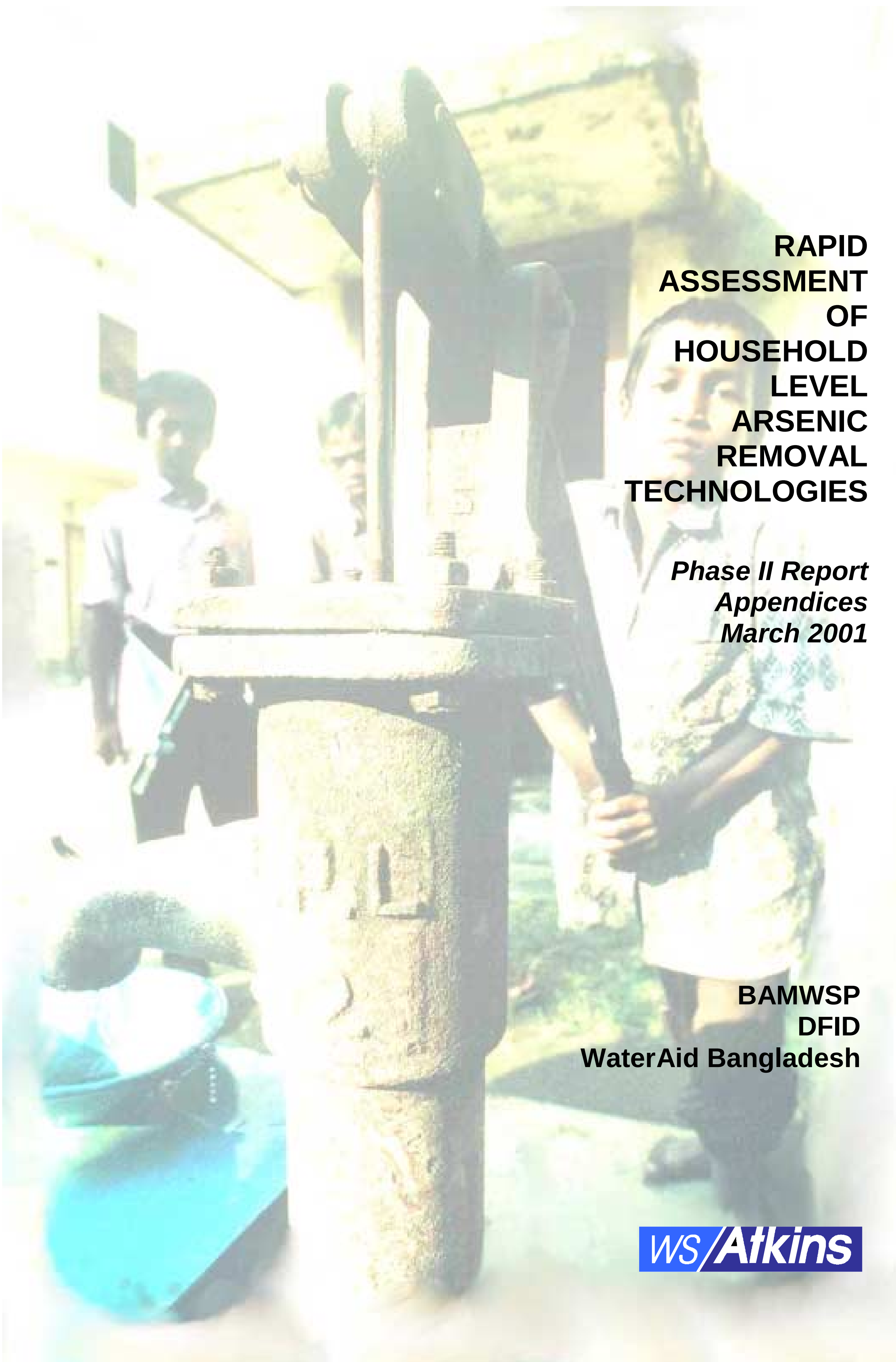

RAPID ASSESSMENT OF HOUSEHOLD LEVEL ARSENIC REMOVAL TECHNOLOGIES

Phase II Report
Appendices
March 2001

BAMWSP
DFID
WaterAid Bangladesh

WS/Atkins

Rapid Assessment of Household Level Arsenic Removal Technologies

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WS Atkins International Ltd

Woodcote Grove, Ashley Road, Epsom, Surrey KT18 5BW
Tel: (01372) 726140 Fax: (01372) 740055

1. APPENDIX 1: SAMPLING PROTOCOLS

PECO 75 TESTS

1.1 INSTRUCTIONS FOR USE OF PeCo 75 ARSENIC TESTING KIT

1. Check kit has been rinsed in distilled water and shaken dry.

2. Place correct sample volume into flask using a clean 50ml cylinder, a 10 ml syringe or a 5 ml syringe.

3. Prepare filter holder (cotton wool placed from bottom, filter B placed in the bottom end and filter A placed in the top of the filter holder) using fine tweezers

4. Add 3 pieces of TABLET 1

5. Put 2 pieces of TABLET 2 on lid, add to flask and immediately insert filter holder into neck of flask. WRITE DOWN TIME

6. Keep swirling gently for 15 minutes, or a until large fizzing tablets all dissolved

7. START NEXT 1 OR 2 PeCo TESTS IF SAMPLES ARE READY

8. Towards end of Stage 6 (reaction) prepare Photometer as follows: -

   - Turn the instrument on
   - Press “SELECT” until the display reads “CALIBRATION”
   - Insert a new filter A into the photometer filter holder
   - Press “MEASURE”
   - If display reads “Done”, “Error 05” or “As 0 ug/l” the photometer had calibrated successfully and is ready to read the test filter
   - If display reads “Defect Filter” press “SELECT” and then “MEASURE”. The photometer should read “Error 05” or “As 0 ug/l” and is calibrated.
   - If problems persist, try calibrating with a new filter A.

9. If the Photometer switches off, repeat the steps above

10. When reaction is complete, place test filter A from the filter holder into Photometer and proceed as follows: -

- Press “SELECT” until “Sample Volume” appears in the display.
- Press the up and down arrows until the correct sample volume is displayed
- Press “MEASURE” and record the displayed result on the record sheet.
- Remove filters A and B and cotton wool and dispose of in Solid Waste container.
- Insert next test filter A and repeat the above steps as necessary.

1.2 DAILY PROGRAMME FOR ARSENIC TESTING

Every day the aim is to sample a feed water and a treated water from 8 or more wells/technology replicates. Feed and treated waters will be tested at the same time.

1. Arrive at a well.

2. If the technology is being filled when you arrive, take 2 samples from the water being fed into the technology (one for PeCo 75 testing and one for laboratory testing). At the same time take 2 samples of the treated water (one for PeCo 75 testing and one for laboratory testing). This will be either water coming from the technology if it is a fast technology (e.g. Tetrahedron) or water that was fed through the technology some time before if it is a slow technology (e.g. DPHE/DAINIDA).

3. If the technology is not being filled but there is some treated water collecting or already collected in the receiving bucket, take 2 treated water samples from this bucket. For the feed water, take 2 samples directly from the well. Do not purge the well before sampling, just rinse the sample bottles in the first few strokes of the hand pump and then directly sample.

4. If there is no treated water, ask the owner to fill the technology if they are available. If it is a fast technology e.g. Tetrahedron, take 2 feed samples and wait for the 2 treated water samples. If it is a slow technology, e.g. GARNET, note the filling time and go on to another well and return later when you are able to sample the treated water.

5. Analyse one sample of the feed water and one sample of the treated water using the PeCo 75 at the same time i.e. use 2 flasks. The feed water sample volume will be 10ml (plus 40ml distilled water and 1ml nitric acid), the treated water sample volume will be 50ml (plus 1 ml nitric acid).

6. While the PeCo 75 test is proceeding (approx. 15 mins) acidify the other feed water and treated water samples that have been collected in the yellow topped sample tubes. Label the samples as indicated at the bottom of the Arsenic Testing Data Sheets.

7. Enter the results of the PeCo 75 analysis on the provided data sheets (noting all other information requested).

8. Go on to the next well and repeat the above process.

9. If possible do a PeCo 75 test on the two provided standard solutions (50ppb and 250ppb) each day. Record the results on the Arsenic Standard Data Sheets Provided.

1.3 SHORT TERM VARIATIONS IN ARSENIC CONCENTRATION

1. At well no. 1, collect a sample of feed water directly from the well. Note the time at which the sample was collected. Split the sample into 4 aliquots (portions). Put one portion in a sample tube, add 1ml nitric acid and label carefully with [(location)-(well no.)-(technology code)-(replicate A, B or C)-(feed)-VAR-(sample no. 1-5)] and date and time. Note labelling on Data Sheet F. On the remaining 3 aliquots, acidify with 1ml nitric acid and carry out a PeCo test for arsenic on each. (See separate instructions.) Enter the results on Data Sheet F.

2. 1.5 hours after the first sample was collected, take a second sample of feed water, split into 4. Keep one sample for lab analysis and test 3 aliquots for arsenic as before.

3. Continue taking samples and analysing for Arsenic every 1.5 hours, until a total of 5 samples have been collected (and 15 arsenic PeCo tests carried out).

4. Do not purge well before each sample.

5. Carry out this testing on one day of each field testing session, at a different well each time. These tests can be carried out at any 3 wells: it is preferable to select 3 wells with a range of arsenic concentrations.

HACH TESTS

1. At each of the three villages a suite of Hach tests will be carried out on a pair of feed and treated water samples from each of the 21 individual technologies. The sampling and testing protocol at each technology is as follows:

2. Collect a sample of the feed water.

3. Ideally take the feed sample as the householder is feeding the technology, from the same bucket that is being used to feed technology. If this is the case fill in code "FO" in the State of Fill row on the Data Sheets.

4. If the technology has already been fed, pump a "feed" sample directly from the well – this will be close enough to feed water chemistry. If this is the case fill in code "FW" in the State of Fill row on the Data Sheets. Do not purge the well.

5. A full sample pot should taken for the Hach analysis and a bucket filled for probe measurements. Clearly label the sample as FEED.

6. Do not filter the sample. Do not acidify.

7. Collect a sample of the treated water. If possible this should be collected as the water comes out of the technology. If the technology is fast, ask the owner to fill it and then collect the water as it comes out. In the case of slower technologies or if there is no one to fill the technology, take a sample from water that has been previously collected. If there will be a long wait for treated water, move onto a different well and return when a sample of treated water is available. Enter one of these codes into the State of Fill section on the Data Sheets:

Treated water code	*Description*
IU	Technology in use and water collected as filtering through
OF	Owner filled technology on request
PF	Previously filtered water samples. Enter also approximate time of last fill.

Again a full sample pot should taken for the Hach analysis and a bucket filled for probe measurements. Clearly label the sample as TREATED.

Do not filter the sample. Do not acidify.

8. Make sure the pH/mV, Conductivity and Dissolved Oxygen probe units are switched on and put the probes into the bucket of feed water.

9. Taking care to keep the feed and treated samples distinct (use the printed laminated sheets to stand sample bottles on), take the required volume of sample from each of the sample pots and run Hach tests on both the feed and treated samples simultaneously. Carry out the tests in the order given here: -

    - **Ferrous Iron** First check if dilution is likely to be required. A table of dilution factors used in Phase 1 is provided. Use the same dilution as was used for ferrous iron in Phase 1 for the feed waters. For treated water run the test initially on undiluted sample and if result is over-range repeat at a suitable dilution. Follow the instructions in the Hach manual for Ferrous Iron. Record the results for feed and treated in the relevant boxes on the proforma sheet.

    - **pH, mV, Conductivity, DO, Temperature** Record the readings for feed water given by the probes in the relevant boxes on the proforma sheet. Rinse the probes and put into the bucket of treated water. Allow some time for readings to stabilise and then return and record the results for treated water in the relevant space on the proforma. In the meantime continue with further Hach tests.

    - **Total Iron** First check the table of dilution factors used in Phase 1 to see if dilution of feed water is likely to be required. If so dilute the sample by the appropriate factor. Follow the instructions in the Hach manual for Total Iron. Record the results in the relevant boxes on the proforma sheets.

    - **Turbidity** Take fresh samples of feed and treated water at this point. If no fresh sample is available note how much time has elapsed between sample collection and analysis. Follow the instructions in the Hach manual for Turbidity.

    - **Sulphide** Put on new pair of rubber gloves. Follow the instructions in the Hach manual for Sulfide (0 to 0.6 mg/l). Record the results in the relevant boxes on the proforma sheets.

    - **Alkalinity** Keep rubber gloves on after rinsing under well. First check if there is a dilution required for the area i.e. dilution factors used in Phase 1. Follow the instructions in the Hach manual for Alkalinity (High Range). Record the results in the relevant boxes on the proforma sheets.

    - **Manganese** Keep rubber gloves on after rinsing under well. Use the Managanese LR test and follow the instructions in the Hach manual. Record the results in the relevant boxes on the proforma sheets.

    - **Phosphate** Keep rubber gloves on after rinsing under well. Use the Phosphorus Reactive test. Follow the instructions in the Hach manual for Phosphorus Reactive (0 to 30.00mg/l). Record the results in the relevant boxes on the proforma sheets.

- **Fluoride** Keep rubber gloves on after rinsing under well. Follow the instructions in the Hach manual for Fluoride (0 to 2.00 mg/l). Record the results in the relevant boxes on the proforma sheets.

- **Chloride** Keep rubber gloves on after rinsing under well. First check if there is a dilution suggested for the area. If a dilution factor is given, dilute the sample(s) by the dilution factor. Follow the instructions in the Hach manual for Chloride. Record the results in the relevant boxes on the proforma sheets.

- **Aluminium** Use the Aluminium (0 – 0.220 mg/l, Low Range) test. Follow the instructions in the Hach manual for Aluminium Eriochrome Cyanine R Method. If the result is over-range, repeat the test using the Aluminium High Range method. Record the results in the relevant boxes on the proforma sheets.

- **Nitrate** Use the Nitrate, low range test and follow the instructions in the Hach manual for Nitrate. If the result is over-range, repeat the test using the Nitrate Medium Range test. Record the results in the relevant boxes on the proforma sheets.

- **Sulphate** Using a 0.2µm syringe filter, filter a portion of the feed sample. Following the instructions in the Hach manual for Sulfate (0 to 70 mg/l), carry out tests on the filtered feed water and unfiltered treated water. Record the results in the relevant boxes on the proforma sheets. (NB in the first week of field testing feed waters were not filtered for this test.)

10. All liquid wastes from Hach tests should be poured into liquid waste container for later disposal by Team Leader.

11. The water quality probes should be calibrated against standard solutions once per week.

12. Hach analysis will be carried out for two technologies per day (seven per field session). By the end of the programme Hach analysis will have been carried out on 21 paired samples of feed and treated water, <u>one from each replicate of each technology.</u> Hach analysis will not have been carried out at each individual well but testing will be scheduled to include as many of the 63 test wells as is practical.

13. At the end of the programme a full suite of Hach tests should be carried out on the prepared multi-element standard solution.

14. On the last days each of the three field testing sessions, *if all of the tests described above scheduled for that session have been completed*, carry out the following additional Hach tests:

15. BUET: Test one feed/treated pair from each BUET replicate for Aluminium, Manganese

16. Alcan: Test one feed/treated pair from each Alcan replicate for Aluminium

17. DPHE/Danida: Test one feed/treated pair from each DPHE/Danida replicate for Aluminium, Manganese, Sulphate

18. Stevens: Test one feed/treated pair from each Stevens replicate for Total Iron, Chloride

19. Sono 3 kolshi: Test one feed/treated pair from each Sono replicate for Total Iron.

20. Tetrahedron: Test one feed/treated pair from each Tetrahedron replicate for Chloride

21. For Aluminium tests where there is a choice of method, use Low Range method initially. If result is out of range (>0.22mg/l Al) repeat test using High Range method.

22. Enter the results of additional Hach tests on the appropriate Data Sheets. Include comment/code in State of Fill cell on how the feed/treated water was collected, as described above.

DEL AGUA TESTS

MICROBIOLOGICAL SAMPLING SHOULD ALWAYS BE CARRIED OUT WEARING GLOVES AND A MASK (IF AVAILABLE). TAKE CARE TO AVOID CONTAMINATION AT ALL STAGES EITHER BY CONTACT WITH SKIN, HAIR AND ALL OTHER SURFACES OR BY BREATHING ONTO THE APPARATUS OR SAMPLE.

1.4 FIELD TRIP 1

DAY 1

Microbiological analysis of feed water for Well 1

Taking a Microbiological Sample from Well 1

1. Wipe opening of well with a clean tissue

2. Pump water for at least 30 seconds.

3. Remove foil and filtration equipment from sample cup. Put foil over the open funnel of the filtration equipment and place on top of the kit without touching inside surfaces. Rinse the sample cup once with well water and then fill. Take care not to touch or breathe into the either the inside of the cup or the water. Place cup on kit and re-cover with foil. Note time on Microbiology Record Sheet.

4. Flame tweezers with the lighter and leave to cool by placing the handle in the test kit as indicated. Do not allow the end of the tweezers to touch anything.
5. Pick up filtration apparatus carefully and push firmly onto the vacuum cup (one with no hole on the side). If this is difficult the black sealing o ring can be lubricated with silicone grease (in spares kit), but take care not to touch or breathe into the inside of the plastic funnel tube. It is best to leave this covered with foil until you are ready to proceed. Place the assembly upright somewhere on the kit NOT on the ground.

6. Loosen the plastic collar and filtration funnel so that they can be easily removed. Do not place these on any surface other than the filtration base.

7. Using the sterile tweezers remove a sterile membrane grid filter from its packet, holding only by the edge.

8. With one hand, lift the filtration funnel and plastic collar above the filtration base. With the tweezers in your other hand, place the membrane

(grid side uppermost) onto the bronze disc filter support. Replace the filter funnel and collar immediately, without allowing them to come into contact with any external objects. It is easiest to hold the filter funnel between thumb and forefinger to ensure that the collar does not slip off and that the fingers do not come into contact with interior surface of the funnel. Carefully replace the sterile tweezers into the holder on the kit. If they touch anything it is important to re-sterilise them using the lighter.

9. Screw the plastic collar down tightly to hold the membrane and provide a watertight seal. The plastic collar should be in position 3 (see diagram)

10. Remove the foil from the sample cup and pour 50 ml into the filtration funnel (middle mark engraved on the inside of the filtration funnel). Replace foil.

11. Insert the plastic connector of the vacuum pump into the vacuum connection on the filtration base. Squeeze the pump bulb several times to create a vacuum then squeeze as required to draw all the water through the membrane filter. When all the water has passed through the filter, disconnect the pump from the filtration apparatus.

12. Prepare a petri dish by removing from the holder and carefully lifting the lid with one hand, then pouring in some sterile broth with the other hand. The amount used should be enough to soak the pad thoroughly and leave a little surplus around the edges (around 2.5ml). Do not turn the lid over or put it down on anything while you are pouring the broth in but hold it over the base of the dish to prevent contamination. As soon as the broth has been poured in replace the lid. One bottle of broth is enough for 16 petri dishes. If you do not use all the dishes in a day, the broth remaining should be discarded so that a new bottle is used each day.

13. Returning to the filtration apparatus, unscrew the collar and remove the funnel and collar with one hand. Using the sterile tweezers in the other hand, lift the membrane carefully from the filtration base. Hold the membrane by the edge only. Replace filtration collar and funnel onto filtration base without touching the inside.

14. Lift the lid of the prepared petri dish and place the membrane grid side uppermost onto the absorbent pad soaked in culture medium. It is important to avoid trapping air bubbles, by starting at one edge of the dish and lowering the membrane by rolling.

15. Replace petri dish lid immediately and label with marker pen directly on the lid:

16. Well No. – Date – Time – 50ml

17. Place the petri dish with lid uppermost into the carrier and return the carrier to the incubator pot.

18. Sterilise the tweezers in the lighter flame again and repeat steps 7 to 13, this time filling the filter funnel with sample water to the top mark (100ml). Label new petri dish:

Well No. – Date – Time – 100ml

Place the petri dish holder (lids uppermost) in the incubator and replace the lid.

Faecal coliform analysis of feed water

19. Repeat exactly the same process (Steps 1 to 18)using the second Del-Agua Kit.

Re-Sterilisation of filtration equipment between wells

20. The sample cup and filtration apparatus must be re-sterilised between samples when testing water from different sources. Rinse the sample cup and filtration assembly with distilled water and carefully dry with a clean tissue.

21. Using the plastic collar, secure the filtration funnel in position 2 (see figure for Step 9).

22. Pour about 1 ml (20 drops) of methanol into the sample cup, and carefully ignite using the lighter. Ensure that the mouth of the cup points away from you. Place the cup on a flat surface (not the kit box).

23. Allow the methanol to burn fro several seconds and then when almost completely burned up, place the filtration apparatus over the sample cup and push firmly into place to form a good seal.

24. Repeat Steps 20 to 23 with the apparatus from the second kit.

25. Leave the filtration apparatus in the sample cups for at least 15 minutes. During this time carry out chorine and turbidty tests.

Chlorine and pH analysis

26. Wash the comparator cells three times under the well and finally fill both cells with the well water.

27. Drop a DPD No. 1 tablet into the right hand cell (Cl2) and a Phenol Red tablet into the left hand cell (pH).

28. Replace the lid of the comparator cell and push down firmly to seal. Invert the comparator repeatedly until the tablets have both dissolved completely. Do not shake as this will introduce air.

29. Immediately read the free chlorine residual and pH concentrations by holding the comparator up to the daylight and matching the colour developed in the cells with the standard colour scale in the central part of the comparator. If the colour falls between two standard colours, then it will be necessary to estimat the concentration. Record the results on the the Microbiology Record sheet.

Turbidity Analysis

30. Slot turbidity tubes together and pour water into the tube from the sample cup until the black circle just disappears when viewed from the top of the tube. Avoid creating bubbles as these may give false readings.

31. The turbidity reading is the value of the line nearest the water level. Record this value on the Microbiology Record Sheet.

Completion of Microbiology Record Sheet

32. Check that all details have been recorded on the Microbiology Record Sheet. Record any obvious source of bacterial contamination close to the well (eg animals, adjacent bathroom, washing etc).

33. Pack up test kit, leaving the filtration apparatus and the sample cup sealed together, and move to next well or technology,

Microbiological analysis of feed water for remaining wells

34. Repeat Steps 1 to 33 at each well, adding each labelled petri dish to the holder and recording the information required on the Microbiology Record Sheet. The final sample should be finished around 4 pm to allow adequate time for incubation. Try to do as many samples in one day as possible.

End of Day – Preparation of Blanks

35. Repeat Steps 3 to 15 using 10 ml of the sterile water provided. The first mark at the bottom of the filter funnel is 10 ml. Label this petri dish: BLANK – Time. Resterilise filtration equipment and sample cup (Steps 19 to 23) ready for the following day. Repeat this with the second Del Agua kit.

36. At the end of the day, at least 1 hour after collection of the final sample, switch on the incubator and record incubation start and finish time on the

Microbiology Record Sheet. Allow the plates to incubate for between 16 and 18 hours exactly. Plug the incubator into the mains on return to the hotel.

DAY 2

Counting Plates

37. Once the incubation is complete, turn off the incubator and remove the petri dishes from the holder.

38. Remove the lid of a petri dish and observe the surface of the membrane in good incident light. Count all yellow colonies that have a diameter of between 1 and 3 mm. Record this result on the Microbiology Record Sheet. Then count all other colonies which may be transparent or red/pink on cooling. Record this result in brackets in the same Count column of the Microbiology Record Sheet.

39. Count all plates incubated in this way.

Microbiological analysis of feed water for wells 8 to 14

40. In the field repeat the programme for Day 1, for as many more wells as possible.

DAY 3 – DAY 7

41. Repeat Day 2 schedule until all 21 wells have been sampled.

Extra Work!

If it proves possible to complete all wells in 3 days, it would be helpful to continue the programme, taking samples from Replicate A of each technology. Speak to your team leader about this. Re-sterilisation of petri dishes is described here – you do not need to do this if you do not have time to do the treated water samples.

Re-sterilise petri dishes

Once all wells have been sampled it will be necessary to re-sterilise the petri dishes, before proceeding further.

Wash with detergent, wipe with methanol on a sterile cotton wool ball and flame inside surface of both the dish and lid using lighter. Put lid on dish while still hot and allow to cool. Carry this procedure out in as clean an environment as possible and avoid contact with hair, skin or breath.

1.5 FIELD TRIP 2

DAY 1

Microbiological analysis of treated water from Replicate A of each technology

1. Collect a sample of treated water from Replicate A of the technology in the sterile sample cup. If possible this should be collected as the water comes out of the technology. If the technology is fast, ask owner to fill and collect water as it comes out. In the case of slower tehnologies or if there is no one to fill the technology, take a sample from water that has been previously collected or return later when the technology is in use. Team members should not fill technologies. Enter one of these codes into the State of Fill column on the Microbiology Record Sheet. Take care when sampling that only the water comes onto contact with the sample cup.

Code	*Description*
IU	Technology in use and water collected as filtering through
OF	Owner filled technology on request
PF (time)	Previously filtered water sampled. Enter also approximate time of last fill and whether bucket was covered etc

2. Carry out microbiological analysis of the treated water sample as described in Steps 3 to 31 for the Field Trip 1.

3. Carry out as many samples as you can each day.

DAY 2 to 7

4. When all A replicate technologies have been sampled, start on the B replicates. Finish these then continue with C replicates. It is important that all technologies are sampled over the 7 day period. It is best to do them in as few days as possible.

1.6 FIELD TRIP 3

Repeat Field Trip 2 programme.

LABORATORY ANALYSIS

1.7 SAMPLE COLLECTION FOR ICP ANALYSIS

1 Visit each of the 21 testing wells in each area. At each well:-

2. Do not purge the well. Collect one sample of water directly from the well. Do not filter. Add 1ml of nitric acid to preserve the sample.

3. If technology is replicate A of Stevens, Alcan, BUET or DPHE/Danida, collect a sample of the treated water. If possible this should be collected as the water comes out of the technology. If the technology is fast, ask the owner to fill it and then collect the water as it comes out. In the case of slower technologies or if there is no one to fill the technology, take a sample from water that has been previously collected. Enter one of these codes into the State of Fill on Data Sheet A:

Treated water code	*Description*
IU	Technology in use and water collected as filtering through
OF	Owner filled technology on request
PF	Previously filtered water samples. Enter also approximate time of last fill.

4. Do not filter the sample. Add 1ml of nitric acid to preserve the sample.

5. Label the samples carefully with [(location code)-(well number)-(technology code)-(replicate A, B or C)-(feed or treated)-ICP] and date. These samples will be returned to UK for ICP analysis.

6. Enter sample numbers and details on Data Sheet A.
7. By the end of the programme 25 ICP samples will have been collected, one feed sample from each well and one treated sample from each of Stevens A, Alcan A, BUET A and DPHE/Danida A.

2. APPENDIX 2: QUALITY CONTROL MEASURES

PECO 75 TESTS

Equipment

2.1 Each of the three field teams were issued with three PeCo 75 arsenic testing kits with a supply of filters and reagents which were kept in sealed containers.

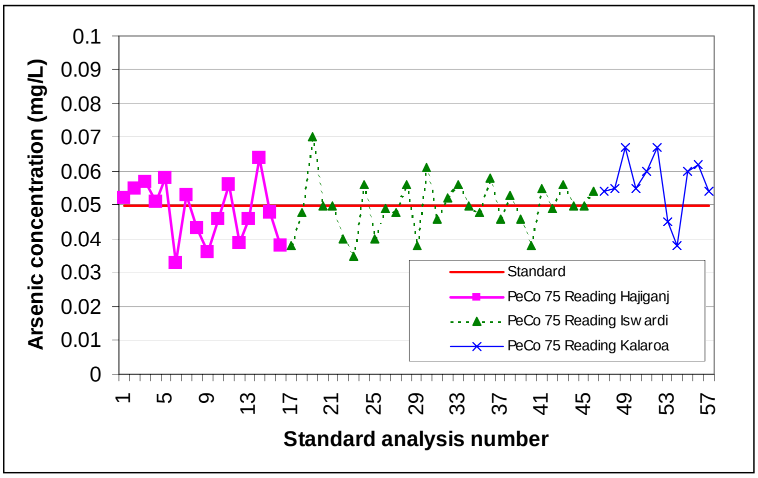
Standard operation procedures

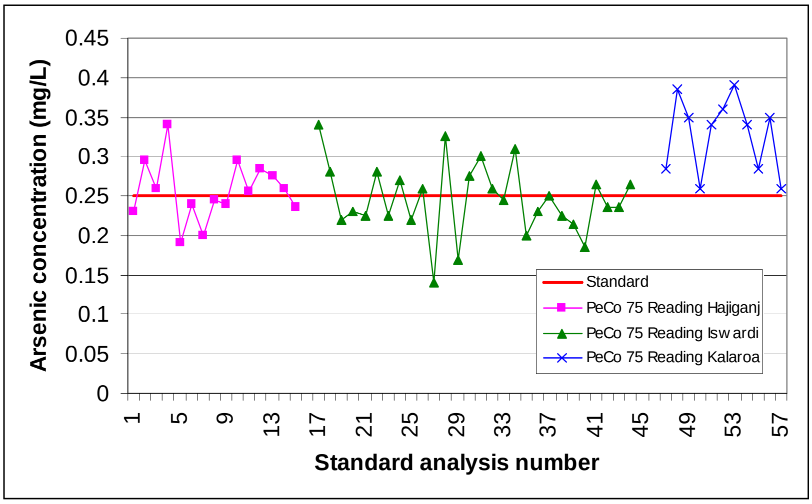
2.2 Extensive training and operation of the PeCo 75 had been completed by all of the technical field survey team members in Phase I of the project. Labelled plastic sample containers were rinsed with the water to be sampled prior to sampling. Sample volumes were measured using rinsed graduated cyclinders or syringes and 1ml of 1:1 nitric acid solution was added to both PeCo 75 test samples and laboratory samples.

2.3 PeCo 75 samples were placed on specially designed table sheets which ensured correct identification of the sample being tested.

2.4 Well number, well owner, grid reference, name of sampler, date, time, dilution, result and confirmation of whether lab sample taken were all entered onto data recording sheets at the time of testing.

2.5 PeCo 75 tests were undertaken on two standard solutions of 0.05mg/L and 0.250mg/L at least every two days to observe any temporal changes in accuracy of the testing. The results are presented in the two figures below.





2.6 Laboratory samples were taken for every feed and treated water sampled as backup in case of anomalies. 15% of these were analysed by AAS-HG to check the accuracy of the PeCo 75. These samples were acidified and labelled with the following information: -

AREA-WELL NO.-TECHNOLOGY-REPLICATE-FEED or TREATED-PAIRED SAMPLE NO.

e.g. KA-5-GA-B-F-7 denotes Kalaroa, Well No. 5, Garnet Replicate B, Feed Water, Paired Sample No.7

HACH TESTS

Equipment

2.7 Each of the three field teams possessed their own set of equipment which comprised: a Hach spectrophotometer, Hach Turbidity and Alkalinity test kits, and pH, conductivity and dissolved oxygen meters. All associated chemicals, spares and associated analytical items used for the work were kept in labelled plastic boxes. The kits were routinely restocked for chemicals, syringes, de-ionised water etc.

Standard operating procedures

2.8 Manuals of operating procedures for the Hach spectrophotometer (Hach file) were prepared prior to field work so as to simplify the analytical procedures for the individual water and probe tests. The individual handbooks on Hach were supplemented by intense training for field assistants by team leaders and trained Hach representatives in Dhaka prior to Phase 1. The manuals contained standard pro forma data sheets for analytical data input. These Standard Operating Procedures are presented as Appendix 1.

2.9 Individual data recording sheets were regularly reviewed by team leaders and relevant sheets were removed or photocopied from the folders following each of the three fieldwork sessions. Data were entered into EXCEL for analysis.

2.10 Data from Phase I was used to give an indication of elemental concentrations and allow prediction of appropriate dilution factors for the Hach spectrophotometer methods. In Phase I Hach tests had been carried out on filtered feed samples. In Phase II the samples were not filtered to allow a direct comparison of total concentration of each parameter in the water before and after treatment to be drawn.

Probe techniques

2.11 Conductivity, pH/Eh and Dissolved oxygen/temperature probes manufactured by Lutron and purchased in Dhaka were used for the fieldwork. Prior to fieldwork the probes were all calibrated and separate units compared on test solutions. Readings on the test solutions from separate units were found to agree to within 1% for conductivity and pH and to within 5% for dissolved oxygen.

2.12 In the field, water quality probes were calibrated by team leaders every week. In the calibration of the pH probe a two standard method (pH 7 and 4) was used. The calibration of the conductivity probe used a 1413µS/cm standard and for the calibration of the dissolved oxygen probe an air saturation standardisation technique was used. The procedures for operating and calibrating the probes were incorporated into the manual on analytical techniques and used by the field operatives as a reference (Hach file).

Chemical analysis in the field

2.13 The Hach portable laboratory system is the most widely used comprehensive water quality testing kit in the world and has a well-established track record. Nonetheless, as a further quality control measure, a multi-element standard was prepared using AA chemical solution standards for use in a Hach standard run that was carried out in each of the three areas. The synthetic solution contained Fe, Mn, Al, PO_4, F, Cl and SO_4 in the concentrations given in Table 2.1. The elemental concentrations in the solution were chosen so that they were within the analytical range of the Hach Spectrophotometer and within the range of typical Bangladesh tube well waters.

Table 2.1 - Hach multi-element standard results

Element	**Hach Spectrophotometer range (mg/L)**	**Target concentration (mg/L)**	**Field standard result**		
			Hajiganj	**Ishwardi**	**Kalaroa**
Fe	0 – 3	1.00	0.84	0.84	0.84
Mn	0 – 0.7	0.5	0.485	0.479	0.485
Al	0 – 0.8	0.5	0.162	0.161	0.162
PO4	0 – 30	10.00	10.06	9.77	9.75
F	0 – 2	1.0	0.92	0.93	0.92
Cl	0 – 20	5	4.8	4.9	4.8

2.14 The detection limits and precision of the Hach spectrophotometer are, for most tests, stated in the Hach manual. For those tests where no detection limit was specified, detection limits were estimated in a one-off study during Phase I following the dilution method specified in the Hach manual. Working ranges, detection limits and precisions of the Hach tests that were used are summarised in Table 2.2.

Table 2.2 - Hach Method detection limits and precisions

Element	**Hach Method**	**Working Range, mg/L**	**Method Detection Limit, mg/L**	**Precision**
Iron (Ferrous)	8146	**0 – 3**	0.01	**± 0.006**
Iron (Total)	8008	**0 - 3**	**0.02**	**± 0.006**
Manganese	8149	**0 – 0.7**	0.005	**± 0.0049**
Aluminium	High Range 8012	**0 – 0.8**	0.05	**± 0.016**
	Low Range 8326	**0 – 0.22**	0.02	**± 0.004**
Phosphate	8178	**0 - 30**	0.03	**± 0.02**
Nitrate	8171	**0 – 0.4**	0.03	**± 0.01**
Chloride	8113	**0 - 20**	0.4	**± 0.3**
Fluoride	8029	**0 – 2**	**0.02**	**± 0.02**
Sulphide	8131	**0 – 0.6**	**0.01**	**± 0.003**
Sulphate	8051	**0 - 70**	**7**	**± 0.9**

Notes:

1) Values in bold type are quoted from the Hach manual. Detection limits in normal type were measured according to dilution methods specified in the Hach manual.

Health and Safety

2.15 A hazard assessment was carried out for all the tests that were to be carried out in the field. This is shown below. Arrangements were made with the British High Commission doctor for emergency call if required. The nature of the survey was passed on, mobile phone numbers and contact details were made available in case the need for urgent attention.

2.16 All field staff were told of the hazards, informed of emergency action and given a copy of the Hach hazard assessment shown below.

2.17 All liquid and solid waste from the field testing was stored in sealed containers and disposed of off site.

HACH TESTING
HAZARD ASSESSMENT
AND HEALTH AND SAFETY INSTRUCTIONS

Test	Reagent	Components	Hazard	Potential Health Effects	Precautions	First Aid	Disposal
Ferrous Iron	Ferrous Iron Reagent Powder Pillows	1, 10-Phenanthroline Sodium Bicarbondate	Low	Eye, skin, respiratory tract irritation.	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. Induce vomiting if swallowed by sticking finger down throat. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
Total Iron	FerroVer Iron Reagent Powder Pillows	Sodium Thiosulfate; 1,10-Phenanthroline-p-toluenesulfonic Acid Salt; Sodium Hydrosulfite; Sodium Citrate; Sodium Metabisulfite	Low	Eye and respiratory tract irritation Allergic respiratory tract reation if inhaled or swallowed	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. DO NOT induce vomiting if swallowed. Drink 2 glasses of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
Alkalinity	Sulphuric Acid 0.035 N standard solution	Sulphuric Acid; Isopropanol; Sulphuric Acid (<0.1%)	Low	Eye, skin, respiratory tract irritation	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
	Phenolphthalein Indicator Powder Pillows	Phenolphthalein; Sodium Chloride	Low	Eye and skin irritation Ingestion – dehydration, vomiting, blood pressure change, muscular twitching, rigidity	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
	Bromcresol Green-Methyl Red Indicator Powder Pillows	Potassium Chloride	Low	Eye and respiratory tract irritation Ingestion – gastrointestinal disturbance, blood pressure change, cardiac depression, gastroenteritis	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
Sulphate	SulfaVer 4 Reagent Powder Pillows	Barium Chloride Citric Acid	Low	Eye, skin, respiratory tract irritation	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. Induce vomiting if swallowed by sticking finger down throat. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container

Test	Reagent	Components	Hazard	Potential Health Effects	Precautions	First Aid	Disposal
Nitrate (medium range)	NitraVer 5 Nitrate Reagent Powder Pillows	Potassium Phosphate, monobasic; Magnesium Sulphate; Cadmium; Gentisic Acid; Sulfanilic Acid	Medium	Eye, skin, respiratory tract irritation Cadmium is a carcinogen	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. Induce vomiting if swallowed by sticking finger down throat. Drink milk or egg whites at frequent intervals. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
Nitrate (low range)	NitriVer 3 Nitrite Reagent Powder Pillows	1,2-Cyclohexanediaminetetraacetic Acid Trisodium Salt; Chromotropic Acid, Disodium Salt; Potassium Phosphate, Monobasic; Potassium Pyrosulfate; Sodium Sulfanilate	Medium	Eye burns, skin and respiratory tract irritation	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. DO NOT induce vomiting if swallowed. Drink 2 glasses of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
	NitraVer 6 Nitrate Reagent Powder Pillows	Sodium Tartrate; 1,2-Cyclohexanediaminetetraacetic Acid Trisodium Salt; Cadmium; Sodium Sulfate; Tartaric Acid; Magnesium Sulfate	Medium	Eye, skin, respiratory tract irritation. Cadmium is a carcinogen	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. Induce vomiting if swallowed by sticking finger down throat. Drink milk or egg whites at frequent intervals. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
Aluminium (high range)	AluVer 3 Aluminium Reagent Powder Pillows	Aurintricarboxylic Acid, Calcium Salt; Disodium Succinate; Succinic Acid	Low	Eye, skin, respiratory tract irritation.	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
	Bleaching 3 Reagent Powder Pillows	Sodium Pyrophosphate; Potassium Pyrosulfate; Magnesium Sulfate	Medium	Eye burns, skin and respiratory tract irritation	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. DO NOT induce vomiting if swallowed. Drink 2 glasses of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
	Ascorbic Acid Powder Pillows	Ascorbic Acid	Low	Possible irritation	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container

Test	Reagent	Components	Hazard	Potential Health Effects	Precautions	First Aid	Disposal
Sulphide	Sulfide 1 Reagent	Sulphuric Acid (55 – 65%); demineralized water	High	Severe eye and skin burns. Ingestion – severe internal burns; nausea; vomiting; death; circulatory disturbance; rapid pulse and breathing; diarrhoea	USE RUBBER GLOVES (rinse gloves at well before removing) Close container when not in use. Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. DO NOT induce vomiting if swallowed. Drink 2 glasses of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
	Sulfide 2 Reagent	Potassium Dichromate (<1%); Demineralised Water	High	Eye, skin, respiratory tract irritation and allergic reaction. Ingestion – abdominal pain, vomiting, dizziness, thirst, fever, coma, liver damage. Chromium is a carcinogen	USE RUBBER GLOVES (rinse gloves at well before removing) Close container when not in use. Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water and induce vomiting by sticking finger down throat. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container
Phosphate	Amino Acid Reagent for Phosphate and Silica	N,N-Dimethylformamide ; Demineralized water; Sodium Metabisulfite; Sodium Sulfite	High	Severe eye, skin and respiratory tract irritation. Harmful to kidneys and liver if inhaled or absorbed through skin. N,N-Dimethylformamide is a carcinogen	USE RUBBER GLOVES (rinse gloves at well before removing) Close container when not in use. Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water and induce vomiting by sticking finger down throat. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container Incompatible with: - Oxidizers; Alkali metals; Nitric acid; metal nitrates; chlorine; bromine
	Molybdate Reagent	Ammonium Molybdate; Demineralised Water; Sulphuric Acid	High	Severe eye burns, skin irritation, internal burns	USE RUBBER GLOVES (rinse gloves at well before removing) Close container when not in use. Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. DO NOT induce vomiting if swallowed. Drink 2 glasses of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader.

Test	Reagent	Components	Hazard	Potential Health Effects	Precautions	First Aid	Disposal
Manganese (high range)	Buffer Powder Pillows Citrate Type	Citric Acid; Sodium Phosphate, Dibasic; Sodium Sulfate	Low	Eye, skin, respiratory tract irritation.	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container Incompatible with metal nitrates and aluminium
	Sodium Periodate Powder Pillows	Sodium m-Periodate (strong oxidizer)	Medium	Severe eye, moderate skin irritation.	Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. Dispose of empty sachets into solids waste container May react violently with reducers and organic materials

Manganese (low range)	Alkaline Cyanide Reagent	Sodium Hydroxide (1 – 5%); Sodium Cyanide (5 – 15%); Demineralized water	Very High	FAST ACTING POISON Burns to eyes and skin. Ingestion and inhalation – toxic and may be fatal. Causes cyanosis, internal burns, anxiety, headache.	USE RUBBER GLOVES (rinse gloves at well before removing) BE EXTREMELY CAREFUL. DO NOT BREATHE IN FUMES. Close container when not in use. Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, INFORM TEAM LEADER IMMEDIATELY. HOSPITAL TREATMENT REQUIRED	Contact with acid forms highly toxic fumes (cyanide gas) *Pour liquid reaction products into separate sealed container labelled "Alkaline Cyanide Liquid Waste"
	PAN indicator Solution 0.1%	Ammonium Acetate; N,N-Dimethylformamide ; Octylphenoxypolyethoxyethanol; Demineralised water	High	Severe eye, skin and respiratory tract irritation. Harmful to kidneys and liver if inhaled or absorbed through skin. N,N-Dimethylformamide is a carcinogen	USE RUBBER GLOVES (rinse gloves at well before removing) BE EXTREMELY CAREFUL. DO NOT BREATHE IN FUMES. Close container when not in use. Avoid ingestion, inhalation and contact with skin.	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water and induce vomiting by sticking finger down throat. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Incompatible with nitric acid, metal nitrates, halogens alkali metals, oxidizers

Test	Reagent	Components	Hazard	Potential Health Effects	Precautions	First Aid	Disposal
Chloride	Mercuric Thiocyanate Solution	Mercuric Thiocyanate (<0.5%); Methyl Alcohol	High	Eye & skin contact – moderate irritation. May be fatal or cause blindness if swallowed.	USE RUBBER GLOVES (rinse gloves at well before removing) Avoid ingestion, inhalation and contact with skin	Rinse affected area with large volumes of water. If swallowed, drink large quantities of water and induce vomiting by sticking finger down throat. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Incompatible with oxidizers
	Ferric Ion Solution	Ferric Perchlorate; Demineralised water; Perchloric Acid	Medium	Causes burns through contact, inhalation and ingestion	USE RUBBER GLOVES (rinse gloves at well before removing) Avoid ingestion, inhalation and contact with skin	Rinse affected area with large volumes of water. DO NOT induce vomiting if swallowed. Drink 2 glasses of water. INFORM TEAM LEADER	Pour into liquid waste container for later disposal by Team Leader. May react violently in contact with alkalies, reducers, organics, combustibles
Fluoride	SPADNS Reagent for Fluoride	Hydrochloric Acid; Sodium Arsenite; Demineralised Water	Medium	Causes burns through contact, inhalation and ingestion Contains Arsenic which is toxic.	USE RUBBER GLOVES (rinse gloves at well before removing) Avoid ingestion, inhalation and contact with skin	Rinse affected area with large volumes of water. DO NOT induce vomiting if swallowed. Drink 2 glasses of water. INFORM TEAM LEADER	* Pour into liquid waste container for later disposal by Team Leader. Incompatible with oxidizers

*HACH guidelines are to dispose of these reagents under the prevailing Hazardous Waste Regulations of the relevant country.

DEL AGUA TESTS

2.18 All Delagua samplers were given instruction in use of the kit and in particular in adoption of sterile technique before the start of the programme.

2.19 The incubators were calibrated and checked to ensure the correct temperatures were maintained for total (37°C) and faecal (44°C) coliform growth.

2.20 With microbiological testing the most critical factor in achieving accurate results is maintenance of sterile conditions in equipment preparation, sampling and processing. All equipment coming into contact with the sample water must remain sterile and the general working environment should be clean. Specific steps were taken to minimise contamination were:-

- Clean gloves and masks were worn by samplers
- Exposure of sterile surfaces (filter, petri dishes, sample cup) to the air minimised when taking a sample. The filter and sample cup were kept covered with sterile foil.
- Sample cup was handled only around the base to minimise risk of contact with sterile inside.
- Filtration and apparatus and sample cup were thoroughly sterilised between samples using methanol.
- Tweezers were regularly sterilised
- Opened bottles of sterile broth were discarded after one day
- Onlookers were encouraged to stand well back.

2.21 For all water sampled, two plates were prepared, using sample volumes of 50ml and 100ml. This aim to ensure that at least one plate was obtained with a count of between 20 and 200 colonies, the recommended range to balance statistical accuracy with practical counting considerations. This also provides a a quality control measure in that duplicate counts are available for all samples.

2.22 A blank sample was included in each incubation run to ensure the quality of sterile techniques in the field and the correct functioning of the incubation process.

LABORATORY ANALYSIS

2.23 In the Intronics Technology Centre, Dhaka a Hydride generation technique was used for the determination of arsenic concentrations in water samples. The equipment used was a Buck Scientific Model 210VGP atomic absorption spectrophotometer attached to a Model 420 Hydride generator.

2.24 Arsenic standards (5, 10, 25 and 30 ppb) were prepared in 1M HCl (5mL conc. HCl in 1L water), these concentration represent the working linear range of the technique used in the laboratory and were used throughout for instrument calibration purposes. Water samples were initially treated with an ascorbic acid /KI solution (50g/L of both ascorbic acid and KI) to reduce As(V) to As(III). The recipe for the individual solutions are detailed in Table 2.3.

Table 2.3 - Solution used in hydride generation technique

Dilution (As concentration range)	Volume of sample mL	Volume of HCl mL	Volume (Asc+KI) mL	Volume water mL
5x (<150ppb)	1	1	1	2
10x (150-300ppb)	1	1	1	7
20x (300-600ppb)	1	1	1	17
Blank	0	1	1	8

2.25 After leaving the samples for 45 minutes the samples were processed by AAS-HG. The machine was allowed to warm up for 30 minutes and the standards were analysed using argon as the carrier gas, a 1.5% NaBH4 solution (made in a 0.5% NaOH solution) and an acidic solution of hydroxylamine + sulphuric acid and hydrochloric acid. On sampling the read out data from the instrument the data was taken when the read out remained constant and arsenic concentrations were taken down in a notebook. The data from the machine represents the concentration of arsenic in the water sample. This must be multiplied by the initial dilution factor to get the actual water sample concentration.

2.26 On treating large quantities of samples a quality control procedure was established in order to reduce sample error and to speed up reporting. In the samples that were analysed standards were routinely analysed after every 5 samples to establish the consistency of the readings. Samples were put through the AAS-HG in a random manner and recorded in an EXCEL spreadsheet. The data was later sorted in serial number and reported (hard copy, floppy disk and by e-mail).

2.27 Solution standards used at the Intronics laboratory were cross checked with standard reference solutions and also with freshly made standards all of which correlated very closely.

3. APPENDIX 3: QUESTIONNAIRES

HOUSEHOLDERS QUESTIONNAIRE

Name of the Technology: …..…………….
Survey..1/2
Date of Interview……/……/..…..

ABOUT THE HOUSEHOLD

Name of the Respondent: …………………………..

Name of Father/Husband: ………………………….

Village: …………………………..

Union: ……………………………

Upazila: ………………………….

Number of Men in household:….. Number of Women:….. Number of children:…..

Householders occupations:……………………………………..

Household income:…………… (monthly)

1. Distance from the Tubewell: ………ft.
2. Distance from the next nearest tubewell:……..ft
3. How much water do you use for:

   a. Drinking…………………. (kolshis)
   b. Cooking…………………. (kolshis)
   c. Washing…………………. (kolshis)

4. From what other sources you use water for drinking and cooking purpose?

   a. b. c.

5. Which member(s) of your family is associated with procuring water?

   a.
   b.
   c.

ABOUT THE TECHNOLOGIES

6. a. How much time you spend everyday for using this technology?

……. hour ……. Minutes

b. How much water you get in a day?

……… litre (no. of buckets?)

c. Can this technology meet your demand for daily water use sufficiently?

Yes….. No…..

7. Have you faced any problem in using this technology? Yes…… No……

If 'yes', what are the problems?

Problems	How many times
………………..	……………
………………..	……………
………………..	……………

8. What is your opinion about the water after use of technology in respect to:

Taste: ………………………………

Smell: ………………………………

Colour: ……………………………..

9. How much money you are prepared to spend for buying the technology for getting arsenic-free water?

Taka:…………..

10. How you wish to pay for buying the technology? (Instalment/Down payment)

a. Individually
b. Collectively

11. How much money you can spend or willing to spend monthly for maintaining the technology?

Taka: ……….

13. Would you spend Tk. 500/- on an arsenic removal technology if you knew it worked and you could buy it now? Yes…… No…..

14. Would you be prepared to share a technology with other households?

    Yes……… No……..

    If Yes, which households would you be prepared to share with?

    ………………………………………………………………………………..

    (How many households and relationship?)

15. What is your opinion on how the technology should be used, managed and maintained collectively?

16. Who are associated with maintenance of the technology?

    a. b. c.

16. In respect of the technology, what is your opinion about

    a. size
    b. height
    c. weight

17. Compared to other household activities, how much you think the activities related to making water arsenic free is important?

18. In your opinion, how the people could be made to understand about the importance of using the technology and related activities to keep it functional?

20. Please mention the place where from it would be advantageous for you to procure the spare parts of the technology and required medicine?

21. What do you like about this technology?

    ………………………………………………………………………………

22. What do you not like about this technology?

    ………………………………………………………………………………

23. Any other comments?

PROPONENTS QUESTIONNAIRE

Name of technology:	
Name and address of proponent organisation:	Name: Address: Phone no: E-mail:
Name of main contact in organisation:	Name: Phone no:

MANUFACTURE

Where are you proposing to manufacture the technology?	
Where are you planning to get your filter materials from?	
How many units are you planning to manufacture in the next year?	

MARKETING

How are you planning to publicise your technology? (e.g. advertising, through other organisations like NGOs, BAMWSP)	
What marketing have you done so far?	

DISTRIBUTION

How will you distribute your technologies to the householders?	

TRAINING

How will you train the householders to use your technologies?	
Who will you use to do the training?	
How much time do you think it takes to properly train the householders?	

SUPPORT SERVICES FOR USERS OF YOUR TECHNOLOGY

What are your plans for providing users with replacements when technologies are broken or they have achieved 'break through'?	
How do you propose to supply users with replacement filter material and with spare parts if they are broken?	
If your technology uses reagents, how will you provide users with a constant supply of reagents?	

If users have problems with operating or maintaining the technologies, how ill you help them with their problems?

WASTE MANAGEMENT PLAN *Very Important*

What elements, if any, do you think need special treatment in your waste liquid sludge or filter material?

How do you propose that the users should dispose of the waste from your technologies?

Are you going to provide any support to the users in terms of managing or collecting the waste material?

If so, how are you going to collect the waste?

If you are going to collect the waste, what are you going to do with it?

TECHNOLOGY USERS IN THE "RAPID ASSESSMENT" PROJECT

Some users who have been using the technologies in this project have expressed a wish to buy your technology.

How do you propose to supply and support the householders in Subidpur, Gargari and Jalalabad?

4. APPENDIX 4: RESULTS

VILLAGE STUDY AREAS: WELL LOCATIONS

Table 4.1 – Well locations: Hajiganj

Project Phase	Well Number used in study	Well Owner	Grid Reference
I	1	Tajul Islam	N 23º15.736' E 090º48.997'
I	2		N 23º14.139' E 090º51.218'
I	3	Dr Fazlul Haq	N 23º15.723' E 090º48.982'
I	4	Kamal Hossain	N 23º15.685' E 090º48.930'
I	5		N 23º14.113' E 090º51.238'
II	H1	Tajul Islam (s/o Anu Mia)	N 23º15.901' E 090º49.189'
II	H2	Md Nuru Mia (s/o Slalmat Ullah Bapari)	N 23º15.915' E 090º49.177'
II	H3	Anu Mia (s/o Nawab Ali)	N 23º15.871' E 090º49.167'
II	H4	Md Khalilur Rahman (s/o Sultan Ahmed Mia)	N 23º15.886' E 090º49.102'
II	H5	Idrish Ali (s/o late Secondar Ali)	N 23º15.848' E 090º49.009'
II	H6	Samsul Haq	N 23º15.784' E 090º48.890'
II	H7	Md Abdur Rashid Kha (s/o late Muslim Khan)	N 23º15.710' E 090º49.028'
II	H8	Kafil Uddin (s/o late Wahed Ali Pandit)	N 23º15.668' E 090º49.080'
II	H9	Nuru Barbari (s/o Abdul Kadir)	N 23º15.658' E 090º49.007'
II	H10	Ali Akbar (s/o Fazil Khan)	N 23º15.697' E 090º49.043'
II	H11	Abdul Momin Munshi	N 23º15.707' E 090º48.924'
II	H12	Nurul Islam	N 23º15.743' E 090º48.982'
II	H13	Khalilur Rahman	N 23º15.733' E 090º48.968'
II	H14	Billal	N 23º15.725' E 090º48.988'
II	H15	Md Moklas Rahman (s/o Md Wahli Ullah)	N 23º15.662' E 090º48.986'
II	H16	Abul Hashim (s/o late Ambar Ali)	N 23º15.647' E 090º48.972'
II	H17	Amir Hossain (s/o late Amin Uddin)	N 23º15.659' E 090º48.981'
II	H18	Joynl Uddin	N 23º15.665' E 090º48.981'
II	H19	Abdur Rob	N 23º15.620' E 090º48.858'
II	H20	Majid Barpari (s/o Abdul Rahman Miazi)	N 23º15.630' E 090º48.937'
II	H21	Ali Akbar (s/o Junab Ali)	N 23º15.673' E 090º49.044'

Table 4.2 – Well locations: Iswardi

Project Phase	Well Number used in study	Well Owner	Grid Reference
I	1 (=I16)	Afzal Hossain (s/o Jafir Uddin Bishwas)	N 24º02.675' E 089º07.019'
I	2 (=I17)	Nowab Ali (s/o Junnu Pk)	N 24º02.695' E 089º06.999'
I	3	Amzad Mollah	N 24º02.' E 089º06.'
I	4 (=I10)	Bhaddhu Bishwas (s/o Ismail Bishwas)	N 24º02.515' E 089º07.130'
I	5 (=I5)	Hasem Ali (s/o Aser Ali)	N 24º02.498' E 089º06.983'
II	I1	Shamser Ali (s/o Ihsan Sardar)	N 24º02.584' E 089º06.972'
II	I2	Idris Ali Sardar (s/o Ihsan Sardar)	N 24º02.588' E 089º06.971'
II	I3	Malek Pk. (s/o late Taslim Pk)	N 24º02.586' E 089º06.995'
II	I4	Akhrer Hossain Mal (s/o Ramjan Mal)	N 24º02.519' E 089º06.947'
II	I5	Hasem Ali (s/o Aser Ali)	N 24º02.498' E 089º06.983'
II	I6	Mahbubul (s/o Chand Ali)	N 24º02.446' E 089º06.989'
II	I7	Mannan Malitha (s/o Safer Malitha)	N 24º02.434' E 089º06.984'
II	I8	Moffazal Sardar (s/o Moksed Ali Sardar)	N 24º02.502' E 089º07.065'
II	I9	Gofur Sarsar (s/o late Jasim Sardar)	N 24º02.516' E 089º07.081'
II	I10	Bhaddhu Bishwas (s/o Ismail Bishwas)	N 24º02.515' E 089º07.130'
II	I11	Sattar Pk (s/o Faiz Uddin)	N 24º02.736' E 089º07.122'
II	I12	Nantu Sardar (s/o Jasim Sardar)	N 24º02.715' E 089º07.083'
II	I13	Keru/Meru Pk (s/o Manik Pk)	N 24º02.734' E 089º07.161'
II	I14	Golam Mostafa (s/o Faqruddin Seikh)	N 24º02.703' E 089º07.155'
II	I15	Jafir Hossain Pk (s/o Keramat Pk)	N 24º02.667' E 089º07.155'
II	I16	Afzal Hossain (s/o Jafir Uddin Bishwas)	N 24º02.675' E 089º07.019'
II	I17	Nowab Ali (s/o Junnu Pk)	N 24º02.695' E 089º06.999'
II	I18	Md Abul Kalam (s/o Meher Ali)	N 24º02.715' E 089º06.990'
II	I19	Toaib Ali (s/o late Bhuttu Fakir)	N 24º02.794' E 089º06.957'
II	I20	Jahurul (s/o Jasim Uddin)	N 24º02.857' E 089º06.962'
II	I21	Jafir Uddin Mridha (s/o Niamot Ali Mridha)	N 24º02.837' E 089º06.973'

Table 4.3 – Well locations: Kalaroa

Project Phase	Well No. used in study	Well Owner	Grid Reference
I	1	DPHE Kalaroa	N 22º51.650' E 089º02.243'
I	2 (=K1)	Md Momin Ali Master	N 22º51.427' E 089º03.883'
I	3	Golam Mawla	N 22º50.738' E 089º01.132'
I	4	late Nasar Ali	N 22º51.474' E 089º03.557'
I	5	Mr Shamim (Police Station)	N 22º51.511' E 089º02.512'
II	K1	Md Momin Ali Master	N 22º51.427' E 089º03.883'
II	K2	Md Eyakub Ali (s/o Wahed Ali)	N 22º51.434' E 089º03.843'
II	K3	Md Nazir Ali (s/o Sekh Mandar Ali)	N 22º51.439' E 089º03.835'
II	K4	Md Matiur Rahaman Sana (s/o late Muksed Ali Sana)	N 22º51.422' E 089º03.826'
II	K5	Md Daud Ali Mollah (s/o Amin Uddin Mollah)	N 22º51.387' E 089º03.820'
II	K6	Md Fazar Ali Gyen (s/o Rahamat Ullah Gyen)	N 22º51.435' E 089º03.828'
II	K7	Md Abdur Rahaman Sana (s/o Khuda Box Sana)	N 22º51.388' E 089º03.836'
II	K8	Md Ruhul Amin (s/o late Soleman Sardar)	N 22º51.484' E 089º03.952'
II	K10	Md Joyn Uddin Khan (s/o Md Deen Ali Khan)	N 22º51.515' E 089º03.870'
II	K11	Md Alfaro Rahman (s/o late Akbar Kha)	N 22º51.555' E 089º03.868'
II	K12	Md Yunus Ali Sana (s/o late Munsi Jahar Ali Sana)	N 22º51.530' E 089º03.817'
II	K13	Md Nazrul Islam (s/o late Tabarak Ali Moral)	N 22º51.364' E 089º03.943'
II	K16	Md Golam Mostafa (s/o Golam Sohrab)	N 22º51.311' E 089º04.096'
II	K19	Md Abdul Aziz Bishash (s/o Nesar Ali Bishash)	N 22º51.339' E 089º04.135'
II	K20	Hasi Akram Ali (s/o Azim)	N 22º51.379' E 089º04.177'
II	K21	Abul Hossen (s/o Azizar Rahman Sardar)	N 22º51.490' E 089º03.785'
II	K22	Abdul Hamid (s/o late Kasim Uddin)	N 22º51.520' E 089º03.791'
II	K25	Md Abdul Hamid (s/o late Zahar Ali Khan)	N 22º51.575' E 089º03.837'
II	K26	Fazlul Karim (s/o Md Abdul Majid Sardar)	N 22º51.465' E 089º03.986'
II	K27	Md Afsar Ali Sardar (s/o Pachu Sardar)	N 22º51.445' E 089º04.046'
II	K28	Amin Uddin Dafadar (s/o late Jinith Ullah)	N 22º51.413' E 089º04.075'

ICP ANALYSES

Table 4.4 - ICP analyses of feed waters

BDL = below detection limit

All concentrations in microgrammes per litre

Sample	Well	Technology	Replicate	F/T no	Li	Na	K	Be	Mg	Ca	Sr	Ba	Al	La	Ti	V	Cr	Mo	Mn	Fe	Co	Ni	Cu	Ag	Zn	Cd	Pb	P	S	B	As	Si
H05F	5	AL	A	F	BDL	9540	5700	0.3	31300	34300	246	29	0	BDL	BDL	BDL	30	BDL	198	7070	15	BDL	3	BDL	14	BDL	BDL	2100	250	40	110	26500
I01F	1	AL	A	F	BDL	19400	4100	BDL	35000	142000	423	174	0	30	BDL	10	40	BDL	863	480	15	BDL	5	BDL	15	BDL	BDL	500	1920	30	80	15300
H11F	11	AL	B	F1	BDL	56700	7750	BDL	38300	46500	310	46	0	BDL	BDL	BDL	30	BDL	87	3680	BDL	BDL	2	BDL	12	BDL	BDL	2820	240	90	290	21000
H16F	16	AL	C	F1	BDL	13800	6700	BDL	42100	45100	294	38	0	BDL	BDL	BDL	30	BDL	82	3960	BDL	BDL	BDL	BDL	3	BDL	BDL	2920	200	30	210	22200
I08F	8	AL	B	F1	BDL	14500	3550	0.2	35800	137000	546	159	120	30	BDL	BDL	30	BDL	1060	702	15	BDL	5	BDL	12	BDL	BDL	540	590	40	140	17700
I20F	20	AL	C	F1	BDL	25200	4050	BDL	29900	136000	439	164	30	25	BDL	BDL	30	BDL	839	996	BDL	BDL	BDL	BDL	7	BDL	BDL	380	15200	BDL	BDL	17200
K26F	26	AL	C	F2	4	27100	4350	BDL	36400	135000	592	357	0	25	BDL	10	40	BDL	73	6600	BDL	BDL	3	BDL	9	BDL	BDL	2160	550	50	270	17600
K22F	22	AL	A	F3	4	24100	5000	BDL	34400	129000	607	345	0	25	BDL	BDL	40	BDL	71	9900	BDL	BDL	2	BDL	14	BDL	BDL	1580	690	50	220	21500
K25F	25	AL	B	F3	4	23900	4150	BDL	33700	123000	561	283	0	30	BDL	BDL	30	BDL	69	5720	10	BDL	6	BDL	8	BDL	BDL	1360	590	50	180	18900
H02F	2	BU	A	F	BDL	21500	7900	0.3	40600	29600	237	39	0	15	6	10	40	BDL	102	3590	15	BDL	8	BDL	19	BDL	BDL	2620	160	30	190	20500
I11F	11	BU	A	F1	BDL	40400	3650	BDL	37700	121000	560	174	0	20	BDL	BDL	40	BDL	748	824	BDL	BDL	BDL	BDL	5	BDL	BDL	160	1340	40	140	17400
I13F	13	BU	B	F1	BDL	15000	3850	0.2	23600	119000	425	164	0	30	BDL	10	BDL	BDL	36	56	10	BDL	BDL	BDL	BDL	BDL	BDL	160	830	20	30	14800
I17F	17	BU	C	F1	BDL	17200	4050	BDL	33800	147000	454	209	20	35	4	10	20	BDL	869	4080	10	BDL	6	BDL	7	BDL	BDL	640	570	30	100	14500
H19F	19	BU	C	F2	BDL	248000	8200	BDL	21600	28300	214	49	0	10	4	BDL	30	BDL	45	2710	10	BDL	5	BDL	11	BDL	BDL	5180	310	320	300	20100
H13F	13	BU	B	F3	BDL	10800	9900	0.5	36400	39100	292	47	30	20	6	15	30	BDL	90	4510	20	BDL	7	BDL	25	BDL	BDL	2200	280	50	230	24400
K01F	1	BU	B	F3	BDL	26900	4550	BDL	38300	141000	619	327	0	20	BDL	BDL	30	BDL	76	6750	BDL	BDL	BDL	BDL	45	BDL	BDL	6220	670	50	240	18000
K11F	11	BU	C	F3	4	25700	4800	BDL	38400	142000	662	364	0	25	BDL	10	40	BDL	73	8190	BDL	BDL	3	BDL	14	BDL	BDL	1980	610	50	260	19200
K19F	19	BU	A	F3	4	31100	4300	0.2	30700	129000	505	319	40	30	6	15	30	BDL	81	8760	15	BDL	7	BDL	11	BDL	BDL	1480	610	60	220	18500
H01F	1	DP	A	F	BDL	20100	7900	0.2	40500	30700	259	39	160	10	BDL	BDL	40	BDL	116	5060	10	BDL	4	BDL	36	BDL	BDL	2240	180	40	220	22300
I04F	4	DP	A	F	BDL	11000	23700	0.3	23300	108000	357	180	40	30	6	BDL	20	BDL	533	4560	10	BDL	6	BDL	10	BDL	BDL	2420	690	20	150	16300
H20F	20	DP	C	F1	BDL	176000	10800	0.3	48000	58200	432	65	140	20	6	10	30	BDL	103	4650	10	BDL	7	BDL	13	BDL	BDL	3840	310	190	270	20200
I12F	12	DP	B	F1	BDL	16500	3400	BDL	41700	146000	622	190	40	30	BDL	BDL	30	BDL	1010	1050	BDL	BDL	BDL	BDL	5	BDL	BDL	420	740	30	110	17400
K05F	5	DP	B	F1	BDL	6700	1800	0.3	8650	31600	142	80	0	15	6	BDL	BDL	BDL	29	2800	BDL	BDL	340	BDL	33	BDL	BDL	2200	220	BDL	40	4730
I19F	19	DP	C	F2	BDL	18900	4450	BDL	35100	143000	436	235	0	30	4	10	40	BDL	963	5680	15	BDL	4	BDL	4	BDL	BDL	720	1540	30	150	15300
K28F	28	DP	A	F2	BDL	31100	4800	BDL	36200	136000	597	311	0	20	BDL	BDL	40	BDL	55	4880	BDL	BDL	BDL	BDL	17	BDL	BDL	1820	640	50	250	17300
H10F	10	DP	B	F3	BDL	8970	4950	0.3	23600	29800	196	39	60	15	4	10	30	BDL	151	10800	15	BDL	6	BDL	74	BDL	BDL	1840	280	30	100	29500
K06F	6	DP	C	F3	BDL	27800	4850	BDL	35700	133000	603	336	20	30	4	10	30	BDL	62	8250	20	BDL	7	BDL	17	BDL	BDL	4200	690	50	230	19400
H14F	14	GA	B	F1	BDL	10000	8900	BDL	31100	34800	274	40	0	15	4	10	20	BDL	100	6750	10	40	8	BDL	50	BDL	BDL	1940	220	40	180	27600
I03F	3	GA	A	F1	BDL	22200	10600	BDL	43100	176000	597	265	0	35	BDL	15	50	20	1140	2310	BDL	BDL	BDL	BDL	5	BDL	BDL	55300	7770	30	240	17100
I10F	10	GA	B	F1	BDL	40800	3650	BDL	28400	115000	441	135	20	30	4	BDL	30	BDL	984	2240	BDL	BDL	6	BDL	BDL	BDL	BDL	260	4330	40	140	15900
I15F	15	GA	C	F1	4	16100	3600	0.4	32700	132000	564	158	80	40	8	15	40	BDL	1190	430	15	BDL	8	BDL	8	BDL	BDL	240	1000	30	130	16800
K07F	7	GA	A	F1	BDL	6100	4250	0.3	8320	30300	140	71	0	10	BDL	BDL	BDL	BDL	22	1570	15	BDL	336	BDL	33	BDL	BDL	18000	180	BDL	50	4240
H17F	17	GA	C	F2	BDL	14900	9850	BDL	38500	42200	274	27	30	BDL	BDL	BDL	30	BDL	165	2910	BDL	BDL	7	BDL	6	BDL	BDL	15600	230	40	140	23600
H07F	7	GA	A	F3	BDL	96600	9300	0.3	46900	59100	409	60	30	20	6	15	30	BDL	110	4330	15	BDL	6	BDL	64	BDL	BDL	3000	290	120	250	20900
K03F	3	GA	B	F3	4	26900	4650	0.2	35100	136000	594	337	20	35	4	15	30	BDL	70	9020	15	BDL	6	BDL	15	BDL	BDL	1360	620	50	230	19400
K08F	8	GA	C	F3	BDL	25100	4450	0.2	36300	132000	592	359	0	20	BDL	BDL	30	BDL	63	6700	15	BDL	9	BDL	62	BDL	BDL	5640	580	50	250	17900
H12F	12	SO	B	F1	BDL	10800	10300	BDL	38300	39000	290	38	0	BDL	BDL	BDL	30	BDL	94	3900	BDL	BDL	4	BDL	10	BDL	BDL	2180	260	40	230	23900
I05F	5	SO	A	F1	4	45500	4700	0.6	73100	211000	1110	304	50	50	6	20	60	BDL	1250	2410	20	BDL	8	BDL	39	BDL	BDL	500	11200	50	550	16900
I09F	9	SO	B	F1	BDL	14200	3750	BDL	33600	126000	512	165	0	20	BDL	BDL	30	BDL	985	4300	BDL	BDL	BDL	BDL	17	BDL	BDL	1280	910	30	290	15700
I21F	21	SO	C	F1	BDL	10300	4250	0.2	33800	137000	395	196	0	30	BDL	BDL	BDL	BDL	824	1360	BDL	BDL	4	BDL	41	BDL	BDL	880	1430	20	170	14100
H06F	6	SO	A	F2	BDL	43000	7400	BDL	35300	41800	268	42	0	15	BDL	BDL	30	BDL	90	3010	15	BDL	5	BDL	8	BDL	BDL	2720	210	80	270	20900
H18F	18	SO	C	F2	BDL	58100	8250	BDL	39300	49700	337	34	0	15	4	BDL	30	BDL	179	4160	15	BDL	7	BDL	452	BDL	BDL	3920	280	90	190	24100
K27F	27	SO	A	F2	4	30400	5750	BDL	48300	186000	850	488	0	30	BDL	BDL	50	30	95	13800	BDL	BDL	BDL	BDL	13	BDL	BDL	1860	830	40	190	20900
K02F	2	SO	B	F3	4	27000	4550	BDL	36300	138000	613	333	0	25	BDL	BDL	50	BDL	81	8830	BDL	BDL	BDL	BDL	11	BDL	BDL	1580	670	50	240	19600
K12F	12	SO	C	F3	4	22700	4800	0.4	35400	140000	633	338	140	35	6	15	30	BDL	70	7640	25	BDL	6	BDL	6	BDL	BDL	1960	590	40	210	19500
H04F	4	ST	A	F	BDL	11400	6100	BDL	32000	31000	228	32	0	BDL	BDL	BDL	30	BDL	193	6540	BDL	BDL	BDL	BDL	11	BDL	BDL	2660	190	30	160	26300
H15F	15	ST	C	F1	BDL	111000	9800	0.4	41400	51900	367	56	60	20	6	15	40	BDL	343	6370	10	BDL	8	BDL	1120	BDL	BDL	4300	390	140	200	20900
I07F	7	ST	A	F1	BDL	14800	3050	BDL	34000	124000	512	135	0	25	BDL	15	BDL	BDL	573	210	BDL	BDL	3	BDL	4	BDL	BDL	220	520	30	280	16800
I14F	14	ST	B	F1	BDL	14600	3150	0.5	22900	106000	403	126	0	20	BDL	BDL	20	BDL	890	564	15	BDL	5	BDL	11	BDL	BDL	520	1140	40	240	16100
I16F	16	ST	C	F1	BDL	14700	3900	BDL	28800	121000	368	136	0	25	6	10	30	BDL	974	366	BDL	BDL	5	BDL	9	BDL	BDL	460	430	BDL	270	15300
K04F	4	ST	A	F2	BDL	16900	12200	0.4	8280	38200	157	523	1960	BDL	14	BDL	30	BDL	95	2780	10	190	885	BDL	9340	BDL	330	15000	2330	110	50	4820
H08F	8	ST	B	F3	BDL	14600	6750	BDL	33700	42600	286	39	0	BDL	BDL	BDL	30	BDL	244	4260	BDL	BDL	BDL	BDL	11	BDL	BDL	2180	380	50	170	25700
K10F	10	ST	B	F3	BDL	24400	4750	BDL	37900	144000	654	349	50	35	BDL	BDL	40	BDL	72	7820	15	BDL	6	BDL	13	BDL	BDL	1560	580	40	220	18900
K13F	13	ST	C	F3	4	29900	4500	0.3	37100	140000	603	373	110	40	6	15	40	BDL	67	7360	15	BDL	8	BDL	23	BDL	BDL	3820	680	60	270	18000
H03F	3	TE	A	F	BDL	13300	7400	0.3	34800	27400	221	33	410	BDL	14	BDL	30	BDL	149	5900	15	BDL	5	BDL	93	BDL	BDL	2140	140	40	190	26000
I02F	2	TE	A	F	BDL	26900	5100	BDL	44000	176000	515	263	0	40	4	BDL	60	BDL	1010	1140	15	BDL	5	BDL	22	BDL	BDL	1060	6910	30	120	15100
H21F	21	TE	C	F1	BDL	9650	5050	BDL	24800	32400	231	33	200	BDL	10	BDL	30	BDL	212	11400	15	BDL	8	BDL	418	BDL	BDL	1960	200	30	120	28400
I06F	6	TE	B	F1	BDL	26500	9250	BDL	46500	186000	681	359	30	45	4	15	20	BDL	958	7310	BDL	BDL	5	BDL	3	BDL	BDL	21200	9290	30	220	15600
I18F	18	TE	C	F2	BDL	17300	4400	0.3	34500	148000	549	356	30	35	4	15	40	BDL	1180	1360	15	BDL	6	BDL	10	BDL	BDL	1700	7700	30	210	16200
K16F	16	TE	B	F2	4	32900	4400	0.3	34100	138000	562	295	30	35	6	15	40	BDL	65	5950	15	BDL	8	BDL	34	BDL	BDL	1840	690	50	250	17700
K20F	20	TE	A	F2	4	30600	4200	BDL	33900	127000	545	386	0	25	BDL	BDL	40	BDL	59	5390	BDL	BDL	3	BDL	16	BDL	BDL	1400	670	50	270	17300
H09F	9	TE	B	F3	BDL	16800	6450	0.4	30900	39000	289	46	60	15	6	15	20	BDL	166	6650	20	BDL	8	BDL	21	BDL	BDL	2160	280	50	170	26900
K21F	21	TE	C	F3	BDL	23700	4950	BDL	33100	128000	595	314	0	20	BDL	BDL	30	BDL	65	6740	BDL	BDL	BDL	BDL	13	BDL	BDL	1600	720	60	210	19600

Table 4.5 – ICP analyses of treated waters

BDL = below detection limit

All concentrations in microgrammes per litre

Sample	Well	Technology	Replicate	F/T no	Li	Na	K	Be	Mg	Ca	Sr	Ba	Al	La	Ti	V	Cr	Mo	Mn	Fe	Co	Ni	Cu	Ag	Zn	Cd	Pb	P	S	B	As	Si
H05T	5	AL	A	T	BDL	9330	5500	BDL	32100	35100	101	4	0	BDL	BDL	BDL	30	BDL	49	12	BDL	BDL	0	BDL	0	BDL	BDL	80	40100	20	BDL	515
H11T	11	AL	B	T1	BDL	55500	7850	BDL	42100	39800	47.4	4	0	BDL	BDL	BDL	40	BDL	68	6	BDL	BDL	0	BDL	5	BDL	BDL	180	54000	60	BDL	380
H16T	16	AL	C	T1	BDL	13500	6600	BDL	41600	44700	232	BDL	0	BDL	BDL	BDL	40	BDL	81	10	BDL	BDL	0	BDL	0	BDL	BDL	80	6240	40	BDL	1330
I08T	8	AL	B	T1	BDL	14400	3300	BDL	42300	90100	75.2	BDL	0	20	BDL	BDL	40	BDL	209	42	BDL	BDL	0	BDL	6	BDL	BDL	280	123000	50	BDL	315
I20T	20	AL	C	T1	BDL	25500	4150	BDL	28600	83000	97.6	BDL	0	15	BDL	BDL	30	BDL	180	10	BDL	BDL	0	BDL	0	BDL	BDL	160	98100	40	BDL	485
K26T	26	AL	C	T2	4	27100	4250	0.6	36100	135000	540	8	40	25	4	15	30	BDL	98	60	BDL	BDL	4	BDL	5	BDL	BDL	100	6400	70	30	1240
K22T	22	AL	A	T3	6	23800	4850	BDL	33900	127000	562	11	60	20	BDL	BDL	40	BDL	164	90	BDL	BDL	0	BDL	12	BDL	BDL	100	6390	50	BDL	1720
K25T	25	AL	B	T3	4	23600	3950	0.3	33400	124000	521	12	0	25	4	10	30	BDL	130	70	BDL	BDL	3	BDL	8	BDL	BDL	120	5870	50	20	1490
H02T	2	BU	A	T	BDL	22100	6800	BDL	32900	47700	223	23	0	BDL	BDL	BDL	40	BDL	15	42	BDL	BDL	9	BDL	58	BDL	BDL	140	310	40	BDL	5010
I11T	11	BU	A	T1	BDL	38300	4550	BDL	31700	70300	281	12	0	10	BDL	BDL	40	BDL	12	44	BDL	BDL	24	BDL	178	BDL	BDL	540	460	50	BDL	1380
I13T	13	BU	B	T1	BDL	15300	4750	BDL	24700	15600	75.8	BDL	0	BDL	BDL	BDL	20	BDL	0	BDL	BDL	BDL	0	BDL	0	BDL	BDL	80	1230	20	BDL	1770
I17T	17	BU	C	T1	BDL	17300	4750	BDL	34500	121000	536	23	30	20	BDL	BDL	40	BDL	13	20	BDL	BDL	42	BDL	98	BDL	BDL	140	1340	30	BDL	2320
H19T	19	BU	C	T2	BDL	248000	7800	BDL	20200	27800	149	4	110	BDL	BDL	BDL	BDL	BDL	7	32	BDL	BDL	20	BDL	44	BDL	BDL	480	190	320	BDL	6690
H13T	13	BU	B	T3	BDL	10900	9050	0.3	31300	44000	175	7	30	BDL	BDL	BDL	30	40	26	154	BDL	BDL	34	BDL	49	BDL	BDL	220	390	60	BDL	3420
K01T	1	BU	B	T3	BDL	25800	4150	BDL	36300	117000	565	63	0	25	BDL	BDL	50	BDL	9	64	BDL	BDL	29	BDL	83	BDL	BDL	120	520	50	BDL	7950
K11T	11	BU	C	T3	BDL	25800	5300	BDL	36900	126000	648	157	0	25	BDL	BDL	30	BDL	40	40	BDL	BDL	44	BDL	106	BDL	BDL	100	450	50	BDL	13000
K19T	19	BU	A	T3	BDL	32100	4750	BDL	31000	113000	483	75	0	15	BDL	BDL	40	BDL	7	100	BDL	BDL	34	BDL	115	BDL	BDL	180	720	60	BDL	9630
H01T	1	DP	A	T	BDL	19600	8350	BDL	39600	31100	248	54	30	BDL	BDL	BDL	30	BDL	594	114	BDL	BDL	0	BDL	149	BDL	BDL	180	25300	30	90	19500
I04T	4	DP	A	T	BDL	10700	3600	BDL	23500	107000	360	145	1010	20	BDL	BDL	30	20	887	1260	BDL	BDL	0	BDL	10	BDL	BDL	260	22300	30	80	14600
H20T	20	DP	C	T1	BDL	171000	11500	BDL	47800	56800	467	65	410	15	BDL	BDL	40	BDL	696	776	BDL	BDL	0	BDL	11	BDL	BDL	920	37300	190	80	17800
I12T	12	DP	B	T1	BDL	16400	3900	BDL	41000	140000	598	159	1560	25	BDL	BDL	40	BDL	674	148	BDL	BDL	3	BDL	5	BDL	BDL	280	29600	40	BDL	15500
K05T	5	DP	B	T1	BDL	7210	1250	BDL	8690	30600	139	62	120	BDL	BDL	BDL	BDL	BDL	108	1010	BDL	BDL	332	BDL	34	BDL	BDL	360	4770	BDL	20	4370
I19T	19	DP	C	T2	BDL	19000	10100	BDL	35300	142000	434	184	1230	20	BDL	BDL	30	BDL	1800	874	BDL	BDL	0	BDL	81	BDL	BDL	17500	29700	40	60	13000
K28T	28	DP	A	T2	BDL	30400	5200	BDL	35300	132000	566	221	110	20	BDL	BDL	50	BDL	575	118	BDL	BDL	0	BDL	24	BDL	BDL	160	34000	60	50	14100
H10T	10	DP	B	T3	BDL	9300	5600	BDL	23500	29800	195	37	450	BDL	BDL	BDL	40	BDL	788	3110	BDL	BDL	0	BDL	7	BDL	BDL	220	34800	30	40	25200
K06T	6	DP	C	T3	BDL	27400	5150	0.4	35400	133000	592	257	290	20	BDL	BDL	30	BDL	551	936	BDL	BDL	2	BDL	13	BDL	BDL	200	29100	60	80	16900
H14T	14	GA	B	T1	4	11100	6250	BDL	23800	57300	252	45	0	10	BDL	BDL	20	30	2	26	BDL	BDL	7	BDL	13	BDL	BDL	760	420	50	50	23500
I03T	3	GA	A	T1	6	23500	5750	BDL	40000	160000	511	83	0	25	BDL	BDL	40	BDL	8	30	BDL	BDL	3	BDL	0	BDL	BDL	3140	8140	30	20	15400
I10T	10	GA	B	T1	6	40900	6150	BDL	30000	111000	427	71	0	15	BDL	BDL	30	BDL	28	74	BDL	BDL	2	BDL	8	BDL	BDL	1360	4940	30	20	15300
I15T	15	GA	C	T1	4	16700	4100	BDL	32900	126000	522	71	50	20	BDL	BDL	40	BDL	8	66	BDL	BDL	0	BDL	2	BDL	BDL	540	1190	30	30	16500
K07T	7	GA	A	T1	6	28600	7000	BDL	37500	134000	562	108	0	20	BDL	BDL	40	BDL	0	26	BDL	BDL	4	BDL	0	BDL	BDL	560	670	50	40	19200
H17T	17	GA	C	T2	BDL	15200	6950	BDL	38200	45000	253	31	0	BDL	BDL	BDL	40	BDL	96	44	BDL	BDL	0	BDL	10	BDL	BDL	840	400	50	80	23400
H07T	7	GA	A	T3	6	98600	9900	0.4	46600	59400	376	70	20	10	BDL	BDL	60	30	5	54	BDL	BDL	5	BDL	9	BDL	BDL	1620	410	150	160	20300
K03T	3	GA	B	T3	8	27200	6500	BDL	35700	119000	550	122	0	20	BDL	BDL	30	BDL	7	106	BDL	BDL	5	BDL	16	BDL	BDL	320	750	40	BDL	17800
K08T	8	GA	C	T3	10	29900	6400	BDL	34200	120000	577	93	0	25	BDL	BDL	40	BDL	2	18	BDL	BDL	5	BDL	0	BDL	BDL	300	2000	40	30	17000
H12T	12	SO	B	T1	20	13300	27800	BDL	7680	10900	35.2	6	60	BDL	BDL	10	30	BDL	8	40	BDL	BDL	0	BDL	0	BDL	BDL	400	2120	40	BDL	3320
I05T	5	SO	A	T1	30	40600	45600	BDL	13800	24300	107	23	0	BDL	BDL	20	BDL	30	88	52	BDL	BDL	2	BDL	0	BDL	BDL	320	4360	60	BDL	3770
I09T	9	SO	B	T2	16	15000	16200	BDL	17400	22400	92.4	16	50	BDL	BDL	BDL	20	BDL	57	82	BDL	BDL	0	BDL	5	BDL	BDL	13900	1640	40	BDL	2290
I21T	21	SO	C	T1	10	10700	6800	BDL	29300	57200	180	42	0	10	BDL	BDL	BDL	BDL	94	6	BDL	BDL	0	BDL	0	BDL	BDL	340	1120	40	BDL	4630
H06T	6	SO	A	T2	78	30800	44600	BDL	9170	16000	57	14	70	BDL	BDL	30	BDL	BDL	7	70	BDL	BDL	0	BDL	6	BDL	BDL	520	4930	80	BDL	4400
H18T	18	SO	C	T2	16	56000	12500	BDL	30500	26300	153	36	0	BDL	BDL	15	30	BDL	0	10	BDL	BDL	3	BDL	3	BDL	BDL	380	610	70	BDL	5200
K27T	27	SO	A	T2	18	30600	12000	BDL	32600	22100	95.4	32	0	BDL	BDL	BDL	30	BDL	8	140	BDL	BDL	2	BDL	5	BDL	BDL	260	1110	50	BDL	3390
K02T	2	SO	B	T3	10	26800	6150	BDL	33900	63200	256	49	0	10	BDL	10	30	BDL	113	106	BDL	BDL	4	BDL	17	BDL	BDL	260	700	60	BDL	7980
K12T	12	SO	C	T3	8	23100	5950	BDL	35800	90400	398	68	0	10	BDL	BDL	40	BDL	223	156	BDL	BDL	0	BDL	16	BDL	BDL	380	630	60	20	9590
H04T	4	ST	A	T	BDL	11100	5950	BDL	30900	30800	211	53	0	BDL	BDL	BDL	30	BDL	422	56	BDL	BDL	0	BDL	8	BDL	BDL	180	18100	30	BDL	24300
H15T	15	ST	C	T1	BDL	107000	9300	BDL	40900	51000	344	56	0	BDL	BDL	BDL	30	BDL	625	32	10	BDL	11	BDL	94	BDL	BDL	420	22700	140	20	19000
I07T	7	ST	A	T1	BDL	15600	2700	BDL	31800	129000	385	56	0	30	BDL	BDL	20	20	209	162	BDL	BDL	0	BDL	13	BDL	BDL	180	11000	30	BDL	12300
I14T	14	ST	B	T1	BDL	16200	4250	BDL	23400	108000	397	84	240	20	14	BDL	20	BDL	806	506	BDL	BDL	4	BDL	11	BDL	BDL	1220	16800	30	BDL	14700
I16T	16	ST	C	T1	BDL	15100	3800	BDL	28500	121000	372	82	0	25	BDL	BDL	30	BDL	716	40	BDL	BDL	0	BDL	0	BDL	BDL	220	30200	20	BDL	12800
K04T	4	ST	A	T2	4	26900	4650	BDL	36300	133000	597	182	0	25	BDL	BDL	30	BDL	246	1110	BDL	BDL	2	BDL	6	BDL	BDL	200	17400	50	40	16400
H08T	8	ST	B	T3	BDL	14800	6800	BDL	32900	40900	258	51	0	BDL	BDL	BDL	30	BDL	389	20	BDL	BDL	0	BDL	19	BDL	BDL	100	17000	50	BDL	22900
K10T	10	ST	B	T3	BDL	26000	4700	BDL	37200	135000	608	198	0	20	BDL	BDL	30	BDL	258	138	BDL	BDL	2	BDL	14	BDL	BDL	1180	14600	40	BDL	16600
K13T	13	ST	C	T3	BDL	30600	4550	BDL	37200	135000	582	233	0	20	BDL	BDL	30	BDL	195	108	BDL	BDL	0	BDL	22	BDL	BDL	200	14000	60	60	16700
H03T	3	TE	A	T	BDL	13200	7250	BDL	34500	27000	211	27	0	BDL	BDL	BDL	40	BDL	98	368	BDL	BDL	0	BDL	85	BDL	BDL	160	400	40	130	24000
I02T	2	TE	A	T	BDL	26900	4250	BDL	39700	161000	534	348	0	30	BDL	BDL	40	BDL	736	154	BDL	BDL	0	BDL	197	BDL	BDL	80	610	210	BDL	16200
H21T	21	TE	C	T1	BDL	9290	4900	BDL	24300	31700	220	21	0	BDL	BDL	BDL	20	30	192	136	BDL	BDL	0	BDL	457	BDL	BDL	100	80	270	BDL	25300
I06T	6	TE	B	T1	6	23700	3800	BDL	36900	144000	537	259	0	25	BDL	BDL	40	BDL	752	2060	BDL	BDL	0	BDL	246	BDL	BDL	600	490	40	40	18500
I18T	18	TE	C	T1	4	18200	3450	BDL	28700	113000	598	230	30	15	BDL	BDL	30	BDL	527	4010	BDL	BDL	5	BDL	143	BDL	BDL	340	320	410	180	13200
K16T	16	TE	B	T2	BDL	33300	4400	BDL	34400	140000	576	270	0	25	BDL	BDL	30	BDL	58	1140	BDL	BDL	2	BDL	265	BDL	BDL	300	480	280	50	17500
K20T	20	TE	A	T2	4	31000	4250	BDL	33600	124000	538	334	0	20	BDL	BDL	40	BDL	57	210	BDL	BDL	0	BDL	121	BDL	BDL	80	770	70	BDL	16600
H09T	9	TE	B	T3	BDL	17300	6850	BDL	30600	37600	286	40	0	BDL	BDL	BDL	30	BDL	161	2310	BDL	BDL	0	BDL	201	BDL	BDL	1100	130	1220	40	25700
K21T	21	TE	C	T3	4	23900	5000	BDL	33100	128000	587	254	0	20	BDL	BDL	40	BDL	150	2000	10	BDL	3	BDL	2150	BDL	BDL	60	520	1790	BDL	19100

PECO 75 ARSENIC ANALYSES

Table 4.6 - Arsenic concentrations in feed and treated waters for each technology

In "Well No." column, "H", "I" and "K" denote Hajiganj, Iswardi and Kalaroa respectively

Alcan			BUET			DPHE/Danida			GARNET			Sono-3-Kolshi			Stevens Institute			Tetrahedron		
Well No.	**Feed (mg/L)**	**Treated (mg/L)**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**
H5	0.150	0.000	H2	0.215	0.002	H1	0.195	0.085	H7	0.315	0.125	H6	0.275	0.014	H4	0.130	0.006	H3	0.160	0.090
H5	0.125	0.001	H2	0.235	0.001	H1	0.200	0.095	H7	0.220	0.098	H6	0.270	0.015	H4	0.190	0.018	H3	0.225	0.059
H5	0.125	0.000	H2	0.190	0.002	H1	0.260	0.160	H7	0.250	0.107	H6	0.250	0.018	H4	0.135	0.010	H3	0.225	0.058
H2	0.180	0.000	H4	0.155	0.000	H5	0.095	0.046	H3	0.235	0.089	H1	0.195	0.002	H6	0.290	0.010	H7	0.290	0.034
H2	0.190	0.000	H4	0.175	0.002	H5	0.145	0.096	H3	0.265	0.091	H1	0.230	0.001	H6	0.230	0.015	H7	0.275	0.005
H2	0.250	0.003	H4	0.200	0.003	H5	0.145	0.071	H3	0.225	0.105	H1	0.215	0.007	H6	0.275	0.014	H7	0.315	0.011
H3	0.250	0.005	H6	0.355	0.000	H2	0.170	0.054	H4	0.175	0.074	H8	0.190	0.006	H1	0.225	0.007	H5	0.175	0.004
H3	0.210	0.000	H6	0.200	0.001	H2	0.210	0.066	H4	0.195	0.100	H8	0.175	0.004	H1	0.250	0.018	H5	0.190	0.027
H11	0.440	0.000	H13	0.240	0.000	H10	0.160	0.061	H14	0.265	0.059	H12	0.290	0.013	H8	0.220	0.003	H9	0.190	0.003
H11	0.375	0.001	H13	0.290	0.000	H10	0.150	0.076	H14	0.220	0.036	H12	0.290	0.012	H8	0.210	0.018	H9	0.205	0.079
H11	0.290	0.002	H13	0.200	0.002	H10	0.105	0.046	H19	0.345	0.295	H16	0.150	0.001	H8	0.200	0.000	H9	0.165	0.059
H20	0.290	0.003	H14	0.225	0.001	H15	0.250	0.066	H19	0.390	0.260	H16	0.180	0.010	H18	0.260	0.047	H13	0.190	0.010
H20	0.295	0.000	H14	0.190	0.002	H15	0.255	0.048	H19	0.315	0.245	H16	0.265	0.003	H18	0.195	0.029	H13	0.215	0.010
H20	0.285	0.001	H14	0.175	0.002	H15	0.335	0.070	H13	0.275	0.150	H20	0.205	0.003	H18	0.195	0.049	H13	0.260	0.004
H17	0.195	0.000	H15	0.320	0.000	H18	0.265	0.095	H13	0.195	0.067	H20	0.350	0.003	H7	0.240	0.059	H19	0.295	0.030
H17	0.185	0.000	H15	0.325	0.001	H18	0.285	0.185	H13	0.240	0.098	H20	0.280	0.005	H7	0.315	0.035	H19	0.415	0.017
H16	0.215	0.000	H19	0.460	0.001	H20	0.290	0.082	H17	0.175	0.027	H18	0.280	0.008	H15	0.285	0.017	H21	0.190	0.001
H16	0.240	0.001	H19	0.310	0.002	H20	0.255	0.107	H17	0.175	0.085	H18	0.210	0.006	H15	0.315	0.017	H21	0.145	0.002
H10	0.095	0.007	H8	0.195	0.000	H11	0.240	0.069	H9	0.170	0.110	H21	0.180	0.007	H12	0.225	0.011	H17	0.180	0.004
H10	0.105	0.015	H8	0.185	0.002	H11	0.260	0.089	H9	0.165	0.070	H21	0.155	0.003	H12	0.240	0.025	H17	0.210	0.012
H10	0.130	0.022	H8	0.200	0.000	H11	0.155	0.105	H9	0.200	0.078	H21	0.155	0.003	H12	0.280	0.015	H17	0.170	0.002
H21	0.120	0.011	H10	0.120	0.000	H12	0.255	0.092	H11	0.305	0.115	H14	0.150	0.003	H9	0.135	0.010	H16	0.130	0.002
H21	0.170	0.007	H10	0.130	0.000	H12	0.225	0.057	H11	0.300	0.185	H14	0.125	0.001	H9	0.250	0.055	H16	0.230	0.004
H21	0.170	0.008	H10	0.120	0.000	H12	0.245	0.085	H11	0.275	0.170	H14	0.195	0.001	H9	0.185	0.019	H16	0.190	0.004
I1	0.070	0.003	I11	0.150	0.003	I4	0.145	0.057	I3	0.200	0.023	I5	0.450	0.016	I7	0.185	0.012	I2	0.100	0.013
I1	0.095	0.000	I11	0.195	0.013	I4	0.135	0.052	I3	0.180	0.019	I5	0.450	0.001	I7	0.195	0.005	I2	0.090	0.012
I1	0.080	0.000	I11	0.075	0.007	I4	0.145	0.054	I3	0.200	0.020	I5	0.230	0.003	I7	0.250	0.015	I2	0.095	0.000
I2	0.060	0.007	I12	0.095	0.000	I3	0.265	0.075	I4	0.160	0.057	I6	0.160	0.000	I5	0.260	0.043	I1	0.075	0.009
I2	0.100	0.009	I12	0.110	0.001	I3	0.220	0.053	I4	0.130	0.048	I6	0.250	0.010	I5	0.550	0.013	I1	0.095	0.009
I2	0.135	0.008	I12	0.110	0.009	I3	0.125	0.028	I4	0.175	0.059	I6	0.155	0.008	I5	0.375	0.010	I1	0.110	0.010
I6	0.245	0.004	I15	0.185	0.012	I13	0.110	0.073	I2	0.095	0.070	I1	0.090	0.010	I4	0.190	0.011	I5	0.670	0.020
I6	0.115	0.009	I15	0.170	0.009	I13	0.135	0.052	I2	0.145	0.038	I1	0.100	0.010	I4	0.175	0.014	I5	0.500	0.024
I8	0.150	0.007	I13	0.100	0.008	I12	0.275	0.025	I10	0.120	0.029	I9	0.255	0.011	I14	0.225	0.010	I6	0.210	0.029
I8	0.100	0.000	I13	0.105	0.015	I12	0.060	0.012	I10	0.130	0.013	I9	0.160	0.000	I14	0.180	0.005	I6	0.155	0.025
I8	0.095	0.000	I13	0.065	0.005	I12	0.060	0.026	I10	0.090	0.023	I9	0.225	0.000	I14	0.150	0.000	I6	0.185	0.016
I9	0.240	0.009	I14	0.265	0.009	I11	0.080	0.024	I8	0.080	0.034	I10	0.145	0.000	I13	0.080	0.000	I7	0.180	0.004

In "Well No." column, "H", "I" and "K" denote Hajiganj, Iswardi and Kalaroa respectively

Alcan			BUET			DPHE/Danida			GARNET			Sono-3-Kolshi			Stevens Institute			Tetrahedron		
Well No.	**Feed (mg/L)**	**Treated (mg/L)**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**	**Well No.**	**Feed**	**Treated**
I9	0.260	0.008	I14	0.265	0.014	I11	0.105	0.023	I8	0.150	0.031	I10	0.180	0.013	I8	0.170	0.011	I7	0.300	0.016
I10	0.145	0.003	I14	0.280	0.008	I11	0.125	0.021	I11	0.150	0.043	I3	0.215	0.005	I8	0.110	0.003	I9	0.210	0.011
I10	0.135	0.007	I18	0.215	0.003	I17	0.140	0.056	I11	0.156	0.023	I3	0.230	0.010	I8	0.140	0.008	I9	0.260	0.005
I10	0.130	0.010	I18	0.230	0.007	I17	0.140	0.049	I11	0.125	0.023	I3	0.240	0.011	I8	0.160	0.013	I9	0.265	0.009
I20	0.035	0.008	I17	0.125	0.007	I19	0.105	0.055	I15	0.135	0.040	I21	0.185	0.009	I16	0.175	0.011	I18	0.185	0.086
I20	0.040	0.009	I17	0.275	0.034	I19	0.195	0.070	I15	0.095	0.022	I21	0.130	0.000	I16	0.175	0.000	I18	0.245	0.083
I21	0.155	0.008	I17	0.085	0.000	I19	0.190	0.043	I15	0.090	0.038	I21	0.125	0.000	I16	0.310	0.006	I18	0.170	0.029
I21	0.190	0.008	I19	0.165	0.010	I18	0.215	0.050	I16	0.195	0.056	I20	0.280	0.012	I15	0.190	0.010	I17	0.125	0.035
I19	0.185	0.010	I19	0.175	0.012	I18	0.240	0.018	I16	0.240	0.055	I20	0.210	0.013	I15	0.155	0.008	I17	0.100	0.024
I19	0.170	0.007	I20	0.195	0.010	I21	0.190	0.025	I16	0.295	0.060	I7	0.215	0.010	I12	0.120	0.013	I17	0.115	0.014
I19	0.135	0.004	I20	0.200	0.003	I21	0.185	0.030	I14	0.285	0.075	I7	0.175	0.003	I12	0.095	0.004	I16	0.245	0.036
I19	0.160	0.008	I20	0.175	0.013	I21	0.176	0.046	I14	0.265	0.056	I7	0.265	0.016	I12	0.105	0.014	I16	0.168	0.035
K22	0.350	0.004	K19	0.300	0.003	K28	0.295	0.130	K7	0.350	0.045	K27	0.250	0.007	K4	0.350	0.030	K20	0.345	0.022
K22	0.285	0.000	K19	0.325	0.000	K28	0.275	0.065	K7	0.335	0.033	K27	0.275	0.000	K4	0.280	0.036	K20	0.260	0.006
K22	0.330	0.000	K19	0.280	0.000	K28	0.110	0.075	K7	0.255	0.035	K27	0.275	0.000	K4	0.215	0.022	K20	0.315	0.011
K13	0.285	0.003	K2	0.295	0.017	K19	0.290	0.195	K27	0.275	0.069	K7	0.305	0.002	K5	0.250	0.029	K26	0.385	0.085
K13	0.315	0.000	K2	0.320	0.012	K19	0.305	0.065	K27	0.280	0.050	K7	0.295	0.000	K5	0.235	0.022	K26	0.330	0.054
K13	0.285	0.001	K2	0.290	0.001	K19	0.275	0.075	K27	0.210	0.048	K5	0.295	0.000	K16	0.355	0.053	K26	0.280	0.056
K1	0.295	0.001	K22	0.325	0.000	K7	0.305	0.210	K28	0.335	0.039	K5	0.295	0.008	K16	0.335	0.060	K13	0.315	0.058
K1	0.335	0.002	K22	0.300	0.003	K7	0.330	0.190	K28	0.335	0.036	K5	0.300	0.004	K16	0.285	0.040	K13	0.345	0.056
K25	0.280	0.001	K1	0.340	0.001	K5	0.300	0.225	K3	0.365	0.028	K2	0.360	0.010	K10	0.300	0.024	K16	0.325	0.056
K25	0.290	0.001	K1	0.235	0.003	K5	0.240	0.195	K3	0.160	0.016	K2	0.340	0.021	K10	0.280	0.025	K16	0.215	0.042
K25	0.295	0.000	K1	0.310	0.000	K5	0.300	0.195	K3	0.285	0.021	K2	0.255	0.003	K10	0.320	0.017	K16	0.240	0.049
K16	0.280	0.003	K4	0.360	0.014	K10	0.190	0.081	K12	0.290	0.070	K3	0.285	0.001	K25	0.335	0.064	K8	0.230	0.049
K16	0.315	0.002	K4	0.330	0.000	K10	0.290	0.165	K12	0.260	0.060	K3	0.320	0.001	K25	0.280	0.038	K8	0.340	0.014
K16	0.290	0.000	K4	0.320	0.001	K10	0.325	0.053	K10	0.250	0.060	K6	0.345	0.003	K26	0.250	0.072	K19	0.275	0.054
K21	0.290	0.004	K27	0.240	0.004	K12	0.345	0.110	K10	0.265	0.064	K6	0.320	0.003	K26	0.325	0.055	K19	0.280	0.018
K21	0.290	0.004	K27	0.280	0.002	K12	0.315	0.275	K10	0.265	0.056	K6	0.335	0.004	K26	0.320	0.078	K19	0.275	0.015
K26	0.340	0.001	K11	0.345	0.024	K6	0.305	0.235	K8	0.375	0.011	K12	0.235	0.005	K13	0.295	0.031	K21	0.290	0.001
K26	0.305	0.000	K11	0.290	0.006	K6	0.265	0.170	K8	0.345	0.010	K12	0.305	0.000	K13	0.215	0.053	K21	0.240	0.000
K26	0.325	0.000	K11	0.290	0.000	K6	0.230	0.090	K8	0.360	0.014	K12	0.245	0.001	K13	0.295	0.050	K21	0.250	0.003
K20	0.280	0.002	K6	0.265	0.002	K21	0.285	0.086	K11	0.295	0.095	K22	0.230	0.006	K28	0.260	0.027	K1	0.245	0.003
K20	0.350	0.005	K6	0.330	0.016	K21	0.280	0.050	K11	0.310	0.055	K22	0.280	0.003	K28	0.245	0.025	K1	0.260	0.004
K20	0.340	0.001	K6	0.315	0.001	K21	0.285	0.052	K11	0.295	0.091	K22	0.275	0.016	K28	0.290	0.021	K4	0.330	0.016
K8	0.255	0.004	K25	0.265	0.005	K3	0.345	0.275	K2	0.335	0.057	K11	0.285	0.003	K20	0.295	0.067	K4	0.330	0.016
K8	0.325	0.002	K25	0.255	0.013	K3	0.340	0.190	K2	0.340	0.075	K11	0.325	0.005	K20	0.350	0.059	K4	0.345	0.050

HACH ANALYSES FOR WATER CHEMISTRY PARAMETERS

Table 4.7 - Field analyses of feed waters using Hach tests and water quality probes

WELL NUMBER	**Date**	Ferrous Iron (mg/L)	pH	Eh (mV)	Conductivity (mS/cm)	Temperature (deg C)	Dissolved Oxygen (mg/L)	Total Iron (mg/L)	Turbidity	Sulphide (mg/L)	Alkalinity (mg/L CaCo3)	Manganese (mg/L)	Phosphate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Aluminium (mg/L)	Nitrate (mg/L)	Sulphate (mg/L)
H01	30/01/01	1.72	7.28	41	0.615	25.8	1.3	4.65	4.1	BDL	260	0.532	5.77	62	BDL	BDL	0.6	BDL
H02	29/01/01	0.43	7.17	35	0.586	25.2	2.8	0.33	31.4	3	260	0.022	2.75	40	0.4	BDL	0.3	BDL
H03	29/01/01	1.74	6.98	46	0.491	24	1.6	4.75	4.71	BDL	260	0.191	4.89	11.4	0.8	BDL	0.7	BDL
H04	30/01/01	1.24	7.09	45	0.469	26.8	2.6	0.98	7.89	0.011	260	0.275	16.51	19	0.34	BDL	1.1	BDL
H05	31/01/01	1.77	7.1	41	0.462	22.5	2.8	5.45	30.6	0.01	240	0.306	8.57	23.5	BDL	0.022	0.5	BDL
H06	01/02/01	0.34	7.38	24	0.745	26.8	2.5	2.7	21.2	0.021	280	0.125	12.59	7.8	0.86	0.026	0.2	19
H07	31/01/01	1.55	7.3	35	1.193	25.5	1.5	5.1	5.02	BDL	280	0.216	6.57	222	BDL	BDL	0.5	BDL
H09	22/2/01	2.2	7.05	47	0.527	27.2	1.9	6.9	7.3	0.013	220	0.177	12.98	27	0.79	0.023	0.6	BDL
H10	21/2/01	0.35	6.77	53	0.374	27.3	1.2	4.9	17.3	0.248	140	0.17	BDL	29	1.78	0.028	0.5	BDL
H11	23/2/01	1.37	7.08	43	0.803	27.2	5.7	1.8	20	0.017	180	0.179	8.11	30	0.35	0.029	0.7	BDL
H12	24/2/01	1.67	7.08	38	0.554	26.9	4.8	2.5	20.23	0.052	260	0.151	22.47	18	0.95	BDL	0.6	BDL
H13	12/02/01	1.14	7.31	28	0.552	24.4	2.2	3.25	13.6	BDL	180	0.147	8.83	56	0.16	0.026	0.6	BDL
H14	13/02/01	1.29	7.12	28	0.499	27.1	2.6	5.2	35.6	BDL	180	0.182	17.15	19	0.54	0.025	1	BDL
H15	10/02/01	0.11	7.16	36	1.55	25.9	2.8	5	8.28	BDL	280	0.234	0.56	16.5	0.41	0.111	0.5	BDL
H16	10/02/01	1.29	7.56	19	0.609	24.6	1.6	3.22	17.3	BDL	140	0.095	5.62	111	0.09	BDL	0.5	BDL
H16	23/2/01	1.47	7.38	24	0.617	27.1	5	3.25	5.92	0.17	260	0.121	10.66	17	0.18	0.029	0.3	BDL
H 17	21/2/01	2.06	7.39	25	0.609	31	2.7	3.15	8.63	BDL	260	0.462	18.34	11	0.21	0.029	0.3	BDL
H18	12/02/01	1.48	7.06	39	0.862	26.3	1.3	0.7	16.2	BDL	220	0.216	6.93	120	0.27	0.032	0.7	BDL
H19	13/02/01	0.05	7.5	11	1.704	28.3	2.1	2.48	9.03	BDL	220	0.075	20.86	189	1.27	0.025	0.8	BDL
H20	11/02/01	0.06	7.19	31	1.661	24.8	1.3	2.3	9.14	BDL	280	0.165	21.38	430	1.07	BDL	0.3	BDL
H21	15/2/2001	1.87	6.94	48	0.443	23.7	2	3.9	57.5	0.018	140	0.363	2.15	18	0.38	0.026	0.8	BDL
I01	29/01/01	0.2	6.99	12	1.03	24.3	8.5	0.42	1.61	BDL	580	0.044	5.46	11.4	BDL	BDL	0.05	29
I01	29/01/01	0.74	6.89	18	1.32	24.5	7.8	1.06	3.07	0.01	600	0.919	4.6	16.7	0.08	BDL	BDL	42
I03	30/01/01	1.06	6.86	20	1.26	24	7.7	2.03	5.03	BDL	580	1.226	2.87	13.2	0.85	BDL	BDL	25
I04	30/01/01	0.03	7.08	6	0.86	23	7.8	3.4	25.6	0.01	420	0.7	10.84	6.1	0.61	0.025	BDL	BDL
I04	23/02/01	2.28	7.21	5	0.78	24	8.5	3.08	1.02	0.025	380	0.49	4.9	2.3	BDL	BDL	BDL	BDL
I05	31/01/01	0.59	7.14	12	1.77	25.3	8.5	2.2	14.4	0.012	620	0.6	4.75	45.4	0.5	BDL	BDL	18
I06	31/01/01	2.03	7.13	11	1.38	24.8	8.9	4.82	36.8	0.027	560	1.024	1.52	8.8	0.2	0.027	BDL	BDL
I07	23/02/01	0.02	7.16	9	0.93	26.4	8.6	0.12	0.99	BDL	480	0.565	5.87	8	0.09	BDL	BDL	
I08	11/02/01	0.81	7.11	9	1	23.4	9.2	1.14	2.12	BDL	540	0.821	5.54	8.8	0.13	BDL	BDL	BDL
I09	13/2/01	2.52	7.14	10	0.98	28.2	8.9	3.16	2.12	BDL	480	0.762	3.96	5	0.57	BDL	BDL	7
I10	11/02/01	0.74	7.17	5	0.98	21.9	8.8	2.16	4.32	BDL	480	0.378	3.81	22.7	0.18	BDL	0.06	BDL
I11	13/02/01	1.41	7.01	10	1.02	18.6	9.6	1.81	4	0.025	540	0.713	2.27	3.7	BDL	BDL	BDL	BDL
I12	13/02/01	0.61	7.03	15	1.13	23.2	8.5	0.88	1.1	BDL	560	0.735	5.75	16	BDL	BDL	BDL	BDL
I13	12/02/01	2	7.17	10	0.92	24.1	8.2	3.09	0.73	0.31	460	1.5	4	3.6	BDL	BDL	BDL	BDL
I14	12/02/01	0.44	7.15	10	0.31	24.6	8.6	0.48	0.59	0.015	440	0.5	3.35	2.7	0.49	BDL	BDL	BDL
I 14	24/02/01	0.42	7.16	8	0.8	25.6	8.4	0.36	0.81	BDL	400	0.6	6.26	5.3	0.22	BDL	0.04	
I16	28/01/01	0.08	7.03	9	0.88	25	8.7		1.2	BDL	480	0.378	4.79	2.4	BDL	BDL	0.1	10
I 16	24/02/01	0.42	7.03	15	0.85	26.6	9.5	0.39	0.6	BDL	480	0.94	6.76	7.8	0.09	BDL	BDL	
I17	28/01/01	0.82	7.02	11	1.1	25	8.7		6.2	BDL	520	0.336	0.98	11.3	BDL	BDL	BDL	BDL
I04	22/02/01	0.03	7.08	6	0.86	23	7.8	3.4	25.6	0.01	420	0.7	10.84	6.1	0.61	0.025	BDL	BDL
I21	22/02/01	0.52	7.02	11	0.98	25.3	8.6	0.47	1.12	BDL	520	0.764	5.21	15.3	0.17	BDL	0.05	BDL
K02	11/02/01	3.23	7.09	13	0.98	25.7	3.8	2.6	8.66	BDL	560	0.173	BDL	8.1	BDL	0.032	BDL	BDL
K02	23/02/01	3.24	6.89	26	0.981	25.3	1.4	0.45	15	BDL	600	0.198	8.49	22.5	0.17	BDL	BDL	BDL
K03	12/02/01	2.35	7.18	10	1.028	23.8	3.8	1	8.95	0.107	600	0.11	4.73	22	BDL	0.062	1.9	BDL
K03	22/02/01	1.14	7.03	19	1.014	26.2	1.3	4.65	20.4	BDL	560	0.193	4.27	24.3	0.2	BDL	BDL	BDL
K04	12/02/01	2.86	7.06	16	0.999	25	1.4	1.83	20.8	0.013	680	0.131	3.14	30	0.08	0.046	BDL	BDL
K07	11/02/01	2.94	7.05	15	1.074	26.4	2.6	1.6	19.3	0.022	600	0.18	5.09	4	BDL	0.056	0.08	BDL
K08	13/02/01	2.65	7.09	14	0.982	22.9	4	3	6.79	BDL	540	0.139	3.46	12.6	0.46	0.078	BDL	BDL
K08	24/02/01	2.17	7.08	16	1.009	26.7	1.5	5.75	15.8	BDL	600	0.143	3.25	9	1.08	0.12	BDL	55
K10	13/02/01	2.72	7.07	15	1.129	25.6	4.1	5.45	10.5	0.032	640	0.162	0.15	0.5	0.58	0.09	BDL	BDL
K10	25/02/01	2.77	7	23	1.061	26.5	1.5	6.3	6.96	BDL	600	0.14	8.22	15.8	BDL	0.045	BDL	HIGH
K11	31/01/01	0.5	7.5	2	1.078	26	6.5	5.45	25.2	0.01	580	0.175	4.59	22.5	BDL	0.042	BDL	BDL
K12	30/01/01	2.57	7.18	19	1.05	26.6	4.2	6.64	11	0.033	700	BDL	6.81	7	BDL	0.036	0.1	BDL
K 16	23/02/01	2.69	7.02	19	1.003	25.7	1.1	5.1	49.1	BDL	600	0.134	6.17	8.6	BDL	0.035	BDL	BDL
K20	02/02/01	0.1	7.5	2	0.986	25.9	10.1	4.35	1.32	0.26	300	0.07	5.41	8	BDL	0.075	BDL	18
K20	23/02/01	2.19	7.1	15	0.968	27.3	1.7	2.2	12.7	0.011	560	0.162	4.7	21.5	0.63	BDL	BDL	36
K21	29/01/01	0.87	7.25	7	0.996	25.5	3.5	0.66	45.7	BDL	640	0.079	6.89	OR	0.41	BDL	BDL	13
K22	30/01/01	0.28	7.11	20	1.002	25.3	3.2	1.7	35.3	0.018	460	0.148	3.32	7.5	BDL	BDL	BDL	BDL
K25	31/01/01	0.22	7.46	3	0.98	25.2	9.4	0.17	55.7	BDL	560	0.141	3.6	28	BDL	0.06	BDL	BDL
K26	24/02/01	1.6	7.15	12	0.99			3.5	0.9	BDL	640	0.143	BDL	24.2	0.11	0.043	BDL	BDL
K27	15/02/01	2.68	6.89	26	1.335	27.4	3	12.6	23.6	BDL	780	0.32	5.24	13.7	BDL	0.037	BDL	BDL
K28	02/02/01	BDL	7.51	2	1.063	25.1	6.5	0.9	6.57	BDL	520	0.121	4.63	14.2	BDL	BDL	BDL	27

BDL = below detection limit

Table 4.8 – Field analyses of treated waters using Hach tests and water quality probes

WELL NUMBER	**Technology**	**Date**	Ferrous Iron (mg/L)	pH	Eh (mV)	Conductivity (mS/cm)	Temperature (deg C)	Dissolved Oxygen (mg/L)	Total Iron (mg/L)	Turbidity	Sulphide (mg/L)	Alkalinity (mg/L CaCo3)	Manganese (mg/L)	Phosphate (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Aluminium (mg/L)	Nitrate (mg/L)	Sulphate (mg/L)
H01	DP A	30/01/01	0.02	6.98	48	0.643	27.4	2.5	0.14	0.86	BDL	200	0.158	6.28	34	0.12	BDL	BDL	45
H02	BU A	29/01/01	0.02	7.68	4	0.604	24.3	5.2	0.07	1.42	1	140	BDL	0.94	38	BDL	BDL	0.1	BDL
H03	TE A	29/01/01	0.26	6.46	78	0.612	24.1	3.8	0.51	0.88	BDL	100	0.112	8.82	11.1	0.32	BDL	BDL	BDL
H04	ST A	30/01/01	0.02	6.79	46	0.471	25.9	3.6	0.02	0.85	BDL	180	0.451	18.14	18.4	BDL	BDL	BDL	75
H05	AL A	31/01/01	0.06	6.54	73	0.499	21.9	2.6	0.04	0.39	0.013	120	0.059	1.16	9.9	BDL	BDL	BDL	BDL
H06	SO A	01/02/01	0.06	8.58	-45	0.483	24	5.8	0.07	3.41	0.027	120	0.009	2.07	7.3	1.58	BDL	BDL	18
H07	GA A	31/01/01	BDL	8.05	-15	1.19	24.5	4.5	0.23	1.2	BDL	220	0.049	2.79	173	BDL	BDL	0.6	BDL
H09	ST C	22/2/01	0.01	6.88	53	0.554	26.6	4.7	0.1	0.88	BDL	140	0.477	9.2	20	0.39	BDL	0.1	80
H10	BU C	21/2/01	BDL	7.55	15	0.405	28.7	3.7	0.06	1.02	0.147	120	0.065	BDL	7	BDL	BDL	1.2	BDL
H11	GA C	23/2/01	BDL	8.22	-24	0.873	26.6	14.8	0.05	2.56	BDL	140	0.199	6.26	59	BDL	BDL	0.6	BDL
H12	DP C	24/2/01	0.02	7.09	35	0.597	25.6	9.8	0.23	1.6	0.061	220	0.409	3.69	25	BDL	0.024	0.2	130
H13	TE B	12/02/01	BDL	6.48	74	0.675	22.4	2.5	0.29	2.03	BDL	120	0.102	5.43	13	0.93	BDL	0.2	BDL
H14	BU B	13/02/01	0.02	7.43	15	0.492	26.1	4.2	0.03	2.61	BDL	220	0.034	12.95	18	BDL	BDL	1.4	BDL
H15	DP B	10/02/01	0.04	6.92	44	1.467	25.6	3.7	1.2	8.16	BDL	220	0.658	5.78	BDL	BDL	0.04	0.1	85
H16	SO B	10/02/01	BDL	8.86	-66	0.411	21	5.3	0.47	7.3	BDL	120	BDL	0.71	45	BDL	BDL	0.2	BDL
H16	TE C	23/2/01	0.02	7.05	40	0.698	24.8	6.6	0.46	3.23	0.156	140	0.117	5.51	72	BDL	BDL	0.1	BDL
H17	AL C	21/2/01	0.01	7.71	9	0.763	31.1	2.3	0.05	0.53	BDL	220	0.058	0.77	15	BDL	BDL	0.2	BDL
H18	ST B	12/02/01	0.05	7.26	26	0.863	23.1	4.6	0.36	2.62	BDL	120	0.249	2.99	130	0.3	BDL	0.1	BDL
H19	GA B	13/02/01	0.06	8.07	-19	1.701	26.6	3.6	0.08	2	BDL	320	0.057	18.06	182	0.23	BDL	0.5	BDL
H20	AL B	11/02/01	0.01	7.27	25	1.652	22.7	1.8	0.06	1.52	BDL	140	0.066	1.33	395	0.21	BDL	BDL	BDL
H21	SO C	15/02/01	0.02	8.26	-38	0.383	23.3	3.3	BDL	1.3	BDL	160	0.017	13.79	23	0.79	BDL	0.1	BDL
I01	AL A	29/01/01	0.01	5.77	77	0.95	21.2	9.2	0.05	0.56	0.018	120	BDL	0.28	9.9	BDL	BDL	0.03	275
I01	TE A	29/01/01	BDL	6.04	63	1.63	21.9	8.7	BDL	0.61	BDL	120	0.7	3.39	31.7	0.07	BDL	0.03	BDL
I03	GA A	30/01/01	0.04	7.91	0	1.06	15.7	12.1	BDL	2.01	BDL	520	0.04	3.59	10.4	0.43	BDL	0.03	26
I04	DP A	30/01/01	0.01	6.95	16	0.81	23.9	8.4	1.5	11.7	0.016	340	0.5	4.54	7.1	0.25	0.062	BDL	72
I04	ST A	23/02/01	0.04	7.05	15	0.77	20.2	9.7	0.05	0.53	0.015	320	0.665	3.38	4.4	BDL	BDL	BDL	43
I05	SO A	31/01/01	BDL	8.28	0	1.06	22.8	9.4	BDL	1.19	0.016	220	BDL	0.66	22.2	0.75	BDL	BDL	59
I06	TE B	31/01/01	BDL	5.93	8.7	1.67	19.6	10.4	0.24	0.62	0.029	60	0.672	BDL	19.2	BDL	BDL	BDL	BDL
I07	SO C	23/02/01	BDL	8.38	-65	0.45	23.9	9.7	BDL	0.44	BDL	220	BDL	1.27	6.6	0.06	BDL	0.03	
I08	GA B	11/02/01	0.03	7.9	0	0.94	19.6	10.1	BDL	1.27	0.027	420	0.062	3.72	16.6	0.26	BDL	0.05	BDL
I09	AL B	13/2/01	BDL	7.06	15	0.92	24.7	9.7	BDL	0.54	0.011	380	0.095	BDL	5.2	0.05	BDL	BDL	42
I10	SO B	11/02/01	BDL	8.55	-72	0.33	15.8	13.1	BDL	1.43	0.01	140	0.031	0.08	7.5	0.06	BDL	0.11	BDL
I11	DP B	13/02/01	0.01	6.99	11	0.97	15.3	13.2	0.05	2.22	0.032	480	0.647	1.11	6.2	0.44	0.1	BDL	65
I12	BU A	13/02/01	BDL	7.37	0	0.95	18.6	10.3	BDL	0.39	BDL	480	0.022	3.24	0.8	BDL	BDL	0.04	BDL
I13	ST B	12/02/01	0.03	7.27	3	0.77	18.5	11.4	BDL	0.68	0.024	400	0.8	1.63	2.6	0.18	BDL	0.06	30
I14	BU B	12/02/01	0.01	7.25	0	0.7	24.4	8.4	0.02	1.05	0.041	340	BDL	3.67	3.8	BDL	BDL	0.03	BDL
I 14	GA C	24/02/01	0.05	8.06	0	0.72	23.2	9.3	0.02	0.97	BDL	420	0.021	11.81	4	0.5	BDL	0.1	
I16	ST C	28/01/01	0.03	6.87	13	0.99	25	9.6		3.25	BDL	340	0.264	3.62	22.5	BDL	BDL	0.06	74
I 16	TE C	24/02/01	0.09	7.01	16	0.96	23.4	9.8	0.04	0.62	0.017	360	0.695	6.77	22.8	0.06	BDL	0.05	
I17	BU C	28/01/01	BDL	7.6	0	0.85	25	8.9		0.87	BDL	340	0.049	BDL	14.8	BDL	BDL	BDL	BDL
I19	AL C	22/02/01	0.01	7.06	8	1.03	24.7	8.8	BDL	0.36	0.033	320	0.7	BDL	12.3	0.06	BDL	0.03	BDL
I21	DP C	22/02/01	0.02	7.25	0	0.98	21.5	9.9	BDL	0.98	BDL	420	0.349	2.49	8.3	0.34	0.077	0.08	47
K02	BU A	11/02/01	BDL	7.73	-16	0.903	22.6	2.6	BDL	0.93	0.015	560	BDL	0.04	33	0.05	0.038	0.1	8
K02	GA C	23/02/01	0.04	7.94	-28	0.851	22.7	6.8	BDL	0.68	BDL	500	0.29	3.4	38.5	BDL	BDL	BDL	BDL
K03	SO B	12/02/01	0.02	8.1	-3.7	0.65	21.2	3.4	0.08	1.2	BDL	400	BDL	1.83	32	0.11	0.035	0.6	16
K03	DP C	22/02/01	0.18	7.42	0	0.001	26.4	3.8	5.4	47.7	0.057	640	0.273	6.76	19.4	BDL	BDL	0.06	BDL
K04	BU B	12/02/01	0.04	7.78	-21	0.903	26.9	1.6	0	1.1	BDL	620	0.056	2.32	12	BDL	0.048	0.24	BDL
K07	SO A	11/02/01	BDL	7.88	-36	0.705	25.1	1.5	0.08	0.8	BDL	420	0.065	BDL	8.4	0.66	0.028	BDL	7
K08	TE B	13/02/01	0.01	7.08	11	0.957	20.3	5.9	0.45	1.79	BDL	600	0.106	1.3	41	BDL	0.041	BDL	BDL
K08	AL C	24/02/01	0.01	7.16	12	0.989	26.6	1.8	0.1	3.07	BDL	9.6	0.147	0.37	12.7	BDL	BDL	0.04	35
K10	DP B	13/02/01	0.02	7.49	-5	1.061	22.8	2.8	0.95	9.11	0.044	620	0.379	7.78	4	BDL	0.062	0.03	70
K10	GA B	25/02/01	0.03	7.84	-23	0.943	25.9	5.4	0.04	1.58	BDL	450	0.011	6.1	16.7	0.39	BDL	0.15	37.5
K11	BU C	31/01/01	0.03	7.49	3	1.139	31.4	6	0.05	0.49	BDL	540	0.085	2.75	23	0.14	0.064	0.03	46
K12	SO C	30/01/01	0.08	8.42	-38	0.76	28.7	5.1	0.05	0.64	BDL	500	BDL	BDL	18	0.73	0.023	0.08	15
K 16	ST A	23/02/01	0.06	7.15	12	0.99	26.5	2.7	10.45	32.2	BDL	620	0.316	4.22	12.7	1.8	0.079	BDL	14
K20	TE A	02/02/01	0.02	7.49	3	1.127	22.1	17	0.09	0.35	BDL	220	0.07	2.45	71	0.2	0.031	BDL	45
K20	ST C	23/02/01	0.01	7.21	9	0.994	25.9	3.1	0.38	1.92	BDL	640	0.294	4.31	8.1	0.32	0.045	BDL	HIGH
K21	TE C	29/01/01	0.25	6.47	53	1.238	18.2	5.2	0.39	0.002	0.66	100	0.179	6.39	4.2	BDL	BDL	BDL	BDL
K22	AL A	30/01/01	BDL	6.87	33	0.893	24.8	3.6	BDL	0.37	BDL	680	0.183	0.9	11.5	0.13	BDL	0.06	120
K25	AL B	31/01/01	0.01	7.48	3	0.95	24.6	5.2	0.06	0.52	BDL	520	0.112	1.43	4.5	BDL	0.028	0.03	BDL
K26	ST B	24/02/01	0.01	7.33	1	0.965			0.03	17.4	0.042	580	0.193	0.57	11	BDL	BDL	BDL	176
K27	GA A	15/02/01	BDL	7.69	-15	1.334	28.9	1.5	BDL	1.07	BDL	700	0.11	9.87	16.9	0.34	BDL	BDL	BDL
K28	DP A	02/02/01	BDL	7.5	3	1.076	23.5	12.6	0.05	4.38	BDL	540	0.592	6.64	17.9	BDL	0.103	BDL	70

BDL = below detection limit

Table 4.9 – Additional Hach analyses of feed and treated waters

Alcan

	Aluminium	
Well number	Feed	Treated
H 5	0.039	BDL
H 11	0.037	BDL
H 16	0.026	BDL
I 1	BDL	BDL
I 10	BDL	BDL
I 20	BDL	BDL
K 22	0.06	BDL
K 25	0.042	BDL
K 26	0.053	BDL

BUET

	Aluminium		Manganese	
Well number	Feed	Treated	Feed	Treated
H 2	0.032	BDL	0.109	0.017
H 13	0.029	BDL	0.144	0.058
H 19	0.021	BDL	0.074	BDL
I 15	BDL	BDL	0.764	0.101
I 18	BDL	BDL	0.728	0.053
I 20	BDL	BDL	0.365	0.033
K 1	BDL	BDL	0.109	0.018
K 11	BDL	BDL	0.111	0.059
K 19	BDL	BDL	0.075	0.019

DPHE/Danida

	Aluminium		Manganese		Sulphate	
Well number	Feed	Treated	Feed	Treated	Feed	Treated
H 5	BDL	0.038	BDL	0.488	BDL	25
H 11	0.03	0.021	0.138	0.614	BDL	BDL
H 15	0.041	0.057	0.188	0.615	BDL	BDL
I 3	BDL	0.222	2.7	2.9	BDL	60
I 11	BDL	BDL	1.5	1.9	BDL	52
I 18	BDL	0.129	0.629	0.585	BDL	51
K 10	0.12	0.4	0.121	0.381	BDL	110
K 19	0.13	0.16	0.162	0.517	BDL	95
K 21	0.12	0.22	0.14	0.582	BDL	115

Sono

	Total Iron	
Well number	Feed	Treated
H 1	4.4	0.05
H 16	5.05	0.25
H 21	9.5	0.1
I 5	2.51	0.48
I 9	2.92	BDL
I 21	0.67	0.02
K 5	5.08	BDL
K 6	3.2	BDL
K 11	5.06	BDL

Stevens

	Total Iron		Chloride	
Well number	Feed	Treated	Feed	Treated
H 6	6.2	1.65	20	11
H 18	0.32	1.78	30	35
H 12	3.05	0.05	BDL	BDL
I 7	0.42	0.09	7.6	10.7
I 16	0.64	0.02	2.6	5.3
K 16	3.3	BDL	129	10.2
K 26	3.45	BDL	18.5	13.1
K 20	3.7	BDL	17.2	12.6

Tetrahedron

	Chloride	
Well number	Feed	Treated
H 7	139	153
H 13	12	143
H 17	33	193
I 2	31.5	36
I 6	22.9	35.6
I 18	8.8	38.4
K 4	18.8	114.5
K 13	12.1	6.2
K 19	29	21.1

BDL = below detection limit

CORRELATIONS BETWEEN ARSENIC REMOVAL AND OTHER WATER CHEMISTRY PARAMETERS

Table 4.10 - Correlation Coefficient between arsenic concentration reduction by technology and feed water parameter concentration

	Alcan	BUET	DPHE/Danida	GARNET	Sono-3-Kolshi	Stevens Institute	Tetrahedron
As	1.00	1.00	0.67	0.76	1.00	0.98	0.99
Fe(II)	-0.16	-0.05	-0.18	0.42	0.21	-0.15	-0.08
pH	0.56	0.51	0.37	0.20	0.13	0.35	0.41
Redox mV	-0.10	-0.18	0.00	-0.35	-0.13	-0.12	-0.29
EC	0.17	0.41	0.49	-0.02	0.46	0.47	0.54
Temp	0.49	0.44	0.40	0.06	0.28	0.35	0.28
DO	-0.10	-0.45	-0.37	-0.17	-0.16	-0.10	0.00
Fe(T)	-0.13	0.14	0.02	0.06	0.06	0.21	0.01
Turbidity	0.12	0.30	-0.09	0.25	-0.09	0.38	-0.04
S2	0.22	-0.12	0.48	0.26	0.33	-0.21	0.09
Alkalinity	-0.15	0.05	0.06	0.39	0.35	0.13	0.16
Mn	-0.47	-0.65	-0.47	-0.50	-0.11	-0.55	-0.06
PO4	0.34	0.19	0.27	-0.38	0.06	-0.17	0.19
Cl-	0.27	0.44	0.33	-0.26	0.12	0.10	0.32
F-	-0.09	0.07	0.27	-0.34	0.09	0.16	0.27
Al	0.39	0.47	0.39	0.52	0.39	0.43	0.23
NO3	0.02	0.04	-0.01	-0.13	-0.03	-0.14	-0.13
SO4	-0.30	0.19	-0.04	-0.04	-0.16	0.34	-0.06
Na	0.37	0.54	0.44	-0.09	0.22	0.41	0.37
K	0.32	0.51	0.10	-0.45	-0.01	0.03	0.06
Mg	0.24	-0.12	0.43	0.05	0.34	0.41	0.34
Ca	-0.11	-0.17	0.16	0.34	0.23	0.17	0.17
Sr	0.22	-0.05	0.33	0.47	0.46	0.36	0.51
Ba	0.25	0.28	0.27	0.57	0.37	0.37	0.31
Al	-0.07	0.27	0.16	-0.14	-0.07	0.13	0.15
La	-0.31	-0.35	0.09	0.08	0.17	0.21	0.06
Ti	0.42	0.43	0.31	-0.02	-0.03	0.10	0.07
Cr	-0.16	0.27	0.28	0.16	0.52	0.68	0.35
Mn	-0.68	-0.42	0.02	-0.31	-0.25	-0.15	-0.12
Fe	0.19	0.24	0.11	0.45	0.17	0.39	0.02
Co	-0.80	-0.08	0.02	0.24	0.35	0.19	0.16
Cu	-0.40	0.29	-0.25	0.10	0.23	0.09	0.19
Zn	-0.23	0.32	0.37	-0.17	-0.20	0.15	0.18
P	0.01	0.52	0.12	-0.19	0.02	0.21	0.02
S	-0.36	0.10	0.26	-0.30	0.12	0.51	0.23
B	0.51	0.66	0.48	-0.05	0.31	0.42	0.38
As (ICP)	0.90	0.67	0.63	0.35	0.58	0.68	0.77
Si	-0.02	-0.15	0.10	-0.17	-0.18	-0.10	-0.19

Table 4.11 - Correlation Coefficient between percentage arsenic reduction by technology and feed water parameter concentration

	Alcan	**BUET**	**DPHE/Danida**	**GARNET**	**Sono-3-Kolshi**	**Stevens Institute**	**Tetrahedron**
As	0.57	0.50	-0.35	0.14	0.48	-0.32	0.30
Fe(II)	0.00	-0.23	-0.63	0.36	0.47	-0.08	-0.15
pH	0.64	0.07	-0.06	-0.13	0.11	-0.31	0.46
Redox mV	-0.29	0.58	-0.07	-0.51	0.09	-0.15	-0.35
EC	0.16	-0.08	0.27	-0.09	0.16	-0.05	0.22
Temp	-0.15	0.50	-0.24	-0.41	0.22	-0.26	0.09
DO	0.07	-0.79	0.35	0.26	-0.36	0.21	0.05
Fe(T)	-0.27	0.26	-0.25	-0.02	0.41	-0.20	-0.19
Turbidity	0.04	0.37	-0.28	0.07	0.19	-0.35	0.20
S2	0.10	0.10	0.31	0.34	0.21	0.01	0.24
Alkalinity	0.08	-0.42	-0.04	0.63	0.08	0.27	0.03
Mn	-0.35	-0.77	0.07	-0.05	0.10	0.53	0.04
PO4	0.43	0.35	0.02	-0.62	-0.01	-0.06	0.02
Cl-	0.19	0.32	0.07	-0.57	0.17	-0.53	0.28
F-	-0.56	0.47	0.21	-0.55	-0.06	0.17	-0.23
Al	0.07	0.30	-0.17	0.36	0.50	-0.32	0.15
NO3	-0.10	0.50	-0.46	-0.27	0.27	-0.20	-0.15
SO4	-0.21	0.15	0.02	0.06	-0.52	-0.01	0.15
Na	0.21	0.24	0.18	-0.13	0.09	-0.25	0.13
K	0.23	0.58	0.15	-0.48	0.09	0.03	0.12
Mg	0.39	0.10	0.53	0.14	0.04	-0.08	0.11
Ca	-0.02	-0.55	0.34	0.53	-0.04	-0.04	-0.06
Sr	0.19	-0.31	0.33	0.52	0.16	-0.12	0.06
Ba	0.10	-0.17	0.11	0.54	0.19	-0.36	-0.09
Al	-0.05	0.10	-0.09	-0.19	0.26	-0.02	-0.04
La	-0.03	-0.65	0.21	0.42	-0.06	0.07	-0.23
Ti	0.42	0.11	0.07	-0.08	0.02	0.21	-0.07
Cr	-0.16	0.19	0.34	0.46	-0.03	-0.08	0.08
Mn	-0.30	-0.40	0.64	0.11	-0.34	0.44	-0.18
Fe	-0.28	0.45	-0.33	0.03	0.45	-0.57	0.04
Co	-0.35	0.38	-0.39	0.32	0.02	-0.21	0.04
Cu	-0.31	0.04	-0.52	0.11	0.27	-0.01	0.10
Zn	-0.34	0.10	0.15	-0.39	0.02	-0.02	0.07
P	-0.02	0.35	0.07	-0.14	0.17	-0.20	0.12
S	-0.32	-0.29	0.42	0.08	-0.06	0.14	-0.10
B	0.30	0.33	0.02	-0.17	0.15	-0.28	0.13
As (ICP)	0.53	0.51	0.26	0.13	0.19	-0.10	0.13
Si	-0.25	0.49	0.16	-0.47	0.04	-0.06	0.00

Table 4.12 - Correlation Coefficient between mean feed water and mean treated water arsenic concentration

Alcan	**BUET**	**DPHE/Danida**	**GARNET**	**Sono-3-Kolshi**	**Stevens Institute**	**Tetrahedron**
-0.47	-0.12	0.80	0.31	0.02	0.58	0.08

MICROBIOLOGICAL DATA

FAECAL COLIFORMS (Thermotolerant Yellow Colonies)

🟦 straw colour filter

🟧 many more small colonies

□ includes small colonies

⬜ straw colour colonies

HAJIGANJ	**Session 2**							**Session 3**							**Xtra Runs**						
Technology	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**fc/100**	**FC 100**	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**fc/100ml**	**FC 100**	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**fc/100**	**FC 100**
Alcam A	HA-2	ds	10/02/2001	x	1	2	3	HA-3	ds	22/02/2001	x	0	0	2							
Buet A	HA-4	ds	10/02/2001	15	1	2	0	HA-6	ds	23/02/2001	28	2	4	6							
DPHE/Dan A	HA-5	ds	10/02/2001	15	0	0	0	HA-2	ds	23/02/2001	28	0	0	2							
Garnet A	HA-3	cb	10/02/2001	15	5	10	23	HA-4	ds	23/02/2001	10	15	30	0	HA-3	cb	14/02/2001	1	32	64	26
Sono Kolshi A	HA-1	ds	10/02/2001	x	123	246	50	HA-8	ds	22/02/2001	11	183	366	128	HA-1	ds	12/02/2001	1	35	70	60
Stevens A	HA-6	cb	10/02/2001	15	0	0	0	HA-1	ds	22/02/2001	27	7	14	12							
Tetrahedron A	HA-7	ds	10/02/2001	x	0	0	0	HA-5	ds	23/02/2001	x	1	2	6							
Alcam B	HA-20	ds	13/02/2001	x	106	212	194	HA-17	ds	21/02/2001	5	3	6	1							
Buet B	HA-14	ds	12/02/2001	17	0	0	0	HA-15	ds	23/02/2001	28	0	0	0							
DPHE/Dan B	HA-15	ds	12/02/2001	17	29	58	47	HA-18	ds	21/02/2001	26	0	0	0	HA-15	ds	14/02/2001	19	>200	400	>200
Garnet B	HA-19	cb	11/02/2001	16	0	0	3	HA-13	cb	21/02/2001	8	0	0	0	HA-19	cb	14/02/2001	1	9	18	23
Sono Kolshi B	HA-16	ds	11/02/2001	x	2	4	10	HA-20	ds	22/02/2001	10	2	4	1	HA-16	ds	12/02/2001	0	3	6	3
Stevens B	HA-18	cb	12/02/2001	17	0	0	0	HA-7	ds	22/02/2001	27	0	0	0							
Tetrahedron B	HA-13	ds	12/02/2001	x	0	0	0	HA-19	ds	22/02/2001	x	0	0	0							
Alcam C	HA-10	ds	11/02/2001	x	12	24	4	HA-21	ds	21/02/2001	9	11	22	x	HA-10	ds	14/02/2001	x	20	40	43
Buet C	HA-8	ds	13/02/2001	18	4	8	7	HA-10	ds	22/02/2001	27	0	0	1							
DPHE/Dan C	HA-11	ds	13/02/2001	18	1	2	1	HA-12	ds	23/02/2001	28	2	4	4							
Garnet C	HA-9	cb	11/02/2001	16	164	328	146	HA-11	cb	23/02/2001	10	50	100	114	HA-9	cb	14/02/2001	1	0	0	0
Sono Kolshi C	HA-21	ds	11/02/2001	x	0	0	0	HA-14	ds	21/02/2001	9	1	2	5	HA-21	ds	13/02/2001	1	3	6	11
Stevens C	HA-12	cb	12/02/2001	17	11	22	21	HA-9	ds	21/02/2001	5	2	4	2	HA-12	cb	14/02/2001	19	7	14	24
Tetrahedron C	HA-17	ds	11/02/2001	x	0	0	0	HA-16	ds	21/02/2001	x	2	4	3							

FAECAL COLIFORMS (Thermotolerant Yellow Colonies)

🟦 straw colour filter

🟧 many more small colonies

☐ includes small colonies

▨ straw colour colonies

ISWARDI	**Session 2**							**Session 3**							**Xtra Run**						
Technology	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**fc/100**	**FC 100**	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**fc/100**	**FC 100**	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**fc/100**	**FC 100**
Buet A	IS-12	ds	11/02/2001	1	0	0	0	IS-15	cb (15mins	22/02/2001	1	3	6	4							
Garnet A	IS-4	cb (1hr)	11/02/2001	1	15	30	17	IS-11	ds	22/02/2001	1	1	2	1	IS-3	ds	02/02/2001	7	6	12	7
Stevens A	IS-5	ds	11/02/2001	1	0	0	0	IS-4	ds	22/02/2001	1	1	2	0	IS-7	cb (1hr)	02/02/2001	7	0	0	0
Tetrahedron A	IS-1	ds	11/02/2001	x	0	0	0	IS-5	ds	22/02/2001	x	0	0	0	IS-2	cb (6hr)	02/02/2001	x	0	0	0
DPHE/Dan A	IS-3	ds	11/02/2001	1	1	2	0	IS-13	cb (1hr)	22/02/2001	1	69	138	120	IS-4	cb (1hr)	02/02/2001	7	2	4	0
Alcam A	IS-2	ds	11/02/2001	x	111	222	175	IS-6	ds	22/02/2001	x	13	26	39	IS-1	ds	02/02/2001	x	48	96	54
Sono Kolshi A	IS-6	ds	11/02/2001	1	10	20	25	IS-1	ds	22/02/2001	1	0	0	1	IS-5	cb (10mins	02/02/2001	x	143	286	157
Buet B	IS-14	ds	12/02/2001	2	0	0	0	IS-18	ds	23/02/2001	1	1	2	4							
Garnet B	IS-8	ds	12/02/2001	2	2	4	15	IS-2	ds	23/02/2001	2	11	22	11							
Stevens B	IS-13	ds	12/02/2001	2	0	0	0	IS-8	cb (overnig	23/02/2001	2	0	0	0							
Tetrahedron B	IS-7	cb(2mins)	12/02/2001	x	0	0	0	IS-9	ds	23/02/2001	x	0	0	0							
DPHE/Dan B	IS-11	cb (2hr)	13/02/2001	3	0	0	0	IS-17	ds	23/02/2001	2	0	0	1							
Alcam B	IS-9	ds	12/02/2001	x	3	6	8	IS-10	ds	23/02/2001	x	4	8	2							
Sono Kolshi B	IS-10	ds	12/02/2001	2	18	36	65	IS-3	ds	23/02/2001	2	0	0	8							
Buet C	IS-18	ds	13/02/2001	3	0	0	5	IS-20	ds	24/02/2001	3	13	26	23							
Garnet C	IS-16	ds	13/02/2001	3	3	6	6	IS-14	ds	24/02/2001	3	0	0	2							
Stevens C	IS-15	cb	13/02/2001	3	0	0	0	IS-12	ds	24/02/2001	3	0	0	0							
Tetrahedron C	IS-17	ds	13/02/2001	x	0	0	0	IS-16	ds	24/02/2001	x	2	4	3							
DPHE/Dan C	IS-13	ds	12/02/2001	2	1	2	3	IS-21	ds	24/02/2001	3	0	0	0							
Alcam C	IS-21	ds	13/02/2001	x	2	4	2	IS-19	ds	24/02/2001	x	63	126	102							
Sono Kolshi C	IS-20	ds	13/02/2001	3	58	116	92	IS-7	ds	24/02/2001	3	1	2	2							

FAECAL COLIFORMS (Thermotolerant Yellow Colonies)

🟦 straw colour filter
🟧 many more small colonies
☐ includes small colonies
⬜ straw colour colonies

KALAROA	**Session 2**						**Session 3**												
Technology	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**FC 100**	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**fc/100**	**FC 100**	**Well No.**	**Sample**	**Date**	**Bleach**	**FC 50**	**FC 100**
Alcam A	-	-	-	-	-	-	KA-1	ds	24/02/2001	x	3	6	9	-	-	-	-	-	-
Buet A	-	-	-	-	-	-	KA-22	ds	24/02/2001	2	504	1008	797	-	-	-	-	-	-
DPHE/Dan A	-	-	-	-	-	-	KA-7	ds	24/02/2001	3	18	36	60	-	-	-	-	-	-
Garnet A	-	-	-	-	-	-	KA-28	ds	24/02/2001	3	236	472	197	-	-	-	-	-	-
Sono Kolshi A	-	-	-	-	-	-	KA-5	ds	24/02/2001	3	0	0	0	-	-	-	-	-	-
Stevens A	-	-	-	-	-	-	KA-16	ds	24/02/2001	3	16	32	15	-	-	-	-	-	-
Tetrahedron A	-	-	-	-	-	-	KA-13	ds	24/02/2001	x	4	8	1	-	-	-	-	-	-
Alcam B	-	-	-	-	-	-	KA-21	ds	22/02/2001	x	4	8	3	-	-	-	-	-	-
Buet B	-	-	-	-	-	-	KA-27	ds	22/02/2001	1	2000	4000	2600	-	-	-	-	-	-
DPHE/Dan B	-	-	-	-	-	-	KA-12	ds	22/02/2001	1	x		14	-	-	-	-	-	-
Garnet B	-	-	-	-	-	-	KA-10	ds	22/02/2001	1	12	24	40	-	-	-	-	-	-
Sono Kolshi B	-	-	-	-	-	-	KA-6	ds	22/02/2001	1	3	6	1	-	-	-	-	-	-
Stevens B	-	-	-	-	-	-	KA-26	ds	22/02/2001	0	0	0	0	-	-	-	-	-	-
Tetrahedron B	-	-	-	-	-	-	KA-19	ds	22/02/2001	x	0	0	0	-	-	-	-	-	-
Alcam C	-	-	-	-	-	-	KA-8	ds	23/02/2001	x	4	8	4	-	-	-	-	-	-
Buet C	-	-	-	-	-	-	KA-25	ds	23/02/2001	2	223	446	150	-	-	-	-	-	-
DPHE/Dan C	-	-	-	-	-	-	KA-3	ds	23/02/2001	2	500	1000	merged	-	-	-	-	-	-
Garnet C	-	-	-	-	-	-	KA-2	ds	23/02/2001	2	329	658	445	-	-	-	-	-	-
Sono Kolshi C		-	-	-	-	-	KA-11	ds	23/02/2001	2	145	290	203	-	-	-	-	-	-
Stevens C	-	-	-	-	-	-	KA-20	ds	23/02/2001	2	26	52	39	-	-	-	-	-	-
Tetrahedron C	-	-	-	-	-	-	KA-4	ds	23/02/2001	x	0	0	0	-	-	-	-	-	-

Bleach	Numbers of days since technology was last bleached
FC 50	Counts on 50 sample volume plate
fc/100	Cells per 100ml from 50 sample volume (Duplicate 1)
FC 100	Counts on 100 ml plate = cells per 100ml (Duplicate 2)

MICROBIOLOGY RESULTS

Untreated Tubewell Waters

AREA: ISHWARDI

			TOTAL COLIFORMS						
Well No.	Well Owner	Contamination Source?	Date	Time	Counts 50ml plate yellow	Rep. 1 Cells/100ml	Counts 50ml plate other	Counts 100ml plate yellow	Counts 100ml plate other
Well 1	Samser Ali	Sampled from shute of Alcan. No concrete apron - bricks	29/01/2001	14:35	0	0	44	0	95
Well 2	Idris Ali Sardar		27/01/2001	9:50	1	2	30	1	35
Well 3	Malek Pk.		28/01/2001	12:30	0	0	>360	0	85
Well 4	Akhrer Hossain		27/01/2001	14:30	1	2	12	1	16
Well 5	Hasem Ali	Concrete apron but muddy	28/01/2001	15:35	0	0	1	1	1
Well 6	Mahbubul	Faulty well, dirty water poured in top of pump	28/01/2001	15:00	1	2	28	3	62
Well 7	Mannan Malitha		28/01/2001	16:20	5	10	148	11	97
Well 8	Moffazal Sardar	No concrete apron - bricks and mud	30/01/2001	17:05	0	0	47	4	>1000
Well 9	Gofur Sasar	Muddy	29/01/2001	10:40	1	2	10	1	19
Well 10	Bhaddu Biswas	No concrete apron - bricks and mud	28/01/2001	16:55	0	0	0	0	0
Well 11	Sattar Pk.	Concrete floor but adjacent VI latrine	30/01/2001	14:45	0	0	0	0	0
Well 12	Nantu Sardar	No concrete apron - bricks and mud	30/01/2001	13:59	2	4	0	0	1
Well 13	Keru & Meru	No concrete apron - bricks and mud	29/01/2001	12:20	0	0	0	0	0
Well 14	Golam Mostafa	Concrete apron	29/01/2001	11:45	0	0	5	0	1
Well 15	Jafir Hossain Pk.	Concete apron	29/01/2001	11:20	0	0	0	0	0
Well 16	Afzal Hossain	No concrete apron - bricks and mud	28/01/2001	17:40	1	2	0	0	16
Well 17	Nowab Ali		29/01/2001	16:00	5	10	0	7	26
Well 18	Abul Kalam		30/01/2001	16:20	0	0	0	1	0
Well 19	Toiab Ali	No concrete apron - bricks and mud	30/01/2001	13:05	5	10	0	8	0
Well 20	Jahurul Master	No concrete apron - bricks but clean	30/01/2001	11:05	0	0	>480	0	>1000
Well 21	Jafir Uddin Mridha	No concrete apron - bricks and mud	30/01/2001	12:20	10	20	5	30	2
		DAY	28-Jan	29-Jan	30-Jan				
		Incubation Start	18:30	18:00	18:00				
		Incubation Finish	10:30	10:00	10:00				
		BLANK	0(50*)	0(0)	0(0)	* contamination at edge of filter			

Untreated Tubewell Waters

AREA: HAJIGANJ

			TOTAL COLIFORMS						
Well No.	Well Owner	Contamination Source?	Date	Time	Counts 50ml plate yellow	Rep. 1 Cells/100ml	Counts 50ml plate other	Counts 100ml plate yellow	Counts 100ml plate other
Well 1	Tajul Islam	Concrete skirt/faeces & flies by analysis	29/01/2001	12.05	0	0	0	0	2
Well 2	Nuru Mia	No concrete skirt/faeces & flies by analysis	29/01/2001	13.25	0	0	0	1	0
Well 3	Anu Mia TE-A	Concrete skirt/faeces & flies by analysis	29/01/2001	10.30	3	6	56	3	125
Well 4	Khalial Rhaman	Concrete skirt/faeces & flies by analysis	29/01/2001	14.30	0	0	0	0	0
Well 5	Md. Idrish Alu	Concrete skirt/faeces & flies by analysis	29/01/2001	15.55	0	0	7	0	9
Well 6	Samsul Haq	Concrete skirt	30/01/2001	11.10	79	158	5	99	7
Well 7	Md. Abdul Rashid Khan	No concrete apron/ pond?	30/01/2001	11.55	0	0	0	0	0
Well 8	Kafil Uddin	No concrete apron/ adjacent toilet	30/01/2001	15.35	119	238	0	221	0
Well 9	Nuru Barbari	Concrete apron	30/01/2001	14.30	0	0	0	0	0
Well 10	Ali Akbar (s/f Fazil Khan)	Concrete apron	30/01/2001	13.00	0	0	1	0	2
Well 11	Abdul Monin Munshi		31/01/2001	16.49	0	0	>100	0	>200
Well 12	Noral Islam	Concrete apron	01/02/2001	12.24	2	4	2	2	5
Well 13	Kahlilur Rhaman	Concrete apron	01/02/2001	13.14	0	0	0	0	2
Well 14	Billal	No concrete apron	01/02/2001	14.37	0	0	0	0	0
Well 15	Md. Moklas Rhaman	No concrete apron/ adjacent toilet	31/01/2001	13.15	0	0	>200	0	>200
Well 16	Abdul Ashim	Concrete apron	31/01/2001	14.10	26	52	7	3	29
Well 17	Amir Hossain	Concrete apron	31/01/2001	11.15	0	0	7	1	16
Well 18	Joynil Uddin	No concrete apron	31/01/2001	12.15	10	20	>69	17	>100
Well 19	Abdur Rob	Concrete apron	31/01/2001	15.50	0	0	4	0	2
Well 20	Barpari	Concrete apron	02/02/2001	16.55	5	10	0	0	0
Well 21	Ali Akbar (s/o Junab Ali)	Well inside toilet/concrete floor	30/01/2001	16.25	3	6	2	1	1
		DAY	29th	30th	31st	1st			
		Incubation Start	18:00	17:30	18:00	18:00			
		Incubation Finish	10:00	9:35	10:00	10:00			
		BLANK		0	0 (2)	0 (0)			

Untreated Tubewell Waters

AREA: KALAROA

			TOTAL COLIFORMS						
Well No.	Well Owner	Contamination Source?	Date	Time	Counts 50ml plate yellow	Rep. 1 Cells/100ml	Counts 50ml plate other	Counts 100ml plate yellow	Counts 100ml plate other
Well 1	Md Momin Ali Master	Well condition good	31/01/2001	10:50	4	8	34	5	94
Well 2	Md Eyakub Ali	Well surround brick - broken and settings loose	31/01/2001	11:40	0	0	4	1	8
Well 3	Md Nazir Ali	Reasonable condition - animals	31/01/2001	12:20	4	8	144	9	258
Well 4	Md Matiur Rahaman Sana	Well condition good	31/01/2001	13:35	0	0	287	0	800
Well 5	Md Daud Ali Mollah	Good condition - bamboo nozzle	31/01/2001	13:00	185	370	0		
Well 6	Md Fazar Ali Gyen	No platform - always stagnant water around	31/01/2001	13:00	0	0	0	0	0
Well 7	Md Abdur Rahaman Sana	Reasonable condition	31/01/2001	15:30	0	0	6	0	2
Well 8	Md Ruhul Amin	Animals	29/01/2001	15:50	0	0	1	0	2
Well 9	Abdul Hamid	Well in good condition - animals	30/01/2001	10:25	15	30	270	39	512
Well 10	Md Joyn Uddin Khan	Animals /haystack	29/01/2001	12:16	4	8	3	13	9
Well 11	Md Alfaro Rahman	No	29/01/2001	12:55	0	0	1	0	0
Well 12	Md Yunus Ali Sana	Animals	29/01/2001	11:37	0	0	1	0	2
Well 13	Md Nazrul Islam	Well surround in poor condition	29/01/2001	15:10	14	28	14	15	27
Well 14	Md Abdul Hamid	Good condition	30/01/2001	11:15	0	0	19	3	32
Well 15	Fazlul Karim		30/01/2001	12:18	12	24	0	7	15
Well 16	Md Golam Mostafa	Good condition	30/01/2001	14:55	0	0	15	25	3
Well 17	Md Afsar Ali Sardar	Broken surround	30/01/2001	11:45	0	0	3	0	18
Well 18	Amin Uddin Dafadar	Intact surround but faulty well - lake water added to pump	30/01/2001	12:52	0	0	13	3	32
Well 19	Md Abdul Aziz Bishash	V good condition well	30/01/2001	15:23	0	0	1	0	4
Well 20	Hasi Akram Ali	Well in good condition	30/01/2001	15:55	0	0	0	0	2
Well 21	Abul Hossen	Animals in yard but away from well	29/01/2001	10:37	0	0	0	1	3
		DAY	29-Jan	31-Jan					
		Incubation Start	18:00	19:55					
		Incubation Finish	10:00	12:00					
		BLANK	0(0)	0(1)					

🟦	straw colour filter	☐	includes small colonies
🟧	many more small colonies	▨	straw colour colonies

Detailed Surveys

🟦 straw colour filter

▯ includes small colonies

many more small colonies

▨ straw colour colonies

Blanks confirm satisfactory processing in all cases

					Total coliforms					Faecal Coliforms					
Technology	Well No.	Date	Sample Details	Time	Counts 50ml plate yellow	Rep. 1 Cells/100ml	Counts 50ml plate other	Counts 100ml plate yellow	Counts 100ml plate other	Counts 50ml plate yellow	Rep. 1 Cells/100ml	Counts 50ml plate other	Counts 100ml plate yellow	Counts 100ml plate other	Comments
IS-SO-A	6	14/02/2001	Feed		1	2	39	5	91	0	0	0	0	0	Direct feed
			Nozzle from top kolshi		0	0	>600	>countable		0	0	2	2	0	Iron staining restricted counting
			Nozzle from 2nd kolshi		11	22	136	18	160	4	8	4	4	6	Nozzle broken by child
			Storage kolshi		2	4	90	38	0	2	4	3	7	20	Standing for 30mins
IS-GA-A	4	14/02/2001	Filling jug		0	0	54	2	125	0	0	0	0	2	Direct feed
			Treated		4	8	159	0	250	0	0	0	0	0	As draining from nozzle
IS-AL-A	1	14/02/2001	Feed		0	0	0	0	12	0	0	0	0	0	Feed from shute
			Treated		10	20	187	20	170	7	14	4	8	4	Sample take straight after
IS-GA-B	11	25/02/2001	Filling jug	10.15	6		157	4	247	0	0	0	0	0	using provided jug - baby put on head
			Treated	10.55	merged	uncountable	1	75	0	20	40	0	56	0	Draining from technology (in yard)
IS-DP-A	13	25/02/2001	Filling jug	12:50	>700	>1400	0	>1200	0	40	80	0	64	1	Cleaned buket and filled with jug. No obvious contamination source
			Treated	16:50	8	16	95	15	228	6	12	0	15	1	Direct from tap
IS-AL-C	19	25/02/2001	Filling vessel	15:30	0	0	164	0	>400	0	0	0	0	0	Sampled from shute. Muddy well
			Treated 1	15:45	26	52	109	38	169	11	22	2	18	5	Sample from tap after 1 min
			Treated 2	16:30	8	16	80	20	112	2	4	0	8	1	Sampled after flushing with full volume (direct paired)

Detailed Surveys

🟦 straw colour filter

many more small colonies

▭ includes small colonies

▨ straw colour colonies

Blanks confirm satisfactory processing in all cases

HA-GA-A	4		Filling Jug		>500	>1000	0	>500	0	>200	>400	0	>200	0	
			Bottom Nozzle		12	24	>200	0	>100	16	32	7	5	23	
HA-SO-A	8	24/02/2001	Filling jug		0	0	>100	0	>100	0	0	0	0	0	Technology bleached and nozzles washed on 23/2/01
			Bottom nozzle		45	90	>50	>100	0	56	112	0	97	0	
			Storage kolshi		>100	>200	0	>100	0	105	210	0	142	0	
HA-SO-C	14	24/02/2001	Filling jug		0	0	>100	0	>100	0	0	0	0	0	
			Bottom nozzle		15	30	>100	12	>100	0	0	0	0	0	
			Storage kolshi		22	44	>100	15	>100	19	38	2	27	8	
HA-SO-A	1	10/02/2001	Bottom nozzle	11:05	>count		0	>count	0	123	266	>50	merged	0	
	1	12/02/2001	Bottom nozzle	17:15	56	112	>200	0	>500	35	70	4	60	2	following bleaching and 2 flushes
	1	13/02/2001	Bottom nozzle	17:18	2	4	>200	3	>200	0	0	0	0	0	following 2nd bleaching of both first and second kolshi directly
HA-SO-C	21	11/02/2001	Bottom nozzle	15:18	41	82	>200	44	>200	merged	merged	merged	merged		
		13/02/2001	Bottom nozzle	15:00	1	2	>100	0	>500	3	6	7	11	0	following bleaching and 2 flushes
		14/02/2001	Bottom nozzle		1	2	>200	1	0	1	2	0	2	0	following 2nd bleaching of both first and second kolshi directly
KA-BU-B		25/02/2001	Feed	12:35	0	0	0	2	0						Not direct but same vessel used
			Top Tap	11:10	10	20	400	13	151						Iron staining restricted counting
			Tap 2 (above column)	11.45	600	1200	0	940	0						
			Bottom delivery tube	12.15	350	700	35	940	0						
KA-GA-C		25/02/2001	Feed	13:15	0	0	1	4	2						high flow rate (nozzle missing)
			Treated	13:45	79	158	0	152	2						under mango tree/ lids cleaned prior to sample

5. APPENDIX 5: ANSWERS FROM HOUSEHOLDER SURVEY

Hajiganj

Alcan Enhanced Activated Alumina

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Enough treated water can be procured by HHs within 5 to 30 minutes technology. 2.No hard labour required to get water. 3. Water is clear. Good for drinking. No bad smell. 4.Women are associated with handling the technology. 5.Size is okay, but children often sit on the two boxes. There is danger of being damaged. 6.This technology can be easily used for 10-12 families. In fact in one location, as many as 22 families use the treated water. 7. HHs prefer to have the spare-parts from the nearby shops or hardware shops.	1. As the technology can be used by so many families, the HHs are interested to procure the technology collectively in partnership with 10/15 families and in installment. 2.HHs are individually ready to pay Tk.700-1000/- for it. 3. They are willing to pay a sum of Tk.100- 200/- a month for maintenance.	1. In case of collective use of the technology, a committee with village elders will be formed to buy the technology. The technology will be placed in one particular house, the owner will be in charge of the maintenance. The HHs using the treated water from the technology will pay the maintenance fee on a monthly basis.	1.Every HH liked the technology as its water is good and enough for so many families as well as easy to handle. But the price is exorbitant restrictive for individual families. HHs also raised the danger of damages in the machine and in such cases, it would be difficult to repair. Cost of repair may also be high. In some instances during the third phase of testing, some households even talked about some kind of bad smell from the water. As evident from discussions with HHs, the initial enthusiasm was missing at the end. Even if they plan to buy the technology collectively, the HHs are not exactly sure who will pay or who will not.

BUET Activated Alumina

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Can get 18-40 liters of water in 20-60 minutes. 2. Treated water is clear and not smelly. 3. Not enough water can be treated. 4.HHs are not happy with the structure. Height needs to be decreased. 5. Majority HHs found it difficult to operate this. The bucket on the top is in such a height that it becomes difficult for housewives to pour water into it. They also find it difficult to apply medicine and stir the water at such a height. The structure also occupies a lot of space on the house-floor. 6. Women are associated with running of the system. 7. HHs felt it would be better for them to get the spares and medicines at the local market.	1.Majority of the HHs expressed their willingness to spend Tk. 250-500/- for the technology. 2. Economically better-off 2/3 HHs were ready to spend Tk.1000-2000/-. 3.Most HHs also prefer to buy on down payment basis.	1.Most HHs expressed their preference to buy the technology individually. Some wanted to have sharing with their own brothers, but not with the neighbours. They are reluctant to share with neighbours as less amount of water can be treated with it. Operation of it is also bothersome.	1.With this technology, it is not possible to get water like one gets from the tube-well. 2. After mixing medicine with water, one is to wait for an hour to get the treated water. Often the children or the neighbours take water sooner, well before full treatment. 3. HHs opined that the people should be made aware of the dangers of arsenic poisoning through mass awareness programme, radio-TV, interpersonal contact by the field workers, etc.

DPHE/Danida Two Bucket Unit

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Can procure 20-72 liters of water within 40-60 minutes. 2. Most HHs opined that the treated water is clearer than that of TW water (less iron), and with no smell. 3.The technology can provide enough water for a single family. 4. The structure is okay and acceptable to most. It is light and can be taken from one place to another easily. 5. The size of the two out of three buckets is acceptable and they have cover over them, but the HHs indicated that if the top bucket were a bit bigger, they could pour more water at a time. 6. The operation is easy and it is also easy to clean. 7. However, for the HHs, waiting for long 4 hours after mixing medicine sometimes becomes a bit difficult. 8. Sometimes, the younger children take water even before the stipulated time of 4 hours. Even the elders do the same without bothering to realize the importance of waiting for the medicine to work. 9. Women as usual are in charge of operation of the technology. 10. HHs prefer to have the medicine in nearby shops or markets.	1.As the technology is acceptable to them, the HHs are ready to buy this. They expressed their willingness to pay Tk. 100-600/- as down payment. A few HHs also want to buy it on installment basis. 2. HHs are ready to pay a monthly cost of Tk.20-100/- as maintenance cost.	1.All HHs preferred to buy the technology on individual basis. They even are willing to allow their neighbours to get the treated water from their place.	1. The HHs are in favour of a strong motivation campaign for making people aware about the dangers of arsenic. They wanted field workers to do the job. Radio-TV can also be utilized.

GARNET Home-made Filter

Operation and Maintenance	Financial Issues	Management Issues	Other
1.According to the users, one can procure 20-50 liters of treated water in 50-90 minutes time. 2.Not difficult to operate. 3.Water is clear, good in drinking and no bad smell from water. 4.Size, structure and height are okay but it is too heavy. 5. Women members of the HHs are mainly engaged with using the technology. 6. They would prefer to get the essential supplies from nearby markets.	1.HHs are ready to spend Tk.200-300/- for buying the technology. 2. They would like to get it on installment, but are ready to pay on down payment basis. 3.They opined that the maintenance cost for the technology should be Tk. 15-20/- a month.	1.As small amount of water can be treated with the technology, most of the HHs preferred to use it on individual basis. A few also wanted to share the treated water with one or two neighbours. 2.If taken collectively, the one who understands the technology better would be given responsibility to manage the operation. But all other partners would have to share the works. A committee can also be formed for the purpose.	1. As the operation of the technology is easy, water is good, and there is no need to mix medicine, people like the technology. However, the water flow is very slow. Other demerits include difficulties in cleaning due to heavy weight of the machine. The nozzles of the pipe often become loose and then children can swallow them.

Sono 3-Kolshi

Operation and Maintenance	Financial Issues	Management Issues	Other
1.A total of 15-45 litres of treated water can be procured in a matter of 20-50 minutes time. 2.The operation of the technology is easy. 3. However, the flow of water is very slow. 4. Some times, the flow completely stops and after fixing it, less water comes out. It is quite bothersome for the waiting housewives. 5.The taste of water is better than that of tube-well, it has no smell. Colour of water is also fine. 6. Women are associated with operating the system. 7.Size is good, but the HHs opined in favour of a bigger 'kolshi' at the bottom. 8. HHs prefer to get the technology from nearby markets or shops.	1.HHs expressed their willingness to buy the technology at a cost of Tk.100-500/- on down payment basis. 2. There were 2 or 3 HHs who expressed their desire to buy on instalment basis. 3. They were also willing to pay Tk. 10-25/- a month for maintenance purpose.	1.Everyone wanted to buy it on individual basis.	1. The HHs were for strong motivation campaign for making people aware of the dangers of arsenic. They wanted mass meeting at village level, person-to-person motivation, and even use of radio-TV for this purpose.

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Operation and Maintenance	Financial Issues	Management Issues	Other
1.Using this technology, one can get 30-80 liters of water in 20-60 minutes. 2. If run without any break, one can get even a double amount of water. 3. The technology is regarded as sufficient to supply enough water for a family. 4.Treated water is good to drink, no bad smell or iron. 5. However, some disliked mixing medicine with water. 6.Women are involved with operating the technology. 7.The structure of the technology is regarded as not so good. If the bucket on the top could be bigger in size, more water could be placed at a time for treatment. 8. HHs favour getting spare-parts/medicine at the local market.	1.Many HHs showed their interest to buy the technology, as they think it would be relatively cheap. 2. They think that they can manufacture such a machine or repair it locally. 3. They are ready to spend Tk.100-400/- to buy one. 4.They are also ready to spend Tk.15-50/- a month for repair. 5.They would prefer to buy in instalment, but would not mind to buy it by down payment.	1.Everyone indicated their preference for individual ownership of the technology. But they indicated their willingness to allow the neighbours to get water. 2. They are against the collective ownership as they feel apprehensive of problems that may crop up if the technology is broken at a latter stage, when people may not be prepared to pay for repair. No one will then take up the responsibility. They are also afraid of hassle in getting water from a single source.	1.HHs stressed on the necessity of campaigning among the unaware village people to inform them about the dangers of arsenic contamination. They are of the opinion that when the villagers do not even take their ailing sons or daughters to a doctor, how can they be willing to spend money for safe arsenic-free water? So strong campaigning is very much needed. 2. They wanted use of posters and radio-TV and house-to-house motivation campaign by field workers.

Tetrahedron Ion Exchange Resin			
Operation and Maintenance	**Financial Issues**	**Management Issues**	**Other**
1.It takes about 30-60 minutes to get treated water in enough amount. It can cater the daily needs of 4/5 families. 2. Water is good to drink, but some housewives complained about bad smell in the treated water. This led some people to stop drinking water on some occasions. 3. HHs faced problems in backwashing the machine. It takes time and the machine has to be moved out of home. 4.Size is appropriate, but housewives found it difficult to move the cylinder from one place to another.	1.HHs are ready to spend Tk.700/- to Tk. 3000/- in installment for buying the technology. 2. If price is less than Tk.2000/-, a few HHs showed their preparedness to buy on down payment. 3. Majority HHs are in favour of procuring the technology on collective basis. They are of the opinion that if 4/5 neighbouring families buy it together, it would cost less for the individuals.	1. If procured on share-basis, the technology will be installed in one person's house, who will be responsible for maintenance of the same. Every sharing family will pay the cost of maintenance and other costs in equal amount. A committee will be formed to run the affairs of treating water.	1.HHs mentioned about easy operating mechanism and about its small size that can be carried to any place. Water can be used without any delay. Little to clean. All these made the technology attractive. 2. HHs also talked about the possibility of getting smell (chlorine) if water is not poured properly on the chlorine slab. 3. They would prefer lower price so that they can afford it.

Iswardi

Alcan Activated Aluminum Filter:

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Can get water as per need. 2. Can be shared among the neighbors. Good for big families. 3.No bad smell. 4.Water is clear and does not make the cooked rice reddish. 5.Easy to get water. 6.Easy to operate. 7.Easy to maintain. 8.The technology occupies a lot of space and it is rather difficult to take bath or to wash clothes near the tube-well. It creates problems for operating the tube-well.	1.All HHs said that the price of the technology is beyond the reach of 'the poor people like us'. 2. All HHs wanted government or NGOs to help them in procuring the technology. "We can provide Tk. 2000-3000 at the most." 3.Some HHs said that it is good and if 10/12 families group together, they can perhaps buy one jointly. 4.'Whatever the price, it is better to buy on individual basis.' 5.A few HHs wanted to pay Tk. 3/400 for buying a technology. 6. They said that they can spare Tk.15/20 a month for maintenance.	1.It would indeed be a bit difficult to manage the technology if it is purchased jointly. 2. Management should be in one hand. 3.HHs prefer to buy technologies individually.	1.The HHs wanted more vigorous campaign to make people aware of the dangers of arsenic. 2. Users wanted the filter to be set up a bit away from the tube-wells. 3. They said that if the technology is taken away, they would again have to drink arsenic contaminated water.

BUET Enhanced Activated Alumina

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Water flow rate is very slow. 2.But water is good. Not much smell. 3.Operated mostly by women. Women face problem while operating it. 4. Structure is very high (5'). Housewives dislike this height, as they face difficulties to pour water into the bucket at such a height. 5.Size is too big to place it inside the small houses.	1.'Price is very much. We can not afford to buy it' 2. Majority HHs were ready to pay Tk.100-300/- but not beyond that. 3.Those willing to buy wanted to buy it individually. 4.They also want to buy on down payment. 5. They are ready to spend Tk. 10-20/- for maintenance.	1.Almost none was in favour of buying the technology collectively. 2.Only one said that he would buy collectively with his brother and the two will share all cost.	1.'As we are poor and illiterate, government should come up to help us to understand the dangers of arsenic. Extensive campaign should be started telling and showing people the dangers of this poison.' 2.'We now know a bit about this problem. What about others? So a bid campaign is required.

DPHE/Danida Two Bucket Unit

Operation and Maintenance	Financial Issues	Management Issues	Other
1.The technology is good as we can get enough water for our use. 2.But 'we cannot get the treated water whenever we need. We are to wait for long four hours before we can use it.' 3.Operation is easy. 4.We do not know the name of the medicine that is to be mixed. 5.HHs wanted to procure the medicine from nearly pharmacies or shops.	1.'The price (of the technology is too high for people like us'. 2. 'If government helps, we can buy it. 3.Most of the HHs (7) said that they can spare only Tk.100-200/- for the technology. 4. For monthly operation, they are ready to spend Tk. 30-50/-.	1. All the 7 HHs that are willing to buy said that they would prefer individual ownership and management.	1.Emphasized on the need to make people aware of the danger of arsenic poisoning through discussion with people. Use of radio-TV is also advocated.

GARNET Home-made Filter

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Treated water is good. 2.No bad smell while drinking. 3.Water flow from the technology is slow. 4.Canget 50-60 liters s day. 5. Not suitable for a big family. 6.Women-members of the HHs handle the operation. 7. They faced difficulties in fixing the water-flow.	1.As people are poor, they showed their reluctance to spend money for the technology. 2. Four HHs expressed their preparedness to spend Tk. 100/- for buying the technology. 3. Most of the HHs said that they can think of buying the technology if procured jointly with others. 4. Some said that they are not ready to spend anything for maintenance. However, 6 HHs said that they would spend Tk. 10-50 a month.	1.Most HHs indicated their preference to manage the technology on individual basis. 2. They want to avoid the botheration that they can face for joint ownership.	1.HHs were in favour of making people aware of arsenic contamination through house-to-house campaign and through radio-TV. 2. 'What we would do if you take the technology away from us? We'll have no good water to drink.' 3. Some HHs opined that this technology is not good.

Sono 3-Kolshi

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Water is good and tastes good. 2.But the flow of water is very slow. Only 30-40 liters a day. 3.It is suitable for a small family. 4. Only drinking purpose may be served with the water. 5.Operation is easy. 6.No medicine is required. Only brich-chips and sand. It is good. 7. 'The water becomes very cold (in winter). We cannot drink it.' 8.As most of us are living in small cottage, we shall face problem in placing it, especially during the rainy season'. 9.It's height is much. It may fall down and be broken. 10. Cleaning can be bothersome.	1.Most of the HHs (5) said that they can afford it. Four HHs said that they are 'very poor' and 'we cannot afford even 50 taka at one time'. 2. 'Can somebody help us in procuring this?' 3.Most HHs (5) said that they are willing to spare Tk.200-300/- for the technology. 4. 'Maintenance cost is not much. We can afford it.'	1. All HHs want to use it individually.	1.'We are poor and illiterate people. We need guidance from you to understand about the problem. We are happy that you are telling us about arsenic problem.' 2. 'There is a possibility of the earthen jars to get broken. What about plastic or tin jars?'

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Operation and Maintenance	**Financial Issues**	**Management Issues**	**Other**
1.Enough water is available from the technology. (60-80 liters.) 2. Majority HHs complained about bad smell from the treated water. 3.Even some of the women reported vomiting. 4.Operation is easy but maintenance is not. 5.Some times the plastic tube attached with the bucket is broken and water run down the floor. 6. 'We do not like this as the smell is awful.'	1.'We will buy if it costs between Tk.100/- to Tk. 300/-.' 2. 'Poor people that we are, we can not spend more than Tk.10/15/- a month for maintenance.' 3.They wanted government to give the facility free of cost.	1.Every HH was in favour of buying the technology individually. 2. They feel it would be difficult to manage if bought collectively.	1.Some housewives were not happy with the quality of water. One said, 'Take it away from my house now! I am not able to drink water to my satisfaction for bad smell.' 2. However, the HHs are becoming aware of the arsenic problem. But they want more motivation campaign for all the people.

Tetrahedron Ion Exchange Resin Filter

Operation and Maintenance	**Financial Issues**	**Management Issues**	**Other**
1.Enough water. Even neighbours can get water from the technology. 2.Easy to operate and maintain. 3.Easy to wash and clean the machine. 4.Sometimes, it smells like bleaching powder. 5.HHs not aware of the name of the 'medicine' (chlorine cake). 6.HHs are interested to procure the medicine from nearby sources like shops/medicine. 7. We can back-wash, but we do not know, but we do not know what parts are inside.	1.We heard about the price. It is about 12,000 taka. It is too much for us. 2. None expressed their willingness to pay so much for the technology. 3. Some HHs however expressed their readiness to procure the technology on sharing basis with the neighbours. 4. Some HHs wanted subsidy from government/NGO for helping them to procure the technology. 5. Most of the HHs said that they can afford to pay Tk. 50-100/- for maintenance per month.	1.If procured on sharing basis, they mentioned about possible difficulties. 2.In that case, the responsibility for management should be with one person. 3. We want the government to decrease the price, so that we can individually buy it.	1.Some HHs said that more campaigning should have been done before introducing the technologies to them. 2.HHs should have been told more about the operation and maintenance. 3. HHs are in favour of more awareness building activities among the poor and illiterate village people.

Kalaroa

Alcan Enhanced Activated Alumina			
Operation and Maintenance Aspect	**Financial Issues**	**Management Issues**	**Other**
1.Takes less time(15-20 Minutes). 2. Requires less labor. 3. Can get enough water quickly (1200-2000 liters). 4.No problem in using, even if size is a bit big . 5.Tastes good, no bad smell. 6.Structure good. 7.Women can easily handle as its operation and maintenance is easy.	1.Willing to spend a between Tk.1000/-to-3000/- 2. Willing to spend Tk. 30/-50/- a month for maintenance. 3. Three HHs out of nine want to buy on installment & the rest (6) on down payment basis.	1.Three HHs out of nine want to share the use of technology. 2.In case of collective management, three HHs out of nine want equal partnership.	1.For making people aware of arsenic problems, use of Radio-TV, mass meeting and courtyard meeting emphasized. 2.Even after treatment of the TW water, rice cooked with the water becomes reddish as before. 3. HHs not aware of the cost, maintenance procedure and the durability (economic life)of the technology. 4. More extensive hands-on facilitation about use of the technology demanded. 5. Not possible to buy if price is high. 6.Wanted govt. to extend the facility to them.

BUET Activated Alumina			
Operation and Maintenance	**Financial Issues**	**Management Issues**	**Other**
1.It takes 60-90 minutes to get water, as HHs are to wait for such time after mixing medicine. 2. Water is not available at any time. Water is also not enough for a large family. Can procure 60-80 liters. Only enough for drinking. 3. It is difficult to adjust the tap. 4.Water is clear, no bad smell. 5.Women manage the technology. 6.Structure is not so good. It is difficult to pour water at a high level. 7. It is difficult to move it from one place to another.	1.Three 9 HHs are ready to spend Tk.700/-, three Tk.1000/- and another three Tk. 500/- . 2. Six HHs are willing to spend Tk. 50/- and another three Tk. 20-50/- a month for maintenance. 3. All 9 HHs are willing to buy it on down payment basis.	1. All 9 HHs prefer to use the technology on individual basis.	1.The stand on which the technology is placed is weak. 2. Difficult to move it from one place to another. 3.Water comes rather slowly. It gets warm under the sun. 4. One HH said, “If other technology available, I’ll not prefer this”. 5. HHs advocated for use of radio-TV, courtyard meeting and newspapers for awaring the people.

DPHE/Danida Two Bucket Unit

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Takes 60-90 minutes to get water. In 12 hours, 50 liters can be collected. 2.Have to wait for 4 hours after mixing medicine. 3.Cannot get water any time without waiting for some time. 4. However, water flow is satisfactory. 5.No problem in using the technology. 6.taste of water is good, water is xclear but sometimes, it smells. 7. Structure is good. 8. Can be moved from one place to another without much effort. 9. Women are involved with running of the technology. 10.HHs prefer to procure the technology/medicines from hardware shop or pharmacy.	1.All the 9 HHs are ready to spare Tk.200- 300/- for the technology. 2.Three HHs expressed their willingness to spend Tk. 50/- , another three HHs Tk. 30-50/- and another three HHs Tk. 10-20/- a month for maintenance purpose. 3. Eight HHs are willing to buy on down payment basis and one HH on instalment basis.	1. Eight HHs are interested to use the technology individually and one on sharing basis.	1.Cleaning of the technology after every use is quite bothersome for the housewives. 2. Can not be used if medicines are not at hand. 3. Three HHs liked the technology as it can be moved from one place to another with ease. 4.People's awareness can be increased through house-to-house campaigning and through mass meeting.

GARNET Home-made Filter

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Treated water comes very slowly. 2. Not enough water. 3.While adjusting flow of water, tube gets open and cannot be readjusted as per instruction. 4.Taste of treated water is not good and sometimes sour. 5. Water is clear. 6. Women are associated with operation and maintenance. 7.Cleaning of the technology is bothersome. 8.Being heavy, it is difficult to move it from one place to another. 9.HHs are interested to procure it from upazila level agents or from local traders.	1.Three HHs are ready to pay Tk. 1500/-,three Tk. 500/- and another three Tk. 200/- to 400/-. 2.Three HHs are ready to spend between Tk. 10/-and Tk.50/- and three Tk. 20/- and another three Tk. 30-50/- a month for maintenance. 3. Eight HHs are ready to procure the technology by down payment and only one by installment.	1. Everyone was interested to use on individual basis.	1.As there is no system of keeping cover over the treated water, there is every scope for pollution. 2.The stand on which the technology is erected is weak and it gets bended. 3.People do not like the use of treated water for cooking rice as it becomes reddish and loose. Even clothes washed with the water gets reddish. 4.HHs are not aware of the cleaning process and about the intervals between cleaning. 5. It is difficult to control flow of water. 6.However, some prefers it as the technology requires no medicine. 7. Use of radio-TV and house-to-house campaign is advocated for awareness building.

Sono 3-Kolshi

Operation and Maintenance	Financial Issues	Management Issues	Other
1.Takes 60-90 minutes to get water. 2.Little labor required. 3.Flow of water is somewhat satisfactory. 4.Enough for a small or medium size family.(40-60 liters) 5.Taste of water is good and there is no smell. 6.Water is clear. 7.Structure is good. 8. Women are mostly associated with treating water. 9.Can be procured from local shops, dealers or from blacksmiths.	1.Three HHs are ready to buy at a cost of Tk.50-100/-, another three HHs for Tk.200-300/- and another three at a cost of Tk. 500/-. 4.All the HHs are willing to spend Tk.10-20/- for monthly maintenance. 5. Seven HHs are ready to buy on down payment and two on installment basis.	1.All HHs except one are interested to use the technology individually. One wants to share it with younger brother. 2. Even for collective use, one person should be given the responsibility to manage.	1.Sometimes sand jams the pipe nozzle. 2.Not enough for a big family. 3. Possibility of the earthen jars to get broken. 4.Some dislikes the water when they see iron gets accumulated on the sand top. 5.HHs like the technology as it is indigenous in origin. 6.No need to use any medicine. 7.Like the technology as they get cool water. 8.HHs recommended house-to-house campaigning for awareness-building.

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Operation and Maintenance	Financial Issues	Management Issues	Other
1.Takes 40-90 minutes and need not wait after mixing medicine. 2.Flow of water is satisfactory. 3.Can procure 150-200 liters of water. 4.More or less, enough water is available, enough for a family. 5.Taste of water is a good, but sometimes, a bit smelly. 6.Structure is okay. 7.Women are associated with running the technology. 8.Can be moved from one place to another easily. 9.Willing to procure the medicine from nearly pharmacy or shops.	1.All 9 HHs are willing to spend Tk. 500/- for it. 2.Three HHs willing to spend Tk. 50-100/- a month for maintenance, another 3 HHs Tk.50/- and another three Tk.20-50/-.	1. All the 9 HHs are interested to buy the technology for individual use.	1.It is bothersome to clean the machine after every use. 2.Cannot be used if there is no medicine. 3.Water gets dirt and polluted as there is no cover for the treated water. 4.One user opined that he felt the water a bit smelly. 5.The water-collecting pipe being big in length collects dirt from the ground. 6.Sometimes, water seeps through the pipe and there is a possibility for the plastic jar to get broken.

Tetra Hedron Ion Exchange Resin

Operation and Maintenance	**Financial Issues**		
1. Less time required (40-60 minutes). 2.Can get water quickly. 3.Enough water can be procured.(possible to get 200-800 liters). 4. Possible to meet requirements of more than one family. 5.Little labor required. 6.No problem except bending the tap for backwashing. 7.Tasteless, a bit of stale/sour. Smell of chlorine felt. 8.Water is very clear. 9. Women take care of the operation & maintenance. 10. Can be moved from one place to other easily. 10. Wanted to procure 'medicine' from local pharmacies.	1.Six HHs willing to spend a maximum of Tk. 1000/- and three between Tk. 300/- to Tk.500/- and three between Tk. 300-to Tk. 2000/- 2. Three HHs ready to spend Tk.100/-to Tk.200/- and three HHs between Tk. 50/- to 100/-and another three HHs Tk. 30/- to Tk. 60/-. 3. Three HHs willing to buy on installment and six on down payment.	1.Eight HHs prefer to use the technology themselves and only 1 HH with neighbors. 2. All wanted to take care of maintenance activities.	1.HHs not aware of maintenance cost and place from where they can procure. 2.All preferred the technology as it can be moved from one place to another with ease. 3.People should be made aware through radio-TV, newspaper, and courtyard meeting. 4.Pouring water on the bleaching cake is a bit bothersome. 5. Would not be able to buy if price is prohibitive.

6. APPENDIX 6: RECOMMENDED IMPROVEMENTS TO TECHNOLOGIES

This table lists practical problems with each of the technologies identified during field testing in Hajiganj, Iswardi and Kalaroa.

Technology	Issue	Observation/comment	Suggestions for improvement
Alcan	Robustness	• First box prone to leakage around the top • Sometimes stop flowing – units need to be tilted slightly or relative levels readjusted to allow flow. • Plugs often go missing • Cover on meter is easily broken	• Rubber seal around lid would prevent overflow
	Ease of use	No problems	
	Maintenance	• No instructions issued for cleaning to reduce bacterialogical contamination. Potential routes for contamination:- • Flat lids make convenient surface for clothes washing and other house hold activities which may result in contamination • Washing above Alcan inlet unless unit is too close to punp	• Sealing units would prevent dirty water seeping in • Change shape of inlet surround so that splashed water tends to drain to waste chute rather than to Alcan inlet
BUET	Robustness	• Stand is flimsy and liable to fall over • Tubes and column are not well sealed and prone to leakage	• Reduce column length and overall height to lower centre of gravity. Use stronger metal for stand
	Ease of use	• Too tall for average villager to reach top bucket • Pipette and bottle of reagent hard to dispense accurate dosage without getting reagent on hands • Adjusting flowrates to correct level on overflow tube is difficult to implement. Usually find water flowing from overflow tube.	• Shorten column (increase cross sectional area to allow sufficient bed volume) • Well sealed bottle with dropper built in to lid
	Maintenance	• Connection tubes are hard to wash and easily contaminated • Sand bucket and cloth become dirty. No instructions issued regarding washing sand. • Water below tap outlet level in sandbucket is left to stagnate	• Regularly mix sand with dilute bleaching agent to clean and rinse thoroughly. However sand bucket is heavy and difficult to manoeuvre. • Outlet in base of bucket

DPHE/Danida	Robustness	• Tap/pipe connection tends to leak • Unstable • Tube from top bucket to filter tends to kink, reducing flowrate • Reagent cakes rapidly	• Make bottom bucket taller, or filter shorter to allow sufficient space for tube
	Ease of use	• Reagent does not easily dissolve • Treated water is strongly discoloured	
	Maintenance	• Water left in bottom bucket below level of tap outlet is not easily cleaned out after each use and tends to be left to stagnate	

GARNET	Robustness	• Nozzles and droppers fall out frequently • Nozzles prone to leakage • Buckets crack easily around base	• Nozzle inserted from the outside would be much easier to fix • Rubber seal around nozzle
	Ease of use	• Difficult to maintain correct flowrate, often find set to flow at maximum rate (e.g. at one location deliberately set at max. rate because at that rate the visible iron is removed and so the filter is assumed to be working)	• Use nozzle with fixed flowrate
	Maintenance	• Buckets extremely heavy and awkward making it difficult to regularly swap them • Difficult to get bricks and sand out of bucket for cleaning and replacing nozzle • Cloths get extremely dirty • Optional cleaning instructions are unlikely to be followed	• Cleaning instructions should be explicit

Sono	Robustness	• Fragile • Nozzles often clog or get pushed inside. No way of rectifying • Stand is flimsy, particularly the one for the large kalshis	• Nozzles inserted from the outside would be easier to deal with
	Ease of use	No problems	
	Maintenance	• Flow rate reduced due to iron coating after relatively short time • No instructions for cleaning • Heavy • No way of regenerating fill, kalshis need regular replacement	• Include instructions for cleaning with dilute bleaching solution or boiling water. If buckets used rather than kalshis, filling and container could be cleaned more easily

Stevens	Robustness	• Green bucket is weak at slot, often breaks • Red bucket cracks easily around base • Tube/bucket connection prone to leakage • Reagent in packets degrades within few days • Reoving sand from filter bucket often damages the foam tube connection, allowing sand into tube	• Vertical slots would make the bucket stronger • Make packaging more air-tight
	Ease of use	• Tube on sand washing bucket does not work – sludge has resettled on sand before the liquid has drained away • Sand washing is time consuming – takes many rinses to get is clean • Sand tends to be lost at every washing • Small packets of reagent create litter which is often picked up by children	• Bucket with pouring lip, with catch to prevent sand loss when decanting sludge and water • A cloth around the inside of the green bucket would remove some of the sludge before it gets into the sand • Large well sealed jar of reagent with measuring spoon or tablet form reagent
	Maintenance	• Long tube often touches ground, easily contaminated • Open bucket susceptible to contamination • No instructions to clean with bleach	• Simple tap would be more hygeinic • Include lid • Include instructions for cleaning sand with bleach and allowing bleach to run right through, including tube

Tetrahedron	Robustness	• Top comes of hydrant fairly easily on some units	• Tighter sealing
	Ease of use	• Backwashing is awkward – need to tilt unit or turn tap connection • Design makes it look as if chlorine tablet should lie flat in sieve therefore often used wrongly • Impossible to get consistant chlorine dosing – depends how directly over tablet water is poured and how fast it is poured	• Slight adjustment in relative height of 2 components • Different shape tablet • Funnel structure to control inflow of water and fix tablet position relative to inflow
	Maintenance	• Stones would not be easily replaced – would brickchips do the same job? • Tablet is potentially dangerous with children around	

7. APPENDIX 7: LIST OF STAFF INVOLVED IN PROJECT

WS Atkins International

Mike Woolgar
David Sutherland
Simon Wood
Dr Don Ross
Anna Macqueen
Lesley McWilliam

Imperial College London

Professor John Monhemius
Dr Peter Swash

Bangladesh Engineering and Technological Services Ltd (BETS)

Engr. Md. Jahangir Chowdhury
Engr. Md. Obaidul Kabir
Md. Rezaul Hasan
Md. Ahammadul Kabir
G.M. Fazle Rabbi
Md. Abdul Hakim
A.K. Azad
Zahid Kamal Siddiqui
Md. Zahurul Islam
Md Salim Mida
Raihan Uddin Ahmed
B.M. Kamal Hossain
A.B.M. Sadiue Rahman
Md Mubarak Hossain
Muhammad Ali
Md. Ferdous Alan
K.A.Al. Mahmud
Kazi Md. Rafique Islam

Intermediate Technology Development Group (ITDG)

Naved Ahmed Chowdhury
Mostafa Haider Chowdhury
Md Abul Hayat
Salma Rashid
Shamsun Nahar
Md Saiful Islam Khan
Shaikh Md Hasib Nehal
SNM Moniruzzaman
Md Amir Hossain
Taslima Khanam
Mr. Sazedur Rahman Chaoudhury