



Phase 2 Intrusive Site Investigation Report

LOCATION	23 New Lane, Skelmanthorpe, Huddersfield HD8 9EH
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FOR	Wendy Campbell
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1. Introduction

In accordance with your instruction, Geoinvestigate Limited has carried out an intrusive site investigation at 23 New Lane, Skelmanthorpe, Huddersfield HD8 9EH.

A Phase 1 Desk Study has previously been completed by Geoinvestigate Limited (G23386, October 2023). The most pertinent findings of the desk study comprised the following:

- The site is currently occupied with a single storey dwelling.
- The most likely potential sources of contamination which may have affected the site include construction and the proposed demolition of housing onsite or within close proximity.
- No visual evidence of potential contamination was apparent during the walkover inspection of the site.
- The most likely potential source of hazardous gas to the site and proposed development comprises any potential shallow historical coal mining activity below the site.
- BGS records show the site to be underlain by Pennine Lower Coal Measures with little to no superficial deposits present.
- Local trial pit records show thin topsoil with sandstone bedrock commencing from shallow depth.
- The most likely geotechnical risks to the site and proposed development might comprise shallow historical coal mining.

A Coal Mining Risk Assessment CMRA has been carried by Geoinvestigate Limited out for the site (G23386, October 2023), which shows the Penistone Green coal seam to be outcropping to the north and the west of the site, which is stratigraphically above the site. The places the Lower Penistone (Black Bed) beneath the site, meaning that it may lie at shallow depths beneath the new dwelling.

It is proposed to demolish the existing bungalow and erect a new dwelling on site. The boundary of the current study area and the proposed developmental layout are presented on the site plan included within Appendix 1 of this report.

The purpose of this Phase 2 investigation has been to establish the true nature of the ground conditions at the site with regard to the potential shallow coal mining, contamination, hazardous gas and geotechnical risks that have been identified during preliminary research, and to determine appropriate foundation solutions for the proposed new structure.

2. Scope of Phase 2 Investigation

2.1 Scope of Works

Given the above, the following investigation was carried out to assess the potential risks to the proposed development:

- Three (3) boreholes (ref. BH1 to BH6) were undertaken at the site to depths of between 1.90m and 2.40m below ground level (bgl) with associated soil sampling, logging and supervision of the works by a suitably qualified geo-environmental engineer / technician. The boreholes were sunk using windowless sampling techniques with a Dando Terrier 2002 mini drilling rig.

- Two (2) rotary open hole boreholes (ref. RH1 and RH2) undertaken to depths of 30.00m bgl under licence from the Coal Authority to probe for shallow mine workings. The boreholes were commenced using Geoinvestigate's Microdrill® system with water flush.
- Three (3) hand excavated trial pits (re. TPA to TPC) to provide additional information on near-surface ground conditions and to collect additional samples for contamination analysis, including from proposed soft landscaping and/or garden areas and locations inaccessible to the drilling rig.
- The installation of three (3) ground gas monitoring wells in boreholes BH1, BH2 and BH3 with allowance for up to between four (4) and six (6) gas monitoring visits over a period of up to three (3) months (if appropriate), including readings below 1000mb and where possible following a sharp drop in atmospheric pressure.
- Geotechnical testing comprising fifteen (15) moisture content determinations, three (3) Atterberg Limit plasticity tests, and a number of water-soluble sulphate concentrations and pH tests to allow suitable foundations and concrete design advice, including assessment of the shrinkage potential of any clay soils.
- Contamination analyses of four (4) samples of topsoil, made ground and natural subsoil recovered at depths of 0.20m. Analysis was variably undertaken for a general suite of potential metal/metalloid contaminants, polycyclic aromatic hydrocarbons (PAHs), asbestos, and petroleum hydrocarbons. Chemical analyses were based on the attending engineer's assessment of soils and ground conditions at the site together with desk study findings. Leachate from two (2) of these samples was tested to check the mobility of potential contaminants given the likely presence of permeable strata and shallow groundwater.
- Provision of a factual and interpretative report including site plan, borehole logs, trial pit logs, geotechnical and contamination soil analysis results, ground gas monitoring results, advice on the contamination, gas and the coal mining situation at the site, appropriate foundation advice, and advice regarding any remediation and validation works that may be necessary.

The trial pit and borehole positions are shown on the plan provided in Appendix 1.

The excavations were sampled and logged at site by a geoenvironmental engineer and the ground conditions encountered are described on the trial pit and borehole logs also provided in Appendix 1.

The results of geotechnical soil testing and soil moisture profiles are included in Appendix 2.

The results of the contamination testing are included in Appendix 3 (Chemtech Environmental Ltd. report no. 129850).

2.2 Sampling Rationale

The borehole positions were chosen to give an indication of the ground conditions generally across the building footprint at the site, both in terms of geotechnical appraisal and assessment of soil contamination. The soils encountered in the boreholes are considered to be broadly representative of soils throughout the

site. The hand excavated trial pit positions were specifically chosen to target proposed areas of soft landscaping or gardens.

3. Phase 2 Investigation Findings

3.1 Encountered Ground Conditions

3.1.1 Windowless Sample Boreholes

The boreholes revealed that the ground conditions were relatively uniform across the site and comprised made ground (likely from recent building demolition) underlain by cohesive natural strata and bedrock.

The boreholes encountered an initial granular made ground comprising sandy gravel/sandy gravel with concrete, brick, pot, and sandstone constituents, this was underlain by clay fill comprising soft to firm and firm sandy gravelly clay, with similar gravel composition. The made ground was encountered to depths of between 0.50m to 0.90m. Beneath this stiff natural sandy gravelly clay as encountered with gravel of sandstone and mudstone.

Weak weathered mudstone rock commenced below depths of between 1.50m and 1.80m and extended to the base of each borehole, with refusal met at depths of between 1.90m and 2.40m.

Standard Penetration Testing (SPTs) was undertaken at intervals throughout the boreholes. Below 1.00m values of between N=16 and N=22 were recorded. SPT testing within the bedrock returned values of between N=44 and N=57, indicating conditions comparable to dense to very dense.

No significant roots or water strikes / ground water were recorded during the works.

3.1.2 Hand Excavated Trial Pits

TPA and TPB (sunk within the existing and proposed garden areas) encountered similar conditions with TPA finding topsoil to 0.60m comprising of clayey gravelly sand with gravel of sandstone and coal. TPB encountered the same topsoil to 0.40m, underlain by firm natural sandy gravelly clay to 0.60m. TPC (in an area where topsoil had been stripped) encountered natural sandy gravelly clay from surface to 0.40m.

The trial pits all remained stable and dry on completion. No significant roots were recovered from the boreholes.

3.1.3 Rotary Open Hole Boreholes

The findings of the CMRA report necessitated that rotary open hole boreholes be sunk at the site as part of this investigation, to explore for possible shallow coal mine workings. These were drilled using Geoinvestigate's custom-built and trademarked Microdrill system, a lightweight tracked drilling rig which uses water flush.

Two (2) holes were drilled to depths of 30.00m (RH1 and RH2) and logs of the findings of these holes are presented in Appendix 1.

The rock descriptions are tentative and generally based on the contents of returned water flush, drilling progress (speed of advance) and water pressures observed during drilling; no cores were recovered from the boreholes to verify these though at several times during excavation the drill-string is withdrawn from the ground to inspect the composition of the build-up on the drill bit.

Gas readings were taken in the boreholes during and following drilling. These are shown on the logs in Appendix 1 (no hazardous gas concentrations were detected).

3.1.4.1 Strata Encountered

The rotary boreholes encountered a 1.80m to 1.90m thick drift horizon, underlain by sandstone/mudstone with sandstone inclusions to between 10.10m and 13.60m. In RH1 a 100mm thick intact coal seam was found at a depth of 10.10m, and in RH2 a 200mm thick mudstone horizon with coal fragments was noted. Beneath this was sandstone/sandstone with mudstone inclusions/mudstone with sandstone inclusions to 30.00m.

No voids or broken ground indicative of shallow mine workings were present within the boreholes. Full water flush return was maintained throughout drilling.

3.1.4.2 Conclusions with Respect to Mining Risk

The Coal Mining Risk Assessment highlighted a high risk due to a possibly worked coal seam (Lower Penistone) which is inferred to sub-crop below the site. Although a 100mm thick coal seam was encountered, this seam has not been worked. Given the thickness and poor quality of the coal seam, it is not considered that this would have been worked.

Therefore, no evidence of mining is present within 30m of the site surface and an ample 28m of unbroken rock cover has been confirmed.

3.2 Soil Moisture and Plasticity Testing

Borehole moisture profiles are presented in Appendix 2. Moisture contents between 11.9% and 24.9% were reported within the made ground. The natural cohesive strata recorded moisture contents between 17.2% and 23.5%. The weathered mudstone returned moisture contents of between 12.2% and 19.5%.

Atterberg Limit testing returned Plasticity Indices (PIs) between 14.8% and 27.4%. The cohesive soils therefore classify as Clay of Low (CL) to High (CH) Plasticity according to BS 5930. These results correspond to Low and Medium Shrinkage Soils (volume change potential) according to NHBC Section 4.2 Building Near Trees.

The moisture profiles indicate no evidence of any significant moisture depletion currently being present within the soils at the site, which correlates with the absence of any significant vegetation at the site.

Given the above, it is considered that the site currently has a low risk of seasonal soil volumetric changes attributable to vegetation. Therefore, were any significant vegetation present then it would be recommended that foundations are designed to mitigate against this accordingly.

4. Contamination Testing

As mentioned in Section 1, construction and use, together with subsequent demolition works within or close to the site might comprise the most viable potential sources of contamination at the site.

The soils most likely to contain contamination were expected to be the made ground deposits, or topsoil deposits, but contamination could feasibly also occur throughout the natural soils within the boreholes

found to a maximum depth of 1.80m. Soils close to surface would be the most relevant regarding human health risk assessment though analysis of leachate was also considered appropriate to ensure no risk to local ground and surface waters exists through potential contaminant leaching and mobilisation.

Other than the presence of occasional brick, concrete and pot fragments, the topsoil and made ground showed no obvious visual or olfactory evidence of potential contamination or contaminative materials. However, given the sites history, the potential for contamination to have affected the site could not be ruled out without soil analyses.

To ensure representation and characterisation of all relevant soil types, the analyses included:

- Sample of topsoil from TPA
- Samples of made ground from BH1 and BH2
- Sample of clay from TPC

Based on the findings of the site works, four (4) samples of topsoil, made ground and natural subsoil from depths of 0.20m recovered from across the site were tested for a range of substances. These samples were tested for a range of substances, depending on their origin, the requirements of the investigation, and the assessment of the attending engineer. Test suites variably included metals/metalloids, PAHs, asbestos, and petroleum hydrocarbons. Leachate from two (2) of the samples was analysed also to determine if there might be any risk of mobile contamination, with testing including TPH where appropriate.

The results of the contamination testing are included in Appendix 3 of this report (Chemtech Environmental Ltd. Report 129850) and have been used in the following contamination risk assessment.

5. Risk Assessment

5.1 Method

Geoinvestigate Ltd. uses a combination of assessment criterion provided by the Environment Agency, DEFRA and by the Chartered Institute of Environmental Health in order to assess the presence of potentially harmful chemicals within soils and water. These include; Environment Agency Environmental Quality Standards (EQSs), Site Specific Assessment Criteria (SSAC) generated using CLEA software version 1.06 site specific risk assessment modelling, DEFRA Category 4 Screening Levels (C4SLs), and Land Quality Management / Chartered Institute of Environmental Health (LQM/CIEH) Safe for Use Levels (S4ULs).

As the site is to be developed as a residential dwelling, it falls within the residential end-use category. As it is possible that persons living on the site may cultivate vegetables / fruit for consumption, consideration to this end is also necessary.

No site-specific assessment criteria (SSAC) have been created for the site as no unusual circumstances (i.e., occupation periods etc.) are considered to be present/likely at the site that would render the generic residential assessment criteria unsuitable.

The results of the contamination testing that has been carried out have been compared to the soil quality values from the above sources. Where they fall below these limit values, they have been deemed safe for residential end use.

Had any results been found to be above the intervention values, an assessment of the available pathways and receptors would have been carried out to determine whether further investigation or remediation might have been necessary.

An appraisal of the chemical results and relevant limits is set out in the Contamination Risk Assessment that follows.

5.2 Contamination Risk to Identified Receptors

5.2.1 Contamination Risk to Human Health

Made ground was encountered to a maximum depth of 0.90m, this was underlain by a cohesive natural clay subsoil.

No visual and/or olfactory evidence of contamination was found in any of the encountered soils, including no visible evidence of asbestos contamination such as roofing board.

As discussed earlier in the report, levels of determinants have been compared to the soil assessment criteria for residential end-use, as published by DEFRA and LQM/CIEH, with DEFRA C4SLs taking priority where more than one target value exists due to their “more pragmatic whist still strongly precautionary” nature (quote from SP1010 C4SL Policy companion Document).

The results of the analyses of eight (8) soil samples recovered at depths of between 0.20m and 1.00m are summarised and presented with the adopted assessment criteria in Table 1.

The analyses have returned low/negligible contaminant concentrations without exception.

A mean Total Organic Carbon Content (TOC) of 3.48% and mean Soil Organic Matter Content (SOM) of 5.98% (estimated from the TOC) were returned from the soil analyses. Therefore, the LQM/CIEH GAC for PAHs and other hydrocarbons were chosen using the highest Soil Organic Matter (SOM) option of 6%, which is considered the most representative value for the samples returned.

Table 1: Chemical Determinants in Soils

Determinant	Range of Returned concentrations (mg/kg)	S4UL (LQM/ClEH)* (mg/kg)	C4SL (DEFRA)* (mg/kg)
Asbestos	None detected (both)	Any presence unacceptable	
Arsenic	8.7-29.0	37	37
Boron	<0.5-0.6	290	
Cadmium	<1.6 (all samples)	11	26
Chromium VI	<0.04-0.1	6	21
Chromium III	24-30	910	
Copper	40-80	2,400	
Lead	28-73		200
Mercury (elemental)	<0.7 (all samples)	1.2	
Nickel	17-23	130	
Selenium	<3 (all samples)	250	
Zinc	68-105	2,700	
pH	5.8-8.2	See Report Section 7.5 "Concrete Design"	
Water Soluble SO ₄	108-1725		
Phenol	<0.5 (all samples)	380	
Total PAH	1.00-2.17		
PAH Naphthalene	0.06-0.04	13	
PAH Acenaphthylene	<0.02 (all samples)	920	
PAH Acenaphthene	<0.02 (all samples)	1,100	
PAH Fluorene	<0.02 (all samples)	860	
PAH Phenanthrene	0.11-0.28	440	
PAH Anthracene	0.02-0.09	11,000	
PAH Fluoranthene	0.16-0.43	890	
PAH Pyrene	0.14-0.34	2,000	
PAH Benzo(a)anthracene	0.09-0.19	13	
PAH Chrysene	0.10-0.20	27	
PAH Benzo(b)fluoranthene	0.09-0.20	3.7	
PAH Benzo(k)fluoranthene	0.04-0.08	100	
PAH Benzo(a)pyrene	0.09-0.19	3.0	5
PAH Dibenzo(a,h)anthracene	<0.02-0.03	0.30	
PAH Indeno(123-cd)pyrene	0.06-0.13	41	
PAH Benzo(ghi)perylene	0.06-0.12	350	
TPH Aromatic C5-C7	<0.01 (both)	300	0.87 (benzene)
TPH Aromatic C7-C8	<0.01 (both)	660	
TPH Aromatic C8-C10	<0.01 (both)	190	
TPH Aromatic C10-C12	<0.5 (both)	380	
TPH Aromatic C12-C16	<1-1.25	660	
TPH Aromatic C16-C21	3.42-17.43	930	
TPH Aromatic C21-C35	10.22-95.99	1,700	
TPH Aromatic C35-C44	<1.5 (both)	1,700	
TPH Aliphatic C5-C6	<0.1 (both)	160	
TPH Aliphatic C6-C8	<0.1 (both)	530	
TPH Aliphatic C8-C10	<0.1 (both)	150	
TPH Aliphatic C10-C12	<0.5 (both)	760 (283**)	
TPH Aliphatic C12-C16	1.37-3.44	4,300 (142**)	
TPH Aliphatic C16-C35	7.60-23.25	110,000	
TPH Aliphatic C35-C44	1.14-4.49	110,000	

*For residential use with allowance for plant uptake / consumption of homegrown produce and SOM of 6% where relevant.

**Value in parentheses denotes estimated soil saturation limit above which a possibility of free-phase contamination *might* exist in soil.

Exceedances of assessment Criteria shown in BOLD type

Concentrations of potential contaminants returned from the analysis of four (4) soil samples fell below the adopted target values without exception.

No asbestos was detected in the two samples inspected.

5.2.2 Contamination Risk to the Controlled Waters

Leachate was analysed from two (2) samples to investigate possible contaminant mobility. These samples were obtained from BH1 and TPC at 0.20m.

Levels for domestic water supply or the protection of aquatic life levels as published by the Environment Agency are presented as the assessment criteria, but these are not strictly target values. They are not directly applicable to leachates because these standards would represent the total concentration in the receiving water bodies following mixing of leached contaminants. As such, the standards are included as an example of good water quality for consideration of how leachable contamination might affect such waters. The results of the testing and the assessment criteria are shown Table 2.

Table 2: Chemical Determinants in Leachate

	Returned Concentrations (µg/l)	UK Standard for Surface Waters intended for Drinking Water Abstraction* (DW) and/or protection of Aquatic Life in surface waters* (Aq) (µg/l)
<i>Inorganic Chemicals</i>		
Arsenic	1.84-2.08	50 (DW, range: 50-100) (No Aq standard)
Boron	10-26	1000 (DW & Aq)
Cadmium	<0.1 (both)	5 (DW & Aq)
Chromium	<0.5-3.8	50 (DW) / 5-250 (Aq, range: 5-250)
Copper	2.2-4.2	50 (DW) / 5-112 (Aq, range: 5-112)
Lead	<0.6-1.4	50 (DW) / 4-250 (Aq, range: 4-250)
Mercury (elemental Hg)	<0.05 (both)	1 (DW & Aq)
Nickel	0.6-0.8	20** (DW) / 50-200 (Aq, range: 50-200)
Selenium	<1.1-1.78	10 (DW) (No Aq standard)
Zinc	<3.2 (both)	3000 (DW, range: 3000-5000) / 30-2000 (Aq, range: 30-2000)
pH	6.7-6.8	Range 5.5 to 10 (UK drinking water standards)
<i>Organic Chemicals</i>		
Cyanide	<5 (both)	50 (DW) / 5 (Aq)
Phenols	<10 (both)	50** (DW) / 300 (Aq)
PAHs (total)	<1.6 (both)	0.2 (DW, range: 0.2-1.0) (No Aq standard)
Individual PAH species above detectible concentrations:		
Acenaphthene	<0.1-0.2	No applicable UK standard
Fluorene	<0.1-0.2	No applicable UK standard
Phenanthrene	<0.1-0.3	No applicable UK standard

*sourced from Environment Agency database at <http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx>.

If more than one option is available (dependant on other water properties or environmental setting) applicability is discussed later.

**Standard for water supply as no standard available for surface water abstraction for drinking water.

***Sum of USEPA 16, each at Lower Limit of Detection of <0.1

As can be seen from Table 4 and the detailed results presented in Chemtech Environmental Ltd. report 129850 (Appendix 3), soils at the site have been shown to not be leaching any potential contaminants at levels that would be expected to have any significant impact on local ground and surface water bodies.

5.3 Review of Results

Analysis of four (4) samples of topsoil, clay and made ground has returned concentrations of potential contaminants falling below the adopted target levels without exception.

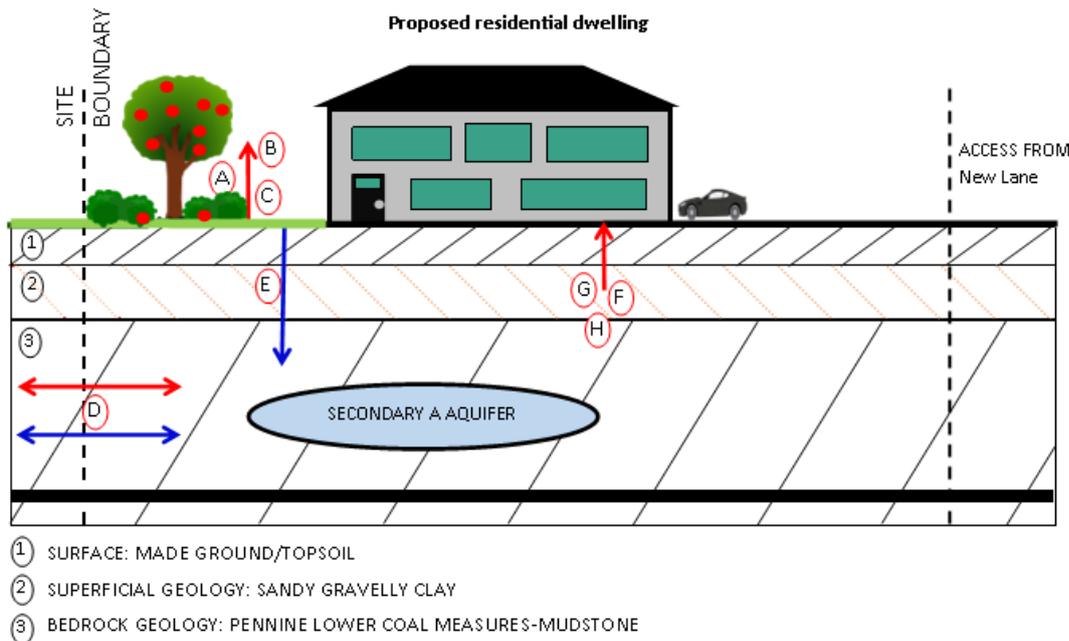
Additionally, analysis of leachate has also returned negligible levels of potential contaminants confirming that the site poses no risk to local ground or surface waters.

As such, the site is deemed to be fit for purpose for its proposed residential land use, and no remedial works will be required prior to redevelopment.

5.3.1 CGHM

The conceptual ground hazard model (CGHM) presented below shows the potential hazards and pollutant linkages which have been considered at the site, all of which are considered to have been satisfactorily disproven.

Figure 1: CGHM – Conceptual cross section of site including a Source, Pathway and Receptor Model



IDENTIFIED HAZARDS Including Potential CONTAMINATION SOURCES

- Possible presence of made ground and historical contamination thereof by past land use and development works at the site.
- Potentially contaminative historical land uses on nearby/adjacent sites including existing dwelling on site
- Possible hazardous gas risk from shallow historical coal mining.
- Potential ground stability issues associated with shallow historical coal mining.

IDENTIFIED RECEPTORS and ASSOCIATED PATHWAY

- A— End Users through Direct Contact / Inhalation / Ingestion. Buildings and hard standing will encompass some of the site, removing any pathway to end users through direct contact in these areas.
 - B— Plants and Trees through uptake, likely given the intended end use and proposed development layout.
 - C— End Users through cultivation and consumption of vegetables / fruit. Considered possible given the intended end use and proposed development layout.
 - D— Neighbouring Sites through lateral migration (in soil and water, including surface water run off).
 - E— Groundwater through leaching of sub-soil.
 - F— Buildings and services through direct contact.
- Linkages A-F broken due to low/negligible contamination and leachate analysis results.
- G— End users and buildings through ground gas migration.
- Linkage G broken, site falls into CS1 based on two initial gas monitoring visits.
- H— Geotechnical risks to buildings and services.
- No coal workings found within rotary boreholes.

6. Hazardous Gas

6.1 Gas Regime

Given the presence of made ground at the site, the potential presence of shallow historical coal mine workings, a ground gas monitoring exercise has been undertaken at the site to quantify the risk in this regard. Gas monitoring wells were installed in boreholes BH1, BH2 and BH3.

The results of two (2) initial gas monitoring visit at the site are presented in Table 3 below. A further set of up to four measurements may be required to complete the gas risk assessment at the site.

Table 3: Summary of Gas Monitoring Data

Borehole	Number of Visits	CH ₄ (%)	CO ₂ (%)	O ₂ (%)	Flow Rate (l/hr)	Atmospheric Pressure (mb)
BH1	2	<0.01	0.3-1.0	18.3-17.8	<0.01 (all)	971
BH2		<0.01	0.1-1.7	18.0-18.4		to
BH3		<0.01	0.3-0.9	16.3-18.2		996

The gas monitoring visit carried out to date at atmospheric pressures of 973mb to 992mb returned:

- Consistently negligible levels of CH₄.
- Near-normal and very slightly depleted oxygen levels.
- Slightly elevated CO₂ levels.
- Consistently negligible H₂S and CO levels below detectable limits (<0.01ppm).
- Consistently negligible flow rates below detectable limits (<0.01 l/hr)

6.2 Radon Gas

The site in an area where <1% of properties are above the radon action level. Therefore, no radon protection measures will be required in the new structure.

7. Conclusions

7.1 Contamination

Soil and leachate analysis results have confirmed that no noteworthy or significant contamination risk exists to potential receptors either within or close to the site (including water receptors).

As such, no remedial works will be required prior to the redevelopment of the site.

Though unlikely, if the development plan were to change significantly, or obvious evidence were uncovered during groundworks of potential contamination that has hitherto not been encountered, then both Geoinvestigate Ltd. and the local planning authority should be notified and, if appropriate, redevelopment works halted/postponed while further assessment and/or remediation work is undertaken.

7.2 Hazardous Gas

Ground gas monitoring is ongoing at the site with two of a potential four to six monitoring visits having been undertaken to date. The monitoring undertaken to date has returned no significantly elevated levels of hazardous gas and negligible gas flow rates (below detectable limits).

Given the absence of any shallow mining at the site, it is considered that the ground gas risk may be reduced to low, even without any gas monitoring results.

Based on the data gathered to date, the site is expected to fall into Characteristic situation 1 (CS1) of the Modified Wilson and Card classification or “Green” of the NHBC Traffic Light System for low rise housing with a ventilated under-floor void (min 150mm) (CIRIA C665). If the continued monitoring returns comparable data, no gas protection will be required in the new building(s). No final decision should be made without further monitoring, however.

No radon protection measures will be required for the new development.

Note that these conclusions are provisional and that the gas monitoring exercise is not yet completed, with only two of a possible four to six sets of readings gathered to date. Final recommendations regarding gas protection will be issued in due course in a Gas Monitoring Addendum Report following completion of the gas monitoring exercise.

7.3 Historical Coal Mining

Based on the rotary boreholes no mine workings have been encountered beneath the site up to 30m bgl. A 100mm thick coal seam was encountered at a depth of 10.20m, however this was not worked. Therefore, no remediation or mitigation will be necessary in terms of coal mining legacy.

7.4 Foundations Design

The ground conditions encountered at the site comprised made ground to a maximum depth of 0.90m, underlain by competent natural clay and mudstone. Natural strata was encountered at depths of between 0.50m and 0.90m. Mudstone rockhead commenced between 1.40m and 1.80m.

Given the above, traditional foundations may be seated at a depth of 1.00m, within the natural clay. The foundations may be based with a safe net bearing pressure of 125kN/m². Following the removal of the overlying weaker made ground the natural strata would provide a suitable base for the construction of a lightly loaded ground bearing floor slab, or a suspended floor.

7.5 Concrete Design

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 108mg/l⁻¹ and 1725mg/l⁻¹ and pH levels of between 5.8 and 8.2. Additionally, the site is inferred to classify as brownfield soils with mobile water.

On this basis concrete in contact with the ground may be designed to ACEC Class DS-3 AC-3s of “BRE Special Digest 1 – Concrete in aggressive ground”.

END OF REPORT

The findings and contents of this (intrusive) Site Investigation Report pertain solely to the study area(s) outlined herein and are based solely on the findings of the excavations undertaken as part of the current exercise unless otherwise stated. The findings and/or recommendations of this report do not take into account any ground conditions that may be present but have hitherto not been encountered and as such further investigation and/or a reconsideration of the findings of this report should be undertaken if such conditions are subsequently encountered or an alternative development plan or land use is subsequently proposed.

This report considers various environmental and/or geological risks posed to the site and/or proposed development and offers advice accordingly as guidance only. The findings of this report will remain valid provided no change of ground or groundwater conditions, either natural or anthropogenic, take place and no warrantee is offered or implied.

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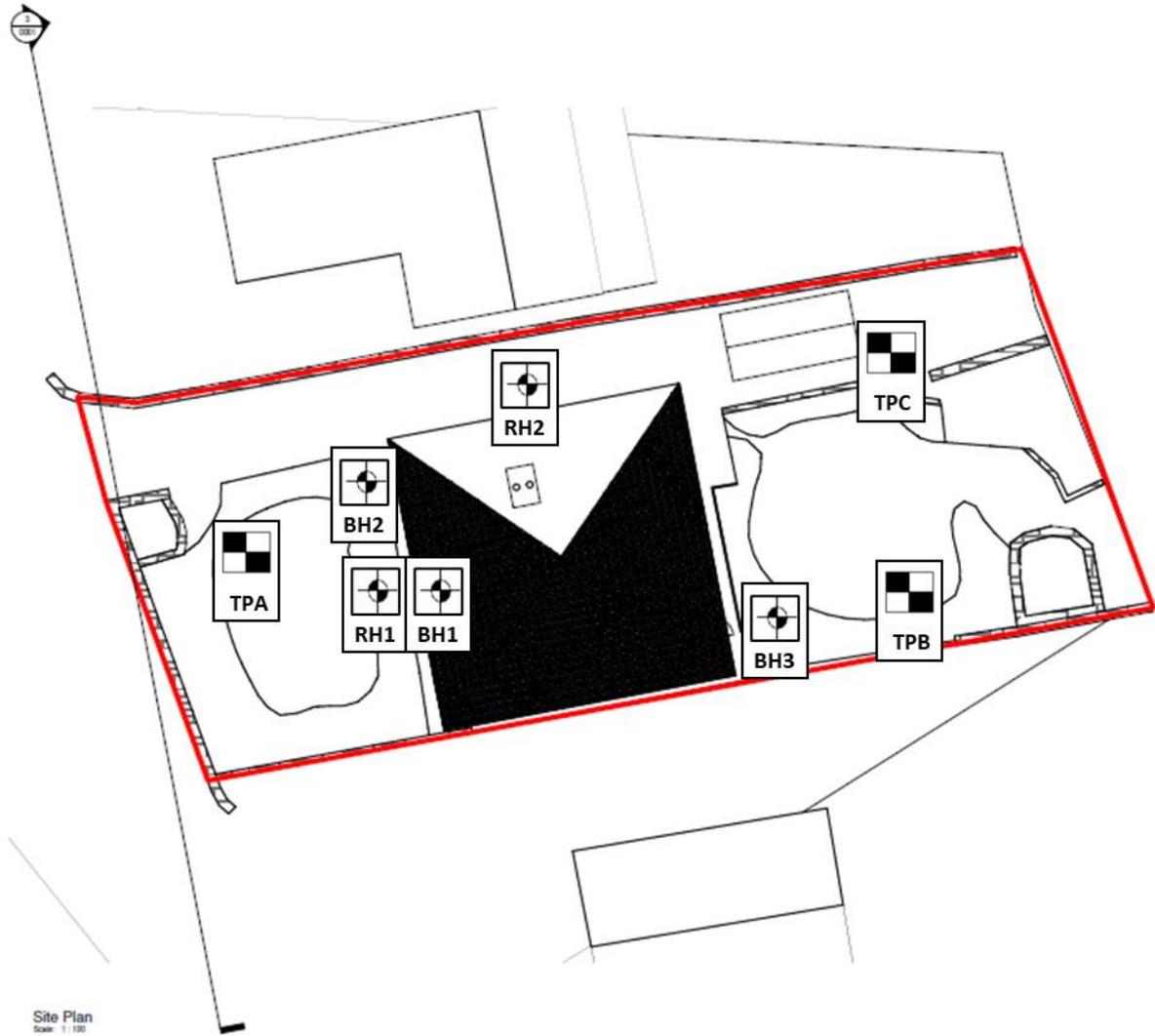
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APPENDIX 1
Site Plan
and
Borehole & Trial pit Logs

GEOINVESTIGATE Ltd.

OUR REF: G23419	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE: 15/01/24	LOCATION: 23 New Lane, Skelmanthorpe, HD8 9EH	



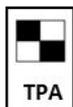
Key



Rotary Borehole Location



Windowless Borehole Location



Trial Pit Location

GEOINVESTIGATE Ltd.

Your Ref.
Our Ref.

G23419

BH No.1 Sheet No. 1 of 1
Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 15/01/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.20	MADE GROUND. Loose light greyish brown sandy gravel. Gravel is fine to coarse of brick, concrete, pot and sandstone.	200			○	Cv kN/m ²			0.25
0.60		400							0.50
1.80	MADE GROUND. Soft to firm very sandy gravelly clay. Gravel is fine to coarse of brick and sandstone.	1200			○		1.00m - 1.45m 4/4/5/5/6/6 N = 22		0.75
	Stiff light brown mottled grey and orange silty sandy gravelly CLAY. Gravel is fine to coarse of sandstone and mudstone.								1.25
	2.00								1.50
2.40	Weak and weathered light brown and grey MUDSTONE.	600			○		2.00m - 2.45m 6/6/8/10/12/14 N = 44		1.75
	Becoming strong at base.								2.25
	Borehole terminated at 2.40m due to refusal.								2.40

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 2.40m
 Borehole remained dry on completion
 Gas well installed to 2.40m with gas bung and cover

Key:

- | | | | |
|--|---------------|--|---------------------------|
| | Slotted Pipe | | Disturbed sample |
| | Plain Pipe | | Shear vane |
| | Bentonite | | Water sample |
| | Gravel Filter | | Standard Penetration Test |

BH1

GEOINVESTIGATE Ltd.

Your Ref.
Our Ref.

G23419

BH No.2 Sheet No. 1 of 1
Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 15/01/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	MADE GROUND. Loose light greyish brown sandy gravel. Gravel is fine to coarse of brick, concrete, pot and sandstone.	100			O	Cv kN/m ²			0.25
0.50		400							0.50
1.40	MADE GROUND. Soft to firm very sandy gravelly clay. Gravel is fine to coarse of brick and sandstone. Stiff light brown mottled grey and orange silty sandy gravelly CLAY. Gravel is fine to coarse of sandstone and mudstone.	900			O		1.00m - 1.45m 2/2/3/4/5/6 N = 18		0.75
									1.25
									1.50
1.90	Weak and weathered light brown and grey MUDSTONE. Becoming strong at base.	500			O		1.90m - 2.11m 10/16/25 N = 51		1.75
	Borehole terminated at 1.90m due to refusal.				O				1.90

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 1.90m
 Borehole remained dry on completion
 Gas well installed to 1.90m with gas bung and cover

Key:

	Slotted Pipe		Disturbed sample
	Plain Pipe		Cv Shear vane
	Bentonite		W Water sample
	Gravel Filter		S Standard Penetration Test

BH2

GEOINVESTIGATE Ltd.

Your Ref.
Our Ref.

G23419

BH No.3 Sheet No. 1 of 1
Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 15/01/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	MADE GROUND. Loose light greyish brown sandy gravel. Gravel is fine to coarse of brick, concrete, pot and sandstone.	100							
					○				0.25
	MADE GROUND. Firm very sandy gravelly clay. Gravel is fine to coarse of brick and sandstone.	800							0.50
0.90							1.00m - 1.45m 2/2/3/3/4/6 N = 16		0.75
					○				1.00
	Stiff light brown mottled grey and orange silty sandy gravelly CLAY. Gravel is fine to coarse of sandstone and mudstone.	600							1.25
1.50									1.50
	Weak and weathered light brown and grey MUDSTONE.	700							1.75
2.20							2.00m - 2.21m 10/18/29 N = 57		2.00
					○				2.20
	Borehole terminated at 2.20m due to refusal.								

Remarks:

Casing to 1.00m
 Dynamic windowless sampling by Terrier Rig to 2.20m
 Borehole remained dry on completion
 Gas well installed to 2.20m with gas bung and cover

Key:

	Slotted Pipe		Disturbed sample
	Plain Pipe		Cv Shear vane
	Bentonite		W Water sample
	Gravel Filter		S Standard Penetration Test

BH3

GEOINVESTIGATE Ltd.

Your Ref.
Our Ref. G23419

RH No.1 Sheet No. 1 of 2
Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 16/01/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
1.80	Brown DRIFT.	1800							
10.1	Light brown MUDSTONE with SANDSTONE inclusions. Becoming light grey from 4.60m.	8300							2.50 5.00 7.50 10.00
10.2	Black COAL, intact.	100							
11.3	Grey MUDSTONE.	1100							
21.5	Light brown SANDSTONE.	10200							12.50 15.00 17.50 20.00
30.0	Light grey SANDSTONE with MUDSTONE inclusions.	8500							22.50 25.00

Remarks: Casing to 1.00m

 Microdrill rotary open hole borehole to 30.00m
 No cores recovered from borehole
 No gas detected from borehole on completion
 Full flush returned. No voids encountered.

RH1

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G23419

RH No.1 Sheet No. 2 of 2

Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 16/01/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
30.0	Light grey SANDSTONE with MUDSTONE inclusions.	8500							27.50 30.00
	Rotary hole terminated at 30.00m.								

Remarks: Casing to 1.00m
 Microdrill rotary open hole borehole to 30.00m
 No cores recovered from borehole
 No gas detected from borehole on completion
 Full flush returned. No voids encountered.

RH1

GEOINVESTIGATE Ltd.

Your Ref.
Our Ref. G23419

RH No.2 Sheet No. 1 of 2
Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 16/01/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
1.90	Brown DRIFT.	1900							
8.10	Light brown MUDSTONE with SANDSTONE inclusions. Becoming light grey from 4.00m.	6200						2.50 5.00 7.50	
13.6	Grey SANDSTONE.	5500						10.00 12.50	
13.8	Dark grey MUDSTONE with coal fragments.	200						15.00	
26.2	Light grey SANDSTONE.	12400						17.50 20.00 22.50	25.00

Remarks: Casing to 1.00m
 Microdrill rotary open hole borehole to 30.00m
 No cores recovered from borehole
 No gas detected from borehole on completion
 Full flush returned. No voids encountered.

RH2

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G23419

RH No.2 Sheet No. 2 of 2

Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 16/01/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type	Result	Flush	Depth to Water	Depth (m)
26.2	Light grey SANDSTONE.	12400								
30.0	Light grey MUDSTONE with SANDSTONE inclusions.	3800								27.50
	Rotary hole terminated at 30.00m.									30.00

Remarks: Casing to 1.00m
 Microdrill rotary open hole borehole to 30.00m
 No cores recovered from borehole
 No gas detected from borehole on completion
 Full flush returned. No voids encountered.

RH2

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G23419

TPA

Sheet No. 1 of 1

Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 17/01/24

Depth	Description of Strata	Thick	Legend	Gas Well	Sample	Test	SPT N Value	Depth to Water	Depth
0.60	TOPSOIL. Loose dark brown clayey gravelly sand. Gravel is fine to coarse of sandstone and coal.	600			O				0.10 0.20 0.30 0.40 0.50 0.60

Remarks: Hand excavated trial pit to 0.60m
Trial pit remained dry on completion.

Key: O Disturbed sample

TPA

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G23419

TPB

Sheet No. 1 of 1

Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 17/01/24

Depth	Description of Strata	Thick	Legend	Gas Well	Sample	Test	SPT N Value	Depth to Water	Depth
0.40	TOPSOIL. Loose dark brown clayey gravelly sand. Gravel is fine to coarse of sandstone and coal.	400							0.10 0.20 0.30 0.40
0.60	Firm orangish brown sandy gravelly CLAY.	200							0.50 0.60

Remarks: Hand excavated trial pit to 0.60m
Trial pit remained dry on completion.

Key: ○ Disturbed sample

TPB

GEOINVESTIGATE Ltd.

Your Ref.

Our Ref. G23419

TPC

Sheet No. 1 of 1

Location: 23 New Lane, Skelmanthorpe, HD8 9EH

DATE: 17/01/24

Depth	Description of Strata	Thick	Legend	Gas Well	Sample	Test	SPT N Value	Depth to Water	Depth
0.40	Firm orangish brown sandy gravelly CLAY.	400			O				0.10 0.20 0.30 0.40

Remarks:

Key: O Disturbed sample

TPC

APPENDIX 2

Geotechnical Testing

GEOINVESTIGATE Ltd.

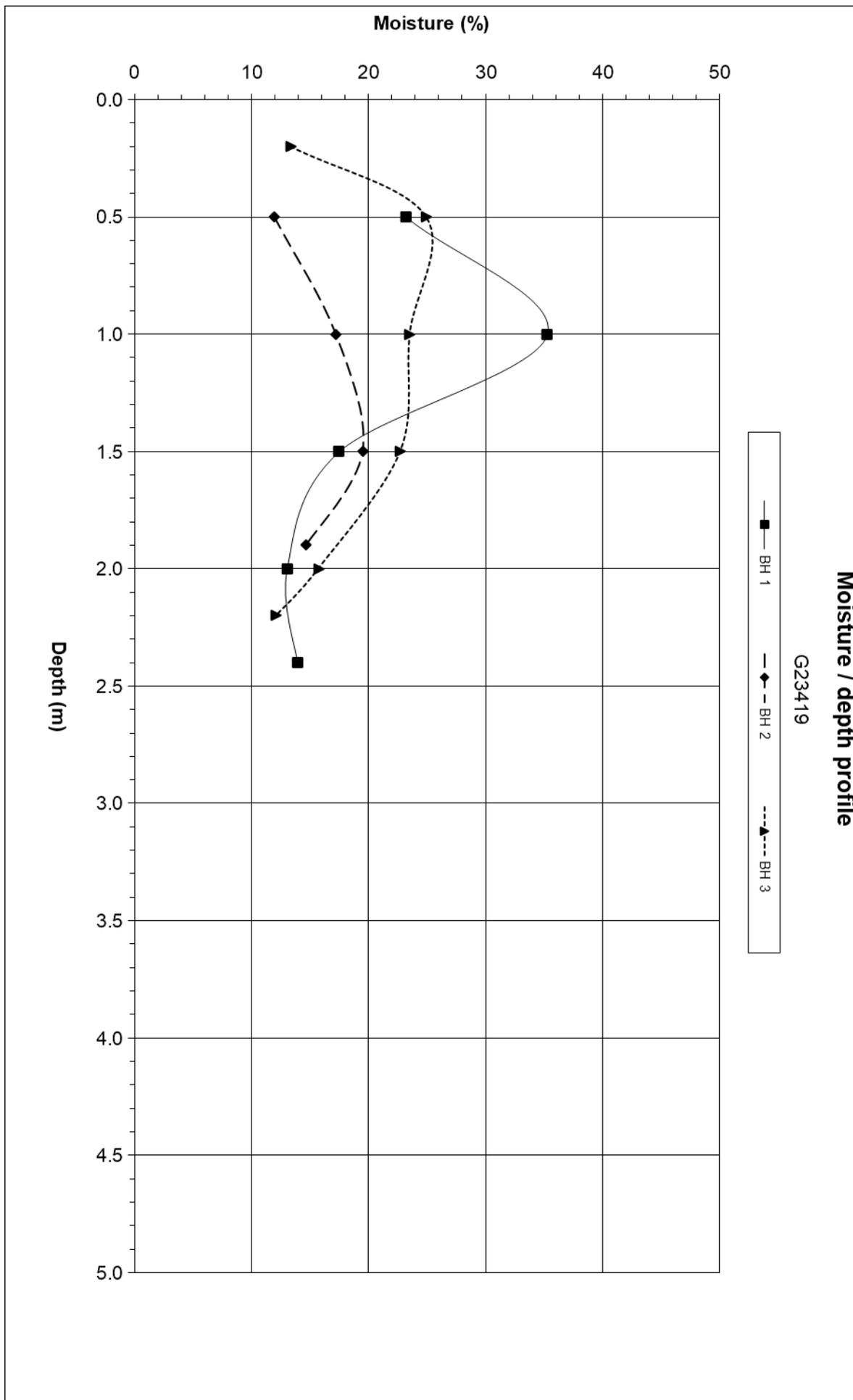
Atterberg Limit Test Results

Our ref. G23419

Your ref.

Location: 23 New Lane, Skelmanthorpe, HD8 9EH

TP / BH No.	Sample Depth (m)	Insitu Moisture Content (%)	% Passing BS 425 Micron Sieve	Corrected Moisture Content (%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index (%)	Soil Classification BS5930 [1999]
1	0.50	23.2						
	1.00	35.3						
	1.50	17.5	89.4	19.6	22.0	42.9	20.9	CI
	2.00	13.1						
	2.40	13.9						
2	0.50	11.9						
	1.00	17.2	86.9	19.8	28.2	55.6	27.4	CH
	1.50	19.5						
	1.90	14.7						
3	0.20	13.4						
	0.50	24.9						
	1.00	23.5						
	1.50	22.7	64.3	35.4	22.0	36.8	14.8	CI
	2.00	15.8						
	2.20	12.2						



APPENDIX 3
Chemtech Analytical Test Report



ANALYTICAL TEST REPORT

Contract no: 129850

Contract name: Proposed Residential Development, 22 New Lane, Skelmanthorpe, HD8 9EH

Client reference: G23419

Clients name: Geo Investigate

Clients address: Units 3a & 4 Terry Dicken Industrial Estate
Ellerbeck Way, Stokesley
North Yorkshire
TS9 7AE

Samples received: 19 January 2024

Analysis started: 19 January 2024

Analysis completed: 26 January 2024

Report issued: 26 January 2024

Key

- U UKAS accredited test
- M MCERTS & UKAS accredited test
- \$ Test carried out by an approved subcontractor
- I/S Insufficient sample to carry out test
- N/S Sample not suitable for testing
- NAD No Asbestos Detected

Approved by:

Rachael Burton

Reporting Team Lead

Chemtech Environmental Limited

SAMPLE INFORMATION

MCERTS (Soils):

Soil descriptions are only intended to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions. MCERTS accreditation applies for sand, clay and loam/topsoil, or combinations of these whether these are derived from naturally occurring soils or from made ground, as long as these materials constitute the major part of the sample. Other materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

Lab ref	Sample id	Depth (m)	Sample description	Material removed	% Removed	% Moisture
129850-1	BH1	0.20	Clayey Sand wit Gravel	-	-	5.4
129850-2	BH2	0.20	Loamy Clayey Sand with Gravel	-	-	13.8
129850-3	TPA	0.20	Loamy Clayey Sand with Gravel	-	-	18.4
129850-4	TPC	0.20	Loamy Clayey Sand with Gravel & Roots	-	-	17.0

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SOILS

Lab number			129850-1	129850-2	129850-3	129850-4
Sample id			23 New Lane	23 New Lane	23 New Lane	23 New Lane
Depth (m)			0.20	0.20	0.20	0.20
Date sampled			15/01/2024	15/01/2024	15/01/2024	15/01/2024
Test	Method	Units				
Arsenic (total)	CE264 ^M	mg/kg As	8.7	20	27	29
Boron (water soluble)	CE063 ^U	mg/kg B	0.6	0.5	<0.5	<0.5
Cadmium (total)	CE264 ^M	mg/kg Cd	<1.6	<1.6	<1.6	<1.6
Chromium (total)	CE264 ^U	mg/kg Cr	26	24	30	28
Chromium (III)	CE208	mg/kg CrIII	26	24	30	28
Chromium (VI)	CE263	mg/kg CrVI	0.1	<0.04	<0.04	<0.04
Copper (total)	CE264 ^M	mg/kg Cu	80	59	45	40
Lead (total)	CE264 ^U	mg/kg Pb	28	48	73	73
Mercury (total)	CE264 ^U	mg/kg Hg	<0.7	<0.7	<0.7	<0.7
Nickel (total)	CE264 ^M	mg/kg Ni	17	20	23	23
Selenium (total)	CE264	mg/kg Se	<3	<3	<3	<3
Zinc (total)	CE264 ^M	mg/kg Zn	68	86	100	105
pH	CE004 ^M	units	8.2	7.0	6.7	5.8
Sulphate (2:1 water soluble)	CE061 ^U	mg/l SO ₄	1725	1548	240	108
Sulphide	CE016	mg/kg S ²⁻	<10	<10	22	41
Cyanide (free)	CE077	mg/kg CN	<1	<1	<1	<1
Cyanide (total)	CE077	mg/kg CN	<1	<1	<1	<1
Thiocyanate	CE145 ^M	mg/kg SCN	<1	2.0	<1	<1
Phenols (total)	CE078	mg/kg PhOH	<0.5	<0.5	<0.5	<0.5
Total Organic Carbon (TOC)	CE197	% w/w C	1.5	3.6	3.7	5.1
Estimate of OMC (calculated from TOC)	CE197	% w/w	2.6	6.2	6.4	8.7
PAH						
Acenaphthene	CE087 ^M	mg/kg	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	CE087 ^M	mg/kg	<0.02	<0.02	<0.02	<0.02
Anthracene	CE087 ^U	mg/kg	0.09	0.05	0.04	0.02
Benzo(a)anthracene	CE087 ^U	mg/kg	0.17	0.11	0.19	0.09
Benzo(a)pyrene	CE087 ^U	mg/kg	0.14	0.10	0.19	0.09
Benzo(b)fluoranthene	CE087 ^M	mg/kg	0.17	0.11	0.20	0.09
Benzo(ghi)perylene	CE087 ^M	mg/kg	0.11	0.07	0.12	0.06
Benzo(k)fluoranthene	CE087 ^M	mg/kg	0.07	0.05	0.08	0.04
Chrysene	CE087 ^M	mg/kg	0.20	0.13	0.20	0.10
Dibenz(ah)anthracene	CE087 ^M	mg/kg	0.02	<0.02	0.03	<0.02
Fluoranthene	CE087 ^M	mg/kg	0.43	0.22	0.37	0.16
Fluorene	CE087 ^U	mg/kg	<0.02	<0.02	<0.02	<0.02
Indeno(123cd)pyrene	CE087 ^M	mg/kg	0.11	0.08	0.13	0.06
Naphthalene	CE087 ^M	mg/kg	0.04	0.04	0.03	0.02
Phenanthrene	CE087 ^M	mg/kg	0.28	0.19	0.20	0.11
Pyrene	CE087 ^M	mg/kg	0.34	0.18	0.31	0.14
PAH (total of USEPA 16)	CE087	mg/kg	2.17	1.33	2.08	1.00

Chemtech Environmental Limited

SOILS

Lab number			129850-1	129850-2	129850-3	129850-4
Sample id			23 New Lane	23 New Lane	23 New Lane	23 New Lane
Depth (m)			0.20	0.20	0.20	0.20
Date sampled			15/01/2024	15/01/2024	15/01/2024	15/01/2024
Test	Method	Units				
TPH						
VPH Aromatic (>EC5-EC7)	CE067	mg/kg	<0.01	<0.01	-	-
VPH Aromatic (>EC7-EC8)	CE067	mg/kg	<0.01	<0.01	-	-
VPH Aromatic (>EC8-EC10)	CE067	mg/kg	<0.01	<0.01	-	-
EPH Aromatic (>EC10-EC12)	CE250	mg/kg	<0.5	<0.5	-	-
EPH Aromatic (>EC12-EC16)	CE250	mg/kg	<1	1.25	-	-
EPH Aromatic (>EC16-EC21)	CE250	mg/kg	17.43	3.42	-	-
EPH Aromatic (>EC21-EC35)	CE250	mg/kg	95.99	10.22	-	-
EPH Aromatic (>EC35-EC44)	CE250	mg/kg	<1.5	<1.5	-	-
VPH Aliphatic (>C5-C6)	CE067	mg/kg	<0.1	<0.1	-	-
VPH Aliphatic (>C6-C8)	CE067	mg/kg	<0.1	<0.1	-	-
VPH Aliphatic (>C8-C10)	CE067	mg/kg	<0.1	<0.1	-	-
EPH Aliphatic (>C10-C12)	CE250	mg/kg	<0.5	<0.5	-	-
EPH Aliphatic (>C12-C16)	CE250	mg/kg	3.44	1.37	-	-
EPH Aliphatic (>C16-C35)	CE250	mg/kg	23.25	7.60	-	-
EPH Aliphatic (>C35-C44)	CE250	mg/kg	4.49	1.14	-	-
Subcontracted analysis						
Asbestos (qualitative)	\$	-	NAD	NAD	-	-

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PREPARED LEACHATES

Lab number			129850-1	129850-4
Sample id			23 New Lane	23 New Lane
Depth (m)			0.20	0.20
Test	Method	Units		
Arsenic (dissolved)	CE265 ^U	µg/l As	2.08	1.84
Boron (dissolved)	CE265	µg/l B	26	10
Cadmium (dissolved)	CE265 ^U	µg/l Cd	<0.1	<0.1
Chromium (dissolved)	CE265 ^U	µg/l Cr	3.8	<0.5
Copper (dissolved)	CE265 ^U	µg/l Cu	4.2	2.2
Lead (dissolved)	CE265 ^U	µg/l Pb	<0.6	1.4
Mercury (dissolved)	CE265	µg/l Hg	<0.05	<0.05
Nickel (dissolved)	CE265 ^U	µg/l Ni	0.8	0.6
Selenium (dissolved)	CE265 ^U	µg/l Se	1.78	<1.1
Zinc (dissolved)	CE265 ^U	µg/l Zn	<3.2	<3.2
pH	CE213 ^U	units	6.7	6.8
Sulphate	CE257 ^U	mg/l	1180.5	<0.3
Sulphur (dissolved)	CE128 ^U	mg/l S	403.2	1.3
Sulphide	CE249	µg/l S ²⁻	<100	<100
Cyanide (free)	\$	µg/l CN	<5	<5
Cyanide (total)	\$	µg/l CN	<5	<5
Thiocyanate	CE014	µg/l SCN	<200	<200
Phenols (total)	CE148	µg/l PhOH	<10	<10
PAH				
Acenaphthene	CE051	µg/l	0.2	<0.1
Acenaphthylene	CE051	µg/l	<0.1	<0.1
Anthracene	CE051	µg/l	<0.1	<0.1
Benzo(a)anthracene	CE051	µg/l	<0.1	<0.1
Benzo(a)pyrene	CE051	µg/l	<0.1	<0.1
Benzo(b)fluoranthene	CE051	µg/l	<0.1	<0.1
Benzo(ghi)perylene	CE051	µg/l	<0.1	<0.1
Benzo(k)fluoranthene	CE051	µg/l	<0.1	<0.1
Chrysene	CE051	µg/l	<0.1	<0.1
Dibenz(ah)anthracene	CE051	µg/l	<0.1	<0.1
Fluoranthene	CE051	µg/l	<0.1	<0.1
Fluorene	CE051	µg/l	0.2	<0.1
Indeno(123cd)pyrene	CE051	µg/l	<0.1	<0.1
Naphthalene	CE051	µg/l	<0.1	<0.1
Phenanthrene	CE051	µg/l	0.3	<0.1
Pyrene	CE051	µg/l	<0.1	<0.1
PAH (total of USEPA 16)	CE051	µg/l	<1.6	<1.6

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
GEOINVESTIGATE SOIL SUITE						
CE264	Arsenic (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.8	mg/kg As
CE063	Boron (water soluble)	Hot water extract, ICP-OES	Dry	U	1	mg/kg B
CE264	Cadmium (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cd
CE264	Chromium (total)	Aqua Regia Extraction, ICPOES	Dry	U	2	mg/kg Cr
CE263	Chromium (VI)	Discrete Analyser	Dry		0.04	mg/kg CrVI
CE146	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE264	Copper (total)	Aqua Regia Extraction, ICPOES	Dry	M	1.6	mg/kg Cu
CE264	Lead (total)	Aqua Regia Extraction, ICPOES	Dry	U	2.3	mg/kg Pb
CE264	Mercury (total)	Aqua Regia Extraction, ICPOES	Dry	U	0.7	mg/kg Hg
CE264	Nickel (total)	Aqua Regia Extraction, ICPOES	Dry	M	2.1	mg/kg Ni
CE264	Selenium (total)	Aqua Regia Extraction, ICPOES	Dry	U	3	mg/kg Se
CE264	Zinc (total)	Aqua Regia Extraction, ICPOES	Dry	M	4	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	As received	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	U	10	mg/l SO ₄
CE016	Sulphide	Distillation, Titration	Dry		10	mg/kg S ²⁻
CE077	Cyanide (free)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE077	Cyanide (total)	Extraction, Continuous Flow Colorimetry	As received		1	mg/kg CN
CE145	Thiocyanate	Weak acid extraction, Colorimetry	Dry	M	1	mg/kg SCN
CE078	Phenols (total)	Extraction, Continuous Flow Colorimetry	As received		0.5	mg/kg PhOH
CE197	Total Organic Carbon (TOC)	Carbon Analyser	Dry		0.1	% w/w C
CE197	Estimate of OMC (calculated from TOC)	Calculation from Total Organic Carbon	Dry		0.1	% w/w
CE087	Acenaphthene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Acenaphthylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(a)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(b)fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(ghi)perylene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Benzo(k)fluoranthene	Solvent extraction, GC-MS	As received	U	0.03	mg/kg
CE087	Chrysene	Solvent extraction, GC-MS	As received	M	0.03	mg/kg
CE087	Dibenz(ah)anthracene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluoranthene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Fluorene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Indeno(123cd)pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Naphthalene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	Phenanthrene	Solvent extraction, GC-MS	As received	U	0.02	mg/kg
CE087	Pyrene	Solvent extraction, GC-MS	As received	M	0.02	mg/kg
CE087	PAH (total of USEPA 16)	Solvent extraction, GC-MS	As received		0.34	mg/kg
ADDITIONAL TESTING						
CE067	VPH Aromatic (>EC5-EC7)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC7-EC8)	Headspace GC-FID	As received		0.01	mg/kg
CE067	VPH Aromatic (>EC8-EC10)	Headspace GC-FID	As received		0.01	mg/kg
CE250	EPH Aromatic (>EC10-EC12)	Solvent extraction, GCxGC-FID	As received		1	mg/kg

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METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE250	EPH Aromatic (>EC12-EC16)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC16-EC21)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC21-EC35)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE250	EPH Aromatic (>EC35-EC44)	Solvent extraction, GCxGC-FID	As received		1	mg/kg
CE067	VPH Aliphatic (>C5-C6)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C6-C8)	Headspace GC-FID	As received		0.1	mg/kg
CE067	VPH Aliphatic (>C8-C10)	Headspace GC-FID	As received		0.1	mg/kg
CE250	EPH Aliphatic (>C10-C12)	Solvent extraction, GCxGC-FID	As received		6	mg/kg
CE250	EPH Aliphatic (>C12-C16)	Solvent extraction, GCxGC-FID	As received		6	mg/kg
CE250	EPH Aliphatic (>C16-C35)	Solvent extraction, GCxGC-FID	As received		15	mg/kg
CE250	EPH Aliphatic (>C35-C44)	Solvent extraction, GCxGC-FID	As received		10	mg/kg
\$	Asbestos (qualitative)	HSG 248, Microscopy	Dry	U	-	-

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METHOD DETAILS

METHOD	PREPARED LEACHATES	METHOD SUMMARY	STATUS	LOD	UNITS
GEOINVESTIGATE LEACHATE SUITE					
CE002	Leachate preparation (EA)	L:S 10:1		-	-
CE265	Arsenic (dissolved)	Analysis by ICPMS	U	0.1	µg/l As
CE265	Boron (dissolved)	Analysis by ICPMS		4	µg/l B
CE265	Cadmium (dissolved)	Analysis by ICPMS	U	0.1	µg/l Cd
CE265	Chromium (dissolved)	Analysis by ICPMS	U	0.5	µg/l Cr
CE265	Copper (dissolved)	Analysis by ICPMS	U	0.6	µg/l Cu
CE265	Lead (dissolved)	Analysis by ICPMS	U	0.6	µg/l Pb
CE265	Mercury (dissolved)	Analysis by ICPMS		0.05	µg/l Hg
CE265	Nickel (dissolved)	Analysis by ICPMS	U	0.4	µg/l Ni
CE265	Selenium (dissolved)	Analysis by ICPMS	U	1.1	µg/l Se
CE265	Zinc (dissolved)	Analysis by ICPMS	U	3	µg/l Zn
CE213	pH	Based on BS 1377, pH Meter	U	-	units
CE257	Sulphate	Discrete Analyser	U	0.3	mg/l
CE128	Sulphur (dissolved)	ICP-MS	U	0.2	mg/l S
CE249	Sulphide	Distillation, Titration		100	µg/l S ₂ -
\$	Cyanide (free)	Continuous Flow Colorimetry		5	µg/l CN
\$	Cyanide (total)	Continuous Flow Colorimetry		5	µg/l CN
CE014	Thiocyanate	Colorimetry		200	µg/l SCN
CE148	Phenols (total)	Continuous Flow Colorimetry		10	µg/l PhOH
CE051	Acenaphthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Acenaphthylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(a)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(b)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(ghi)perylene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Benzo(k)fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Chrysene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Dibenz(ah)anthracene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluoranthene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Fluorene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Indeno(123cd)pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Naphthalene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Phenanthrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	Pyrene	Solvent extraction, GC-MS		0.1	µg/l
CE051	PAH (total of USEPA 16)	Solvent extraction, GC-MS		1.6	µg/l

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DEVIATING SAMPLE INFORMATION

Comments

Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.

For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.

Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
NSD	Sampling date not provided
NST	Sampling time not provided (waters only)
EHT	Sample exceeded holding time(s)
IC	Sample not received in appropriate containers
HP	Headspace present in sample container
NCF	Sample not chemically fixed (where appropriate)
OR	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
129850-1	BH1	0.20	N	
129850-2	BH2	0.20	N	
129850-3	TPA	0.20	N	
129850-4	TPC	0.20	N	

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ADDITIONAL INFORMATION

Notes

Opinions and interpretations expressed herein are outside the UKAS accreditation scope.

Unless otherwise stated, Chemtech Environmental Ltd was not responsible for sampling.

All testing carried out at Unit 6 Parkhead, Stanley, DH9 7YB, except for subcontracted testing.

Methods, procedures and performance data are available on request.

Results reported herein relate only to the material supplied to the laboratory.

This report shall not be reproduced except in full, without prior written approval.

Samples will be disposed of 6 weeks from initial receipt unless otherwise instructed.

For soils and solids, all results are reported on a dry basis. Samples dried at no more than 30°C in a drying cabinet.

For soils and solids, analytical results are inclusive of stones, where applicable.

APPENDIX 4
Coal Authority Permit & Site Photos



The Coal
Authority

Permit to Enter or Disturb Coal Authority Interests

Permit 27624

Name and Address of Permit Holder:

*Wendy Campbell
23 New Lane
Skelmanthorpe
HD8 9EH*

Site Location:

*23 New Lane
Skelmanthorpe
HD8 9EH*

This certificate hereby grants the above named Permit Holder a Permit to carry out:-

Ground investigation by three boreholes to 30m

within the Authority's interests at the identified site location above as shown on the Grant Permit Boundary (overleaf) for the period of **12 months** from the granted date shown below. *The granting of this Permit does not constitute advice given by the Authority in relation to the proposed operations. It is the Permit Holder's responsibility to obtain appropriate health, safety, environmental, technical and legal advice.*

Conditions:

- *Manned entry (i.e.) into mine entries/workings) is strictly prohibited.*
- *Water flush*
- *Gas Monitoring CO, CH₄, CO₂, O₂, H₂S at borehole and rig*
- *Operators undertaking the work must be in possession of this certificate and the Permit boundary plan at the time of works*
- *Appropriate borehole sealing without delay and to withstand site level changes*

Signed: *Helen Day* Granted Date: *4 December 2023*

For and on behalf of The Coal Authority

Nominated Representative: Helen Day, Permitting Manager;

The Coal Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG

Tel: 01623 637450; E-Mail: permissions@coal.gov.uk



The Coal
Authority

Granted Permit Boundary

Permit Ref: 27624

Permit Boundary:



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