a phosphate effect?).

Congruent dissolution (during Step 3)

Reductive dissolution of iron oxides is clearly an important process in Bangladesh aquifers. It produces high dissolved iron concentrations. Although the concept of congruent dissolution of solids with adsorbed species is not a straightforward one, it is informative to calculate the magnitude of As release that might be expected if it is assumed that the arsenic is uniformally distributed in the oxide phase and that the oxide dissolves congruently. We do this by assuming that the As/Fe mole ratio in the initial solid phase is preserved during dissolution.

Using the As and Fe data from the oxalate dissolution of Bangladesh sediments (Figure 11.17), we estimate that a sediment with 1% Fe_{ox} has an average As_{ox} of 4 mg kg^{-1}. In a 4 mg Fe L^{-1} groundwater, congruent dissolution would only be expected to release 1.6 µg L^{-1} As. This is a minimal contribution to the observed As load of contaminated groundwaters and is insufficient to account for the high As concentrations observed.

If the calculated As concentration in the Hfo just before the reduction step (3.3e-2 mol As kg^{-1} Hfo) is used, then the congruent release of As in the case of 4 mg L^{-1}

would be 16 μg L^{-1} As, an order of magnitude greater but still insufficient to account for the observed high As concentrations.

Reduction in specific surface area (Step 4)

The specific surface area of Hfo used in Steps 1–3 above was 600 $m^2\ g^{-1}$. It is likely that with ageing, the Hfo will show a gradual reduction in specific surface area and an increase in particle size as a result of crystallisation to a more stable mineral structure. Haese et al. (1998) found a decrease in specific surface area of iron oxides below the redox boundary in pelagic sediments from the eastern and western equatorial Atlantic. This is a form of diagenesis. In our calculations, we assume that the surface site density (sites per nm^2) and binding constants remain unchanged.

As can be seen from Figure 12.8, Step 4, a decrease in the specific surface area to 300 $m^2\ g^{-1}$ has resulted in an increase in As concentration to 92 μg L^{-1}. Under these conditions (high P), the dissolved As concentration increases nearly linearly with decreasing surface area.

Reduction in binding affinity of the arsenite ion (Steps 5 and 6)

A second possible impact of diagenesis is a change in the bulk (mineral) and surface structure with a consequent change in the binding affinity for all adsorbed ions including arsenic species. This could reflect the formation of mixed Fe(II)-Fe(III) oxides including green rusts. As discussed in Table 12.1, this could lead to a reduction in binding affinity which would trigger an additional release of As. For example a reduction by one log K unit in the binding constant of As(III) (i.e. log K from 5.41 to 4.41) increases the calculated groundwater arsenic concentration to 813 μg L^{-1}. A reduction by two log K units gives a groundwater arsenic concentration of 3820 μg L^{-1}. Changes to the As(V) binding constant in these calculations are not relevant since all of the As is assumed to be As(III). However, if As(V) were present, then a similar reduction in the affinity of those binding constants would have a similar effect.

Conclusions from the model calculations

- Starting with a river sediment containing Fe(III) oxides and in equilibrium with river water containing 1 μg L^{-1} As(V), calculations show that it is possible to produce groundwaters containing hundreds or even thousands of μg L^{-1} of As by desorption processes.
- Many factors affect the scale of this 'magnification' in As concentrations including the chemistry of the river water and groundwater and the nature of the sediments in both the river and after burial in the aquifer.
- Competitive interactions at oxide surfaces (e.g. with phosphate) can lead to modelled reversals in pH and redox dependence, and to important changes in the calculated slopes of the As adsorption isotherms which tend to become more linear.
- It is the difference between the amount of sorption by the river sediment when initially buried and the present-day sediment that is important, not the absolute magnitudes of their sorption.
- An important factor could involve various diagenetic changes to the structure of the iron oxide minerals following burial. These could include a change in composition towards a mixed Fe(II)-Fe(III) oxide, a reduction in specific surface area and a change in binding affinity for As(V) and As(III).
- Therefore model calculations have demonstrated that, providing the correct conditions are met to promote As desorption, it is not necessary to invoke any form of exceptional 'arsenic contamination' in the original sediments in order to give groundwater As concentrations greatly exceeding the WHO drinking water guideline value – it can occur with 'average' sediments containing a few mg kg^{-1} of arsenic.
- The adsorption/desorption reactions can be described using the Dzombak and Morel diffuse layer model (DLM) but at present there are insufficient experimental data over the relevant range of conditions to be confident that the predictions are reliable. Furthermore, other minerals such as clays may also be important for adsorption and the DLM has not been tested adequately for these.
- The CD-MUSIC model of Hiemstra and van Riemsdijk is the most promising model for a quantitative description of these competitive interactions but the required model parameters need to be established for all of the important reactions.
- The calculations above have shown that adsorption/desorption reactions are very sensitive to may parameters including other basic water quality parameters. Since we know that the Bangladesh groundwater quality is highly variable, it is likely that the role of adsorption/desorption reactions will be similarly variable, and consequently particularly difficult to model accurately.
- Laboratory experiments need to be carried out urgently to quantify these sediment–water interactions in detail. This will lead to an improved understanding of the processes involved, better models and databases, and ultimately improved predictions. Such models are needed to inform water resource planners of the possible impacts and sustainability of the future use of deep and shallow tubewells in Bangladesh.

12.4.4 Reductive codissolution

We have demonstrated above that reductive (congruent) dissolution of As-rich iron oxides alone is insufficient to account for the development of the high-As groundwater concentrations observed. In principle, adsorption-desorption reactions probably could. In reality, dissolution and desorption reactions occur simultaneously in just the same way that during the precipitation of a new solid phase trace ions are incorporated into the phase, a process called coprecipitation.

Sometimes coprecipitation is indistinguishable from adsorption onto the evolving solid phase, as in the case of the coprecipitation of many divalent cations during the formation of Hfo (Kinniburgh and Jackson, 1981), i.e. it makes no difference whether the trace ions are added before the precipitation of the major mineral phase or afterwards. In contrast, coprecipitated ions are irreversibly incorporated into the bulk solid structure and become increasingly less accessible to exchange with the surrounding solution ions as diffusion and reaction proceeds. This leads to the formation of a solid solution. In this case, the sequence of mixing is important. This is likely to be true with anions such as phosphate, arsenate and arsenite.

The incorporation of impurities during coprecipitation can itself alter the mineral properties and affect the rate of 'ageing' or recrystallisation of the mineral, usually by slowing it down. For example, when arsenic was coprecipitated with Fe to form an As-containing Hfo, more As was incorporated than when a similar amount of As was added to a preformed Hfo precipitate because of the larger surface area (smaller particle size) of the coprecipitated Hfo sample (Waychunas et al., 1993). The presence of As 'poisons' the Hfo surface and slows down recrystallisation.

The science of coprecipitation is rather 'murky' but is of undoubted importance in the natural environment – it is probably the rule rather than the exception. Natural minerals contain a wide range of trace impurities. The reverse process, which we can call *codissolution*, is likely to be equally important. Where this dissolution is driven by reducing conditions we have *reductive codissolution.*

Therefore a more realistic model for the release of arsenic, phosphate and other anions in Bangladesh groundwaters might involve both reductive dissolution and desorption and will lead to the simultaneous release of Fe and other coprecipitated 'metals'. Desorption occurs through competitive and electrostatic interactions at the mineral surface. In the case of arsenic, changing from oxidising to reducing conditions may of itself lead to the desorption of arsenic as a result of a change in the interactions of arsenate and arsenite species and the reductive dissolution of As-containing minerals.

12.5 TRANSPORT OF ARSENIC

12.5.1 Simple 1-D model of flushing

There are too many uncertainties at present to make a reliable model of the transport of arsenic in Bangladesh aquifers but it is instructive to begin to think about it by making some simple calculations. We consider a 50 m column of aquifer sand divided into five 10-m thick layers, i.e. 0–10 m, 10–20 m, etc. All the sand material has been assumed to be derived from river sediment in equilibrium with 1 μg As L^{-1} in the same way that was assumed in the preceding calculations and then the pH dropped, the phosphate increased and the sediment reduced as before (Step 3, Figure 12.8). The sediment in the depth interval 20–30 m is assumed to contain five times as much iron oxide as the other layers and unlike the other layers is assumed to have undergone diagenesis to Step 5 (Figure 12.8). This gives an initial pore water concentration of 45 μg As L^{-1} from 0–20 m and 30–50 m, and 905 μg As L^{-1} from 20–30 m. This is one way of generating a high-As zone. It is important to remember that all of the sediments have evolved from initial contact with a 1 μg As L^{-1} river

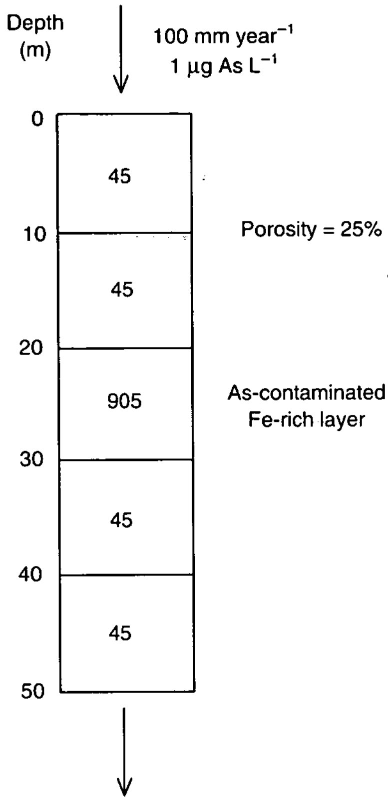

Figure 12.9. Five-layer model used to investigate vertical flushing of arsenic from a middle As-contaminated iron-rich layer of sediments (1% Fe compared with 0.2% Fe for the remainder). The numbers in the boxes are the initial dissolved As concentrations in μg As L^{-1}.

water, i.e. essentially 'uncontaminated' water.

Fresh river-type water containing 1 μg As L^{-1} and 0.03 mg L^{-1} phosphate-P was then infiltrated from the surface at a rate of 100 mm a^{-1}. This rate is of the same order of magnitude as the rate of natural recharge (Chapter 5). If we assume a water-filled porosity of 25%, then this means that the water front will move at 400 mm a^{-1} (2.5 years per metre) or equivalently, it will take 25 years to cross one 10 m layer. (one pore volume) or 125 years to pass through the entire 50 m sand column. The configuration is shown in Figure 12.9. A uniform dispersivity of 0.5 m and a diffusion coefficient of 10^{-9} m^2 s were also assumed.

The results of 2000 years of flushing are shown in Figure 12.10. The highly-contaminated horizon decreases in concentration from 905 μg L^{-1} to 125 μg L^{-1} in the first 200 years. The curve represents the classic desorption front and its shape is related to the differential of the desorption isotherm (Appelo and Postma, 1994). The dimensionless partition coefficient for As is 130 in the less contaminated layers and 35 in the high groundwater As layer.

As a result of the downward movement of As from the highly contaminated layer, the layer beneath it increases in As concentration from 45 to about 180 μg L^{-1} after 140 years. The lowest layer at 40–50 m increases more slowly and does not reach its maximum arsenic concentration until after about 400–500 years. It also takes longer to flush the As away from this deepest layer such that even and wells, as in a comprehensive hydrogeochemical contaminant transport model.

12.6 Is the Bengal Basin groundwater arsenic problem unique?

As described above, the release of arsenic is a natural geochemical process that appears to be a response to the burial of 'typical' alluvial and deltaic sediments. Peaks of porewater As concentrations a few centimetres thick are often found in sediments. Indeed, the release of phosphate and to a lesser extent arsenic following the establishment of anaerobic conditions has been known since the 1970's. Where the rate of sedimentation is especially large, as in the Atlantic shelf region off the Amazon delta (Sullivan and Aller, 1996), the depth of this high arsenic zone can be up to a metre in thickness.

The large size of the Bengal Basin delta region and the recent history of very rapid sediment accumulation means that there is an unusually large volume and thickness of young, reduced sediments undergoing the early stages of diagenesis. This appears to be when the arsenic is released. Because of the unusual thickness of such recent sediments, the probability of drawing water from a highly contaminated zone is relatively high. In smaller deltas, the water from high-As zones (peaks) will tend to be diluted with water from low-As zones and the groundwater problem will be correspondingly smaller.

For the reasons given above, large delta regions probably do face an increased risk of having a significant groundwater arsenic problem compared with small delta regions. This is ironic since many of these large deltas are amongst the most densely-populated regions in the world and they usually have highly productive and readily exploitable aquifers. However, given the present state of knowledge, groundwater from all recent alluvial aquifers and deltas regions of the world must be considered 'at risk' from arsenic contamination and need to be screened for arsenic if they are to be used for drinking water.

Arsenic contamination of groundwater is also very extensive in other non-delta areas with recent sediments (e.g. the Argentine Pampas) but the population density in these area is usually much smaller than in delta regions.

12.7 Summary

- The high correlation between arsenic and iron in Bangladesh sediments and the known strong sorption of As(V) and As(III) by iron(III) oxides suggests that these oxides play an important role in creating the high arsenic groundwaters in Bangladesh.
- Significant loadings of As(V) and As(III) occur on iron(III) oxides even at equilibrium concentrations of a few $\mu g\ L^{-1}$, a concentration which is probably characteristic of the concentration found in large rivers in Bangladesh. However, we could find no literature data for As concentrations in typical Bangladesh rivers.
- When sediment is buried, the oxidation of fresh organic matter rapidly leads to the development of anaerobic conditions and, we suspect, the release of arsenic.
- The precise mechanism of arsenic release is still unknown. It probably occurs by a variety of mechanisms including the reductive desorption of arsenic due to the transformation of As(V) to As(III), the reductive dissolution of iron oxides, and a change in surface structure and specific surface area of the iron oxides due to diagenetic reactions. We collectively describe all of these processes as the *iron oxide reduction hypothesis*. Arsenic release may also occur due to competition from other strongly bound anions such as phosphate, bicarbonate and silicate. Anything that causes an increase in the concentration of these anions is likely to lead to an additional desorption of arsenic.
- Desorption reactions rather than (congruent) dissolution reactions appear to be dominant although the two probably occur simultaneously in a process that can be called 'codissolution' - the reverse of coprecipitation.
- The As(V) and As(III) sorption isotherms for the oxidised (brown) and reduced (grey) sediments are not yet known and so it is not yet possible to calculate the arsenic transport properties of the sediments accurately. However, it appears that there must be a significant increase in arsenic mobility in the reduced sediments.
- The high solid solution ratio in aquifers means that immeasurably small changes in the amount of arsenic in the sediment can lead to a large change in the groundwater arsenic concentration. Total sediment arsenic concentrations are therefore not of themselves a reliable guide to the potential of a sediment to give a groundwater arsenic problem. This can occur with an average sediment containing only a few $mg\ kg^{-1}$ of arsenic.
- The low hydraulic gradients and the strongly stratified nature of the Bangladesh aquifers means that in the absence of pumping, the flushing of the released arsenic and other solutes is likely to be very slow. Although the calculations contain many uncertainties, this rate of flushing is unlikely to be helpful in improving the situation on a human timescale.
- Over many thousands of years, much of the arsenic will be flushed away and groundwater concentrations reduced. This may explain why high arsenic concentrations tend to be found mainly in relatively young sediments. Once equilibrium with the new groundwater environment has been achieved, there will be little need for the further release of arsenic.
- The generation of high arsenic groundwaters in Bangladesh is therefore believed to occur as a result of a natural geochemical processes that probably occur to some extent in all alluvial and deltaic sediments but are exacerbated in the Bay of Bengal because of the large volume of young sediments. All similarly exploited aquifers must be considered to be 'at risk' from arsenic contamination and, where they are exploited for drinking water, need to be tested for arsenic by random survey.

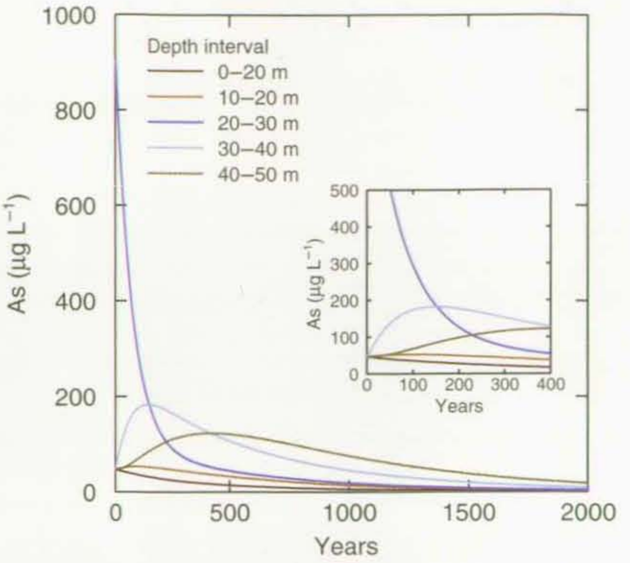

Figure 12.10. Simulated flushing of arsenic-rich groundwater from an Fe-rich layer at 20–30 m depth.The large groundwater arsenic concentration in that layer reflects the simulated effect of sediment diagenesis rather than an initially high level of sediment contamination. The inset shows a close-up of the early stages.

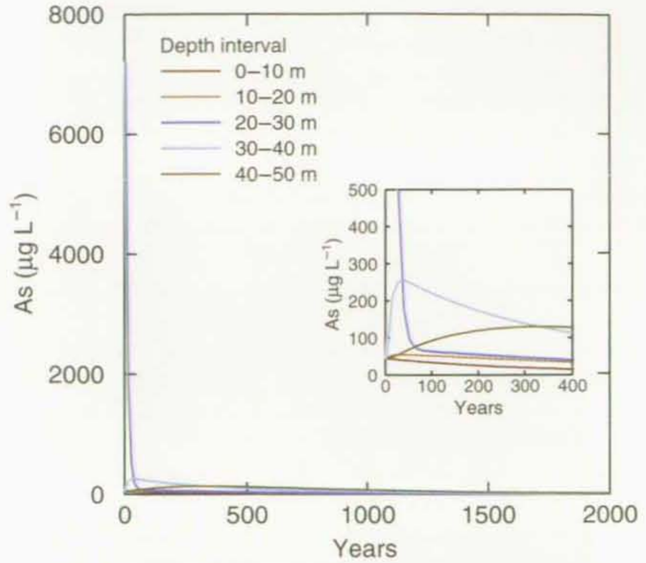

Figure 12.11. Simulated flushing of arsenic-rich groundwater from an Fe-rich layer at 20–30 m depth with very weak As(III) binding. Conditions are the same as in Figure 12.10 except that the As(III) binding constant has been reduced by an order of magnitude. The inset shows a close-up of the early stages.

after 2000 years and 160 pore volumes of 1 μg As L^{-1} water, the As concentration in this layer is still 17 μg As L^{-1}. By this time, the original heavily contaminated horizon has reduced to 3 μg As L^{-1}. The high-As horizon is high primarily because the As partition coefficient is low, not because it contained a lot of As. A corollary of this is that it is relatively easy to flush the arsenic from this horizon.

Arsenic is also slowly flushed from the top 20 m as the low-As 'river' water passes through these layers. The rate of reduction is slow and even after 1000 years, the As concentration in the top 10 m exceeds 10 μg L^{-1}. The arsenic from the top 10 m is leached to the 10–20 m layer and as a consequence, the As concentration in this layer reduces at an even slower rate.

Exactly the same simulation as above was then carried out with the only difference being that the affinity of arsenic(III) for the iron oxide in the contaminated horizon was decreased by a further factor of 10 ($\Delta \log K=-2$ from the original value). This could be because the oxide had undergone more diagenesis, for example. The dimensionless partition drops from 35 to 3.5 in the highly-contaminated layer. The total quantity of As in the system remains the same.

Reducing the strength of the arsenic binding induces a large desorption of As. This results in a corresponding greater initial peak As concentration of 7200 μg As L^{-1} in the contaminated layer (Figure 12.11). However, since this As is only very weakly bound, it is readily flushed out. After 75 years, the As concentration is below 70 μg As L^{-1}. It then remains close to that concentration for some time thereafter. The lower layer becomes the most contaminated layer as it receives the arsenic released from the higher layer.

These calculations highlight some of the features that can be expected to take place as arsenic is slowly leached from the Bangladesh sediments. In particular, it will be a period of slowly changing concentrations as the arsenic moves through the aquifer. The calculations highlight an important feature of the situation: are the variations in concentration due to changes in the total amount of As present or due to changes in binding affinity (or both)? Both can give rise to high concentrations of As in groundwater but their future evolution is quite different. The oxalate extracts suggest that variations in the amount of arsenic present are likely to be a factor.

While the above simulations are only indicative, i.e. they are completely dependent on the nature of the sorption isotherms assumed, they demonstrate several additional features: (i) during the natural flushing of the aquifer, some highly-contaminated areas will decrease in arsenic concentration while others will increase; (ii) the rate of change depends on the buffer capacity of the sediment and the distance from the contaminated region; (iii) the indicated timescales are long in human timescales, and (iv) the results are critically dependent on the adsorption isotherms and the rate of groundwater flow. These factors are themselves sensitive to many parameters and are subject to a great uncertainty at present. Therefore the timescales and concentrations observed above should not be taken to represent any particular situation in Bangladesh. Rather they should only be used to indicate the types of behaviour that might be expected, and perhaps more importantly, highlight what needs to be better understood before reliable predictions of arsenic transport in Bangladesh aquifers can be made.

More realistic simulations will also need to take into account the 3-D nature of the problem and include rivers

13 Conclusions and Recommendations

13.1 PRINCIPAL FINDINGS

Below we summarise the main findings from our study. A more detailed account can be found in the Summary volume of this report.

13.1.1 Scale of the groundwater arsenic problem

A nationwide survey was undertaken to estimate the regional scale of the groundwater arsenic problem in Bangladesh. All arsenic analyses were carried out in the BGS laboratories using sensitive and reliable instruments. The results from the 3534 wells sampled throughout Bangladesh (apart from the Chittagong Hill Tracts) showed that 27% of all shallow wells (<150 m depth) were contaminated with arsenic (As) above the Bangladesh standard (50 $\mu g\ L^{-1}$). This increases to 46% when the more stringent WHO guideline value (10 $\mu g\ L^{-1}$) is used. 9% of all sampled wells exceeded 200 $\mu g\ L^{-1}$ and 1.8% exceeded 500 $\mu g\ L^{-1}$.

Only 1% of 'deep' wells (depth >150 m) exceeded the Bangladesh standard and 5% exceeded the WHO guideline value. This contrasts sharply with the statistics from the shallower aquifers. However, it must be remembered that most of the deep wells sampled were from only a small part of Bangladesh – the southern coastal region where salinity in the shallow wells is a problem, and from the Sylhet region in the north-east where there is no suitable aquifer at shallower depths. Recent data from DPHE tend to confirm this observation in other parts of Bangladesh but there is clearly a need for a more systematic study of the deep aquifer.

The population exposed to drinking water in excess of the Bangladesh arsenic standard was estimated in two slightly different ways: one estimate gave a population of about 35 million and the other gave an estimate of 28 million. These figures increase to some 57 and 46 million people, respectively, when the WHO guideline value is used. We have not been able to place reliable error estimates on these figures but believe that the larger of the two estimates is probably more representative. The total number of tubewells in Bangladesh is not known for certain but is believed to be in the range 6–11 million. The large majority of these are private wells.

A very large range of As concentrations is found in Bangladesh – from less than 0.25 $\mu g\ L^{-1}$ to more than 2000 $\mu g\ L^{-1}$. The severity of the problem varies over the country and is strongly related to geology. Only the young alluvial and deltaic Holocene sediments are affected – no contamination was found in the older Plio-Pleistocene aquifers of the Barind and Madhupur Tracts, and little in the alluvial fan deposits in the north and north-west. The most highly contaminated areas are found to the south and south-east of Bangladesh in an area centered around Chandpur District. Some 90% of sampled wells in Chandpur District were contaminated according to the Bangladesh standard and practically all were greater than the WHO guideline value.

Seven deep wells from Dhaka city were sampled – these abstract their water from the old Dupi Tila aquifer of the Madhupur Tract and had very low As concentrations (all below the instrumental detection limit of 0.25 $\mu g\ L^{-1}$).

8 of the 61 districts sampled had no samples exceeding the Bangladesh standard for As – these came from the extreme north-west of Bangladesh and from the southern coastal area where deep wells predominate. All districts except Thakurgaon had at least one sampled well exceeding the WHO guideline value for As.

13.1.2 Spatial variability of arsenic contamination

Within the overall trends dictated by the geology described above, there is very large amount of spatial variability. Much of this is very localised. Some 40% of the variation (in log terms) found over the whole country occurs within distances of about 2 km. Neighbouring wells within a village can have quite different concentrations of As (and other water quality parameters). This reflects the large amount of local variation in sediment characteristics and hydrogeological regimes, both laterally and vertically. A considerable amount of vertical variation in sediment characteristics is observed, often on a scale of centimetres, when undisturbed core material is examined in detail. The corresponding change in pore water chemistry is not known but could be similarly variable.

Dissolved arsenic concentrations vary with depth but not in a simple or predictable way. The two generalisations that seem to be valid are that very shallow wells (within say 5 m of the water table) tend to have quite low As concentrations and as discussed above, deep wells (greater than 150 m total depth) tend to have very low arsenic concentrations. It appears that there is therefore often something like a bell-shaped arsenic-depth curve with variable concentrations in the widely exploited intermediate depth range (around 15–150 m). These observations are derived from an analysis of wells at different locations but are consistent with our piezometer measurements where various depths were sampled at the same location (within a few metres). From our limited experience and that of others, hand-dug wells also invariably have low As concentrations even in highly contaminated areas. This probably reflects additional geochemical factors coming into play (see below).

As a consequence of the spatial variation, described above, all drinking water wells developed in the shallow Holocene aquifer (usually grey sands) must be considered 'at risk' from As contamination and need to be tested if they are to be used for drinking water.

13.1.3 Other water quality issues

Table 13.1 summarises the statistics for the exceedances of various inorganic parameters measured in this study. It is clear that arsenic is not the only groundwater problem, although it is undoubtedly the most serious. Manganese is also a serious problem in terms of the number and scale of exceedances. However, the chronic toxicity of Mn in drinking water at the concentrations observed is not well understood. The U.S. Environmental Protection Agency (USEPA) does not include Mn in its primary (health-related) drinking water standards although it does gives it a limit of 0.05 mg L^{-1} in its secondary (aesthetic and cosmetic) standards.

Arsenic and manganese are not highly correlated and so there are some wells that fail on the arsenic criterion and some that fail on the manganese criterion. Only 33% of shallow wells complied with both the WHO guideline values for arsenic and manganese.

Uranium and to a lesser extent boron show some health-related exceedances as do some of the other trace elements. The USEPA has proposed a maximum contaminant level (MCL) of 20 μg L^{-1}, equivalent to an activity of 30 pCi L^{-1}, for uranium in drinking water. This is ten times greater (less strict) than the provisional WHO guideline value.

Iron, ammonium and sodium (salinity) are present at undesirably high concentrations in many wells but are not thought to be a risk to human health. There are no data for mercury – this needs to be measured at a random selection of wells (taking appropriate precautions to avoid loss).

There needs to be a long-term policy decision for dealing with these other non-compliances. Lower than desirable concentrations of fluoride and iodide are found in some groundwaters, especially in the north of Bangladesh.

We have not looked for possible pesticide contamination. Pesticides are widely used in Bangladesh and a random reconnaissance survey of shallow wells should be undertaken to establish the potential scale of any problem. We have also not measured the concentration of radioactive elements such as radium.

13.1.4 Source of the arsenic

There is no doubt that the source of the As is natural, i.e. derived from 'ordinary' sediments by natural geochemical processes. The quantity of As present in groundwater (and adsorbed by the sediments) is simply too large to be derived from a discrete pollution source. Also its distribution across Bangladesh and West Bengal and with depth does not tally with a pollution source. There is also no need to postulate exceptional sources such as a particular mineralised area in the upstream catchment, as some workers have done for neighbouring West Bengal (Acharyya et al., 1999), although of course such areas may exist. This is one of the lessons that needs to be learned from the Bangladesh arsenic problem.

There is more than enough arsenic in most sediments to give rise to an As problem given the appropriate geochemical conditions for release and mobilisation. If all of the arsenic in a sediment containing 1 mg As kg^{-1} sediment dissolves in the groundwater, then the arsenic concentration in the groundwater would be 6000 μg L^{-1} or more, way above all drinking-water standards. Both the average world and typical Bangladesh sediments contain several times this amount of arsenic. In other words, Bangladesh sediments do not appear to contain an exceptional amount of arsenic *in total* yet give rise to exceptionally large groundwater arsenic concentrations. The high solid/solution ratio in aquifers and the great toxicity of arsenic mean that the contamination of groundwaters is sensitive to an imperceptible shift in the speciation of arsenic. A change of only a few per cent in the partitioning of arsenic between sediment and water is sufficient to give rise to a significant groundwater arsenic problem.

This is not to say that all sediments are equally likely to give rise to a groundwater As problem, or that Bangladesh sediments do not have some properties that make them particularly strong candidates for such problems. The greatest concentrations of As, along with many other elements, are associated with the fine-grained materials and these could therefore be a potential source of As. Fine-grained materials are found not only in fine-grained (non-aquifer) horizons, particularly clay horizons, but also to a lesser degree in the coarser, sandy horizons (aquifers). It may be that the concentration of fine-grained iron oxides in the coarse sediments is one of the important factors controlling the development of the groundwater As problem in Bangladesh and elsewhere.

There is also often a good correlation between the iron content of the sediment and its arsenic content. While iron is found in both iron oxides and iron sulphides, the low sulphur content of most Bangladesh sediments indicates that the dominant source of iron in these sediments is the oxides not sulphides. The structure of the iron oxides, the location of As on or within the oxides, and the binding strength for the surface-bound As are also important, i.e. the lability of the As.

It does appear, as a tentative generalisation from the small number of Bangladesh sediments studied in this project, that the higher the concentration of iron oxides in the sediments, the greater the likelihood of a groundwater As problem. This is consistent with the iron oxide reduction hypothesis in which the iron oxides are the principal source of released arsenic. This difference in iron oxide abundance appears to be an important reason for the greater prevalence of As in groundwaters from south-eastern Bangladesh compared with northern Bangladesh.

Somewhat confusingly, there is not necessarily a direct relationship between the As content of various sediments and the As concentrations in groundwaters in contact with such sediments – there may be other controlling factors. The mere presence of a good correlation between iron oxides and arsenic is also not by itself sufficient to indicate that the oxides are the dominant source of arsenic – the reverse could equally be argued, i.e. it could be that they are a sink. In practice, iron oxides buffer the arsenic concentration in the sediment pore waters and are both sources and sinks of As – they can both adsorb As and release it depending on the solution concentration and the surface loading with As as given by the sorption isotherm.

The concentration of iron in groundwater, and hence the extent of reductive dissolution, is also not necessarily directly related to the iron oxide content of the sediments.

Table 13.1. Exceedances of various inorganic chemicals observed in the DPHE/BGS National Hydrochemical Survey*

Parameter	Chemical symbol	WHO guideline maximum value (mg L^{-1})	Bangla-desh standard (mg L^{-1})	% exceedance Shallow aquifer		% exceedance Deep aquifer		Comments
				WHO GV	Bangladesh standard	WHO GV	Bangladesh standard	
Chemicals of health significance								
Antimony	Sb	0.005 (P)	–	–	–	–	–	Not measured in NHS. SS data suggest not a problem
Arsenic	As	0.01 (P)	0.05	46	27	4.6	0.9	Serious problem
Barium	Ba	0.7	0.1?	0.2	28	1.2	26	Occasional problem according to WHO guideline
Beryllium	Be	NAD	–	–	–	–	–	Not measured in NHS. Rarely detected in SS (always <0.1 μg L^{-1})
Boron	B	0.5 (P)	1.0	2.8	0.4	29	8	Occasional problem especially in more saline waters
Cadmium	Cd	–	–	–	–	–	–	NHS data not sensitive enough. SS data showed no exceedances
Chromium	Cr	0.05 (P)	0.05	0.2	0.2	<1	<1	SS confirms essentially no problem
Copper	Cu	2 (P)	1	0	0	0	0	SS confirms no problem
Fluoride	F	1.5	1	–	–	–	–	SS and BWDB indicates if anything, too low especially in NW
Lead	Pb	0.01	0.05	–	–	–	–	NHS data not sensitive enough. Results from SS suggest not a problem
Manganese	Mn	0.5 (P)	0.1	39	79	2	22	Widespread exceedances sometimes of large magnitude
Molybdenum	Mo	0.07	–	–	–	–	–	NHS data not sensitive enough. Results from SS suggests not a problem
Mercury	Hg	0.001	–	–	–	–	–	Not measured
Nickel	Ni	0.02 (P)	0.1	6	0.1	0.9	0.3	Rare problem. Not exceeded in SS.
Nitrate	NO_3	50	10	–	–	–	–	Not measured in NHS but SS indicates very low in most groundwaters. Greatest problem likely in shallow, polluted wells
Selenium	Se	0.01	0.01	–	–	–	–	Not measured in NHS but 20 samples were all <0.0005 mg L^{-1}
Uranium	U	0.002 (P)	–	–	–	–	–	Not measured in NHS but results from SS suggest a significant exceedance especially in more oxidising waters
Substances that may give rise to complaints by consumers								
Aluminium	Al	0.2	0.2	1.7	1.7	6	6	Normally below 0.1 mg L^{-1}
Ammonia	NH_3	1.5	–	–	–	–	–	Frequent exceedances
Iron	Fe	0.3	0.3–1.0	68	55	32	15	Frequent exceedances
Potassium	K	10	12	10	8	4	2	Occasional problem especially in southern Bangladesh
Sodium	Na	200	200	8.5	8.5	49	49	Serious problem in coastal areas
Zinc	Zn	3	5	0	0	0.3	0.3	Not a serious problem

* See Chapter 6, *The National Hydrochemical Survey* and Volume 3, the *Hydrochemical atlas* for details.

– means no reliable data.

(P) – The Provisional guideline maximum value. This term is used for constituents for which there is some evidence of a potential hazard but where the available information on health effects is limited; or where an uncertainty factor greater than 1000 has been used in the derivation of the tolerable daily intake (TDI). Provisional guideline values are also recommended: (1) for substances for which the calculated guideline value would be below the practical quantification level, or below the level that can be achieved through practical treatment methods; or (2) where disinfection is likely to result in the guideline value being exceeded.

NAD – No adequate data to permit recommendation of a health-based guideline value.

NHS – DPHE/BGS National Hydrochemical Survey

SS – Detailed results from Special Study Areas survey (3 *upazilas*) carried out in this study (see Chapter 7, *Hydrogeochemistry of three Special Study Areas*).

Other factors such as the supply of reductants, the extent of microbial activity and the concentrations of other solutes are also important. The argument for oxides being a source term becomes stronger if diagenetic changes to the oxide structure are important since this provides a direct relationship between the amount of iron oxide in a sediment and the amount of arsenic released into the sediment pore water. These factors are not well understood.

It is not yet clear whether the arsenic presently abstracted in groundwater has moved from an area of fine-grained high-As sediments (which are not normally part of the screened interval) or whether it has been derived directly from the screened sandy horizons. Insufficient is known about the movement of As between the various horizons in Bangladesh aquifers to answer this point. We suspect that in some cases there has been movement, particularly close to the surface, but that this is not necessarily generally so. The fine-grained horizons will tend to be naturally protected from rapid leaching by their low permeability. Diffusion processes will be important over the longer term.

It is difficult to derive detailed mechanisms of geochemical processes from field data alone, especially from general survey data. There are simply too many correlated variables and the natural variability provides a blanket of 'noise' which obscures the underlying relationships. The processes involved need to be studied in detail both in the field and in the laboratory.

Furthermore, the natural process of chromatographic separation during groundwater flow means that the various products of geochemical reactions will become spatially separated with time. This 'uncorrelates' the chemistry and obscures the nature of the release mechanisms involved, thereby greatly complicating simple interpretations of groundwater-quality variations.

Once released from the sediment, the arsenic will be slowly flushed away ultimately emerging in a river (to be re-oxidised and re-adsorbed by the river sediments) or to emerge from the sea-bed in the Bay of Bengal. The extremely low relief in Bangladesh leads to very slow rates of groundwater movement, especially at depth which means that this flushing will take thousands of years to take place – this is not long on the geological timescale, many aquifers in the world consist of sediments that are millions of years old. Limited evidence from groundwater 'dating' techniques confirms the relatively old age of the deeper groundwater, especially in south-east Bangladesh, and hydrogeological calculations suggest that it could take several thousand years for the shallow aquifer to be flushed once. It will probably take many pore volumes of fresh water to pass through the aquifer before the As is completely flushed out – this depends on the nature of the As sorption isotherms which are presently largely unknown. The rate of flushing during the last glacial period would have been much faster than at present and may account in part for the very low As concentrations found in older sediments.

13.1.5 Changes with time

There are very few reliable data for the changes of As concentration with time. Changes can be expected at various scales from hourly to decades and longer. Some of these can be expected to be fluctuating, others will show systematic trends reflecting the various geochemical and hydrogeological processes involved. The extent of these changes is expected to vary with location, including the depth of the well, and the depth to the water table and redox boundary and the location of highly contaminated zones. In general, the deeper the well, the smaller the likely variation with time. There is an urgent need for a long-term monitoring programme to be set up and maintained in Bangladesh. This should examine all the timescales of variation since they all have important implications – both for field testing and for long-term water resources planning;

This project installed sets of closely-spaced piezometers terminated at different depths in our three Special Study Areas. In these, water level and water quality were monitored every two weeks for up to one year. There was some variation in As concentrations, and other water quality parameters, but usually not that much and none that we could confidently say was a real reflection of changes in the aquifer with time. We experienced some difficulties in ensuring adequate quality control in sample collection and analysis. This monitoring should be continued with additional safeguards.

13.1.6 Broader consequences

The finding of high As concentrations in groundwaters from the Bengal Basin raises questions about the As concentration in groundwaters from other delta regions in the world. This is especially true if, as we believe, the contamination is entirely natural and does not require exceptional concentrations of As in the sediments. The scientific literature contains many references to enhanced pore water concentrations of As (and related P) from river, lake and ocean sediments. These are usually seen as small peaks in concentration a matter of a few centimetres or tens of centimetres below the water-sediment interface, and are usually associated with the onset of reducing conditions and iron oxide dissolution.

The geochemical processes therefore appear to be widespread but their scale is very variable. Historically, the rate of sedimentation in the Bay of Bengal is amongst the highest in the world, and the volume of young sediments is therefore correspondingly large (as is the degree of exploitation of the aquifers). Since it is in young sediments where the arsenic problems are greatest, the scale of the problem in Bangladesh is also likely to be exceptional in scale. All similar delta regions where groundwater is used for drinking water therefore need to be tested for As as a matter of some urgency.

13.2 GROUNDWATER TESTING FOR ARSENIC

13.2.1 The mitigation strategy

The scale of the arsenic problem in Bangladesh is clearly very large, as is now widely acknowledged. A detailed discussion of many of the issues involved is given in WaterAid (2000b). The fact that not all wells have yet been systematically tested should not delay rapid action to supply low-As water to all affected localities (Smith et al., 2000). Future testing should be clearly focused on helping the mitigation effort, i.e. solving the problem, not documenting it.

The arsenic map of Bangladesh shows that there are clear regional differences in the extent of contamination and that these differences are dictated to a considerable extent by the underlying geology. The aquifers derived from older sediments of the Barind and Madhupur Tracts and deeper aquifers more generally do not appear to have a serious arsenic problem, at least at present. It is the aquifers derived from 'shallow' young, grey (reducing) sediments that give rise to most of the problematic groundwaters.

As a consequence of the high degree of short-range spatial variability in As concentrations, all wells in the 'at risk' aquifers identified above need to be tested for arsenic if they are used for drinking water. This is a mammoth task and presents severe technical, institutional and social challenges. The scale of such testing is likely to be feasible only by using field-test kits.

There are many possible approaches to arsenic mitigation and difficult decisions need to be made and acted upon. For example, there needs to be an acceptable balance between further testing and the provision of safe drinking water. It may be decided that in areas known to be highly contaminated, there is no need to test all wells immediately but that the resources would be better applied to the provision of safe drinking water for all as rapidly as possible. On the other hand, to ignore the presence of acceptable low-arsenic wells in a contaminated area might be counterproductive.

This testing is presently being coordinated by The Bangladesh Arsenic Mitigation Water Supply Programme (BAMWSP, www.bamwsp.org) with others, including DPHE, UNICEF, WHO and many NGO's, being actively involved (WaterAid, 2000b). Implementing a mitigation strategy involves many difficult decisions and is a massive task in terms of organisation. All strategies face some risk since there is no precedent for a response of the magnitude required. Sharing of non-contaminated wells is one emergency option. Locating all small, localised arsenic hot spots in northern Bangladesh also poses a problem (although not a high-priority one).

A top priority in any case must be to locate as many As-affected patients as rapidly as possible through mass awareness and screening campaigns. Once a patient is identified and a decision made about the best option for the provision of safe drinking water, then a follow-up testing programme around the patients' home could be carried out to indicate the scale of the local problem. Such a patient identification approach would not pick up some badly-affected areas, e.g. in the south-east, where there are few patients but considerable contamination. However, these areas have now been quite well identified and action should be taken there anyway.

Much depends on the willingness of the people to alter their way of life, probably in a way that will involve significantly more work, particularly for women. Tubewells are popular because they are convenient (in the absence of a distributed water supply). This situation is made all the more difficult by the complete absence of obvious, visible signs of arsenic poisoning in some of the highly contaminated areas. Often the water looks good and tastes good, and nobody seems to be suffering, yet. There is therefore a credibility problem.

While the arsenic problem is likely to be the most serious in terms of its possible health impact, there are other causes of concern too, particularly of manganese which frequently exceeds both the Bangladesh drinking water standard and the WHO guideline value. The long-term mitigation effort must consider all possible threats not just that of arsenic. This could affect the relative merits of different arsenic mitigation strategies.

13.2.2 Field-test kits

The 1997 DPHE-UNICEF survey used field-test kits to provide the first nationwide view of the extent of arsenic contamination in Bangladesh. The recognised shortcomings in the reliability of the field test-kits used were offset to some extent by the large number of tests undertaken. The regional pattern was clear and has been largely confirmed by subsequent testing. This was a good use of these field-test kits. Compliance testing of individual wells is more demanding since breaching a national standard in a public water supply is particularly serious given the number of people affected (and the potential political fallout) while condemning a privately-owned well from use is also a serious step to take.

The reliability of the test kits for this type of testing is therefore of greater importance than in regional reconnaissance surveys. It is also significant that the arsenic concentration in water from many of the wells (not just a few) in Bangladesh lies close to the present Bangladesh standard. This means that if a two-way classification is used (fit and not fit) many wells will be 'misclassified' or their classification may genuinely change from day to day. This is not necessarily important from a health point of view but may lead to confusion when the public understanding of risk is so poor.

While doing anything is probably better than doing nothing, we think that a field-test kit specification with a detection limit of 5–10 $\mu g\ L^{-1}$ is highly desirable and in principle now possible. By 'reliable' we suggest that a determination should give results within ±20% of the true value or $\pm 5\ \mu g\ L^{-1}$ (whichever is the greater), 95% of the time. Development of the kits should proceed in parallel with the overall mitigation effort and need not delay it. The kit should also be robust and simple to use so that it can withstand the rigours of continuous use in Bangladesh and elsewhere. Ideally the kits should be able to be manufactured in Bangladesh and sold in the local markets along with their chemicals. These would have to be of high purity. One-off and recurrent costs are also important. The kit should obviously work well in the region of 50 $\mu g\ L^{-1}$. The development and mass production of such a kit is an important technical challenge posed by the Bangladesh arsenic problem. WaterAid (2000b) lists all of the test kits presently available in Bangladesh. The latest generation of kits is looking much more promising. The better kits no longer give just a 'yes'/'no' response but are semi-quantitative.

Hach (USA) have recently introduced a field-test kit for arsenic with gradations at 0, 10, 30, 50, 70, 300, and 500 $\mu g\ L^{-1}$. A small modification allows testing down to

5 µg L^{-1}. This is a significant improvement on earlier kits but the kit requires 5 separate chemicals to be added and is quite slow. We believe that a cut-down version (3 chemicals) is also being developed. The Hach kit minimises exposure to toxic arsine gas and in the full kit, a reagent has been added to remove the interference of up to 5 mg L^{-1} H_2S. The cost of the kit is $95 (October 2000) for 100 tests (US delivery) and $75 for a 100 test replacement reagent set, i.e. about $0.50–1.00 per test (a shallow tubewell costs something like $100 to install). Many of the latest improvements are in design rather than in additional costly hardware, e.g. greater sensitivity by concentrating the arsine gas onto a smaller area of filter paper, greater precision by improving the stability of the gas flow and the reproducibility of the gas-filter paper interaction.

The arsine generator with the latest 'Arsenator' gives a coloured spot on a small disk of filter paper. This can be read by eye down to 5 µg L^{-1}. If the calculator-style reader (PeCo75) is used to read the 'colour', the minimum reported concentration is reduced to 1 µg L^{-1}. Larger concentrations are reported in 1 µg L^{-1} increments. This small instrument, manufactured by Peter's Engineering, Graz, Austria (peters.engineering@styria.com) and currently having a price of about $800, is likely to be more suitable for field testing than the larger Arsenator that we used in Mandari. This also is significant progress.

One advantage of the greater sensitivity and reliability of this new generation of kits is that the improved data would also inform planners of the likely impact of changing the Bangladesh standard to a lower value, the present WHO guideline value, for example. If Bangladesh ever decided to adopt such a new standard, retesting of already tested wells would then not need to be undertaken. It is also desirable that laboratory retesting is reduced to a minimum, i.e. only sufficient to maintain adequate QA.

13.2.3 Priorities for screening and mitigation

Approach to mitigation

The challenge of the arsenic mitigation programme should be to reduce the cumulative intake of arsenic by the population of Bangladesh as a whole as rapidly as possible. In the sense that people in the most contaminated areas will have the shortest latency period before symptoms develop and that solving their problems would be the most rapid way of reducing the total intake of arsenic by the population at large, they should be given the highest priority. Priority in the mitigation should therefore be given to the badly-affected areas identified in the south and east of Bangladesh. At a regional level, the resources for such a short-term programme should be allocated according to the severity of the problem, based for example on the percentage of wells in a district that are affected, or on the average arsenic concentration in the area, or on the probability that the water quality standard in the area will be exceeded.

Exactly how this is done must be left to the health and water-supply professionals but mass awareness must be a key part of any programme (as it is). While there is a danger of overreaction if the severity of the situation is communicated, equally there is a danger of complacency if it is not. It is difficult to appreciate the dangers when the water is so clean and clear, when people around you are not obviously suffering and when the more tangible and immediate benefits of tubewell water are so great. We would stress three key messages: (i) warning of the danger – everyone should be aware of the first signs of arsenic poisoning and should know where to go for diagnosis and treatment. It should be stressed that the absence of visible symptoms does not mean that all is well, that sometimes the damage is internal and not visible, that it may take many years before symptoms do develop and that the damage once done may be irreversible; (ii) tubewell water can still be used for washing etc but not for drinking or cooking. There should be clear advice on how to obtain safe drinking water; (iii) the drilling of all new tubewells in the shallow aquifer throughout Bangladesh should cease, even of private wells. Individuals should be encouraged to save their money until a better long-term option can be recommended.

A blanket screening of all *upazilas* is likely to dilute the effort required in the worst-affected areas and so will delay helping the most needy. The regional patterns shown by our national survey and the large DPHE-UNICEF field-test kit survey are likely to be sufficiently robust to be used in setting the priority areas. A precise knowledge of the percentage contamination in individual unions or *upazilas* is not necessary in order to implement such a programme. The overall picture is already clear enough.

In the absence of any reliable information on the long-term changes in arsenic concentrations with time, the best assumption for planning purposes is that the present distribution of contaminated wells will not change appreciably in the short term (in a systematic sense). The priority should therefore be to cover the whole of Bangladesh once, starting with the worst-affected areas, before remeasuring wells as some have suggested. Such remeasurements are likely to confound the picture and lead to delays. Once the initial screening programme has been completed, and some decisions made about the long-term solutions, the necessity for remeasurement and more regular monitoring can be reassessed. The arsenic concentration in Bangladesh groundwaters varies by more than four orders of magnitude. This is far greater than any time trends are ever likely to be.

Short-term (emergency) programme

Smith et al. (2000) have discussed a mitigation strategy for Bangladesh in a clear and rational way. They suggested that:

- the arsenic problem should be declared a public health emergency to facilitate the rapid allocation of funding and the prompt expansion of interventions;
- all cases of arsenicosis should be identified;
- in affected areas, an immediate interim source of 'arsenic-free' water should be identified and the implementation of a long-term solution begun;
- patients' progress should be monitored and the continued use of the interim source of water ensured until the long-term source becomes available;

- care for patients should be provided, including vitamin supplementation, lotions for patients with keratoses and treatment of infections.

They also suggested four possible short-term responses:

(i) identify nearby safe tubewells;

(ii) provide a water filter (e.g. a candle filter) for each household;

(iii) provide chemicals to be used daily to remove arsenic from drinking water;

(iv) use surface water treated by filtration and chlorination.

They also suggested that highly contaminated wells should be closed once an alternative temporary source has been identified. There is no point in even attempting to treat the most contaminated wells.

Smith et al. (2000) also stated strongly that delaying action in order to be thorough in research and long-term planning can be a mistake. Compared with many other public health issues like malaria, cholera and tuberculosis, the solution to the arsenic problem is relatively clear cut. The challenge is to replicate a strategy such as that outlined above over the whole of Bangladesh and in a timely manner.

It can also be argued that a random survey of a small number of wells in all mouzas should be undertaken in order to locate possible 'hot spots' in otherwise less contaminated areas. At present, many of the worst hot spots have now probably been located as a result of patient identification and follow-up screening but there must be others somewhat less highly contaminated that will need to be found eventually. However, this should not be allowed to detract from the rapid implementation of the mitigation programme in the highly contaminated regions of the south of Bangladesh which have already been clearly identified.

Long-term programme

Household treatment is not ideal as a long-term solution. It would therefore seem preferable if the long-term drinking water supply does not require arsenic removal. There are four possible sources of low-arsenic water in Bangladesh:

(i) rainwater;

(ii) treated surface (river or pond) water;

(iii) dug well water;

(iv) deep tubewell water.

These options need to be evaluated thoroughly not just in terms of arsenic but in terms of all water quality parameters, including bacteriological quality. Socio-economic factors are also important of course. Not all options are available everywhere and so a single solution is unlikely.

13.3 USE OF DUG WELLS

Our data from a limited number of sites in western Bangladesh indicate that As concentrations in dug wells are usually low at around 10 $\mu g\ L^{-1}$ or less, i.e. they normally comply with the WHO guideline value and invariably with the 50 $\mu g\ L^{-1}$ Bangladesh standard.

Our data are mostly for filtered waters and therefore represent minimal values if particulate matter is present in the water. However, our data for two unfiltered dug well samples did not show a large increase above the filtered samples. Larger particles can be easily filtered out using traditional methods.

Since traditional, large-diameter dug wells in Bangladesh are normally open to the atmosphere and tap the shallowest parts of the aquifer, they are particularly vulnerable to contamination from bacteria and other surface-derived pollutants. Data from our Special Study Areas also indicate that dug well waters contain relatively high concentrations of uranium (up to 47 $\mu g\ L^{-1}$ in Chapai Nawabganj). Iron concentrations are usually very low in dug well water; manganese concentrations are often low but not necessarily so.

In view of the possible sensitivity of water-quality parameters including arsenic, uranium and nitrogen species to redox status, it is possible that the specific method of dug well construction could significantly influence water quality, e.g. traditional brick-lined dug wells vs modern concrete-lined 'ring' wells. Subtle changes in the design might be able to give improved water quality by changing the aeration and sanitary protection.

If the benefits of low As water mean that dug wells are to be used as part of the mitigation programme, care needs to be taken that these are constructed to a high standard including the appropriate sanitary seals. A hand pump should be fitted. It may also be necessary to disinfect the water.

Certainly the concentration of arsenic in dug wells is likely to vary with time for all sorts of reasons – they are necessarily close to a fluctuating water table, for example. However, this should not detract from the overwhelming evidence to date from both Bangladesh and West Bengal that in arsenic-contaminated areas, the water from dug wells is normally of substantially better quality in terms of arsenic than water from adjacent shallow tubewells.

As far as we are aware, nobody has studied the effect of continuous abstraction of water from dug wells on the arsenic concentrations in the waters and this deserves study. In practice, the yield of water available from dug wells is quite limited. Hence dewatering is likely to be the factor limiting the productivity of dug wells.

Dug wells do offer a possible water-supply option particularly for those areas where the other options are limited. As far back as 1997 in Chapai Nawabganj, DPHE moved a hand pump tubewell a few metres from a highly contaminated tubewell (more than 2000 $\mu g\ L^{-1}$) to an existing adjacent low-As dug well with immediate benefit to the users.

13.4 USE OF DEEP TUBEWELLS

Our data, and that of others, show that deep groundwaters usually have low concentrations of As (and other detrimental trace elements). The As concentrations are usually less than 1 $\mu g\ L^{-1}$ and would therefore comply with all existing national standards and the WHO guideline value.

Deep tubewells may therefore form useful alternative safe water sources, where deep aquifers exist. Only 2% of the deep wells sampled in our national survey exceeded the WHO guideline value for manganese (0.5 mg L^{-1}) whereas 39% of shallow wells did. However, our deep well data were from the SW and SE coastal districts of Bangladesh (Barisal, Sylhet, Lakshmipur, Faridpur, Khulna, Satkhira, Bagerhat, Patuakhali, Pirojpur, Bhola and Barguna) and from parts of Sylhet and Faridpur.

More surveys need to be carried out in the deep aquifers to test whether this is a general characteristic. Also, modelling needs to be used to test the possible impacts of long- and medium-term seasonal drawdown of high-As groundwater from shallow levels following increased abstraction of deep groundwaters. A basic hydrogeological resource assessment needs to be undertaken to assess the long-term sustainability of the deep aquifer, i.e. over the next 50 years, by which time the population of Bangladesh is estimated to be 230 million. It is clear that if the deep aquifer is to be extensively exploited, an aquifer protection strategy needs to be devised and implemented. This should include its possible exploitation for both drinking water and irrigation water. Some form of licensing may need to be introduced.

Some of the exploratory deep boreholes recently drilled by DPHE have shown salinity at depth. These were found as far north as Manikganj and Munshiganj. Therefore not all deep groundwater may be of potable quality. There is also considerable concern that extensive exploitation of the deep groundwater in southern Bangladesh may induce greater saline intrusion in the southern coastal belt where fresh groundwater is at a premium.

13.5 IN-SITU ARSENIC REMOVAL

13.5.1 Principles

The subsurface removal of As has obvious attractions and has been successfully used elsewhere in the world. It is usually linked to some form of artificial recharge. Two approaches are possible for the in situ removal of As in high-permeability aquifers. Both rely on microbiological reactions:

Oxidation of the groundwaters in situ

This relies on the strong adsorption of As (especially As(V)) by iron(III) oxides that are formed when reduced, near-neutral sediments and groundwaters are oxidised. The oxidation can be brought about by the injection of air or an oxidising agent such as hydrogen peroxide. The reaction is mediated by microorganisms.

In the Vyredox approach (Hallberg and Martinelli, 1976) developed in Finland for the in situ removal of iron and manganese from groundwater, a ring of wells injects aerated water around a central supply well. The water has to be degassed before injection. The iron precipitates in the outer part of the aquifer furthest from the supply well and then the manganese precipitates closer to the supply well. Clogging of the aquifer is not normally a serious problem in the life-time of the plant. It takes an induction period before the system works efficiently.

A Vyredox-type system is quite sophisticated and in its normal design is unlikely to be appropriate for rural Bangladesh. However, there are simpler approaches involving gravity infiltration which may be adaptable to local conditions. Experiments of this nature have been carried out in West Bengal with some success (CGWB, 1999).

If a sulphide-rich horizon is oxidised, then there will be release of significant amounts of sulphate which in extreme cases could exceed water-quality standards. There will also be a release of arsenic but this will be partially readsorbed by the precipitated iron oxides. Some acidity will also be released. This will react with dissolved bicarbonate, and free solid carbonates if present, and in most Bangladesh situations should not result in a large pH change.

This approach would need the input of large amounts of oxidants to effect a redox change as oxidation of both dissolved and particularly exchangeable and solid constituents (Fe^{2+}) is needed. Such systems have now been successfully modelled (Appelo et al., 1999).

Sulphate reduction

Precipitation of sulphides, particularly iron sulphides, will tend to coprecipitate As and other elements and thereby reduce groundwater As concentrations. The reaction is mediated by microorganisms and is the subject of ongoing research (J. Saunders, personal communication, 2000). In most of the high-As areas in Bangladesh where the method would be most useful, there is insufficient native sulphate present in the groundwater to work unamended.

Sulphate would therefore need to be added in dissolved form using some kind of bed infiltration or lagoon. $CaSO_4$ seems the best form of sulphate to add. This would lead to the generation of iron sulphides (eventually pyrite) in situ in a manner that is somewhat analogous to the natural reduction process that occurs after saline intrusion.

13.6 PASSIVE SEDIMENTATION

It is common in Bangladesh to allow the Fe in high-Fe waters to settle out overnight following air oxidation. This removes excessive Fe and will also incidentally remove some As, Mn and phosphate by adsorption and coprecipitation. The amount of As removed will depend on many factors such as the pH of the water and the amount of As present and its speciation as well as the amounts of Fe, phosphate, bicarbonate, silicate, calcium etc. in the water. The median concentration of Fe in As-contaminated (>50 µg L^{-1}) groundwaters from the NHS was 4.1 mg L^{-1}. Time, and the efficiency with which the flocs are separated may also be important.

13.6.1 Short-term settling

An analysis of Chapai Nawabganj groundwaters left to stand in the open air for periods of up to 30 hours was carried out in order to investigate the efficacy of the passive sedimentation approach. Samples were collected from boreholes at three sites: Rahaichar 1 and 2 and Goalpara. Groundwater from Rahaichar 2 was visibly cloudy (iron-oxide particles) on pumping but that from the other two

Table 13.2. Temporal variations in chemical composition of three water samples from Chapai Nawabganj after standing in a container open to air for various times

Time hours	$As_{T\ filt}$ µg L^{-1}	$As(III)_{filt}$ µg L^{-1}	$As_{T\ unfilt}$ µg L^{-1}	$As(III)_{unfilt}$ µg L^{-1}	$As(III)/As_T$ %	pH	$Fe_{T\ filt}$ mg L^{-1}	$P_{T\ filt}$ mg L^{-1}
Rahaichar 1								
0	1460	1220	1380	1060	83	7.04	0.561	0.18
6	1320	1160	1420	1060	87		0.196	0.14
29	1250	937	1370	981	75	7.43	0.192	0.13
Goalpara								
0	272	214	279	199	78	7.16	0.757	0.32
7	277	238	285	184	86		0.049	0.18
30	258	198	269	184	77	7.53	0.167	0.15
Rahaichar 2								
0	46.5	32.2	126	<1	69	7.00	0.033	<0.1
19	33.0	26.0	78.1	40.7	79	7.44	0.024	<0.1

sites was clear. Samples from the sites had initial dissolved (filtered) As concentrations of 1465 µg L^{-1}, 47 µg L^{-1} and 272 µg L^{-1}, respectively, with near neutral pH values (Table 13.2; Figure 13.1)). Concentrations of As_T (unfiltered) were similar to the dissolved concentrations in the Rahaichar 1 and Goalpara samples, indicating that most of the As was present in dissolved form. However, the As concentration was more than 60% higher in the Rahaichar 2 sample, indicating that a significant amount of As was present in particulate form in this sample.

In all samples collected, As(III) constituted the dominant species (about 80% of total As) and remained so throughout the standing period. Oxidation of As(III) was therefore minimal over a period of a few hours. The pH was near neutral. During standing, the pH increased by about 0.4 units as a result of CO_2 degasing and oxidation of Fe(II) to Fe(III). Concentrations of dissolved Fe decreased during the experiments from 0.56 to 0.19 mg L^{-1} in Rahaichar 1, from 0.76 to 0.17 mg L^{-1} in the Goalpara water and from 0.03 to 0.02 mg L^{-1} in Rahaichar 2. Concentrations of dissolved P were between 0.13–0.32 mg L^{-1} in Rahaichar 1 and Goalpara but <0.1 mg L^{-1} in Rahaichar 2 (Table 13.2).

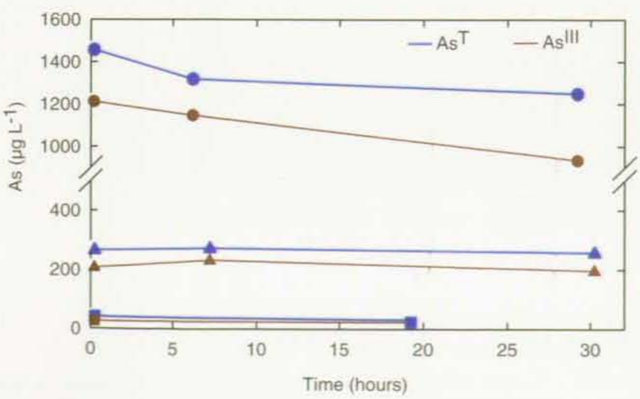

Figure 13.1. Effect of time on the reduction in total dissolved arsenic and As(III) following passive oxidation of three tubewell waters from Chapai Nawabganj.

By the end of the standing period, total dissolved As concentrations had decreased slightly in all three samples, by between 5% and 30%. However, final concentrations in two cases remained above the Bangladesh standard and in all cases above the WHO guideline value. The lack of a substantial loss of As with time is believed to be due in part to the poor uptake of As(III) species and the relatively low concentrations of Fe. The increase in pH and the presence of a substantial amount of dissolved P will also tend to reduce the efficiency of any As(V) removal.

Phosphate tended to be reduced proportionately more than As (Table 13.2) because it was present as the strongly adsorbed phosphate species whereas As was present mostly as weakly adsorbed As(III) species.

13.6.2 Longer-term settling

We also took 28 unacidified but contaminated samples that had been collected during our surveys and reanalysed them for arsenic after several months of storage (and after refiltering). This is a form of passive sedimentation with a long time allowed for oxidation. Iron oxidation is in any case rapid in unacidified samples, a matter of minutes or a few hours depending on the degree of aeration, and so the precipitation of Fe should be similar to that expected from a typical passive sedimentation experiment. However, as indicated above, As(III) oxidises more slowly and so this long-term experiment will contain a higher proportion of As(V) than a typical field experiment. In this respect, it should give maximal removal of As since As(V) is probably coprecipitated more efficiently than As(III) in Bangladesh groundwaters.

Even after standing, most of the waters exceeded the Bangladesh standard for As (Figure 13.2). As expected, the efficiency of As removal depended on the dissolved Fe concentration. Removal positively correlated with the Fe concentration before standing. Up to 80% of the As was removed when there was 10 mg L^{-1} Fe in the water but less than 40% was removed when there was only 3 mg L^{-1} Fe. However, while the iron removed some of the As, the As concentration remained above an acceptable concentration even in some of the waters with very high Fe con-

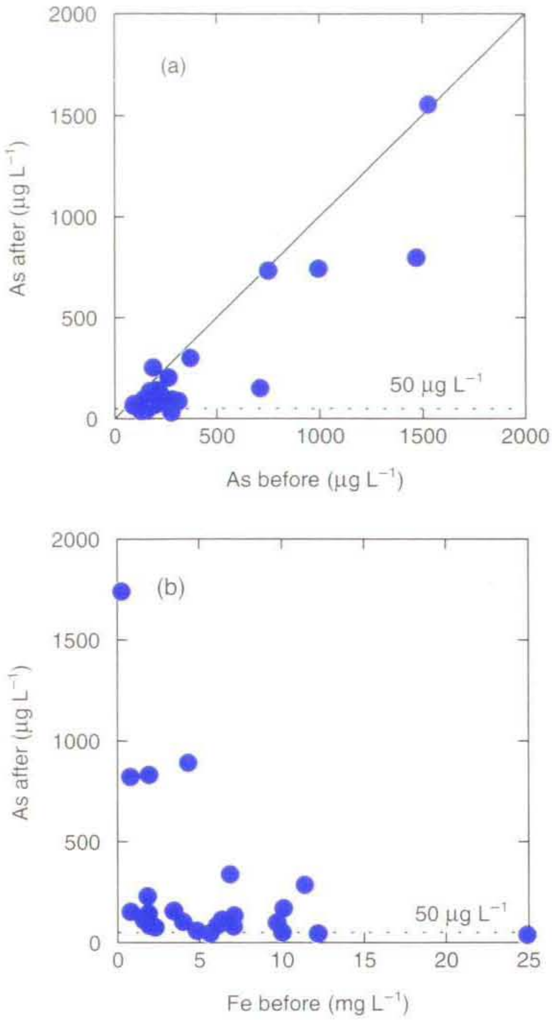

Figure 13.2. Comparison of As concentrations in a range of Bangladesh tubewell waters before and after a long period of standing. (a) change in As concentrations; (b) effect of initial Fe concentration on the final As concentration.

centrations (above 10 mg L^{-1}). In only four of the 28 contaminated waters did the treatment reduce the As to an acceptable level. This confirms the conclusion from field tests that while passive sedimentation may help in some cases, especially where there is high Fe, it is often not sufficient to bring contaminated waters to below the Bangladesh standard and is therefore not an ideal method.

There have been a number of other studies of the efficiency of passive sedimentation for removing As. For example, a recent test on 17 contaminated tubewells showed that passive sedimentation reduced the arsenic concentrations to below the 50 µg L^{-1} standard in just 2 of the 17 tubewell samples studied (WaterAid, 2000a). The As concentration in the remaining 15 samples was reduced to varying extents but not to below the standard. This agrees with model calculations and our ad hoc investigations of passive sedimentation.

It is of course possible to increase the efficiency of As removal by adding supplementary Fe or alum. An improvement in terms of As removal efficiency can also be obtained by oxidising the As(III) to As(V). In the SORAS method (Gechter, 2000; Wegelin et al., 2000), this is achieved by adding a little lemon juice and exposing to sunlight. Arsenic removal efficiencies using the SORAS approach in Chapai Nawabganj averaged 67%. Adding a little potassium permanganate improves the removal efficiency still further.

The assumption that As mitigation can be significantly advanced by the widescale adoption of passive sedimentation (e.g. Nickson et al., 1998; 2000) is not accepted by most involved in the mitigation effort. While passive sedimentation will always reduce the arsenic concentration to some extent, Smith et al. (2000) caution against promoting this approach since it is not generally effective enough to reduce the cumulative dose and may delay the introduction of a more effective solution. Others involved in the arsenic mitigation effort in Bangladesh have adopted a similar line and it currently has 'no proponents' (WaterAid, 2000b).

13.7 SITING OF NEW WELLS

It is true that the more that is known about the detailed sedimentology, hydrogeology and history of an aquifer, the better any predictions about the extent of As contamination in the aquifer are likely to be. Bangladesh sediments show great vertical variability, often over scales of centimetres and this is unlikely to be predictable in a practical way. Detailed water quality surveys also often show great spatial variability over lateral distances of tens of metres. Reconciling these two aspects in many arsenic-affected villages would be an enormous (and expensive) task. Existing borehole logs also do not provide all the information required. It is a major undertaking to characterise the sediments geochemically, and while the relationship between sediment chemistry and groundwater quality will become clearer as more information is obtained, this relationship is at present far from straightforward. The sediment characteristics alone do not necessarily capture all the features of importance, e.g. the extent of past groundwater flushing, and because of the high solid/solution ratios in aquifers, water quality can be sensitive to imperceptibly small changes in sediment chemistry.

Very detailed studies, including laboratory studies, can be valuable for understanding the reasons for the observed variations in arsenic contamination in a few key places and therefore should improve our understanding of the processes involved, oxidation versus reduction, for example. Detailed field studies could lead to a better understanding of the problem that may lead to some useful 'rules of thumb' for well siting at a village level. Simply mapping the arsenic concentrations in existing wells will help to identify high-arsenic areas within a village. If a pattern emerges, this could be used to give some idea of the likelihood of finding 'uncontaminated' wells in an area. But as our experience in Mandari indicates, even this is likely to be difficult. Furthermore, given the scale of the problem already facing Bangladesh at present, it seems wise to minimise all further drilling of new boreholes in the shallow aquifer until the present situation is under control and can be reviewed objectively.

13.8 APPROACH ADOPTED IN THIS STUDY

The focus of this project was to understand the scale of the groundwater arsenic problem in Bangladesh and its causes.

We were aware from the outset that there was a paucity of data on many aspects of importance to the groundwater arsenic problem and we attempted to fill some of these more important gaps. The task has been made difficult by the complexity of the problem and the great degree of spatial variability found within Bangladesh. Statistics are very important and ultimately relate to risk. There is a great danger of being misled by the specific rather than seeing the general. We always wanted to obtain more data to establish the generalities with greater certainty. Even so, with more than 150,000 new pieces of data, much still remains uncertain about the detailed mechanisms of arsenic release.

We discuss below some areas of topical interest. Historians of science will no doubt review the lessons to be learned from the late recognition of the 'groundwater arsenic problem' in Bangladesh and elsewhere but we believe that the topic will lead to the exploration of new areas of science. Perhaps the greatest surprise has been the finding that sediments with 'average' arsenic concentrations can give rise to highly contaminated groundwaters under entirely natural conditions, a message that even today is not fully appreciated.

13.9 SOME AREAS OF CURRENT DEBATE

13.9.1 The nature of the debate

Much has been written recently about the Bangladesh groundwater arsenic problem in the popular press, on the web and in scientific journals. Some of this is enlightening but much is, in our opinion, ill-informed and poorly presented. While science thrives on open discussion and encourages dissenting views, this can provide a mixed message to policy makers and can cloud the real issues that deserve immediate attention.

Sometimes the differences appear to arise from the different use or interpretation of a word or phrase, as for example when discussing the population 'at risk' or 'deep tubewells'. Other times it arises from unwarranted attempts to generalise from the specific as in the discussion of arsenic release mechanisms or the arsenic-depth relationship. Sometimes it is based on ignorance of the situation in Bangladesh or of a basic misunderstanding of hydrogeology or geochemistry. Of course, sometimes the weight of evidence is insufficient to point to a single definite interpretation and so genuine differences are also perfectly reasonable.

Below we highlight what we consider are some of the important technical issues raised by the groundwater arsenic problem in Bangladesh and on which, in some cases at least, our project data provide useful new information. In a number of areas, our views differ significantly from those of others and so where appropriate, we provide the evidence that we have used to arrive at our conclusions.

Unravelling the detailed sequence of events that has led to the development of highly-contaminated groundwaters in Bangladesh and elsewhere is a not a trivial task. It is a bit like forensic science: we can see the crime but have to establish a plausible explanation of how it happened, when it happened and the motives. As with forensic science, the best approach is first of all to painstakingly collect a wide variety of information (data), some of which may not at first appear to be directly relevant to the crime under investigation. Then all of this information is sifted through and the most plausible explanation that accounts for all of the then known 'facts' is sought. In difficult cases, lateral thinking helps. At first, there may be doubt in the assessment and we will have to adopt a 'balance of probability' approach. However, unlike investigating a real crime, we can be confident that given enough time and effort, science will eventually narrow down the possibilities to near certainty.

As yet, we are far from that position of 'near certainty' and so we readily admit that in many areas, the best that can be done is to speculate on the possible 'timing' and 'motives' of the groundwater arsenic problem in Bangladesh. Some of the statements expressed below have been attributed to specific sources; others are more general points of discussion that we have heard and believe deserve some response.

13.9.2 The number of tubewells in Bangladesh

There is no definitive estimate of the number of tubewells in Bangladesh. The uncertainty affects both the scale and planning of any comprehensive arsenic testing programme and the consequent mitigation effort required. It is less critical to estimates of the exposed population (see below) since most (97%) of the rural population is believed to use groundwater. The issue of the number of tubewells is therefore more concerned with the degree of sharing.

While the number of Government (DPHE)-drilled wells is about 1.2 million, there is no requirement for private wells to be licensed and so the number of these is far less certain. The results of the BAMWSP (NESP) survey of six *upazilas* (Chapter 6) found that there were just over six times as many non-Government wells as Government wells. Estimates of the number of wells has steadily increased since 1997. At present, the best estimate is probably in the range 6-11 million wells.

As more surveys are undertaken, these estimates should improve. The most reliable estimates are likely to come from comprehensive ('all wells') surveys such as the detailed village and *upazila* surveys undertaken by BAMWSP, NIPSOM, UNICEF and various NGO's. What is clear is that a large number of private wells have been installed in recent years, especially in the last decade. We found that 68% of the sampled wells in our National Hydrochemical Survey (n=3534) had been installed since the beginning of 1990. In our village survey in Mandari, the figure was even higher (86%).

Not all wells drilled remain in working order and so some distinction needs to be made between the number of wells and the number of operational wells. The recent NESP survey of six *upazilas* found that about 5% of the wells were not working. There was however considerable variation between the *upazilas*.

13.9.3 Reporting of the scale of the groundwater arsenic problem in Bangladesh

The following two statements were downloaded from the web and illustrate the confusion that can arise when words are used casually and without definition:

> *'The latest statistics available on the arsenic contamination in groundwater indicates that 59 districts around 85% of the total area of Bangladesh and about 75 million people are at risk. It is estimated that at least 1.2 million people are exposed to Arsenic poisoning with 24 of millions potentially exposed.'*
>
> www.dainichi-consul.co.jp/english/arsen.htm
> (Dated March 25, 1999; downloaded 17 July, 2000)

> *'According to a survey, jointly carried out by Dhaka Community Hospital and School of Environmental Studies (SOES) of Jadavpur University, Calcutta in 1997, an estimated 75 million people are at risk of drinking arsenic-contaminated water and of developing its adverse effects.'*
>
> www.dainichi-consul.co.jp/english/arsenic/as82.txt
> (Dated August 17, 1998; downloaded 17 July, 2000)

What do *'at risk'*, *'exposed'* and *'potentially exposed'* mean? What are the definitions of an *'at risk'* district and *'at risk'* people? What is the definition of 'arsenic-contaminated'? In the first statement, the 75 million people said to be *'at risk'* does not seem to imply that they are all actually drinking arsenic-contaminated water whereas in the second statement, it does.

We think that it is useful to define terms as follows: an *'at risk' aquifer* is an aquifer which shows sufficient indications of a possible groundwater arsenic problem to warrant the widespread testing of wells within the area in which that aquifer is exploited; an *at risk individual* is an individual drinking groundwater from an *at risk* aquifer, and an *exposed individual* is a person drinking above the prescribed limit for arsenic in drinking water. The *affected population* is the number of people with confirmed arsenic-related symptoms. Therefore not all 'at risk' individuals will be *exposed*. The number of exposed individuals will depend on the level of exposure used, i.e. the prescribed limit. In the context of Bangladesh this is typically either taken as 50 $\mu g\ L^{-1}$ (the Bangladesh standard) or 10 $\mu g\ L^{-1}$ (the WHO guideline value).

Risk varies on a continuous scale and so always needs careful definition. Some people use it in a quantitative sense while others use it only qualitatively. The definition of the number of people *at risk* given above is only qualitative and is highly dependent on the nature of the 'sufficient indications' - as the processes governing the formation of arsenic-affected groundwaters are better understood and as more data for a particular aquifer are obtained, the nature of the risk in a given area will be able to be refined. It may then be possible to exclude some areas from the *at risk* area. Eventually, as more and more testing takes place and the nature of the contamination becomes better understood, the *at risk* population should converge down to the actually *exposed* population. With these definitions, estimates of *at risk* populations must be treated with a great deal of caution since they attempt to quantify what is essentially a qualitative concept. We believe that estimates of the *exposed* population in a given area are of greater value but are more difficult to calculate. We see no value in the term *potentially exposed*.

An analogy may help. Smoking is a well-known risk factor for lung cancer but not everybody who smokes will die of lung cancer. Living in an arsenic-affected district is a risk factor but not all wells in a district are necessarily affected and so not everybody in the area will be exposed to arsenic contamination.

Estimating the population currently exposed to 'arsenic-contaminated water' is difficult and there are many ways of doing it. Each way will give a different answer. For example, it obviously depends on the definition of 'arsenic-contaminated' used (e.g. 50 $\mu g\ L^{-1}$ or 10 $\mu g\ L^{-1}$) and in cases where only some of the wells have been sampled, both on the way in which the arsenic concentrations in the unsampled wells are estimated and the way that the number of people drinking from those wells are estimated.

Perhaps more relevant to an assessment of the health risk would be an estimate of the daily *dose* of arsenic from drinking water as a function of the population taking in that daily dose, that is, a dose density function. This would take into account the amount of drinking water actually ingested (hot countries such as tropical Bangladesh are known to have significantly higher intakes than temperate countries) and the fact that individuals may drink water from more than one well. If several wells are used per individual, then the approximately log-normal distribution of arsenic contamination means that highly contaminated wells will have a disproportionate influence on the number of people taking in an excessive dose of As.

Where every well in a village or *upazila* has been sampled, no extrapolation to unsampled wells is required for that area and the only sources of uncertainty arise from the estimates of arsenic concentration (contaminated or not) and the number of people drinking from a particular well.

However since most of the wells in Bangladesh have not yet been tested for arsenic, estimates of the arsenic concentration in the unsampled wells and the number of people drinking from these wells are necessary. This is essentially a statistical exercise and different *estimates* can be made depending on the data available and the assumptions made. Even with the same raw data, different scientists are likely to make different estimates. Hopefully though, these differences will be small.

At present, our National Hydrochemical Survey database probably provides the most readily available dataset for estimating the nationwide statistics for arsenic-exposed populations in Bangladesh. No other survey to date has combined both a uniform (and near random) national coverage with reliable (laboratory) analyses for arsenic at the $\mu g\ L^{-1}$ level, accurate recording of the location of wells (by GPS) and open reporting. The mere hint of any bias in the selection of wells is enough to throw the resulting 'statistics' into doubt. There are so many affected wells in Bangladesh that it would be easy to find a large number of contaminated wells either by using patient identification as a 'lead' or by adapting the sampling scheme to track down arsenic-rich areas as they are identified. This is one approach adopted by DPHE and others in their mitigation programme.

Randomisation of itself does not guarantee 'accurate' statistics since all estimates are themselves subject to an uncertainty depending on the sampling and analytical uncertainty, the sample density and the nature of the spatial variability. The high degree of variability observed in groundwater arsenic concentrations in Bangladesh (more than four orders of magnitude) and the weak spatial dependence mean that a large number of samples will be required to establish reliable statistics. For example, with about 8 samples per *upazila*, our *upazila*-based statistics are subject to a large and perhaps unacceptable error while the district-based statistics based on about 50 samples should be more reliable and more acceptable. Of course, as the size of the area concerned is increased, the resolution and perhaps the usefulness of the results decreases.

The main assumption that we have made in estimating the exposed population is that the wells sampled in our National Survey were 'randomly' selected and so provided unbiased estimates of the distribution of arsenic contamination over the sampled area. While we accept that our site selection was not random in the strict sense, there was no intentional bias (in terms of water quality) and as yet we have no reason to suspect any such bias. Nevertheless we accept that our statistics should only be used as a guide and should be updated as more and better information becomes available. We wholly endorse the importance of the random selection of wells as the ideal in reconnaissance surveys but are aware of various practical problems preventing this from being always realised.

We made two estimates of the number of people presently exposed to arsenic concentrations exceeding the 50 $\mu g\ L^{-1}$ limit in drinking water in Bangladesh based on different methods of extrapolating from sampled wells to the large number of unsampled wells. Method 1 used a technique called disjunctive kriging to estimate the probability of obtaining an arsenic-contaminated well in a given 5 km grid square while Method 2, which was based on discretisation over a whole *upazila*, used the percentage of contaminated wells in that *upazila* to estimate this probability. These probabilities were then multiplied by the estimated 1999 populations of people drinking water in the grid square or *upazila* and summed to give the exposed populations. This involved additional assumptions about the population of a grid square (same density as in the *upazila* as a whole or a weighted average where more than one *upazila* was involved), the population growth rate since the 1991 Census (2.1% per annum) and the percentage of people using groundwater for drinking water (97%).

Method 1 gave an estimate of the exposed population of 35 million people while Method 2 gave an estimate of 28 million. If a standard of 10 $\mu g\ L^{-1}$ is assumed, these figures increase to 57 million and 46 million people, respectively.

We accept of course that these estimates are themselves both subject to error, and we are not sure how large these errors are. Errors arise both from the interpolation of arsenic concentrations and population density. Others, particularly Dhaka Community Hospital (see opening statements), claim that the number 'at risk' is closer to 75 million people. While we have not seen the detailed assumptions on which this figure has is based, we believe that it must assume that when a district has more than a certain number of contaminated wells, all people in that district are counted as 'at risk' to arsenic-contaminated water. They are indeed 'at risk' in the sense that the probability that they are drinking contaminated groundwater may be quite high because they live in a generally arsenic-contaminated area but this is different from saying that they are all definitely 'exposed' to arsenic-contaminated groundwater. Our exposed population estimate includes an additional factor that accounts for the probability that a given well is contaminated (this varies from 0–1). Therefore care has to be taken to explain precisely what is being discussed in order to avoid confusion. If scientists cannot write clearly on these issues then there is little chance that the popular press will do so.

Finally, a statement such as 'every round of water quality tests shows more wells exceed the Bangladesh standard of 50 parts per billion (ppb) for arsenic in drinking water' is either stating the obvious or is ambiguous and therefore confusing!

13.9.4 Identifying the dominant mechanisms of arsenic release – oxidation or reduction?

The arguments about whether the arsenic problem in the Bengal Basin results from the oxidation of sulphide minerals or from reducing conditions have continued for some time. Case studies in other parts of the world have demonstrated that arsenic can be released by both mechanisms. The oxidation reaction has been much more widely studied and is better understood, mainly because it is the dominant reaction taking place in many mining areas, sometimes on a dramatic scale. It also involves readily-identified minerals.

We suspect that both oxidation of sulphide and reduction of sulphate are presently taking place in different parts of the Bangladesh aquifers, for example at different depths, at different times and in different places. There are demonstrable large differences in redox conditions, water levels, water-level fluctuations and sediment characteristics throughout Bangladesh and so demonstrating one particular mechanism at a particular location is not the same as demonstrating that it is the principal process taking place elsewhere. Isolated observations should not be allowed to confuse the discussion. It is the process that is dominantly associated with arsenic release into solution in Bangladesh aquifers that is of primary concern here, e.g. in the badly affected areas of south-east Bangladesh and in the hot spots of northern Bangladesh. We believe this to be normally associated with strongly reducing groundwater conditions and we have not seen any data suggesting the contrary. Amazingly, no data have ever been presented to support the pyrite oxidation hypothesis in Bangladesh.

It is sometimes said that the exact mechanism of arsenic release is of academic interest and not relevant to the mitigation effort. This is largely true for the emergency mitigation programme but not for the longer-term programme where some insight into the possible future impacts and interactions resulting from proposed policies is required. One hypothesis (reduction) implies that the processes are essentially natural and have been occurring for long periods of time, the other places strong blame on the recent 'over-abstraction' of groundwater as the cause of the As problem ('over-abstraction' is often used incorrectly in the Bangladesh context since while abstraction of irrigation water has increased the annual water table flucuations, full aquifer recovery normally occurs during the rainy season and there is no long-term decline in water tables). Continued 'over-abstraction' also implies that there will be a potential worsening of arsenic contamination with time. At the present time, this is only speculation.

The release mechanism therefore has important implications for future groundwater management, agricultural policy and ultimately rural livelihoods. It is therefore far from being only of academic interest and needs careful examination. A detailed understanding of the processes will also help scientists to identify other aquifers in the world most at risk.

13.9.5 Popular misconceptions relating to the source of arsenic

Pyrite is present and so must be the source of arsenic

Authigenic pyrite, although not abundant, has been observed in Bangladesh sediments from both shallow and deeper sediments (see Chapter 11). This has been used as evidence by some for the pyrite oxidation hypothesis. However, the presence of sulphide minerals in the aquifers proves neither the oxidation nor the reduction hypothesis. Pyrite is an expected end product of sulphate reduction, and its presence in the solid phase can therefore be used equally as evidence for sulphate reduction. Precipitation of iron sulphides will tend to scavenge some arsenic from the groundwater and will lower the arsenic concentration. Furthermore, where the sediments have been subjected to a marine influence either at the time of deposition or subsequently, relatively high sulphur contents in the sediments can be expected since seawater contains some 2700 mg L^{-1} of sulphate. SEM photographs of Bangladesh sediments show euhedral pyrite grains not having been strongly weathered, which suggests that they are newly formed and points against active oxidation.

Although some scientists still propose that the oxidation of arsenopyrite is an important process in Bangladesh sediments, this is not supported by data and we know of no studies that have identified arsenopyrite as a common mineral in Bangladesh sediments. If anything, the culprit is pyrite, or some other iron sulphide mineral, which contains As as a minor constituent. But again we stress: no convincing evidence has yet been put forward to support this hypothesis.

> *Some sulfate minerals are very insoluble and would support very low levels of sulfate in solution. One such mineral, which is very prevalent in acid sulfate soils, is jarosite.'*
>
> (email discussion, D. Fanning, July 2000)

There is no observed positive correlation between As and SO_4 in either the National Survey groundwaters or groundwaters from the Special Study Areas. The spatial distributions of As and SO_4 are also very different. Arsenic and SO_4 concentrations should be positively correlated to some extent if sulphide oxidation is the main As-release mechanism. Indeed, the inverse relationship is observed in shallow groundwaters from the Special Study Areas and provides strong evidence that sulphate reduction accompanies As release. Relatively high SO_4 concentrations and more oxidising conditions are found in groundwaters from some parts of northern Bangladesh (e.g. the Tista Fan). However, these have the lowest As concentrations. High As concentrations are found in the south-east of Bangladesh where SO_4 concentrations are generally low (<1 mg L^{-1}). Sulphate can also be derived from pollution sources but is usually accompanied by other pollution indicators such as chloride.

Sulphide oxidation must lead to SO_4 release and a consequent substantial increase in the dissolved SO_4 concentration. Shallow piezometers (10 m) and dug wells from Chapai Nawabganj provide samples from the zone of water-table fluctuation and close to the redox boundary. These do sometimes show significant increases in SO_4 relative to deeper groundwaters locally and are therefore candidates for possible sulphide oxidation. Nonetheless, As concentrations are notably lower in these groundwaters than at deeper levels. Where pyrite oxidation occurs and is accompanied by the oxidation of iron, precipitation of iron(III) oxides will usually occur with some resorption of arsenic. Some calculations (C.A.J. Appelo, personal communication, July 2000) suggest that as much as 90% of the released arsenic could be resorbed by these freshly precipitated oxides. In that sense, pyrite oxidation is a relatively inefficient mechanism for arsenic release.

In any case, there is no evidence to link iron sulphide oxidation with the generation of the high As groundwaters generally observed in Bangladesh. Therefore while iron sulphide oxidation certainly could be a mechanism for arsenic release, and should be seriously considered, we believe that it is as yet unsupported by hard evidence. Indeed, the reverse appears to be the case.

The lack of high sulphate concentrations in arsenic-affected Bangladesh groundwaters provides key evidence against the pyrite oxidation hypothesis. It has been proposed by some that pyrite oxidation is the primary mechanism of arsenic release but that some sulphate-containing mineral is forming that prevents the build-up of high sulphate concentrations in Bangladesh groundwaters. Several minerals have been suggested as possibilities: gypsum ($CaSO_4.2H_2O$), jarosite ($KFe_3(SO_4)_2(OH)_6$), and K-alunite ($KAl_3(SO_4)_2(OH)_6$). Saturation indices for these minerals in Bangladesh groundwaters are typically strongly negative and so their formation is highly unlikely. Qualitatively, gypsum is rather soluble and is normally only formed where sulphate concentrations are a few thousand mg L^{-1}; K-alunite is unlikely because of the near-neutral pH values and corresponding low Al activities, and jarosite is unlikely because it contains iron as Fe^{3+} not Fe^{2+} which is the dominant iron species in Bangladesh groundwaters. The mineral rozenite ($FeSO_4.4H_2O$) was observed in a Bangladesh sediment by Chowdhury et al. (1999). This mineral is typical of acid sulphate environments and was probably formed by oxidation after sampling, i.e. it is probably an artefact created during storage. The high-arsenic groundwaters of Bangladesh do not have the characteristics of acid mine drainage!

Therefore while there are occasional reports of these rare minerals in Bangladesh sediments, these are likely to be based on observations of partially-oxidised sediments since few workers have taken the very considerable efforts required to prevent oxidation following sampling. Many new minerals can form when Bangladesh's reduced sediments are allowed to oxidise. If claims for rare minerals known to be formed as a result of oxidation are identified and claimed to be present in Bangladesh aquifers, it is incumbent on the observers to provide a convincing case that this formation has not happened post-sampling.

Pyrite oxidation produces acid waters and since these are not generally found, this supports the reduction hypothesis

This is not a useful argument because of the widespread occurrence of solid carbonate minerals in Bangladesh sediments and the strong likelihood that these carbonates buffer the groundwaters at near-neutral pH values. The pH will then depend strongly on the partial pressure of CO_2. This in turn is governed by production of CO_2 from bacteriological oxidation of organic matter, dissolution of carbonates, and the diffusion of gaseous CO_2 to and from the atmosphere.

13.9.6 Evidence supporting the iron oxide reduction hypothesis

The release of small amounts of arsenic from recently-buried sediments appears to be a very general phenomenon that has been observed in river, lake and ocean sediments as well as in flooded soils (Smedley and Kinniburgh, 2001). Most young sediments are strongly reducing below a very thin oxidised layer. The study by Sullivan and Aller (1996) is indicative of the potential generality of the processes involved. They measured detailed pore water (dissolved) As and Fe profiles in sediments from the Amazon shelf region of the Atlantic ocean several hundred kilometres off the coast of Brazil. Even in this pristine and randomly selected environment, there was evidence of a broad pore water arsenic peak some 50–200 cm below the ocean-sediment interface. Peak As concentrations ranged up to 300 $\mu g\ L^{-1}$ with an average of about 135 $\mu g\ L^{-1}$. There was also a closely-related peak of dissolved Fe(II) concentrations, often peaking at a slightly shallower depth and several hundred times greater in magnitude (on a molar scale). Similar profiles have been observed in other studies of ocean sediments albeit at a much reduced scale.

It is easy to see some similarity between these results and our piezometer profiles albeit with the vertical scale stretched by an order of magnitude or more in our profiles. Many of the underlying processes that have been active in the Atlantic sediments are almost certainly similar to those that have been active in Bangladesh sediments and in reducing aquifers in alluvial and deltaic environments in other parts of the world (Chapter 2). Interestingly, Sullivan and Aller (1996) also found the same bell-shaped As-depth profile that is observed in Bangladesh and the authors postulated that some unknown mineral was responsible for lowering the As concentration at depth. While the details remain uncertain, it is clear that the release of arsenic is a very general, natural phenomenon that varies in magnitude but that does not call for truly exceptional conditions.

We found a negative correlation between As and redox potential in the groundwaters from the Special Study Areas (albeit a weak correlation), as well as negative correlations with SO_4 and U. This is consistent with reduction being important. The highest As concentrations were also found where As(III) is the dominant dissolved species. These observations all indicate that high As concentrations occur in the most reducing groundwaters, rather than those affected by oxidation. Data from our piezometers show that arsenic concentrations tend to be low in the shallowest, most oxidised horizons.

Although only limited S isotope data are available, enriched $\delta^{34}S$ compositions (>10 ‰) in the low-SO_4 waters from the Special Study Areas suggest that the SO_4 present represents the residue after sulphate reduction rather than a product of pyrite oxidation. Arsenic-affected groundwaters also sometimes show evidence of H_2S and CH_4 gas, both indicative of strongly reducing conditions.

Major irrigation programmes in Bangladesh are concentrated principally in the drier north-west, and seasonal groundwater drawdown is consequently greatest in this area. All other things being equal, pyrite oxidation would be expected to be greatest in the north-west since this is where the greatest volumes of freshly exposed sediments are found. This spatial pattern of groundwater fluctuation does not fit with the map of groundwater As contamination. In the low-lying part of the delta worst affected by As, seasonal groundwater-level fluctuations are less extreme and water levels are typically much closer to the ground surface.

The evidence overwhelmingly indicates that sulphide oxidation is *not* the major cause of As release in Bangladesh. However, wherever sulphate concentrations exceed those expected from rainfall, pollution and residual seawater, some sulphide oxidation is indicated and some resulting arsenic release may have occurred. The most likely place for this to take place is in the unsaturated zone above the redox boundary. Dug wells are a likely source of such partially oxidised waters and sometimes show high sulphate concentrations and yet from our experience, and that of others, usually give low arsenic concentrations. The young sediments in the Jamuna (Brahmaputra) valley in northern Bangladesh also commonly give rise to relatively high sulphate and high iron shallow groundwaters and may reflect some pyrite oxidation. Nevertheless, the arsenic concentrations are low in these higher sulphate waters. Therefore, even where there is a possibility of pyrite oxidation occurring, it does not appear to give rise to high-As groundwaters.

The evidence is therefore overwhelming that arsenic-affected groundwaters in Bangladesh are usually strongly reducing. This does not prove that the reducing conditions are either necessary or driving the releasing of arsenic. The two factors might just be related. For example, Appelo (personal communication, 2000; www.xs4all.nl/~appt/co2_hfo) has argued that the increase in bicarbonate concentrations found in going from surface water to groundwater could account for the release of sufficient As to give the observed groundwater concentrations. Bicarbonate concentrations are high, often very high, in Bangladesh (and other arsenic-affected areas) and these ions will undoubtedly compete with adsorbed As(V) species to some extent. The question is whether this is sufficient to account for the release of arsenic, particularly since As(III) is also the dominant species in many of the arsenic-affected Bangladesh groundwaters. Our *Special Study Area* investigations showed that there was a positive correlation between arsenic and bicarbonate in Chapai Nawabganj (especially amongst the earliest set of data which was biased towards the more highly contaminated tubewells) while in Lakshmipur and Faridpur the overall correlation was poor. There are some groundwaters with high bicarbonate and low arsenic concentrations. It appears that bicarbonate competition is one factor but not the only factor, or even the dominant factor, involved in As release.

As demonstrated elsewhere (Chapter 12), the change in oxidation state of As from As(V) to As(III) may also release some As by reductive desorption. Burial of sediments leads to many correlated changes – open to closed systems, mineral dissolution and precipitation, ion exchange, sorption–desorption, new microbiological environment etc. – and it is not possible to look at the changes in terms of any one process. We have already raised the possibility that diagenetic changes in the nature of the iron oxides following burial may be important. This is pure speculation – there is no direct evidence that it is important but it could be, and at least should be considered along with the other possible mechanisms. There is clearly 'new science' to be learned.

Ultimately, an understanding of the precise sequence of events leading to the high arsenic concentrations will only be convincing when a full quantitative geochemical transport model can explain all of the major features. At present, the necessary geochemical characterisation of the sediments and the chemical speciation and transport models needed are not yet either known or reliable enough to give convincing, quantitative predictions. This is especially true of the competitive adsorption reactions which are difficult to predict accurately and which are likely to be be important. The situation should change in the next few years as the large amount or research begun as a result of the present groundwater arsenic problems worldwide begin to bear fruit.

13.9.7 Role of reductive dissolution

As discussed above, the evidence for the direct involvement of reduction is strong though not yet overwhelming. Nevertheless, studies of the release of arsenic and phosphorus by reduced sediments and soils elsewhere provide support for the reduction hypothesis. Nickson et al. (1998) proposed that reductive dissolution of arsenic-rich iron oxyhydroxides was the principal source of arsenic in the 'Ganges' delta aquifers and while this is indeed one likely mechanism, we suspect that it is not the sole mechanism responsible for arsenic release. Some groundwaters contain more As than Fe (on a weight and molar basis) which hints at desorption being an important process although it does not definitely prove it. Our model calculations (Chapter 12) also suggest that other processes could make an even greater contribution to the arsenic release than reductive dissolution which in terms of congruent dissolution would be expected to release only minor amounts of arsenic.

The most highly contaminated water sample from the Chapai Nawabganj hot spot contained 2.3 mg L^{-1} As_T, mostly as As(III), and only 0.17 mg L^{-1} Fe. The most highly contaminated sample from the National Survey contained 1.67 mg L^{-1} As_T and only 0.19 mg L^{-1} Fe. This could only be achieved by reductive dissolution if it was also combined with extensive Fe precipitation (as a sulphide or carbonate) or with substantial groundwater movement leading to the chromatographic separation of the As and Fe.

It could be argued that reductive dissolution should lead to a good correlation between dissolved iron and dissolved arsenic, as found in some studies of soils and sediments. While there is usually a statistically significant correlation between As and Fe in groundwaters from arsenic-affected areas, this is often far from perfect and indeed is not to be expected even when reductive dissolution is the key process involved in arsenic release. For example, there is no guarantee that the source oxide minerals have a constant As/Fe ratio, especially when the groundwaters are derived from a large geographical area.

We have shown (Chapter 12) that congruent dissolution of oxides is unlikely to be the main mechanism of arsenic release. We suspect and expect that desorption of arsenic is important although this is difficult to prove without detailed laboratory experiments. Desorption is inextricably tied up with reductive dissolution and the two processes are likely to occur simultaneously. Certainly adsorption/desorption of arsenic and of many other elements on metal oxides is well documented, especially for iron oxides. Desorption differs significantly from simple reductive dissolution in that it does not necessarily involve reduction, arsenic can be released without any concomitant release of iron, and unlike dissolution, desorption is very sensitive to many solution parameters including pH, redox status, and the speciation of the groundwater including the concentrations of As(III), As(V), phosphate, silicate, bicarbonate, DOC, calcium and magnesium, for example.

Any process that causes a substantial increase in the concentration of any of these specifically adsorbed species is likely to have an impact on the other adsorbed species. This can occur both by direct competition for adsorption sites as well as through indirect electrostatic effects. These interactions impart a strong positive correlation between many groundwater parameters making it difficult to know which process is 'driving' the release. Possible geochemical processes driving the change could involve induced pH and redox changes, the leaching of phosphate fertilisers, phosphate and silicate mineral dissolution, organic matter oxidation with bicarbonate production and phosphate and arsenic release, carbonate dissolution and mineral dissolution and diagenesis.

Reductive desorption of As due to a change in the oxidation state of As from As(V) to As(III) is expected from model calculations (DPHE/BGS/MML, 1999). However, calculations (Chapter 12) suggest that this may not be true in the presence of substantial quantities of phosphate. The amount of As desorption is also sensitive to the surface properties of oxide minerals such as their surface charge, surface area (particle size) and surface structure.

The diagenetic changes that occur and on changing from an oxidising to a reducing environment are not well understood for the iron oxide minerals present in Bangladesh sediments, or indeed more generally for Fe(III) oxides in other reducing environments. However, it is reasonable to speculate that there could be significant surface and structural changes following sediment burial and the rapid imposition of anaerobic conditions. Ageing of fresh hydrous ferric oxide (Hfo) is a natural process that has been demonstrated in the laboratory and in natural sediments. This involves an increase in particle size, reduction in surface area and a change in bulk and surface structure. Some ageing even occurs under oxidising conditions. This ageing process is likely to lead to some As release but some As is also likely to be permanently occluded in the structure of the evolving solid phase. This needs to be understood better. The bulk chemistry of iron oxides is also important since some of the As in naturally-occurring iron oxides is likely to be present as a solid-solution and thus unavailable for rapid release.

13.9.8 Role of organic matter

Organic matter undoubtedly plays an important role in the development of the high-As groundwaters in Bangladesh. It can do this in three principal ways: (i) solid organic matter buried with the river sediment could be a *source* of As that is released when the organic matter is oxidised (like phosphate); (ii) dissolved organic matter could help to *mobilise* adsorbed arsenic through its interactions with mineral (oxide and clay) surfaces; (iii) *indirectly* through redox processes – the microbiological oxidation of organic matter, especially of the young, labile organic matter present in freshly buried sediments, imposes the strongly reducing conditions that lead to many other transformations.

The relative importance of these three processes is difficult to judge at present. As with all discussions about the reasons for the high-As groundwaters, the relatively small mass transfers required from solid to solution phase make it difficult to rule out many potential sources. Quantification is required.

While buried peat deposits are occasionally found in Bangladesh sediments, most sediments contain only small amounts of organic matter, usually less than 1% C. If we assume that the sediment at burial contains 1% C (2% organic matter) and that this organic matter contains 5 mg As kg^{-1}, then this will contribute 0.1 mg As kg^{-1} to the sediment arsenic load, a significant but generally minor proportion of the total load. Nevertheless, since it will be released when the organic matter is oxidised, it could contribute to the arsenic in groundwater. It all depends on the extent of oxidation, the As content of the original organic matter and the size of potential sinks.

High DOC concentrations are characteristic of many high-As groundwaters in reducing environments (e.g. Taiwan, Hungary and China) but it is not known whether this is incidental, a characteristic of groundwaters in young sediments undergoing rapid diagenesis, or bears a stronger causal relation. The DOC concentrations of Bangladesh groundwaters are typically slightly higher than for average groundwaters but usually not exceptionally so, and certainly lower than found in most soil pore waters. The interactions of DOC with adsorbed As(III) and As(V) are poorly understood quantitatively and need to be studied in more detail.

The development of reducing conditions appears to be an important precursor to the release of arsenic, and this is undoubtedly related to the oxidation of organic matter. It is also reflected in the high bicarbonate concentrations of many of the As-affected groundwaters. While it could be anticipated that the greater the organic matter content, the greater the tendency for strongly reducing conditions to be created, the relationship is unlikely to be that straightforward. Other factors, particularly the 'biological availability' of the organic matter, are likely to be important. Young soil organic matter is likely to be more reactive than older organic matter such as that in peats.

13.9.9 Iron-rich groundwaters and arsenic

Iron-rich groundwaters are common and are found throughout the world. If all such waters contain excessive concentrations of arsenic, then the problems that have occurred in the Bengal Basin and elsewhere would probably never have happened. It is simply not correct to equate iron-rich groundwaters with arsenic-contaminated groundwaters. There are many iron-rich groundwaters which contain very low concentrations of arsenic as for example in many UK groundwaters. We found that even in Bangladesh, the overall correlation between the iron and arsenic concentrations in groundwaters from the shallow aquifer was not particularly good although there is undoubtedly sometimes a 'statistically significant' correlation especially on a local scale. The deep aquifer in Lakshmipur gave iron-rich groundwaters and yet these were low in arsenic. There are also other environments in which severely arsenic-contaminated groundwaters occur which are not iron-rich. Iron-rich groundwater is one 'risk factor' but there are other factors involved.

13.9.10 Contamination of the deep aquifer

The evidence from our National survey showed that some 5% of the sampled deep wells (i.e. wells greater or equal to 150 m depth) exceeded the WHO guideline value for arsenic and 1% exceeded the Bangladesh standard. However, most of these deep wells had been installed to avoid salinity problems in shallower groundwaters and were mostly from the southern coastal region of Bangladesh. The statistics cannot therefore be applied to other parts of Bangladesh and it is clear that a systematic study of the deep aquifer in other parts of Bangladesh is required. Exactly at what depth such low As groundwaters are found is not certain since there are not many wells in the deeper parts of the shallow aquifer. This relationship is likely to vary in different parts of the country depending on the depositional history (Chapter 3). However, the statistics that do exist (Chapter 6) suggest that wells will often need to exceed 150 m depth to access low As groundwater.

There is considerable confusion in Bangladesh over the use of the word 'deep' in the context of 'deep well' and 'deep aquifer'. A 'deep well' can refer strictly to the depth of the well, as in this report, with cutoffs usually given at 150 m or 200 m. It can also refer to the type of well construction, i.e. irrigation wells are often described as 'deep wells' even though they are usually placed in the lower part of the 'shallow' aquifer. These wells are designed to deliver a greater yield than ordinary hand-pump tubewells and are consequently larger diameter and are often drilled by reverse circulation as opposed to the 'sludger method' used for most domestic supply hand-pump tubewells. The irrigation wells are usually fitted with removable diesel pumps. Even a strict 'depth' classification can be confusing since with deep wells, the screened interval may not be placed at the bottom of the well. It is the location of the screened interval that is of greatest interest.

Use of the terms 'deep' aquifer and 'shallow' aquifer implies that there are two distinct aquifer units separated by a substantial aquiclude (clay layer). This is not necessarily the case as we found in Faridpur. The presence or absence of an aquiclude has important implications for the long-term sustainability of low As deep wells, and therefore needs to be better understood across Bangladesh.

It is often heard in Bangladesh and neighbouring West Bengal that deep wells have been found to be contaminated. It is also frequently said that deep wells that were originally arsenic-free have become contaminated in a matter of a few years. In view of the possible role that deep wells could play in the long-term supply of safe drinking water in Bangladesh, such assertions need to be established beyond doubt and if substantiated, the reasons need to be understood. This means that the data need to be put in the public domain and open to peer review. This includes both the analytical data and information about the sampling methodology and well construction. These observations of contaminated deep wells are so important that they need to be confirmed, preferably by independent scientists.

It is also important to distinguish between whether it is the well that is contaminated or the aquifer. A deep well may be contaminated because shallow, contaminated groundwater has been drawn down either as a result of drawdown in the aquifer induced by pumping or of inappropriate well construction resulting in some form of short-circuiting close to the well casing – this distinction is obviously important and will require a detailed case-by-case investigation of affected wells to resolve. It is also sometimes the case that deep wells have multiple screened intervals to increase productivity which means that the contamination could be derived from the shallower interval. Also, where only a relatively small percentage of wells are found to be contaminated, there is scope for various errors to creep in – including errors in sampling, analysis and reporting. There is sometimes confusion over feet and metres, for example.

13.9.11 Source of high phosphate concentrations

Bangladesh groundwaters contain unusually high phosphate concentrations for groundwater – a median concentration of 0.3 mg L^{-1}, an average concentration of 0.75 mg L^{-1} and a maximum concentration of 18.9 mg L^{-1} from our National Survey (n=3530). The variation is also large but not as great as for arsenic (in a relative sense).

From a geochemical point of view, explaining the high phosphate concentrations is every bit as much of a challenge as explaining the high arsenic concentrations. Therefore not surprisingly, the source of the phosphate is also the subject of differences of opinion. Some for example believe that it is derived from phosphate fertilisers or from degradation of organic matter (e.g. Acharyya et al., 1999, 2000). However, the evidence points to a natural non-fertiliser source. Phosphate transport from the surface can be expected to be retarded to some extent and therefore quite slow. Yet a substantial number of deep wells (depth greater than 150 m) contain high phosphate concentrations (greater than 1 mg L^{-1}). These deep waters are also likely to be several thousand years old and therefore will predate the use of fertiliser. If leaching of fertilisers were the principal source of phosphate, phosphorus concentrations should be a maximum at shallow depths. Our piezometer data indicate that, if anything, phosphorus concentrations in the shallow aquifer tend to increase with depth. High P porewaters are also found in sediments far from fertiliser inputs and in diverse geochemical environments (lakes etc). Also, if fertilisers were an important source of phosphorus, dug wells should show high phosphate concentrations since they are the shallowest of wells (albeit somewhat displaced from agricultural activity). Again, our limited data from Chapai Nawabganj show the reverse. Of course, phosphate derived from fertiliser leaching is a possibility in some shallow groundwaters but this should not be confused with the more general situation relating to the typical high-P and high-As groundwaters of Bangladesh.

The decomposition of organic matter will undoubtedly release some phosphate (and arsenic) into solution. The Redfield formula gives the molar C/P ratio as 106 (based on algal organic matter) and so assuming a closed system and that half of the bicarbonate in a bicarbonate-rich water (say 610 mg L^{-1} HCO_3^-) has been derived from organic matter decomposition, this would release 1.5 mg L^{-1} P. Much of this is likely to be readsorbed by the oxides present in the sediment as reflected by the large concentrations of oxalate-extractable sediment P (Figure 11.15). In practice, some CO_2 will have been lost to the atmosphere and so the extent of oxidation will be greater than this. Therefore while oxidation of organic matter will contribute to some of the dissolved P, it is unlikely to supply it all especially in the high-P waters found in Bangladesh. Data from our Special Study Areas do not indicate a significant correlation between bicarbonate and phosphate, further weakening the case for organic matter being the dominant source of dissolved P. While the arsenic content of organic matter is unknown, similar arguments can probably be applied to arsenic. Certainly there are groundwaters with high bicarbonate concentrations and low arsenic concentrations (e.g. dug wells, Faridpur 'deep' wells).

Rather we believe that the phosphorus is predominantly of natural, inorganic origin, rather like the arsenic. While there is not a very strong correlation between arsenic and phosphorus concentrations in individual wells, the National Hydrochemical Survey and maps show a somewhat similar spatial distribution with the highest phosphorus concentrations in the south and east of Bangladesh where the arsenic concentrations are also highest. Chromatographic separation resulting from groundwater flow, especially separation of As(III) and P, could contribute to the generally poor As-P correlation observed on a well to well basis.

Therefore, as for arsenic, some of the phosphate could well be derived from reductive dissolution of, and desorption from, iron (and other) oxides. Indeed, according to the iron oxide reduction hypothesis, it would be surprising if elevated phosphorus concentrations were not observed in the high-arsenic areas. However, unlike arsenic, no change in oxidation state of the phosphorus takes place and so reductive desorption does not contribute to phosphate release suggesting that the other processes (dissolution, oxidation of organic matter, competitive interactions and diagenetic changes to the oxides) may be important.

There is evidence from the phosphorus and sodium maps of some spatial correlation between the two and so seawater or buried shell-material from marine sediments could be another possible source. Apatite has been observed in the sediments. Biotite is a further possible mineral source – Bangladesh sediments contain abundant biotite – but since biotite weathering is accelerated by the oxidation of structural Fe^{2+} it would be expected to be greatest in the shallowest horizons above the redox boundary. As mentioned above, the field data indicate a deeper source.

The pyrite oxidation hypothesis for arsenic release is less attractive for explaining the high phosphate concentrations. While arsenic has both siderophilic (metal-loving) and chalcophilic (sulphur-loving) tendencies, phosphorus is more strongly siderophilic and therefore would not be expected to be released in great quantities from pyrite oxidation. We could find no data for the phosphorus content of pyrites to confirm this, but expect it to be quite low.

13.9.12 Depth relationships

Arsenic in groundwater in Bangladesh increases with depth
Nickson et al. (1998)

Despite the assertions made by Nickson et al. (1998), the As concentrations in groundwater do not always, or even generally, simply increase with depth. A bell-shaped arsenic-depth relationship is much more likely and when appropriate measurements have been made, this is what is observed – as with our piezometers, for example. Very shallow wells (say within 5 m of the water table) tend to have quite low concentrations and deep wells tend to have very low concentrations with intermediate depths having variable but higher concentrations of arsenic. In contaminated areas, arsenic concentrations in groundwater tend to increase most rapidly within 10–20 m of the surface. The exact relationships are likely to be more closely related to the depth below the water table rather than the ground surface, and the extent of annual water table fluctuations. Other factors, such as variations in the 'source term' and in the geochemical environment, will also play a role and so simple, generally applicable As–depth relations are unlikely especially when viewed at a particular site.

There are therefore horizons where arsenic increases with depth and horizons where it decreases with depth. In the shallowest horizons, sediment-water interactions are less advanced and there is likely to be a zone of active flushing where any arsenic released will tend to have been washed away. Furthermore, according to the iron oxide reduction hypothesis, the strongly reducing conditions necessary for arsenic release will not have been fully established close to the surface. Hence groundwater As concentrations will tend to be low. Below the redox boundary, As concentrations can be expected to increase. This has been observed in studies of lake and ocean sediments.

In the deepest horizons, the sediments will be older and any arsenic released will tend to have been flushed away perhaps at a time when the sea level was much lower and strong flushing of the aquifer was more likely. Also, if as we suspect, arsenic release is in part at least, a response to the sudden imposition of reducing conditions on freshly buried sediments, then older sediments with their older and less labile organic matter will be less able to maintain the strongly reducing conditions required.

In intermediate horizons, groundwater As concentrations can be expected to vary up or down depending on local variations in the As source, mobilisation and transport terms. For example, they may reflect local variations in the iron oxide content of the sediments at the time of burial (source term), or the redox status depending on the organic matter content (mobilisation term), or the degree of flushing depending on the permeability of the strata, the hydraulic gradients and the local groundwater flow patterns (transport term). There is evidence from our studies in Mandari of strong water quality stratification of the shallow aquifer pointing to the importance of these local variations.

In terms of understanding the processes involved as a function of depth, it can be confusing to mix data for wells drilled at different depths but from different places. Sets of piezometers at the same location but at different depths, as used in this study, are a better way of understanding such relationships.

13.9.13 Hand-dug wells, tubewells and when the arsenic was released

'We know of no difference in the inorganic and organic quality of water from tubewells and hand-dug wells. Both extract water from subsurface geological formations i.e., groundwater and from about the same depth.'

From 'Groundwater Arsenic Poisoning And A Solution To The Arsenic Disaster In Bangladesh', by Thomas E Bridge: www.bangladesh-web.com/news/jan/14/fv4n104.htm (downloaded 17 July, 2000).

Dug wells at a given depth should give the same water quality as tubewells from the same depth

'The beginning of poisoning does appear to have occurred after the drilling of the tubewells.'

'The absence of reported poisoning prior to the nineteen eighties supports the theory that the poisoning of the groundwater is recent'.'

See Thomas E Bridge and Meer T Husain, '*The Increased Draw Down And Recharge in Groundwater Aquifers And Their Relationship to the Arsenic Problem in Bangladesh*', undated article; www.dainichi-consul.co.jp/english/arsenic/article/meerarticle6.html (downloaded 17 July, 2000).

A criticism of the DPHE/BGS/MML (1999) Phase I report was that we suggested that the arsenic had probably been in the groundwater for a long time, whereas Bridge and Husain say that this is contrary to historical medical evidence. In particular, they could not understand why hand-dug wells which were widely used in the past should be different from modern tubewells from a similar depth. They stated that it would be 'illogical to find hand dug wells are uncontaminated and tubewells are contaminated in a similar geological, hydrological and geochemical conditions'.

This is a basic misconception. Groundwater abstracted from hand-dug wells and tubewells at the same depth can have very different arsenic concentrations precisely because of the different hydrological and geochemical conditions. Our 1997 findings from two dug wells in the highly contaminated region of Chapai Nawabganj showed that these both had low arsenic concentrations. We suggested that this was probably due to more oxidising conditions in the hand dug wells or to the lack of contact of the shallowest groundwaters with arsenic-bearing strata.

It seems perfectly reasonable to us to expect that the redox conditions in a large diameter open well will be different from those of a tubewell at a similar depth. Since we believe that strongly reducing conditions are probably required for arsenic release in Bangladesh, it makes sense that there could be real differences between arsenic concentrations in water from dug wells and tubewells. Much other evidence from Bangladesh and West Bengal now confirms this, including our more recent results from the piezometers in Chapai Nawabganj.

The introductory quotes have been used to support the idea that since dugwells are expected to have the same water quality as tubewells, and since tubewells are contaminated now and yet there were no arsenic patients until recently, the arsenic could not 'always' have been present in the groundwater but must be a recent phenomenon. It has been suggested that the construction of the Farakka barrage on the River Ganges has led to the oxidation of pyrite and thereby caused the high As groundwaters now observed in Bangladesh (and West Bengal?). As indicated under the discussion of sources given above, there is no evidence to support this rather tortuous hypothesis.

Air can diffuse freely down a dug well and so it is likely that conditions will be more oxidising at the base of a dug well than in a tubewell of a similar depth. This is borne out by observations of many redox-sensitive parameters such as dissolved oxygen, nitrate, ammonium and sulphate. The nature and extent of any lining of the dug well could have an influence on the redox conditions at the base of the well, and hence on arsenic concentrations. Allowing, and even promoting, aeration in the immediate vicinity of the dug well may therefore be beneficial. It is also inappropriate to mix data from dug wells with data from tubewells when examining As-depth relationships.

Before the drilling of tubewells, drinking water in Bangladesh was derived from surface water ponds and from dug wells, both now known to be sources of relatively low-arsenic water (and high levels of bacterial contamination). Therefore the apparent overlap of tubewell use and the recognition of symptoms is perfectly understandable since the tubewell water is the principal source of the arsenic!

This says absolutely nothing about exactly when the 'groundwater was poisoned' (other than it was before it was drunk!). Our 'dating' of groundwaters provides some indication of when the contamination may have occurred. For example, we have found some shallow groundwaters which have very low tritium concentrations yet high arsenic concentrations. This suggests that the source of the arsenic predates the 1960's. Experience of arsenic release in soils and sediments elsewhere suggests that some arsenic release can occur very rapidly after sediment burial and the development of strongly reducing conditions. It often takes about two weeks for reducing conditions to become established in recently-flooded soils, for example. Desorption processes tend to be very rapid (usually in seconds to days) and so the initial As release could have occurred within a matter of weeks following burial. There is also likely to be a slower release related to further burial and the development of strongly reducing conditions, to oxide mineral dissolution, clay mineral weathering and to slow, diagenetic changes to the structure of the minerals which sorb As. It appears that in Bangladesh further arsenic release occurs as the sediments become more deeply buried (or older) such that the highest groundwater arsenic concentrations are frequently found in the 20–30 m bgl depth range.

We are not sure of the relative importance of these fast and slow release mechanisms. We believe that much of the arsenic was released thousands of years ago rather than recently. However, this does not mean that there will be no changes to the arsenic concentration in well water. Movement of groundwater, either reflecting natural groundwater gradients or those induced by pumping, will also lead to the movement of arsenic. Some wells will increase in concentration with time, some will decrease. In the very long term, at timescales well beyond those of significance to the present management of the aquifers, arsenic concentrations can be expected to decrease as fresh water flushes away the arsenic that has been released. Since the arsenic release is essentially a one-off response to the dramatic change in geochemical environments following burial, further release is not expected.

Not surprisingly, the time when groundwater began to be exploited for drinking water also coincided with the time when groundwater began to be heavily exploited for irrigation. However, there is no evidence to connect directly the onset of widescale irrigation with the onset of arsenic poisoning. However, others continue to speculate that 'excessive' groundwater abstraction for irrigation and the use of phosphate fertilisers are prime causes of the groundwater arsenic problem (Acharyya et al., 2000).

It is also often said that some tubewells had been in use in Bangladesh long before, perhaps 60–70 years before, the recent rapid expansion of the 1970's and later. Yet 'there were no arsenic patients then'. Two points: firstly, who says that nobody suffered from chronic arsenic poisoning in those early days and secondly, what is the evidence for such a statement? Although tubewells were undoubtedly used before the recent expansion, the number in use was much, much smaller than at present. Therefore, the number of arsenic-affected individuals would have been correspondingly far fewer and would probably have gone undetected especially since the symptoms would not have been widely recognised.

13.9.14 Borehole logging and borehole licensing

Despite the very large number of tubewells drilled in Bangladesh, it is still difficult to form a reliable 3-dimensional picture of the aquifers both at the regional scale and the local scale. This is because most of the domestic tubewells have been drilled by private contractors using the sludger (hand flap) method and there is no requirement or system to record details of the borehole logs on completion. Even details of most of the government-drilled tubewells are not struction in order to prevent rapid vertical leakage down the borehole, that no shallow horizons are screened to increase productivity and that the aquifer has a reasonable layer of clay separating the shallow and deep aquifers, there is every reason to expect that the water quality should remain good for the life-time of the well. This is because there are few driving forces for chemical change at depth (in terms of chemical gradients). We also know from carbon dating that the deep waters are often several thousand years 'old' and from modelling that natural groundwater flow is slow. Why should conditions suddenly change when tapped by a small well? Nevertheless we are conscious of contrary information coming from elsewhere (but have not seen the data and detailed background), particularly from West Bengal, and so we advocate that all deep wells used for public supply are monitored for arsenic at regular intervals, say every 6 months for at least five years and perhaps for ever, to ensure that any adverse trends are quickly identified. Hopefully, there will be improvements in arsenic testing procedures that will make such monitoring more feasible for Bangladesh.

The main impact of deep wells is likely to arise where shallow water of very different quality is induced to flow to the deep aquifer as a result of irrigation pumping or the use of some other high-capacity pump. Not surprisingly, our modelling (Chapter 5) indicates that installing high capacity wells at depth will induce some groundwater flow from shallower horizons and may therefore slowly increase arsenic contamination at depth. There needs to be a groundwater protection policy for the deep aquifer. This should consider any possible impacts of abstraction on the movement of the saline-freshwater boundary in the southern coastal region.

13.9.16 Toxicity of different arsenic species found in groundwater

Arsenic can exist in various forms in groundwater. The two dominant 'species' are arsenate (oxidised form) and arsenite (reduced form). Various forms of organic arsenic can be found in surface waters but there is no evidence that they exist at significant concentrations in groundwater. The proportions of arsenite and arsenate found in Bangladesh groundwaters appear to vary greatly although this needs confirming. More work needs to be done on reliable methods for preserving As species and for speciating arsenic in Bangladesh (and other) groundwaters. Certainly much of the As in Bangladesh aquifers is in the reduced valence state as arsenite species. There are a number of projects investigating both the solid and solution phase speciation of As in Bangladesh aquifers and the situation should be much clearer in the near future.

It is often stated that arsenite in drinking water is considerably more toxic to humans than arsenate. This appears to be based on studies with micro-organisms. There is no evidence that this is the case with humans. Arsenate is rapidly reduced to arsenite in the human gut. This makes the setting of drinking water standards and the testing of arsenic relatively straightforward. Measurement of total arsenic should be adequate. No existing national drinking water standards attempt to differentiate between the different forms of arsenic, neither does the WHO guideline value.

13.9.17 Relationship between number of arsenic patients and groundwater quality

Low level arsenic poisoning is a chronic disease and there is a lag time before symptoms become apparent. This delay or latency is typically about 10 years from first exposure to the development of skin lesions, particularly keratoses and more than 20 years for skin cancer (Smith et al., 2000). The present-day concentration of arsenic in drinking water is therefore only one factor to be considered when comparing maps of arsenic in drinking water with maps of the known incidence of arsenic-related diseases. Many of the wells in Bangladesh are less than 10 years old. We found that 68% of shallow wells sampled in our NHS had been constructed in 1990 or later. The percentage in Mandari was even greater. Rapid action now could therefore save a lot of suffering in the next 10–20 years.

All other things being equal (which is not necessarily the case), the first patients to be diagnosed will tend to be those who have been drinking highly contaminated water for the longest time. These will have been located precisely because they developed symptoms, i.e. not by random survey. The most commonly quoted figure for the number of people affected by skin lesions and arsenicosis in Bangladesh is 8000 although it is unclear exactly how this figure was derived. It is likely to be an underestimate. It is certainly a very small number in relation to the total number of people exposed to arsenic contamination. A more recent estimate of the number of people in Bangladesh 'affected by arsenic and suffering from arsenic dermatitis (Black spots, eruptions and even cracking of skin)' is 150,000 (from www.sdnbd.org/dphe_profile.htm). It is not clear whether this number includes estimates of those with as yet undiagnosed problems such as internal cancers. Smith et al. (2000) say that for Bangladesh, 'estimates indicate that at least 100,000 cases of skin lesions caused by arsenic have occurred and there may be many more'.

Experience from elsewhere suggests that the lifetime risk of developing skin cancer from the ingestion of 1 μg As per kg body weight per day (roughly equivalent to 1 L d^{-1} at a concentration of 50 μg L^{-1}) is 1 per 1000 to 2 per 1000 (Smith et al., 2000). Skin cancers are usually not fatal if treated appropriately. In other countries, the main causes of death associated with chronic ingestion of arsenic in drinking water are internal cancers. The risk of getting any type of cancer at the 50 μg L^{-1} level of exposure could easily be as high as 1 in 100 (Smith et al., 2000).

Patients from the Chapai Nawabganj hot spot area were in some cases consuming water containing in excess of 1000 μg L^{-1} As. This concentration is not typical of Nawabganj district as a whole and is the exception rather than the rule. In this respect, our arsenic maps, especially the smoothed map, may be confusing since they emphasise the typical rather than the exceptional. Even though much of northern Bangladesh plots in the lowest probability class interval used (<0.1) in our smoothed probability maps (Chapter 9), this does not imply that the area is essentially uncontaminated. A 10% chance of drinking As-contaminated water is still a very high probability. More tellingly, the mean groundwater concentration (represent-readily available. This is understandable given the large number of shallow tubewells but there is a case for all deep tubewells to be licensed by the government and for details of the borehole logs to be lodged in a systematic way. This could form a beginning to an aquifer protection policy for the deep aquifers. Some incentive would probably need to be given to private contractors to make such a notification scheme work.

It would be very useful to always record the lithological variations with depth (sand, silt, clay, peat etc.) and the colour of the sediments (grey, brown etc.). The texture is obviously important in terms of potential groundwater yield but can also yield valuable information about the depositional environment. The colour is useful since it reflects the oxidation state (and maybe age) of the sediments. For example, a change from grey to orange-brown may help to identify the Holocene-Pleistocene boundary.

13.9.15 Moratorium on drilling of all new shallow wells

There is certainly a good case for having a moratorium on the drilling of all new shallow wells in the arsenic 'at risk' areas. New wells add to the burden of an already large testing programme. DPHE have halted all such drilling activity but the installation of private wells continues. The justification for a moratorium is partly economic – if the probability of the new well being contaminated is 50%, then the cost of drilling a well with acceptable quality will actually be double that of drilling a single well. Other alternatives may then become more attractive. In practice, in order to provide a clear and unambiguous message, it would be best if there was a complete cessation on the drilling of all new wells in the shallow aquifer for the time being throughout Bangladesh even though there are areas in northern Bangladesh where the shallow aquifer does not pose a threat. Sharing of water from certified 'good' wells would be a better interim solution and would be a simple message to convey – 'a bottled water distribution system without the bottles', i.e. use any approach to the distribution of safe drinking water that works.

There are also other potential constraints on the use of hand-pump tubewells in the shallow aquifer. These constraints may become more serious in the future (Figure 13.3). The decline in water table during the latter part of the dry season may put increasing numbers of suction hand pumps out of reach of the water table, especially in the uplifted Pleistocene Tract areas. Salinity is a problem in the coastal region. Even in areas where 'no constraints' are indicated such as the Chittagong Hill Tracts (Figure 13.3), the ground may be unsuitable for the widespread development of hand-pump tubewells. The arsenic constraint is very widespread throughout Bangladesh, especially if a lower limit than the present Bangladesh standard is sought (which should be the long-term aim). When this is combined with other chemical constraints, particularly of manganese, it is hard to avoid the conclusion that the shallow aquifer in Bangladesh is largely unsuitable for drinking water supply.

Naturally there has been something of a backlash against the use of all groundwater in Bangladesh. Certainly the arsenic issue, indeed all water quality issues, would be easier to manage and monitor if far fewer wells were used

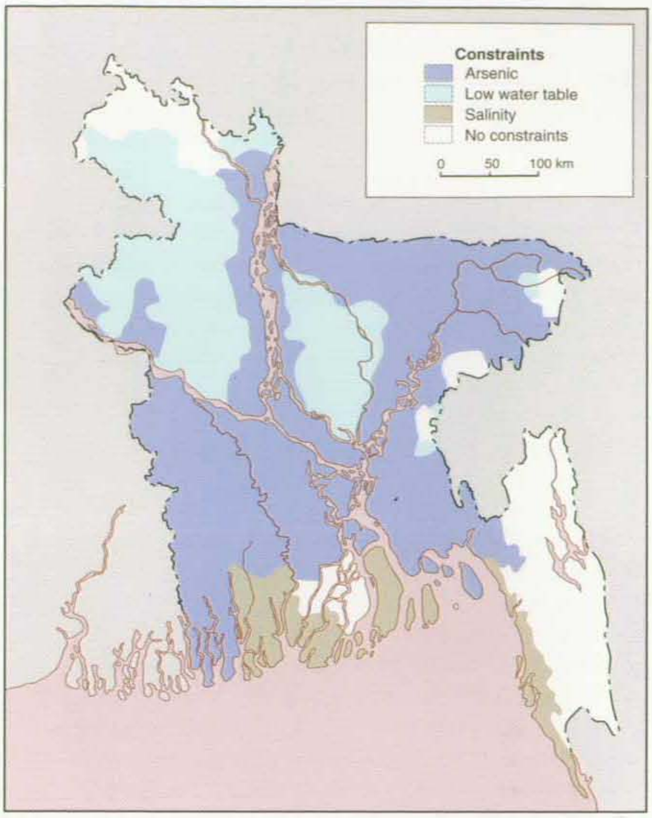

Figure 13.3. Map showing possible constraints on the future use of hand-pump tubewells (after NWMP, 2000).

for drinking water. Ideally there should be a trend away from individual tubewells towards a smaller number of wells with a local distribution network perhaps in the manner suggested in NWMP (2000). The water could then be more easily treated for arsenic, iron and manganese, if necessary, and more easily monitored. Low-arsenic deep-well groundwater could also be used as primary source of drinking water. There is no reason to dismiss the use of all groundwater in Bangladesh just because of the water quality problems in the shallow aquifer. Groundwater provides a valuable source of drinking water in many parts of the world, and will continue to do so. The water quality needs to be assessed objectively on a case-by-case basis. Surface water is not without its own problems. Existing shallow tubewells can continue to be used for washing etc.

The case for the drilling of deep wells in contaminated areas such as the south-east of Bangladesh is strong since the available evidence is that these often provide good-quality drinking water, albeit at an increased cost. However, there are important questions about the way that deep boreholes are constructed and more generally about the long-term sustainability of deep groundwaters. These questions are currently being addressed by the DPHE and others. Experience of using deep wells in the southern coastal region of Bangladesh over many years has shown that the quality of the deep groundwater there has not deteriorated as a result of the leakage of saline water from shallower depths. The same should be true of arsenic in this area at least.

Providing that the wells are properly sealed during coning a measure of the mean dose) is more than two orders of magnitude lower in parts of northern Bangladesh compared with the worst-affected areas in the south. The chances of drinking As-contaminated water are much lower there and this should be reflected in the strategy adopted of the short-term or emergency mitigation programme.

In the SE of Bangladesh, the mean concentrations in the drinking water are greater but the incidence of arsenic-related diseases is less than in parts of the Ganges valley in west central Bangladesh. The shape of the As frequency distribution is likely to vary in different parts of the country and so the mean As concentration may not provide a good reflection of the number of highly contaminated tubewells in a particular area.

The recently published results of the comprehensive screening carried out by the National Emergency Screening Program (NESP) (BAMWSP, 2000) recorded 3119 patients in 6 *upazilas* which also suggests that the total number of patients in Bangladesh is definitely considerably greater than 8000. There is also a large difference between the large number of patients found in one *upazila* from Chandpur district in the south-east in this survey with the results of a parallel DPHE-UNICEF survey in an adjacent *upazila* in the same district where the number of patients found was very low. The reasons for this difference need to be resolved.

This discussion is complicated by the commonly-held belief that arsenic concentrations in tubewells are increasing with time. Unfortunately the data to support this statement as a general trend have not been presented. Our monitoring results to date do not support such a conclusion but also do not prove that such a trend is not occurring at least over timescales of years, decades or longer. The situation is still unclear. Quantifying small but significant time trends is very difficult and investigations must be carefully planned to separate the various plausible sources of variation – analytical uncertainty, recovery from disturbances due to well installation and diurnal, seasonal and long-term changes. Merely taking a few ad hoc samples at various places and at various times is insufficient to establish such trends reliably. This is clearly an important issue that deserves further attention.

The question of whether there is a threshold concentration of arsenic below which no symptoms are likely to occur (in the lifetime of an individual) is hotly debated. Scientists are currently divided on this. This issue is closely related to the question of the linearity of the dose-response curve. It has significant implications not only for the setting of drinking water standards but also for any mitigation strategy. If the response is linear, merely blending high- and low-arsenic waters may reduce the arsenic concentration to below the accepted drinking water standard but would not reduce the overall incidence of disease. A greater population would be exposed to low, but significant, arsenic concentrations and might therefore suffer from an arsenic-related disease, albeit later in life.

13.9.18 Lessons to be learned

In retrospect, it is clear that mistakes were made in not picking up the groundwater arsenic problem in Bangladesh earlier, and in not acting on the earliest indications rapidly enough. Smith et al. (2000) recommend that all drinking water sources should be tested for arsenic. In most developed countries, this is now the case for all public supplies but the situation with small, private supplies is less clear. A discussion between the general public, scientists, policy makers, development organisations and funding agencies on what steps might be taken to prevent future 'arsenic' problems arising would be helpful.

There are broader issues to do with drinking water quality standards than arsenic. What other 'surprises' are waiting to be found? How do we find them quickly? The range of potential problem chemicals is very large. As analytical techniques improve, we can measure more determinands at lower levels and gradually gain a greater idea of the risks posed by a broader range of chemicals. However, the cost of a full chemical analysis increases accordingly. Even in developed countries, many small private water sources are not presently tested for the full range of WHO health-related parameters. Some would argue that it would be too burdensome and 'bureaucratic' to require them to do so. The cost would be too great given the perceived risk at the time. In practice, as the cost of a 'full' chemical analysis of a water sample increases, the number of private wells tested is likely to decrease.

There are of course also chemicals that maybe should be on the WHO list, and one day will be, but about which there is not enough information at present to form such a judgement. Various trace organics are obvious examples. Thallium, for example, is already on the USEPA list of contaminants covered by their National Primary Drinking Water Regulations but is not on the current WHO list.

13.10 RECOMMENDATIONS FOR FUTURE RESEARCH

Below we outline a number of topic areas where future scientific research could contribute to the understanding and solution of the groundwater arsenic problem in Bangladesh. These topics are not intended to detract from the number one priority in Bangladesh – to identify all affected individuals and to provide everybody with 'arsenic-free' drinking water rapidly. If there is a shortage of funding, then the more long-term or 'academic' research should take second place. It will probably be done later anyway.

Some of the topics listed below should aid the mitigation programme in Bangladesh directly, others are more generic, require sophisticated laboratories and are best carried out outside of Bangladesh. The suggested topics concentrate on chemical and geological studies. We do not include mitigation, health or social studies although these are of course important. We are also aware that programmes may already be underway for addressing some of the issues outlined below.

Arsenic analysis and field-test kits – reliable arsenic analyses are essential for arsenic testing. There is a need for field-test kits which can detect arsenic in the range 5–200 $\mu g\ L^{-1}$ reliably. These should be cheap enough to be available on the local markets. There has been a significant improvement in the design of field-test kits in the last three years and the challenge now is to make these kits widely available and affordable in Bangladesh. Although the development of accurate field-test kits should not delay the emergency testing and mitigation work (Smith et al., 2000), improvements in the technology will have undoubted medium- to long-term benefits and should reduce the inevitable confusion that will occur when deciding on the long-term suitability of various drinking water sources. It would also be beneficial if the present Bangladesh drinking water standard for As were reduced to the WHO guideline value;

Arsenic distribution with depth in the shallow aquifer – most shallow wells are screened in the shallowest horizons that will guarantee fresh water with an adequate yield. There is a dearth of data about how arsenic concentrations vary below this depth, i.e. in the deeper parts of the shallow aquifer. This should be determined at a number of strategic locations using nested sets of piezometers, or failing that, a suitable downhole water sampler;

Arsenic contamination of the 'deep' aquifer – there are reports of arsenic contamination of the deep aquifer in Bangladesh, and sometimes reports of once arsenic-free deep wells becoming contaminated with time. These are such important conclusions that the facts need to be established beyond doubt as quickly as possible. From our experience of deep wells in southern Bangladesh, the large majority of tested wells are presently very low in arsenic, mostly (but not always) less than 10 $\mu g\ L^{-1}$. DPHE's experience from their deep well drilling programme is broadly similar.

Therefore all deep wells that are identified as being contaminated (>10 $\mu g\ L^{-1}$) should be double checked by resampling and re-analysis. The re-analysis should be carried out by an independent and reputable laboratory, preferably using an analytical method with sensitivity at the low $\mu g\ L^{-1}$ level. This testing should be done blind. Until this has been done, such reports should be viewed with caution. It may be worthwhile duplicating all testing of deep wells from the outset, i.e. taking duplicate samples and sending to different laboratories, or maintaining the second sample in a secure place in case re-analysis is called for (rather like the procedures adopted for drug testing of athletes). Professional statistical advice should be sought.

For those deep wells positively confirmed as contaminated in this way, it needs to be established whether the aquifer itself is contaminated or whether the contamination is due to leakage due to poor well design or construction, multiple screened intervals or an error in recording the well depth.

Countrywide availability of the 'deep' aquifer – better maps of the distribution, depth and water quality (arsenic, manganese, iron and salinity, at least) of the deep aquifer are needed over the whole of Bangladesh. This should include an assessment of the thickness of any intervening aquiclude so that hydrogeological modellers can model the flow of water to and through the deep aquifer. We recommend that a PC database is set up containing coded lithological logs from throughout Bangladesh. This should make use of existing data where they are of suitable quality but there will need to be a new drilling programme to fill in important gaps in knowledge.

Sustainability of the deep aquifer and regional groundwater flows – a better idea of the nature of the regional groundwater flows and of the rate of recharge to the deep aquifer are needed. If a substantial amount of water is to be abstracted from the deep aquifer, then the ability of the deep aquifer to sustain this for 50 years or longer needs to be established. Also the impact that this may have on existing deep flows and on the possibility of further saline intrusion in the coastal region needs to be determined.

Dating of groundwaters and sediments – the ages of the groundwaters and sediments are an important scientific aspect of the arsenic problem and should be systematically studied using a variety of dating techniques.

Detailed village-scale studies – detailed studies of the hydrogeology and hydrochemistry of small areas, say about the size of a village or mouza, should be undertaken to understand better the reasons for the large degree of spatial variability in arsenic concentrations observed. This should include a comprehensive water-quality testing programme with accurate georeferencing of the well locations. A geostatistical analysis of the data can be used to quantify the spatial variability. A range of key hydrochemical parameters should be measured, not just arsenic. These should include all of the major ions, as well as iron, manganese, bicarbonate and phosphate. The study areas should not be confined to arsenic-rich areas. Parallel sediment studies should be carried out to understand the geochemical and hydrogeological processes involved. The aim is to both understand the geochemical and hydrogeological processes taking place in a quantitative way, their history and the reasons for the variability in the observed groundwater quality.

A hand-held GPS is the best way of recording the exact location of a well (along with the well owner, etc) and is now sufficiently accurate to uniquely identify the position of virtually every well in Bangladesh. At present, GPS instruments are too expensive for everyday use in Bangladesh but this will probably change with time.

Monitoring changes in arsenic concentration with time – it is important to maintain a monitoring network of wells so that any changes presently taking place can be identified. This should include wells at various depths and modes of construction, and should span the various possible timescales of change – hourly, daily, seasonal and long term. Deep wells will need monitoring less frequently than shallow wells, say every 6 months in the first instance. This should include a continuation of the present sets of piezometers constructed in this project with new sites in the low-arsenic regions. Monitoring frequency should allow a redundancy of about 50%, i.e. if you are looking for monthly changes, sample at least twice per month. This allows for some problems in sampling and analysis. The very best possible methods of chemical analysis should be used since changes are likely to be quite small. To do otherwise is a waste of time and can be misleading.

Construction of deep tubewells – it is important to ensure that there is a minimum of downward leakage of arsenic from the potentially-contaminated shallow aquifer to the deep aquifer. These may arise because of inappropriate methods of well construction, e.g. improper sealing of the shallower, contaminated horizons. Therefore methods need to be devised and promoted to ensure that wells are properly sealed when constructed. Tests should be undertaken to estimate the extent of leakage where deep wells have been confirmed as contaminated. Natural isotopic variations and artificial tracers could prove useful for this.

Adsorption studies on Bangladesh sediments and model oxides – it is clear that adsorption-desorption processes are of critical importance in determining the extent of the groundwater arsenic problem in Bangladesh and elsewhere. Fundamental laboratory-based studies are needed to establish the quantitative nature of the arsenic adsorption isotherms and the competitive interactions that might affect the extent of arsenic adsorption in Bangladesh sediments. These should be carried out on both oxidised and reduced sediments. Speciation of solid phase iron (Fe(II), Fe(III)) and arsenic (As(III), As(V)) should be undertaken on carefully-preserved sediments. Spectroscopic methods may help to resolve this speciation at both the bulk and mineral particle scales. A detailed study of the interactions of arsenic (As(III), As(V)) and other competing solutes should be carried out on model minerals, especially iron oxides, to establish a plausible modelling approach. Possible competing anions such as phosphate, bicarbonate, silicate and dissolved organic matter should be included. This will lead to the establishment of an appropriate modelling methodology (i.e. the model itself and a database of model parameters appropriate for Bangladesh conditions).

Transport of arsenic in Bangladesh aquifers – the pathways and timescales for arsenic movement to tubewells (hand-pump and irrigation) should be established using a contaminant transport model. This should be backed up by field tracer tests and traditional hydrogeological procedures such as pump tests and piezometer monitoring. Column (laboratory) studies could be used to establish the validity of the contaminant transport model used. The adsorption isotherm included should be consistent with the known adsorption properties of the sediments (see above). The overall aim is to be able to predict the movement of arsenic in Bangladesh aquifers under a variety of realistic hydrogeological and pumping conditions.

Impact of irrigation on the groundwater arsenic problem and the downstream impacts of using arsenic-contaminated groundwater for irrigation – although we believe that the relatively recent increase in the use of irrigation in Bangladesh is not the primary cause of the present groundwater arsenic problem, irrigation may well have some long-term impact through both hydrogeological (flow) and geochemical mechanisms. Extensive abstraction of groundwater, especially from the deeper parts of the aquifer, will alter the groundwater flow patterns within the aquifer. In general, there will be enhanced flow and mixing near the well. Given the heterogeneous distribution of arsenic within Bangladesh aquifers, this is likely to impact on the arsenic concentration in the abstracted groundwater. This needs quantifying. Large-volume urban groundwater supplies will have a similar effect.

There are also possible impacts relating to the influence of arsenic on crop growth, soil quality and the quality of any foodstuffs used for human or animal consumption.

The abstraction of groundwater for irrigation also has significant non-arsenic impacts on rural water supply in Bangladesh. The enhanced seasonal drawdown during the dry season may result in the water table falling below the depth at which traditional suction handpumps can operate. This has already happened in some parts of Bangladesh.

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