

BAA.2210 Victoria North HIF Infrastructure Main Works

Emerging Water Technical Note

Prepared by BAM Nuttall

25/11/22

Table of Contents

Table of Contents	2
1.0 Introduction	3
2.0 Discovery of Emerging Water	3
3.0 Testing of water to date	3
4.0 Assessment of the Risk	4
4.1 Comparison of testing results to target levels	4
4.2 Groundwater monitoring	4
4.3 Cohesive band of material	6
5.0 Proposal of Delayed Remediation Zone	7
5.1 Proposed Methodology	7
5.2 Permanent Solution	8
6.0 Conclusion	8
Appendix 1a – Cheetham Hill Culvert Investigation	9
Appendix 1b – Onsite Drainage Investigation	20
Appendix 2 – Location of Water Samples	29
Appendix 3 – Testing Results	32
Appendix 4 – UU Testing Results	43
Appendix 5 – Ground Water Monitoring Locations	46
Appendix 6 – Phase 1 Drawing	48
Appendix 7 – Geological Long section – Red Bank Plateau	50

1.0 Introduction

The purpose of this technical note is to enable the discharge of planning condition 7a, planning reference 133143/VO/2022. This will be achieved by; giving a brief background to the emerging water, explaining the testing completed to date, assessing the risk and describing the proposed approach.

2.0 Discovery of Emerging Water

The emerging water was initially located on site at the location shown in Appendix 1b – Onsite Drainage Investigation, following tree clearance in the area.

Extensive site investigations have taken place and we have an extensive knowledge of the drainage within our site, this report is in Appendix 1a – Cheetham Hill Culvert Investigation and Appendix 1b – Onsite Drainage Investigation.

A fenced zone was established around the emerging water, as a temporary solution whilst investigations were being undertaken.

A temporary on-site pumping and storage facility was established for a 2-day duration. This allowed the water to be quickly extracted and stored and removed from site by road tanker direct to the (United Utilities) UU treatment plant. This provided a lowering of the water level in the area and access to carry out further investigations to locate the source of the water emergence.

Additionally, a temporary trade effluent discharge license has been granted for six months by UU to enable any dewatering direct to sewer rather than using tanker disposal.

The investigation the emerging water to be discharging from a broken pipe (Appendix 1b – Onsite Drainage Investigation fig 4) which historically drained to the public sewer across site via a now derelict drainage network, at the point of the emerging water. The ultimate source of the incoming flows is still unknown, but there is potential for it to be emanating from a historic landfill to the north of the site. Tracing the pipe below the Showman's Guild embankment has found that 14.5m from the break it changes direction which has prevented the camera team getting further. This information is being used to determine possibilities of where this pipe goes, but the length before the turn suggests the turn is either before or at the crest of the embankment, which makes any intrusive survey impractical.

3.0 Testing of water to date

Initial testing and investigation focussed on the nitrogen levels in the emerging water and looked at analysis to confirm the requirements on the temporary trade effluent licence, in place with UU.

However, early consultation with the Environment Agency (EA) discussed the potential for the emerging water to be leachate from the historic Queens Road landfill. These discussions indicated that there was an additional contaminant from an EA point of view which was PFAS. As such, testing for PFAS was undertaken with the intention to compare the results to the UK Drinking Water Standard and Inland Surface Water Standards. The EA informally confirmed that these standards were appropriate for comparison, however EA and United Utilities (UU) still need to formally accept these standards as a basis for comparison.

The proposed additional testing focussed on 17no trial holes arranged in concentric circles emanating out from the discovered broken pipe on site and taking water samples from each of these locations, which are being sent away for lab testing (inc PFAS and Total Oxidisable Precursor (TOP) Assay). In addition to these, samples of the water in the river were also taken at locations off site (back of HG Paints) where there is a source of orange water that enters the river upstream of our site. These

samples have been taken for comparison as this is believed to be an additional drainage outfall of the historic landfill drainage. See Drawing in Appendix 2 – Location of Water Samples.

Additional to PFAS testing, UU carried out their own testing, alongside BAM testing, which identified high levels of dissolved methane (Appendix 4 – UU Testing Results), which also needed to be managed.

4.0 Assessment of the Risk

4.1 Comparison of testing results to target levels

Test results can be seen in Appendix 3 – Testing Results. These are the tests completed by BAM focusing on; PFAS / PFOS, from the 17no. locations, and UU testing from the emerging water directly, focusing on results for trade effluent discharge.

Initial review of the PFOS results against the UK Drinking Water standard ‘wholesomeness’ threshold are shown below, in Table 1.

Table 1 - Initial Partial Review of Results

Location		Standard	Test Result
Site Emerging Water	PFOS	0.1ug/l (100ng/l)	6.3ng/l and 21.2ng/l
	PFOA		4.8ng/l and 8.9ng/l

In summary, although the ponded orange water does contain PFAS chemicals, they are not present at levels that exceed the current UK Drinking Water Standard.

Against the inland surface water standard of 0.65ng/l for PFOS, the data show that this standard is exceeded in the Irk at all sampling points. There is no river sample upstream of the culvert outlet at HMG Paints, so it’s not possible to say with certainty that the river water exceeds this standard before it passes the Victoria North site but PFOS is frequently detected above the inland surface water standard in surface waters across England. (*Perfluorooctane sulfonate (PFOS) and related substances: sources, pathways and environmental data, October 2019 – EA*)

The UU testing results show other contaminants that need to be removed, similarly to the temporary trade effluent discharge conditions, they are methane and suspended solids. The methane in particular is seen in the test results to be of a noticeably high value, in all test samples. The acceptable levels for these will need to be confirmed by UU as part of any permanent solution.

Following discussion with the Environment Agency (Neil Peters (BAM / Andy Davies (EA) 4/11/22), it has been confirmed that the decision to use the above levels, from the UK drinking water standard, the basis for comparison is correct. With this in mind and pending final confirmation it appears the issue of PFOS contamination is not be an issue for us on the site.

The initial review with the EA also suggested that, due to the testing undertaken by UU which identified high methane, the management of the methane for permanent discharge, is now the driver for the permanent solution not the PFOS.

4.2 Groundwater monitoring

Additional work has been undertaken to monitor groundwater levels and flow rate from the emerging water area. Interpretation of geotechnical data specifically in the area has also been undertaken.

The location of the groundwater levels from existing ground test locations can be seen in Appendix 5 – Ground Water Monitoring Locations and summarised in the Table 2 below. This table also compares

the Original Ground Level (OGL) with Formation and Finished Ground Level (FGL) (along Plateau Av through the emerging water).

Table 2 - Ground Water Levels

ID	Location	Water Level to OGL (m)	OGL to Formation (m)	Cut/Fill	OGL to FGL (m)	
Pt. 18	RB01 ca. CH.120	>-2.5	-0.65	Cut		
Pt. 19	RB02 ca. CH.180	>-2.5	-2.20	Cut		
Pt. 20	RB02 ca. CH.240	>-2.5	-2.30	Cut		
Pt. 1	RB03 ca. CH.280 North	>-2.5	0.30	Fill	1.4	Plateau Av
Pt. 2	RB03 ca. CH.280 South	>-2.5	-3.20	Cut		
Pt. 3	RB03 ca. CH.310	>-2.5	-1.50	Cut		
Pt. 4	RB04 ca. CH.330	0	0.20	Fill	1.2	Plateau Av
Pt. 5	RB04 ca. CH.350 North	>-2.5	0.20	Fill		
Pt. 6	RB04 ca. CH.350 South	>-2.5	0.10	Fill		
Pt. 7	RB04 ca. CH.380	-0.45	0.10	Fill	0.9	Plateau Av
Pt. 8	RB04 ca. CH.390 South	>-2.5	0.60	Fill		
Pt. 9	RB05c ca. CH.400	-2.30	0.70	Fill		
Pt. 10	RB05c ca. CH.420	-1.00	0.30	Fill		
Pt. 11	RB05c ca. CH.430	-0.35	0.20	Fill	1.2	Plateau Av
Pt. 12	RB05c ca. CH.450 North	-1.20	0.70	Fill		
Pt. 13	RB05c ca. CH.450 South	-1.05	0.10	Fill		
Pt. 14	RB05a ca. CH.480	-0.50	-0.20	Cut	0.5	Plateau Av
Pt. 15	RB05a ca. CH.540	-0.60	-0.20	Cut	0.2	Plateau Av
Pt. 16	RB05a centre of plot	-1.20	0.50	Fill		
Pt. 17	RB05a ca. CH.650	-1.40	0.10	Fill		
Wells are 2.5m deep so dry condition is to that level						

Plotting the difference relative to OGL gives the next graph, Figure 1, shows we are only encountering ground water within 200mm of levels around Pt4 CH330 (Plateau Av), and not in areas where the plots are being developed .

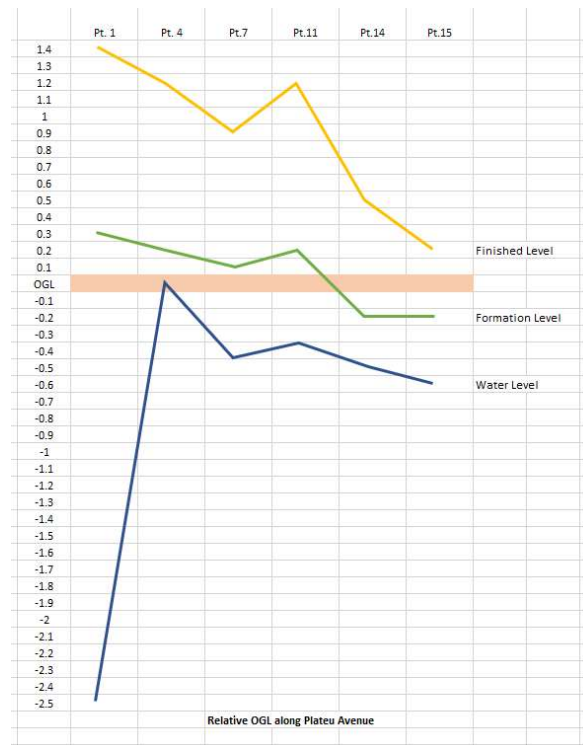


Figure 1 - Ground Water Levels Against OGL

The above ground water measurements suggest that the emerging water is not draining through the ground at a level which will be encountered during proposed earthworks on the plots. Additionally, the presence of dry wells in the context of a constant 0.216l/s flow rate into the area of emerging water suggests that water is not infiltrating through the ground freely at a level which will be interfaced with during wider earthworks across the site. Due to the made ground in the area it may be that it is freely infiltrating vertically to lower levels outside of the remediation levels.

4.3 Cohesive band of material

Reviewing the geotechnical boreholes around the emerging water, Figure 2 and Appendix 7 – Geological Long section – Red Bank Plateau, provides evidence to support the change in water level between Pt.7 and Pt.9, -450mm to -2300mm (OGL), is prevented from infiltrating by a localised lens of cohesive material. Which runs along between Plateau Avenue and the development plots of RB05, between TP108 and BH205.

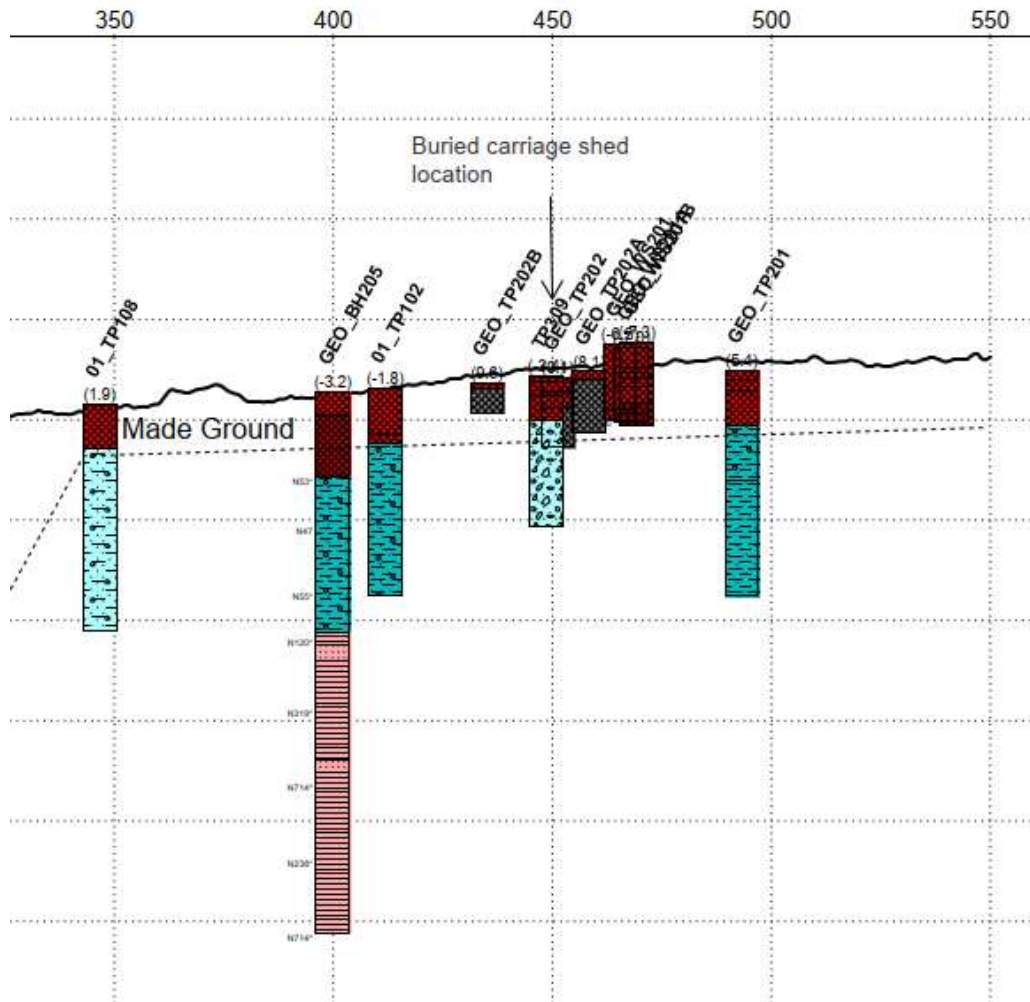


Figure 2- Geotechnical Boreholes from GIR (pdf pg 1188)

5.0 Proposal of Delayed Remediation Zone

5.1 Proposed Methodology

The proposed methodology is to delay the remediation works in the largest extents of wet ground, on a day following significant rainfall, until the final end solution has been identified and installed for the control of the emerging water. Phase 1 drawing (Appendix 6 – Phase 1 Drawing), shows this extent around the emerging water location.

This approach will remove the potential for rework and also allow the plot earthworks to continue. The proposal of delaying the works in this particular area is based on; the contamination being already accounted for in the site wide GIR/CWRA, that there is no pathway between the delayed remediation zone and carriage shed as per remediation strategy and that the ground water is not present at a level at which wider earthworks will be undertaken, based on known ground conditions and site investigation.

It is worth noting that ARUP have produced a CWRA for the site prior to the discovery of this localised emerging water source. It is believed that the pipe fracture is something that has happened some time ago and that the groundwater quality monitored on the site during the most recent rounds of investigation (2021 and 2022) takes into account the impact of the leachate on groundwater quality.

5.2 Permanent Solution

Once we have finalised characterising the chemical makeup of the emerging water then a design for a permanent solution can be considered. This will have to be agreed with all interested parties and the solution implemented before remediation works can take place within the wet ground. Given the testing suggests that the methane levels are the focus of this proposal. Initial discussions have started with ARUPs Wastewater design teams, to review the conditions, but no works can be started on the concept design until discussions with UU agree parameters to work to.

If the solution involves discharge into the public network then this will be subject to agreement from United Utilities who will define the levels of contaminants which can be acceptably discharged into the public network. In addition to this, UU have confirmed that the original source of the flows and expected flow rates into the public network will need to be defined prior to any consideration of discharging to the public network.

Once all the testing results are reviewed by all parties and agreement reached on the acceptable levels of various compounds within the effluent, suitable investigation will need to be defined to work out the solution for permeant discharge. At this time there is not enough information to define what the permanent solution will be as there are too many variables. There is also potential that as the drainage was from land that is not within the Victoria North development area, that an offsite solution may have to be developed.

6.0 Conclusion

Based on the available testing data, site geotechnical information and understanding that the emerging water has been an on-site issue for a prolonged period of time, we are confident that undertaking wider earthworks across the site will not detrimentally impact the ground conditions or ground water across the site. To ensure this, we are proposing that a no remediation zone to be created around emerging water source which encompasses the largest extent of wet ground around the source, following a significant rainfall to prevent movement of any potentially contaminated soils. This no remediation zone will remain in place until a permanent design solution for controlling the emerging water source is developed and agreed with all parties.

As such, we are confident that Condition 7a can be partially discharged to enable wider remediation works to commence in-line with the Pre-Development Remediation Strategy (LKC 22 1587).

Appendix 1a – Cheetham Hill Culvert Investigation

On site investigation works to attempt to locate the believed route of Cheetham hill culvert

Following the receipt of the below information of the possible route of the Cheetham Hill Culvert across the development site investigation works were undertaken to locate and plot the position.

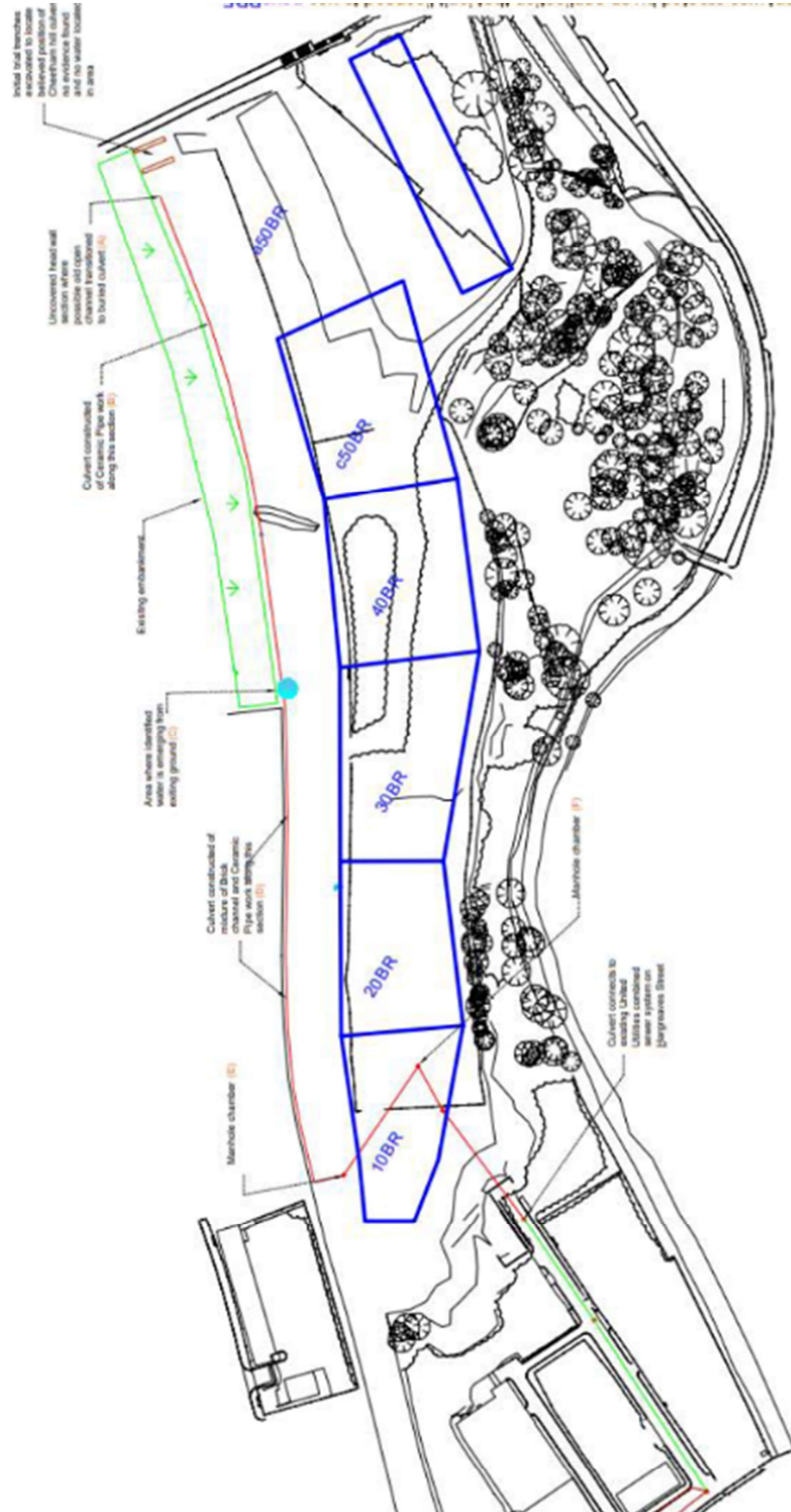
As can be seen on the enclosed drawing and photographs an exiting drainage system was identified across the site which eventually connected to the UU combined drainage system in Hargreaves Street.

Historical Information

The below drawing was initially provided in an aid to the location of the Culvert. Surveys of existing drainage system to locate any connections to the culvert were undertaken without success.



Identified drainage system across development area



Photographs of investigation works undertaken

A. Headwall uncovered



B. Clay pipe work of culverted section of drain



C. Area where water emerges from existing ground



D. Identified areas of culvert/drain construction



E. Manhole chamber



F. Manhole Chamber

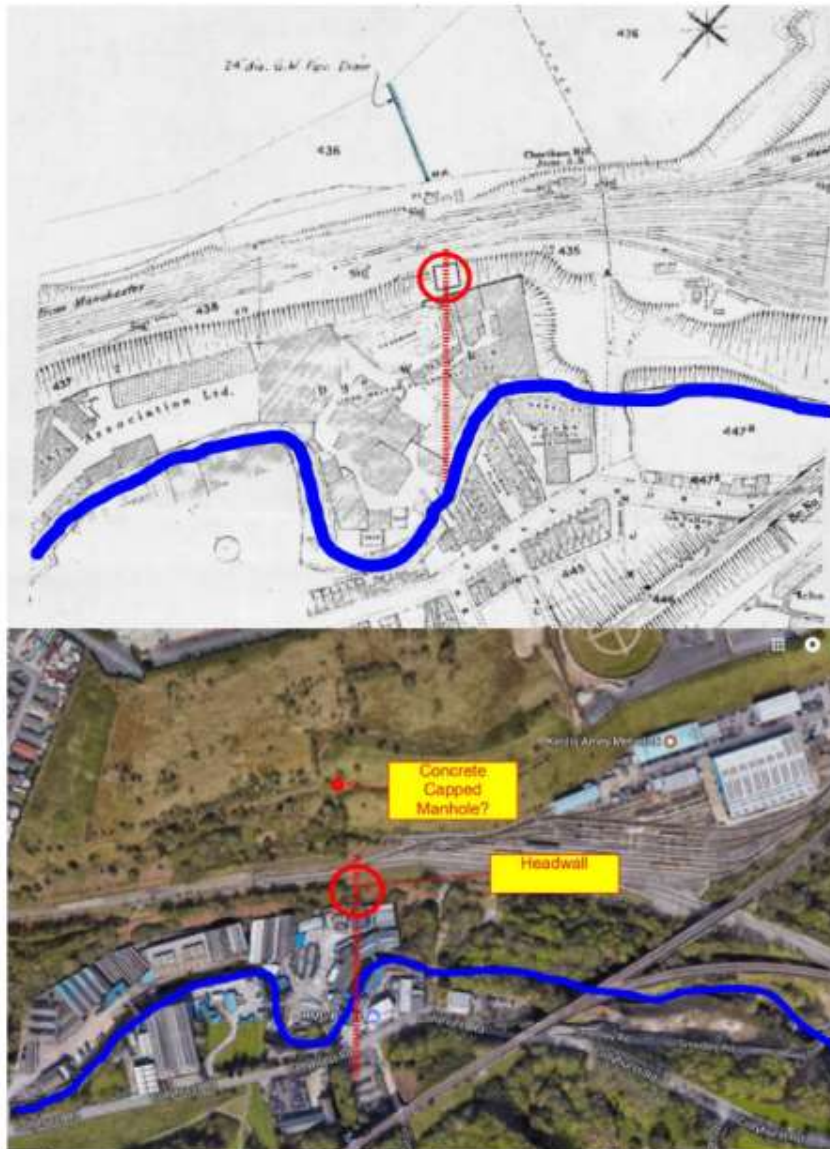


Located alignment of Culvert

Following investigations and research on previous works undertaken in the wider area it has been discovered that the Cheetham hill culvert does not enter the Victoria North site area.

It was identified that the culvert now runs through the Packaging products site and outfalls into the river irk as shown below upstream of the Victoria North site area.





Photos taken 2022 Showing route of culvert to river outfall



Head wall (original photos taken)



Outfall present day overgrown



Google Earth screen shots showing location of Cheetham hill Culvert entering River Irk



Appendix 1b – Onsite Drainage Investigation

Please note – these images refer to and are intended to be used with the associated drainage markup.

Fig 1: Open channel off site towards Queens Road tram depot.



Fig. 2: Incoming pipe from the Showman's Guild direction @ CH430, with a significant flow of water. This water appears clear compared to the water in the channel.



Fig. 3: Approx. 450mm pipe going from the channel to the spring location under the bund.



Fig 4: Emerging water location, after pumping.



Fig 5: Attempted trail hole to locate the culvert run @ CH290. This hole had to be abandoned due to high ground water, however the culvert was seen.



Fig. 6: In this location we observed the culvert running parallel to Honey Street retaining wall passing over a second culvert of similar construction, coming from under Honey Street Wall. The first culvert continues along the wall and the second one continues to a nearby chamber. Water has been observed to be running through this second run. These two runs eventually converge in the manhole that was found with a Kelly block in it.



Fig. 7: This chamber is the destination of the run coming from under the wall in figure 6.



Fig. 8: A 200mm ceramic pipe coming from behind Honey Street wall @CH100. This pipe has had a constant trickle of water coming out since it was discovered.



Fig. 9: a pair of trial holes completed to locate the culvert.



Fig. 10: A second 200mm pipe coming in from behind the wall, this one is dry.



Fig. 11: 'T' junction in the culvert which, in operational condition, would collect water from in front of the retaining wall from both directions. This water is channelled South-East to another chamber.



Fig. 12: Chamber at the bottom of the haul road. Picture taken on the inside, with the concrete 'V' shapes coming from the 'T' in figure 11 and a derelict and dry pipe running along the plateau.

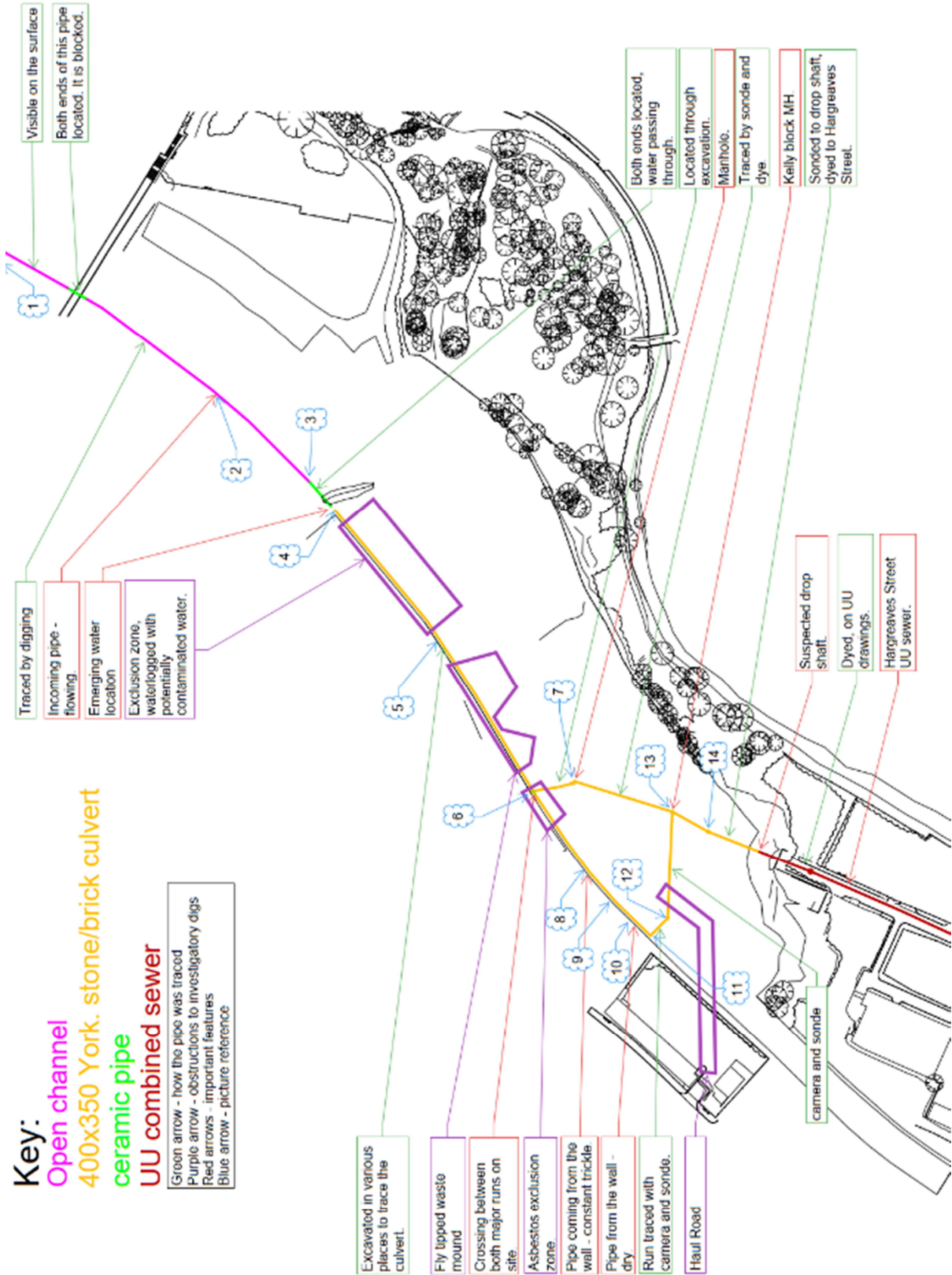


Fig. 13: This manhole was discovered by sending a sonde down from the manhole in figure 7. When it was located, a large concrete block had been wedged in it for an unknown reason. When the block was removed, the chamber was full of debris which was also subsequently removed. This chamber is the point at which both main runs we have discovered on site converge.



Fig. 14: 6m deep manhole which has water running through it. This manhole looks much more modern than the rest. Dye was put into the water in this chamber which was then seen on Hargreaves Street. We tried to sonde from this chamber but hit an obstruction. We suspect due to no water build up and the level difference between this chamber and Hargreaves Street that there is a drop shaft on this section.





Appendix 2 – Location of Water Samples



Appendix 3 – Testing Results



Envirolab
Sandpits Business Park
Mottram Road
Hyde
Cheshire
SK14 3AR
Attention: Subcon Envirolab

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528777
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

CERTIFICATE OF ANALYSIS

Date of report Generation:	27 October 2022
Customer:	Envirolab
Sample Delivery Group (SDG):	221021-71
Your Reference:	22/10268
Location:	11777
Report No:	666251
Order Number:	P0750164

We received 7 samples on Friday October 21, 2022 and 7 of these samples were scheduled for analysis which was completed on Thursday October 27, 2022. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Hawarden.

All sample data is provided by the customer. The reported results relate to the sample supplied, and on the basis that this data is correct.

Incorrect sampling dates and/or sample information will affect the validity of results.

The customer is not permitted to reproduce this report except in full without the approval of the laboratory.

Approved By:



Sonia McWhan
Operations Manager



ALS Laboratories (UK) Limited. Registered Office: Torrington Avenue, Coventry CV4 9GU. Registered in England and Wales No. 02391955.

Version: 3.4 Version Issued: 27/10/2022



CERTIFICATE OF ANALYSIS

Validated

SDG: 221021-71
Client Ref.: 22/10268

Report Number: 666251
Location: 11777

Superseded Report:

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
27054444	22/10268/1 SW01			17/10/2022
27054445	22/10268/2 SW02			17/10/2022
27054446	22/10268/3 SW03			17/10/2022
27054449	22/10268/4 SW04			17/10/2022
27054450	22/10268/5 SW05			17/10/2022
27054451	22/10268/6 SW06			17/10/2022
27054452	22/10268/7 SW07			17/10/2022

Only received samples which have had analysis scheduled will be shown on the following pages.



CERTIFICATE OF ANALYSIS

Validated

SDG: 221021-71
Client Ref.: 22/10288

Report Number: 868251
Location: 11777

Superseded Report:

Results Legend X Test N No Determination Possible Sample Types - S - Soil/Solid UNS - Unspecified Solid GW - Ground Water SW - Surface Water LE - Land Leachate PL - Prepared Leachate PR - Process Water SA - Saline Water TE - Trade Effluent TS - Treated Sewage US - Untreated Sewage RE - Recreational Water DW - Drinking Water Non-regulatory UNL - Unspecified Liquid SL - Sludge G - Gas OTH - Other	Lab Sample No(s)	27084452	27084451	27084450	27084449	27084448	27084445	27084444
	Customer Sample Reference	22/102887 SW07	22/102886 SW06	22/102885 SW05	22/102884 SW04	22/102883 SW03	22/102882 SW02	22/102881 SW01
	AGS Reference							
	Depth (m)							
	Container	1000ml glass bottle (ALE220)	1000ml glass bottle (ALE220)	1000ml glass bottle (ALE220)	1000ml glass bottle (ALE220)	1000ml glass bottle (ALE220)	1000ml glass bottle (ALE220)	1000ml glass bottle (ALE220)
	Sample Type	SW	SW	SW	SW	SW	SW	SW
PFAS Liquids	All	NDPs: 0 Tests: 7						
		X	X	X	X	X	X	X

10:53:46 27/10/2022

Page 3 of 9



CERTIFICATE OF ANALYSIS

Validated

SDG: 221021-71
Client Ref.: 22/10268

Report Number: 666251
Location: 11777

Superseded Report:

[illegible]



CERTIFICATE OF ANALYSIS

Validated

SDG: 221021-71
Client Ref.: 22/10268

Report Number: 666251
Location: 11777

Superseded Report:

[illegible]



CERTIFICATE OF ANALYSIS

Validated

SDG: 221021-71
Client Ref.: 22/10268

Report Number: 666251
Location: 11777

Superseded Report:

Table of Results - Appendix

Method No	Reference	Description
TM337	PFAS in Environmental Water Matrices	Analysis of PFAS

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Laboratories (UK) Limited Haverdon (Method codes TM).



CERTIFICATE OF ANALYSIS

Validated

SDG: 221021-71
Client Ref.: 22/10288

Report Number: 868251
Location: 11777

Superseded Report:

Test Completion Dates

Lab Sample No(s)	27054444	27054445	27054446	27054449	27054450	27054451	27054452
Customer Sample Ref.	22102881 SW01	22102882 SW02	22102883 SW03	22102884 SW04	22102885 SW05	22102886 SW06	22102887 SW07
AGS Ref.							
Depth							
Type	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water	Surface Water
PFAS Liquids	27-Oct-2022	27-Oct-2022	27-Oct-2022	27-Oct-2022	27-Oct-2022	27-Oct-2022	27-Oct-2022



CERTIFICATE OF ANALYSIS

Validated

SDG: 221021-71
Client Ref.: 22/10268

Report Number: 666251
Location: 11777

Superseded Report:

ASSOCIATED AQC DATA

PFAS Liquids

Component	Method Code	QC 2730	QC 2736
Perfluoro-1-butanedisulfonate	TM337	93.75 58.95 : 133.73	90.63 58.95 : 133.73
Perfluoro-1-heptadisulfonate	TM337	90.87 54.69 : 144.16	89.5 54.69 : 144.16
Perfluoro-1-hexadisulfonate	TM337	95.63 67.55 : 114.13	93.13 67.55 : 114.13
Perfluoro-1-octadisulfonate	TM337	100.13 67.93 : 114.13	95.75 67.93 : 114.13
Perfluoro-n-butanolic acid	TM337	94.25 58.88 : 133.65	96.0 58.88 : 133.65
Perfluoro-n-decanedisulfonate	TM337	89.88 53.68 : 141.43	102.0 53.68 : 141.43
Perfluoro-n-decanolic acid	TM337	89.75 61.18 : 121.03	92.88 61.18 : 121.03
Perfluoro-n-dodecanolic acid	TM337	93.38 66.38 : 114.15	94.88 66.38 : 114.15
Perfluoro-n-heptanolic acid	TM337	103.0 53.11 : 138.39	102.5 53.11 : 138.39
Perfluoro-n-hexanolic acid	TM337	96.63 70.19 : 123.96	91.13 70.19 : 123.96
Perfluoro-n-nonanolic acid	TM337	92.13 70.31 : 115.61	91.88 70.31 : 115.61
Perfluoro-n-octanolic acid	TM337	103.63 66.70 : 113.95	99.63 66.70 : 113.95
Perfluoro-n-pentadisulfonate	TM337	96.0 55.00 : 120.70	90.75 55.00 : 120.70
Perfluoro-n-pentanolic acid	TM337	86.5 55.25 : 127.03	84.25 55.25 : 127.03
Perfluoro-n-undecanolic acid	TM337	88.5 68.19 : 119.41	85.63 68.19 : 119.41
Perfluoro-octane sulfonate 6:2	TM337	101.0 68.34 : 123.46	97.88 68.34 : 123.46
Perfluoro-octanesulfonamide	TM337	86.13 67.41 : 114.44	87.75 67.41 : 114.44

The above information details the reference name of the analytical quality control sample (AQC) that has been run with the samples contained in this report for the different methods of analysis .
The figure detailed is the percentage recovery result for the AQC .
The subscript numbers below are the percentage recovery lower control limit (LCL) and the upper control limit (UCL). The percentage recovery result for the AQC should be between these limits to be statistically in control .



CERTIFICATE OF ANALYSIS

SDG: 221021-71
Client Ref: 22/10268Report Number: 666251
Location: 11777

Superseded Report:

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH₄ by the BRE method, VOC TICs and SVOC TICs.

2. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

3. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

4. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

5. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

6. NDP - No determination possible due to insufficient/unsuitable sample.

7. Results relate only to the items tested.

8. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

9. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix effect.

10. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

11. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences, in both cases the sample would be diluted which would cause the method detection limit to be raised.

12. For dried and crushed preparations of soils volatile loss may occur e.g volatile mercury.

13. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

14. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

15. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

16. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

17 Data retention. All records, communications and reports pertaining to the analysis are archived for seven years from the date of issue of the final report.

18. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as "mixed hydrocarbons". Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

19. Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	Container with Headspace provided for volatiles analysis
2	Incorrect container received
3	Deviation from method
4	Matrix interference
⬇	Sample holding time exceeded in laboratory
@	Sample holding time exceeded due to late arrival of instructions or samples
§	Sampled on date not provided

20. Asbestos

When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2021), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as "Not detected". If no asbestos fibre types are found all will be reported as "Not detected" and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials and soils are obtained from supplied bulk materials and soils which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2021).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining.

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anorthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Respirable Fibres

Respirable fibres are defined as fibres of <3 µm diameter, longer than 5 µm and with aspect ratios of at least 3:1 that can be inhaled into the lower regions of the lung and are generally acknowledged to be most important predictor of hazard and risk for cancers of the lung.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Appendix 4 – UU Testing Results

13.09.22

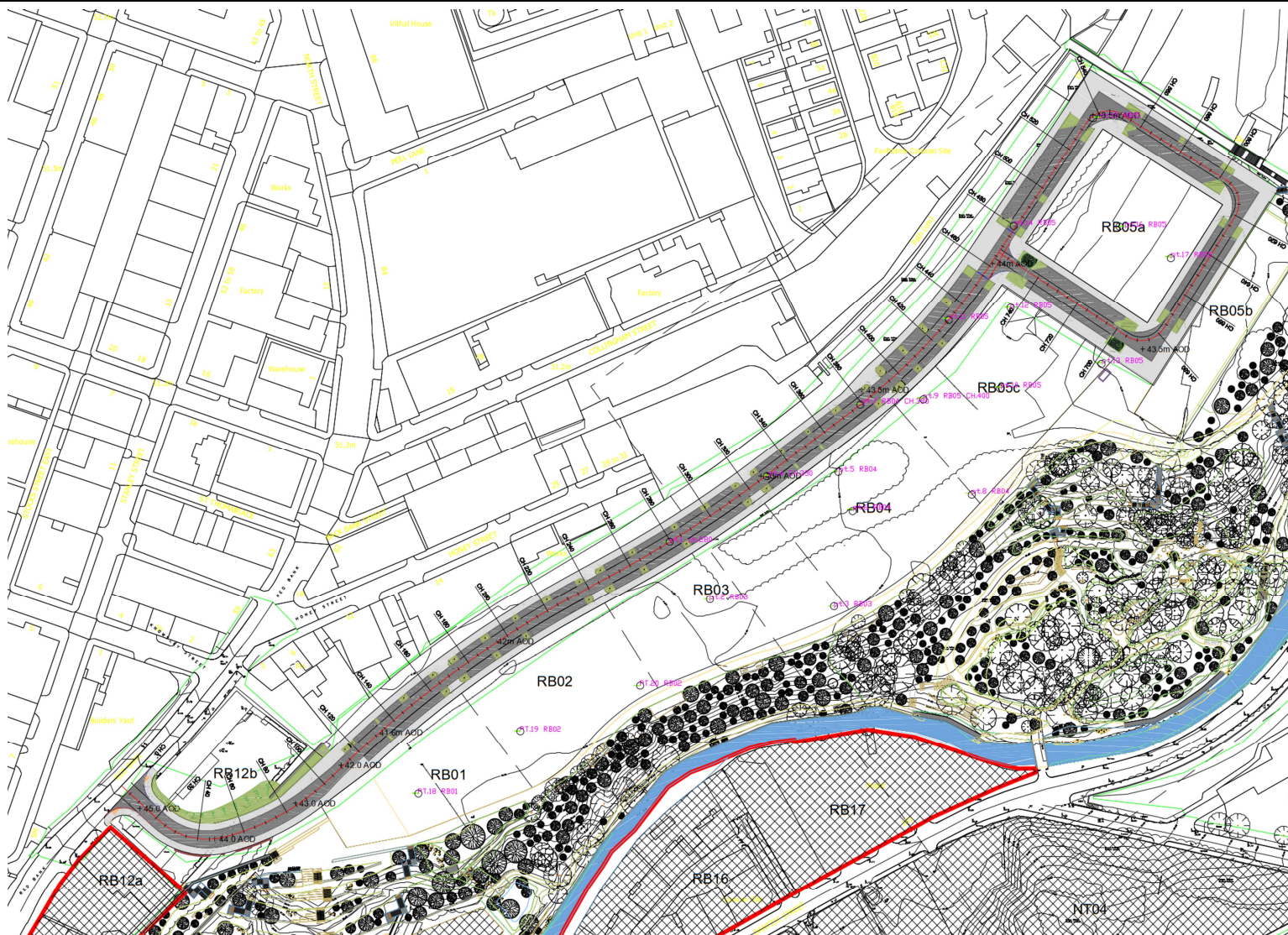
Determinands				
Code	Description	Value	Units	Pass ?
ODCB	1,2 Dichlorobenzene	0.18	mg/l	
CLBE	Chlorobenzene	0.24	mg/l	
CADM	Cadmium as Cd	1.67	ug/l	
AMMO	Ammonia as N	30.90	mg/l	
NITR	Nitrate as N	0.88	mg/l	
NITI	Nitrite as N	0.03	mg/l	
TIN	Tin as Sn	0.03	mg/l	
LEAD	Lead as Pb	21.40	ug/l	
PH	pH Value	7.50	PH	
COPP	Copper as Cu	15.43	ug/l	
ZINC	Zinc as Zn	32.00	ug/l	
CHRO	Chromium as Cr	4.47	ug/l	
SELE	Selenium as Se	2.22	ug/l	
NICK	Nickel as Ni	4.27	ug/l	
STDI	Styrene Dissolved	0.22	mg/l	
ETHX	2-Ethylhexanol	0.24	mg/l	
ETBE	Ethylbenzene	0.23	mg/l	
ANTI	Antimony as Sb	3.58	ug/l	
VANA	Vanadium as V	8.76	ug/l	
TOME	Total Toxic Metals (5)	53.40	ug/l	
T23B	1,2,3-Trichlorobenzene	0.94	ug/l	
T24B	1,2,4-Trichlorobenzene	0.87	ug/l	
TCLB	1,3,5-Trichlorobenzene	0.84	ug/l	
CODS	C.O.D. (Settled)	27.50	mg/l	
METH	Methane	11.22	mg/l	
DIME	Dichloromethane	6.62	ug/l	
MPXY	Xylene (meta, para)	3.87	ug/l	
TRCM	Chloroform	5.35	ug/l	
TCME	Carbon Tetrachloride	0.74	ug/l	
BENZ	Benzene	5.67	ug/l	
MEBE	Toluene	4.58	ug/l	
TONI	Total Nitrogen	32.00	mg/l	
BERY	Beryllium as Be	0.26	ug/l	
TCET	Tetrachloroethene	0.56	ug/l	
TRET	Trichloroethene	0.59	ug/l	
DCLE	1,2 Dichloroethane	5.88	ug/l	
OXYL	Xylene (ortho)	4.60	ug/l	
Comments				

25.10.22

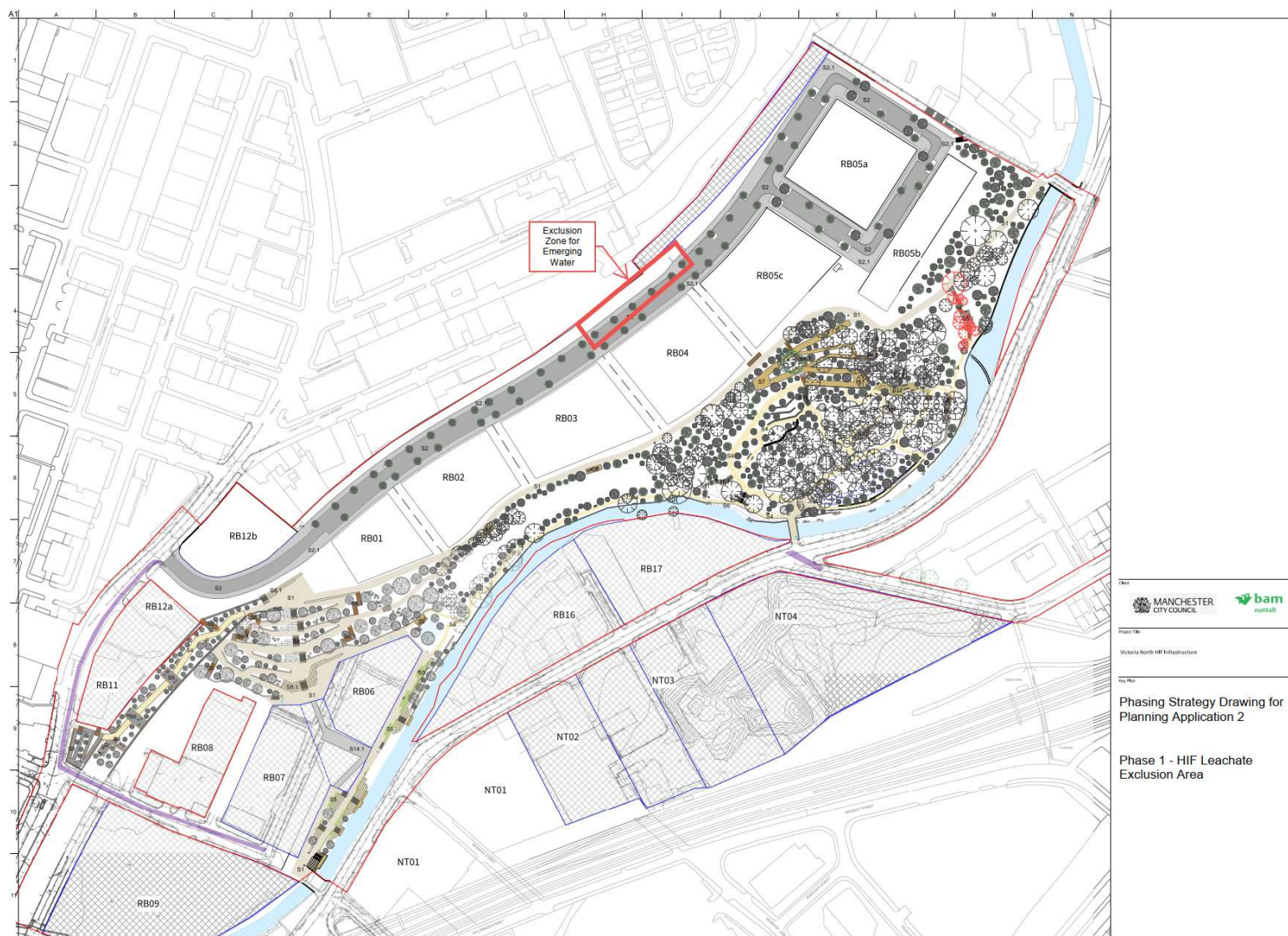
Det Code	Det Title	Qual	Value	Units	Analyst Comments
4CXY	4CL35 XYLENOL	LT	1.9420	mg/l	BAM NUTTAL FROM SOURCE
BENZ	BENZENE	LT	5.6700	µg/l	BAM NUTTAL FROM SOURCE
CHME	PCHLOROMCRESOL	LT	7.5750	mg/l	BAM NUTTAL FROM SOURCE
CODS	COD SETTLED	LT	27.5000	mg/l	BAM NUTTAL FROM SOURCE
CR34	METHYLPHENOLS 34	LT	3.5600	mg/l	BAM NUTTAL FROM SOURCE
DBIS	XYLENE MIXED		0.0000	µg/l	BAM NUTTAL FROM SOURCE
DC24	24 DICHLOROPHENOL	LT	3.0100	mg/l	BAM NUTTAL FROM SOURCE
DCLE	12 DICHLOROETHAN	LT	5.8800	µg/l	BAM NUTTAL FROM SOURCE
DCPD	DICYCLOPENTADIENE	LT	1.9600	µg/l	BAM NUTTAL FROM SOURCE
DIME	DICHLOROCH3	LT	6.6200	µg/l	BAM NUTTAL FROM SOURCE
DIXY	25 DICL 35 XYL	LT	1.6100	mg/l	BAM NUTTAL FROM SOURCE
HCBU	HEXACHLOROBUTADIE	LT	0.8900	µg/l	BAM NUTTAL FROM SOURCE
HEXA	HEXANE	LT	0.7400	µg/l	BAM NUTTAL FROM SOURCE
MEBE	TOLUENE	LT	4.5800	µg/l	BAM NUTTAL FROM SOURCE
METH	METHANE		6.4350	mq/l	BAM NUTTAL FROM SOURCE

MPXY	mp XYLENE MIXED	LT	3.8700	µg/l	BAM NUTTAL FROM SOURCE
MTBE	METHYL T B ETHER	LT	0.8600	µg/l	BAM NUTTAL FROM SOURCE
NAPH	NAPHTHALENE	LT	15.8400	µg/l	BAM NUTTAL FROM SOURCE
OCPH	2 CHLOROPHENOL	LT	1.8300	mg/l	BAM NUTTAL FROM SOURCE
OCRE	2 METHYLPHENOL	LT	1.5500	mg/l	BAM NUTTAL FROM SOURCE
OXYL	12 DIMETHYLBENZE	LT	4.6000	µg/l	BAM NUTTAL FROM SOURCE
PCPH	4 CHLOROPHENOL	LT	1.8500	mg/l	BAM NUTTAL FROM SOURCE
PH	PH		7.0000	pH units	BAM NUTTAL FROM SOURCE
PHEL	PHENOL	LT	3.2200	mg/l	BAM NUTTAL FROM SOURCE
SULP	SULPHATE as SO4		27.0000	mg/l	BAM NUTTAL FROM SOURCE
T23B	123 TRI CL BENZ	LT	0.9400	µg/l	BAM NUTTAL FROM SOURCE
T24B	124 TRI CL BENZ	LT	0.8700	µg/l	BAM NUTTAL FROM SOURCE
TBME	TRIBROMOMETHANE	LT	0.7200	µg/l	BAM NUTTAL FROM SOURCE
TCE1	111 TRICHLOROET	LT	0.6800	µg/l	BAM NUTTAL FROM SOURCE
TCE2	112 TRICHLOROET	LT	1.0300	µg/l	BAM NUTTAL FROM SOURCE
TCET	TETRACHLOROETHENE	LT	0.5600	µg/l	BAM NUTTAL FROM SOURCE

Appendix 5 – Ground Water Monitoring Locations



Appendix 6 – Phase 1 Drawing



Appendix 7 – Geological Long section – Red Bank Plateau

