



**PHASE 2 GROUND INVESTIGATION:
BONC WEN, WREXHAM**

GSL2774

VERSION 1

26 SEPTEMBER 2022

FINAL

Prepared for:

North Wales Housing Association

Prepared by: S Imiolczyk

GroundSolve Ltd

DOCUMENT CONTROL

Report No. :	GSL2774
Report Status:	FINAL
Version No.:	1
Project Engineer:	S Imiolczyk
Date of Issue:	26/09/2022

This report has been prepared by GroundSolve Ltd with all reasonable care and diligence, within the best practice and guidance current at the time of issue within the proposed redline boundary and proposed Site end use as presented by the Client.

This report is confidential to the Client and GroundSolve Ltd accepts no responsibility whatsoever to third parties to whom this report is presented.

Version No.	Description of Issue / Revision	Date of Issue	Author	Reviewed By	Approved By
1	FINAL	16/09/2022	S Imiolczyk	J Thorburn	Sam Fishburne
			BSc (Hons) MSc FGS CEng MICE	BSc FGS	BEng MSc FGS CGeol RoGEP

CONTENTS

1	INTRODUCTION.....	1
1.1	Proposed Development	1
1.2	Objectives	2
1.3	Previous Investigations	2
1.4	Limitations	3
2	SITE DETAILS AND DESCRIPTION	4
3	FIELDWORK.....	5
3.1	Introduction	5
3.2	Dynamic (Window) Sample Boreholes.....	5
3.3	Trial Pits	5
3.4	Samples and Sample Containers.....	5
4	LABORATORY TESTING	6
4.1	Chemical Laboratory Testing	6
5	GROUND CONDITIONS	8
5.1	General.....	8
5.2	Ground Surface / Topsoil	8
5.3	Anthropogenic Materials	8
5.4	Natural Deposits (Devensian Till)	9
5.5	Bedrock	9
6	GENERIC QUANTITATIVE RISK ASSESSMENT & PROPOSED REMEDIATION	10
6.1	Assessment for the Protection of Human Health	10
6.2	Human Health Risk Assessment.....	13
6.3	Assessment for the Protection of Controlled Waters	14
6.4	Permanent Ground Gases.....	14
6.5	Risks to Human Health (Construction Phase)	15
6.6	Revised Conceptual Site Model	16
7	WASTE ASSESSMENT.....	18
7.1	Waste Hierarchy	18
7.2	Waste Characterisation and Classification.....	18
8	GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS.....	20
8.1	Fieldwork and Laboratory Data Review	20
8.2	Foundation Recommendations.....	20
8.3	Trees	21

8.4	Reuse of Materials	21
8.5	Groundwater & Excavations	21
8.6	Buried Concrete and Pipework	22
9	REFERENCES	23
10	DEFINITIONS	25

FIGURES

APPENDICES

Appendix A – SITE PHOTOGRAPHS

Appendix B – EXPLORATORY HOLE LOGS

Appendix C – CHEMICAL TEST RESULTS

Appendix D – SUMMARY OF LABORATORY TEST RESULTS

1 INTRODUCTION

GroundSolve Ltd (GSL) was commissioned by North Wales Housing Association (NWA / “the Client”) to undertake a Phase II site investigation and contaminated land risk assessment for an area of land at Bonc Wen Car Park, Rhosllanerchrugog, Wrexham (the “Site”), see **Figure 1**.

This report has been devised to generally comply with the relevant principles and requirements of a range of guidance including:

- Welsh Local Government Assoc- Development of Land Affected By Contamination Guide for Developers 2017
- Part IIA of the Environment Protection Act, 1990;
- BS5930:2015: “Code of practice for site investigations”;
- BS10175: 2011 +A2:2017 “Investigation of Potentially Contaminated Sites - Code of Practice”;
- The Building Regulations 2010. Part C (HM Government 2013)
- Environment Agency: Land Contamination Risk Management (LCRM), Version 3, October 2020;
- Environment Agency (2017) “The Environment Agency’s Approach to Groundwater Protection” November 2018 Version 1.2.

1.1 Proposed Development

Current plans are to construct three 2-story blocks of apartments, with associated parking and gardens, see **Figure 2**.

Foundation loads are not known at this stage but based on experience are anticipated to be between 50 and 75kN per meter run for two to three storey structures. Floor slab loading are anticipated to be low, probably not exceeding 5kN/m². Development levels will be close to existing levels, with the site being largely flat.

The recommendations in this report are based on these assumptions, consequently, they should be reviewed, and if necessary revised during the detailed design.

As such, in accordance with the ‘Updated technical background to the CLEA model’ (Environment Agency, 2009) and ‘Suitable 4 Use Levels’ (LQM / CIEH 2015) the proposed generic land use for this development is RESIDENTIAL WITH HOMEGROWN PRODUCE.

1.2 Objectives

The purpose of the report is to provide an assessment of the site using published information and information on conditions at the site in relation to the proposed residential development.

The findings and conclusions of the risk assessments have been set out and recommendations given for the proposed residential end use. If there is a subsequent change in the proposed land, the risk assessments and conclusions should be reviewed to determine whether they are still applicable for the revised end use.

This document is a working document and may need to be updated, in agreement with the relevant regulatory bodies, at any stage during development dependent on the conditions encountered. This version of this document is to be issued to regulators for approval (i.e., Wrexham Council).

1.3 Previous Investigations

A number of previous investigations have been undertaken in relation to the geotechnical/mining issues present on site:

- A previous investigation was found on the BGS website, which comprised five boreholes drilled to investigate the mine workings beneath the site.
- A site investigation was carried out in April 2015 by SRL, for NWA. As part of this investigation the underlying ground was drilled to prove the depth to the underlying coal seams, trial pits were excavated, and shallow soil samples collected. DCEL subsequently produced a Geotechnical Design Report, including some limited contamination testing, although this testing does not meet current standards or requirements.
- In May 2016 Nkc Geotech Ltd undertook a mineshaft investigation, and produced recommendations to treat the shaft and workings.
- GSL subsequently carried out a review of all existing information, and carried out a detailed mining risk assessment. This assessment removed the requirement to grout mine workings at depth, and provided recommendations for capping the mine shafts.
- Finally, GSL carried out a further mineshaft investigation in September 2021, in order to locate both shafts in order for the recommended remedial works to be designed.

Prior to this phase of works, GSL undertook a Phase One Preliminary Risk Assessment (**GSL2773/PRA/01**), detailing all background information pertaining to the site. This report should be read in conjunction with the Phase One Preliminary Risk Assessment. It also supersedes the original desk study and geotechnical report prepared by Datrys.

1.4 Limitations

This report relates to the site and underlying ground conditions as they relate to the relevant receptors identified in the Phase 1 Preliminary Risk Assessment. Detailed discussion on the deeper ground conditions and mining-related geotechnical issues are not provided, as these have been reported separately, and a Permit to Treat the mineshafts present on site has currently been issued to the client by the Coal Authority.

This report has been prepared for the sole use of NWA and their advisors. No other third party may rely upon or reproduce the contents of this report without the written approval of GroundSolve Ltd. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk.

2 SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview.

Site name	Bonc Wen, Rhosllanerchrugog
Site address	Bonc Wen Car Park, Rhosllanerchrugog, Wrexham LL14 2EE
National Grid Reference (NGR)	SJ289463
Approximate Site area	2,300m ²
Site shape	Roughly rectangular
Current land use on the Site	Open land both vegetated and concreted
Surrounding land uses	Car park, open land and housing
General topography and ground levels	172m – 174m OD

Current photographs of the site are presented in **Appendix A**.

3 FIELDWORK

3.1 Introduction

The fieldwork was carried out on 17th August 2022. GroundSolve personnel were present to supervise all work, describe the ground encountered, and take samples. Fieldwork procedures were undertaken in accordance with the relevant sections of:

- British Drilling Association "Guidance for Safe Intrusive Activities on Contaminated or Potentially Contaminated Land" (2008);
- BS5930:2015 + A1:2020 "Code of Practice for Site Investigations;"
- BS10175:2011 + A2:2017 "Investigation of Potentially Contaminated Sites – Code of Practice."

The investigation included:

- 5 No. windowless sample boreholes to a maximum depth of 3.0mBGL,
- One hand-dug trial pit, to a depth of 0.3mBGL,
- Sampling for chemical and geotechnical testing of soils,
- Description of the ground encountered in accordance with BS5930:2015 + A1:2020, Code of Practice for Site Investigations.

3.2 Dynamic (Window) Sample Boreholes

Five windowless sampling boreholes (WS01 to WS05) were completed using a tracked windowless sample rig. The exploratory hole logs are presented in **Appendix B**. The borehole locations are presented on **Figure 3**.

3.3 Trial Pits

One hand-dug trial pit (HD01) was excavated near the mine shaft locations, to obtain a sample for chemical testing. The exploratory hole log is presented in **Appendix B**. The trial pit location is presented on **Figure 3**.

3.4 Samples and Sample Containers

Soil samples for chemical analysis each comprised a pair of samples: a plastic tub for metals and inorganics, and twin amber glass jars for organics.

Soil samples were stored in cool boxes with ice packs and dispatched directly to the testing laboratory, for all phases of the investigation.

4 LABORATORY TESTING

4.1 Chemical Laboratory Testing

Chemical samples were submitted to a UKAS accredited laboratory in accordance with ISO17025 and are also MCERTS accredited for soil analysis in accordance with the Environment Agency's scheme. The laboratory carries out Quality Assurance and Quality Control in accordance with BS ISO 17025 and participate in external laboratory comparison and quality control schemes. Details of the accreditation and the methods of analysis are provided on the relevant test reports.

The selection of samples for laboratory testing and analytes to be determined were made based on the preliminary CSM and relevant observations during the investigations. The sample selection rationale is as follows:

- To gain a good coverage across the Site of the various material types and strata encountered;
- To investigate the specific locations of previous potentially contaminative land uses as identified within the Phase 1 desk study and subsequent CSM;
- To fully characterise the made ground material known to underlie the site.

The selected soil samples were tested for a range of typical contamination indicators including specific tests for contaminants suspected as being present from the desk study, CSM, and observations made on-site. Tests were also performed which were used to support the modelling of contaminant transport and impacts (e.g. TOC) and for waste classification purposes.

Each of the soil samples were analysed for the 'total' concentration of a suite of potential contaminants.

The results of the laboratory analysis are presented in **Appendix C**. The various suites of analysis for the soil are presented in **Table 5.1** below:

Table 5.1 Suites of Analysis for Environmental Soil Samples

Determinand	Soil Suite 1
Number of Samples	9
Index Tests	
Asbestos Screen / Quantification	✓
pH	✓
Metals	
As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Zn (all totals)	✓
Inorganics	
Acid Soluble Sulphate	✓
Cyanide - Total	✓
Sulphate (2:1 extract on soil samples)	✓
Organics	

Determinand	Soil Suite 1
Phenols - Total (monohydric)	✓
Total Organic Carbon (TOC)	✓
PAH (Speciated USEPA 16)	✓
Speciated TPH (C5-C35)	✓

5 GROUND CONDITIONS

5.1 General

The site investigations have allowed the site-specific ground conditions to be described and this information was used to provide an improved conceptual ground model. The geology encountered during the site investigations was generally consistent with existing publicly available information online on the British Geological Survey (BGS) GeoIndex (onshore) viewer, and previous phases of investigation carried out at the site by GSL and others.

A summary of the general strata encountered across the site is provided in **Table 6.1** below, with more detailed description given in the following sub sections.

Table 6.1: Summary of Strata Encountered

Geological Strata	Maximum Depth Below Ground Level to Base of Strata (m)	Maximum Strata Thickness (m)
Made Ground	2.4	2.4
Glacial Till	>3.0	-
Bedrock	Not encountered in this investigation, however known to be present at depths of between 10.0-12.5mBGL from previous works	-

5.2 Ground Surface / Topsoil

The site surface varies from tarmac in the existing car park areas, to concrete slab beneath the footprint of the former community centre, and rough grass/vegetation in the remainder.

No significant organic-rich topsoil layer was recorded in any holes drilled in vegetated areas.

5.3 Anthropogenic Materials

Made Ground was present beneath tarmac/concrete hardstanding and vegetation, at all locations across the site.

The made ground was of variable composition, with both cohesive and granular layers encountered.

The granular made ground was typically described as loose or very loose, dark brown or grey, gravelly sand or sandy gravel. The gravel typically comprised brick fragments, sandstone, and clinker.

The cohesive made ground was typically described as soft dark brown slightly sandy slightly gravelly clay. The gravel typically comprised sandstone and clinker, with occasional brick fragments.

No visual or olfactory evidence of contamination was noted during the fieldwork.

5.4 Natural Deposits (Devensian Till)

Underlying the Made Ground, Devensian (Glacial) Till was recorded across the site in all of the windowless sample boreholes, proven to a depth of 3.0m bgl in this investigation.

The till was generally logged as a soft becoming firm blueish grey slightly sandy clay. Previous phases of investigation have noted that the till becomes stiff with depth. Although no groundwater strikes were recorded in the boreholes, the softer clay near the surface is likely to be due to a perched water table at the base of the made ground.

5.5 Bedrock

Bedrock was not encountered during this investigation; however, the previous mining investigations have proved rockhead at depths ranging between 10.0m and 12.5m below current ground level.

6 GENERIC QUANTITATIVE RISK ASSESSMENT & PROPOSED REMEDIATION

6.1 Assessment for the Protection of Human Health

The results of the soil analyses are presented below, where they have been compared to suitable generic assessment criteria (GACs), in order to allow a generic quantitative risk assessment (GQRA) to be carried out for the site and the proposed development.

The Category 4 Screening Levels (C4SLs) published by DEFRA (2014) have been adopted in the first instance, which have been published for six substances to date. Where a C4SL is unavailable, the "Suitable 4 Use Levels" (S4ULs) published by LQM/CIEH (2015) have been adopted.

These criteria have been derived using the CLEA model for a range of standard end-use scenarios and a range of soil organic matter (SOM) contents. It should be noted that the C4SL values are derived on the basis of a "low level of toxicological concern", while the S4UL values are based on a "tolerable" or "minimal" level of risk. As such, the S4ULs describe a lower level of risk than the C4SLs, and are equivalent to the former Soil Guideline Values (SGVs, published by the Environment Agency) and the previous editions of the LQM/CIEH GAC values.

The GQRA is based on a soil with a Soil Organic Matter of 6%, for a residential with plant uptake end use.

Note that the chemical test results on several samples of the made ground presented in the original Datrys report (samples of made ground collected from trial pits, see **Figure 3** for locations, and **Appendix C** for original data) have also been incorporated into the dataset, and screened against current guideline values.

A full summary of the chemical test results is presented in **Appendix D**.

Metals

The results from the metal analysis have recorded two exceedances of arsenic (WS5 at 0.8m depth, TP04 at 1.75m depth), six of lead (WS2 at 0.6m, WS2 at 1.6m, WS4 at 0.7m, WS5 at 0.8m, HDTP01 at 0.2m TP1 at 0.5m), and two of zinc (WS02 at 1.6m, WS04 at 0.7m).

The average values only exceed the adopted GAC for lead. All exceedances were within samples of the made ground. A sample taken from the glacial till tested did not record any exceedances for metals.

Table 7.1 Metals Suite

Metals	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Arsenic	2.2	79	23.29	10	37	C4SL	2
Boron, water soluble	< 0.40	1	0.51	9	290	S4UL	0
Cadmium	0.19	19	7.51	11	22	C4SL	0
Chromium III	6.3	23	12.17	9	910	S4UL	0
Chromium, Hexavalent	< 0.50	<0.5	0.5	9	21	C4SL	0
Copper	22	270	85.78	9	2400	S4UL	0
Lead	39	2400	659.4	10	200	C4SL	6
Mercury	< 0.05	0.23	0.11	9	1.2	S4UL	0
Nickel	7.1	33	18.92	9	130	S4UL	0
Phenol - Monohydric	< 0.10	<0.1	0.1	9	380	S4UL	0
Selenium	0.58	1.9	1.31	9	250	S4UL	0
Zinc	57	13000	2282.85	13	3700	S4UL	2

These exceedances are distributed across the site area, and the heavy metal contaminants are typical of slightly ashy made ground, typically found associated with mining areas and railways.

PAHs

All samples selected for analysis have generally recorded low PAH levels.

Two exceedances of benzo(a)pyrene were recorded (WS02 at 0.6m, TC2 at 0.9m). A single exceedance of benzo(b)fluoranthene (WS02 at 0.6m), and a single exceedance of dibenzo(ah)anthracene (WS02 at 0.6m) were recorded.

Table 7.2 Polyaromatic Hydrocarbons

Polyaromatic Hydrocarbons (PAH)	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Acenaphthene	< 0.010	0.62	0.14	9	1100	S4UL	0
Acenaphthylene	< 0.010	0.24	0.09	9	920	S4UL	0
Anthracene	< 0.010	3	0.63	9	11000	S4UL	0
Benzo(a)anthracene	< 0.010	6	1.9	11	13	S4UL	0
Benzo(a)pyrene	< 0.010	6.7	2.21	11	5	C4SL	2
Benzo(b)fluoranthene	< 0.010	7.1	1.87	9	3.7	S4UL	1
Benzo(g,h,i)perylene	< 0.010	3.7	0.42	9	350	S4UL	0
Benzo(k)fluoranthene	< 0.010	2.7	0.71	9	100	S4UL	0
Chrysene	< 0.010	7.7	2.16	10	27	S4UL	0
Dibenzo(a,h)anthracene	< 0.010	0.81	0.1	9	0.3	S4UL	1
Fluoranthene	0.37	13	3.31	9	890	S4UL	0
Fluorene	< 0.010	0.61	0.15	9	860	S4UL	0
Indeno(1,2,3-c,d)pyrene	< 0.010	3.8	0.43	9	41	S4UL	0
Naphthalene	< 0.010	2	0.51	9	13	S4UL	0
Phenanthrene	< 0.010	7.9	2.03	9	440	S4UL	0
Pyrene	0.29	10	2.78	9	2000	S4UL	0

Petroleum Hydrocarbons (PHC)

No hydrocarbon impacted material was encountered during the fieldwork.

Table 7.3 Petroleum Hydrocarbons

Petroleum Hydrocarbons	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Aliphatic C5-C6	< 0.010	<0.01	0.01	9	160	S4UL	0
Aliphatic C6-C8	< 0.010	12	1.34	9	530	S4UL	0
Aliphatic C8-C10	< 0.10	9.2	1.11	9	150	S4UL	0
Aliphatic C10-C12	< 0.10	12	1.42	9	760	S4UL	0
Aliphatic C12-C16	< 0.10	32	3.64	9	4300	S4UL	0
Aliphatic C16-EC35	< 0.10	50	5.64	9	110000	S4UL	0
Aliphatic C35-C40	< 0.10	<0.1	0.1	9	110000	S4UL	0
Aromatic C5-C7	< 0.010	<0.01	0.01	9	300	S4UL	0
Aromatic C7-C8	< 0.010	7.5	0.84	9	660	S4UL	0
Aromatic C8-C10	< 0.10	11	1.31	9	190	S4UL	0

Petroleum Hydrocarbons	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Aromatic C10-C12	< 0.10	5.3	0.68	9	380	S4UL	0
Aromatic C12-C16	< 0.10	48	5.42	9	660	S4UL	0
Aromatic >C16-C21	< 0.10	91	10.2	9	930	S4UL	0
Aromatic >C21-C35	< 0.10	190	21.2	9	1700	S4UL	0
Aromatic >C35-EC40	< 0.10	<0.1	0.1	9	1700	S4UL	0

The speciated Total Petroleum Hydrocarbons (TPH) results have shown very low concentrations, all below the relevant detection limits. The TPH concentrations are below the GAC's and do not represent a significant increased risk to long term human health and give no cause for concern.

Asbestos

Asbestos can be present in soil as fragments of bulk Asbestos Containing Materials (ACMs) (e.g., asbestos cement sheeting) and also as discrete asbestos fibres within the soil matrix. This investigation has carried out assessments to determine whether both bulk fragments of asbestos and discrete fibres are present in the soil at the site. The asbestos assessment commenced on site with inspection of the Made Ground by our site staff for the presence of bulk ACMs. During the fieldwork no suspected ACMs were identified.

Laboratory assessments were carried out in order to confirm the site assessment that ACMs were absent, and no asbestos was detected in any of the samples retrieved from site.

6.2 Human Health Risk Assessment

Based on the above results, there is a risk to the proposed development from elevated metal and PAH concentrations in the made ground, and therefore remedial measures will be required.

Much of the site will remain in use as a car park, with tarmac hard standing severing direct contact/dust pathways between the made ground and site end users.

Where garden areas are proposed, it is recommended that any made ground is removed by excavation to a depth of at least 600mm, and replaced with clean capping layer, comprising imported subsoil (400mm minimum) and topsoil (200mm minimum). Due to the depth of the made ground across the site, it will not be feasible to remove all of the made ground down to the underlying glacial till.

The capping layer will require validation of its thickness and testing to demonstrate its suitability for use once it has been placed.

Upon completion of the development and placement/validation of a clean capping layer in all garden and soft landscaped areas, the overall risk posed to site end users would be considered very low.

6.3 Assessment for the Protection of Controlled Waters

The total concentrations detected within soil samples do not generally indicate particularly high concentrations which would be indicative of a significant source of groundwater contamination. However, the lead concentrations are relatively high. There is a significant layer of low permeability Glacial Till below the made ground, and much of the site will remain as car parking areas upon development., with a clean capping layer placed above any made ground which would otherwise be exposed in garden or landscaped areas.

Overall, it is assessed that there is a low possibility of a contaminant linkage between and the underlying groundwater in the Secondary A Aquifer.

Groundsolve believe that the site does not pose a significant risk to Controlled Waters because:

- the site is underlain by low permeability Glacial Till;
- the groundwaters at and in the vicinity of the site are not abstracted for human consumption;
- there are no credible pathways to surface water receptors west of the site, due to the urban nature of the surrounding land and presence of drainage.

6.4 Permanent Ground Gases

The phase 1 desk study identified the potential presence of organic rich made ground, and the underlying mine workings, as potential sources of ground gas.

The intrusive investigation did not encounter any organic rich made ground, with the made ground comprising slightly ashy, gravelly sand, largely of brick, clinker, and sandstone. These materials are not considered to be a credible source of ground gas.

Previous mining investigations have included gas monitoring whilst drilling into the underlying working and shafts. None of the previous intrusive investigations recorded the presence of gases associated with abandoned mineworkings (principally methane and carbon dioxide).

The fieldwork carried out on site has shown that drift deposits comprise glacial till (predominantly clay) deposits from 1.0m proven to 12.5m with low gas permeability. As part of the new development, it is proposed that the mineshafts are to be treated by capping at the rockhead depth 10.0m to 12.5mbgl, with a suitable gas membrane layer installed beneath the cap. The treatment of the mineshafts will break the pathway between any potential migrating ground gases related to the past coal mining and the new developments. The only remaining pathway will be migration via the low permeability till, which is considered unlikely and a low risk.

In line with CL:AIRE document: ISBN: 978-1-905046-39-3 (Good practice for Risk Assessment for Coal Mine Gas Emissions – Oct 2021), the ground gas risk from shallow mine workings after the mineshafts are treated is considered low.

The Site is located within an area where between 3-5% of properties may be affected by radon; therefore, basic radon protective measures are required.

Basic radon protection measures, combined with a raft foundation, will offer some protection from other ground gases, and given the low risk and restricted pathways present, the overall risk posed by ground gases to the proposed development is considered to be low.

6.5 Risks to Human Health (Construction Phase)

During the construction works there will be a risk from dust to on-site workers and people occupying adjacent properties. Appropriate risk assessments should be carried out by the contractor to allow appropriate controls for the mitigation of risk to health of construction workers to be put in place. This risk can be controlled to within acceptable limits by:

- Method statement for site activities including control of dust generation;
- Having adequate site hygiene facilities allowing staff to keep a good level of personal hygiene;
- The method statement shall have a contingency plan which should be implemented if the presence of significantly elevated levels of lead is suspected in groundworks; and
- Only permitting smoking or eating on site in appropriate pre-designated areas.

Given the presence of heavy metals (principally lead) and PAHs, even in low levels, together with the proximity of residential receptors in the environs of the site and construction workers, control of fugitive dust will be a priority. As a minimum it is anticipated the works will be undertaken in accordance with BRE best practise guidance, and that the

following measures will be introduced to assist with control of dust generation during the groundworks phase of the works:

- Access roads and any stockpiles created during groundworks should be regularly damped down with water;
- Vehicles used to transport materials/wastes and aggregates should be enclosed or tarpaulined;
- Vehicle movements and speed should be kept to a minimum within the site ;
- Dust generating equipment (e.g., mobile crushing and screening equipment) should be located to minimise potential nuisance impacts to receptors as far as practicable; and
- Minimising drop heights of all loading and unloading activities that involve the transfer of soils and demolition materials.

6.6 Revised Conceptual Site Model

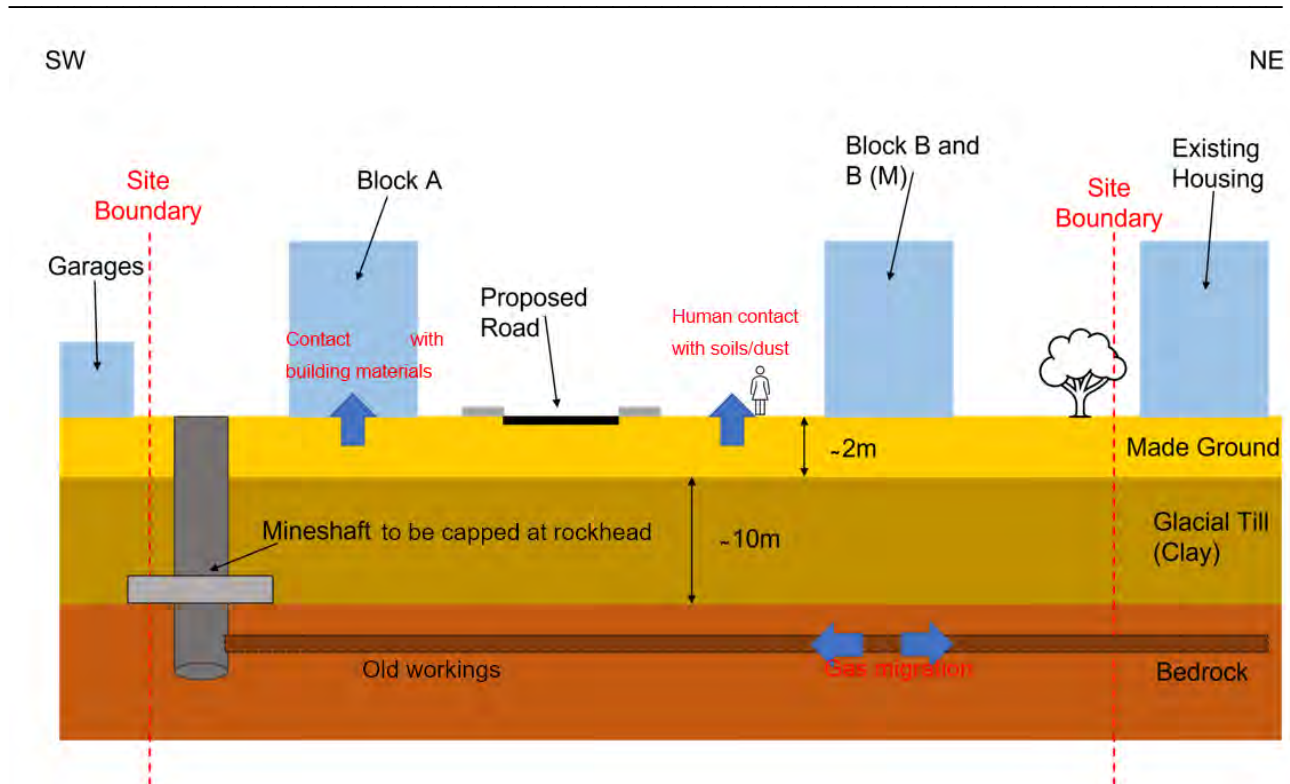
The proposed development comprises a residential development with garden areas, and a large car parking area.

The conceptual site model has been updated since the Phase 1 Preliminary Risk Assessment, as the findings of the Phase 2 site investigation revealed the following general downward succession:

- Site surface: concrete hardstanding, tarmac, or vegetation;
- Made Ground to 1.0-3.0m depth;
- Devensian Till: encountered in all areas, comprising a layer of firm becoming stiff clay;
- Coal measures bedrock (proven in previous investigations) at depths of between 10.5-12m.

The potential contamination at the site has been reassessed using the contaminant-pathway-receptor linkage approach. Following the site investigation, the plausible contaminant sources have been updated or confirmed as slightly elevated concentrations of heavy metals and PAHs (primarily lead).

The updated conceptual site model is presented graphically below:



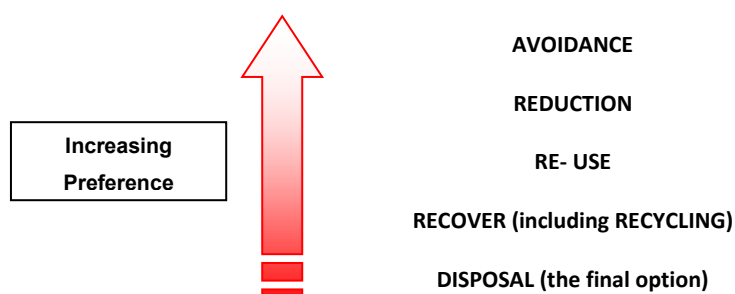
The only complete source-pathway-receptor linkages are between the existing made ground and the site end users. After completion of the proposed remedial works, placement of a clean capping layer in all soft-finished areas, this pathway will be severed.

Whilst unexpected contamination is not anticipated, the proposed development could encounter previously unrecorded hotspots of contaminants. These will be assessed and mitigated in accordance with current good practice.

7 WASTE ASSESSMENT

7.1 Waste Hierarchy

In accordance with government guidance, it is required that the production and disposal of waste is managed in accordance with the following hierarchy of preference:



7.2 Waste Characterisation and Classification

If there is a portion of excess soil this will then have to be sent to a suitable landfill site. A two-phase approach is required comprising:

- Waste Characterisation; and
- Waste Classification (Waste Acceptance Criteria).

Waste Characterisation

The results of the total concentrations from the chemical testing on soil samples have been assessed to determine whether or not they are hazardous in terms of waste classification. The results of this assessment indicate that three samples out thirteen samples encountered during the investigation can be classified as hazardous due to the zinc concentrations. The three samples were all from the black gravelly clay Made Ground.

Waste Classification

In order to determine whether soils can be sent to a licensed landfill for disposal further testing is required comprising landfill Waste Acceptance Criteria (WAC) analysis for both total concentrations for certain chemicals and for leachate analysis. No WAC testing was carried out as part of this investigation. WAC testing will have to be carried out to confirm the landfill waste classification and if any pre-treatment is required. This is best carried out once all material

to be disposed of is stockpiled, and volumes can be accurately assessed. It should be noted that natural clay can be classified as Inert Waste 17 05 04: Soil and stones only (excluding topsoil, peat, soil and stones).

Testing Frequency

There are also set requirements for the required sampling and testing frequencies for materials being sent for disposal at landfills. The required testing frequencies for each different waste type are summarised in **Table 8.1** below.

Table 8.1 Laboratory Sampling Testing Frequencies

Testing Level	Quantity of Waste	Number of Samples	
		Homogeneous	Heterogeneous & New Wastes
Level 1 Characterisation (Description, Total Concentrations & Leaching)	<100T	2	5
	<500T	3	8
	<1000T	5	14
	10,000 T	11	22
	Per additional 10,000T	+5 pro rata	+10 pro rata
Level 2 Compliance For Regularly Generated Wastes (Total Concentrations & Leaching)		1 per defined waste sub-population per year	3 per defined waste sub-population per year
Level 3 Verification Delivery document & visual check Chemical testing as per Level 2 suite		Visual – Each Load	Visual – Each Load
		1 per year per waste stream	3 per year per waste stream

8 GEOTECHNICAL ASSESSMENT AND RECOMMENDATIONS

8.1 Fieldwork and Laboratory Data Review

The proposed development comprises a residential development with garden areas, and a large car parking area.

No loading information has been provided for this report, however typical building loads of no more than 50-75kN/m are anticipated.

The shallow ground conditions predominantly comprise loose made ground overlying firm becoming stiff glacial till, at depths of between 1.5-3.0m.

SPT N values vary within the made ground between 3 and 11, indicating a very loose to loose consistency. The SPT N values in the underlying glacial till were between 4 and 10 in this investigation (to a maximum depth of 3.0mBGL), however increased rapidly beneath this depth in the previous phases of investigation.

The made ground itself will not be a suitable bearing stratum for the proposed development. It is anticipated that the soft glacial till encountered at the base of the made ground is due to softening due to perched water standing on the interface of the made ground and till, with the till generally being of firm to stiff consistency beneath this softened layer.

8.2 Foundation Recommendations

Based on the findings of the previous mining investigation, raft foundations are required to address the residual mining risks at the site.

This investigation has encountered a thickness of made ground across the site, which will not be suitable as a founding stratum without ground treatment (most warranty providers now require this to be full-depth of any made ground to accept rafts).

Based on the composition of the made ground encountered and in light of the chemical test results, it is recommended that all of the made ground is excavated out from beneath the footprint of the proposed structures, and levels raised back up with well-compacted imported granular material.

The rafts would then be constructed on the granular material, adopting an allowable bearing capacity of 50kN/m² to avoid overstressing the softened surface of the underlying glacial till.

8.3 Trees

A number of mature trees and bushes are located on or adjacent to the northwestern corner of the site. A comprehensive tree survey of those trees within the site boundary, and up to 20m beyond the site boundary (assuming mature high water demand trees are not present along the boundary) will be required to determine the effect of existing trees to proposed properties and also to assess the condition of trees which are to remain.

Due to the proposed foundation solution being rafts founded on imported granular fill, which will be taken down to the glacial till at depths ranging from 1.0m-3.0m, there will be very limited potential for any heave/shrinkage to occur. This should be reviewed once the tree survey has been carried out, and any trees to be removed identified.

Any proposed felling or removal of trees or hedgerows should be agreed with the Local Authority as part of the pre-planning discussions for development and should be carried out outside the bird nesting season (it may be possible that tree felling can be carried out during the bird nesting season under the direction of an ecologist).

Care must be taken to ensure that any existing trees scheduled for retention are not adversely affected by construction operations. Further guidance on this aspect of site works is given in the British Standards "Guidance for Trees in Relation to Constructions", BS5837.

8.4 Reuse of Materials

The glacial deposits are considered suitable as structural fill material subject to placement and compaction with an approved earthworks specification.

8.5 Groundwater & Excavations

It is not expected that significant groundwater will be encountered in any excavations at this site. It is anticipated that any groundwater in excavations can be controlled by sump pumping. If inflows are relatively localised, this may cause softening of the ground and require localised excavation support in order to prevent instability of the sides of excavations.

Excavations through the made ground are unlikely to be stable, with shallow excavations into the glacial till likely to stand unsupported for short periods of time. All excavations should be carried out in accordance with CIRIA Report 97 "Trenching Practice" and BS6031: 2009: Code of Practice for Earthworks. Further guidance on this aspect of site works is given in the British Standards for "Workmanship on Building Sites", BS 8000, Parts 1 and 14, and in the Construction Industry Training Board's Site Safety Note 10.

Anticipated excavation depths should generally be readily achieved using conventional hydraulic plant (e.g. wheeled JCB or similar) although larger plant will have higher excavation rates.

8.6 Buried Concrete and Pipework

The results of laboratory pH and sulphate content indicate that ACEC Class AC-1/DS-1 conditions prevail in accordance with BRE Special Digest 1, 2005 (the Design Concrete Class). Therefore, special precautions are not required at the site for the design of concrete in terms of the durability and structural performance.

9 REFERENCES

- BRE BR211 (2015). Radon: Guidance on Protective Measures for New Dwellings. IHS BRE Press, Bracknell.
- BRE SD1 (2005). Concrete in Aggressive Ground. Special Digest 1 (revised edition). IHS BRE Press, Bracknell.
- BRE 414 (2001) Protective measures for housing on gas-contaminated land. BRE.
- BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites - Code of Practice. British Standards Institution, London.
- BS5930:2015+A12020 Code of practice for ground investigations BSI
- BS8485 2015 Code of Practice for the design of protective measures for methane and carbon dioxide ground gases in new buildings. British Standards
- BS8576-2013 Guidance on investigations for ground gas – permanent gases and volatile organic compounds (VOCs). BSI,
- CIRIA Rep R 132 (1996) A Guide for Safe Working on Contaminated Sites. Report 132, CIRIA, London.
- CIRIA C552 (2001) Contaminated land risk assessment. A guide to good practice (report no. C552).
- CIRIA C665 (2007) Assessing the risks posed by hazardous gases to buildings CIRIA, London
- CIRIA C681 (2009) Unexploded ordnance (UXO) A guide for the construction industry (C681)
- CIRIA C785 (2019) Unexploded ordnance (UXO) risk management guide for land-based projects (C785)
- CIRIA C758D (2019) Abandoned mine workings manual (C758D)
- Contaminated Land: Applications in Real Environments (CL:AIRE) (2011) Definition of Waste Code of Practice (version 2).
- Department of Environment Food and Rural Affairs (DEFRA) (2012) Environmental Protection Act 1990:Part 2A Contaminated Land Statutory Guidance (report no. PB13735).
- Environment Agency (2000) Technical Aspects of Site Investigation. Report P5-065/TR, Environment Agency, Bristol.
- Environment Agency (2002) Guidance on Monitoring Landfill Leachate, Groundwater and Surface Water. Report LFTGN02, Environment Agency, Bristol.
- Environment Agency (2007) Evaluation of Models for Predicting Plant Uptake of Chemicals from Soil. Report SC050021/SR, Environment Agency, Bristol.
- Environment Agency (2015) Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (1st edition).European Union (1998) Drinking Water Directive (Council Directive 98/83/EC).
- Land Contamination Risk Management (LCRM) Environment Agency October 2020
<https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm> .
- LQM/CIEH Ltd (2015) S4ULs for Human Health Risk Assessment. Land Quality Press, Nottingham.
- SoBRA (2017) Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater – Version 1.0.
- The Water Framework Directive, (Standards and Classification) Directions (England and Wales).
- World Health Organisation (2017) Guidelines for Drinking Water Quality (4th edition).
- Britain From Above - <https://britainfromabove.org.uk/en/image/WPW060399>
<http://www.warstateandsociety.com/Bombing-Britain>

<https://www.epa.gov/pfas/basic-information-pfas>

UK Maps of Radon, <http://www.ukradon.org/information/ukmaps>

Health and Safety Executive (2015) Construction (Design and Management) Regulations.

Coal Authority Interactive Map Viewer, <http://mapapps2.bgs.ac.uk/coalauthority/home.html>

BGS Geology of Britain Viewer <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>

10 DEFINITIONS

AOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GQRA	Generic Quantitative Risk Assessment
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
ppm	Parts per million
ppmv	Parts per million by volume
SAC	Special Area of Conservation
SPZ	Source Protection Zone
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest

FIGURES



OS LICENSE No. 100030802

SCALE 1:50,000 @ A4

Figure Title

SITE LOCATION

FIGURE 1



SCALE 1:500 @ A3

Figure Title
Proposed Development
and
Location of Shafts

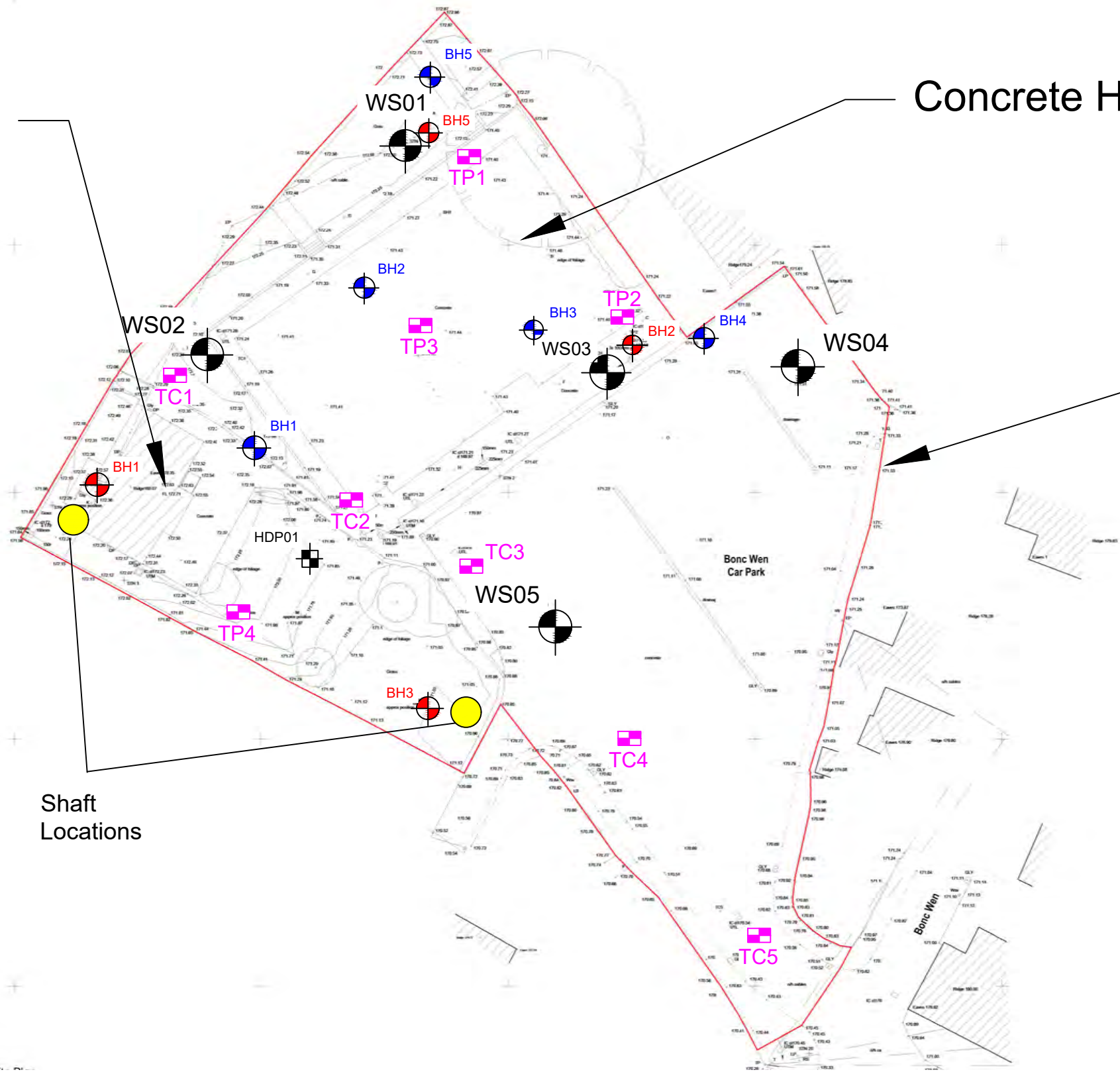
FIGURE 2

Previous Building

Concrete Hardstanding

Site Boundary

Shaft Locations



Legend

-  August 2022 GSL Investigation
-  BGS Borehole Positions
-  SRL Borehole Positions (2015)
-  Datrys Trial Pit Location (2015)

SCALE 1:500 @ A3

Figure Title
Exploratory Hole Locations

APPENDIX A – SITE PHOTOGRAPHS



1 – Western part of site, with concrete slab from former community centre building visible



2 – Northwestern area of site, concrete slab visible and adjacent residential properties



3 – Car park in eastern half of site

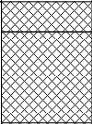


4 – Site entrance in southeastern corner



5 – Footpath along western site boundary

APPENDIX B – EXPLORATORY HOLE LOGS

				Windowless Sample Record				WS01			
Project Name: Bonc Wen				Client: Brenig Construction				Date: 17/08/2022			
Location:				Contractor:				Co-ords: E328981.49 N346410.15			
Project No. : 2774				Crew Name: MT Geoservices				Drilling Equipment: Dando Terrier			
Borehole Number WS01		Hole Type WLS		Level		Logged By RP		Scale 1:50		Page Number Sheet 1 of 1	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
		0.30	ES	N=5 (3,3/2,1,1,1)	0.20			Brown sandy CLAY with frequent rootlets. (MADE GROUND) Soft dark brown slightly clayey gravelly SAND. Gravel is very angular to angular fine to coarse of glass, brick sandstone and clinker. (MADE GROUND) Soft blackish brown slightly sandy slightly gravelly CLAY. Gravel is angular fine to coarse of clinker and sandstone. (MADE GROUND) Soft becoming firm bluish grey slightly sandy CLAY.		1	
		1.20	SPT		0.80						
		1.40	ES		1.50						
		2.00	SPT	2.45	2						
								End of Borehole at 2.450m		4	
										5	
										6	
										7	
										8	
										9	
										10	
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.00	100										
Remarks										GroundSolve Ltd Unit 1 Well House Barns Chester Road Bretton CH4 0DH	
No groundwater encountered.											

Project Name: Bonc Wen

Client: Brenig Construction

Date: 17/08/2022

Location:

Contractor:

Co-ords: E328967.25 N346394.04

Project No. : 2774

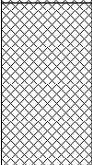
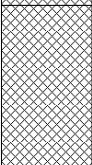
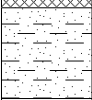
Crew Name: MT Geoservices

Drilling Equipment: Dando Terrier

Borehole Number
WS02Hole Type
WLS

Level

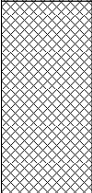
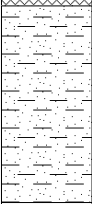
Logged By
RPScale
1:50Page Number
Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.60	ES		0.20			Loose light brown slightly clayey SAND. (MADE GROUND)	1
		1.20	SPT	N=7 (2,1/1,2,1,3)	1.30			Very loose dark brown gravelly SAND. Gravel is very angular to angular fine to coarse of sandstone, brick and clinker. (MADE GROUND)	
		1.60	ES					Soft dark brown slightly gravelly CLAY. Gravel is angular to subangular fine to medium of sandstone and clinker. (MADE GROUND)	
		2.00	SPT	N=11 (2,3/3,3,3,2)	2.40			Soft becoming firm bluish grey slightly sandy CLAY.	
					3.00			End of Borehole at 3.000m	
									2
									3
									4
									5
									6
									7
									8
									9
									10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.00	100										
2.00	92										
3.00	79										

Remarks

No groundwater encountered.

				Windowless Sample Record				WS04			
Project Name: Bonc Wen				Client: Brenig Construction				Date: 17/08/2022			
Location:				Contractor:				Co-ords: E329013.88 N346390.79			
Project No. : 2774				Crew Name: MT Geoservices				Drilling Equipment: Dando Terrier			
Borehole Number WS04		Hole Type WLS		Level		Logged By RP		Scale 1:50		Page Number Sheet 1 of 1	
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
					0.10			Tarmac (MADE GROUND) Very loose light grey slightly sandy angular to subangular fine to coarse GRAVEL of sandstone. (Sub-base) (MADE GROUND)		1	
					0.40						
		0.70	ES						Soft dark brown slightly sandy very gravelly CLAY. Gravel is subangular to subrounded fine to coarse of quartzite sandstone and brick. (MADE GROUND)		
		1.20	SPT	N=3 (2,1/0,1,0,2)							
		2.00	SPT	N=4 (1,1/0,2,1,1)			1.70		Very soft becoming soft greyish brown slightly sandy CLAY. (GLACIAL TILL)		2
					3.00						
								End of Borehole at 3.000m		3	
										4	
										5	
										6	
										7	
										8	
										9	
										10	
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.00	100										
2.00	92										
3.00	79										
Remarks										GroundSolve Ltd Unit 1 Well House Barns Chester Road Bretton CH4 0DH	
No groundwater encountered.											

Project Name: Bonc Wen

Client: Brenig Construction

Date: 17/08/2022

Location:

Contractor:

Co-ords: E329033.98 N346324.95

Project No. : 2774

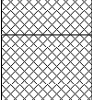
Crew Name: MT Geoservices

Drilling Equipment: Dando Terrier

Borehole Number
WS05Hole Type
WLS

Level

Logged By
RPScale
1:50Page Number
Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.10			Black asphalt (MADE GROUND)	
					0.40			Very loose light grey slightly sandy GRAVEL of sandstone. (MADE GROUND)	
		0.80	ES		0.90			Soft dark brown slightly sandy gravelly CLAY. Gravel is angular to subangular fine to coarse of brick, sandstone and clinker. (MADE GROUND)	1
		1.20	ES		1.40			Soft black slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of mudstone and sandstone. (MADE GROUND)	
					2.00			Very soft to soft bluish grey slightly sandy CLAY.	2
								End of Borehole at 2.000m	
									3
									4
									5
									6
									7
									8
									9
									10

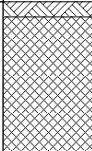
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
1.00	100										
2.00	92										

Remarks

No groundwater encountered.

Trial Pit Log

Project Name: Bonc Wen			Client: Brenig Construction			Date: 17/08/2022		
Location:			Contractor:			Co-ords: E328968.39 N346367.51		
Project No. : 2774			Crew Name:			Equipment:		
Location Number HDP01		Location Type OP		Level		Logged By		Scale 1:25
								Page Number Sheet 1 of 1

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.05			Brown sandy CLAY with abundant rootlets. Very loose black gravelly SAND. Gravel is subangular to subrounded fine to medium of sandstone and clinker.	
					0.50			End of Borehole at 0.500m	
									1
									2
									3
									4
									5

Dimensions		Trench Support and Comment				Pumping Data		
Pit Length	Pit Width	Pit Stability	Shoring Used	Remarks		Date	Rate	Remarks
Remarks								

Personnel:
 Drilled by:
 Logged by:
 Checked by:

Equipment & methods:
 Plant: Dando/Comacchio305
 Method: Cable percussion/rotary
 Flush: Water SPT Hammer details:

Hole diameter & casing depths:
 Dia (mm): to: Casing depth: 6.00 12.60

Coordinates & level:
 UK National Grid 328993.08mE 346403.17mN

Dates:
 Start: 23/02/2015
 End: 03/03/2015
 Backfilled: 03/03/2015

Backfill/ Well Inst.	Water- strikes	Legend	Level (Thickness)	Depth	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
						Date Casing	Time Water	Depth	Type & No.	Results
			(0.20)	0.20	MADE GROUND: Concrete					
			(0.25)	0.45	MADE GROUND: Medium to coarse limestone GRAVEL					
			(0.75)	1.20	MADE GROUND: Dark grey slightly fine sandy CLAY			0.50	ES1	
								1.00	ES2	
					Stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse, sub-angular, sub-rounded, sandstone, mudstone, coal		Dry	1.50 - 1.95	U1	55 blows
								2.00	D1	
								2.00	ES3	
								2.20 - 2.65	S	
								2.20	S1	N=13 (2,3/3,4,3,3)
			(2.60)				Dry	2.70 - 3.15	U2	70 blows
								3.30	D4	
							Dry	3.40 - 3.85	S	
								3.40	S2	N=19 (3,3/4,5,5,5)
							Dry	3.90 - 4.35	U3	120 blows
			3.80		Very stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse, sub-angular, sub-rounded, sandstone, mudstone, coal, gritstone, granite		Dry	4.50	D5	
								4.60 - 5.05	S	
								4.60	S3	N=21 (3,4/4,5,6,6)
							Dry	5.10 - 5.55	U4	110 blows
								5.60	D6	
							Dry	5.80 - 6.25	S	
								5.80	S4	N=24 (4,4/5,6,7,6)
							Dry	6.30 - 6.75	U5	110 blows
								6.80	D7	
							Dry	7.00 - 7.45	S	
								7.00	S5	N=23 (4,5/6,5,6,6)
							Dry	7.50 - 7.95	U6	110 blows
								8.00	D8	
							Dry	8.20 - 8.65	S	
								8.20	S6	N=18 (3,5/4,5,4,5)
							Dry	8.70 - 9.15	U7	105 blows
								9.30	D9	
							Dry	9.40 - 9.85	S	
								9.40	S7	N=26 (4,4/5,6,9,6)
							Dry	9.90 - 10.35	U8	115 blows

Continued next sheet

Instrumentation details: ID: Type: Diam: Remarks:	General remarks:	Groundwater entries:		Chiselling:	
		Struck:	Rose to: Rate of (20 mins) inflow: Depth sealed:	From: to: Duration (min):	Tool:
P101 P201	18.20 to 19.70m Loss of flush at 18.2m - unable to case. BH Terminated	No Groundwater Encountered			

Personnel: Drilled by: Logged by: Checked by:	Equipment & methods: Plant: Dando/Comacchio305 Method: Cable percussion/rotary Flush: Water SPT Hammer details:	Hole diameter & casing depths: Dia (mm): to: Casing depth: 6.00 12.60	Coordinates & level: UK National Grid 328993.08mE 346403.17mN	Dates: Start: 23/02/2015 End: 03/03/2015 Backfilled: 03/03/2015
---	--	---	---	---

Backfill/ Well Inst.	Water- strikes	Legend	Level (Thickness)	Depth	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
						Date Casing	Time Water	Depth Core run	Type & No.	Results
					Very stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse, sub-angular, sub-rounded, sandstone, mudstone, coal, gritstone, granite			10.40	D10	
				6.00			Dry	10.60 - 11.05	S S8	N=75 (6,9/9,16,23,27)
								11.10	D11	
							Dry	11.50 - 11.95	U9	140 blows
								12.00	D12	
			(0.10)	12.50	Extremely weak brown / orange weathered thinly laminated silty MUDSTONE		Dry	12.60 - 12.76	S S9	100 (25/100)
				12.60	Extremely weak grey weathered thinly laminated MUDSTONE with zones recovered as weathered clay and fracture zones. Bedding is 90degrees to core axis, clayey, smooth, planar			12.60		
			(1.30)					12.90 - 14.40	89 0 0	
				13.90	Weak grey thinly bedded fine-medium grained SANDSTONE. Bedding is 90degrees to core axis, clayey, smooth, planar					
			(0.50)							
				14.40	Weak to moderately strong grey and dark grey thinly bedded SILTSTONE. Bedding is 90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, clean, planar, smooth					
			(0.40)							
				14.80	Weak grey thinly bedded MUDSTONE. Discontinuity sets - Bedding is 90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical to 20degrees, clean, planar, smooth			14.40 - 15.60	87 30 0	
			(1.64)							
				16.44	Medium strong grey and orange fine grained thinly laminated SANDSTONE with slump structures. Discontinuity sets - Bedding is 90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, clean, planar, smooth			15.60 - 17.10	102 24 24	
			(0.89)		16.90m - 17.10m: subrounded flute clast structures					
				17.33	Weak dark grey thinly bedded MUDSTONE. Discontinuity sets - Bedding is 90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, clean, planar, smooth			17.10 - 18.30	90 34 0	
			(2.37)							
					18.70m - 19.70m: Highly weathered clayey Mudstone - poor bedding structure			18.30 - 19.70	103 0 0	
				19.70	Exploratory hole ends at 19.70 m					

Instrumentation details: ID: Type: Diam: Remarks: P101 - - P201 - -	General remarks: 18.20 to 19.70m Loss of flush at 18.2m - unable to case. BH Terminated	Groundwater entries: Struck: Rose to: Rate of (20 mins) inflow: Depth sealed: No Groundwater Encountered	Chiselling: From: to: Duration (min): Tool:
---	---	---	---

Personnel: Drilled by: Logged by: Checked by:	Equipment & methods: Plant: Dando/Comacchio305 Method: Light cable percussion Flush: Water SPT Hammer details:	Hole diameter & casing depths: Dia (mm): to: Casing depth: 6.20	Coordinates & level: UK National Grid 329009.01mE 346387.03mN	Dates: Start: 18/02/2015 End: 19/02/2015 Backfilled: 19/02/2015
---	---	---	---	---

Backfill/ Well Inst	Water- strikes	Legend	Level (Thickness)	Depth	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
						Date Casing	Time Water	Depth	Type & No.	Results
			(0.10)	0.10	MADE GROUND: Macadam					
			(0.40)		MADE GROUND: Graded Granular Fill - Limestone					
				0.50	MADE GROUND: Black fine-coarse sandy fine-coarse GRAVEL sized ash/cinder			0.50	ES1	
			(1.10)					1.00	ES2	
				1.20		1.20	Dry	1.20 - 1.65	S S1	N=7 (1,1/2,1,2,2)
				1.60	MADE GROUND: Black slightly sandy ashy CLAY. Gravel is fine-coarse ash occasional brick			2.00	ES3	
			(0.70)					2.20 - 2.65	U1	50 blows
				2.30	Stiff orange brown grey mottled slightly sandy slightly gravelly CLAY with occasional sandstone cobble. Gravel is fine-coarse, sub-angular, sub-rounded sandstone, quartzite			2.70	D1	
			(1.70)			1.70	Dry	2.90 - 3.35	S S2	N=10 (2,2/2,1,3,4)
								2.90 3.00	ES4	
							Dry	3.40 - 3.85	U2	140 blows
				4.00				3.90	D2	
					Stiff becoming very stiff brown grey fissured slightly sandy slightly gravelly CLAY with occasional sandstone cobble. Gravel is fine-coarse, sub-angular, sub-rounded sandstone, quartzite	3.20	Dry	4.10 - 4.55	S S3	N=10 (1,2/2,2,3,3)
							Dry	4.60 - 5.05	U3	100 blows
								5.10	D3	
						5.20	Dry	5.30 - 5.75	S S4	N=21 (2,3/4,5,6,6)
							Dry	5.80 - 6.25	U4	100 blows
						6.20	Dry	6.40 6.50 - 6.95	D4 S S5	N=21 (3,3/4,5,6,6)
							Dry	7.00 - 7.45	U5	100 blows
			(6.70)					7.50	D5	
						6.20	Dry	7.70 - 8.15	S S6	N=21 (2,4/5,4,5,7)
							Dry	8.20 - 8.65	U6	150 blows
						6.20	Dry	8.60 - 9.05	S S7	N=25 (8,4/5,5,6,9)
							Dry	8.60 9.20 - 9.65	U7	100 blows
								9.70	D6	
						6.20	Dry	9.90 - 10.35	S	N=23 (3,4/5,6,6,6)

Continued next sheet

Instrumentation details:
 ID: Type: Diam: Remarks:

General remarks:

Groundwater entries:
 Struck: Rose to: Rate of
 (20 mins) inflow: sealed:
 No Groundwater Encountered

Chiselling:
 From: to: Duration (min): Tool:

Personnel: Drilled by: Logged by: Checked by:	Equipment & methods: Plant: Dando/Comacchio305 Method: Light cable percussion Flush: Water SPT Hammer details:	Hole diameter & casing depths: Dia (mm): to: Casing depth: 6.20	Coordinates & level: UK National Grid 329009.01mE 346387.03mN -	Dates: Start: 18/02/2015 End: 19/02/2015 Backfilled: 19/02/2015
---	---	---	--	---

Backfill/ Well Inst.	Water- strikes	Legend	Level Depth (Thickness)	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
					Date Casing	Time Water	Depth	Type & No.	Results
				Stiff becoming very stiff brown grey fissured slightly sandy slightly gravelly CLAY with occasional sandstone cobble. Gravel is fine-coarse, sub-angular, sub-rounded sandstone, quartzite			9.90	S8	
			10.70	Very stiff grey, black, brown slightly friable slightly sandy gravelly CLAY with occasional cobble. Gravel is fine-coarse, flat, sub-angular mudstone, coal		Dry	10.50 10.60 - 11.05	D7 U8	120 blows
			(2.30)				11.10	D8	
						Dry	11.60 - 12.05 11.60	S S9	N=55 (7,7/14,14,15,12)
							12.00	D9	
			13.00	Extremely weak black slightly friable carbonaceous MUDSTONE		Dry	13.00 - 13.45	U9	100 blows
			(0.57)			Dry	13.40 13.40 - 13.57 13.40	D10 S S10	100 (25,- for 0mm/100,- for 0mm)
			13.57	Exploratory hole ends at 13.57 m					
					Casing Date	Water Time	Depth	Type & No.	Results
Instrumentation details: ID: Type: Diam: Remarks:					Groundwater entries: Struck: Rose to: Rate of Depth (20 mins) inflow: sealed: No Groundwater Encountered				Chiselling: From: to: Duration (min): Tool:
AGS Notes: For explanation of symbols and abbreviations see key sheet. All depths are reduced levels in metres. Log issue: Scale: 1:50 (c) TerraConsult www.terraconsult.co.uk					Project: Bonc Wen, Rhosllanerchrugog Project No: SRL-164 Client: Datrys Design Engineering				

Personnel:	Equipment & methods:	Hole diameter & casing depths:	Coordinates & level:	Dates:
Drilled by:	Plant: Dando/Comacchio305	Dia (mm): to: Casing depth:	UK National Grid	Start: 10/02/2015
Logged by:	Method: Light cable percussion	7.50	328991.20mE 346353.54mN	End: 27/02/2015
Checked by:	Flush: Water SPT Hammer details:	18.00	-	Backfilled: 27/02/2015

Backfill/ Well Inst	Water- strikes	Legend	Level Depth (Thickness)	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
					Date Casing	Time Water	Depth	Type & No.	Results
			(0.50)	MADE GROUND: Fine to coarse GRAVEL sized concrete and brick with fine-coarse sand matrix and cinder fragments			0.20	ES1	
			0.50				0.40	D4	
				MADE GROUND: Brown fine-coarse SAND and fine-medium GRAVEL sized brick, concrete, cinder with lime waste and clay pockets			0.50	ES2	
			(1.00)				0.80	D5	
							1.00	ES3	
			1.50	MADE GROUND: Black and grey ashy slightly sandy CLAY and medium-coarse yellow sandstone GRAVEL	-1.20	Dry	1.20 - 1.65	S	N=16 (2,4/5,4,3,4)
							1.20	S1	
			(0.90)				1.70	D6	
							2.00	ES4	
			2.40	MADE GROUND: Grey fine-coarse sandy fine-coarse angular mudstone GRAVEL	-1.70	Dry	2.20 - 2.65	S	N=12 (3,3/2,3,4,3)
							2.20	S2	
			(1.30)				2.70	D7	
							3.00	ES5	
			3.70	Stiff becoming very stiff orange brown grey mottled slightly sandy slightly gravelly CLAY. Gravel is fine-coarse, sub-angular, sub-rounded, flat, sandstone, mudstone, coal	-3.20	Dry	3.20 - 3.65	S	N=15 (3,5/4,4,3,4)
							3.20	S3	
							3.70	D8	
							4.00	ES6	
							4.20 - 4.65	U1	102 blows
							4.70	D9	
							4.90 - 5.35	S	N=18 (2,3/5,4,5,4)
							4.90	S4	
							5.20	D10	
							5.40 - 5.85	U2	85 blows
							5.90	D11	
							6.10 - 6.55	S	N=18 (6,3/4,4,5,5)
			(5.50)				6.10	S5	
							6.50	D12	
							6.60 - 7.05	U3	85 blows
							7.10	D13	
							7.30 - 7.75	S	N=20 (3,3/4,5,6,5)
							7.30	S6	
							7.80	D14	
							7.90 - 8.35	U4	82 blows
							8.50	D15	
							8.60 - 9.05	S	N=19 (2,4/4,4,5,6)
							8.60	S7	
							9.00	D16	
			9.20	Very stiff grey brown sandy slightly gravelly friable CLAY. Gravel is fine-coarse, sandstone, mudstone and coal			9.10 - 9.55	U5	100 blows
							9.60	D17	
							9.80 - 10.25	S	N=24 (3,4/6,5,7)
							9.80	S8	
Continued next sheet					Casing Date	Water Time	Depth	Type & No.	Results
Instrumentation details: ID: Type: Diam: Remarks: P101 : : P201 : :					Groundwater entries: Struck: Rose to: Rate of Depth (20 mins) inflow: sealed: No Groundwater Encountered			Chiselling: From: to: Duration (min): Tool:	

Personnel:	Equipment & methods:	Hole diameter & casing depths:	Coordinates & level:	Dates:
Drilled by:	Plant: Dando/Comacchio305	Dia (mm): to: Casing depth:	UK National Grid	Start: 10/02/2015
Logged by:	Method: Light cable percussion	7.50	328991.20mE 346353.54mN	End: 27/02/2015
Checked by:	Flush: Water SPT Hammer details:	18.00	-	Backfilled: 27/02/2015

Backfill/ Well Inst.	Water- strikes	Legend	Level (Thickness)	Depth	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
						Date Casing	Time Water	Depth Core run	Type & No.	Results
			(2.70)		Very stiff grey brown sandy slightly gravelly friable CLAY. Gravel is fine-coarse, sandstone, mudstone and coal			10.30 Dry 10.50 - 10.95	D18 U6	110 blows
								11.10	D19	
			11.90 (0.30)		Extremely weak completely weathered orange and white fine-medium grained SANDSTONE		7.50	Dry 12.00 - 12.34 12.00	S S9	100 (12,11/21,42,37 for 40mm)
			12.20		Extremely weak highly weathered grey MUDSTONE			12.50	D20	
			(1.00)							
							7.50	Dry 13.00 - 13.10 13.00	S S10	100 (25 for 40mm/100 for 55mm)
			13.20 (0.65)		Extremely weak grey weathered thinly laminated MUDSTONE. Bedding is clayey, deconstructed with brown pelite pebbles			13.20 - 14.20	100 11 0	
			13.85		Medium strong to strong light grey and grey thickly laminated fine-medium SANDSTONE with occasional fracture zones.					
			(0.65)		Discontinuity sets - Bedding is 90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, orange, clean, planar, smooth			14.20 - 14.90	129 41 24	
			14.50		Medium strong dark grey silty thickly laminated MUDSTONE. Discontinuity sets - Bedding is 90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, orange, clean, planar, smooth					
			(1.20)					14.90 - 16.40	92 25 7	
			15.70 (0.70)		Medium strong light grey and dark grey SILTSTONE with slump structures. Discontinuity sets - Bedding is 85-90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical to 20degrees, orange, clean, planar, smooth					
			16.40		Weak grey slightly weathered laminated MUDSTONE with zones recovered as clay and gravel. Discontinuity sets - Bedding is 90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, orange, clean, planar, smooth			16.40 - 17.90	100 23 8	
			(1.50)							
			17.90 (0.60)		No returns - Possible worked Coal Seam			17.90 - 18.50	0 0 0	
			18.50		Extremely weak grey weathered MUDSTONE with zones recovered as clay and clayey Gravel			18.50 - 19.50	100 0 0	
			(1.50)					19.50 - 19.90	100 0 0	

Continued next sheet

Instrumentation details:	General remarks:	Groundwater entries:	Chiselling:
ID: Type: Diam: Remarks:	17.90 to 18.50m Loss of returns / flush - cased to 18m	Struck: Rose to: Rate of (20 mins) inflow. Depth sealed:	From: to: Duration (min): Tool:
P101 - -		No Groundwater Encountered	
P201 - -			

AGS Notes: For explanation of symbols and abbreviations see key sheet.
All depths are reduced levels in metres.

Log issue:
Scale: 1:50 (c) TerraConsult, www.terraconsult.co.uk

Project: Bonc Wen, Rhosllanerchrugog
Project No: SRL-164
Client: Datrys Design Engineering

Project: **Bonc Wen, Rhosllanerchrugog**
Project No: **SRL-164**
Client: **Datrys Design Engineering**

Personnel:		Equipment & methods:		Hole diameter & casing depths:		Coordinates & level:		Dates:	
Drilled by:		Plant:	Dando/Comacchio305	Dia (mm):	to:	Casing depth:	UK National Grid	Start:	16/02/2015
Logged by:		Method:	Light cable percussion			9.20	328951.56mE	End:	23/02/2015
Checked by:		Flush:	Water			17.50	346377.90mN	Backfilled:	25/02/2015
		SPT Hammer details:							

Backfill/ Well Inst.	Water- strikes	Legend	Level (Thickness)	Depth	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
						Date Casing	Time Water	Depth	Type & No.	Results
			(0.40)		MADE GROUND: Brick and concrete demolition material			0.20	ES1	
			0.40							
			(0.30)		MADE GROUND: Brown fine-coarse GRAVEL of sandstone, coal, brick with sandy clay pockets			0.50	ES2	
			0.70							
					MADE GROUND: Grey/dark grey sandy slightly gravelly CLAY. Gravel is fine-coarse, sub-angular, brick, cinder, glass, sandstone			1.00	ES3	
			(1.30)				Dry	1.20 - 1.65	U1	28 blows
								1.70	D4	
			2.00		MADE GROUND: Grey and orange slightly clayey slightly sandy fine-coarse flat, sub-angular Mudstone GRAVEL		Dry	1.90 - 2.35	S	N=9 (1,2/2,2,3,2)
								1.90	S1	
								2.00	ES4	
			(1.10)				Dry	2.40 - 2.85	U2	51 blows
								2.90	D5	
			3.10		MADE GROUND: Firm orange brown slightly sandy slightly gravelly CLAY. Gravel is fine-medium sub-angular, cinder, coal, sandstone		Dry	3.10 - 3.55	S	N=10 (2,2/2,3,2,3)
			(0.50)					3.10	S2	
			3.60		Stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine to coarse, sub-angular, sub-rounded, sandstone, occasional coal		Dry	3.60 - 4.05	U3	60 blows
								4.00	ES6	
								4.10	D6	
							Dry	4.30 - 4.75	S	N=13 (2,3/3,4,3,3)
								4.30	S3	
							Dry	4.80 - 5.25	U4	75 blows
								5.30	D7	
							Dry	5.50 - 5.95	S	N=17 (3,3/4,5,4,4)
								5.50	S4	
							Dry	6.00 - 6.45	U5	110 blows
								6.50	D8	
			(6.20)				Dry	6.70 - 7.15	S	N=24 (2,5/5,5,7,7)
								6.70	S5	
							Dry	7.20 - 7.65	U6	100 blows
								7.80	D9	
							Dry	7.90 - 8.35	S	N=23 (2,4/5,6,6,6)
								7.90	S6	
							Dry	8.40 - 8.85	U7	100 blows
								8.90	D10	
							Dry	9.10 - 9.55	S	N=22 (2,3/5,5,6,6)
								9.10	S7	
							Dry	9.60 - 10.05	U8	150 blows
			9.80							
			(0.30)							

Continued next sheet

Instrumentation details:		General remarks:		Groundwater entries:		Chiselling:	
ID:	Type: Diam: Remarks:	15.00 to 15.30m Complete loss of flush - cased to 15.3m		Struck:	Rose to: Rate of (20 mins) inflow: Depth sealed:	From:	to: Duration (min): Tool:
P101	- -			No Groundwater Encountered			
P201	- -						

Personnel:	Equipment & methods:	Hole diameter & casing depths:	Coordinates & level:	Dates:
Drilled by:	Plant: Dando/Comacchio305	Dia (mm): to: Casing depth:	UK National Grid	Start: 16/02/2015
Logged by:	Method: Light cable percussion	9.20	328961.56mE 346377.90mN	End: 23/02/2015
Checked by:	Flush: Water SPT Hammer details:	17.50	-	Backfilled: 25/02/2015

Backfill/ Well Inst.	Water- strikes	Legend	Level (Thickness)	Stratum Description	Progress, Casing & Water Data		Samples & In Situ Testing		
					Date Casing	Time Water	Depth Core run	Type & No.	Results
			10.10 (0.43)	Extremely weak orange fine-medium grained SANDSTONE Weak weathered orange brown thinly laminated fine to medium SANDSTONE. Bedding is 70degrees, clayey, rough. Jointing is sub-vertical, clayey	9.20	Dry	10.00 10.10 - 10.32 10.10 10.10 - 10.70	D11 S 100S 0 0	100 (21.5 for 15mm/46.54 for 50mm)
			10.53 (0.17)	Extremely weak slightly weathered brown clayey MUDSTONE					
			10.70 (0.90)	Extremely weak grey slightly weathered thinly laminated MUDSTONE. Discontinuity sets - bedding is 85-90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, clean, smooth, planar					
			11.60 (1.33)	Very weak grey slightly weathered thinly laminated MUDSTONE. Discontinuity sets - bedding is 85-90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, clean, smooth, planar 12.20m - 12.70m: ..highly fractured Mudstone			10.70 - 12.20 12.20 - 12.70	99 0 0 100 0 0	
			12.93 (3.67)	Extremely weak grey slightly weathered thinly laminated MUDSTONE with clayey fracture zones. Discontinuity sets - bedding is 85-90degrees to core axis, clean, smooth, planar. Jointing is sub-vertical, clean, smooth, planar 14.50m: with occasional brown strong Siltstone pebbles			12.70 - 14.00 14.00 - 14.50 14.50 - 15.50	92 6 0 116 24 24 95 22 0	
			16.60 (0.40)	Extremely weak black clayey carbonaceous MUDSTONE with COAL			15.50 - 17.00	93 0 0	
			17.00 (0.10)	Soft brown CLAY - SEATEARTH					
			17.10 (0.20)	Black bright COAL			17.00 - 17.50	60 0 0	
			17.30 (0.30)	Soft brown CLAY - SEATEARTH					
			17.60 (0.30)	Extremely weak grey MUDSTONE			17.50 - 17.90	75 0 0	
			17.90 (0.35)	Black bright COAL					
			18.25 (1.95)	Extremely weak grey highly weathered friable clayey MUDSTONE - SEATEARTH			17.90 - 19.40 19.40 - 20.20	100 0 0 125 0 0	

Continued next sheet

Instrumentation details: ID: Type: Diam: Remarks: P101 - - P201 - -	General remarks: 15.00 to 15.30m Complete loss of flush - cased to 15.3m	Groundwater entries: Struck: Rose to: Rate of Depth (20 mins) inflow: sealed: No Groundwater Encountered	Chiselling: From: to: Duration (min): Tool:
--	---	---	--

AGS Notes: For explanation of symbols and abbreviations see key sheet
All depths are reduced levels in metres.

Log issue:
Scale: 1:50 (c) TerraConsult. www.terraconsult.co.uk

Project: Bonc Wen, Rhosllanerchrugog
Project No: SRL-164
Client: Datrys Design Engineering

Personnel:		Equipment & methods:		Hole diameter & casing depths:		Coordinates & level:		Dates:	
Drilled by:		Plant:	Dando/Comacchio305	Dia (mm):	to:	Casing depth:	UK National Grid	Start:	16/02/2015
Logged by:		Method:	Light cable percussion			9.20	328951.58mE 346377.90mN	End:	23/02/2015
Checked by:		Flush:	Water	SPT Hammer details:		17.50		Backfilled:	25/02/2015

Backfill/ Well Inst.	Water- strikes	Legend	Level Depth (Thickness)	Stratum Description	Progress, Casing & Water Data		Rotary Coring			
					Date Casing	Time Water	Depth Core run	TCR SCR ROD	II	Results
			20.20	Extremely weak grey highly weathered friable clayey MUDSTONE - SEATEARTH						
			(0.70)	Weak grey slightly weathered laminated MUDSTONE with zones recovered as clay. Discontinuity sets - Bedding is 90degrees to core axis, clean, smooth, planar.						
			20.90	Extremely weak grey weathered friable clayey MUDSTONE			20.20 - 21.70	98 14 0		
			(1.27)							
			22.17	Black bright COAL			21.70 - 22.60	100 0 0		
			(0.33)							
			22.50	Black carbonaceous clayey friable MUDSTONE						
			(0.10)							
			22.60	No returns - Possible worked Coal Seam						
			(1.50)				22.60 - 24.10	0 0 0		
			24.10	Exploratory hole ends at 24.10 m						

Instrumentation details:		General remarks:		Casing		Water		Core run		TCR		II		Results	
ID:	Type:	Diam:	Remarks:	15.00 to 15.30m Complete loss of flush - cased to 15.3m	Date	Time		Depth		SCR					
P101	-	-	-												
P201	-	-	-												

Notes: For explanation of symbols and abbreviations see key sheet. All depths are reduced levels in metres.		Project: Bonc Wen, Rhosllanerchrugog		Groundwater entries:		Chiselling:	
Log issue:		Project No: SRL-164		Struck: Rose to: Rate of Depth		From: to: Duration (min): Tool:	
Scale: 1:50		Client: Datrys Design Engineering		(20 mins) inflow: sealed:			
(c) TerraConsult, www.terraconsult.co.uk				No Groundwater Encountered			

APPENDIX C – CHEMICAL TEST RESULTS



2183

Final Report

Report No.: 22-31835-1
Initial Date of Issue: 25-Aug-2022
Client Groundsolve Ltd
Client Address: Unit 1 Well House Barns
Chester Road
Bretton
Chester
CH4 0DH

Contact(s): Elizabeth Smith
Ross Page
Stefan Imiolczyk

Project 2774 Bonc Wen

Quotation No.: **Date Received:** 19-Aug-2022

Order No.: **Date Instructed:** 19-Aug-2022

No. of Samples: 9

Turnaround (Wkdays): 5 **Results Due:** 25-Aug-2022

Date Approved: 25-Aug-2022

Approved By:



Details: Stuart Henderson, Technical
Manager

Results - Soil

Project: 2774 Bonc Wen

Client: Groundsolve Ltd	Chemtest Job No.:				22-31835	22-31835	22-31835	22-31835	22-31835	22-31835	22-31835	22-31835
Quotation No.:	Chemtest Sample ID.:				1491385	1491386	1491387	1491388	1491389	1491390	1491391	1491392
Order No.:	Client Sample Ref.:				ES	ES	ES	ES	ES	ES	ES	ES
	Client Sample ID.:				1	2	1	2	1	1	1	2
	Sample Location:				WS01	WS01	WS02	WS02	WS03	WS04	WS05	WS05
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.30	1.40	0.60	1.60	0.50	0.70	0.80	1.20
	Date Sampled:				17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD								
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	7.2	8.1	3.1	16	8.3	22	16	16
pH	U	2010		4.0	8.4	7.8	8.2	8.2	8.2	8.3	10.1	8.4
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	1.0	< 0.40	0.40	0.48	0.52	0.44	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	0.011	0.089	0.046	0.067	< 0.010
Sulphur (Elemental)	U	2180	mg/kg	1.0	9.5	15	47	23	93	54	200	14
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	2.4	6.3	100	7.0	37	4.9	55	2.6
Arsenic	U	2455	mg/kg	0.5	8.9	2.2	7.6	31	6.2	16	48	16
Cadmium	U	2455	mg/kg	0.10	2.5	0.19	2.8	5.7	0.52	7.8	12	8.1
Chromium	U	2455	mg/kg	0.5	6.9	6.3	23	7.6	15	7.7	16	13
Copper	U	2455	mg/kg	0.50	22	35	22	220	22	58	270	50
Mercury	U	2455	mg/kg	0.05	0.05	< 0.05	0.06	0.12	< 0.05	0.18	0.23	0.12
Nickel	U	2455	mg/kg	0.50	22	15	7.1	20	7.2	16	27	33
Lead	U	2455	mg/kg	0.50	140	39	330	1600	95	600	2400	150
Selenium	U	2455	mg/kg	0.25	0.58	1.5	1.8	1.1	1.9	0.78	1.5	1.2
Zinc	U	2455	mg/kg	0.50	600	57	930	4800	210	13000	1400	2800
Chromium (Trivalent)	N	2490	mg/kg	1.0	6.9	6.3	23	7.6	15	7.7	16	13
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	12	22	40	14	28	10	29	39
Aliphatic TPH >C5-C6	N	2680	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Aliphatic TPH >C6-C8	N	2680	mg/kg	0.010	< 0.010	< 0.010	12	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Aliphatic TPH >C8-C10	N	2680	mg/kg	0.10	< 0.10	< 0.10	9.2	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	2680	mg/kg	0.10	< 0.10	< 0.10	12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	2680	mg/kg	0.10	< 0.10	< 0.10	32	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	2680	mg/kg	0.10	< 0.10	< 0.10	34	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	2680	mg/kg	0.10	< 0.10	< 0.10	16	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	N	2680	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	2680	mg/kg	1.0	< 1.0	< 1.0	120	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C5-C7	N	2680	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Aromatic TPH >C7-C8	N	2680	mg/kg	0.010	< 0.010	< 0.010	7.5	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Aromatic TPH >C8-C10	N	2680	mg/kg	0.10	< 0.10	< 0.10	11	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	2680	mg/kg	0.10	< 0.10	< 0.10	5.3	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	2680	mg/kg	0.10	< 0.10	< 0.10	48	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	2680	mg/kg	0.10	< 0.10	< 0.10	91	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Soil

Project: 2774 Bonc Wen

Client: Groundsolve Ltd	Chemtest Job No.:				22-31835	22-31835	22-31835	22-31835	22-31835	22-31835	22-31835	22-31835
Quotation No.:	Chemtest Sample ID.:				1491385	1491386	1491387	1491388	1491389	1491390	1491391	1491392
Order No.:	Client Sample Ref.:				ES	ES	ES	ES	ES	ES	ES	ES
	Client Sample ID.:				1	2	1	2	1	1	1	2
	Sample Location:				WS01	WS01	WS02	WS02	WS03	WS04	WS05	WS05
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.30	1.40	0.60	1.60	0.50	0.70	0.80	1.20
	Date Sampled:				17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022	17-Aug-2022
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD								
Aromatic TPH >C21-C35	N	2680	mg/kg	0.10	< 0.10	< 0.10	190	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	N	2680	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Aromatic Hydrocarbons	N	2680	mg/kg	1.0	< 1.0	< 1.0	350	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	2.0	< 2.0	< 2.0	470	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Naphthalene	N	2800	mg/kg	0.010	< 0.010	< 0.010	2.0	< 0.010	< 0.010	0.47	1.6	0.51
Acenaphthylene	N	2800	mg/kg	0.010	< 0.010	< 0.010	0.24	< 0.010	< 0.010	0.22	0.21	0.085
Acenaphthene	N	2800	mg/kg	0.010	< 0.010	< 0.010	0.62	< 0.010	< 0.010	0.15	0.27	0.16
Fluorene	N	2800	mg/kg	0.010	< 0.010	< 0.010	0.61	< 0.010	< 0.010	0.18	0.36	0.16
Phenanthrene	N	2800	mg/kg	0.010	< 0.010	1.0	7.9	1.0	1.3	1.0	3.1	2.0
Anthracene	N	2800	mg/kg	0.010	< 0.010	0.29	3.0	0.43	0.28	0.31	0.71	0.43
Fluoranthene	N	2800	mg/kg	0.010	0.37	1.9	13	1.2	1.7	2.4	4.0	3.1
Pyrene	N	2800	mg/kg	0.010	0.29	1.6	10	1.1	1.7	2.1	3.7	2.6
Benzo[a]anthracene	N	2800	mg/kg	0.010	< 0.010	0.83	6.0	0.77	1.2	1.6	1.7	1.3
Chrysene	N	2800	mg/kg	0.010	< 0.010	0.85	5.9	0.70	0.94	1.4	2.0	1.1
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	< 0.010	1.1	7.1	0.95	1.5	1.4	2.2	1.3
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	< 0.010	0.46	2.7	0.30	0.60	0.55	0.81	0.46
Benzo[a]pyrene	N	2800	mg/kg	0.010	< 0.010	0.88	6.5	0.73	1.6	1.5	1.8	1.2
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	< 0.010	< 0.010	3.8	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	< 0.010	< 0.010	0.81	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	< 0.010	< 0.010	3.7	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total Of 16 PAH's	N	2800	mg/kg	0.20	0.66	8.9	74	7.2	11	13	22	14
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Soil

Project: 2774 Bonc Wen

Client: Groundsolve Ltd	Chemtest Job No.:		22-31835		
Quotation No.:	Chemtest Sample ID.:		1491393		
Order No.:	Client Sample Ref.:		ES		
	Client Sample ID.:		1		
	Sample Location:		HDP01		
	Sample Type:		SOIL		
	Top Depth (m):		0.20		
	Date Sampled:		17-Aug-2022		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	12
pH	U	2010		4.0	7.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.55
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010
Sulphur (Elemental)	U	2180	mg/kg	1.0	21
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	1.0
Arsenic	U	2455	mg/kg	0.5	18
Cadmium	U	2455	mg/kg	0.10	6.0
Chromium	U	2455	mg/kg	0.5	14
Copper	U	2455	mg/kg	0.50	73
Mercury	U	2455	mg/kg	0.05	0.11
Nickel	U	2455	mg/kg	0.50	23
Lead	U	2455	mg/kg	0.50	690
Selenium	U	2455	mg/kg	0.25	1.4
Zinc	U	2455	mg/kg	0.50	1300
Chromium (Trivalent)	N	2490	mg/kg	1.0	14
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Organic Matter	U	2625	%	0.40	24
Aliphatic TPH >C5-C6	N	2680	mg/kg	0.010	< 0.010
Aliphatic TPH >C6-C8	N	2680	mg/kg	0.010	< 0.010
Aliphatic TPH >C8-C10	N	2680	mg/kg	0.10	< 0.10
Aliphatic TPH >C10-C12	N	2680	mg/kg	0.10	< 0.10
Aliphatic TPH >C12-C16	N	2680	mg/kg	0.10	< 0.10
Aliphatic TPH >C16-C21	N	2680	mg/kg	0.10	< 0.10
Aliphatic TPH >C21-C35	N	2680	mg/kg	0.10	< 0.10
Aliphatic TPH >C35-C44	N	2680	mg/kg	0.10	< 0.10
Total Aliphatic Hydrocarbons	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C5-C7	N	2680	mg/kg	0.010	< 0.010
Aromatic TPH >C7-C8	N	2680	mg/kg	0.010	< 0.010
Aromatic TPH >C8-C10	N	2680	mg/kg	0.10	< 0.10
Aromatic TPH >C10-C12	N	2680	mg/kg	0.10	< 0.10
Aromatic TPH >C12-C16	N	2680	mg/kg	0.10	< 0.10
Aromatic TPH >C16-C21	N	2680	mg/kg	0.10	< 0.10

Results - Soil

Project: 2774 Bonc Wen

Client: Groundsolve Ltd	Chemtest Job No.:		22-31835		
Quotation No.:	Chemtest Sample ID.:		1491393		
Order No.:	Client Sample Ref.:		ES		
	Client Sample ID.:		1		
	Sample Location:		HDP01		
	Sample Type:		SOIL		
	Top Depth (m):		0.20		
	Date Sampled:		17-Aug-2022		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
Aromatic TPH >C21-C35	N	2680	mg/kg	0.10	< 0.10
Aromatic TPH >C35-C44	N	2680	mg/kg	0.10	< 0.10
Total Aromatic Hydrocarbons	N	2680	mg/kg	1.0	< 1.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	2.0	< 2.0
Naphthalene	N	2800	mg/kg	0.010	< 0.010
Acenaphthylene	N	2800	mg/kg	0.010	< 0.010
Acenaphthene	N	2800	mg/kg	0.010	< 0.010
Fluorene	N	2800	mg/kg	0.010	< 0.010
Phenanthrene	N	2800	mg/kg	0.010	1.0
Anthracene	N	2800	mg/kg	0.010	0.25
Fluoranthene	N	2800	mg/kg	0.010	2.1
Pyrene	N	2800	mg/kg	0.010	1.9
Benzo[a]anthracene	N	2800	mg/kg	0.010	1.2
Chrysene	N	2800	mg/kg	0.010	1.0
Benzo[b]fluoranthene	N	2800	mg/kg	0.010	1.3
Benzo[k]fluoranthene	N	2800	mg/kg	0.010	0.52
Benzo[a]pyrene	N	2800	mg/kg	0.010	1.3
Indeno(1,2,3-c,d)Pyrene	N	2800	mg/kg	0.010	< 0.010
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.010	< 0.010
Benzo[g,h,i]perylene	N	2800	mg/kg	0.010	< 0.010
Total Of 16 PAH's	N	2800	mg/kg	0.20	11
Total Phenols	U	2920	mg/kg	0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N-dimethyl-p-phenylenediamine.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

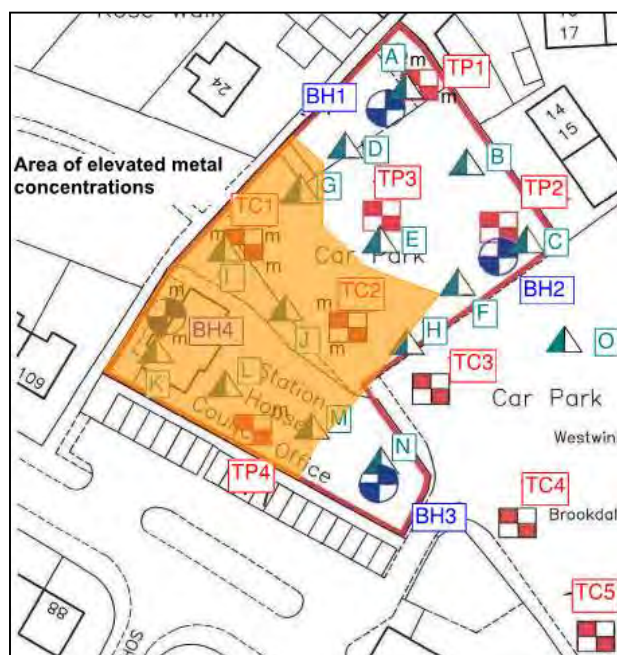
Contaminants

The results of the sample chemical testing have provided detailed information on the concentration levels of chemicals present in the soils of the site. Comparison with the SIRIUS GAC has revealed that the trigger levels for residential use have been exceeded in the following:

Chemical	SGV	Location	Depth (m)	Measured	Measured / SGV
Metals					
Arsenic	30 mg/kg	TP 04	1.75	79	2.46
Cadmium	10 mg/kg	TC 02	0.9	18	1.80
		TC 01	1.3	19	1.90
Lead	450 mg/kg	TP 01	0.5	550	1.22
Zinc	450 mg/kg	TC 02	0.9	1200	2.7
		TC 01	1.3	1100	2.4
		TP 01	0.5	980	2.1
		BH4	1.0	1400	3.1
		BH4	3.0	1000	2.2
		TC 01	0.6	860	1.9
Inorganics					
pH	4 - 8	TC 02	0.9	8.6	1.1
		BH2	1.0	8.1	1.0
		BH3	0.5	11.5	1.4
		BH3	2.0	11.8	1.5
		BH3	3.0	11.2	1.4
		BH4	0.2	10.8	1.4
		BH4	0.5	9.0	1.1
		BH4	1.0	10.0	1.3
		BH4	2.0	9.6	1.2
		BH1	1.0	8.3	1.0
		BH1	2.0	10.3	1.3
		TC 02	0.6	9.5	1.2

PAH's					
Benzo(a)anthracene	3.3 mg/kg	BH3	0.5	4.3	1.3
		TC 02	0.6	7.7	2.3
Benzo(a)pyrene	0.83 mg/kg	BH3	0.5	4.6	5.5
		BH4	0.2	1.7	2.0
		TC 01	0.6	2.1	2.5
		TC 02	0.6	6.7	8.1
Chrysene	6.1 mg/kg	TC 02	0.6	7.7	1.3
VOC's					
Benzene	0.054 mg/kg	TP 04	1.75	0.11	2.0
1,3,5-trimethylbenzene	0.16 mg/kg	TP 04	1.75	6.4	38.1
1,2,4-trimethylbenzene	0.16 mg/kg	TP 04	0.3	0.48	3.0
		TP 04	1.0	0.17	1.1
		TP 04	1.75	12	75

The potential areas associated with the above elevated concentrations are plotted below. The boundaries have been derived by extending the area of contamination midway to a sample point that is below the SGV level.



Area of elevated metal concentrations

APPENDIX D – SUMMARY OF CHEMICAL TEST RESULTS

Residential with gardens (6% SOM)

Metals & Non-Metals	WS01	WS01	WS02	WS02	WS03	WS04	WS05	WS05	HDP01	TP1	TC2	TP03	TP04	BH1	BH1	BH2	BH3	BH3	BH4	BH4	BH4	BH4	BH4							
	0.3	1.40	0.60	1.60	0.50	0.70	0.80	1.20	0.20	0.5	0.9	1.3	1.75	1	2	1	2	3	0.2	0.5	1	2	3	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
Arsenic	8.9	2.2	7.6	31	6.2	16	48	16	18	-	-	-	79	-	-	-	-	-	-	-	-	-	-	2.2	79	23.29	10	37	C4SL	2
Boron, water soluble	< 0.40	1	< 0.40	0.4	0.48	0.52	0.44	< 0.40	0.55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.40	1	0.51	9	290	S4UL	0
Cadmium	2.5	0.19	2.8	5.7	0.52	7.8	12	8.1	6	19	18	-	-	-	-	-	-	-	-	-	-	-	-	0.19	19	7.51	11	22	C4SL	0
Chromium III	6.9	6.3	23	7.6	15	7.7	16	13	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.3	23	12.17	9	910	S4UL	0
Chromium, Hexavalent	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.50	<0.5	0.5	9	21	C4SL	0
Copper	22	35	22	220	22	58	270	50	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	270	85.78	9	2400	S4UL	0
Lead	140	39	330	1600	95	600	2400	150	690	550	-	-	-	-	-	-	-	-	-	-	-	-	-	39	2400	659.4	10	200	C4SL	6
Mercury	0.05	< 0.05	0.06	0.12	< 0.05	0.18	0.23	0.12	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.05	0.23	0.11	9	1.2	S4UL	0
Nickel	22	15	7.1	20	7.2	16	27	33	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.1	33	18.92	9	130	S4UL	0
Phenol - Monohydric	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	<0.1	0.1	9	380	S4UL	0
Selenium	0.58	1.5	1.8	1.1	1.9	0.78	1.5	1.2	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.58	1.9	1.31	9	250	S4UL	0
Zinc	600	57	930	4800	210	13000	1400	2800	1300	980	1200	-	-	-	-	-	-	-	-	-	-	-	57	13000	2282.85	13	3700	S4UL	2	

Petroleum Hydrocarbons	WS01	WS01	WS02	WS02	WS03	WS04	WS05	WS05	HDP01	TP1	TC2	TP03	TP04	BH1	BH1	BH2	BH3	BH3	BH4	BH4	BH4	BH4	BH4	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
	0.3	1.40	0.60	1.60	0.50	0.70	0.80	1.20	0.20	0.5	0.9	1.3	1.75	1	2	1	2	3	0.2	0.5	1	2	3							
Benzene	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	-	-	-	-	-	-	-	-	0.11	0.11	1	0.87	C4SL	0
Aliphatic C5-C6	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	<0.01	0.01	9	160	S4UL	0
Aliphatic C6-C8	< 0.010	< 0.010	12	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	12	1.34	9	530	S4UL	0
Aliphatic C8-C10	< 0.10	< 0.10	9.2	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	9.2	1.11	9	150	S4UL	0
Aliphatic >EC10-EC12	< 0.10	< 0.10	12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	12	1.42	9	760	S4UL	0
Aliphatic >EC12-EC16	< 0.10	< 0.10	32	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	32	3.64	9	4300	S4UL	0
Aliphatic >EC16-EC35	< 0.10	< 0.10	50	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	50	5.64	9	110000	S4UL	0
Aliphatic >EC35-EC40	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	<0.1	0.1	9	110000	S4UL	0
Aromatic C5-C7	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	<0.01	0.01	9	300	S4UL	0
Aromatic C7-C8	< 0.010	< 0.010	7.5	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	7.5	0.84	9	660	S4UL	0
Aromatic C8-C10	< 0.10	< 0.10	11	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	11	1.31	9	190	S4UL	0
Aromatic >EC10-EC12	< 0.10	< 0.10	5.3	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	5.3	0.68	9	380	S4UL	0
Aromatic >EC12-EC16	< 0.10	< 0.10	48	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	48	5.42	9	660	S4UL	0
Aromatic >EC16-EC21	< 0.10	< 0.10	91	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	91	10.2	9	930	S4UL	0
Aromatic >EC21-EC35	< 0.10	< 0.10	190	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	190	21.2	9	1700	S4UL	0
Aromatic >EC35-EC40	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.10	<0.1	0.1	9	1700	S4UL	0

Polyaromatic Hydrocarbons (PAH)	WS01	WS01	WS02	WS02	WS03	WS04	WS05	WS05	HDP01	TP1	TC2	TP03	TP04	BH1	BH1	BH2	BH3	BH3	BH4	BH4	BH4	BH4	BH4	Min (mg/kg)	Max (mg/kg)	Average (mg/kg)	Count	Adopted Guideline (mg/kg)	Source	Exceedances
	0.3	1.40	0.60	1.60	0.50	0.70	0.80	1.20	0.20	0.5	0.9	1.3	1.75	1	2	1	2	3	0.2	0.5	1	2	3							
Acenaphthene	< 0.010	< 0.010	0.62	< 0.010	< 0.010	0.15	0.27	0.16	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	0.62	0.14	9	1100	S4UL	0
Acenaphthylene	< 0.010	< 0.010	0.24	< 0.010	< 0.010	0.22	0.21	0.085	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	0.24	0.09	9	920	S4UL	0
Anthracene	< 0.010	0.29	3	0.43	0.28	0.31	0.71	0.43	0.25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	3	0.63	9	11000	S4UL	0
Benzo(a)anthracene	< 0.010	0.83	6	0.77	1.2	1.6	1.7	1.3	1.2	-	-	-	-	-	-	4.6	-	-	1.7	-	-	-	-	< 0.010	6	1.9	11	13	S4UL	0
Benzo(a)pyrene	< 0.010	0.88	6.5	0.73	1.6	1.5	1.8	1.2	1.3	2.1	6.7	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	6.7	2.21	11	5	C4SL	2
Benzo(b)fluoranthene	< 0.010	1.1	7.1	0.95	1.5	1.4	2.2	1.3	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	7.1	1.87	9	3.7	S4UL	1
Benzo(g,h,i)perylene	< 0.010	< 0.010	3.7	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	3.7	0.42	9	350	S4UL	0
Benzo(k)fluoranthene	< 0.010	0.46	2.7	0.3	0.6	0.55	0.81	0.46	0.52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2.7	0.71	9	100	S4UL	0
Chrysene	< 0.010	0.85	5.9	0.7	0.94	1.4	2	1.1	1	-	7.7	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	7.7	2.16	10	27	S4UL	0
Dibenzo(a,h)anthracene	< 0.010	< 0.010	0.81	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	0.81	0.1	9	0.3	S4UL	1
Fluoranthene	0.37	1.9	13	1.2	1.7	2.4	4	3.1	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.37	13	3.31	9	890	S4UL	0
Fluorene	< 0.010	< 0.010	0.61	< 0.010	< 0.010	0.18	0.36	0.16	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	0.61	0.15	9	860	S4UL	0
Indeno(1,2,3-c,d)pyrene	< 0.010	< 0.010	3.8	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	3.8	0.43	9	41	S4UL	0
Naphthalene	< 0.010	< 0.010	2	< 0.010	< 0.010	0.47	1.6	0.51	< 0.010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	2	0.51	9	13	S4UL	0
Phenanthrene	< 0.010	1	7.9	1	1.3	1	3.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	< 0.010	7.9	2.03	9	440	S4UL	0
Pyrene	0.29	1.6	10	1.1	1.7	2.1	3.7	2.6	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.29	10	2.78	9	2000	S4UL	0

	WS01	WS01	WS02	WS02	WS03	WS04	WS05	WS05	HDP01	TP1	TC2	TP03	TP04	BH1	BH1	BH2	BH3
--	------	------	------	------	------	------	------	------	-------	-----	-----	------	------	-----	-----	-----	-----