Monitoring and Maintenance Plan

Foundry Central West - Teesworks

FEBRUARY 2025

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Version Control (optional)

Issue	Revision No.	Date Issued	Page No.	Description	Reviewed By
01	01	12/02/25			

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Appendices

1 Introduction

This management document, compiled by Arcadis Consulting (UK) Ltd (Arcadis), provides details of the planned groundwater monitoring at the Foundry Central West (FCW) site including sampling methodology, along with the maintenance plan for the monitoring network. The planned groundwater monitoring is being conducted as requisite surveillance requested by the Environment Agency (EA) under a Deposit for Recovery (DfR) permit.

This document will be maintained by Arcadis through the duration of the active permit and updated accordingly based on any necessary changes that may occur.

2 Groundwater Monitoring Locations

Groundwater monitoring locations are presented in Arcadis document *10047374-AUK-XX-XX-CO-YY-1037-01-Foundry Central West Groundwater Criteria Memo.*

A total of four locations on the down hydraulic gradient site boundary and three on the up hydraulic gradient site boundary are proposed. The locations are presented on Figure 10047374-AUK-XX-XX-DR-ZZ-1036-02-FCW_Permit GW_Loc included as Appendix A with survey details in Table 1 and Table 2

Table 1:Down Hydraulic Gradient Monitoring Wells

Down Hydraulic Gradient Locations	Easting	Northing	Top of Well Pipe Elevation (meters above Ordnance Datum)
FOU-AUK-BH101S	455913.731	525679.282	7.817
A-BH18D	455802.102	525505.716	6.976
A-BH35S	455767.037	525264.537	7.079
B-BH26S	455901.227	525102.781	7.109

Table 2: Up Hydraulic Gradient Monitoring Wells

Up Hydraulic Gradient Locations	Easting	Northing	Top of Well Pipe Elevation (meters above Ordnance Datum)
FOU-AUK-BH102	456219.312	525559.572	7.191
FOU-AUK-BH103S	456143.281	525366.005	7.148
FOU-AUK-BH104	456060.623	525170.01	6.953

3 Monitoring Duration and Frequency

Details of the planned duration and frequency of monitoring are presented in Arcadis document *10047374-AUK-XX-XX-CO-YY-1037-01-Foundry Central West Groundwater Criteria Memo*.

4 Compliance Limits

Compliance limits are presented in Arcadis document *10047374-AUK-XX-XX-CO-YY-1037-01-Foundry Central West Groundwater Criteria Memo.* The groundwater memo also details the decision making process and actions that will be taken in the event of a breach of compliance limits.

5 Groundwater Monitoring Methodology

Groundwater monitoring will involve two tasks conducted concurrently as detailed below:

1. Assessment of the condition of the monitoring well
    a. Is the cover secure to prevent unauthorised access.
    b. Are the monitoring well headworks in good condition and accessible for sampling.
2. Groundwater Elevation Survey (See Arcadis' Technical Method Statement Groundwater and NAPL Monitoring (Appendix B)) modified to record to the top of the well pipe.
    a. Recording of depth to, and elevation of, groundwater.
    b. Recording of depth to base of the monitoring well.
    c. Not expected, but if present recoding of depth to, and elevation of, non-aqueous phase liquids (NAPL).
3. Collection of a groundwater sample for laboratory analysis (See Arcadis' Technical Method Statement Low Flow Sampling Using a Peristaltic Pump (Appendix B)). Samples will be collected from the mid-point of the well response zone (slotted section).

6 Storage, Preservation and Transport of Samples

Measures taken to ensure the quality and integrity of the groundwater samples, from collection to receipt of the samples by the laboratory is summarised below:

Task	Details
Storage	Containers as specified as required by the testing laboratory for each analyte will be used for the collection of samples.
Preservation	Filling of sample containers to minimise headspace and low storage temperature to minimise the potential for volatilisation and biodegradation of volatile compounds prior to analysis
Decontamination	Groundwater samples will be collected using dedicated disposable tubing in order to prevent cross-contamination.
Transport	Samples will be stored in dedicated sample boxes provided by the laboratory. Sample details and analytical requests will be recorded on the laboratory chain of custody form included with samples, prior to dispatching to laboratory for analysis. Samples will be dispatched to the laboratory on the day of sampling, where practicable.

7 Laboratory Analysis

Laboratory analysis of groundwater samples will be undertaken at a United Kingdom Accreditation Service (UKAS) & Monitoring Certification Scheme (MCertS) accredited (for selected chemical analysis) laboratory and an Arcadis approved supplier.

8 Quality Assurance and Quality Control (QA/QC)

Groundwater samples will be submitted to an Arcadis approved supplier and UKAS laboratory. The samples will be submitted with a chain of custody identifying the client, the Arcadis project reference, the Consultant / Project Manager, the nature of the sample (i.e., water) and the parameters to be tested.

Quality Assurance/ Quality Control (QA/ QC) at the laboratories will be carried out as part of their standard procedures. Arcadis' QA/ QC was conducted in line with in-house procedures, as part of our International Standards Organisation (ISO) 9001 and ISO 14001 accreditation.

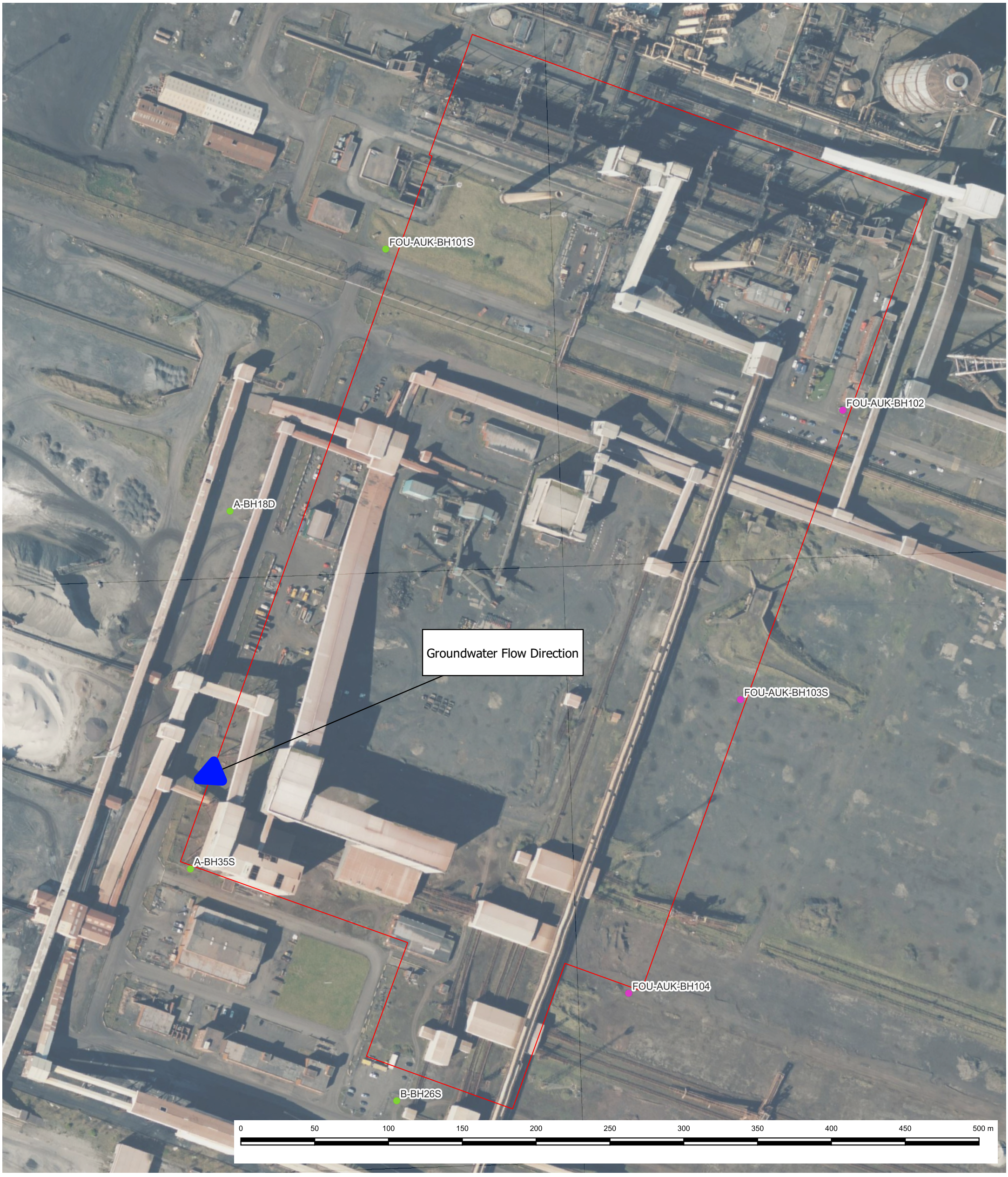
9 Monitoring Well Network Maintenance Plan

The following maintenance will be undertaken:

1. Monitoring well covers will be locked to prevent unauthorised access, and will be labelled with the location identity.
2. To reduce the risk of damage to the monitoring wells during the DfR activities the locations will be protected by hard barriers with high visibility / reflective surfaces. The location of the wells will be provided to the Principal Contractor and will be communicated to all plant operators working on site.
3. If during the tasks defined in Section 5 a monitoring well is noted to be subject to sediment build up following initial well development prior to the first sampling event, an attempt will be made to remove the sediment in line with Arcadis' Technical Method Statement monitoring well development (Appendix B).
4. Minor damage to monitoring wells (e.g. re-cement in a top hat cover) will be rectified before the following monitoring visit.
5. Wells damaged to the extent that that the tasks in Section 5 are no longer possible will be replaced by a new installation to the same design located within 5m of the original location. The data sets for the new and original location will be combined for future assessments.

Appendix A

10047374-AUK-XX-XX-DR-ZZ-1036-02-FCW_Permit GW_Loc



Legend

Monitoring Purpous

- Permit Compliance
- Up Hydraulic Gradient Surveillance

Base Maps

Bing

Redline

- Permit

Notes:

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Title: Permit Monitoring Locations

Site: Teesworks - Foundry Central West

Client:
South Tees Developement Corporation

Project:
10047374

Date: 23/01/2025
Drawn By: JALM
DRG No: 10047374-AUK-XX-XX-DR-ZZ-1036-02-FCW_Permit GW_Loc

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Appendix B

Arcadis Technical Method Statements

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ENVIRONMENT – TECHNICAL METHOD STATEMENT

Task

Groundwater and non-aqueous phase liquid (NAPL) monitoring

Equipment

- Interface probe (groundwater and NAPL monitoring) or dip meter (groundwater monitoring)
- Groundwater and NAPL recording sheet
- Decon-90 or comparable cleaning solution and paper towels (e.g. “blue roll”)
- Ratchet set and screwdriver
- Marker paint

Steps

(1) Prepare the monitoring well

Confirm the monitoring well number against the site plan and fill in initial details on recording sheet (e.g. location number, weather etc). If on disused site, the location can be marked using marker paint. Unscrew the monitoring well cover and well bung and set to one side. The screwdriver may be used to carefully prise open the lid, and to clear the screw holes from dust/stones if needed.

WATCH POINT! The screws and washers should be kept in a safe location ready for re-use on completion of the monitoring.

(2) Undertake the monitoring

Switch on the interface probe or dip meter, and lower gently into the monitoring well.

If using a dip meter, a continuous beep means that the probe has encountered water, either at the air-water or NAPL-water interface. The probe should be raised and lowered slightly to confirm the depth at which the probe beep is triggered. Using the monitoring well cover half placed across the monitoring well, or any other flat object which create a surface level with the ground, read the depth on the probe measure at which the beep first occurs from the centre of the well directly over the well pipe, to the nearest 1mm. Record the depth to water measurement on the recording sheet. Continue to lower the dip meter to the base of the well. Where resistance is met, representing accumulated fines or the base of the monitoring well, record the depth to base in the same way as for the depth to groundwater.

If using an interface probe, a continuous beep means that the probe has encountered NAPL, either at an air-LNAPL or water-DNAPL interface. Upon hearing a continuous beep, the probe should be raised and lowered slightly to confirm the depth at which the probe beep is triggered. Using the same methodology outlined above, record the depth to LNAPL (if present) on the recording sheet to the nearest 1mm. Continue to lower the probe gently until an intermittent beep is heard (depth to water). Record the depth to water on the recording sheet. Continue to lower the interface probe to the base of the well. If a continuous beep is encountered, DNAPL may have been encountered within the base of the monitoring well. If this occurs, the probe should be raised and lowered slightly to confirm the depth at which the probe (continuous) beep is triggered and the depth to DNAPL recorded. Continue to lower the probe to the base of the monitoring well. Where resistance is met, representing accumulated fines or the base of the monitoring well, record the depth to base in the same way as for the depth to groundwater.

WATCH POINT! For raised covers record readings the same way as Flush covers. Recording DTP / DTW and DTB from top of the cover, from the centre directly above the well pipe. Top hat cover height relative from ground level can then be subtracted following this measurement.

Images

ENVIRONMENT – TECHNICAL METHOD STATEMENT

Steps

(3) Complete monitoring

Remove the dip meter or interface probe from the monitoring well, using Decon-90 and a paper towel (or other suitable cleaning method) to clean the probe measure and probe itself. Replace the well bung and well cover, and secure firmly.

WATCH POINT! If using a dip meter, if the probe tape or probe is highly odorous or there is visual evidence of contamination (e.g. sheen) when removed from the monitoring location, NAPL may be present. Contact the Project/ Task Manager to determine whether an interface probe should instead be used.

(5) Quality control

Ensure that paper towels are disposed of appropriately. Ensure that the probe and attached tape measure is appropriately decontaminated before use on a new monitoring location.

NOTE – some interface probes operate differently, if in doubt, please check the tone emitted in a control solution of water to ensure that a solid tone is emitted as opposed to an intermittent tone.

Images

ENVIRONMENT – TECHNICAL METHOD STATEMENT

Task
Low-flow groundwater sampling using a peristaltic pump

Equipment
- Peristaltic pump (with internal battery or external supply)
- Multi-parameter probe and calibration solutions
- Oil-water interface probe or dip meter
- 4x6 mm low-flow tubing
- Silicone tubing
- Laboratory-prepared sample containers
- Waste purge water storage (bucket or 25 litre barrel) and measuring jug
- Arcadis low flow sampling recording sheets
- Appropriate equipment for cutting low-flow tubing
- Borehole opening equipment

Eijkelkamp Peristaltic Pump 12 VDC Standard Manual -
https://www.eijkelkamp.com/files/media/Gebruiksaanwijzingen/EN/m2-1225eperistalticpump.pdf

Before heading to site, contact sampling laboratory to order sample containers (number and type varies dependent on compounds investigating). Samples should be scheduled to be collected daily where possible.

WATCH POINT! The peristaltic pump is not watertight, therefore, during use the top portion of the pump should be covered if undertaking pumping in wet / adverse conditions.

Steps

(1) Calibrate the multi-parameter probe for dissolved oxygen (DO), electrical conductivity, pH and Oxidation-Reduction Potential (ORP), using appropriate calibration solutions and water (as per manufacturer's instructions).

WATCH POINT! Make sure calibration solutions are in date. Care should be taken with the cable between the multi-parameter probe and handset to prevent damage to the cable. Calibration solutions can be acidic or basic and therefore should not be mixed. The waste calibration solutions should be collected in a drum and are not to be discharged to ground.

(2) Prepare work area around monitoring well, as detailed on traffic management plan / in Health and Safety Plan (HASP).

(3) Measure depth to NAPL, if present and initial depth to water and depth to base of well. Refer to Technical Method Statement *Groundwater and NAPL Monitoring* for details.

WATCH POINT! If NAPL is encountered in the monitoring well, confirm with Project Manager or Task Manager before continuation of groundwater sampling.

(4) Measure out and cut low-flow tubing to pre-determined depth or to halfway through the water column *i.e.* half-way between the depth to water and depth to base or monitoring well. The pipe inlet MUST be within the slotted section of the well.

WATCH POINT! Prior to cutting tubing make sure that the sampling depth is within the screened section of the well by reference to BH logs or previous data. If needs be, adjust the tubing length.

(5) Ensure the peristaltic pump is turned off. Undo the bolts holding the clear cover of the peristaltic pump and remove the cover. Place a length of silicon tubing around the rolling heads of the peristaltic. Replace the clear cover and associated bolts. Trim silicon to suitable length.

WATCH POINT! Water that enters the covered area beneath the plastic may impact the pumps ability to draw up water. If there is restricted flow, this area should be tried and pumping continued.

(6) Connect low-flow tubing to silicon tubing.

(7) Lower the low-flow tubing down the well until it is fully extended.

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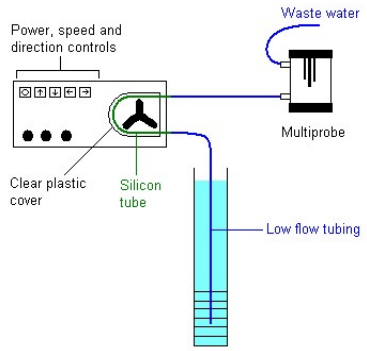

Set up of peristaltic pump

Peristaltic pump

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ENVIRONMENT – TECHNICAL METHOD STATEMENT

Task

Low-flow groundwater sampling using a peristaltic pump.

Steps (Continued)

WATCH POINT! If it is difficult to get the tubing to the required depth add a short length (~1") of silicon tubing to the end of the low flow tube, this will help stop it getting stuck. Tubing should only be weighted as a last resort, and weight objects should be thoroughly cleaned before use, and in between each well, and attached to tubing using cable ties or similar (not gaffa tape).

(8) Connect the other end of the silicon tubing to the bottom of the multiprobe flow cell using a separate length of low flow tubing.

(9) Purged water from the top outlet of the flow cell should be directed into a measuring jug using another length of low-flow tubing.

(10) Connect line into flow cell of a multi-parameter probe and record DO, conductivity, pH and ORP readings every 5 minutes for at least 30 minutes or until DO, conductivity, pH and ORP readings stabilise, as detailed below, over three readings. If using a Troll or SmartTroll probe the stabilisation parameters should be pre-set as follows:

- DO +/- 10% of reading or 0.2 mg/l, whichever greater
- Temp +/- 0.2 degrees C
- pH +/- 0.2 pH Units
- +/- 20 mv +/- 3% of reading, whichever is greater

Also monitor depth to water throughout purging, to observe if draw-down in the monitoring well is occurring.
Measure and record the volume of purge water using the measuring jug, record its visual/ olfactory appearance and store in a drum/barrel, to be disposed of it in accordance with the site's procedures.

WATCH POINT! If significant drawdown is observed and it is unlikely that the well can be pumped until the parameters stabilize and then have enough water remaining to sample, obtain a grab sample from the tubing prior to the flow cell and make a note on your site notes.

WATCH POINT! If poor water retrieval is experienced, this is likely due to high sediment content in the zone that is being pumped. Attempt to elevate the depth that is being pumped at or shake the tubing to release the sediments. If after both of these tasks a different methodology, bailers or foot pump, may be required to obtain a sample.

(11) Sample the groundwater directly from the water return tubing (disconnect line from flow cell) into the laboratory provided containers. Seal the containers with no head space (for vials) and minimum head space for bottles. Place samples in dedicated cool box with cooling aids.

WATCH POINT! Water samples must be collected from the tubing before the flow cell, not after, to prevent cross contamination from water previously run through the flow cell itself.

WATCH POINT! For some testing, water samples will be required to be pre-filtered prior to sending to the labs.

(12) Turn off the peristaltic pump and dispose of all tubing, both low flow and silicon, which carry groundwater from the well to the flow cell. Measure and record the final depth to water. Replace the well bung and well cover, and secure firmly.

WATCH POINT! Waste plastic and PPE should be separated from other waste materials and be disposed of in a manner consistent with the start up notes and current waste legislation. All generated waste that is transported back to field services must be accompanied by a signed waste transfer note. Refer to Standard Operating Procedure on Waste Management for further information.

(13) Once monitoring is complete, fill the multi-parameter probe with water and store on the container.

Image

ENVIRONMENT – TECHNICAL METHOD STATEMENT

Task
Groundwater monitoring well development

Equipment
- Toolkit and appropriate keys to open monitoring well covers
- Interface probe
- Well development/purging equipment (surge block, bailer, pump or inertial pump tubing and valve)
- Water containers for developed/purged water (where applicable)
- Multiprobe (optional)

Steps

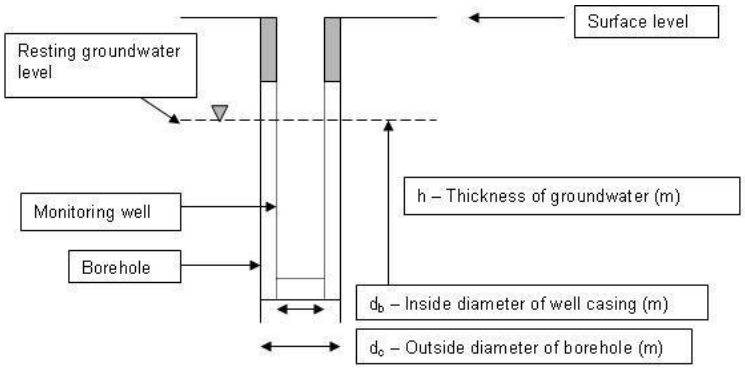
(1) Set up

Open monitoring well cover. If the top casing surrounding the monitoring well is water logged, all standing water should be bailed out prior to removing the well cap. Prior to monitoring well development the static water level and non aqueous phase liquid thickness (if present) should be measured using Technical Method Statement for groundwater and NAPL monitoring.

WATCH POINT! If a significant quantity of non-aqueous phase liquid is present (greater than 2-3mm) the well should not be developed, thus preventing the mobilisation of contaminants into solution or the smearing of product.

(2) Preparatory calculations

In order to give an indication of the volume of water to be removed there are two options, as detailed below:



Option A
The well volume is calculated based on the well diameter using the following equation:

$$\text{Well Volume} = \pi \cdot d_b^2 \cdot h / 4$$

Calculations of volume of water within the well for standard well diameters and volumes for developing and purging are included with this method statement.

Option B
Where requested to develop/purge the whole volume of borehole, the total borehole and well volume is calculated based on borehole diameter and makes allowance for the filter pack porosity, using the following equation:

$$\text{Well Volume} = [\pi \cdot d_b^2 \cdot h / 4] + \{[\pi (d_c^2 - d_b^2) / 4] \cdot \varphi \}$$

Where φ is the porosity of the filter pack.

Image

Steps

(3) Monitoring well development

The process of well development aims to remove fine sediments from the borehole and from the aquifer along the screened section of the well. The development process will assist with limiting the quantity of sediment entering the borehole during future sampling events and should assist with the collection of a sediment free groundwater sample representative of the aquifer conditions. Well development should, ideally “stress” the well and aquifer. This is typically achieved by pumping in surges, adjusting the depth of the pump and/or agitation with a surge block or inertial pump. The rate of pumping must be greater than that proposed for the subsequent groundwater monitoring.

Monitoring well development should continue until the water is visibly clean and / or of constant quality (e.g. constant electrical conductivity). As an initial indication monitoring well development should involve the removal of approximately 10 times the calculated volume of water in the well. In cases where the monitoring well is developed until dry, monitor recharge of groundwater to assess viability of 10 times calculated volume removal, and discuss with the Project Manager to determine appropriate development volumes.

The development procedure will be achieved by either:

- Pumping with an electrical submersible pump.
- Pumping with an inertial pump.
- Air lifting.
- Bailing.

WATCH POINT! All development should target the full screened section of the borehole, and in many cases should attempt to remove any fines that may have entered and settled at the bottom of the borehole. Where fines are present, a combination of pumping and surging (using a surge block) may be appropriate.

(4) Quality Assurance / Quality Control

Well development is to be carried out using disposable equipment or fully decontaminated equipment, care should to be taken to ensure that development equipment does not come into contact with any potentially contaminated surfaces that may result in the cross-contamination of groundwater. Every effort must be taken to avoid cross contamination of the monitor wells.

Water should be collected and disposed of in line with the Standard Operating Procedure and project Start-up Notes.

In some cases, developing of wells may be required where NAPL has been reported. If required, a procedure for separation of product and minimising the potential for mobilisation or smearing of contamination must be developed, and agreed with the Project or Task Manager.

Image

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Supplementary Information

1" Boreholes

Water column thickness (cm)	Volume of water (cm3)	Volume for Development (Litres)	Volume for Purging (Litres)
1	5.07	0.05	0.02
2	10.13	0.10	0.03
3	15.20	0.15	0.05
4	20.27	0.20	0.06
5	25.34	0.25	0.08
6	30.40	0.30	0.09
7	35.47	0.35	0.11
8	40.54	0.41	0.12
9	45.60	0.46	0.14
10	50.67	0.51	0.15
50	253.35	2.53	0.76
100	506.71	5.07	1.52

2" Borehole

Water column thickness (cm)	Volume of water (cm3)	Volume for Development (Litres)	Volume for Purging (Litres)
1	20.27	0.20	0.06
2	40.54	0.41	0.12
3	60.80	0.61	0.18
4	81.07	0.81	0.24
5	101.34	1.01	0.30
6	121.61	1.22	0.36
7	141.88	1.42	0.43
8	162.15	1.62	0.49
9	182.41	1.82	0.55
10	202.68	2.03	0.61
50	1013.41	10.13	3.04
100	2026.83	20.27	6.08

4" Borehole

Water column thickness (cm)	Volume of water (cm3)	Volume for Development (Litres)	Volume for Purging (Litres)
1	81.07	0.81	0.24
2	162.15	1.62	0.49
3	243.22	2.43	0.73
4	324.29	3.24	0.97
5	405.37	4.05	1.22
6	486.44	4.86	1.46
7	567.51	5.68	1.70
8	648.59	6.49	1.95
9	729.66	7.30	2.19
10	810.73	8.11	2.43
50	4053.66	40.54	12.16
100	8107.32	81.07	24.32

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