



Hoyle Ing, Linthwaite

Phase 2 Geo-Environmental Investigation

For: Redwaters Yorkshire Ltd

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CONTENTS

1.0 INTRODUCTION

- 1.1 Brief
- 1.2 Third Parties

2.0 SCOPE OF INVESTIGATION WORK

- 2.1 Dynamic Sampling Boreholes
- 2.2 Foundation Inspection Pits
- 2.3 Site Testing and Sampling
- 2.4 Laboratory Testing

3.0 FINDINGS

- 3.1 Ground Conditions
- 3.2 Visual and Olfactory Contamination Findings
- 3.3 Water Strikes
- 3.4 Geotechnical Site Testing
- 3.5 Geotechnical Laboratory Testing
- 3.6 Environmental Laboratory Test Results
- 3.7 Ground Gas Monitoring Results
- 3.8 Groundwater Depth Monitoring Results
- 3.9 Foundation Inspection Pits

4.0 ENVIRONMENTAL CONCLUSIONS

- 4.1 Assessment of Environmental Results
- 4.2 Revised Conceptual Models
- 4.3 Outline Remedial Strategy

5.0 GEOTECHNICAL CONCLUSIONS

- 5.1 Geotechnical Assessment of Ground Conditions
- 5.2 Groundwater
- 5.3 Foundations
- 5.4 Floor Slabs
- 5.5 Earthworks and External Areas

6.0 RECOMMENDATIONS

APPENDICES

APPENDIX 1	LIMITATIONS OF INVESTIGATION WORK AND REPORT
APPENDIX 2	FIGURES AND DRAWINGS - SI-01 Site Location Plan - SI-05 Exploratory Hole Location Plan - SI-06 Updated Conceptual Site Model Diagram - Proposed Development plan
APPENDIX 3	DYNAMIC SAMPLE LOGS AND PHOTOGRAPHS
APPENDIX 4	FOUNDATION INSPECTION PIT LOGS AND PHOTOGRAPHS
APPENDIX 5	GEOTECHNICAL LABORATORY TEST RESULTS
APPENDIX 6	CHEMICAL LABORATORY TEST RESULTS AND SCREENING TABLES
APPENDIX 7	GROUND GAS AND GROUNDWATER DEPTH MONITORING VISITS

1.0 INTRODUCTION

This Phase 2 Geo-Environmental Investigation Report has been prepared at the request of Redwaters Yorkshire Ltd. Instructions to proceed were received in April 2023.

This report pertains to a c. 0.04 Ha site off Hoyle Ing, Linthwaite, located 5.15 km southwest of Huddersfield Town Centre, at the approximate postcode HD7 5RX. The National Ordnance Survey Grid Reference for the centre of the site is 409826E, 414453N.

The site currently comprises a small disused car park which is bound by Hoyle Ing along the northeastern boundary, residential properties to the southeast and established trees along the southwest and northwest boundaries. An aerial photo of the site is included below:



Figure 1: Aerial image of the site dated May 2021.

This Phase 2 Geo-Environmental Investigation Report is to be used for submission to the Local Authority as part of a planning application. It is the Client's intention to develop the site into a pair of semi-detached houses with associated access road, private gardens and areas of soft landscaping.

A proposed development plan is contained in Appendix 2, an extract is included below:

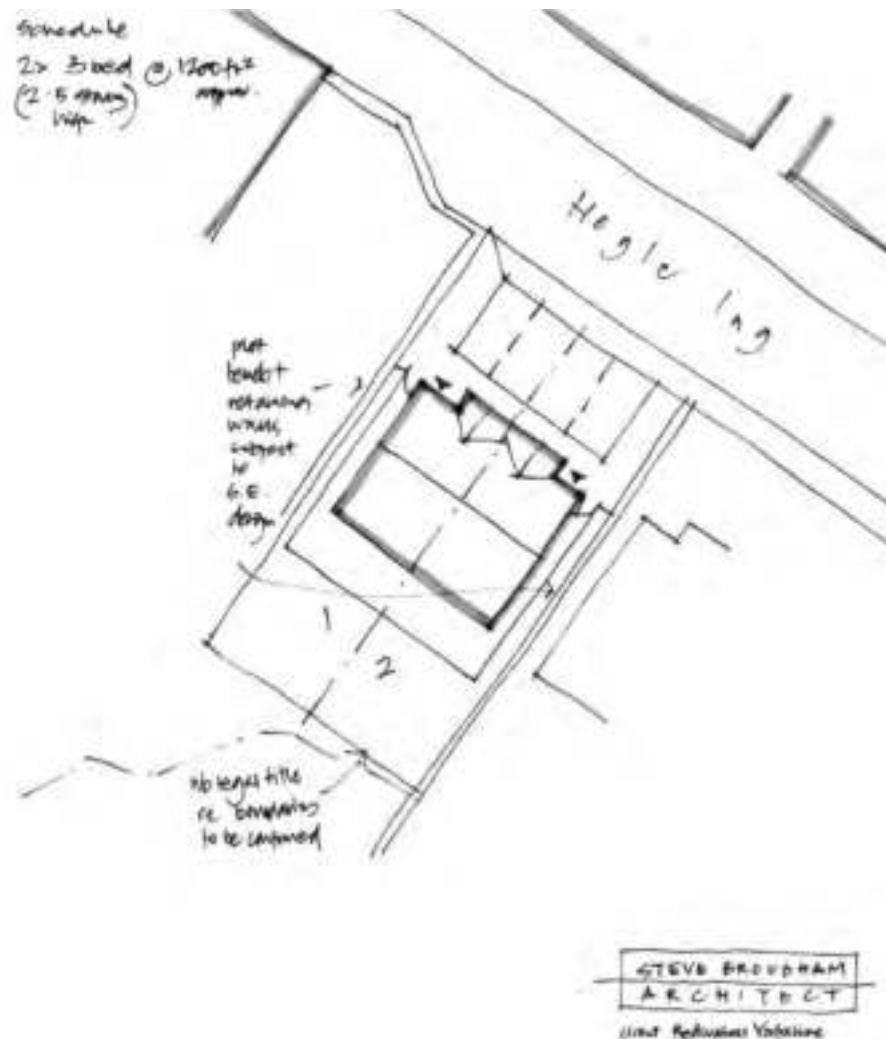


Figure 2: Extract of the proposed development plan

1.1 Brief

The brief was to carry out an intrusive geo-environmental ground investigation for the site based upon the findings of the *IGE Consulting Phase 1 Geo-Environmental Report (3836a-01, dated March 2023)*, the *IGE Consulting Proposed Scope of Ground Investigation (3836/01A/AJ, dated June 2023)* and the proposed

development outlined in Section 1.0. The investigation was to include the following tasks:

- a) Undertake / install appropriate exploratory holes and collect representative samples from exploratory holes and arrange appropriate chemical testing in accordance with the latest legal framework, record olfactory and / or visual evidence of contamination during intrusive works and undertake on site in-situ and laboratory geotechnical testing;
- b) Formulate conceptual models to accommodate the findings of the ground investigation works in terms of the risk to human health, ground gas, controlled waters and the wider environment;
- c) Undertake ground gas and groundwater depth monitoring to determine the ground gas regime with a minimum of 12 No. visits over 6 months.
- d) Identify the risks and evaluate whether a Phase 3 numerical risk assessment and / or a Remedial Strategy, is required.
- e) Undertake an assessment of the ground conditions to provide outline recommendations for the proposed foundations.

A report was to be provided to summarise the findings and recommendations.

1.2 Third Parties

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2.0 SCOPE OF INVESTIGATION WORK

This Phase 2 Geo-Environmental Investigation has been designed based on the findings of the *IGE Consulting Phase 1 Geo-Environmental Report (3836-01A dated March 2023)*, the *IGE Consulting Proposed Scope of Ground Investigation (3836/01A/AJ, dated June 2023)* and the Client's requirements in relation to the proposed development outlined in Section 1.0.

It should be noted that a general scope of works was agreed with the Local Authority following submission of a proposed scope of works letter report (*Ref: 3836/01/AJ dated May 2023*) and a subsequent meeting with the Senior Technical Officer (Natalie Heaney) on 2nd June 2023. Further details regarding the scope of works were discussed during the meeting and verbally agreed, with a revised scope of works letter report (*3826-01/AJ/A*) with additional details submitted to the Local Authority following the meeting.

The ground investigation works were undertaken on 7th June 2023 and comprised 4 No. dynamic sampling boreholes and 2 No. retaining wall foundation inspection pits. Subsequent laboratory testing was undertaken between 7th June and 19th July 2023.

Drilling of dynamic sampling boreholes was carried out by Pearson Drilling Ltd. Testing of soil samples for environmental purposes was carried out by Elab (TPH-CWG was sub-contracted to ALS) and testing of soils for geotechnical laboratory testing was undertaken by Murray Rix Ltd in accordance with the Environment Agency's MCERTS (Monitoring Certification) quality assurance accreditation scheme. These organisations were appointed directly by IGE Consulting to carry out these contracting works.

The locations of the exploratory holes were topographically surveyed (X-Y-Z axis) with an accuracy of 20mm.

The ground investigation was undertaken in general accordance with:

- BS 5930 (2015) + A1 (2020) Code of Practice for Ground Investigation;
- BS EN ISO 17892 Geotechnical investigation and testing - Laboratory testing of soil;

- BS 10175 (2011) Investigation of Potentially Contaminated Sites – Code of Practice; and
- BS EN 1997-2 (2007) Eurocode 7 – Geotechnical Design – Ground Investigation and Testing.

The environmental sampling strategy for the site has been completed in accordance with CLR4 and the design of the investigation was carried out in accordance with R&D Technical Report P 5-TR066, LCRM (2020) and BS:8485 (2015) + A1 (2019). Further details pertaining to the ground investigation works are outlined in the following sections.

The limitations of the investigation work and report are included in Appendix 1.

An extract of the exploratory hole location plan is included below for reference. The exploratory hole location plan is contained in Appendix 2.



Figure 3: Extract of the exploratory hole location plan (Ref: SI-05)

2.1 Dynamic Sampling Boreholes

In total, 4 No. dynamic sampling boreholes (DS01 to DS04, inclusive) were constructed spatially across the site to depths of between 3.50m and 5.35m bgl (138.85m and 143.00m AOD).

The dynamic sample boreholes were undertaken in order to achieve the following:

- to establish the thickness, extent and characteristics of Made Ground and underlying natural superficial deposits;
- to undertake in-situ geotechnical testing within these deposits;
- to obtain samples from these deposits for classification and laboratory testing;
- to allow for the installation of ground gas and groundwater monitoring wells.

Details of the ground gas monitoring wells installed are included in Section 3.7.

The locations of the dynamic sampling boreholes are shown on the exploratory hole location plan in Appendix 2 and the dynamic sampling borehole logs are contained in Appendix 3.

2.2 Foundation Inspection Pits

2 No. foundation inspection pits (FIP01 - FIP02, inclusive) were undertaken along the eastern boundary of the site where an existing retaining wall is present in order to determine the nature of the retaining wall foundations. The foundation inspection pits were undertaken to depths of 0.40m (144.97m AOD) and 0.30m (144.96m AOD) respectively and were terminated beneath the base of the foundations.

Foundation inspection pits were not undertaken for the retaining wall along the western boundary as the base of the retaining wall is off-site.

The locations of the foundation inspection pits are shown on the exploratory hole location plan in Appendix 2 and the dynamic sampling borehole logs are contained in Appendix 4.

2.3 Site Testing and Sampling

The following site tests and sampling were carried out:

- a) Retrieval of environmental samples and bulk disturbed samples from dynamic sampling sleeves for the purposes of chemical and geotechnical laboratory testing and classification.
- b) Where possible, in-situ and ex-situ shear strength testing was undertaken within fine grained material (clay) from the dynamic sampling borehole sleeve samples using a 19mm hand shear vane in accordance with BS1377-9.
- c) Standard Penetration Tests (SPTs) were undertaken at regular 1.00m intervals between 1.20m and 5.00m bgl within the dynamic sampling boreholes.
- d) During the construction of the dynamic sample boreholes, a Tiger LT photo-ionisation detector (PID) with a 10.6eV lamp was used to determine the presence of volatile organic compounds

Sampling

Samples of the Made Ground and underlying natural deposits and groundwater were obtained for chemical laboratory testing to determine the risk to human health and controlled waters. Environmental samples were collected from each of the dynamic sample boreholes at each change of strata and every 0.50m for chemical testing. Targeted samples were also obtained where any visual and / or olfactory evidence of contamination was encountered. This was undertaken to ensure appropriate samples were collected to determine the risk to human health and controlled waters.

In order to prevent cross-contamination, disposable gloves were utilised and the gloves changed between each sample, particularly where any visual and / or olfactory evidence of contamination was noted. These samples were placed into sterile sealed containers to facilitate MCERTS chemical laboratory testing of potential contaminants. Amber glass jars (250g and 60g) were utilised to obtain samples to test for metals, PAHs, TPH, inorganics and VOCs, ensuring there was no headspace within the 60g jar utilised for VOC testing. 500 - 1000g plastic tubs were utilised for asbestos identification and quantification. The chemical testing suite is detailed in Section 2.4.1 below.

The sealed containers were placed into cool boxes and collected by the laboratory

on the same day following completion of the exploratory holes in order to preserve the samples. It should be noted that chemical testing was not undertaken on every environmental sample collected, the number of samples and determinands to be tested was dependent on the ground conditions, visual and olfactory evidence of contamination and based on the conceptual site model.

Where groundwater was encountered, groundwater samples were collected during construction of the exploratory hole and sent for chemical laboratory testing. Groundwater samples were collected using a bailing method and placed into sterile sealed containers within cool boxes and collected by the laboratory as soon as possible on the day of sample collection. The groundwater samples were collected during construction of the exploratory holes to allow the ground gas monitoring wells to be installed above the groundwater level in order to obtain suitable ground gas monitoring results. No drilling fluid or drilling oil was utilised during the ground investigation work in order to prevent cross contamination. The chemical testing suite for groundwater samples is detailed in Section 2.4.1 below.

Bulk disturbed samples were collected in every strata for geotechnical laboratory testing.

In the proposed scope of works it was stated that where elevated concentrations of determinands were recorded within the solid samples, leachate testing was to be undertaken. However, following chemical analysis of the solid and groundwater testing, outlined below and discussed in Section 3.6, leachate testing was not deemed necessary as elevated concentrations of determinands were noted within the groundwater samples. Refer to section 3.6 for further discussion on the results.

2.4 Laboratory Testing

2.4.1 Chemical Laboratory Testing

12 No. soil samples were obtained during exploratory hole construction and sent to i2 Analytical laboratories for chemical testing. These samples were placed into sterile sealed containers to facilitate MCERTS chemical laboratory testing of potential contaminants. Chemical testing suites are outlined below and are based upon the contaminative sources identified within the Phase 1 report.

Asbestos ID and quantification if positive, sulfate, pH, nitrate, total and free cyanide, arsenic, barium, cadmium, chromium, chromium (hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc, total petroleum hydrocarbon screen, speciated total petroleum hydrocarbons (TPH-CWG), BTEX and MTBE, speciated Phenols, Speciated Polyaromatic Hydrocarbons and VOCs.

2 No. groundwater samples were obtained from DS01 and DS02. A water strike was recorded in DS03 but a groundwater sample could not be collected due to insufficient water volume. The remainder of the exploratory holes were dry. The samples were obtained using bailers and placed into sterile sealed containers to facilitate MCERTS chemical laboratory testing of potential contaminants. Chemical testing suites are outlined below and were based upon the contaminative sources identified within the Phase 1 report.

Arsenic, barium, beryllium, calcium, cadmium, chromium, copper, mercury, magnesium, nickel, lead, selenium, vanadium, zinc, electrical conductivity, hardness (as CaCO₃), pH, redox potential, speciated Polyaromatic Hydrocarbons, BTEX and MTBE and speciated Total Petroleum Hydrocarbons.

VOCs were not included within the groundwater testing suite given the very low PID results recorded during the ground investigation.

2.4.2 Geotechnical Laboratory Testing

The following geotechnical laboratory tests were carried out on selected samples obtained from across the site:

- a) Determination of moisture content in accordance with BS EN ISO 17892-1:2014.
- b) Determination of liquid limit and plastic limit in accordance with BS EN ISO 17892-12:2018+A1:2021 Clause 5.3 and 5.5.
- c) BRE Special Digest suite for aggressive ground conditions.

3.0 FINDINGS

3.1 Ground Conditions

The typical ground conditions encountered across the site are as follows:

- **Made Ground** comprising reddish brown, gravelly, slightly clayey, fine to coarse SAND or brown mottled black, mottled reddish brown, slightly sandy, clayey, angular to subangular, fine to coarse to a depth of between 2.20m and 3.50m bgl (140.70m - 142.80m AOD), underlain by:
- **Made Ground** comprising very soft to soft, grey, mottled black, slightly gravelly, slightly sandy CLAY to a depth of between 3.60m and 4.90m bgl (139.30m - 141.40m AOD), underlain by:
- **Marsden Formation** recovered as light yellowish brown, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL to a depth of between 3.74m and 5.45m bgl (138.75m - 141.26m AOD)

3.1.1 Notable Exceptions

The ground conditions encountered within DS04 were noted to be significantly different to DS01 - DS03. This is anticipated to be as DS04 was located in a relatively undisturbed area of the site (i.e. not in close proximity to the historical reservoir or track). The ground conditions encountered in DS04 are as follows:

- **Topsoil** comprising dark brown, gravelly, slightly clayey, fine to coarse SAND with frequent rootlets to a depth of 0.50m bgl (146.00m AOD), underlain by:
- **Marsden Formation** (weathered mudstone) recovered as soft, becoming firm to stiff, orangish brown, mottled grey, slightly gravelly, sandy CLAY to a depth of 2.50m bgl (144.00m AOD), underlain by:
- **Marsden Formation** (weathered sandstone) recovered as yellowish brown, slightly gravelly, slightly clayey, fine to coarse SAND to a depth of 3.50m bgl (143.00m AOD), underlain by:
- **Marsden Formation** (weathered sandstone) recovered as yellowish brown, mottled orangish brown, sandy, angular to subangular, fine to coarse GRAVEL to a depth of 3.62m bgl (142.88m AOD).

3.2 Visual and Olfactory Contamination Findings

During the intrusive exploratory hole investigation works, the soils were examined carefully for both visual and olfactory evidence of contamination.

During the construction of the dynamic sample boreholes, a Tiger LT photo-ionisation detector (PID) with a 10.6eV lamp was used to determine the presence of volatile organic compounds. Samples for on-site VOC testing utilising the PID were collected at multiple intervals (minimum 0.50m) from each stratum and where visual and / or olfactory evidence of contamination was identified.

The samples were collected as soon as the dynamic sample liner was retrieved, with a small amount of sample placed in sterile, sealed plastic bag. The sample were slightly agitated before a VOC reading was undertaken by inserting the tip of the PID into the bag ensuring direct contact with the sample did not occur to prevent blocking the PID sensor. Information including the result, the on-site activities (drilling), weather conditions (dry, high atmospheric pressure of 1024mbar), the state of the ground (dry) and any visual and / or olfactory evidence of contamination was recorded in-line with BS8576 (2013) Section 10.6.

The following visual and / or olfactory evidence of contamination was encountered during the ground investigation:

- A hydrocarbon odour was noted in Made Ground in DS01 between 1.70m and 3.50m bgl (142.50m - 140.70m AOD). PID readings of between 0.00ppm - 0.30ppm were recorded within the stratum. A sample of this stratum (2.30m bgl) was sent for chemical analysis.
- A hydrocarbon odour was noted in Made Ground in DS02 between 3.00m and 3.45m bgl (142.10 - 141.65m AOD). A PID reading of 0.60ppm was recorded within the stratum. A sample from this stratum could not be analysed due to the very small sample volume obtained from the SPT and lack of recovery from the barrel, however, a sample from the underlying stratum at 4.70m bgl was sent for chemical analysis.

Although not considered visual or olfactory evidence of contamination a humic odour was noted in Made Ground in DS02 between 1.30m and 1.70m bgl (143.80m - 143.40m AOD). PID readings of between 0.00ppm and 0.10ppm were recorded within the stratum.

In total, 52 No. PID readings were undertaken in the 4 No. dynamic sample boreholes. The PID results ranged from 0.00ppm (below detection limit) to 1.00ppm. The majority of the samples recorded VOC concentrations of <0.5ppm, with the exception of the following:

Location	Depth (m bgl)	Depth (m AOD)	Stratum	PID Result (ppm)
DS03	0.2	144.80	Made Ground	0.50
DS02	0.3	144.80	Made Ground	0.60
DS02	3	142.10	Made Ground	0.60
DS02	4.7	140.30	Made Ground	0.70
FIP01	0.2	145.17	Made Ground	0.80
DS03	3.2	141.80	Made Ground	1.00

3.3 Water Strikes

Numerous water strikes were recorded during the ground investigation, they have been summarised in the below table:

Exploratory Hole	Depth (m bgl)	Depth (m AOD)	Stratum	Comments
DS01	1.70	142.50	Made Ground	Groundwater level recorded at 1.70m bgl following the completion of the borehole. Groundwater sample obtained.
DS02	2.20	142.90	Made Ground	Groundwater level recorded at 2.20m bgl during the construction of the borehole. Groundwater sample obtained.
DS03	2.20	142.80	Made Ground	Groundwater level following the completion of the borehole recorded at 3.20m bgl. A groundwater sample was not obtained due to insufficient water volume.

Water strikes are detailed on the dynamic sample borehole hole logs contained in Appendices 3.

3.4 Geotechnical Site Testing

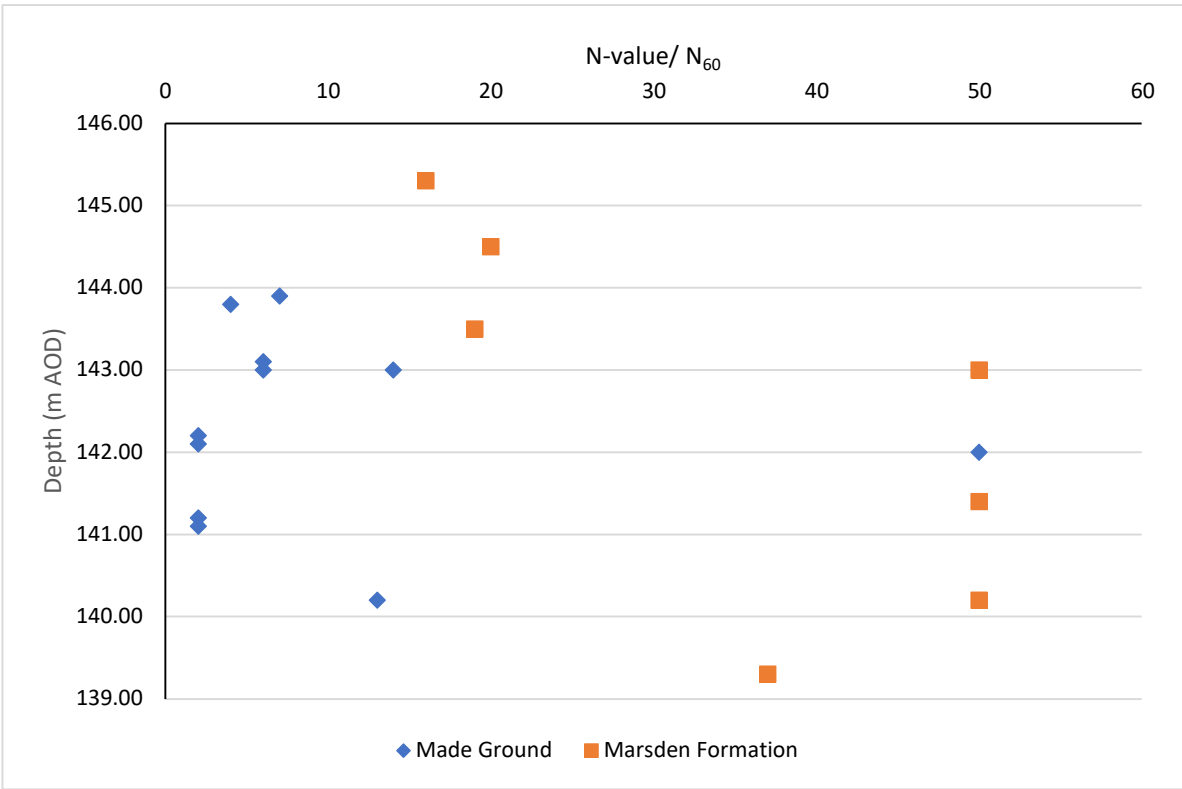
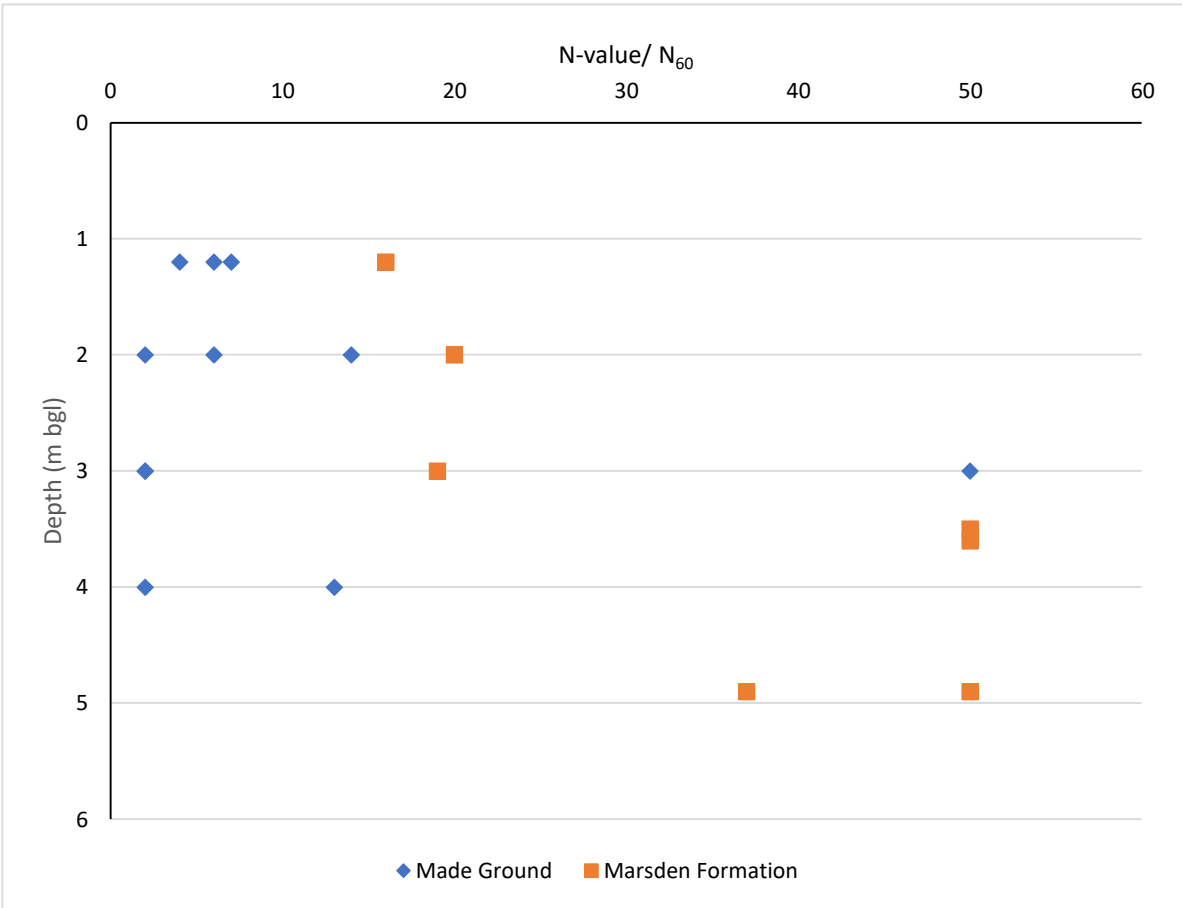
The results of the geotechnical testing undertaken during the ground investigation are summarised below.

3.4.1 Standard Penetration Tests

Standard penetration tests (SPTs) were undertaken at regular 1.00m intervals during the construction of the dynamic sampling boreholes.

The following graph shows that the N-values recorded within the Made Ground and weathered Marsden Formation were highly variable with no significant correlation. The N-values recorded within the Made Ground were generally low, with the exception of an N-value of 50 being recorded in DS03 at 3.00m bgl, anticipated to be due to a cobble.

The N-values in the weathered Marsden formation were generally higher, with each exploratory hole terminating on a refusal (N-value of 50+) within suspected weathered sandstone with the exception of DS01 where an N-value of 37 was recorded at 4.90m bgl.



SPT results are included on the dynamic sample borehole logs presented in Appendix 3.

3.4.2 Hand Shear Vane (19mm) Tests

Where possible, both in-situ and ex-situ undrained shear strength testing was undertaken on samples of fine-grained material (clay) within dynamic sampling boreholes using a 19mm hand shear vane in accordance with BS1377-9. It should be noted that undertaking hand shear vane tests below 2m bgl within dynamic sample boreholes is considered inappropriate; the increased sampling disturbance at depth can produce unrepresentative results.

Due to the depth of cohesive deposits encountered, typically greater than 2m bgl, only 2 No. hand shear vane tests were undertaken. Both were undertaken in DS04 within weathered Marsden Formation at depths of 1.70m and 1.90m bgl and recorded undrained shear strengths of 150kPa and 146kPa respectively.

Hand shear vane test results are included on the dynamic sampling borehole logs, contained within Appendices 3.

3.5 Geotechnical Laboratory Testing

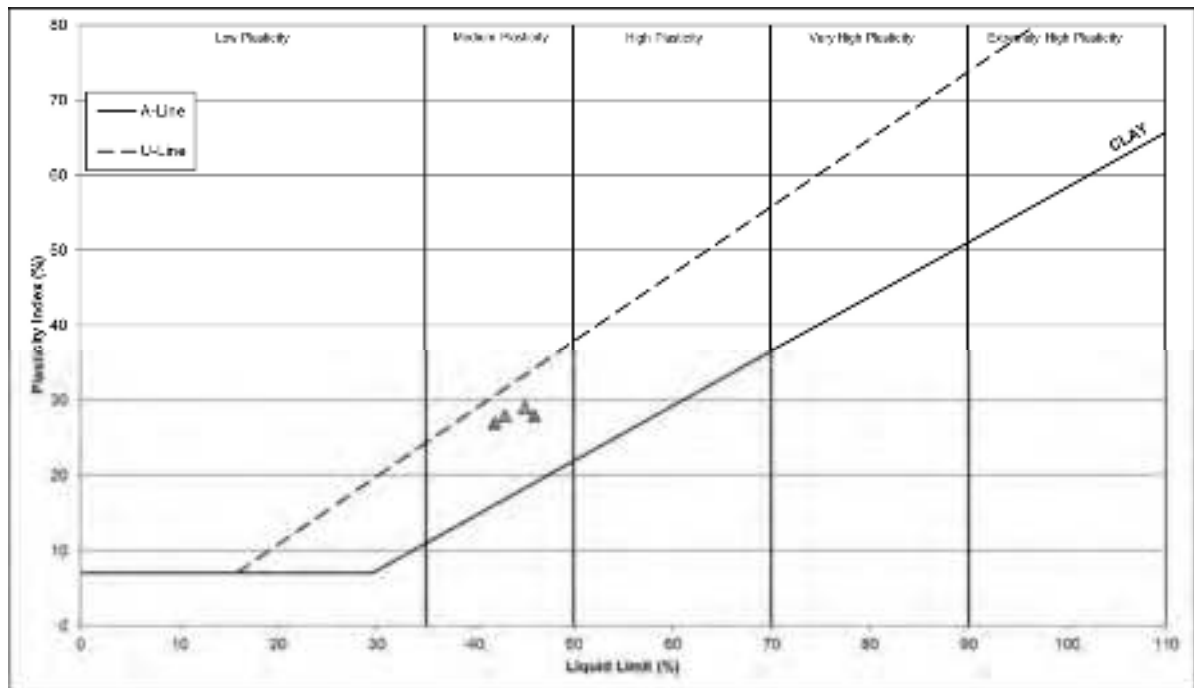
The results of the geotechnical laboratory tests undertaken during the ground investigation are summarised below. The full geotechnical laboratory test results are included in Appendix 5.

3.5.1 Atterberg Limit Tests

Atterberg limit tests were undertaken on 2 No. samples from natural weathered Marsden Formation samples and 2 No. samples of Made Ground. The results of the Atterberg testing are as follows:

Sample	Sample Depth (m bgl)	Strata	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Passing through 425 micron (%)	Modified Plasticity Index
DS03	1.20	Made Ground	29	42	15	27	94	29
DS01	3.50	Made Ground	49.2	46	18	27	90	30
DS04	0.80	Marsden Formation	27.2	45	16	29	88	33
DS04	1.20	Marsden Formation	16.9	43	15	28	82	34

Orange = medium volume change potential.



Orange = Weathered Marsden Formation, Blue = Glacial Till

The Atterberg Limit tests indicate that the Made Ground and cohesive weathered Marsden Formation deposits are generally of medium plasticity in-line with BS14688 Part 2 and medium volume change potential, in-line with NHBC Chapter 4.2 guidance.

3.5.2 BRE Special Digest Suite Testing

In accordance with BRE Special Digest 1: Concrete in Aggressive Ground (2005), the site has been classified as Brownfield with mobile groundwater. BRE SD1 testing suites were undertaken on 7 No. samples of Made Ground and 2 No. samples of weathered Marsden Formation in order to determine the Design Sulfate (DS) levels and the Aggressive Chemical Environment for Concrete (ACEC), with the findings summarised below:

Sample	Depth (m bgl)	Strata	DS Class	ACEC Class
DS01	2.30	Made Ground	DS-4	AC-4
DS02	0.80	Made Ground	DS-2	AC-2
DS03	1.10	Made Ground	DS-2	AC-2
DS02	3.00	Made Ground	DS-4	AC-5

DS01	3.70	Made Ground	DS-4	AC-4
DS02	4.70	Made Ground	DS-1	AC-2z
DS03	2.80	Made Ground	DS-1	AC-1
DS04	0.80	Weathered Marsden Formation	DS-1	AC-3z
DS04	3.30	Weathered Marsden Formation	DS-1	AC-3z

3.6 Environmental Laboratory Test Results

The findings of the chemical test results, summarised below, will be assessed against generic assessment criteria (GAC) for the purposes of screening allowable concentrations in comparison to the measured site concentrations. The GAC are defined based on the critical receptors identified at the site, detailed in the Phase 1 Investigation. Receptors are considered in relation to:

- Human health receptors (e.g. end-users, construction workers and the general public) via measured solid concentrations, and;
- Additional receptors which may be relevant e.g. flora/fauna, water, buried concrete.

The GAC adopted for assessment of soils in relation to Human Health are based on published LQM/CIEH S4ULs (2015) for those compounds for which published criteria are available for varying scenarios (residential, commercial, allotment, public open space). In the absence of LQM/CIEH S4ULs (2015) the following GAC defining documents are adopted - CL:AIRE Soil GAC for Human Health Assessment (2010) and Category 4 Screening Levels (C4SLs) (2014).

The primary risk to human receptors from free cyanide in soils is an acute risk (i.e. a single dose could have a lethal affect as opposed to adverse effects from cumulative intake (chronic affect)). There is no current UK guidance available for calculating acute risks from free cyanide, therefore an in-house methodology has been used to derive an acute GAC of 60 mg/kg for all exposure scenarios. The value is given for Free or Easily Liberatable Cyanide but should be used to assess Total Cyanide in the absence of cyanide speciation. In cases where the Total Cyanide exceeds the GAC then analysis for Free or Easily Liberatable Cyanide should be completed.

GACs / Tier 1s for waters must be selected to assess potential risks to the identified environmental receptors. There are numerous UK and European guidelines for waters based on the site situation and different receptors. GACs utilised include - The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009 (Part 7:Groundwater Threshold Values), UK Drinking Water Standards (2000), Environmental Quality Standards, World Health Organisation concentrations, Environment Agency guidance concentrations and United States Environmental Protection Agency – Region 9 GACs.

Appendix 6 contains the full screening tables for 10 No. samples of Made Ground and 2 No. samples of natural deposits. Any exceedances of GACs are indicated below. All results have been assessed against the relevant GACs for a **residential with home grown produce** scenario based on a measured organic matter content of **2.5%**.

3.6.1 Made Ground

Numerous GAC exceedances including metals, PAHs and TPH fractions were recorded within the Made Ground samples, the majority from DS01. These are detailed in the table below.

	Determinand	Location	Depth (m bgl)	Result (mg/kg)	GAC (mg/kg)
PAH	Naphthalene	DS01	2.30	562	5.60
	Phenanthrene	DS01	2.30	1310	220
	Fluoranthene	DS01	2.30	1090	560
	Benzo(a)anthracene	DS01	2.30	395	14
	Chrysene	DS01	2.30	414	31
	Benzo(b)fluoranthene	DS01	0.30	7.99	4.00
		DS01	2.30	318	
	Benzo(k)fluoranthene	DS01	2.30	137	110
	Benzo(a)pyrene	DS01	0.30	9.4	3.2
		DS01	2.30	347	
	Indeno(1,2,3-cd)pyrene	DS01	2.30	172	46
	Dibenz(a,h)anthracene	DS01	0.30	1.37	0.32

		DS01	2.30	42.7	
Metals	Arsenic	DS01	2.30	81	37
		DS02	1.80	53	
		DS03	1.10	40	
	Lead	DS01	2.30	377	200
		DS01	3.70	466	
		DS02	1.80	298	
		DS03	1.10	358	
	Cadmium	DS01	3.70	2.10	2.10
TPH	Aromatic TPH C12 - C16	DS01	2.30	395	330
	Aromatic TPH C16 - C21	DS01	2.30	1170	540
	Aromatic TPH C21 - C25	DS01	2.30	1520	1500

An asbestos screen was performed on all Made Ground samples. No asbestos was found to be present within any of the samples tested.

BTEX and MTBE were not recorded at concentrations in excess of their respective detection limits in the majority of samples, with the exception of DS01 at 2.30m bgl. The concentrations of BTEX within the DS01 samples were recorded below their respective GACs.

Although no evidence of VOCs was identified during the ground investigation (i.e. PIDs of <1.00ppm), volatile organic compounds were included within the testing schedule for the sample from DS01 at 2.30m bgl due to the visual and olfactory evidence of contamination (considered to be the worst case sample). VOCs were not tested within other samples due to the very low PID readings recorded. The concentrations of all VOCs tested were recorded below their respective detection limits with the exception of 1,3,5-Trimethylbenzene which was recorded at a concentration of 31.7µg/kg. No GAC (S4UL or C4SL) is available for trimethylbenzene.

Total and speciated phenols were included within the testing suite for the DS01 sample at 2.30m bgl (worst case sample). Phenols were not included within the chemical testing for the remaining samples given the lack of sources identified. The concentration of total and speciated Phenols were all recorded below their respective

detection limits with the exception of 2,3,5-trimethylphenol which was recorded at a concentration of 3mg/kg. No GAC (S4UL or C4SL) is available for trimethylphenol, however, the GAC for total Phenol is 200mg/kg which is significantly higher than the concentrations recorded within the sample.

3.6.2 Natural Deposits

No GAC exceedances or elevated concentrations of determinands were recorded within the natural deposits.

3.6.3 Groundwater

2 No. groundwater samples were obtained from DS01 and DS02. It should be noted that VOCs were not included within the groundwater testing suite given the very low PID results recorded during the ground investigation. All determinants assessed against threshold value for drinking water standards were recorded below the threshold values with the exception of arsenic and benzo(a)pyrene (BaP) in both samples.

The threshold values used for arsenic and BaP are the drinking water threshold values; these are considered to be the most comprehensive set of threshold values. However, these threshold values are considered to be highly conservative as the groundwater samples are anticipated to pertain to perched water within the Made Ground / infilled reservoir and the site is not within a drinking water protected area or underlain by a Principal Aquifer. No threshold values for general quality groundwater are available for either determinands.

Elevated TPH concentrations were also recorded in both samples of groundwater.

A screening table for the groundwater and surface water samples is included below:

Determinant	DS01	DS02	Screening Values	Exceedances
Inorganics				
Electrical Conductivity (uS/cm)	585	203	2500 (at 25°C) ⁽³⁾	
Hardness (as CaCO ₃) (mg/l)	293	402	-	-
pH	7.6	7.8	6.5-10 ⁽³⁾	
Redox Potential	274	321	-	-
PAHs				
Naphthalene	63.8	3.53	-	-

Acenaphthylene	15.4	2.50	-	-
Acenaphthene	80.1	10.1	-	-
Fluorene	85.4	9.33	-	-
Phenanthrene	421	99.8	-	-
Anthracene	98.5	22.0	-	-
Fluoranthene	586	209	-	-
Pyrene	503	181	-	-
Benzo (a) anthracene	284	105	-	-
Chrysene	255	105	-	-
Benzo (b) fluoranthene	243	111	-	-
Benzo (k) fluoranthene	190	74.1	-	-
Benzo (a) pyrene	309	123	0.7⁽⁴⁾	2
Indeno (1,2,3-cd) pyrene	131	54.6	-	-
Dibenzo(a,h)anthracene	34.9	15.6	-	-
Benzo(ghi)perylene	157	65.5	-	-
Dissolved Metals				
Arsenic	37.3	23.5	10⁽²⁾	2
Barium	619	323	-	-
Beryllium	< 1	< 1	-	-
Calcium	101000	143000	-	-
Cadmium	< 0.5	< 0.5	5 ⁽²⁾	0
Chromium	< 0.5	< 0.5	50 ⁽²⁾	0
Copper	< 0.5	< 0.5	2000 ⁽²⁾	0
Cobalt	0.6	1.3	-	-
Mercury	< 0.05	< 0.05	1.0 ⁽²⁾	0
Magnesium	10200	11100	-	-
Nickel	0.8	2.3	20 ⁽²⁾	0
Lead	< 0.5	< 0.5	10 ⁽²⁾	0
Selenium	< 1	< 1	10 ⁽³⁾	0
Vanadium	< 0.5	1.0	-	-
Zinc	< 1.2	< 1.2	5000 ⁽⁴⁾	0
BTEX and MTBE				
All Benzene, Toluene, Ethylbenzene, Xylenes and MTBE recorded below their respective detection limits with the exception of the following:				
Xylenes	2.24	-		
TPHCWG				
>C5-C6 Aliphatic	< 1.0	< 1.0	-	-
>C6-C8 Aliphatic	< 1.0	< 1.0	-	-
>C8-C10 Aliphatic	< 5.0	28.3	-	-
>C10-C12 Aliphatic	31.6	171	-	-
>C12-C16 Aliphatic	1850	679	-	-
>C16-C21 Aliphatic	5230	2880	-	-
>C21-C35 Aliphatic	5930	16700	-	-
>C35-C40 Aliphatic	2650	6080	-	-
Total (>C5-C40) Aliphatic	15700	26600	-	-
>C5-C7 Aromatic	< 1.0	< 1.0	-	-
>C7-C8 Aromatic	< 1.0	< 1.0	-	-
>C8-C10 Aromatic	< 5.0	116	-	-
>C10-C12 Aromatic	101	137	-	-
>C12-C16 Aromatic	1970	848	-	-

>C16-C21 Aromatic	3830	3010	-	-
>C21-C35 Aromatic	4870	17500	-	-
>C35-C40 Aromatic	1660	4600	-	-
Total (>C5-C40) Aromatic	12400	26200	-	-
Total (>C5-C40) Ali/Aro	28100	52700	-	-

All units are in ug/l unless otherwise stated.

(1) P20 UK Drinking Water Standards

(2) UK Drinking Water Standards (2016)

(3) Groundwater Threshold Values, part 7 of The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directive 2009

(4) Selected water Quality Standards, Appendix 8 to Environment Agency Environmental Quality Standards; Hydrogeological Risk Assessment for Landfills

(5) Freshwaters priority hazardous substances, priority substances and other pollutants environmental quality standards (EQS)

3.7 Ground Gas Monitoring Results

The following dynamic sampling boreholes were installed with a standpipe to allow for monitoring of ground gas concentrations which may be present:

Exploratory Hole	Response Zone Stratum	Response Zone Depth m bgl (m AOD)	
		Top of Response Zone	Base of Response Zone
DS01	Made Ground comprising reddish brown, mottled dark brown, gravelly, slightly clayey, fine to coarse SAND	0.50 (143.70)	1.50 (142.70)
DS03	Made Ground comprising light brown, mottled orangish brown, gravelly, slightly clayey, fine to coarse SAND.	1.30 (143.70)	2.00 (143.00)
DS04	Weathered Marsden Formation comprising yellowish brown, mottled dark grey, slightly gravelly, clayey, fine to coarse SAND	3.00 (143.50)	3.50 (143.00)

The monitoring wells are constructed of 51mm diameter HDPE plain pipe to the depth of the response zone. The response zones comprise slotted pipe surrounded by a gravel annulus which are sealed above and below with hydrated bentonite seals. The monitoring wells are topped with a flush lockable cover.

The response zones of the ground gas monitoring installations were placed within a single, unsaturated stratum. The response zones of DS01 and DS03 targeted the Made Ground (source) and the response zone of DS04 was within a granular band underlying c. 3m of cohesive deposits, which was deemed to be a potential preferential pathways for ground gas migration from the adjacent landfill in-line with BS8576 (2013) Section 8.4 and 9.2.3. The response zones were kept short (0.50m -

1.00m) with a gas-tight bentonite seal above and below the response zone in-line with BS8576 (2013) Section 8.5.

The ground gas monitoring wells were also placed spatially to target sources. DS04 was placed in the southern site section nearer the off-site landfill and DS01 and DS03 were placed targeting deep Made Ground in-line with BS8576 (2013) Section 8.4. Given the very small size of the site, a low-risk area was not identified on-site to determine background concentrations. An extract of the exploratory hole location plan is included below for reference:



Figure 4: Extract of the exploratory hole location plan (SI-05)

4 No. visits out of a scheduled programme of 12 No. visits have been completed. 12 No. visits are proposed given the high risk associated with the adjacent infilled quarry / landfill and the sensitivity of the proposed development, in-line with in-line with BS8576 (2013) Section 8.7, Figure 6. However, following the initial visits, it is recommended that an initial ground gas risk assessment is undertaken and consultation with the Environmental Health Officer is commenced to determine if all 12 No. visits are required.

The visits have been undertaken on a roughly fortnightly basis, targeting rising, falling and steady atmospheric pressure events, including where atmospheric pressure is below 1000mbar. This will allow the worst-case conditions to be observed as well as all other conditions in order to obtain as much data as possible for a conclusive ground gas risk assessment in-line with BS8576 (2013) Section 8.6.

The results have been summarised below:

Gas Monitoring Well	Steady O ₂ Concentration (%)	Peak CO ₂ Concentration (%)	Peak CH ₄ Concentration (%)	Peak H ₂ S Concentration (ppm)	Atmospheric Pressure (mbar)	Steady Gas Flow (l/hr)
DS01	19.4 - 20.4	0.2 - 0.7	<0.1	<1.0	995 - 1007	<0.1
DS03	19.8 - 20.6	0.4 - 0.7	<0.1	<1.0	994 - 1007	<0.1
DS04	18.9 - 20.6	0.3 - 2.2	<0.1	<1.0	994 - 1007	<0.1

Ground gas monitoring was undertaken utilising a GFM 4300 gas analyser.

Gas Monitoring Well	Steady Volatiles (ppm)	Steady Carbon Monoxide
DS01	<0.1 - 0.2	<0.1
DS03	<0.1 - 0.7	<1.0 - 10
DS04	1.8 - 2.1	<1.0 - 10

The ground gas monitoring results and calibration certificates are included in Appendix 7.

3.8 Groundwater Depth Monitoring Results

The above wells were also installed for the purposes of groundwater depth monitoring. Groundwater monitoring is ongoing, however, after 4 No. visits the following range of results has been recorded:

Groundwater Monitoring Well	Response Zone (m bgl)	Water Level (m bgl)
DS01	0.50 – 1.50	Dry - 1.44
DS03	1.30 - 2.00	Dry - 1.99
DS04	3.00 - 3.50	Dry

The groundwater monitoring results are included with the gas monitoring results in Appendix 7.

3.9 Foundation Inspection Pits

2 No. foundation inspection pits (FIP01 and FIP02) were undertaken along the eastern boundary of the site where an existing retaining wall is present in order to determine the nature of the retaining wall foundations.

FIP01 encountered a foundation to a depth of 300mm bgl, protruding 100mm from the face of the retaining wall. FIP02 encountered a foundation to a depth of 250mm, protruding 50mm from the face of the retaining wall.

The foundation inspection pits were undertaken to depths of 0.40m (144.97m AOD) and 0.30m (144.96m AOD) respectively and were terminated beneath the base of the foundations. The foundations were constructed of sandstone cobbles / boulders which is in-line with the retaining wall construction. Photographs are included below for reference, additional details are included on the foundation inspection pit logs in Appendix 4.



Figure 5: Photographs of FIP01 (left) and FIP02 (Right).

4.0 ENVIRONMENTAL CONCLUSIONS

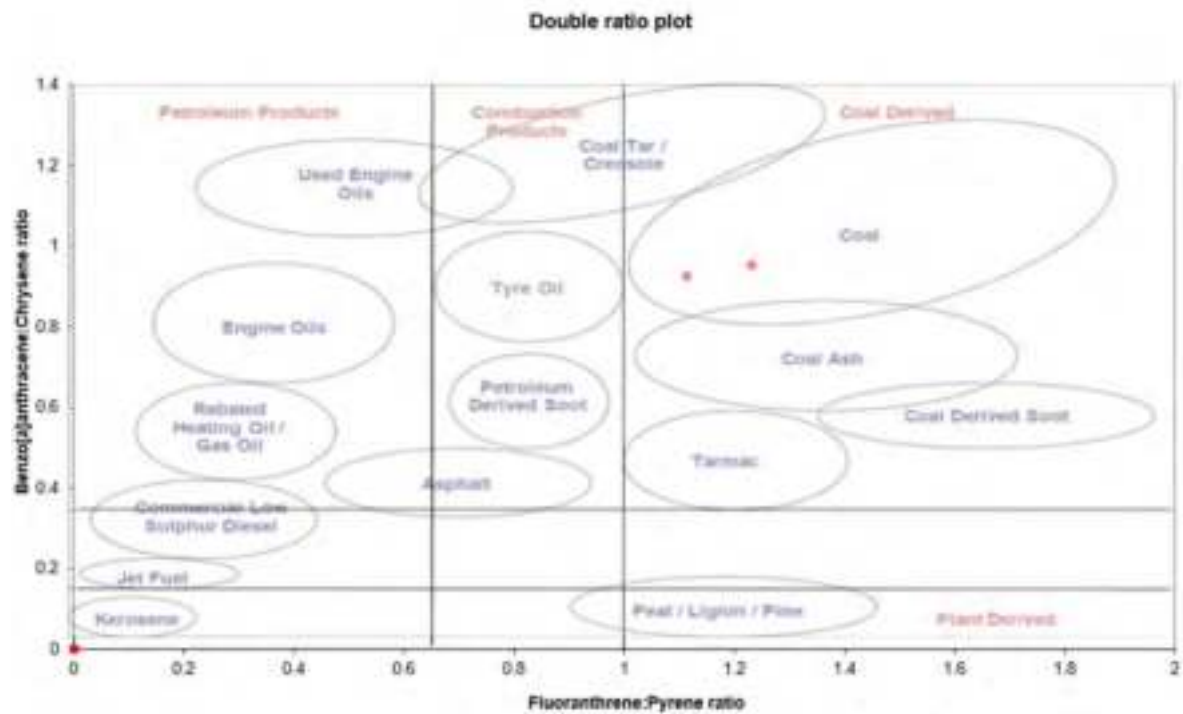
4.1 Assessment of Environmental Results

Soil sample analyses have assessed the presence of contaminants on a spatial basis, and the concentrations at which they occur across the site.

Numerous GAC exceedances including metals, PAHs and TPH were recorded within the Made Ground samples, the majority were recorded within DS01.

Due to the elevated concentrations of PAHs and TPH recorded in the sample from DS01 at 2.30m bgl TPH forensics / identification was requested in order to determine what the source of the hydrocarbon contamination may be. The laboratory determined that *'the chromatogram is not a standard looking trace therefore is not easy to interpret. The sample mainly comprises aromatic material and specifically a series of discrete peaks indicating potential PAHs or phenolic compounds'*. However, it should be noted that speciated and total phenols were recorded at concentrations below their respective detection limit for the sample in DS01 at 2.30m bgl, with the exception of 2,3,5-trimethylphenol which was recorded at a concentration of 3 mg/kg. Therefore, it is uncertain what the source of the hydrocarbon is, anecdotal evidence suggests that a tank (unknown contents) was historically been present in the vicinity of DS01, however, this cannot be confirmed.

A double ratio plot was also undertaken on 2 No. samples from DS01 (0.30m and 2.30m bgl) where elevated concentrations of PAHs were recorded. Based on the double ratio plot the PAHs appear to be coal derived, although significantly elevated concentrations of PAHs were recorded in DS01 at 2.30m bgl, the double ratio is not indicative of a fuel or coal tar / creosote.



No asbestos was found to be present within any of the samples tested. No GAC exceedances for the '*residential with home grown produce*' land use scenario were recorded for any of the natural samples sent for laboratory chemical testing.

2 No. groundwater samples were obtained from DS01 and DS02. The concentrations of arsenic and Benzo(a)pyrene were above the threshold value for drinking water. The threshold values for drinking water were utilised as these threshold values are considered to be the most comprehensive set of threshold values. However, these threshold values are considered highly conservative. No threshold values for general quality groundwater are available for either determinands. Elevated TPH concentrations were also recorded in both samples of groundwater.

4.2 Revised Conceptual Models

The original conceptual models produced in the *IGE Consulting Phase 1 Geo-Environmental Investigation Report* (Ref: 3836-01A) have been revised / updated using the findings from the Geo-Environmental Ground Investigation.

4.2.1 Human Health Risk Assessment

The possible sources of on-site contamination identified within the Phase 1 report include:

- On-Site Made Ground
- On-Site Suspected Infilled Historical Reservoir (1892 – 1968)
- On-Site Car Park (1993 – Present)
- ~~On-Site~~ and Off-site Historical Infilled Quarry (Landfill 1960s - 1990s)
- Off-Site Historical Dye Works (48m NW, 1905 – 1985)
- Off-site Historical Unspecified Tank (25m SE, 1930 - 1956)
- Off-Site Historical Industrial Uses (Mills, tanks, brickworks, electricity substations)

Following consultation with the Local Authority including the receipt of the available information regarding the extent of the off-site landfill (shown below) as well as an updated site boundary, the landfill is now deemed to be off-site, as per the below extract. This was confirmed by the lack of Made Ground in DS04 located in the southern site section.



Figure 6: Extract of the landfill extents plan as provided by the Senior Technical Officer (purple and green hatched areas), the former incorrect site boundary (red) and the amended site boundary (blue)

The human health receptors identified within the Phase 1 report include:

- End users (residents – ‘residential with home grown produce’ land use scenario).
- Construction workers.
- The general public and adjacent site users including from possible changes in ground gas regime following development.

The human health pathways identified within the Phase 1 report include:

- Ingestion of soil directly (including on home grown produce) and indoor dust*;
- Inhalation of soil dust (indoor and outdoor);
- Dermal contact with soil (indoor and outdoor);
- Inhalation of soil vapours (indoor and outdoor);
- Oral background;
- Inhalation background.

** Treated as one pathway*

Revised Conceptual Model for Human Health Risk Assessment

Made Ground was encountered across the majority of the site, with the exception of in DS04 in the southern site section. Numerous GAC exceedances including metals, PAHs and TPH were recorded within the Made Ground. The majority of the GAC exceedances were recorded in DS01 at 2.30m bgl indicating that a contaminative hotspot is present in the vicinity of DS01 in the northern site section. Therefore, on-site Made Ground including the suspected infilled reservoir remain contaminative sources.

As discussed above, following consultation with the Local Authority during which a plan of the recorded extent of the Royd House Tip (landfill) was provided, the landfill has been determined to be off-site. The findings of DS04 undertaken in the southern site section concurs with this as topsoil underlain by natural deposits was encountered, in contrast to the Made Ground encountered across the remainder of the site. The Made Ground on-site is anticipated to be associated with historical site uses including an infilled reservoir rather than the Royd House Tip Landfill.

Anecdotal evidence suggests that a tank was historically present in the vicinity of DS01 which concurs with the presence of a contaminative hotspots. However, no evidence is available regarding the presence, location or contents of a tank on-site. Based on the chromatogram analysis and double ratio plot of the sample from DS01 at 2.30m bgl which recorded the highest concentrations of PAHs and TPH, it is unclear what the source of the hydrocarbon contamination is as the trace was not usual (i.e. fresh or weathered diesel or hydrocarbon). However, the hydrocarbon contamination is not anticipated to be coal tar / creosote or a fuel spill.

Although hardstanding (buildings and driveways) will be present across much of the site following development which will significantly reduce if not negate the pathways associated with the contaminants of concern, dermal, ingestion and inhalation pathways will remain present within the private gardens and areas of soft landscaping. Vapour pathways are discussed in the ground gas risk assessment below.

Consequently, due to the GAC exceedances, the visual and olfactory evidence of contamination recorded and the presence of potential pathways, the site is considered to pose a **moderate to high risk** to human health of site occupants and construction workers. Therefore, remedial measures are deemed necessary. An outline remedial strategy is included in Section 4.3. Any potential increase in risk to construction workers associated with acute interaction with soils can be mitigated with appropriate PPE and health and safety procedures.

It is recommended that a stand-alone detailed remedial strategy is produced following this report and completion of all post-fieldwork monitoring.

4.2.2 Ground Gas Risk Assessment

Potential ground gas sources identified within the Phase 1 report include:

- On-Site Made Ground
- On-Site Suspected Infilled Historical Reservoir (1892 – 1968)
- ~~On-Site~~ and Off-site Historical Infilled Quarry (Landfill 1960s - 1990s)

Potential ground gas pathways identified within the Phase 1 report include:

- Preferential migration beneath hardstanding

- Foundations, service ducts and trenches
- Dissolved gases within groundwater
- Ingress through wall cavities / floors and subsequent accumulation
- Inhalation of ground gas and vapours
- Vertical and lateral migration through granular deposits / granular bands in cohesive deposits

Potential ground gas receptors identified within the Phase 1 report include:

- End users, and to a lesser extent, site workers, if confined spaces are present in which gases are able to accumulate
- Building and structures

Revised Conceptual Model for Ground Gas Risk Assessment

Made Ground was encountered across the majority of the site, which may be associated with the suspected infilled reservoir. The total organic content (TOC) of the Made Ground was noted to be highly variable (0.38% - 19%). The highest organic content is not associated with a significantly elevated concentration of PAHs or TPH, therefore the Made Ground is anticipated to be organic in places i.e. possibly at the base of the historical infilled reservoir. The higher TOC values were also associated with a humic odour in DS02 between 1.30m and 1.70m bgl. Therefore, the on-site Made Ground, including the infilled reservoir, cannot be discounted as a potential ground gas source.

3 No. ground gas monitoring wells were installed. DS01 and DS03 were installed with a response zone within the Made Ground, targeting a potential source, and DS04 was installed with a response zone within the weathered Marsden Formation, targeting a possible pathway from the off-site landfill.

Based on the 3 No. ground gas monitoring visits undertaken to date, which recorded a maximum carbon dioxide concentration of 0.7% v/v within the wells targeting the Made Ground and methane concentrations below detection limit (0.1% v/v), the Made Ground is not considered to be a significant ground gas source. However, ground gas monitoring is ongoing, and this should be re-assessed following additional monitoring.

As discussed in Section 4.2.1, the Royd House Tip Landfill has been confirmed to be off-site. Based on the anticipated infilling dates of the landfill (1960s - 1990s) and based on BS8576 (2013) Figure 6, the ground gas risk associated with the landfill was deemed to be high within the Phase 1 Report. A possible ground gas pathway in the form of a granular stratum beneath natural cohesive deposits was identified in DS04 and therefore was screened with a response zone. During the initial 3 No. ground gas monitoring visits, a maximum carbon dioxide concentration of 2.2% v/v was recorded in DS04. No methane or steady flow rates above detection limit were recorded. It should be noted that the third ground gas monitoring visit was undertaken during a falling atmospheric pressure event and where the atmospheric pressure was below 1000mbar.

These ground gas concentrations may be reflective of either background ground gas concentrations or possible migration of landfill gas. Based on the concentrations of ground gas recorded to date and given the age of the landfill (1960s - 1990s) the landfill may be reaching the end of its methanogenic phase. Consequently, based on the initial ground gas monitoring results, possible landfill gas migration is not considered a significant risk as although lateral migration pathways may be present, the concentration of landfill gas is relatively low. However, ground gas monitoring is on-going with a minimum of 6 No. visits up to 12 No. visits to be undertaken therefore this should be re-assessed following completion of min 3 No. additional ground gas monitoring visits.

It should also be noted that during the initial 3 No. ground gas monitoring visits, a steady carbon monoxide concentration of 10ppm was recorded in both DS03 and DS04 which exceeds the World Health Organisation guideline value of 6.1ppm for indoor air (WHO Guidelines for indoor air quality: selected pollutants' (2010) WHO Geneva).

Although hydrocarbon contamination was recorded on-site, particularly in DS01, no significant concentrations of volatile organic compounds were recorded. During PID testing undertaken during construction of the dynamic sample boreholes a maximum concentration of 1.00ppm was recorded. All VOCs tested were recorded at concentrations below detection limit with the exception of 1,3,5-Trimethylbenzene which was recorded at a concentration of 31.7µg/mg in DS01 at 2.30m bgl. During

ground gas monitoring, a maximum steady VOC reading (utilising PID with a 10.6eV lamp) of 2.1ppm was recorded.

The results of the 4 No. ground gas monitoring visits have been assessed in accordance with BS 8485 (2015) + A1 (2019). The characteristic Gas Screening Value (GSV) is calculated by dividing the maximum methane or carbon dioxide concentration by 100 and multiplying by the maximum steady flow rate recorded at the same monitoring point (the instrument detection limit of 0.1 l/hr is utilised when below detection limit flow rates are recorded). If required, the worst case GSV can be calculated by dividing the maximum carbon dioxide and methane concentration by 100 and multiplying by the maximum steady flow rate on-site.

The results of the 4 No. initial ground gas monitoring visits have been included below for reference:

Gas Monitoring Well	Steady O ₂ Concentration (%)	Peak CO ₂ Concentration (%)	Peak CH ₄ Concentration (%)	Peak H ₂ S Concentration (ppm)	Atmospheric Pressure (mbar)	Steady Gas Flow (l/hr)
DS01	19.4 - 20.4	0.2 - 0.7	<0.1	<1.0	995 - 1007	<0.1
DS03	19.8 - 20.6	0.4 - 0.7	<0.1	<1.0	994 - 1007	<0.1
DS04	18.9 - 20.6	0.3 - 2.2	<0.1	<1.0	994 - 1007	<0.1

Ground gas monitoring has recorded a maximum peak carbon dioxide concentration of 2.2% v/v was recorded in DS04. No methane or steady flow rates above detection limits were recorded.

As no steady flow rates were recorded on-site, the GSV and the worst case GSV for carbon dioxide at the site can be calculated as $(2.2/100)*0.1 = 0.0022\text{l/hr}$.

Based on the above GSV the site is in-line with a Characteristic Situation 1 (CS1). However, due to the ground gas risk associated with the off-site landfill, the elevated carbon monoxide concentration recorded and as only 3 No. ground gas monitoring visits have been undertaken to date, it is considered prudent to designate the site as a **Characteristic Situation (CS2)** for a conservative approach while ground gas monitoring is on-going.

Based on the proposed development (Type A Building), in accordance with BS8485 (2015) +A1 (2019) ground gas protection measures will be required to mitigate the ground gas risk, achieving a minimum of **3.5 points**. Details of suitable ground gas protection measures to achieve the required points are outlined in Section 5.3.1.

Although no significant concentrations of volatile organic compounds were recorded during the ground investigation or during subsequent chemical testing or ground gas monitoring, due to the presence of hydrocarbon contamination on-site and the inherent risk of VOCs, it is recommended that a VOC resistant membrane is utilised to ensure the risk of VOCs is mitigated.

Radon

The Indicative Atlas of Radon in England and Wales produced by the Health Protection Agency and British Geological Survey indicates that the site lies within a lower probability area, less than 1% of homes are above the action level. Consequently, in-line with BR211 (2023) no radon protection measures are necessary in the construction of new dwellings or extensions.

4.2.3 Controlled Waters Risk Assessment

The possible sources of on-site contamination identified within the Phase 1 report include:

- On-Site Made Ground
- On-Site Suspected Infilled Historical Reservoir (1892 – 1968)
- On-Site Car Park (1993 – Present)

The controlled water receptors identified within the Phase 1 report include:

- Groundwater contained within the underlying Secondary A Aquifer within the bedrock (unknown depth).
- Surface Water – River Colne (140m SW)

The controlled waters pathways identified within the Phase 1 report include:

- Vertical migration along future foundations and pooling at base / beneath foundations.

- Vertical migration through possible granular Made Ground (if present) and granular lenses in natural cohesive deposits.
- Lateral migration along low permeability natural deposits and pooling at relative low points.
- Negligible infiltration through low-permeability natural cohesive deposits.
- Migration through underlying bedrock.
- Migration along groundwater flow.
- Overland flow

Revised Conceptual Model for Controlled Waters Risk Assessment

Made Ground has been encountered across the majority of the site with elevated concentrations of metals, PAHs and TPH. A contaminative hotspot with significantly elevated concentrations of TPH and PAHs was recorded in the vicinity of DS01 in the northern site section. Groundwater samples obtained from suspected perched water within the Made Ground from DS01 and DS02 also recorded elevated concentrations of TPH, arsenic and benzo(a)pyrene. The concentrations of arsenic and BaP were noted to be above the threshold values used (drinking water threshold values as these are the most comprehensive data set). However, the threshold values are considered highly conservative for the site in question as a Principal Aquifer or Source Protection Zone is not present beneath the site or in close proximity to the site. Consequently, contamination sources have been recorded on-site.

A cohesive stratum of Made Ground is present below the granular Made Ground across the majority of the site. Where the cohesive Made Ground is absent, cohesive natural deposits have been recorded. Although Made Ground is inherently heterogenous in nature, the cohesive deposits are anticipated to be acting as an aquitard to reduce if not negate the vertical migration of contaminants as no visual or olfactory evidence of contamination was noted within the stratum or the underlying natural deposits.

Chemical testing of the underlying natural deposits could not be undertaken as there was minimal recovery of the weathered bedrock from the standard penetration tests and the recovered material comprised a high proportion of gravel. Therefore, the samples were deemed unsuitable for chemical testing. However, 3 No. samples of the cohesive Made Ground, underlying the granular Made Ground deposits where

elevated concentrations of TPH and PAHs were recorded were sent for chemical testing. No elevated concentrations of TPH or PAHs were recorded within the underlying cohesive Made Ground. 2 No. samples of natural deposits from DS04 were also sent for chemical testing which recorded concentrations of TPH below detection limit and very low concentrations of PAHs (0.34mg/kg to 0.40mg/kg total PAHs). The results concur with the inferred lack of vertical and lateral migration of contaminants from the Made Ground.

Additionally, as discussed in detail in Section 4.3 below, it is recommended that the contaminated material associated with the hotspot in the vicinity of DS01 is excavated and removed off-site to lower the risk to controlled waters and human health. Due to the presence of anticipated perched water at between 1.70m - 2.20m bgl, it has been recommended that the groundwater is pumped out into a tanker for off-site disposal. Therefore, as a by-product there will be a betterment on-site.

Based on BGS boreholes located c. 250m south west of the site (BGS Borehole Ref: SE01SE7/A and B), the groundwater within the bedrock (Secondary A Aquifer) is present at depth (c. 18m bgl). Therefore, given the significant unsaturated zone present the likelihood of contamination migrating vertically into the underlying Secondary A Aquifer is further reduced. It should be noted that the weathered Marsden Formation encountered on-site was dry, which concurs with a shallow unsaturated zone.

No surface water features exist on-site or in close proximity to the site. The nearest surface water feature pertains to the River Colne located 140m south west. Based on the location and distance of the surface water receptor from the site, migration pathways are deemed unlikely. Given the distance, the presence of drainage features and soft landscaping between the site and River Coln, overland flow is not considered to be a feasible pathway. Lateral migration along shallow groundwater is also not considered a feasible pathway.

Consequently, the risk to controlled waters is deemed **low** as no significant contaminative linkages have been identified. However, due to the likely piled foundation solution (discussed in Section 5.3) it is recommended that a detailed piling risk assessment is undertaken. However, installation of piled foundations is not

anticipated to increase the risk to controlled waters as the piles will be in intimate contact with the surrounding soils, are likely to be terminated within the unsaturated zone within the bedrock (<18m bgl) and mitigation measures (i.e. cone head to piles) can be undertaken to minimise the risk to controlled waters.

4.2.4 Conceptual Model for Building Materials & Services

In accordance with BRE Special Digest 1: Concrete in Aggressive Ground (2005), the site has been classified as Brownfield with mobile groundwater, the Made Ground has been classified as Design Sulfate level **DS-1 to DS-4** and subsequently within the Aggressive Chemical Environment for Concrete (ACEC) classification of **AC-1 - AC-4**. The natural deposits have been classified as Design Sulfate Level DS-1 and subsequently within the Aggressive Chemical Environment for Concrete (ACEC) classification of **AC-3z**. Therefore, special precautions are required regarding the use of concrete within the Made Ground and natural deposits to achieve **AC-4**.

Due to the elevated concentrations of PAHs, TPH and metals recorded on-site, barrier pipe will be required for proposed drainage. It is recommended that a water pipe risk assessment is undertaken.

The chemical laboratory testing results are contained within Appendix 6.

4.3 **Outline Remedial Strategy**

As discussed in section 4.2.1, due to the numerous human health GAC exceedances for the residential with plant uptake scenario recorded within the Made Ground, remedial measures are required for the proposed development.

As a contaminative hotspot has been encountered in DS01, it is recommended that the contaminated material in the vicinity of DS01 is removed. A 600mm clean cover system will also be required in all private gardens and areas of public open space / soft landscaping in order to break the contaminative linkages. A capillary break layer (i.e. 100mm - 200mm of gravel) is also recommended below the clean cover system due to the presence of groundwater at depth with elevated concentrations of TPH and PAHs. Details of the required hotspot removal and clean cover system are included below.

As stated in section 4.2.2, ground gas protection measures achieving a minimum of 3.5 points are required for the proposed residential development. As discussed in Section 4.2.2, it is also considered prudent to install a VOC resistant membrane to mitigate the risk of VOCs associated with hydrocarbon contamination. Options for ground gas protection measures achieving the required number of points are given below.

4.3.1 Hotspot Removal

The exact area impacted by the contaminative hotspot is unknown as hotspot delineation was not undertaken as part of the site investigation works. However, based on the visual and olfactory evidence of contamination findings and the results of the chemical laboratory testing, the contaminative hotspot is anticipated to be limited spatially to the north western site section in the vicinity of DS01. Although visual and olfactory evidence of contamination was also recorded elsewhere in DS02 and DS03, the concentrations of TPH and PAHs recorded in DS02 and DS03 were significantly lower than those recorded in DS01.

The most effective remedial strategy for the contaminative hotspot is considered to be the removal of the source (contaminated soil and groundwater). This will reduce the risk to human health and controlled waters. The proposed remedial works should include excavation of material to a depth of c. 3.50m bgl in the vicinity of DS01 to remove the contaminated material (c. 75m³ - 90m³ based on a c. 5m x 5m area around DS01). The material is not suitable for re-use on-site and should be disposed of off-site to a licensed waste facility. Due to the presence of an existing retaining wall along the western boundary of the site, consideration will be required for the effect of the excavation on the retaining wall, with trench stabilisation or another technique required to ensure stability.

Groundwater was encountered at depths of between 1.70m and 2.20m bgl in DS01, DS02 and DS03. Consequently, any impacted water needs to be removed to allow the impacted soils to be excavated. It is recommended that the water is pumped into tankers for off-site removal. It should also be noted that as the groundwater was not screened in the monitoring wells in order to obtain reliable ground gas concentrations, it is unknown whether any groundwater recharge may occur. If recharge occurs, a

groundwater barrier may be required to stop the groundwater flow to the contaminative hotspot prior to dewatering. This will be determined during the activities on-site.

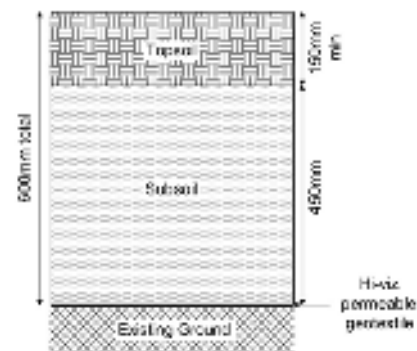
Following removal of the contaminated material in the vicinity of DS01 and the installation of a clean cover system (discussed below), no feasible pathways will be present to end-users. The volatile fraction of the hydrocarbon contamination is not significant and will be significantly reduced by removal of the hydrocarbon contamination, however, it is recommended that a VOC resistant membrane is utilised to ensure the risk of VOCs is further reduced.

It is recommended that a qualified geo-environmental engineer is present to undertake a watching brief during the hotspot removal.

4.3.2 Clean Cover System

The following procedure is outlined for use in private gardens and in areas of soft landscaping where Made Ground is deeper than 600mm below finalised levels .

1. Excavate to 600mm bgl in private gardens
2. A 600mm clean cover system is recommended to be added to the proposed private gardens. This is to consist of:
 - No less than 150mm and no more than 300mm suitable topsoil, underlain by;
 - Suitable subsoil to a total (topsoil + subsoil) depth of 600mm (450mm in areas of soft landscaping), underlain by;
 - A no-dig capillary break layer
 - Validate in line with the below strategy.



Clean Cover System Validation

Once the 600mm clean cover system is required to break contaminative linkages, validation requirements include:

- Details of the source of the cover material;

- Chemical test results to demonstrate that the soil is free from contamination and 'suitable for use' in-line with the below chemical testing suites and rates.
- Waste transfer notes to provide evidence of source;
- Confirmation of cover depth by either measurement tape or topographical survey with photographs at a frequency of one pit per plot.

No suitable topsoil or subsoil is present on-site therefore all topsoil and subsoil will need to be imported. All imported topsoil and subsoil must be validated as detailed below to ensure its suitability for use (i.e., no glass or plastic is to be included and meets chemical testing acceptability criteria).

Imported topsoil and subsoil is required to be tested at source prior to import to confirm suitability. All topsoil and subsoil, whether site-won or imported is required to be tested at the following frequency:

Source	Material End Use	Sampling Frequency ¹	Testing Suites ³ (see below)
Greenfield Source:	Topsoil	1 per 200m ³	A, B, C, D, F
	Subsoil	1 per 200m ³	A, B, C, D, F
Brownfield Source:	Topsoil	1 per 50m ³	A, B, C, D, F, H
	Subsoil	1 per 100m ³	A, B, C, D, F
	General Fill ²	1 per 1000m ³	A, B, C, E, G

- 1) Minimum 3 samples regardless of volume.
- 2) 'General Fill' is material used primarily to raise levels, specifically not within areas of private gardens, public open space, or soft landscaping, e.g. 6F2.
- 3) In addition to the standard suites given, the laboratory testing suite should include any additional contaminants of concern based on the source of the samples.

Testing Suites:

- A. Asbestos ID, Asbestos quantification.
- B. pH, total and free cyanide, soluble sulfate, organic matter.
- C. Arsenic, Beryllium, Boron, Cadmium, Chromium (III and VI) Copper, Lead, Inorganic Mercury, Nickel, Selenium, Vanadium, Zinc.
- D. Speciated PAHs: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Indeno(1,2,3-cd)pyrene, Dibenz(a,h)anthracene, Benzo(ghi)perylene.
- E. Total (non-speciated) PAHs.
- F. Speciated Total Petroleum Hydrocarbons (TPH): Aliphatic >EC5 - EC6, >EC6 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, and > EC35 - EC44, and Aromatic >EC5 - EC7, >EC7 - EC8, >EC8 - EC10, >EC10 - EC12, >EC12 - EC16, >EC16 - EC21, >EC21 - EC35, > EC35 - EC44.
- G. Total Petroleum Hydrocarbons (TPH): TPH EC6 – EC40.
- H. BTEX: Benzene, Toluene, Ethylbenzene, p- & m-xylene, o-xylene. Methyl tertiary butyl ether (MTBE).

Once tested, the results are to be compared against the following Acceptability Criteria:

Suite	Determinand (mg/kg unless stated)	Acceptability Criteria for:			
		Private Gardens	Public Open Space (residential)	Soft Landscaping or Public Open Space (Park)	General Fill
A	Asbestos (%)	ND	ND	ND	<0.001 – 0.01%
B	pH	>6 - <8 ⁽³⁾	>6 - <8 ⁽³⁾	>6 - <8 ⁽³⁾	>5 - <10 ⁽³⁾
	Total Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾
	Free Cyanide	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾	0.5 ⁽³⁾
	Soluble Sulfate (mg/l)	500 ⁽³⁾	500 ⁽³⁾	500 ⁽³⁾	500 ⁽³⁾
C	Arsenic	37	79	170	640
	Beryllium	1.7	2.2	63	12
	Boron	290	21000	46000	240000
	Cadmium	11	120	560	190
	Chromium (III)	910	1500	33000	8600
	Chromium (VI)	6	7.7	220	33
	Copper	2400	12000	44000	68000
	Lead	200 ⁽¹⁾	630 ⁽¹⁾	1300	2330 ⁽¹⁾
	Inorganic Mercury	40	120	240	1100
	Nickel	130	230	800	980
	Selenium	250	1100	1800	12000
	Vanadium	410	2000	5000	9000
	Zinc	3700	81000	170000	730000
D	Naphthalene	2.3	4900	1200	
	Acenaphthylene	170	15000	29000	
	Acenaphthene	210	15000	29000	
	Fluorene	170	9900	20000	
	Phenanthrene	95	3100	6200	
	Anthracene	2400	74000	150000	
	Fluoranthene	280	3100	6300	
	Pyrene	620	7400	15000	
	Benzo(a)anthracene	7.2	29	49	
	Chrysene	15	57	93	
	Benzo(b)fluoranthene	2.6	7.1	13	
	Benzo(k)fluoranthene	77	190	370	
	Benzo(a)pyrene	2.2	5.7	11	
	Indeno(1,2,3-cd)pyrene	27	82	150	
	Dibenz(a,h)anthracene	0.24	0.57	1.1	
	Benzo(ghi)perylene	320	640	1400	
E	Total PAHs				1000 ⁽⁴⁾
F	TPH-CWG - Aliphatic >EC5 - EC6	42	570000	95000	
	TPH-CWG - Aliphatic >EC6 - EC8	100	600000	150000	
	TPH-CWG - Aliphatic >EC8 - EC10	27	13000	14000	
	TPH-CWG - Aliphatic >EC10 - EC12	130	13000	21000	
	TPH-CWG - Aliphatic >EC12 - EC16	1100	13000	25000	
	TPH-CWG - Aliphatic >EC16 - EC21	65000	250000	450000	
	TPH-CWG - Aliphatic >EC21 - EC35				
	TPH-CWG - Aliphatic > EC35 - EC44	65000	250000	450000	
	TPH-CWG - Aromatic >EC5 - EC7	70	56000	76000	
	TPH-CWG - Aromatic >EC7 - EC8	130	56000	87000	
	TPH-CWG - Aromatic >EC8 - EC10	34	5000	7200	
	TPH-CWG - Aromatic >EC10 - EC12	74	5000	9200	
	TPH-CWG - Aromatic >EC12 - EC16	140	5100	10000	

	TPH-CWG - Aromatic >EC16 - EC21	260	3800	7600	
	TPH-CWG - Aromatic >EC21 - EC35	1100	3800	7800	
	TPH-CWG - Aromatic > EC35 - EC44	1100	3800	7800	
G	TPH > EC6 - EC40				5000 ⁽⁴⁾
H	Benzene	0.087	72	90	
	Toluene	130	56000	87000*	
	Ethylbenzene	47	24000	17000*	
	p & m-xylene	56	41000	17000*&***	
	o-xylene	60	41000	17000*	
	MTBE (Methyl Tertiary Butyl Ether)	LOD ⁽³⁾	LOD ⁽³⁾	LOD ⁽³⁾	

LQM/CIEH S4ULs for Human Health Risk Assessment (3rd edition, 2015) used unless stated:

- 1) Category 4 Screening Levels (March 2014)
- 2) CL:AIRE Soil GAC for Human Health Assessment (January 2010)
- 3) In-house screening criteria used as no GAC methodology currently exists
- 4) Hazardous waste thresholds. This limit only applies to imported material, not to in-situ soil.

Assumed 1% SOM (most conservative) for those values dependent upon SOM.

ND = Not Detected

LOD = Limit of Detection

*Exceeds vapour saturation limit

**Exceeds solubility saturation limit

The above acceptability criteria for PAHs for imported topsoil and subsoil are based on the published LQM/CIEH S4ULs (2015) for each individual PAH and not based on the Category 4 Screening Level using benzo(a)pyrene as a surrogate marker. This is as the source of the imported material is unknown therefore using the surrogate marker approach may not be suitable as the distribution of PAHs in the imported material may not be similar to those in the Culp et al. (1998)¹ study. Once chemical testing had been undertaken on imported soil and the distribution of PAHs compared to the distribution in the Culp et al. (1998) study, it may be suitable to use the surrogate marker approach / C4SL.

4.3.3 Ground Gas Protection Measures

As stated in Section 4.2.2, ground gas protection measures achieving a **minimum of 3.5** points are required for the proposed residential development. Based on no basement and the unknown suspended floor slab design, examples of how the required 3.5 points can be achieved are given below:

		BS:8485 (2015) + A1 (2019) Scores	Floor Slab Design Options			
			Pre-cast Beam and Block Suspended Slab		Cast In-situ Suspended Slab	
			Design Choice	Score	Design Choice	Score
F10	Precast suspended segmental subfloor	0	✓	0		

¹ Culp et al. (1998), *A comparison of the tumors induced by coal tar and benzo[a]pyrene in a 2-year bioassay*, **Carcinogenesis**, vol.19, no.1, pp.117–124.

	Cast in-situ ground bearing floor slab (with only nominal mesh reinforcement)	0.5				
	Cast in-situ monolithic reinforced ground bearing raft or reinforced cast in-situ suspended floor slab with minimal penetrations	1 or 1.5*			✓	1.5
Ventilation	Pressure relief pathway	0.5			✓	0.5
	Passive sub-floor dispersal layer	1.5 or 2.5**	✓	2.5		
	Active dispersal layer	1.5 to 2.5				
	Active positive pressurisation	1.5 to 2.5				
Membra	Ground gas and VOC resistant membrane***	2	✓	2	✓	2
Total Points Achieved			4.5		4.0	

* To achieve a score of 1.5 the raft or suspended floor slab should be well reinforced to control cracking and have minimal penetrations cast in.

** 2.5 points = very good performance. 1.5 points = good performance.

*** To achieve the 2 points the gas membrane must meet all criteria set out in BS:8485 (2015) + A1 (2019) Table 7.

4.3.4 Hotspot Discovery Strategy

As a hydrocarbon hotspot has been encountered in the northern site section in the vicinity of DS01, possibly associated with a historical tank. Although their presence is deemed unlikely, the presence of further contaminative hotspots cannot be discounted. Consequently, a discovery strategy is included below for unexpected contamination:

Potentially contaminative material can be identified as follows:

- Appears oily / has an iridescent sheen
- Hydrocarbon odour e.g., oily or petroleum odour
- Solvent odour e.g., sharp or sweet odour
- Waste materials e.g., metals, plastic etc.
- Asbestos e.g., fibrous sheeting / roofing / board / lagging etc.
- 'Landfill' odour e.g., rotten / putrefying / leachate odour

Or any other material that looks man-made or does not match its surroundings – if in doubt, check.

If any of the above material is discovered, the following procedure must be carried out:

- a) Stop works in the area of the contamination discovery.
- b) Inform the Site Manager.
- c) Record the visual and olfactory evidence of contamination.
- d) Suitably qualified geo-environmental engineer to investigate the contamination; take samples, photographs and in-situ tests and discover the extents of the contamination, and to identify potential contaminants and specify chemical testing, if necessary.
- e) Either dig out the contaminated material and stockpile, on an impermeable membrane if necessary, or leave in-situ whilst awaiting chemical test results, if needed – whichever presents the least risk.
- f) Suitably qualified geo-environmental engineer to re-visit the site's risk assessment, taking into account the newly discovered contamination and recommend remediation, if necessary, or other next steps.
- g) If the risk assessment and remediation strategy is changed as a result, the Local Authority and/or the Environment Agency should be informed and/or consulted.
- h) Lastly, undertake remediation of the affected area if this has been deemed appropriate.

As discussed previously, it is recommended that a detailed remedial strategy is undertaken as well as further works to delineate the identified contamination hotspot.

4.3.5 Tank Discovery Strategy

Anecdotal evidence suggests that a tank was historically present in the northern site section. Although no evidence of a tank was noted during the ground investigation, the presence of an underground storage tank cannot be discounted, although is considered highly unlikely. Any tanks will require appropriate decommissioning and validity testing. The procedure for the discovery of a tank is included below:

- a) Stop works in the area of the UST discovery.
- b) Inform the Site Manager.
- c) Suitably qualified geo-environmental engineer to investigate the tank, including measuring the size, contents, condition, and visual and olfactory evidence of contamination. Geo-environmental engineer to record the location

- of the tank on a site plan, take photographs, and sample the contents to send for chemical testing to determine the contents.
- d) Suitably qualified contractor to empty the tank and dispose of contents at a suitably licensed disposal facility.
 - e) Suitably qualified contractor to undertake integrity testing in line with the 'Blue Book' method (APEA / EI *'Design, Construction, Modification, Maintenance and Decommissioning of Petrol Filling Stations'* 4th ed. (April 2018)), to determine whether the tank is intact or has been compromised.
 - f) Suitably qualified geo-environmental engineer to undertake a risk assessment based on the contents of the tank and the results of the integrity testing, to determine whether to decommission the tank and leave in-situ or to remove the tank.
 - g) Suitably qualified contractor to clean and 'inert' the tank, and provide a gas safe certificate, in line with the 'Blue Book' method.
 - h) Suitably qualified contractor to either decommission the tank in-situ in line with the 'Blue Book' method or remove the tank and dispose of at an appropriate facility.
 - i) If excavated and removed, suitably qualified geo-environmental engineer to investigate the base and the sides of the resultant excavations and if any contamination is found, undertake the Procedure for Discovery of Unexpected Contamination above.

5.0 GEOTECHNICAL CONCLUSIONS

5.1 Geotechnical Assessment of Ground Conditions

The intrusive investigation works have revealed that the ground conditions at the site generally comprise Made Ground underlain by weathered Marsden Formation (bedrock).

The principal strata identified are outlined in further detail below.

5.1.1 Made Ground

Made Ground was encountered in the majority of exploratory holes, with the exception of DS04 in the southern site section. The Made Ground was noted to be relatively consistent, comprising mostly coarse soils (sand and gravel) to a depth of between 2.20m and 3.50m bgl (140.70m - 142.80m AOD) underlain by a fine (clay) stratum to a depth of between 3.60m and 4.90m bgl (139.30m - 141.40m AOD).

11 No. SPTs were undertaken within the Made Ground. The N-values recorded within the Made Ground were generally low (2 - 14, average 10), with the exception of an N-value of 50 being recorded in DS03 at 3.00m bgl, anticipated to be due to a cobble.

2 No. Atterberg Limit tests were undertaken on samples of fine grained Made Ground, which indicated that the clay is generally of medium plasticity and medium volume change potential.

5.1.2 Weathered Marsden Formation

Weathered Marsden Formation was encountered in all exploratory holes. In DS01 - DS03 where Made Ground was present, the deposit was encountered at a depth of between 3.60m and 4.90m bgl (139.30m - 141.40m AOD) and was recovered as light yellowish brown, fine to coarse sand and angular to subangular, fine to coarse gravel.

In DS04, no Made Ground was recorded. Strata representative of the Marsden Formation were noted to comprise soft, becoming firm to stiff orangish brown, mottled grey, slightly gravelly, sandy clay, underlain by yellowish brown, slightly gravelly, slightly clayey, fine to coarse sand, becoming gravel of sandstone.

7 No. SPTs were undertaken in this stratum recording N-values of between 11 and 50 (average 20). A refusal (N-value of 50) was recorded at the base of the majority of exploratory holes, with the exception of DS01 and the SPTs were noted to increase with depth in the Marsden Formation in DS04 where numerous SPTs were undertaken within the formation.

2 No. hand shear vane tests were undertaken within the fine grained deposits of the Marsden Formation in DS04 at depths of 1.70m and 1.90m bgl which recorded undrained shear strengths of 150kPa and 146kPa respectively.

2 No. Atterberg tests were undertaken on samples of fine grained Marsden Formation from DS04 which indicated that the clay is of medium plasticity and medium volume change potential.

5.2 Groundwater

Groundwater was encountered at depths of between 1.70m and 2.20m bgl in DS01 - DS03 during construction of the dynamic sample boreholes. No groundwater strike was noted in DS04. No groundwater depth monitoring wells were installed as part of the site investigation works, monitoring wells were installed in the unsaturated zone above for ground gas monitoring purposes.

However, based on observations during the ground investigation, including the lack of groundwater within natural deposits in DS04 and natural deposits at the base of DS01 - DS03 as well as the topography of the surrounding area (retaining walls along the eastern and western boundaries of the site), the groundwater is anticipated to be perched water within the granular Made Ground.

Perched water was encountered during the ground investigation. Given the complete range of seasonal and temporal conditions at the site will not have been captured during this ground investigation period, temporary groundwater control measures are likely to be required for excavation works.

5.3 Foundations

Based on existing site levels, due to the presence of Made Ground to depths in excess of 2.50m bgl in the vicinity of the proposed plots, utilising traditional strip or trench foundations is not deemed suitable. Therefore, a non-percussive short piled foundation solution or steel tubular piles is considered necessary, bearing or socketed into the underlying shallow bedrock. The pile type should be confirmed by a specialist piling contractor and sufficient anchorage depth should be confirmed.

The use of a raft foundation solution or ground improvement via vibratory stone columns is not recommended due to the presence of existing retaining walls along the eastern and western boundaries of the site which lie in very close proximity to the proposed plots.

Established trees are present along the boundaries of the site. The majority of the shallow Made Ground was noted to be granular with rare thin bands of clays (200mm - 300mm thick) at between 1.00m and 1.70m bgl. Due to the thin nature of the clay bands, heave precaution is unlikely to be required, however, this should be confirmed by specialist piling contractors. If the locations of the proposed plots are altered and are positioned further south where fine grained natural deposits are present at shallow depth, heave precaution may be required.

5.4 Floor Slabs

Based on existing levels, the presence of more than 600mm of Made Ground across the site and foundation depths greater than 1.50m bgl, a suspended floor slab will be required for the proposed plots in line with NHBC / Premier guidance.

5.5 Earthworks and External Areas

5.5.1 Stockpile Management

During the course of the development there will also be areas of stockpiled soils intended for use within the proposed gardens. These will have been subjected to off-site testing and approved for use on site. It is imperative that the stockpiles are well managed to avoid inadvertent mixing or depositing of surplus or deleterious materials

that would compromise the continued use. We would recommend that the site management reviews the proposed positions for placement of stockpiles and places either fencing or warning signs to ensure compliance.

5.5.2 Export of Materials

Any soils to be removed from site must be classified in accordance with WM3 under the definition of waste and chemically tested to determine their destination, i.e. reuse or landfill, including the recommended hotspot removal arisings. Waste ticket records must also be retained as proof of the export of materials from site.

6.0 RECOMMENDATIONS

- Following any variation in a finalised proposed development detailed design including earthworks design, proposed levels and arboricultural survey (tree survey) it is recommended that the above conclusions are re-appraised to determine the suitability.
- The conclusions of this report should be agreed with relevant regulatory authorities prior to the commencement of works.
- Ground gas protection measures in-line with a Characteristic Situation 2 (CS) including a VOC resistant membrane are deemed necessary given the identified ground gas sources and hydrocarbon contamination on-site.
- Remedial measures in the form of hotspot removal and a 600mm clean cover system with a capillary break layer are deemed necessary with respect to soil and groundwater at the site.
- If any hereto unidentified visual or olfactory evidence of contamination is encountered during earthworks or construction work, then the Local Authority Environmental Health Officer and Environment Agency should be contacted immediately to determine appropriate mitigation measures.
- Further work including a cable percussive borehole may be required for pile design.
- A piling risk assessment may be required due to the presence of contamination identified on-site.
- It is recommended that a structural survey of the retaining walls along the eastern and western boundaries of the site is undertaken prior to construction.

APPENDIX 1

LIMITATIONS OF INVESTIGATION WORK AND REPORT AND CONTAMINATED LAND LEGISLATIVE FRAMEWORK

LIMITATIONS OF REPORT

This consultancy report was compiled and carried out by IGE Consulting Limited ('IGE') for the client, as defined in the main report (the 'client'), on the basis of a defined programme and scope of works and the terms of a contract between IGE and the client. IGE undertook this with all reasonable skill and care, taking into account the limits of the scope of works required by the client, the prevailing site conditions, the time scale involved and the resources, including financial and manpower resources, agreed between IGE and the client. IGE cannot accept responsibility to any parties whatsoever, following the issue of this report, for any matters arising which may be considered outwith the agreed scope of works.

Unless otherwise agreed this report has been prepared exclusively for the use and reliance of the client in accordance with generally accepted consulting practices. This report may not be relied upon, or transferred to, by any other party without the written agreement of its author. If a third party relies on this report, it does so wholly at its own and sole risk and IGE disclaims any liability to such parties.

It is IGE's understanding that this report is to be used for the purpose described in the 'Brief' section of this report. That purpose was a significant factor in determining the scope and the services to be provided. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of, or reliance upon the report in those circumstances by the client without IGE's review and advice shall be at the client's sole and own risk.

The information contained in this report is protected by disclosure under Part 3 of the Environmental Information Regulations 2004 pursuant to the provisions of Regulation 12(5) without the consent in writing of a Director of IGE.

This report is a function of the date it was written and should be read in light of any subsequent changes in legislation, statutory requirements and industry practices. Ground conditions can also change over time and further investigations or assessment should be made if there is any significant delay in acting on the findings of this report. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of IGE. In the absence of such written advice of IGE, reliance on the report in the future shall be at the client's own and sole risk. Should IGE be requested to review the report in the future, IGE shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between IGE and the client.

The observations and conclusions described in this report are based solely upon the scope of works agreed between the client and IGE. IGE has not performed any observations, investigations, studies or testing not specifically set out or mentioned within this report. IGE is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the agreed scope of works. For the avoidance of doubt, this report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species (e.g. Japanese Knotweed). It is recommended that the client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification of asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace full and proper surveys.

LIMITATIONS OF INVESTIGATION WORK

Where field investigations have been carried out these have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions can also be variable and as investigation excavations only allow examination of the ground at discrete locations, the potential exists for ground conditions to be encountered which are different to those considered in this report. The explored extent of the site area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition, chemical analysis was carried

out for a limited number of parameters, based on an understanding of the available operational and historical information, and it should not be inferred that other chemical species are not present.

The groundwater conditions entered on the exploratory hole records are those observed at the time of investigation. The normal speed of investigation usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions and higher groundwater levels may occur at other times of the year than were recorded during this investigation.

Exploratory Holes

Where exploratory holes have been carried out as part of this investigation, the spacing has been determined to provide a reasonable indication of the general ground conditions across the site, but the number has ultimately been limited by commercial constraints. The findings of the exploratory holes relate specifically to the exploratory hole locations and are no absolute guarantee of the ground conditions between such locations. Due allowance should be made for the possibility of variation in conditions between exploratory hole locations.

Extent of Contamination Testing

The extent of contaminated land testing carried out on samples obtained from the site has been determined in accordance with the latest legal guidance issued by the government to provide, with reasonable certainty, the probable general levels of contamination present on site that could pose a significant hazard to human health or waters. The extent of site investigation works including chemical testing has also been limited by reasonable commercial constraints. Although extensive testing of samples has been carried out, the volume of samples taken for testing are a minute fraction of the total volume of soils and groundwater present on site. Therefore, there is a residual risk that undetected pockets of contamination may be present on site, situated between testing locations.

When investigating or developing potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and temporally. The absence of certain ground, ground gas, contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

Extent of Geo-Environmental Studies

This report is strictly limited to the nature of contamination contained within the ground and groundwater at the site. The report does not cover environmental aspects such as air or noise pollution and ground vibrations and the like. In addition, ecological matters relating to wildlife, flora and fauna have not been investigated as part of this report. In particular, the site has not been inspected for the presence or otherwise of invasive species e.g. Japanese Knotweed. It is recommended that the Client appoints a specialist in this subject to carry out a detailed inspection / survey of the site if its presence is suspected. Where mention has been made to the identification asbestos or asbestos-containing materials this is for indicative purposes only and does not constitute or replace a full and proper survey. If an Unexploded Ordnance (UXO) report has been obtained within the report, it has been so on the basis of Health and Safety concerns and no assessment has been made other than transcribing the recommendations of the sub-contractor contained within the report. In terms of a potential contaminative source, unless ordnance has been manufactured / stored on site, UXOs will only be determined as a contaminative source following a positive identification on site.

CONTAMINATED LAND LEGISLATIVE FRAMEWORK

Environmental risks are assessed in accordance with Contaminated Land (England) (Amendment) Regulations (2012), Part IIA of the Environmental Protection Act 1990, and Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, DEFRA (2012). Part IIA provides a statutory definition of contaminated land. To fall within this definition it is necessary that, as a result of the condition of the land, substances may be present on or under the land such that:

- (a) Significant harm is being caused or there is a significant possibility of such harm being caused; or
- (b) Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused.

Risk from contamination is assessed by consideration of possible linkages between contaminant sources and potential receptors which could be harmed or polluted and the potential pathways between them – known as the Contaminant Linkage. For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source – a substance that is capable of causing pollution or harm;
- A receptor – something which could be adversely affected by the contaminant;
- A pathway – a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

The Environment Agency Land Contamination: Risk Management (LCRM 2020) provides the technical framework for structured decision making about land contaminations. LCRM (2020) advocates a phased approach to risk assessment comprising:

- Preliminary Risk Assessment (PRA) – desk study and qualitative assessment;
- Generic Quantitative Risk Assessment (GQRA) – assessment of contaminant concentrations against generic assessment criteria;
- Detailed Quantitative Risk Assessment (DQRA) – detailed site-specific risk assessment and development of site-specific assessment criteria.

Each of these phases follows the same basic steps but adds site specific details and further certainty into the assessment as the stages progress. The basic steps are:

- Hazard Identification and hazard assessment- development or refinement of the source – pathway – receptor conceptual model, and identification of potential pollutant linkages;
- Risk Estimation – qualitative risk estimation predicting magnitude and probability of potential consequences that may arise as a result of a hazard.
- Risk Evaluation – deciding whether a risk is unacceptable.

The key to the classification is that the designation of risk is based upon the consideration of both:

- (a) The magnitude of the potential consequence which takes into account both the potential severity of the hazard and the sensitivity of the receptor;
- (b) The magnitude of probability which takes into account both the presence of the hazard and receptor and the integrity of the pathway.

Generic Quantitative Risk Assessment (GQRA) will utilise generic assessment criteria (GAC) for the purposes of screening allowable concentrations in comparison to the measured site concentrations. The GAC are defined based on the critical receptors identified at the site. Receptors are considered in relation to:

- Human health receptors (e.g. site users) via measured solid concentrations;
- The water environment (e.g. groundwater and surface water) via measured leachate / water concentrations.

Additional receptors may be relevant dependant on the site e.g. flora/fauna, water supply pipes, buried concrete.

The GAC adopted for assessment of soils in relation to Human Health are based on published Soil Guideline Values (SGV) in 2009 for those compounds for which published criteria are available for varying scenarios (residential, commercial, allotment). In the absence of SGVs the following GAC defining documents are adopted - LQM/CIEH S4ULs (2015), CL:AIRE Soil GAC for Human Health Assessment (2010) and Category 4 Screening Levels (C4SL's) (2014).

GACs for waters must be selected to assess potential risks to the identified environmental receptors. There are numerous UK and European guidelines for waters based on the site situation and different receptors. GACs utilised include - The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009 (Part 7: Groundwater Threshold Values), UK Drinking Water Standards (2000), Environmental Quality Standards, World Health Organisation concentrations, Environment Agency guidance concentrations and United States Environmental Protection Agency – Region 9 GACs.

APPENDIX 2

FIGURES AND DRAWINGS



FOR GUIDANCE PURPOSES ONLY

Approximate Site Boundary

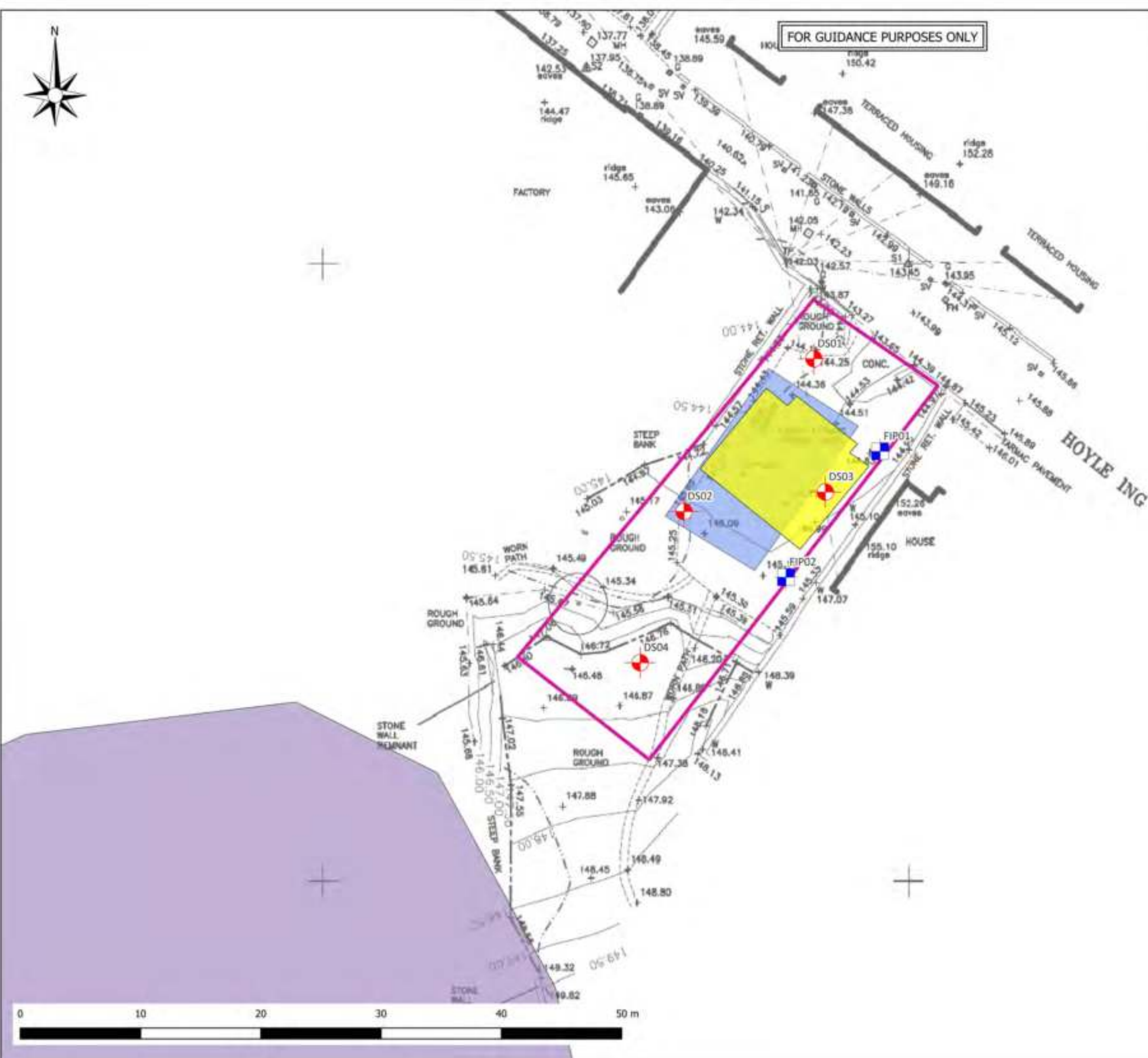


Rev	Drawn	Date	Description
Drawing Status: Information			
Contract:			
Land off Hoyle Ing, Linthwaite			
For: Redwaters (Yorkshire) Ltd.			
Drawing Title:			
Site Location Plan			
IGE consulting Office 16, Bartle House, Manchester, M2 3WQ Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 914 9170			
Scale: 1:1000 @A3		Date: Jul 2023	
Drawn: AJ		Checked: AE	
Contract No.	Drawing No.		
3836	SI-01	P1	



FOR GUIDANCE PURPOSES ONLY

- Approximate Site Boundary
- IGE Foundation Inspection Pits (May 2023)
- IGE Dynamic Sample Boreholes (June 2023)
- Proposed Plots
- Historical Landfill Extent (1960s - 1990s)
- Historical Reservoir (1892 - 1948)



Rev	Drawn	Date	Description
Drawing Status: Information			
Contract: Land off Hoyle Ing, Linthwaite For: Redwaters (Yorkshire) Ltd.			
Drawing Title: Exploratory Hole Location Plan			
IGE consulting			
Office: 16, Bartle House, Manchester, M2 3WQ Email: contact@igeconsulting.co.uk Web: www.igeconsulting.co.uk Tel: 0161 914 9170			
Scale: 1:300 @A3		Date: Jul 2023	
Drawn: AJ		Checked: AE	
Contract No.	Drawing No.		
3836	SI-05	P1	

- 1 This drawings is indicative and not to scale.
- 2 This drawing is to be read in conjunction with all relevant Architects and Service Engineers drawings.

Sources 1. On-Site Made Ground 2. On-Site Possible Infilled Reservoir (1892 - 1968) 3. On-Site Disused Car Park (1993 - Present) 4. Off-Site Unspecified Tank (25m SE 1930 - 1956) 5. Off-Site Historical Dye Works (29 NW 1905 -1985) 6. Off-Site Infilled Quarry / Royd House Tip Landfill (Infilled 1960s - 1990s) 7. Off-Site Historical Industrial Activities (30-136m 1892 - 1996)
--

8. Pooling Beneath Future Foundations
9. Pooling in Relative Low Points Above Low Permeability Deposits

1. On-Site Made Ground
2. On-Site Possible Infilled Reservoir (1892 - 1968)
3. Off-Site Infilled Quarry / Landfill (1960s - 1990s)

NOTE: The extents of Royd House Tip Ladfill were confirmed to be off-site.

1. Dermal Contact
2. Inhalation of Soil Dust and Vapours
3. Ingestion of Soil Directly

1. Vertical Migration Along Current and Future Foundations
2. Vertical Migration Through Granular Made Ground, Granular Natural Deposits and Granular Lenses Within Natural Cohesive Deposits
3. Lateral Migration Along Low-Permeability Natural Deposits
4. Negligible Migration Through Fractures and Fissures in Bedrock
5. Migration Along Groundwater Flow
6. Negligible Migration Through Low Permeability Natural Deposits
7. Overland Flow

1. Preferential Migration Beneath Hardstanding, Along Foundations, Service Ducts and Trenches
2. Dissolved Gases Within Groundwater
3. Ingress Through Wall Cavities / Floors and Subsequent Accumulation
4. Inhalation of Ground Gas and Vapours
5. Vertical Migration Through Granular Deposits

1. End User
2. Construction Workers
3. General Public / Adjacent Site Users
4. Secondary A Aquifer within bedrock
(c. 18m bgl)
5. Buildings and Services
6. River Coln (140m SW)

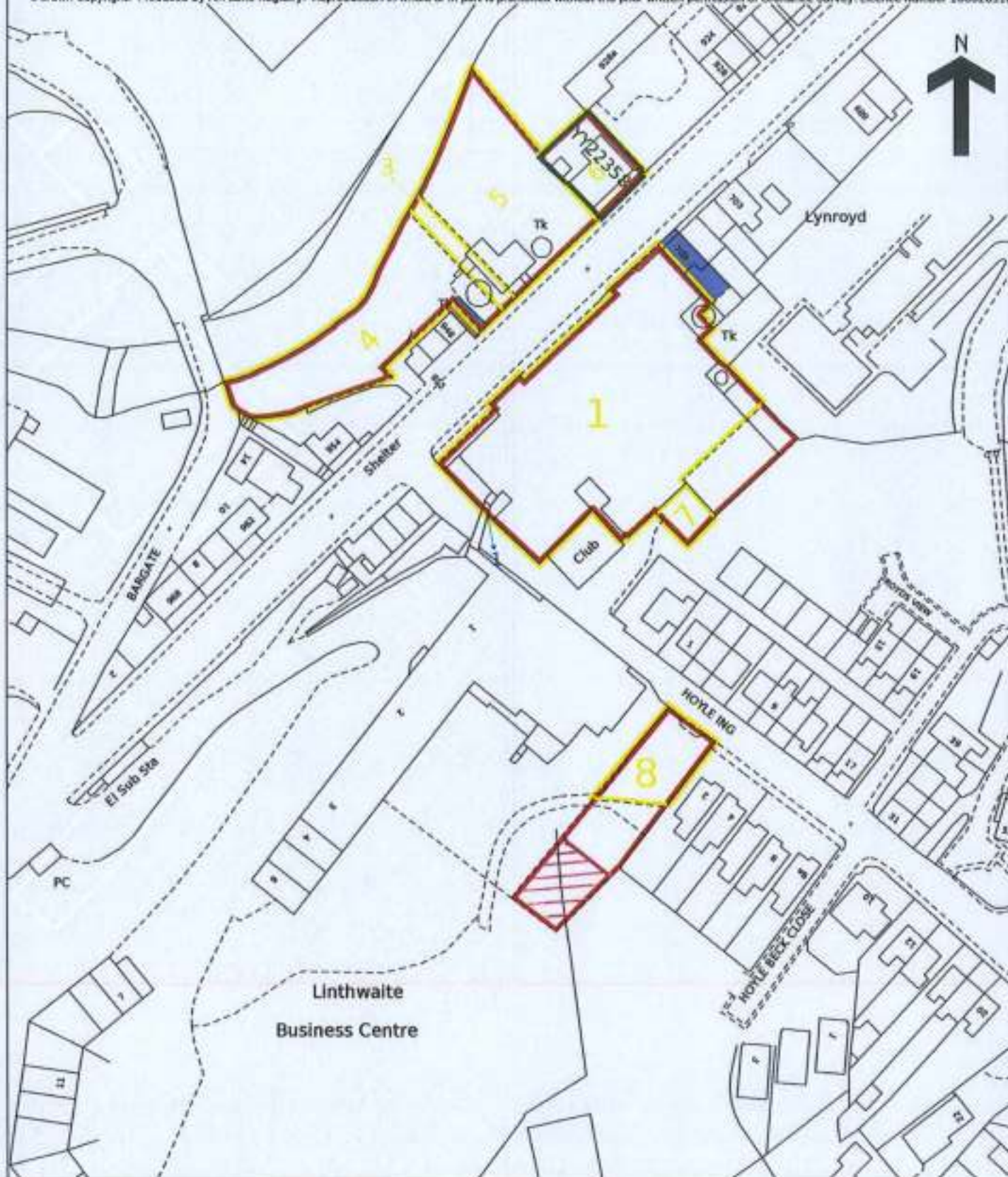


HM Land Registry
Official copy of
title plan

Title number **WYK441329**
Ordnance Survey map reference **SE0914NE**
Scale **1:1250 enlarged from 1:2500**
Administrative area **West Yorkshire :**
Kirklees



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drawn 27th Nov 2018

schedule

2x 3 bed @ 1200 ft²
(2.5 storey)
high

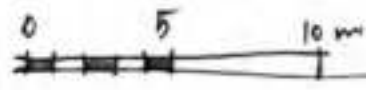
plot level + retaining
walls
subject
to
S.E.
design

no legal title
re boundaries
to be confirmed

Hogley Ing

STEVE BROUHAM
ARCHITECT

client Redwaters Yorkshire
project Site at Hogley Ing Rd
drawing Section site plan
status Discussion Only
drawing no 1718-4D-SK01



1:250 @ A1+

APPENDIX 3

DYNAMIC SAMPLE BOREHOLE LOGS AND PHOTOGRAPHS

IGE consulting		Office 16, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170		Dynamic Sample Borehole Log ver. 1.5				Dynamic Sample No. DS01 Sheet 1 of 1																																																																																																																																																																																																											
Project Name: Hoyle Ing				Co-ords: 409824E - 414464N		Project No. 3836																																																																																																																																																																																																													
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Client: Redwaters (Yorkshire) Ltd				Date: 07/06/2023		Checked By LM																																																																																																																																																																																																													
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<table><tr><th rowspan="2">Well / Backfill</th><th rowspan="2">Water Strikes</th><th colspan="3">Sample and In Situ Testing</th><th rowspan="2">Depth (m)</th><th rowspan="2">Level (m AOD)</th><th rowspan="2"></th><th rowspan="2">Stratum Description</th><th rowspan="2"></th></tr><tr><th>Depth(m)</th><th>Type</th><th>Results</th></tr><tr><td rowspan="25"></td><td></td><td>0.30</td><td>ES</td><td rowspan="3">0.00ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">Reddish brown, mottled dark brown, gravelly, slightly clayey, fine to coarse SAND with moderate cobble content. Cobbles are angular to subangular of sandstone (50%) and red brick (50%). Gravel is angular to subangular, fine to coarse of red brick (50%), sandstone (20%), limestone (10%) clinker (10%) and mudstone (10%). MADE GROUND</td><td rowspan="3">1</td></tr><tr><td>0.30</td><td>PID</td></tr><tr><td>0.50</td><td>B</td></tr><tr><td></td><td></td><td>0.70</td><td>ES</td><td rowspan="3">0.00ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr><tr><td>0.70</td><td>PID</td></tr><tr><td>1.20 - 1.65</td><td>D</td></tr><tr><td></td><td></td><td>1.20</td><td>SPT</td><td rowspan="3">N=6 (1,2/1,1,2,2)</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr><tr><td>1.30 - 1.70</td><td>B</td></tr><tr><td>1.40</td><td>ES</td></tr><tr><td></td><td></td><td>1.40</td><td>PID</td><td rowspan="3">0.00ppm</td><td rowspan="3">1.50</td><td rowspan="3">142.70</td><td rowspan="3">Soft, grey, mottled reddish brown, gravelly, sandy CLAY. Gravel is angular to subangular, fine to coarse of red brick (50%), limestone (20%), sandstone (20%) and concrete (10%). MADE GROUND</td><td rowspan="3"></td></tr><tr><td>1.80</td><td>D</td></tr><tr><td>1.80</td><td>ES</td></tr><tr><td></td><td></td><td>1.80</td><td>PID</td><td rowspan="3">0.10ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">Black, mottled reddish brown, slightly sandy, clayey, angular to subangular, fine to coarse GRAVEL of concrete (30%), red brick (30%), paper (30%) and sandstone (10%). Strong hydrocarbon odour. MADE GROUND</td><td rowspan="3">2</td></tr><tr><td>2.00 - 2.45</td><td>D</td></tr><tr><td>2.00</td><td>SPT</td></tr><tr><td></td><td></td><td>2.00</td><td>PID</td><td rowspan="3">N=2 (1,0/0,0,1,1) 0.00ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr><tr><td>2.30</td><td>ES</td></tr><tr><td>2.50</td><td>PID</td></tr><tr><td></td><td></td><td>2.50</td><td>PID</td><td rowspan="3">0.30ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr><tr><td>2.80</td><td>ES</td></tr><tr><td>3.00 - 3.45</td><td>D</td></tr><tr><td></td><td></td><td>3.00</td><td>SPT</td><td rowspan="3">N=2 (2,0/1,0,0,1) 0.00ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr><tr><td>3.00</td><td>PID</td></tr><tr><td>3.20</td><td>ES</td></tr><tr><td></td><td></td><td>3.30</td><td>PID</td><td rowspan="3">0.00ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr><tr><td>3.50 - 4.00</td><td>B</td></tr><tr><td>3.70</td><td>ES</td></tr><tr><td></td><td></td><td>3.70</td><td>PID</td><td rowspan="3">0.00ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">Very soft to soft, grey, mottled black, slightly gravelly, slightly sandy CLAY. Gravel is subangular to subrounded, fine to coarse. MADE GROUND</td><td rowspan="3"></td></tr><tr><td>4.00 - 4.45</td><td>D</td></tr><tr><td>4.00</td><td>SPT</td></tr><tr><td></td><td></td><td>4.00</td><td>SPT</td><td rowspan="3">N=13 (1,0/1,4,4,4) 0.00ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">Becoming soft to firm from 4.00m bgl.</td><td rowspan="3">4</td></tr><tr><td>4.30</td><td>PID</td></tr><tr><td>4.40</td><td>ES</td></tr><tr><td></td><td></td><td>4.70</td><td>PID</td><td rowspan="3">0.30ppm</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr><tr><td>4.80</td><td>ES</td></tr><tr><td>4.90</td><td>D</td></tr><tr><td></td><td></td><td>5.00</td><td>SPT</td><td rowspan="3">N=37 (12,7/12,9,8,8)</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3">Weathered SANDSTONE. Recovered as: Light yellowish brown, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL. MARSDEN FORMATION</td><td rowspan="3">5</td></tr><tr><td>5.45</td><td></td></tr><tr><td></td><td></td></tr><tr><td colspan="10">Dynamic Sample terminated at 5.45m.</td></tr><tr><td colspan="10">6</td></tr></table>										Well / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)		Stratum Description		Depth(m)	Type	Results			0.30	ES	0.00ppm			Reddish brown, mottled dark brown, gravelly, slightly clayey, fine to coarse SAND with moderate cobble content. Cobbles are angular to subangular of sandstone (50%) and red brick (50%). Gravel is angular to subangular, fine to coarse of red brick (50%), sandstone (20%), limestone (10%) clinker (10%) and mudstone (10%). MADE GROUND	1	0.30	PID	0.50	B			0.70	ES	0.00ppm					0.70	PID	1.20 - 1.65	D			1.20	SPT	N=6 (1,2/1,1,2,2)					1.30 - 1.70	B	1.40	ES			1.40	PID	0.00ppm	1.50	142.70	Soft, grey, mottled reddish brown, gravelly, sandy CLAY. Gravel is angular to subangular, fine to coarse of red brick (50%), limestone (20%), sandstone (20%) and concrete (10%). MADE GROUND		1.80	D	1.80	ES			1.80	PID	0.10ppm			Black, mottled reddish brown, slightly sandy, clayey, angular to subangular, fine to coarse GRAVEL of concrete (30%), red brick (30%), paper (30%) and sandstone (10%). Strong hydrocarbon odour. MADE GROUND	2	2.00 - 2.45	D	2.00	SPT			2.00	PID	N=2 (1,0/0,0,1,1) 0.00ppm					2.30	ES	2.50	PID			2.50	PID	0.30ppm					2.80	ES	3.00 - 3.45	D			3.00	SPT	N=2 (2,0/1,0,0,1) 0.00ppm					3.00	PID	3.20	ES			3.30	PID	0.00ppm					3.50 - 4.00	B	3.70	ES			3.70	PID	0.00ppm			Very soft to soft, grey, mottled black, slightly gravelly, slightly sandy CLAY. Gravel is subangular to subrounded, fine to coarse. MADE GROUND		4.00 - 4.45	D	4.00	SPT			4.00	SPT	N=13 (1,0/1,4,4,4) 0.00ppm			Becoming soft to firm from 4.00m bgl.	4	4.30	PID	4.40	ES			4.70	PID	0.30ppm					4.80	ES	4.90	D			5.00	SPT	N=37 (12,7/12,9,8,8)			Weathered SANDSTONE. Recovered as: Light yellowish brown, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL. MARSDEN FORMATION	5	5.45				Dynamic Sample terminated at 5.45m.										6									
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<table><tr><th colspan="2">Water Strike</th><th colspan="2">Casing Details</th><th colspan="3">Sample Sleeve Runs</th></tr><tr><th>Depth Strike</th><th>Remarks</th><th>Depth Base</th><th>Diameter</th><th>Depth Top (m)</th><th>Depth Base (m)</th><th>Diameter (mm)</th></tr><tr><td>1.70</td><td rowspan="4">Groundwater level recorded at 1.70m bgl following the completion of the borehole.</td><td></td><td></td><td>1.20</td><td>2.00</td><td>87 80%</td></tr><tr><td></td><td></td><td></td><td>2.00</td><td>3.00</td><td>77 40%</td></tr><tr><td></td><td></td><td></td><td>3.00</td><td>4.00</td><td>67 70%</td></tr><tr><td></td><td></td><td></td><td>4.00</td><td>5.00</td><td>67 50%</td></tr></table>										Water Strike		Casing Details		Sample Sleeve Runs			Depth Strike	Remarks	Depth Base	Diameter	Depth Top (m)	Depth Base (m)	Diameter (mm)	1.70	Groundwater level recorded at 1.70m bgl following the completion of the borehole.			1.20	2.00	87 80%				2.00	3.00	77 40%				3.00	4.00	67 70%				4.00	5.00	67 50%																																																																																																																																																																			
Water Strike		Casing Details		Sample Sleeve Runs																																																																																																																																																																																																															
Depth Strike	Remarks	Depth Base	Diameter	Depth Top (m)	Depth Base (m)	Diameter (mm)																																																																																																																																																																																																													
1.70	Groundwater level recorded at 1.70m bgl following the completion of the borehole.			1.20	2.00	87 80%																																																																																																																																																																																																													
				2.00	3.00	77 40%																																																																																																																																																																																																													
				3.00	4.00	67 70%																																																																																																																																																																																																													
				4.00	5.00	67 50%																																																																																																																																																																																																													



Image 1. DS01 Hand Dug Pit:
Viewed left to right, top to bottom.
0.00m - 1.20m bgl.



Image 2. DS01 Sample:
Viewed left to right, top to bottom.
1.20m - 2.00m bgl.
2.00m - 3.00m bgl.
3.00m - 4.00m bgl.
4.00m - 4.90m bgl.

IGEconsulting				Office 16, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170				Dynamic Sample Borehole Log				Dynamic Sample No. DS02									
								ver. 1.5				Sheet 1 of 1									
Project Name: Hoyle Ing								Co-ords:		409815E - 414452N				Project No. 3836							
Location: Linthwaite								Level (m AOD):		145.10				Logged By AS							
Client: Redwaters (Yorkshire) Ltd								Date:		07/06/2023				Checked By LM							
Well / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)		Stratum Description													
		Depth(m)	Type	Results																	
		0.30	B	0.60ppm	1.30	143.80		Reddish brown, mottled dark brown, gravelly, slightly clayey, fine to coarse SAND with high cobble content. Cobbles are angular to subangular of red brick (70%), sandstone (20%) and concrete (10%). Gravel is angular to subangular, fine to coarse of red brick (50%), sandstone (20%), limestone (10%), concrete (10%) and clinker (10%). MADE GROUND							1						
		0.30	ES																		
		0.30	PID																		
		0.80	B	0.10ppm				Orangish brown, mottled black, clayey, fine to coarse SAND and angular to subrounded, fine to coarse GRAVEL of clinker (70%) and sandstone (30%). Strong humic odour. MADE GROUND								2					
		0.80	ES																		
		0.80	PID																		
		1.20 - 1.65	D	N=7 (1,3/3,1,1,2) 0.10ppm				Greyish brown, mottled black, gravelly, slightly clayey, fine to coarse SAND. Gravel is angular to subangular, fine to coarse of glass (40%), clinker (30%) and sandstone (30%). MADE GROUND									3				
		1.20	SPT																		
		1.20	PID																		
		1.40	ES	0.00ppm				Black, mottled grey, slightly gravelly, slightly sandy, silty CLAY. Gravel is subangular to subrounded, fine to coarse of sandstone. Strong hydrocarbon odour. MADE GROUND										4			
		1.40	PID																		
		1.50	B																		
		1.80	ES	0.10ppm				Soft, grey, mottled black, slightly gravelly, sandy CLAY. Gravel is subangular to subrounded, fine to coarse. MADE GROUND											5		
		1.80	PID																		
		2.00 - 2.45	D																		
		2.00	SPT	N=6 (2,3/1,0,3,2) 0.10ppm				Weathered SANDSTONE. Recovered as: Light greyish brown, slightly clayey, fine to coarse SAND and angular to subrounded, fine to coarse GRAVEL. MARSDEN FORMATION Dynamic Sample terminated at 4.98m.												6	
		2.00	PID																		
		3.00 - 3.45	D																		
		3.00	SPT	N=2 (1,0/0,0,1,1) 0.60ppm				Groundwater level recorded at 2.20m bgl during the construction of the borehole.													
		3.00	PID																		
4.00	SPT																				
4.30	ES	0.00ppm																			
4.30	PID																				
4.70	ES																				
4.70	PID	0.70ppm																			
4.90 - 4.98	D																				
4.90	SPT																				
4.90	PID	N=50 (20 for 60mm/50 for 20mm) 0.00ppm																			
4.90	SPT																				
4.90	PID																				

Remarks:				Water Strike		Casing Details		Sample Sleeve Runs		
Depth Strike		Remarks		Depth Base	Diameter	Depth Top (m)	Depth Base (m)	Diameter (mm)		
2.20		Groundwater level recorded at 2.20m bgl during the construction of the borehole.				1.20	2.00	87 90%		
						2.00	3.00	77 0%		
						3.00	4.00	67 0%		
						4.00	4.98	67 50%		



Image 1. DS02 Hand Dug Pit:
Viewed left to right, top to bottom.
0.00m - 1.20m bgl.



Image 2. DS02 Sample:
Viewed left to right, top to bottom.
1.20m - 2.00m bgl.
4.00m - 5.00m bgl.

Office 16, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170				Dynamic Sample Borehole Log				Dynamic Sample No. DS03 Sheet 1 of 1																	
Project Name: Hoyle Ing				Co-ords: 409826E - 414452N		Project No. 3836																			
Location: Linthwaite				Level (m AOD): 145.00		Logged By AS																			
Client: Redwaters (Yorkshire) Ltd				Date: 07/06/2023		Checked By LM																			
Well / Backfill		Water Strikes		Sample and In Situ Testing			Depth (m)		Level (m AOD)		Stratum Description														
				Depth(m) Type Results																					
				0.20 B 0.20 ES 0.20 PID 0.50ppm							Reddish brown, mottled dark grey, slightly clayey, fine to coarse SAND with medium cobble content. Cobbles are angular to subangular of red brick (50%) and sandstone (50%). Gravel is angular to subangular, fine to coarse of clinker (50%), red brick (30%) and sandstone (20%). MADE GROUND														
				0.70 B 0.70 ES 0.80 PID 0.30ppm			1.00		144.00		Soft, dark grey, mottled orangish brown, gravelly, slightly sandy CLAY. Gravel is angular to subangular, fine to coarse of sandstone (50%), paper (30%) and mudstone (20%). MADE GROUND														
				1.10 ES 1.20 B 1.20 ES 1.20 - D 1.65 1.20 SPT N=4 (1,0/1,0,1,2) 1.20 PID 0.00ppm 1.20 PID 0.10ppm 1.30 PID 0.00ppm 1.70 ES 1.70 PID 0.20ppm 2.00 - D 2.45 2.00 SPT N=14 (2,2/3,2,3,6) 2.00 PID 0.10ppm 2.30 ES 2.30 PID 0.20ppm			1.30		143.70		Light brown, mottled orangish brown, gravelly, slightly clayey, fine to coarse SAND. Gravel is angular to subangular, fine to coarse of sandstone (60%) and limestone (40%). MADE GROUND														
				2.80 ES 2.80 PID 0.20ppm 3.00 - D 3.45 3.00 SPT N=50 (6,3/7,31,8,4) 3.00 PID 0.10ppm 3.20 D 3.20 PID 1.00ppm			2.20		142.80		Soft to firm, dark greyish brown, gravelly, sandy CLAY. Gravel is angular to subangular, fine to coarse of sandstone. MADE GROUND														
				3.60 D 3.60 SPT N=50 (20 for 60mm/50 for 80mm) 3.60 PID 0.10ppm			3.00		142.00		Reddish brown, mottled light brown, sandy, angular to subangular, fine to coarse GRAVEL of sandstone with occasional gravel sized pockets of soft, black, sandy, silty CLAY. MADE GROUND														
				3.60 D 3.60 SPT N=50 (20 for 60mm/50 for 80mm) 3.60 PID 0.10ppm			3.60		141.40		Weathered SANDSTONE. Recovered as: Light grey, fine to coarse SAND and subangular to subrounded, fine to coarse GRAVEL. MARSDEN FORMATION														
				3.60 PID 0.10ppm			3.74		141.26		Dynamic Sample terminated at 3.74m.														
Remarks:												Water Strike		Casing Details		Sample Sleeve Runs									
Dynamic Sample Borehole terminated at 3.74m bgl due to refusal on bedrock.												Depth Strike		Remarks		Depth Base		Diameter		Depth Top (m)		Depth Base (m)		Diameter (mm)	
												2.20		Groundwater level following the completion of the borehole recorded at 3.20m bgl.						1.20 2.00 3.00		2.00 3.00 3.60		87 90% 77 70% 67 20%	



Image 1. DS03 Hand Dug Pit:
Viewed left to right, top to bottom.
0.00m - 1.20m bgl.



Image 2. DS03 Sample:
Viewed left to right, top to bottom.
1.20m - 2.00m bgl.
2.00m - 3.00m bgl.
3.00m - 3.60m bgl.

 Office 16, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170		Dynamic Sample Borehole Log			Dynamic Sample No.						
					DS04						
					Sheet 1 of 1						
Project Name: Hoyle Ing					Co-ords: 409813E - 414440N		Project No. 3836				
Location: Linthwaite					Level (m AOD): 146.50		Logged By AS				
					Date: 07/06/2023		Checked By LM				
Client: Redwaters (Yorkshire) Ltd					Weather: Sunny						
Well / Backfill	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m AOD)	Stratum Description				
		Depth(m)	Type	Results							
		0.30	B	0.00ppm	0.50	146.00	Dark brown, gravelly, slightly clayey, fine to coarse SAND with frequent rootlets. Gravel is subangular to subrounded, fine to coarse of sandstone (70%), mudstone (20%) and natural wood fragments (10%). TOPSOIL				
		0.30	ES								
		0.30	PID								
		0.70	PID	0.00ppm				Weathered MUDSTONE. Recovered as: Soft, orangish brown, slightly gravelly, sandy CLAY. Gravel is subangular to subrounded, fine to coarse. MARSDEN FORMATION			
		0.80	B								
		0.80	ES								
		1.20 - 1.50	B	N=16 (3,3/3,5,4,4)	1.20	145.30	Weathered MUDSTONE. Recovered as: Firm to stiff, greyish brown, mottled orangish brown, slightly gravelly, sandy CLAY. Gravel is subangular to subrounded, fine to coarse. MARSDEN FORMATION				
		1.20 - 1.65	D								
		1.20	SPT								
		1.20	PID								
		1.30	ES								
		1.30	PID								
		1.60 - 1.90	B								
		1.70									
		1.70	PID								
		1.80	ES								
		1.90									
		2.00 - 2.45	D	HVP=150	2.50	144.00	Weathered SANDSTONE. Recovered as: Yellowish brown, slightly gravelly, slightly clayey, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse. MARSDEN FORMATION				
		2.00 - 2.50	B	0.10ppm							
		2.00	SPT								
		2.00	PID	0.20ppm	3.00	143.50	Weathered SANDSTONE. Recovered as: Yellowish brown, mottled dark grey, slightly gravelly, clayey, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse. MARSDEN FORMATION				
		2.30	ES								
		2.30	PID								
		2.70	ES	0.10ppm	3.50	143.00	Weathered SANDSTONE. Recovered as: Yellowish brown, mottled dark grey, slightly gravelly, clayey, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse. MARSDEN FORMATION				
		2.70	PID								
3.00 - 3.45	D										
3.00 - 3.50	B	N=19 (4,5/5,4,5,5)	3.50	142.88	Weathered SANDSTONE. Recovered as: Yellowish brown, mottled dark grey, slightly gravelly, clayey, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse. MARSDEN FORMATION						
3.00	SPT										
3.00	PID										
3.30	ES	0.20ppm	3.62	142.88	Weathered SANDSTONE. Recovered as: yellowish brown, mottled orangish brown, sandy, angular to subangular, fine to coarse GRAVEL. MARSDEN FORMATION						
3.30	PID										
3.50	D										
3.50	SPT	N=50 (20 for 50mm/50 for 70mm)	Dynamic Sample terminated at 3.62m.								
3.50	PID	0.20ppm									
Remarks:					Water Strike		Casing Details		Sample Sleeve Runs		
Dynamic Sample Borehole terminated at 3.62m bgl due to refusal on bedrock.					Depth Strike	Remarks	Depth Base	Diameter	Depth Top (m)	Depth Base (m)	Diameter (mm)
						No strike.			1.20	2.00	87 100%
									2.00	3.00	77 80%
									3.00	3.50	67 50%



Image 1. DS04 Hand Dug Pit:
Viewed left to right, top to bottom.
0.00m - 1.20m bgl.



Image 2. DS04 Sample:
Viewed left to right, top to bottom.
1.20m - 2.00m bgl.
2.00m - 3.00m bgl.
3.00m - 3.50m bgl.

APPENDIX 4

FOUNDATION INSPECTION PIT LOGS AND PHOTOGRAPHS

IGE Office 11, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170				Hand Dug Pit Log ver. 1.0				Trial Pit No. FIP01 Sheet 1 of 1		
Project Name: Hoyle Ing					Level (mAOD): 145.37		Date: 17/05/2023		Project No. 3836	
Location: Linthwaite					Weather: Sunny				Logged By AS	
Client: Redwaters (Yorkshire) Ltd					Co-ords: 409832E - 414455N				Checked By AJ	
Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)	Stratum Description				
	Depth (m)	Type	Results							
	0.10 0.10 0.10	B ES PID	PID=0.4	0.15	145.22	Soft to firm, dark brown, slightly gravelly, sandy CLAY with occasional rootlets. Gravel is angular to subrounded, fine to coarse of red brick (30%), sandstone (30%), clinker (30%), glass (5%) and plastic (5%). MADE GROUND				
	0.20 0.20 0.20	B ES PID	PID=0.8			Brown, mottled black, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL of red brick (50%), sandstone (20%), clinker (20%) and limestone (10%) with medium cobble content. Cobbles are angular to subangular of sandstone (50%) and red brick (50%). MADE GROUND <i>Foundation encountered at 0.20m bgl.</i>				
				0.40	144.97	Trial Pit terminated at 0.40m.				
1										
Water Strike						FIP01 Retaining Wall Ground Level MADE GROUND				
Depth Strike (mbgl)		Remarks								
		No strike.								
Stability:										
Occasional small collapses.										
Remarks:										
Hand Dug Pit terminated at 0.40m bgl for foundation inspection.										

Trial Pit Photos

FIP01

Hoyle Ing



Image 1. HDP01 Pit



Image 2. HDP01 Spoil

IGE consulting Office 11, Bartle House, Oxford Court Manchester M2 3WQ email: contact@igeconsulting.co.uk web: www.igeconsulting.co.uk tel: 0161 914 9170				Hand Dug Pit Log ver. 1.0				Trial Pit No. FIP02 Sheet 1 of 1			
Project Name: Hoyle Ing					Level (mAOD): 145.26		Date: 17/05/2023		Project No. 3836		
Location: Linthwaite					Weather: Sunny				Logged By AS		
Client: Redwaters (Yorkshire) Ltd					Co-ords: 409825E - 414446N				Checked By AJ		
Water Strike	Samples & In Situ Testing			Depth (mbgl)	Level (mAOD)		Stratum Description				
	Depth (m)	Type	Results								
	0.20 0.20 0.20	B ES PID	PID=0.2	0.05	145.21		Soft to firm, dark brown, slightly gravelly, sandy CLAY with occasional rootlets. Gravel is angular to subrounded, fine to coarse of sandstone (70%) glass (15%) and plastic (15%). MADE GROUND Brown, mottled black, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL of sandstone (40%), clinker (40%) and limestone (20%) with medium cobble content. Cobbles are angular to subangular of sandstone. MADE GROUND Foundation encountered at 0.15m bgl.				
								0.30	144.96		Trial Pit terminated at 0.30m.
1											
Water Strike							FIP02 Retaining Wall Ground Level MADE GROUND				
Depth Strike (mbgl)		Remarks									
		No strike.									
Stability: Occasional small collapses.											
Remarks: Hand Dug Pit terminated at 0.30m bgl for foundation inspection.											

Trial Pit Photos

FIP02

Hoyle Ing



Image 1. HDP02 Pit



Image 2. HDP02 Spoil

APPENDIX 5

GEOTECHNICAL LABORATORY TEST RESULTS

TEST REPORT

Client IGE Consulting Ltd

Address Office 16
Bartle House
Oxford Court
Manchester
M2 3WQ

Contract Hoyle Ing

Job Number MRN 4601/43

Date of Issue 13 July 2023

Page 1 of 5

Approved Signatories

S J Hutchings, O P Davies

Notes

- 1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.
- 2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.
- 3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.
- 4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted.
- 5 The results included within the report are representative of the samples submitted for analysis.
- 6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.



Andrew House, Hadfield Street, Dukinfield, Cheshire SK16 4QX Tel: 0161 475 0870
Email: enquiries@murrayrix.com Website: www.murrayrix.com

Also at: London: 020 8523 1999

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MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

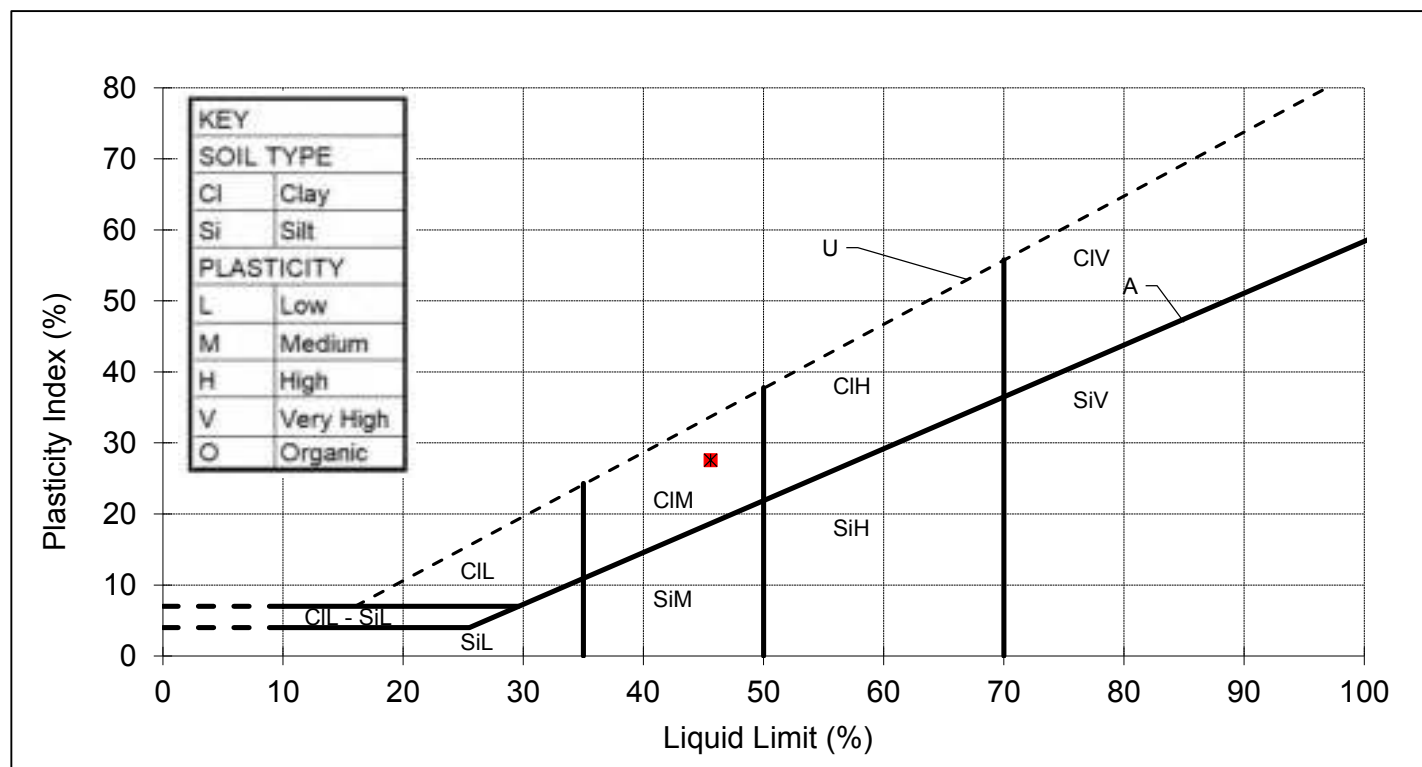
CLIENT	IGE Consulting Ltd
SITE	Hoyle Ing
JOB NUMBER	MRN 4601/43

SAMPLE LABEL	DS01 @ 3.5-4.0	DATE SAMPLED	07-Jun-23
SAMPLE No.	126640	DATE RECEIVED	13-Jun-23
DATE TESTED	23-Jun-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	17.8	44.1	1.033	
Determination 2 (avg)	18.0	44.2		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
49.2	46	18	28	90



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

13-Jul-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

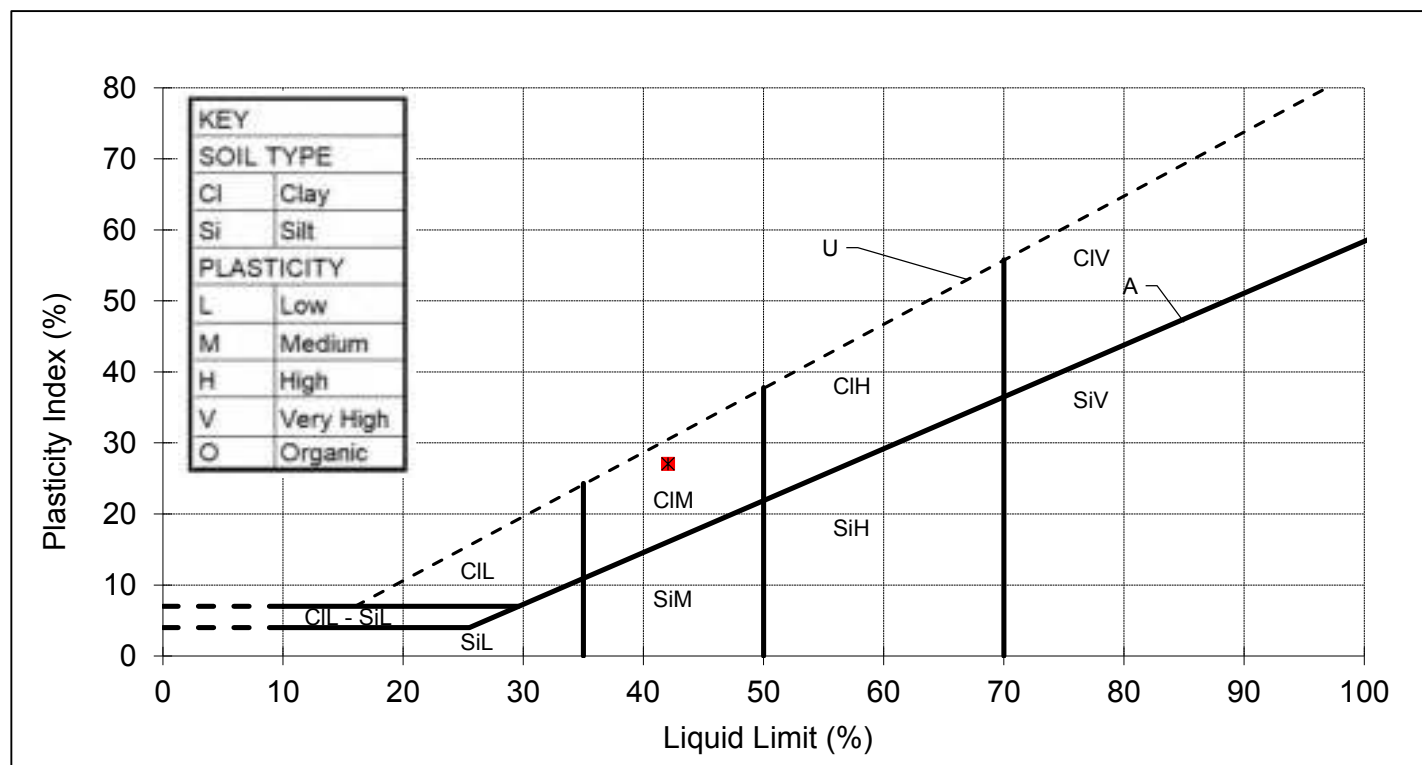
CLIENT	IGE Consulting Ltd
SITE	Hoyle Ing
JOB NUMBER	MRN 4601/43

SAMPLE LABEL	DS03 @ 1.2	DATE SAMPLED	07-Jun-23
SAMPLE No.	126641	DATE RECEIVED	13-Jun-23
DATE TESTED	23-Jun-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	18.6	41.1	1.027	
Determination 2 (avg)	18.4	40.8		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
29.0	42	15	27	94



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

13-Jul-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

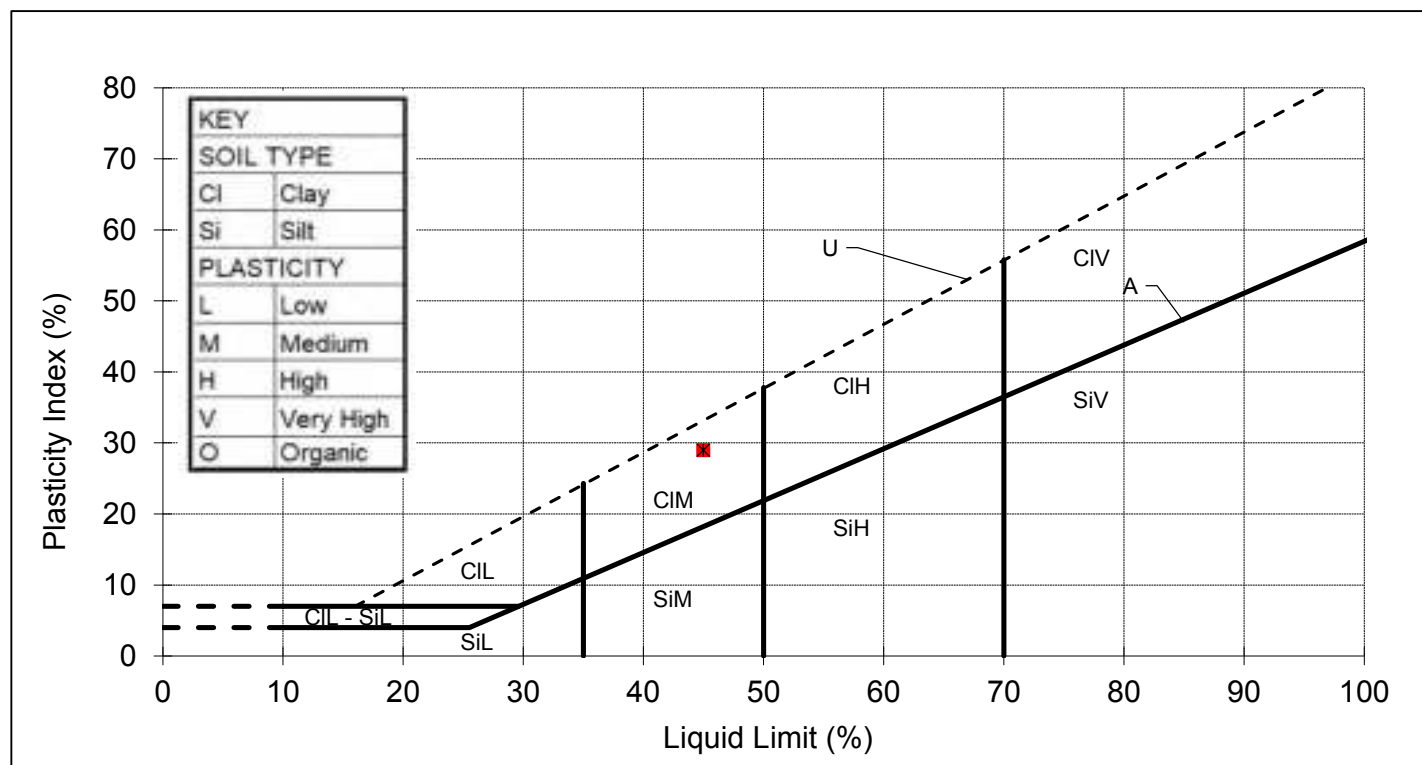
CLIENT	IGE Consulting Ltd
SITE	Hoyle Ing
JOB NUMBER	MRN 4601/43

SAMPLE LABEL	DS04 @ 0.8	DATE SAMPLED	07-Jun-23
SAMPLE No.	126642	DATE RECEIVED	13-Jun-23
DATE TESTED	23-Jun-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	18.2	43.5	1.034	
Determination 2 (avg)	18.2	43.5		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
27.2	45	16	29	88



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

13-Jul-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

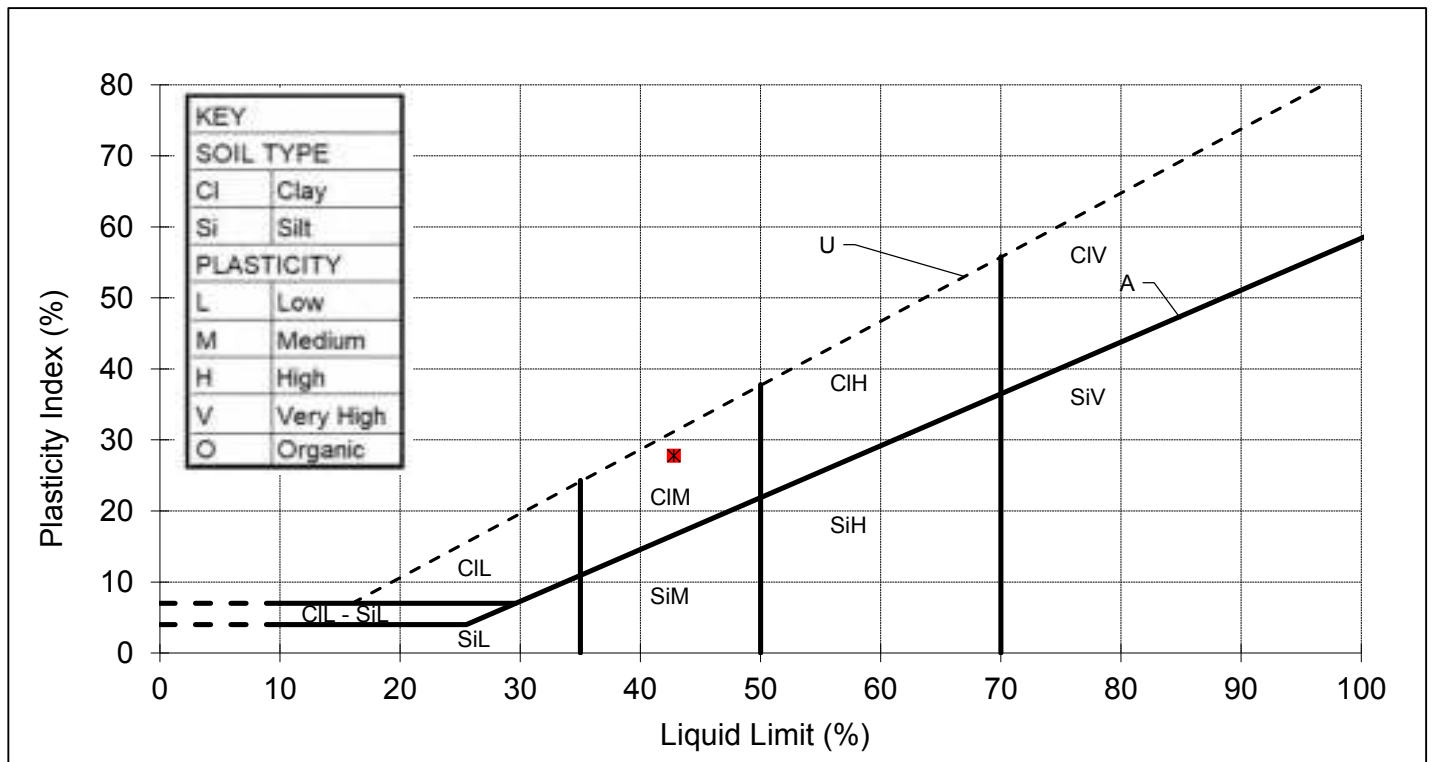
CLIENT	IGE Consulting Ltd
SITE	Hoyle Ing
JOB NUMBER	MRN 4601/43

SAMPLE LABEL	DS04 @ 1.2-1.5	DATE SAMPLED	07-Jun-23
SAMPLE No.	126643	DATE RECEIVED	13-Jun-23
DATE TESTED	23-Jun-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	18.5	41.7	1.026	
Determination 2 (avg)	18.6	41.7		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
16.9	43	15	28	82



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

13-Jul-23

APPENDIX 5

CHEMICAL LABORATORY TEST RESULTS AND SCREENING TABLE



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THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 23-48583

Issue: 1

Date of Issue: 28/06/2023

Contact: Aga Stefanowicz

Customer Details: IGE Consulting Ltd
Office 16, Bartle House
Oxford Court
Manchester
M2 3WQ

Quotation No: Q22-03729

Order No: Not Supplied

Customer Reference: 3836

Date Received: 07/06/2023

Date Approved: 28/06/2023

Details: Hoyle Ing

Approved by:

Tim Reeve, Quality Officer

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

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Sample Summary

Report No.: 23-48583, issue number 1

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
326999	DS01 0.30	07/06/2023	08/06/2023	Sandy silty loam	
327000	DS01 2.30	07/06/2023	08/06/2023	Sandy loam	
327001	DS01 3.70	07/06/2023	08/06/2023	Silty loam	
327002	DS01 4.80	07/06/2023	08/06/2023	Loamy sand	
327003	DS02 0.80	07/06/2023	08/06/2023	Sandy loam	
327004	DS02 1.80	07/06/2023	08/06/2023	Sandy silty loam	
327005	DS02 4.70	07/06/2023	08/06/2023	Silty clayey loam	
327006	DS03 1.10	07/06/2023	08/06/2023	Sandy loam	
327007	DS03 2.80	07/06/2023	08/06/2023	Sandy loam	
327008	DS04 0.30	07/06/2023	08/06/2023	Silty loam	
327009	DS04 0.80	07/06/2023	08/06/2023	Sandy silty loam	
327010	DS04 3.30	07/06/2023	08/06/2023	Loamy sand	
327011	DS02 3.00 - 3.45	07/06/2023	08/06/2023	Silty loam	



Results Summary

Report No.: 23-48583, issue number 1

				ELAB Reference	326999	327000	327001	327002	327003	327004	327005	327006	327007	327008	327009
				Customer Reference											
				Sample ID											
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sample Location	DS01	DS01	DS01	DS01	DS02	DS02	DS02	DS03	DS03	DS04	DS04
				Sample Depth (m)	0.30	2.30	3.70	4.80	0.80	1.80	4.70	1.10	2.80	0.30	0.80
				Sampling Date	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Determinand		Codes	Units	LOD											
Soil sample preparation parameters															
Moisture Content		N	%	0.1	8.2	21.3	41.1	12.1	9.2	18.0	30.8	28.4	28.3	18.9	16.0
Material removed		N	%	0.1	23.5	39.1	< 0.1	12.9	34.6	36.4	< 0.1	13.8	< 0.1	< 0.1	2.5
Description of Inert material removed		N		0	Stones	Stones	None	Stones	Stones	Stones	None	Stones	None	None	Stones
Metals															
Arsenic		SM	mg/kg	2	9.0	81.0	27.0	6.0	18.0	53.0	11.0	40.0	10.0	19.0	10.0
Barium		SM	mg/kg	2.5	243	245	286	46.0	103	230	66.0	222	85.0	63.0	40.0
Beryllium		SM	mg/kg	0.5	0.6	1.5	2.5	< 0.5	0.8	2.6	0.6	1.7	1.4	1.0	1.0
Cadmium		SM	mg/kg	0.2	0.4	1.6	2.1	0.3	0.4	1.1	0.2	0.7	0.8	0.4	0.3
Chromium		SM	mg/kg	2	26.0	96.0	44.0	18.0	29.0	30.0	24.0	36.0	27.0	23.0	27.0
Copper		SM	mg/kg	4	44.0	225	124	23.0	78.0	398	45.0	82.0	54.0	37.0	22.0
Lead		SM	mg/kg	3	93.0	377	466	53.0	96.0	298	42.0	358	165	72.0	27.0
Water soluble magnesium		SM	g/l	0.01	n/t	< 0.01	0.03	n/t	< 0.01	n/t	< 0.01	< 0.01	< 0.01	n/t	< 0.01
Mercury		SM	mg/kg	1	< 1.0	6.1	1.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nickel		SM	mg/kg	3	22.0	50.0	45.0	17.0	30.0	37.0	11.0	38.0	35.0	14.0	19.0
Selenium		SM	mg/kg	2	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.2	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Vanadium		SM	mg/kg	1	25.0	76.0	42.0	13.0	36.0	53.0	26.0	44.0	24.0	35.0	30.0
Zinc		SM	mg/kg	3	106	290	359	80.0	85.0	186	39.0	156	233	59.0	76.0



Results Summary

Report No.: 23-48583, issue number 1

ELAB Reference	326999	327000	327001	327002	327003	327004	327005	327006	327007	327008	327009
Customer Reference											
Sample ID											
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sample Location	DS01	DS01	DS01	DS01	DS02	DS02	DS02	DS03	DS03	DS04	DS04
Sample Depth (m)	0.30	2.30	3.70	4.80	0.80	1.80	4.70	1.10	2.80	0.30	0.80
Sampling Date	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023

Determinand	Codes	Units	LOD											
Anions														
Water Soluble Nitrate	M	mg/kg	40	< 40	49	45	< 40	< 40	< 40	< 40	< 40	< 40	< 40	< 40
Water Soluble Nitrate	U	mg/l	20	n/t	24	23	n/t	< 20	n/t	< 20	< 20	< 20	n/t	< 20
Water Soluble Sulphate	M	g/l	0.02	n/t	0.17	0.49	n/t	0.10	n/t	0.02	< 0.02	< 0.02	n/t	< 0.02
Water Soluble Sulphate	M	mg/kg	40	< 40	333	976	163	204	54	40	< 40	< 40	< 40	< 40
Inorganics														
Acid Soluble Chloride	N	%	0.01	n/t	< 0.10	< 0.10	n/t	< 0.10	n/t	< 0.10	< 0.10	< 0.10	n/t	< 0.10
Free Cyanide	N	mg/kg	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
Total Cyanide	M	mg/kg	1	< 1.0	2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Sulphur	N	%	0.01	n/t	0.44	0.52	n/t	0.10	n/t	0.03	0.12	0.03	n/t	0.03
Acid Soluble Sulphate (SO4)	U	%	0.02	n/t	0.24	0.19	n/t	0.21	n/t	0.03	0.05	0.03	n/t	0.03
Water Soluble Boron	N	mg/kg	0.5	< 0.5	1.0	2.1	< 0.5	< 0.5	0.6	0.6	0.6	< 0.5	0.6	< 0.5
Miscellaneous														
pH	M	pH units	0.1	8.1	7.9	7.1	7.3	10.6	8.6	6.1	6.8	6.9	5.4	5.3
Soil Organic Matter	U	%	0.1	1.4	4.8	9.3	0.6	1.3	3.7	1.4	4.8	2.5	3.3	0.9
Total Organic Carbon	N	%	0.01	1.4	9.9	9.6	0.38	2.5	19	1.0	6.0	1.3	5.5	1.0
Phenols														
Phenol	M	mg/kg	1	n/t	< 1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
M,P-Cresol	N	mg/kg	1	n/t	< 1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
O-Cresol	N	mg/kg	1	n/t	< 1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
3,4-Dimethylphenol	N	mg/kg	1	n/t	< 1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
2,3-Dimethylphenol	M	mg/kg	1	n/t	< 1	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
2,3,5-trimethylphenol	M	mg/kg	1	n/t	3	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t
Total Monohydric Phenols	N	mg/kg	5	n/t	< 5	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t	n/t



Results Summary

Report No.: 23-48583, issue number 1

				ELAB Reference	326999	327000	327001	327002	327003	327004	327005	327006	327007	327008	327009
				Customer Reference											
				Sample ID											
				Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Sample Location	DS01	DS01	DS01	DS01	DS02	DS02	DS02	DS03	DS03	DS04	DS04
				Sample Depth (m)	0.30	2.30	3.70	4.80	0.80	1.80	4.70	1.10	2.80	0.30	0.80
				Sampling Date	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023
Determinand		Codes	Units	LOD											
Polyaromatic hydrocarbons															
Naphthalene	MS	mg/kg	0.02	0.05	562	0.21	0.10	0.09	0.26	< 0.02	0.05	0.02	< 0.02	< 0.02	< 0.02
Acenaphthylene	MS	mg/kg	0.02	0.12	5.13	0.03	0.02	0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Acenaphthene	MS	mg/kg	0.02	0.24	204	0.19	0.19	0.08	0.21	< 0.02	0.05	< 0.02	< 0.02	< 0.02	< 0.02
Fluorene	US	mg/kg	0.02	0.25	204	0.21	0.22	0.05	0.14	< 0.02	0.03	< 0.02	< 0.02	< 0.02	< 0.02
Phenanthrene	MS	mg/kg	0.02	4.55	1310	1.24	1.21	0.77	1.76	0.13	0.44	0.07	0.12	0.05	0.05
Anthracene	US	mg/kg	0.02	1.11	330	0.39	0.35	0.23	0.36	0.03	0.10	< 0.02	0.03	< 0.02	< 0.02
Fluoranthene	MS	mg/kg	0.02	11.9	1090	1.99	1.46	2.36	2.81	0.25	0.85	0.12	0.24	0.07	0.07
Pyrene	MS	mg/kg	0.02	10.7	885	1.65	1.20	2.15	2.42	0.19	0.74	0.11	0.20	0.06	0.06
Benzo(a)anthracene	US	mg/kg	0.02	6.41	395	0.83	0.60	1.16	1.32	0.10	0.39	0.07	0.11	0.03	0.03
Chrysene	MS	mg/kg	0.02	6.91	414	0.95	0.64	1.34	1.49	0.12	0.46	0.09	0.16	0.04	0.04
Benzo(b)fluoranthene	MS	mg/kg	0.02	7.99	318	0.92	0.60	1.30	1.34	0.12	0.46	0.08	0.15	0.04	0.04
Benzo(k)fluoranthene	MS	mg/kg	0.03	3.63	137	0.42	0.26	0.57	0.57	0.05	0.19	0.04	0.06	< 0.03	< 0.03
Benzo(a)pyrene	US	mg/kg	0.02	9.40	347	0.88	0.60	1.28	1.37	0.11	0.45	0.08	0.13	0.04	0.04
Indeno(1,2,3-cd)pyrene	MS	mg/kg	0.02	5.72	172	0.56	0.37	0.82	0.82	0.08	0.29	0.06	0.09	0.03	0.03
Dibenzo(a,h)anthracene	MS	mg/kg	0.02	1.37	42.7	0.13	0.09	0.20	0.22	< 0.02	0.07	< 0.02	0.02	< 0.02	< 0.02
Benzo[g,h,i]perylene	MS	mg/kg	0.02	5.93	175	0.57	0.36	0.86	0.88	0.07	0.31	0.06	0.09	0.02	0.02
Total PAH(16)	NS	mg/kg	0.34	76.3	6600	11.2	8.27	13.3	16.0	1.27	4.89	0.80	1.41	0.40	0.40
BTEX															
Benzene	M	ug/kg	10	< 10.0	< 10.0	n/t	n/t	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	n/t	n/t
Toluene	M	ug/kg	10	< 10.0	11.0	n/t	n/t	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	n/t	n/t
Ethylbenzene	M	ug/kg	10	< 10.0	< 10.0	n/t	n/t	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	n/t	n/t
Xylenes	M	ug/kg	10	< 10.0	113	n/t	n/t	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	n/t	n/t
MTBE	N	ug/kg	10	< 10.0	< 10.0	n/t	n/t	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	n/t	n/t
Total Petroleum Hydrocarbons															
Total TPH (>C8-C40) (EH_1D_Total)	N	mg/kg	5	53	n/t	19	15	247	42	< 5	21	< 5	13	< 5	< 5



Results Summary

Report No.: 23-48583, issue number 1

ELAB Reference	327010	327011
Customer Reference		
Sample ID		
Sample Type	SOIL	SOIL
Sample Location	DS04	DS02
Sample Depth (m)	3.30	3.00 - 3.45
Sampling Date	07/06/2023	07/06/2023

Determinand	Codes	Units	LOD		
Soil sample preparation parameters					
Moisture Content	N	%	0.1	9.5	44.7
Material removed	N	%	0.1	< 0.1	22.2
Description of Inert material removed	N		0	None	Stones, Wood, Rubber
Metals					
Arsenic	SM	mg/kg	2	< 2.0	n/t
Barium	SM	mg/kg	2.5	21.0	n/t
Beryllium	SM	mg/kg	0.5	< 0.5	n/t
Cadmium	SM	mg/kg	0.2	< 0.2	n/t
Chromium	SM	mg/kg	2	10.0	n/t
Copper	SM	mg/kg	4	6.0	n/t
Lead	SM	mg/kg	3	3.0	n/t
Water soluble magnesium	SM	g/l	0.01	< 0.01	0.05
Mercury	SM	mg/kg	1	< 1.0	n/t
Nickel	SM	mg/kg	3	12.0	n/t
Selenium	SM	mg/kg	2	< 2.0	n/t
Vanadium	SM	mg/kg	1	12.0	n/t
Zinc	SM	mg/kg	3	26.0	n/t



Results Summary

Report No.: 23-48583, issue number 1

ELAB Reference	327010	327011
Customer Reference		
Sample ID		
Sample Type	SOIL	SOIL
Sample Location	DS04	DS02
Sample Depth (m)	3.30	3.00 - 3.45
Sampling Date	07/06/2023	07/06/2023

Determinand	Codes	Units	LOD		
Anions					
Water Soluble Nitrate	M	mg/kg	40	< 40	n/t
Water Soluble Nitrate	U	mg/l	20	< 20	23
Water Soluble Sulphate	M	g/l	0.02	< 0.02	1.17
Water Soluble Sulphate	M	mg/kg	40	< 40	n/t
Inorganics					
Acid Soluble Chloride	N	%	0.01	< 0.10	< 0.10
Free Cyanide	N	mg/kg	1	< 1.0	n/t
Hexavalent Chromium	N	mg/kg	0.8	< 0.8	n/t
Total Cyanide	M	mg/kg	1	< 1.0	n/t
Total Sulphur	N	%	0.01	0.01	0.77
Acid Soluble Sulphate (SO4)	U	%	0.02	0.02	0.35
Water Soluble Boron	N	mg/kg	0.5	< 0.5	n/t
Miscellaneous					
pH	M	pH units	0.1	5.3	6.4
Soil Organic Matter	U	%	0.1	< 0.1	n/t
Total Organic Carbon	N	%	0.01	0.13	n/t
Phenols					
Phenol	M	mg/kg	1	n/t	n/t
M,P-Cresol	N	mg/kg	1	n/t	n/t
O-Cresol	N	mg/kg	1	n/t	n/t
3,4-Dimethylphenol	N	mg/kg	1	n/t	n/t
2,3-Dimethylphenol	M	mg/kg	1	n/t	n/t
2,3,5-trimethylphenol	M	mg/kg	1	n/t	n/t
Total Monohydric Phenols	N	mg/kg	5	n/t	n/t



Results Summary

Report No.: 23-48583, issue number 1

ELAB Reference	327010	327011
Customer Reference		
Sample ID		
Sample Type	SOIL	SOIL
Sample Location	DS04	DS02
Sample Depth (m)	3.30	3.00 - 3.45
Sampling Date	07/06/2023	07/06/2023

Determinand	Codes	Units	LOD		
Polyaromatic hydrocarbons					
Naphthalene	MS	mg/kg	0.02	< 0.02	n/t
Acenaphthylene	MS	mg/kg	0.02	< 0.02	n/t
Acenaphthene	MS	mg/kg	0.02	< 0.02	n/t
Fluorene	US	mg/kg	0.02	< 0.02	n/t
Phenanthrene	MS	mg/kg	0.02	0.04	n/t
Anthracene	US	mg/kg	0.02	< 0.02	n/t
Fluoranthene	MS	mg/kg	0.02	0.06	n/t
Pyrene	MS	mg/kg	0.02	0.04	n/t
Benzo(a)anthracene	US	mg/kg	0.02	0.02	n/t
Chrysene	MS	mg/kg	0.02	0.03	n/t
Benzo(b)fluoranthene	MS	mg/kg	0.02	0.03	n/t
Benzo(k)fluoranthene	MS	mg/kg	0.03	< 0.03	n/t
Benzo(a)pyrene	US	mg/kg	0.02	< 0.02	n/t
Indeno(1,2,3-cd)pyrene	MS	mg/kg	0.02	< 0.02	n/t
Dibenzo(a,h)anthracene	MS	mg/kg	0.02	< 0.02	n/t
Benzo[g,h,i]perylene	MS	mg/kg	0.02	< 0.02	n/t
Total PAH(16)	NS	mg/kg	0.34	< 0.34	n/t
BTEX					
Benzene	M	ug/kg	10	< 10.0	n/t
Toluene	M	ug/kg	10	< 10.0	n/t
Ethylbenzene	M	ug/kg	10	< 10.0	n/t
Xylenes	M	ug/kg	10	< 10.0	n/t
MTBE	N	ug/kg	10	< 10.0	n/t
Total Petroleum Hydrocarbons					
Total TPH (>C8-C40) (EH_1D_Total)	N	mg/kg	5	< 5	n/t

Results Summary

Report No.: 23-48583, issue number 1

ELAB Reference	327000
Customer Reference	
Sample ID	
Sample Type	SOIL
Sample Location	DS01
Sample Depth (m)	2.30
Sampling Date	07/06/2023

Determinand	Codes	Units	LOD	
VOC				
Heptane	N	ug/kg	10	< 10.0
Octane	N	ug/kg	10	< 10.0
Nonane	N	ug/kg	10	< 10.0
Benzene	M	ug/kg	10	< 10.0
Toluene	M	ug/kg	10	11.0
Ethylbenzene	M	ug/kg	10	< 10.0
m+p-xylene	M	ug/kg	10	73.0
o-xylene	M	ug/kg	10	40.5
cis-1,2-dichloroethane	N	ug/kg	10	< 10.0
1,1-Dichloroethane	M	ug/kg	10	< 10.0
Chloroform	M	ug/kg	10	< 10.0
Tetrachloromethane	M	ug/kg	10	< 10.0
1,1,1-Trichloroethane	M	ug/kg	10	< 10.0
Trichloroethylene	M	ug/kg	10	< 10.0
Tetrachloroethylene	M	ug/kg	10	< 10.0
1,1,1,2-Tetrachloroethane	M	ug/kg	10	< 10.0
1-1-2-2-Tetrachloroethane	M	ug/kg	10	< 10.0
Chlorobenzene	M	ug/kg	10	< 10.0
Bromobenzene	M	ug/kg	10	< 10.0
Bromodichloromethane	M	ug/kg	10	< 10.0
Methylethylbenzene	M	ug/kg	10	< 10.0
1,1-Dichloro-1-propene	M	ug/kg	10	< 10.0
Trans - 1-2 -dichloroethylene	N	ug/kg	10	< 10.0
2,2-Dichloropropane	N	ug/kg	10	< 10.0
Bromochloromethane	N	ug/kg	10	< 10.0
1,2-Dichloroethane	M	ug/kg	10	< 10.0
Dibromomethane	M	ug/kg	10	< 10.0
1,2-Dichloropropane	M	ug/kg	10	< 10.0
cis-1,3-Dichloro-1-propene	M	ug/kg	10	< 10.0
trans-1,3-Dichloro-1-propene	M	ug/kg	10	< 10.0
1,1,2-Trichloroethane	N	ug/kg	10	< 10.0
Dibromochloromethane	N	ug/kg	10	< 10.0
1,3-Dichloropropane	N	ug/kg	10	< 10.0
1,2-dibromoethane	N	ug/kg	10	< 10.0
Styrene	N	ug/kg	10	< 10.0
Propylbenzene	N	ug/kg	10	< 10.0
2-Chlorotoluene	N	ug/kg	10	< 10.0
1,2,4-Trimethylbenzene	N	ug/kg	10	< 10.0
4-Chlorotoluene	N	ug/kg	10	< 10.0
t-butylbenzene	N	ug/kg	10	< 10.0
1,3,5-Trimethylbenzene	N	ug/kg	10	31.7
1-methylpropylbenzene	N	ug/kg	10	< 10.0
p-cymene	N	ug/kg	10	< 10.0
1,3-Dichlorobenzene	N	ug/kg	10	< 10.0
Butylbenzene	N	ug/kg	10	< 10.0
1,2-Dibromo-3-chloropropane	N	ug/kg	10	< 10.0
Hexachlorobutadiene	N	ug/kg	10	< 10.0
1-2-3 - Trichlorobenzene	N	ug/kg	10	< 10.0
Naphthalene	N	ug/kg	10	554
1-2-4 - Trichlorobenzene	N	ug/kg	10	< 10.0
1,4-Dichlorobenzene	N	ug/kg	10	< 10.0
1,2-Dichlorobenzene	N	ug/kg	10	< 10.0
Bromoform	N	ug/kg	10	< 10.0



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Results Summary

Report No.: 23-48583, issue number 1

Asbestos Results

Analytical result only applies to the sample as submitted by the client. Any comments, opinions or interpretations (marked #) in this report are outside UKAS accreditation (Accreditation No2683). They are subjective comments only which must be verified by the client.

Elab No	Depth (m)	Clients Reference	Description of Sample Matrix #	Asbestos Identification	Gravimetric Analysis Total (%)	Gravimetric Analysis by ACM Type (%)	Free Fibre Analysis (%)	Total Asbestos (%)
327000	2.30	DS01	Brown Soil, Stones, Clinker, Brick, Concrete	No asbestos detected	n/t	n/t	n/t	n/t
327006	1.10	DS03	Brown Soil, Stones, Clinker	No asbestos detected	n/t	n/t	n/t	n/t
327007	2.80	DS03	Brown Soil, Stones, Clinker	No asbestos detected	n/t	n/t	n/t	n/t
327008	0.30	DS04	Brown Soil, Stones, Clinker, Organics	No asbestos detected	n/t	n/t	n/t	n/t

Method Summary

Report No.: 23-48583, issue number 1

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Free cyanide	N	As submitted sample	16/06/2023	107	Colorimetry
Hexavalent chromium	N	As submitted sample	16/06/2023	110	Colorimetry
pH	M	Air dried sample	20/06/2023	113	Electromeric
Acid Soluble Sulphate	U	Air dried sample	20/06/2023	115	Ion Chromatography
Total Petroleum Hydrocarbons in solids	N	As submitted sample	16/06/2023	117	GC-FID
W. Sol Metals	SM	Air dried sample	24/06/2023	SUBCON	ICPMS
Soil organic matter	U	Air dried sample	19/06/2023	119	Titrimetry
Phenols in solids	M	As submitted sample	16/06/2023	121	HPLC
Water soluble anions	M	Air dried sample	19/06/2023	172	Ion Chromatography
Low range Aliphatic hydrocarbons soil	N	As submitted sample	21/06/2023	181	GC-MS
Low range Aromatic hydrocarbons soil	N	As submitted sample	21/06/2023	181	GC-MS
VOC in solids	M	As submitted sample	19/06/2023	181	GC-MS
BTEX in solids	M	As submitted sample	21/06/2023	181A	GC-MS
Water soluble boron	N	Air dried sample	19/06/2023	202	Colorimetry
Total cyanide	M	As submitted sample	16/06/2023	204	Colorimetry
Total organic carbon/Total sulphur	N	Air dried sample	19/06/2023	210	IR
Aliphatic hydrocarbons in soil	N	As submitted sample	16/06/2023	214	GC-FID
Aliphatic/Aromatic hydrocarbons in soil	N	As submitted sample	21/06/2023	214	GC-FID
Aromatic hydrocarbons in soil	N	As submitted sample	21/06/2023	214	GC-FID
Total organic carbon/Total sulphur	N	Air dried sample	19/06/2023	216	IR
Asbestos identification	U	Air dried sample	16/06/2023	281	Microscopy
Aqua regia extractable metals	M	Air dried sample	28/06/2023	300	ICPMS
Soil organic matter	U	Air dried sample	19/06/2023	BS1377:P3	Titrimetry

Tests marked N are not UKAS accredited

Report Information

Report No.: 23-48583, issue number 1

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
NS	Subcontracted to approved laboratory. UKAS accreditation is not applicable.
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"
LOD	LOD refers to limit of detection, except in the case of pH soils and pH waters where it means limit of discrimination. Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed. ELAB are unable to provide an interpretation or opinion on the content of this report. The results relate only to the sample received. PCB congener results may include any coeluting PCBs Uncertainty of measurement for the determinands tested are available upon request Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month
 All water samples will be retained for 7 days following the date of the test report
 Charges may apply to extended sample storage

TPH Classification - HWOL Acronym System

HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
2D	GC-GC - Double coil gas chromatography
#1	EH_Total but with humics mathematically subtracted
#2	EH_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry



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THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 23-48797

Issue: 1

Date of Issue: 06/07/2023

Contact: Aga Stefanowicz

Customer Details: IGE Consulting Ltd
Office 16, Bartle House
Oxford Court
Manchester
M2 3WQ

Quotation No: Q22-03729

Order No: Not Supplied

Customer Reference: Not Supplied

Date Received: 07/06/2023

Date Approved: 08/06/2023

Details: Hoyle Ing

Approved by:

Tim Reeve, Quality Officer

Any comments, opinions or interpretations expressed herein are outside the scope of UKAS accreditation (Accreditation Number 2683)

This report may only be reproduced in full



Sample Summary

Report No.: 23-48797, issue number 1

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
328698	DSO1	07/06/2023	08/06/2023		
328699	DSO2	07/06/2023	08/06/2023		

Results Summary

Report No.: 23-48797, issue number 1

ELAB Reference	328698	328699
Customer Reference		
Sample ID		
Sample Type	WATER	WATER
Sample Location	DSO1	DSO2
Sample Depth (m)		
Sampling Date	07/06/2023	07/06/2023

Determinand	Codes	Units	LOD		
Dissolved Metals					
Arsenic	U	ug/l	0.5	37.3	23.5
Barium	U	ug/l	1	619	323
Beryllium	U	ug/l	1	< 1	< 1
Calcium	U	ug/l	50	101000	143000
Cadmium	U	ug/l	0.5	< 0.5	< 0.5
Cobalt	U	ug/l	0.5	0.6	1.3
Chromium	U	ug/l	0.5	< 0.5	< 0.5
Copper	U	ug/l	0.5	< 0.5	< 0.5
Mercury	U	ug/l	0.05	< 0.05	< 0.05
Magnesium	U	ug/l	50	10200	11100
Nickel	U	ug/l	0.5	0.8	2.3
Lead	U	ug/l	0.5	< 0.5	< 0.5
Selenium	U	ug/l	1	< 1	< 1
Vanadium	U	ug/l	0.5	< 0.5	1.0
Zinc	U	ug/l	1.2	< 1.2	< 1.2
Miscellaneous					
Electrical Conductivity	U	uS/cm	50	585	203
Hardness (as CaCO ₃)	N	mg/l CaCO ₃	0.1	293	402
pH	U	pH units	0.1	7.6	7.8
Redox Potential	N	mV	-1000	274	321
Polyaromatic hydrocarbons					
Naphthalene GCMS	N	ug/l	0.01	63.8	3.53
Acenaphthylene GCMS	N	ug/l	0.01	15.4	2.50
Acenaphthene GCMS	N	ug/l	0.01	80.1	10.1
Fluorene GCMS	N	ug/l	0.01	85.4	9.33
Phenanthrene GCMS	N	ug/l	0.01	421	99.8
Anthracene GCMS	N	ug/l	0.01	98.5	22.0
Fluoranthene GCMS	N	ug/l	0.01	586	209
Pyrene GCMS	N	ug/l	0.01	503	181
Benzo (a) anthracene GCMS	N	ug/l	0.01	284	105
Chrysene GCMS	N	ug/l	0.01	255	105
Benzo (b) fluoranthene GCMS	N	ug/l	0.01	243	111
Benzo (k) fluoranthene GCMS	N	ug/l	0.01	190	74.1
Benzo (a) pyrene GCMS	N	ug/l	0.01	309	123
Indeno (1,2,3-cd) pyrene GCMS	N	ug/l	0.01	131	4.6
Dibenzo(a,h)anthracene GCMS	N	ug/l	0.01	34.9	15.6
Benzo(ghi)perylene GCMS	N	ug/l	0.01	157	65.5
Total PAH(16) GCMS	N	ug/l	0.01	3460	1190

Results Summary

Report No.: 23-48797, issue number 1

ELAB Reference	328698	328699
Customer Reference		
Sample ID		
Sample Type	WATER	WATER
Sample Location	DSO1	DSO2
Sample Depth (m)		
Sampling Date	07/06/2023	07/06/2023

Determinand	Codes	Units	LOD		
BTEX					
Benzene	U	ug/l	1	< 1.00	< 1.00
Toluene	U	ug/l	1	< 1.00	< 1.00
Ethylbenzene	U	ug/l	1	< 1.00	< 1.00
Xylenes	U	ug/l	1	2.24	< 1.00
MTBE	U	ug/l	1	< 1.00	< 1.00
TPH CWG					
>C5-C6 Aliphatic (HS_1D_MS)	N	ug/l	1	< 1.0	< 1.0
>C6-C8 Aliphatic (HS_1D_MS)	N	ug/l	1	< 1.0	< 1.0
>C8-C10 Aliphatic (EH_CU_1D_AL)	N	ug/l	5	< 5.0	28.3
>C10-C12 Aliphatic (EH_CU_1D_AL)	N	ug/l	5	31.6	171
>C12-C16 Aliphatic (EH_CU_1D_AL)	N	ug/l	5	850	679
>C16-C21 Aliphatic (EH_CU_1D_AL)	N	ug/l	5	5230	2880
>C21-C35 Aliphatic (EH_CU_1D_AL)	N	ug/l	5	5930	16700
>C35-C40 Aliphatic (EH_CU_1D_AL)	N	ug/l	5	2650	6080
Total (>C5-C40) Aliphatic (HS_1D_MS+EH_CU_1D_AL)	N	ug/l	5	15700	26600
>C5-C7 Aromatic (HS_1D_MS)	N	ug/l	1	< 1.0	< 1.0
>C7-C8 Aromatic (HS_1D_MS)	N	ug/l	1	< 1.0	< 1.0
>C8-C10 Aromatic (EH_CU_1D_AR)	N	ug/l	5	< 5.0	116
>C10-C12 Aromatic (EH_CU_1D_AR)	N	ug/l	5	101	137
>C12-C16 Aromatic (EH_CU_1D_AR)	N	ug/l	5	1970	848
>C16-C21 Aromatic (EH_CU_1D_AR)	N	ug/l	5	3830	3010
>C21-C35 Aromatic (EH_CU_1D_AR)	N	ug/l	5	4870	17500
>C35-C40 Aromatic (EH_CU_1D_AR)	N	ug/l	5	660	4600
Total (>C5-C40) Aromatic (HS_1D_MS+EH_CU_1D_AR)	N	ug/l	5	12400	26200
Total (>C5-C40) Ali/Aro (HS_1D_MS+EH_CU_1D_Total)	N	ug/l	5	28100	52700

Method Summary

Report No.: 23-48797, issue number 1

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Water					
Aliphatic/Aromatic hydrocarbons in water	N		05/07/2023		GC-FID
pH of waters	U		04/07/2023	113	Electromeric
PAHs and/or PCBs in waters	N		30/06/2023	135	GC-MS
Electrical conductivity of water	U		06/07/2023	136	Electromeric
BTEX in waters	U		05/07/2023	200	GC-MS
Low range Aliphatic hydrocarbons water	N		05/07/2023	200	GC-MS
Low range Aromatic hydrocarbons water	N		05/07/2023	200	GC-MS
Redox potential in waters	N		06/07/2023	201	Electromeric
Aliphatic hydrocarbons in water	N		30/06/2023	215	GC-FID
Aromatic hydrocarbons in water	N		03/07/2023	215	GC-FID
Dissolved metals by ICP in waters	U		29/06/2023	301	ICPMS
Hardness in waters	N		30/06/2023	APHA	ICPMS

Tests marked N are not UKAS accredited

Report Information

Report No.: 23-48797, issue number 1

Key

U	hold UKAS accreditation
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I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
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LOD	LOD refers to limit of detection, except in the case of pH soils and pH waters where it means limit of discrimination. Soil sample results are expressed on an air dried basis (dried at < 30°C), and are uncorrected for inert material removed. ELAB are unable to provide an interpretation or opinion on the content of this report. The results relate only to the sample received. PCB congener results may include any coeluting PCBs Uncertainty of measurement for the determinands tested are available upon request Unless otherwise stated, sample information has been provided by the client. This may affect the validity of the results.

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month
 All water samples will be retained for 7 days following the date of the test report
 Charges may apply to extended sample storage

TPH Classification - HWOL Acronym System

HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
2D	GC-GC - Double coil gas chromatography
#1	EH_Total but with humics mathematically subtracted
#2	EH_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry



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The Environmental Laboratory Ltd
Unit A2, Windmill Road
Ponswood Industrial Estate
St. Leonards on Sea
East Sussex
TN38 9BY

Attention: Customer Services

CERTIFICATE OF ANALYSIS

Date of report Generation: 23 June 2023
Customer: The Environmental Laboratory Ltd
Sample Delivery Group (SDG): 230616-125
Your Reference: 23-48583
Location: 23-48583
Report No: 693549
Order Number: PO-11577

We received 8 samples on Friday June 16, 2023 and 8 of these samples were scheduled for analysis which was completed on Thursday June 22, 2023. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

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

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

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

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

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

Approved By:

Sonia McWhan

Operations Manager





CERTIFICATE OF ANALYSIS

Validated

SDG: 230616-125
Client Ref.: 23-48583

Report Number: 693549
Location: 23-48583

Superseded Report:

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
28167178	326999/DS01		0.30	07/06/2023
28167179	327000/DS01		2.30	07/06/2023
28167180	327003/DS02		0.80	07/06/2023
28167181	327004/DS02		1.80	07/06/2023
28167182	327005/DS02		4.70	07/06/2023
28167183	327006/DS03		1.10	07/06/2023
28167184	327007/DS03		2.80	07/06/2023
28167185	327010/DS04		3.30	07/06/2023

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



CERTIFICATE OF ANALYSIS

Validated

SDG: 230616-125
Client Ref.: 23-48583

Report Number: 693549
Location: 23-48583

Superseded Report:

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm
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Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Inclusions	Inclusions 2
28167178	326999/DS01	0.30	Dark Brown	Sand	Crushed Brick	Stones
28167179	327000/DS01	2.30	Dark Brown	Sandy Loam	Stones	Crushed Brick
28167180	327003/DS02	0.80	Dark Brown	Sand	Fibres	Crushed Brick
28167181	327004/DS02	1.80	Dark Brown	Loamy Sand	Crushed Brick	Glass & Stones
28167182	327005/DS02	4.70	Grey	Clay	None	None
28167183	327006/DS03	1.10	Dark Brown	Loamy Sand	Stones	Crushed Brick
28167184	327007/DS03	2.80	Grey	Stone/Soil	Stones	None
28167185	327010/DS04	3.30	Light Brown	Sandy Loam	None	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.



Validated

CERTIFICATE OF ANALYSIS

SDG: 230616-125
Client Ref.: 23-48583

Report Number: 693549
Location: 23-48583

Superseded Report:

[illegible]



CERTIFICATE OF ANALYSIS

Validated

SDG: 230616-125

Report Number: 693549

Superseded Report:

Client Ref.: 23-48583

Location: 23-48583

Table of Results - Appendix

Method No	Description
PM024	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material
TM089	Determination of Gasoline Range Hydrocarbons (GRO) by Headspace GC-FID (C4-C12)
TM116	Determination of Volatile Organic Compounds by Headspace / GC-MS
TM414	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GCxGC-FID

NA = not applicable.

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



CERTIFICATE OF ANALYSIS

Validated

SDG: 230616-125
Client Ref.: 23-48583

Report Number: 693549
Location: 23-48583

Superseded Report:

Test Completion Dates

Lab Sample No(s)	28167178	28167179	28167180	28167181	28167182	28167183	28167184	28167185
Customer Sample Ref.	326999/DS01	327000/DS01	327003/DS02	327004/DS02	327005/DS02	327006/DS03	327007/DS03	327010/DS04
AGS Ref.								
Depth	0.30	2.30	0.80	1.80	4.70	1.10	2.80	3.30
Type	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)	Soil/Solid (S)
EPH CWG GC (S)	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023
GRO by GC-FID (S)	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023
Sample description	20-Jun-2023	20-Jun-2023	20-Jun-2023	20-Jun-2023	20-Jun-2023	20-Jun-2023	20-Jun-2023	20-Jun-2023
TPH CWG GC (S)	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023
VOC MS (S)	22-Jun-2023	22-Jun-2023	22-Jun-2023	22-Jun-2023	21-Jun-2023	22-Jun-2023	21-Jun-2023	21-Jun-2023

CERTIFICATE OF ANALYSIS

SDG: 230616-125
Client Ref: 23-48583

Report Number: 693549
Location: 23-48583

Superseded Report:

Appendix

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

2. If sufficient sample is received a sub sample will be retained free of charge for 15 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

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

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

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

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

7. Results relate only to the items tested.

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

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

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

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

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

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

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

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

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

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

General

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

19. Sample Deviations

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

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

20. Asbestos

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

Identification of Asbestos in Bulk Materials & Soils

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

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

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

Visual Estimation Of Fibre Content

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

Respirable Fibres

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

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

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

IGE			Project: Hoyle Ing - Made Ground																					
Job No: 3836																								
Lab Sample Number			326999	327000	327001	327002	327003	327004	327005	327006	327007	327008	Statistical Analysis					GAC - S4UL unless stated			C4SL			
Sample Reference			DS01	DS01	DS01	DS01	DS02	DS02	DS02	DS03	DS03	DS04	Statistical Results					Residential with Home Grown Produce			Residential with home grown produce			
Sample Number													Count	Standard Deviation	Minimum	Maximum	Average	Maximum	2.5% Residential with Home Grown Produce	Pass/ Fail	Exceedances	Residential with home grown produce	Pass/ Fail	Exceedances
Depth (m)			0.3	2.3	3.7	4.8	0.8	1.8	4.7	1.1	2.8	0.3												
Date Sampled			07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023	07/06/2023												
Analytical Parameter (Soil Analysis)			Units	LoD																				
Stone Content			%	0.1	23.5	39.1	0.1	12.9	34.6	36.4	0.1	0.1	10	16.25	0.1	39.1	16.1	39.1						
Moisture Content			%	0.01	8.2	21.3	41.1	12.1	9.2	18	30.8	28.3	10	10.54	8.20	41.10	21.63	41.10						
Asbestos																								
Asbestos in Soil Screen			Type	N/A	-	None Detected	-	-	-	-	-	None Detected	None Detected	None Detected	4	-	-	-	-	-				
General Inorganics																								
pH - Automated			pH Units	N/A	8.1	7.9	7.1	7.3	10.6	8.6	6.1	6.8	6.9	5.4	10	1.44	5.40	10.60	7.48					
Total Cyanide			mg/kg	1	1	2	1	1	1	1	1	1	1	1	10	0.32	1.00	2.00	1.10	2.00	60	Pass	0	
Free Cyanide			mg/kg	1	1	1	1	1	1	1	1	1	1	1	10	0.00	1.00	1.00	1.00	1.00	60	Pass	0	
Total Sulphate as SO4			%	0.005	-	0.24	0.19	-	0.21	-	0.03	0.05	0.03	-	6	0.098	0.030	0.240	0.125					
Water Soluble Sulphate as SO4 16hr extraction (2:1)			mg/kg	40.00	40	333	976	163	204	54	40	40	40	40	10	292.51	40.00	976.00	193.00					
Water Soluble SO4 16hr extraction (2:1 Leachate Equivalent)			g/l	0.02000	-	0.17	0.49	-	0.1	-	0.02	0.02	0.02	-	6	0.18338	0.02000	0.49000	0.13667					
Total Sulphur			%	0.010	-	0.44	0.52	-	0.44	-	0.03	0.12	0.03	-	6	0.216	0.030	0.520	0.207					
Organic Matter (automated)			%	0.10	1.4	4.8	9.3	0.6	1.3	3.7	1.4	4.8	2.5	3.3	10	2.58	0.60	9.30	3.31					
Total Organic Carbon (automated)			%	0.01	1.4	3.9	8.6	0.38	2.5	19	1	5.5	1.3	5.5	10	5.85	0.38	19.00	5.66					
Water Soluble Nitrate (2:1) as NO3			mg/kg	40	40	49	45	40	40	40	40	40	40	40	10	3.10	40.00	49.00	41.40					
Water Soluble Nitrate (2:1) as NO3 (leachate equivalent)			mg/l	20	-	24	23	-	20	-	20	20	20	-	6	1.83	20.00	24.00	21.17					
Speciated PAHs																								
Naphthalene			mg/kg	0.02	0.05	562	0.21	0.1	0.09	0.26	0.02	0.05	0.02	0.02	10	177.69	0.02	562.00	56.28	562.00	5.60	Fail	1	
Acenaphthylene			mg/kg	0.02	0.12	5.13	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	10	1.61	0.02	5.13	0.54	5.13	420	Pass	0	
Acenaphthene			mg/kg	0.02	0.24	204	0.19	0.08	0.21	0.02	0.05	0.02	0.02	0.02	10	64.47	0.02	204.00	20.50	204.00	510	Pass	0	
Fluorene			mg/kg	0.02	0.25	204	0.21	0.22	0.05	0.14	0.02	0.03	0.02	0.02	10	64.48	0.02	204.00	20.50	204.00	400	Pass	0	
Phenanthrene			mg/kg	0.02	4.55	1310	1.24	1.21	0.77	1.76	0.13	0.44	0.07	0.12	10	413.90	0.07	1310.00	132.03	1310.00	220	Fail	1	
Anthracene			mg/kg	0.02	1.11	330	0.39	0.35	0.23	0.36	0.03	0.1	0.02	0.03	10	104.26	0.02	330.00	33.26	330.00	5400	Pass	0	
Fluoranthene			mg/kg	0.02	11.9	1090	1.99	1.46	2.36	2.81	0.25	0.85	0.12	0.24	10	343.93	0.12	1090.00	111.20	1090.00	560	Fail	1	
Pyrene			mg/kg	0.02	10.7	885	1.65	1.2	2.15	2.42	0.19	0.74	0.11	0.2	10	279.20	0.11	885.00	90.44	885.00	1200	Pass	0	
Benzo(a)anthracene			mg/kg	0.02	6.41	395	0.83	0.6	1.16	1.32	0.1	0.39	0.07	0.11	10	124.54	0.07	395.00	40.60	395.00	1100	Fail	1	
Chrysene			mg/kg	0.02	6.91	414	0.95	0.64	1.34	1.49	0.12	0.46	0.09	0.16	10	130.51	0.09	414.00	42.62	414.00	22	Fail	1	
Benzo(b)fluoranthene			mg/kg	0.02	7.99	318	0.92	0.6	1.3	1.34	0.12	0.46	0.08	0.15	10	100.13	0.08	318.00	33.10	318.00	330	Fail	2	
Benzo(k)fluoranthene			mg/kg	0.03	3.63	137	0.42	0.26	0.57	0.57	0.05	0.19	0.04	0.06	10	43.13	0.04	137.00	14.28	137.00	93	Fail	1	
Benzo(a)pyrene			mg/kg	0.02	9.4	347	0.88	0.6	1.28	1.37	0.11	0.45	0.08	0.13	10	109.26	0.08	347.00	36.13	347.00	270	Fail	2	
Indeno(1,2,3-cd)pyrene			mg/kg	0.02	5.72	172	0.56	0.37	0.82	0.82	0.08	0.29	0.06	0.09	10	54.11	0.06	172.00	18.08	172.00	36	Fail	1	
Dibenz(a,h)anthracene			mg/kg	0.02	1.37	42.7	0.13	0.09	0.2	0.22	0.02	0.07	0.02	0.02	10	13.43	0.02	42.70	4.48	42.70	0.28	Fail	2	
Benzo(ghi)perylene			mg/kg	0.02	5.93	175	0.57	0.36	0.86	0.88	0.07	0.31	0.06	0.09	10	55.05	0.06	175.00	18.41	175.00	340	Pass	0	
Total PAH																								
Speciated Total EPA-16 PAHs			mg/kg	0.34	76.3	6600	11.2	8.27	13.3	16	1.27	4.89	0.8	1.41	10	2082.53	0.80	6600.00	673.34					
Heavy Metals / Metalloids																								
Arsenic (aque regia extractable)			mg/kg	2	9	81	27	6	18	53	11	40	10	19	10	24.07	6.00	81.00	27.40	81.00	37	Fail	3	
Barium (aque regia extractable)			mg/kg	2.5	243	245	286	46	103	230	66	222	85	63	10	93.59	46.00	286.00	159.30	286.00	-	Pass	0	
Cadmium (aque regia extractable)			mg/kg	0.2	0.4	1.6	2.1	0.3	0.4	1.1	0.2	0.7	0.8	0.4	10	0.63	0.20	2.10	0.80	2.10	11	Pass	0	
Chromium (hexavalent)			mg/kg	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	10	0.00	0.80	0.80	0.80	0.80	6	Pass	0	
Chromium (aque regia extractable)			mg/kg	2	26	96	44	18	29	30	24	36	27	23	10	22.51	18.00	96.00	35.30	96.00	910	Pass	0	
Copper (aque regia extractable)			mg/kg	4	44	225	124	23	78	398	45	82	54	37	10	116.80	23.00	398.00	111.00	398.00	2400	Pass	0	
Lead (aque regia extractable)			mg/kg	3	93	377	466	53	96	298	42	358	165	72	10	157.43	42.00	466.00	202.00	466.00	200	Fail	4	
Mercury (aque regia extractable)			mg/kg	1	1	6.1	1.6	1	1	1	1	1	1	1	10	1.60	1.00	6.10	1.57	6.10	40	Pass	0	
Nickel (aque regia extractable)			mg/kg	3	22	50	45	17	30	37	11	38	35	14	10	13.39	11.00	50.00	29.90	50.00	130	Pass	0	
Selenium (aque regia extractable)			mg/kg	2	2	2	2	2	2	2	2	2	2	2	10	0.06	2.00	2.20	2.02	2.20	250	Pass	0	
Vanadium (aque regia extractable)			mg/kg	1	25	76	42	13	36	53	26	44	24	35	10	17.84	13.00	76.00	37.40	76.00	410	Pass	0	
Zinc (aque regia extractable)			mg/kg	3	106	290	359	80	85	186	39	156	233	59	10	106.61	39.00	359.00	159.30	359.00	3700	Pass	0	
Magnesium (water soluble)			mg/l	10	-	10	30	-	10	-	10	10	10	-	6	8.16	10.00	30.00	13.33					
Monoaromatics & Oxygenates																								
Benzene			µg/kg	10	10	-	-	-	10	10	10	10	10	-	7	0.00	10	10	10.00	10	170	Pass	0	
Toluene			µg/kg	10	10	11	-	-	10	10	10	10	10	-	7	0.38	10	11	10.14	11	290000	Pass	0	

APPENDIX 7

GROUND GAS AND GROUNDWATER DEPTH MONITORING RESULTS

Gas Monitoring

Site: Hoyle Ing, Linthwaite Recent weather: Sunny Precipitation: None 2hr pre-visit pressure: 1023
 Job No.: 3836 Date: 16.06.2023 Air temperature: 20°C Ground condition: Dry
 Engineer: AS Start time: 09:34 Cloud cover: 30% Pressure trend: Falling 2hr post-visit pressure: 1022
 Visit No.: 1 End time: 10:15 Wind 1.3 km/h NE On-site activities (e.g.construction): None



Exploratory hole	Time	Response zone range	Water level	Base level	Atm. pressure	CH ₄		LEL		Hex		CO ₂		O ₂			H ₂ S		CO		Total Volatiles (PID)		PID CF	Flow	
		(m bgl)	(m bgl)	(m bgl)	(mbar)	(%)		(%)		(%)		(%)		(%)			(ppm)		(ppm)		(ppm)			(l/hr)	
						peak	steady	peak	steady	peak	steady	peak	steady	high	steady	low	peak	steady	peak	steady	peak	steady		peak	steady
DS01	09:34	0.50 - 1.50	DRY	1.51	1007	<0.1	<0.1	<0.1	<0.1	0.002	0.001	0.7	0.7	20.4	19.7	19.7	<1	<1	<1	<1	1.6	<0.1	1.0	<0.1	<0.1
DS03	09:49	1.30 - 2.00	DRY	2.12	1007	<0.1	<0.1	<0.1	<0.1	0.001	0.001	0.4	0.4	20.8	20.6	20.6	<1	<1	10	10	5.0	0.6	1.0	<0.1	<0.1
DS04	10:02	3.00 - 3.50	DRY	3.39	1007	<0.1	<0.1	<0.1	<0.1	0.001	0.001	1.5	1.5	20.9	19.5	19.5	<1	<1	10	10	2.2	2.1	1.0	<0.1	<0.1
												</													

Comments: _____

- Values recorded below instrument detection level.
- Response zone flooded. Results unreliable.

Gas Monitoring

Site: Hoyle Ing, Linthwaite Recent weather: Rain Precipitation: None 2hr pre-visit pressure: 1015

Job No.: 3836 Date: 28.06.2023 Air temperature: 18°C Ground condition: Damp

Engineer: AS Start time: 10:08 Cloud cover: 90% Pressure trend: Falling 2hr post-visit pressure: 1014

Visit No.: 2 End time: 10:47 Wind: 6.3 km/h NE On-site activities (e.g.construction): None



Exploratory hole	Time	Response zone range	Water level	Base level	Atm. pressure	CH ₄		LEL		Hex		CO ₂		O ₂			H ₂ S		CO		Total Volatiles (PID)		PID CF	Flow	
		(m bgl)	(m bgl)	(m bgl)	(mbar)	(%)		(%)		(%)		(%)		(%)			(ppm)		(ppm)		(ppm)			(l/hr)	
						peak	steady	peak	steady	peak	steady	peak	steady	high	steady	low	peak	steady	peak	steady	peak	steady		peak	steady
DS01	10:08	0.50 - 1.50	DRY	1.51	1000	<0.1	<0.1	<0.1	<0.1	0.006	0.005	0.4	0.4	20.6	20.3	20.3	<1	<1	10	<1	1.2	<0.1	1.0	<0.1	<0.1
DS03	10:21	1.30 - 2.00	DRY	2.11	1000	<0.1	<0.1	<0.1	<0.1	0.006	0.006	0.6	0.6	20.6	20.0	20.0	<1	<1	<1	<1	3.0	0.7	1.0	<0.1	<0.1
DS04	10:36	3.00 - 3.50	DRY	3.40	1000	<0.1	<0.1	<0.1	<0.1	0.006	0.006	1.9	1.9	20.6	19.0	19.0	<1	<1	<1	<1	1.5	1.4	1.0	<0.1	<0.1
					</																				

Comments: In DS01, the CO concentration flickered between <1 and 10ppm for approx. 30s, then remained steady at <1ppm.

- Values recorded below instrument detection level.
- Response zone flooded. Results unreliable.

Site: Hoyle Ing, Linthwaite

Job No.: 3836

Date: 14.07.2023

Recent weather: Rain

Air temperature: 16°C

Precipitation:

Light rain

2hr pre-visit pressure: 1011

Engineer: AS

Start time: 09:40

Cloud cover: 100%

Pressure trend:

Falling

2hr post-visit pressure: 1007

Visit No.: 3

End time: 10:15

Wind 11.3 km/h SE

On-site activities
(e.g.construction):

None

[illegible]

Comments: CO concentrations in DS01 and DS03 displayed 10ppm for short periods of time before returning to 0ppm. PID readings in DS03 recorded a first peak of 11.1ppm, dropping to 0.9ppm, then a second peak of 19.7, stabilising at 0.6ppm.

- Values recorded below instrument detection level.
- Response zone flooded. Results unreliable.

Gas Monitoring

Site: Hoyle Ing, Linthwaite Recent weather: Rain Precipitation: Light rain 2hr pre-visit pressure: 1016
 Job No.: 3836 Date: 04.08.2023 Air temperature: 14°C Ground condition: Damp
 Engineer: AS Start time: 09:14 Cloud cover: 90% Pressure trend: Rising 2hr post-visit pressure: 1018
 Visit No.: 4 End time: 09:53 Wind: 1.6 km/h NE On-site activities (e.g.construction): None



Exploratory hole	Time	Response zone range	Water level	Base level	Atm. pressure	CH ₄		LEL		Hex		CO ₂		O ₂			H ₂ S		CO		Total Volatiles (PID)		PID CF	Flow	
		(m bgl)	(m bgl)	(m bgl)	(mbar)	(%)		(%)		(%)		(%)		(%)			(ppm)		(ppm)		(ppm)			(l/hr)	
						peak	steady	peak	steady	peak	steady	peak	steady	high	steady	low	peak	steady	peak	steady	peak	steady		peak	steady
DS01	09:14	0.50 - 1.50	1.44	1.51	1004	<0.1	<0.1	<0.1	<0.1	0.016	0.015	0.2	0.2	20.4	20.4	20.4	<1	<1	<1	<1	0.5	<0.1	1.0	<0.1	<0.1
DS03	09:27	1.30 - 2.00	1.99	2.11	1003	<0.1	<0.1	<0.1	<0.1	0.015	0.015	0.7	0.7	20.7	19.9	19.9	<1	<1	10	<1	1.6	<0.1	1.0	<0.1	<0.1
DS04	09:38	3.00 - 3.50	DRY	3.40	1003	<0.1	<0.1	<0.1	<0.1	0.015	0.015	0.3	0.3	20.7	20.6	20.2	<1	<1	<1	<1	0.2	0.1	1.0	<0.1	<0.1
														</											

Comments: DS04 bung dislocated. CO concentrations in DS02 displayed 10ppm for short periods of time before returning to 0ppm.

- Values recorded below instrument detection level.
- Response zone flooded. Results unreliable.

TEST DATE AND CONDITIONS			
Date	24/11/2022		
Atmospheric Pressure	982	mB	
Ambient Temperature	21.1	°C	
EnviroNics Serial No.	5089		

**GFM436 Final Inspection & Calibration
Check Certificate**

GAS DATA LTD

Unit 4, Fairfield Court

Seven Stars Estate

Wheler Rd

Coventry

CV3 4LJ

Tel 02476303311



Fax 02476307711

Customer	IGE Consulting Ltd
Certificate Number	123692
Order Number	332744

Serial Number	13397
Software Version	G436-00.0027/0010

Recalibration DUE Date
24/11/23

Instrument Checks					
Keyboard	✓		Display Contrast	✓	
Pump Flow In	500	Accept > 200 cc/min	Pump Flow @ -200mB	250	Accept > 200 cc/min
Clock Set / Running	✓		Labels Fitted	✓	

Gas Checks						
Sensor	CH ₄		CO ₂		O ₂	
	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %	Instrument Gas	True Gas Value %
	Readings %		Readings %		Readings %	
	59.7	60	40.0	40	20.9	20.9
	Accept ±1.0		Accept ±1.0		Accept ±0.5	
	5.0	5	5.0	5	6.0	6
	Accept ±0.3		Accept ±0.3		Accept ±0.3	
Zero Reading 100% N2	0.0	0	0.0	0	0.0	0
	Accept ±0.0		Accept ±0.0		Accept ±0.1	

Optional Gas Checks						
Applied Gas & Range		Concentration Tested @ (ppm)	Instrument Readings (ppm)			
Gas Type	Range (ppm)		Zero Reading		Instrument Gas Reading	
H2S	5000	1500	0	Accept ±0.0	1500	Accept ±5.0
CO	2000	1000	0	Accept ±0.0	1000	Accept ±5.0
Hexane	2.0%	2.0%	0	Accept ±0.0	1.99	Accept ±10.0

Cross Gas Effects									
Applied Gas (ppm)		Instrument Readings (ppm)							
Gas Type	Concentration	Toxic 1:	H2S	Toxic 2:	CO	Toxic 3:	HEX		
H2S	1500	1500		0		0			
CO	1000	100		1000		0			
Hexane	2.0%	0		0		1.99			

Pressure Checks			
Atmospheric Pressure [AP] (mB)			
Current Atmospheric Pressure (mB)		Instrument Atmospheric Pressure Reading (mB)	
AP Open Ports		982	Accept ± 2.0
AP Port (Internal)	+800 mB	800	Accept ± 5.0
	+1200 mB	1200	Accept ± 5.0

Flow Checks					
Borehole Flow			Differential Pressure		
Applied Reading (l/h)	Instrument Reading (l/h)		Applied Pressure (Pa)	Instrument Reading (Pa)	
-30	-30.1	Accept ± 3.0	-277	-280	Accept ± 50
-3	-3.0	Accept ± 1.0	-14	-14	Accept ± 6.0
0	00.0	Accept ± 0.0	0	0	Accept ± 0.5
3	3.0	Accept ± 0.5	16	15	Accept ± 3.0
30	29.8	Accept ± 3.0	336	331	Accept ± 50
60	60.0	Accept ± 6.0	1023	1020	Accept ± 130
90	90.4	Accept ± 9.0	2032	>>>>	Accept ± 250

Temperature Checks		
Calibration Temperature	Instrument Temperature Reading °C	
Applied Temperature °C		
-10	-10.0	Accept ± 2.0
0	0.0	Accept ± 1.0
30	30.0	Accept ± 1.0
60	60.0	Accept ± 1.0
100	100.0	Accept ± 1.0

Technician:
Jack Rutland

Date Tested:
24/11/2022

The instrument identified by the serial number stated above has been tested by Gas Data personnel for calibration accuracy on the date and under the ambient conditions stated. Gas Data Ltd internal BS EN ISO9001:2015, BS EN ISO14001:2015, BS EN ISO45001:2018 compliant workshop procedures were followed to apply known calibration test gases, gas flow rates, pressures and temperatures of the values stated.

The results displayed on the instrument at each stage are recorded above.

Gas Data Ltd is certified to BS EN ISO9001:2015, BS EN ISO14001:2015, BS EN ISO45001:2018.

TEST DATE AND CONDITIONS			
Date	24.11.22		
Atmospheric Pressure	982	mB	
Ambient Temperature	21.1	°C	
EnviroNics Serial No.	50809		

GAS DATA LTD Unit 4 Fairfield Court Seven Stars Estate Coventry CV3 4LJ UK +44 (0)24 7630 3311	 GAS DATA LISTEN - ANALYSE - INSURE
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GFM436-1 OUTWARD INSPECTION & QUALITY CHECK SHEET

INSTRUMENT DETAILS			
SO Number	Instrument Type	Instrument Serial Number + SW Version	Job Number(s)
332744	GFM436	13597 G436-27/10	123692

Calibration Technician *[Signature]*

Date 24.11.22

Inspection Technician *[Signature]*

Date 28.11.22

INSTRUMENT CHECKS		Pass (P), Fail (F) or not applicable (NA)	INSTRUMENT PACKING LIST		Tick if included
Function Tests	Dust Caps Fitted	P	Instrument		✓
	Keyboard Test (All Keys)	P	Leather Case		✓
	Backlight	P	Instrument Strap		✓
	Clock Set / Running	P	AC Battery Charger (UK)		✓
	Comms Test	P	AC Battery Charger (EURO)		X
	Pump Flow Test (In & Out)	P	AC Battery Charger (US)		X
	Overall Leak Test (30mB)	n/a	AC Battery Charger (AUS)		X
	Battery Charge Test	P	Gas Sample Pipe - (new issue)		X
	Service Date set to?	24.11.23	Flow Sample Pipe - (new issue)		X
Channel Tests	Data Logging Enabled?	P	Hard Carry Case		✓
	Verify CH4/LEL/Hexane/PID	P	Spares Pot		✓
	Verify CO2	P	Allen Key		X
	Verify O2	P	Temperature Probe		X
	Verify H2S	P	Vane Anemometer		X
	Verify CO	P	USB Cable		✓
	Verify LEL	P	USB Memory stick		X
	Verify 1 st Option Gas	NA	SM V5 Software	Ver 6.5.05	X
	Verify Atmospheric pressure	P	Internal Filter Pack	Qty	X
	Verify differential pressure	P	External Filter Pack	Qty	X
	Verify flow	P	Field Guide		X
	Verify temperature probe input	P	Extra Items: <i>Sample Tubes</i> <i>Filters</i>		
	Verify vane anemometer input	P			
	DataBase Checks	Jobcard(s) completed and signed	P	Comments:	
Jobcard(s) booked off database		P			
Calibration certificate completed		P			
Complete & print QI record		n/a			
Label Checks	No. of Calibration label fitted	GDC 11649			
	MCERTS label displayed	N/A			
	Warranty label fitted	P			
H2S Range	H2S Range from Sales Order	5000	ppm		
	H2S Range from Cal Cert	5000	ppm		
	Over-range value correct?	P			

CHECKLIST FOR

PHOCHECK TIGER^{LT} PRODUCT

KIT CONTENTS

Tiger ^{LT} Instrument	✓
Li-ion Battery Pack	✓
Instrument Boot	✓
Charger	✓
Power Supply (12V)	✓
Warranty Registration Card	✓
Safety Notice for Tiger Instrument	✓
USB Cable	✓
Accessory Kit	✓

QUALITY CHECK

Firmware version:	0.6.01
Integrity seal present?	Yes/No

Final instrument inspection date:	T. Payne	04/07/22
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PD-FM-115-05



Unrivalled Gas Detection.

ION Science Ltd, The Hive, Butts Lane, Fowlmere, Cambs, SG8 7SL, UK
T +44 (0)1763 208503 E info@ionscience.com W ionscience.com

CALIBRATION CERTIFICATE



Date of Calibration: - 4th July 2022

Calibrated by: - T. Payne

Customer: - Shawcity Limited

Description: - Tiger^{LT}

Manufacturer: - ION Science Ltd

Type Number: - N/A

Serial Number: - T-119471

Certificate Number: - 261408

Signed: - T. Payne

Service Due date: - July 2023

This instrument has been factory calibrated to fully documented procedures in accordance with our ISO 9001:2015 Quality Management System.

Measurement standards are derived from volumetric and time sources which have been calibrated at an accredited laboratory traceable to National or International standards. The following list indicates the serial numbers of equipment used during the calibration procedure.

BAR02	C9559 / A14353 ¹	C9568 / A14344 ¹		
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¹ Gas mixtures prepared using equipment traceable to N.P.L. standards against Suppliers Certificate No.

The instrument has been calibrated at a temperature of 20.9°C ± 0.25°C and a barometric pressure of 1017.3 mbar ± 2 mbar.

ION Science hereby certify that on the day of calibration the instrument was working according to the manufacturer's original sales specification as checked by the calibration procedure, unless otherwise stated.

Copies of this certificate may only be reproduced in full.

Calibrations are valid as certified only on date of Calibration. For correct instrument operation please see the User Manual.

RESULTS ON DESPATCH

Applied Concentration	Instrument Indication
101.6 ppm Isobutylene	101.9 ppm Isobutylene
4932.4 ppm Isobutylene	4997 ppm Isobutylene

The estimated applied gas uncertainty is ± 2.0%

Comments: -

PD-FM-115-05

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