



GEOLOGICAL  
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GEOENVIRONMENTAL  
DATA ACQUISITION  
CONSULTANCY



## Phase 2 Intrusive Site Investigation Report

LOCATION	33a Church Lane, Clayton West, Huddersfield HD8 9LY
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FOR	Byram Construction Ltd
CLIENT REF.	
OUR REF.	G24327

Prepared by

Checked by

Matthew Pennington BSc (Hons)  
Geoenvironmental Engineer

Stuart Howe BSc (Hons) FGS  
Senior Geotechnical Engineer



**Head Office**

Units 3a and 4 Terry Dicken Industrial  
Estate  
Ellerbeck Way  
Stokesley  
North Yorkshire  
TS9 7AE

**Manchester**

Suite 26 Atlantic Business Centre  
Atlantic Street  
Altrincham  
WA14 5NQ

**Nottingham**

Unit 4 Bailey Brook Industrial Estate  
Amber Drive, Langley Mill  
Nottingham  
NG16 4BE

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## 1. Introduction

In accordance with your instruction, Geoinvestigate Limited has carried out an intrusive site investigation at 33a Church Lane, Clayton West, Huddersfield, HD8 9LY.

A Phase 1 Desk Study has previously been completed by Geoinvestigate Limited (G24327, November 2024). The most pertinent findings of the desk study comprised the following:

Site Suitability	Desk Study Finding	Preliminary Assessment
Normal Foundations	Bedrock expected to be present at shallow depth with possible thin drift deposits. Consideration should be made to vegetation influence if clay soils are encountered.	Unclear due to mining risk
Soakaways	Sandstone bedrock may offer sufficient permeability.	Potentially Suitable

Potential Risks	Desk Study Finding	Preliminary Risk Assessment
Radon Gas	Less than 1% of properties affected	Very Low
Chemical Contamination	Historical nearby and on-site land uses potentially giving rise to a range of inorganic and organic contaminants including asbestos, metals/metalloids, PAHs and petroleum hydrocarbons.	Low
Hazardous Gas	Potential for hazardous gas to migrate from possible unrecorded coal mine workings and if deep made ground is present.	Moderate
Ground Instability / subsidence	Potential for vegetation influence on shrink-swell clays which may be present, including risk of soil heave. Potential for significant deposits of compressible made ground.	Low
Ground Instability / subsidence	Potential for unrecorded shallow coal mining.	Moderate

NB. Arbitrary potential hazard assessment: High (Red), Moderate (Amber), Low (Yellow), Very Low (Green), Negligible (uncoloured)

It is proposed to construct a new residential development at the site with associated soft landscaping (including private gardens) and hardstanding access roads and parking. 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 contamination, coal mining, hazardous gas and geotechnical risks that have been identified during preliminary research, and to determine appropriate foundation solutions for the proposed new structure(s).

## 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:

- Four (4) boreholes (ref. BH1 to BH4) were undertaken at the site to depths of between 1.40m and 2.00m below ground level (mbgl) with associated soil sampling, logging and supervision of the works by a suitably qualified geo-environmental engineer. The boreholes were commenced using windowless sampling techniques with a Dando Terrier 2002 mini drilling rig.
- Three (3) rotary open hole boreholes (ref. RH1 to RH3) undertaken to depths of between 15.00m and 30.00mbgl under licence (29287) from the Coal Authority to probe for shallow mine workings. The boreholes were commenced using the Geoinvestigate Microdrill® system with water flush.
- Two (2) hand excavated trial pits (ref. TPA and TPB) to provide additional information on near-surface ground conditions 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 BH4 with allowance for up to 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 twenty-two (22) moisture content determinations, a single (1) Atterberg Limit plasticity test, 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 made ground recovered at depths of between 0.20m and 0.50m. Analysis was variably undertaken for a general suite of potential metal/metalloid contaminants, polycyclic aromatic hydrocarbons (PAHs), asbestos, and petroleum hydrocarbons (including BTEX\*). 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.  
\*Benzene, toluene, ethyl benzene and xylenes
- 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 (I2 Analytical Ltd. report no. 24-056769-1).

## 2.2 Sampling Rationale

The borehole positions were chosen to give an indication of the ground conditions generally throughout 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 Ground Conditions

#### 3.1.1 Windowless Sample Boreholes

The ground conditions differed across the site. In the east of the site (BH1 and BH2) made ground was encountered overlying natural strata predominantly comprising sandy gravelly clay over sandstone gravel, whereas in the east of the site (BH3 and BH4) topsoil was encountered underlain by natural strata comprising sand and gravel.

The made ground comprised sandy gravel fill with gravel constituents of concrete, slag, brick, tile and sandstone. Borehole BH2 was overlain by 0.10m sandstone slab. A minor ash constituent was also noted. This stratum was encountered to depths of between 0.80m (BH1) and 0.50mbgl (BH2).

The natural ground comprised an upper layer of firm sandy gravelly clay containing gravel constituents of sandstone to depths of between 1.20m (BH1) and 1.40m (BH2). Beneath the upper clay was medium dense sandy gravel of sandstone. This extended to between 1.60. and 2.00m where the boreholes were terminated or met refusal.

In BH3 and BH4, in the east of the site, topsoil was found to depths of 0.30mbgl, underlain by very clayey gravelly sand to 0.60mbgl in both BH3 and BH4. This was underlain by medium dense to dense gravelly sand/ sandy gravel to between 1.40mbgl and 1.50mbgl where the borehole was terminated due to refusal.

The basal medium dense and dense granular strata was considered to represent completely weathered sandstone rock.

Hand shear vane tests returned values between 40kN/m<sup>2</sup> and 45kN/m<sup>2</sup> in the upper clay stratum at depths of between 0.50m and 1.40m, indicating generally firm condition.

Standard Penetration Tests (SPTs) were undertaken throughout the boreholes. Testing in the natural granular soils returned N values of between N=15 and N=50+, indicating generally medium dense to very dense condition.

Roots were noted to a depth of 1.00mbgl within BH2 only. No ground water was recorded during the works.

### 3.1.2 Hand Excavated Trial Pits

Trial pits TPA to TPD all encountered broadly similar conditions to the boreholes. The turf onto made ground comprising clayey gravelly sand to depths of between 0.20m (TPA) and 0.50m (TPD).

The trial pits all remained stable and dry on completion.

### 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 and ironstone mine workings. These were drilled using the Geoinvestigate custom-built and trademarked Microdrill system, a lightweight tracked drilling rig which uses water flush.

Three (3) holes were drilled to depths between 15.00m (RH3) and 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).

The rotary boreholes encountered rockhead at depths between 1.40m and 1.60m comprising sandstone then siltstone. Grey and dark grey mudstone was then encountered between depths of circa 21m and 23m underlain by siltstone then sandstone to 30m (where drilled).

The Coal Mining Risk Assessment highlighted a high risk due to a possibly worked coal seam (Clay Cross Soft Coal) which is inferred to sub-crop and dip below the site 90m north of the development. However, this seam was not encountered in the boreholes, nor were any voids or broken ground and might be considered therefore too deep to affect the surface at the study site.

Therefore, no evidence of mining is present within 30m of the site surface and an ample 25m of unbroken rock cover has been confirmed. When referencing the ten-times thickness rule of thumb discussed above, there appears to be an ample competent rock cover to the seam thickness ratio.

## 3.2 Soil Moisture, Plasticity Testing and Vegetation Influence.

Borehole moisture profiles are presented in Appendix 2. Moisture contents between 12.3% and 25.8% were reported within the made ground. The natural strata recorded moisture contents between 10.8% and 29.6%.

Based on the ostensibly granular composition of the soils encountered at the site, extensive plasticity testing was not considered necessary or possible on *most* of the soils encountered.

Atterberg Limit testing on the sample of clayey soil from a depth of 1.00m in BH2 classified as essentially non-plastic material.

Given the above and the presence of deeper ostensibly granular soils at the site, it was considered that no special precautions are required with regard to foundation design and seasonal vegetation influence.

## 4. Contamination Testing

As mentioned in Section 1, the use of the study site itself (garages) and construction and demolition work within 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, but contamination could feasibly also occur throughout the full thickness of made ground strata.

Soils close to surface would be the most relevant regarding human health risk assessment though analysis of leachate from the made ground 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 plastic fragments, the made ground showed no obvious visual or olfactory evidence of potential contamination or contaminative materials. However, given the site's 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:

- Samples of the largely granular near surface made ground stratum from TPA and TPB.

Based on the findings of the site works, four (4) samples of made ground from depths of between 0.20m and 0.50m 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 (including BTEX in some cases). 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 (I2 Analytical Ltd. Report 24-056769 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.

Where results have been found to be above the intervention values, an assessment of the available pathways and receptors has been carried out to determine whether further investigation or remediation may be 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 Sensitive Receptors**

### **5.2.1 Human Health**

Made ground was encountered to a maximum depth of 0.80m, this was underlain by a cohesive natural clay subsoils which in turn were underlain by granular deposits.

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

As discussed earlier in the report, levels of determinands 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).

A mean Total Organic Carbon Content (TOC) of 2.95% and mean Soil Organic Matter Content (SOM) of 11.90% (estimated from the TOC) was returned from the soil analyses.

The LQM/CIEH GAC for PAHs and other hydrocarbons were chosen using the samples specific Soil Organic Matter (SOM) content, which is considered the most representative value for the samples returned.

A summary of the results is shown in Table 1 below.

**Table 1: Summary of Chemical Determinands in Soil**

Determinand	Units	Limits of Detection	Total Samples	Returned Concentrations		Threshold Ranges S4UL / C4SL	
				Min	Max	Min	Max
pH	pH Unit	N/a	4	7	8	-	-
Water Soluble Sulphate as SO <sub>4</sub> (2:1)	mg/l	<1.25	4	9.83	32.7	-	-
Moisture Content	%	< 0.01	4	6	17	-	-
Organic Matter	%	< 0.1	4	1.3	5.6	-	-
<b>Metals</b>							
Arsenic	mg/kg	<1	4	7.9	47	37	37
Boron (Water Soluble)	mg/kg	< 1	4	0.6	1	290	290
Cadmium	mg/kg	< 0.2	4	<0.2	< 0.2	11	11
Copper	mg/kg	< 4	4	18	51	2400	2400
Chromium III	mg/kg	< 2	4	9.1	22	910	910
Hexavalent Chromium	mg/kg	< 1.8	4	<1.8	< 1.8	6	6
Free Cyanide	mg/kg	< 1	4	<1	< 1	140	140
Total Cyanide	mg/kg	< 1	4	<1	< 1	140	140
Lead	mg/kg	< 1	4	28	420	200	200
Mercury (Aqua regia extractable)	mg/kg	< 0.3	4	<0.3	< 0.3	410	410
Nickel	mg/kg	< 1	4	4.8	25	120	180
Selenium	mg/kg	< 1	4	<1	2	250	250
Zinc	mg/kg	< 1	4	33	140	3700	3700
Asbestos Screen	-	-	2	Not Detected		Detection	
<b>Organics</b>							
Total Phenols (Monohydric)	mg/kg	< 1	4	<1	< 1	120	380
Naphthalene	mg/kg	< 0.05	4	<0.05	0.06	2.3	13
Acenaphthylene	mg/kg	< 0.05	4	<0.05	< 0.05	170	920
Acenaphthene	mg/kg	< 0.05	4	<0.05	0.25	210	1100
Fluorene	mg/kg	< 0.05	4	<0.05	0.19	170	860
Phenanthrene	mg/kg	< 0.05	4	0.12	3	95	220
Anthracene	mg/kg	< 0.05	4	<0.05	0.64	2400	11000
Fluoranthene	mg/kg	< 0.05	4	0.19	3.9	280	890
Pyrene	mg/kg	< 0.05	4	0.15	3.2	620	2000
Benzo(a)anthracene	mg/kg	< 0.05	4	0.13	1.4	7.2	13
Chrysene	mg/kg	< 0.05	4	0.15	1.3	15	27
Benzo(b)fluoranthene	mg/kg	< 0.05	4	0.12	1	2.6	3.7
Benzo(k)fluoranthene	mg/kg	< 0.05	4	0.06	0.77	77	100
Benzo(a)pyrene	mg/kg	< 0.05	4	0.09	1.1	5	5
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.05	4	0.06	0.46	27	41
Dibenz(a,h)anthracene	mg/kg	< 0.05	4	<0.05	0.09	0.24	0.3
Benzo(ghi)perylene	mg/kg	< 0.05	4	0.05	0.52	320	350
Speciated Total EPA-16 PAHs	mg/kg	< 0.08	4	1.15	17.9	-	-

**Table 1 (cont): Summary of Chemical Determinands in Soil**

Determinand	Units	Limits of Detection	Total Samples	Returned Concentrations Threshold Ranges S4UL / C4SL		Threshold Ranges S4UL / C4SL	
				Min	Max	Min	Max
Ali >C5-C6	mg/kg	< 0.02	1	<0.01	< 0.02	42	160
Ali >C6-C8	mg/kg	< 0.02	1	<0.01	< 0.02	100	530
Ali >C8-C10	mg/kg	< 0.05	1	<0.01	< 0.05	27	150
Ali >C10-C12	mg/kg	< 1	1	<1	< 1	130	760
Ali >C12-C16	mg/kg	< 2	1	<2	< 2	1100	4300
Ali >C16-C21	mg/kg	< 8	1	<8	< 8	65000	110000
Ali >C21-C35	mg/kg	< 8	1	<8	< 8	65000	110000
Ali >C35-C44	mg/kg	< 8.4	0	0	< 8.4	65000	110000
Ali >C5-44	mg/kg	< 10	0	0	< 10	-	-
Aro >C5-C7	mg/kg	< 0.01	1	<0.01	< 0.01	70	300
Aro >C7-C8	mg/kg	< 0.01	1	<0.01	< 0.01	130	660
Aro >C8-C10	mg/kg	< 1	1	<0.02	< 1	34	190
Aro >C10-C12	mg/kg	< 1	1	<1	< 1	74	380
Aro >C12-C16	mg/kg	< 2	1	<2	< 2	140	660
Aro >C16-C21	mg/kg	< 10	1	<10	< 10	260	930
Aro >C21-C35	mg/kg	< 10	1	<8	< 10	1100	1700
Aro >C35-C44	mg/kg	< 8.4	0	0	< 8.4	1100	1700
Aro >C5-44	mg/kg	< 10	0	0	< 10	-	-
<b>VOCs / SVOCs</b>							
Benzene	ug/kg	< 2	1	<5	< 2	0.87	3.7
Toluene	ug/kg	< 5	1	<5	< 5	130	660
Ethylbenzene	ug/kg	< 2	1	<5	< 2	47	260
p & m-xylene	ug/kg	< 2	1	<5	< 2	59	320
o-Xylene	ug/kg	< 2	1	<5	< 2	60	330
MTBE (Methyl Tertiary Butyl Ether)	ug/kg	< 5	1	<5	< 5	61	350

The analysis has shown two slightly elevated concentrations of arsenic and lead.

A summary of the exceedances determined during laboratory testing and subsequent assessment are shown in table 2 below.

**Table 2: Soil Threshold Exceedances and Locations**

Location	Depth (mbgl)	Determinand(s)	Observed Concentration (mg/kg)	Threshold (mg/kg)
TPA	0.50	Arsenic	47	37
TPB	0.50	Lead	420	200

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

Elevated concentrations of arsenic (As) and lead (Pb) have been returned in two of the four analysed samples. These samples were recovered from depths of 0.20m and 0.50m in TPA and TPB respectively.

Generally, PAHs and TPHs have been returned levels below detectable concentrations and/or the adopted target values.

No asbestos was detected in either of the two samples inspected.

These exceedances appear to be restricted to only the darker, predominantly sand made ground. As such, a localised remediation exercise will be required to address this issue before the site can be deemed suitable for residential use.

### 5.2.2 Controlled Waters

Given the possible historical contamination sources, and permeable deposits below the site, leachate was analysed from two (2) samples to investigate possible contaminant mobility. These samples were obtained from TPA (0.20m) and TPB (0.20m).

The leaching test is an aggressive test (de-ionised water) and is not in aqueous equilibrium (steady state) with the solid sample, this may cause overestimation of the aqueous phase concentrations compared to groundwater in contact with the same contaminated soils and therefore may not give results that are an accurate representation of the groundwater risk on site. Further to this, the leaching test was actually developed for inorganic constituents, with the leaching of organics being poorly understood, and again may not be representative of their presence. The main risk is expected to be from inorganic contaminants.

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 and attenuation of the 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.

A summary of the leachate testing is shown in table 3 below.

**Table 3: Chemical Determinands in Leachate**

Determinands	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)
	Min	Max	
<i>Inorganic Chemicals</i>			
Arsenic	1.2	3.9	50 (DW, range: 50-100) (No Aq standard)
Boron	12	13	1000 (DW & Aq)
Cadmium	< 0.08	< 0.08	5 (DW & Aq)
Chromium	< 0.4	2.4	50 (DW) / 5-250 (Aq, range: 5-250)
Copper	4.7	<b>10</b>	50 (DW) / 5-112 (Aq, range: 5-112)
Lead	<b>8.8</b>	<b>11</b>	50 (DW) / 4-250 (Aq, range: 4-250)
Mercury (elemental Hg)	< 0.5	< 0.5	1 (DW & Aq)
Nickel	< 0.3	1.1	20** (DW) / 50-200 (Aq, range: 50-200)
Selenium	< 4.0	< 4.0	10 (DW) (No Aq standard)
Zinc	7.4	12	3000 (DW, range: 3000-5000) / 30-2000 (Aq, range: 30-2000)
pH	7.7	8.3	Range 5.5 to 10 (UK drinking water standards)
<i>Organic Chemicals</i>			
Cyanide	<10		50 (DW) / 5 (Aq)
Phenols	<10		50**(DW) / 300 (Aq)
PAHs (total)	<0.16	<b>0.25</b>	0.2 (DW, range: 0.2-1.0) (No Aq standard)
Individual PAH species:			
Acenaphthene	< 0.01	0.03	No applicable UK standard
Acenaphthylene	< 0.01	< 0.01	No applicable UK standard
Anthracene	< 0.01	< 0.01	0.4 (surface water quality, max. allowable)
Benzo[a]anthracene	< 0.01	< 0.01	No applicable UK standard
Benzo(a)pyrene	< 0.01	< 0.01	0.1 (surface water quality, max. allowable)
Benzo(b)fluoranthene	< 0.01	< 0.01	0.03 (surface water quality, annual average)
Benzo(ghi)perylene	< 0.01	< 0.01	0.002 (surface water quality, annual average)
Benzo(k)fluoranthene	< 0.01	< 0.01	0.03 (surface water quality, annual average)
Chrysene	< 0.01	< 0.01	No applicable UK standard
Dibenzo(a,h)anthracene	< 0.01	< 0.01	No applicable UK standard
Fluoranthene	< 0.01	< 0.01	1 (surface water quality, max. allowable)
Fluorene	< 0.01	0.03	No applicable UK standard
Indeno(123-cd)pyrene	< 0.01	< 0.01	0.002 (surface water quality, annual average)
Naphthalene	<0.01	0.07	10 (Aq, UK inland waters)
Phenanthrene	0.07	0.12	No applicable UK standard
Pyrene	< 0.01	< 0.01	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 I2 Analytical Ltd. report 24-056769 (Appendix 3). A summary of potential risks determined during laboratory testing and subsequent assessment are shown in table 4 below and generally returned concentrations below target levels.

**Table 4: Leachate Risk Locations**

Location	Depth (mbgl)	Determinand(s)	Threshold (µg/l)	Observed Concentration (µg/l)
TPA	0.20	Lead	4-250	11
		PAH (total)	0.2	0.25
TPB	0.20	Lead	4-250	8.8
		Copper	5-112	10

Some leachates returned elevated lead and copper concentrations which exceed the lowest threshold of the assessment criteria options (of several possible choices). These lowest options relate to freshwater with very low calcium carbonate content (<50mg/l which is unlikely in water of pH 7.7 to 8.3 as measured for these leachates (Low CaCO<sub>3</sub> content would be expected to more likely in more acidic waters than this). Though no data has been collected regarding the calcium carbonate content of local waters and underlying groundwater, the low concentrations and consequently extremely minor nature of any possible exceedances of lower target values suggests that these results do not represent any noteworthy risk to underground or surface waters.

Slightly elevated PAH (total) has been detected in leachate from the topsoil recovered from TPA. This value exceeds the corresponding environmental quality standard (EQS) but is not considered to be of any concern. The absence of any groundwater, surface water receptors close to the site, and the low soil analysis results suggest that the overall leaching risk is negligible and poses no noteworthy risk to the water environment.

### 5.3 Hazardous Gas / Ground Gas

#### 5.3.1 Gas Regime

Given the potential presence of shallow historical coal mine workings, and the potential for deep infilled ground at nearby sites, 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 BH4.

The results of five (5) initial gas monitoring visits at the site are presented in Table 5 below. A further set of up to four measurements may be required to complete the gas risk assessment at the site.

**Table 5: Summary of Gas Monitoring Data**

Job Number G24327		CH <sub>4</sub> (%)		CO <sub>2</sub> (%)	O <sub>2</sub> (%)							
Client Byram Construction Ltd		Minimum		0	1	17.4						
Site 35a Church Lane, Holmfield		Maximum		0	2.7	20						

Borehole	Number of Visits	CH <sub>4</sub> (%)		CO <sub>2</sub> (%)		O <sub>2</sub> (%)		Flow Rate (l/hr)	H <sub>2</sub> S (ppm)	CO (ppm)	Atmospheric Pressure (mb)
		Min.	Max.	Min.	Max.	Min.	Max.				
BH1	5	0	0	1.3	2.7	17.8	19.2	<0.1	0	0	998
BH2	5	0	0	1	2.6	18	19.7	<0.1	0	0	to
BH4	5	0	0	1.1	2.2	17.4	20	<0.1	0	0	1037

The gas monitoring visit carried out to date at atmospheric pressures of 998mb to 1037mb returned:

- Low and marginal levels of CO<sub>2</sub>.
- Consistently negligible or very low levels of CH<sub>4</sub>.
- Near-normal oxygen levels.
- Consistently negligible H<sub>2</sub>S and CO levels below detectable limits (<1ppm).
- Consistently negligible flow rates below detectable limits (<0.1 l/hr).

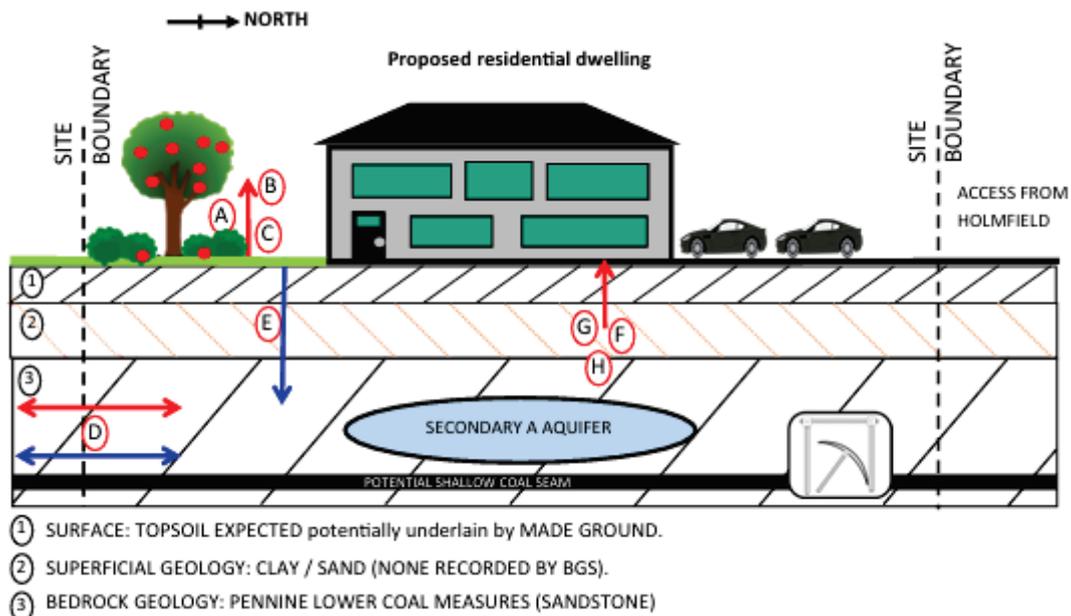
#### 5.3.2 Radon Gas

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

## 6. Conceptual Ground Hazard Model (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 and/or demolition works at the site.
- Potentially contaminative historical land uses on nearby/adjacent sites including; former onsite and adjacent buildings and two quarries.
- Potential for made or infilled ground to generate hazardous gases either within the study site or on adjacent/nearby sites.
- Possible hazardous gas risk from shallow historical coal mining.
- Potential ground stability issues associated with; vegetation influence and shrink-swell clays, potentially weak and compressible made ground, compressible natural deposits and 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 likely given the intended end use and proposed development layout.
- Linkages A-C considered to be potentially complete due to elevated levels of Arsenic and Lead in near-surface made ground analysed from the site. Remedial works required.
- D— Neighbouring Sites through lateral migration (in soil and water, including surface water run off).**
- E— Groundwater through leaching of sub-soil.**
- Linkages D & E considered disproven due to negligible contaminant levels in leachates, impermeable natural subsoils, absence of any nearby surface water features, and absence of asbestos in soils (re. risk of airborne fibres).
- F— Buildings and services through direct contact.**
- See Report Section 7.5 for appropriate concrete design advice.
- Barrier type water supply pipe not recommended given no elevated petroleum hydrocarbon levels detected in soils. Pipe line risk assessment is still suggested.
- G— End users and buildings through ground gas migration.**
- Ground gas monitoring exercise ongoing.
- H— Geotechnical risks to buildings and services.**
- See report sections 7.3 and 7.4 for appropriate foundation and mining advice.

## 7. Conclusions

### 7.1 Soil & Water Contamination

Soil and leachate analysis results suggest that most soils at the site are uncontaminated and suitable for use in a residential context.

However, the samples analysed from TPA and TPB (within the proposed garden areas) returned elevated arsenic and lead concentrations which may be indicative of a localised contamination issue. This may be an anomalous result, but further investigation would be required to confirm that hypothesis.

The most cost-effective and appropriate method of remediation is likely to comprise the installation of a capping layer (often referred to as a cover system). This comprises the excavation and removal of soils to (normally) 600mm below the proposed finished ground levels, followed by replacement with at least a 600mm thickness (or other agreed thickness) of proven uncontaminated new soils. Made ground extends to variable depths across the site, beyond 600mm below the current ground levels, and has been confirmed to pose limited risk to local ground and surface waters through leaching. As such, the confining of these soils below a new capping layer will minimise the quantity of waste to be excavated and transported to landfill, while posing no residual risk to the proposed development or water environment.

The local planning authority (LPA) will most likely require a “remediation and validation strategy” document for approval prior to commencement of the remedial works, and a “validation report” on completion of the works confirming their success.

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

Ground gas monitoring is ongoing at the site with two of a potential 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). Readings have been taken at low atmospheric pressure.

Based the data gathered to date, the site is expected 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.

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

No hydrocarbon vapour protection is expected to be necessary for the new development.

Note that these conclusions are provisional and that the gas monitoring exercise is not yet completed, with five of a possible 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**

The rotary boreholes drilled at the site encountered no broken ground or voiding indicative of any shallow mining beneath the site. In addition, although coal fragments were noted within the mudstone at 21m no coal seams were encountered. Based on the ground conditions encountered in the rotary boreholes, any potential mine-workings present are at depths below the 30.00m depth of the rotary drilling activity. If traditional shallow foundations are adopted, then it is considered the development will not be affected by mine workings due to the site having sufficient thickness of competent rock cover.

### **7.4 Foundation Design**

The encountered ground conditions comprised shallow made ground underlain by form very sandy clay then medium dense granular strata. In BH3 and BH4 the initial clay horizon was absent. Refusal was met at comparatively shallow depth within medium dense to dense strata, on what was considered to represent weathered sandstone rock.

Based on the conditions above, foundations should extend to depth of 1.00m at BH3 and BH4, and to 1.50m at BH1 and BH2, to ensure minimal settlement.

Seated at the forgoing depths within the medium dense to dense granular strata, foundations may be designed to a safe net bearing pressure of 150kN/m<sup>2</sup>, based on the lowest SPT N Value of N=22 returned. Providing the safe bearing capacity is not exceeded settlement would be anticipated to be less than 25mm.

Following removal of the weaker made ground and cohesive soils, the medium dense granular strata would provide a suitable base to commence construction of a lightly loaded ground bearing floor slab.

Groundwater was not encountered during the investigation; therefore, it is not likely that groundwater ingress will pose an issue during the forming of foundation excavations. However, all excavations should be monitored during construction for groundwater ingress, particularly after periods of heavy and/or prolonged rainfall, and mitigated accordingly, i.e., via sumps and pumping.

### **7.5 Concrete Design**

The results of chemical analyses of the fill returned Water Soluble Sulphate levels of between 9.83mg/l<sup>-1</sup> and 32.70mg/l<sup>-1</sup> and pH levels of between 6.6 and 7.9. Additionally, the site is inferred to classify as brownfield soils with no mobile water.

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

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**END OF REPORT**

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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.

No copying of this report or any part of its contents is permitted without written permission of Geoinvestigate Ltd. nor should the report be made available to any third party without similar prior arrangement.

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**Head Office**

Units 3a and 4 Terry Dicken Industrial  
Estate  
Ellerbeck Way  
Stokesley  
North Yorkshire  
TS9 7AE

**Manchester**

Suite 26 Atlantic Business Centre  
Atlantic Street  
Altrincham  
WA14 5NQ

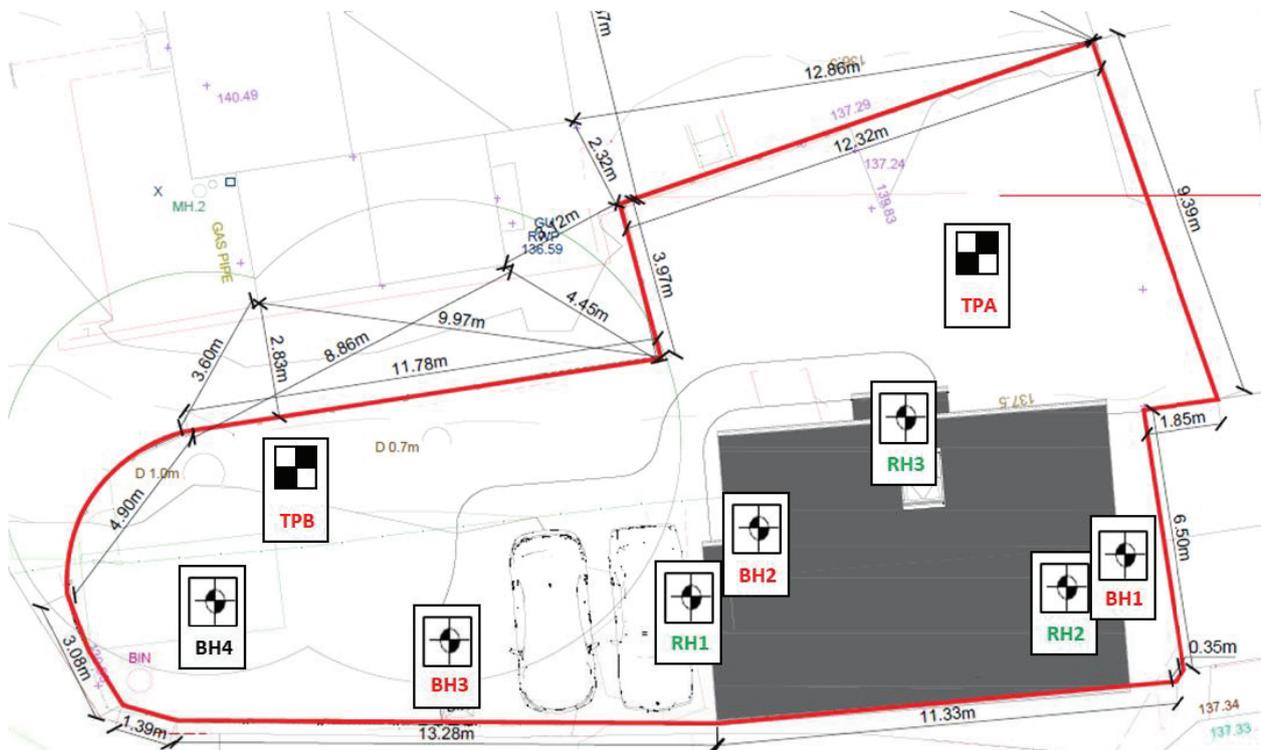
**Nottingham**

Unit 4 Bailey Brook Industrial Estate  
Amber Drive, Langley Mill  
Nottingham  
NG16 4BE

**APPENDIX 1**

Site Plan  
and  
Exploratory Hole Logs

OUR REF: G24327	YOUR REF:	SITE PLAN (NOT TO SCALE)
DATE: 07/11/24	LOCATION: 35a Church Road, Holmfild HD8 9LY	



**Key**



Windowless Sample Borehole Location



Windowless Sample Borehole Location with gas monitoring installation



Rotary Borehole Location



Trial Pit Location

		Client Ref: Our Ref: G24327 Date: 07/11/2024 Location: 33a Church Lane, Holmfield, Huddersfield, HD8 9LY						<b>BH 1</b> Sheet No 1 of 1	
		Comments:				Logged by: B.G			
Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	TURF and TOPSOIL. Soft dark brown sandy gravelly clay. Gravel is fine to coarse of sandstone and brick.	100							
0.80	MADE GROUND. Medium dense grey and black very sandy gravel. Gravel is fine to coarse of sandstone, brick, concrete, slag and tile.	700							0.25
1.20	Firm brown very sandy very gravelly CLAY. Gravel is fine to coarse of sandstone.	400					1.00m - 1.45m 2/2/3/4/4/4 N = 15		0.50
2.00	Medium dense light brown clayey sandy GRAVEL. Gravel is fine to coarse of sandstone.	800					2.00m - 2.01m N = 50+		0.75
	Borehole terminated at 2.00m due to refusal.								1.00
									1.25
									1.50
									1.75
									2.00
<b>Remarks:</b> Casing to 1.00m Dynamic windowless sampling by Terrier Rig to 2.00 mbgl Borehole remained dry on completion Gas well installed to 2.00m with gas bung and cover		<b>Key:</b> Slotted Pipe Plain Pipe Bentonite Gravel Filter		Disturbed sample Shear vane Water sample Standard Penetration Test		<b>BH 1</b>			

		Client Ref: Our Ref: G24327 Date: 07/11/2024 Location: 33a Church Lane, Holmfield, Huddersfield, HD8 9LY						<b>BH 2</b> Sheet No 1 of 1	
		Comments:						Logged by: B.G	
Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.10	SANDSTONE SLAB.	100				Cv kN/m <sup>2</sup>			
0.50	MADE GROUND. Loose to medium dense dark grey sandy gravelly clay. Gravel is fine to coarse of sandstone, brick, concrete and slag.	500			O				0.25
1.40	Firm brown very sandy very gravelly CLAY. Gravel is fine to coarse of sandstone.  Roots noted to 1.00m.	900			O	40			0.50
1.60	Medium dense light brown clayey sandy GRAVEL. Gravel is fine to coarse of sandstone.  Borehole terminated at 1.60m due to refusal.	200			OS		1.60m - 1.61m N = 50+		0.75
									1.00
									1.25
									1.50
<b>Remarks:</b> Casing to 1.00m Dynamic windowless sampling by Terrier Rig to 1.60 mbgl Borehole remained dry on completion Gas well installed to 1.60m with gas bung and cover		<b>Key:</b> Slotted Pipe Plain Pipe Bentonite Gravel Filter		Disturbed sample Cv Shear vane W Water sample S Standard Penetration Test		<b>BH 2</b>			

		<b>Client Ref:</b> <b>Our Ref:</b> G24327 <b>Date:</b> 07/11/2024 <b>Location:</b> 33a Church Lane, Holmfield, Huddersfield, HD8 9LY <b>Comments:</b>						<b>BH 3</b> <b>Sheet No 1 of 1</b> <b>Logged by:</b> B.G	
Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF and TOPSOIL. Loose dark brown clayey gravelly sand. Gravel is fine to coarse of sandstone and brick.	300			O	Cv kN/m <sup>2</sup>			0.25
0.60	Medium dense brown very clayey gravelly SAND. Gravel is fine to coarse of sandstone.	300			O				0.50
1.50	Medium dense to dense light brown very gravelly SAND/very sandy GRAVEL. Gravel is fine to coarse of sandstone.	900			OS		1.00m - 1.45m 5/6/5/5/6/6 N = 22		0.75 1.00 1.25 1.50
	Borehole terminated at 1.50m due to refusal.								
<b>Remarks:</b> Casing to 1.00m Dynamic windowless sampling by Terrier Rig to 1.50 mbgl Borehole remained dry on completion			<b>Key:</b> 				<b>BH 3</b>		

		Client Ref: Our Ref: G24327 Date: 07/11/2024 Location: 33a Church Lane, Holmfield, Huddersfield, HD8 9LY					<b>BH 4</b> Sheet No 1 of 1		
		Comments:			Logged by: B.G				
Depth (m)	Description of Strata	Thickness	Legend	Gas Well	Sample	Test Type Result	SPT N Value (Depth)	Depth to Water	Depth (m)
0.30	TURF and TOPSOIL. Loose dark brown clayey gravelly sand. Gravel is fine to coarse of sandstone and brick.	300			O	Cv kN/m <sup>2</sup>			0.25
0.60	Medium dense brown very clayey gravelly SAND. Gravel is fine to coarse of sandstone.	300			O				0.50
1.40	Dense light brown very gravelly SAND/ very sandy GRAVEL. Gravel is fine to coarse of sandstone.	800			OS		1.00m - 1.45m 6/6/8/10/12/15 N = 45		0.75 1.00 1.25
	Borehole terminated at 1.40m due to refusal.								
<b>Remarks:</b> Casing to 1.00m Dynamic windowless sampling by Terrier Rig to 1.40 mbgl Borehole remained dry on completion Gas well installed to 1.40m with gas bung and cover		<b>Key:</b> Slotted Pipe Plain Pipe Bentonite Gravel Filter		Disturbed sample Shear vane Water sample Standard Penetration Test		<b>BH 4</b>			

## GEOINVESTIGATE Ltd.

**Your Ref.**
**Our Ref.** G24327

**TP No.A Sheet No. 1 of 1**
**Location:** 33a Church Lane, Holmfield, Huddersfield, HD8 9LY

**DATE:** 07/11/24

Depth (m)	Description of Strata	Thickness	Legend	Sample	Test Type Result	Root Information	Depth to Water	Depth (m)
0.20	TURF onto MADE GROUND. Medium dense grey sandy gravel. Gravel is fine to coarse of sandstone, dolomite and concrete.	200		O				0.20
0.50	MADE GROUND. Loose to medium dense dark brown clayey gravelly sand. Gravel is fine to coarse of sandstone, brick, flint and concrete. Plastic noted Roots noted Trial pit terminated at 0.50m.	300		O				0.50

**Remarks:** Hand excavated to 0.50m  
Trial pit remained stable and dry on completion

**Key:** O Disturbed sample  
Cv Shear vane  
W Water sample

## GEOINVESTIGATE Ltd.

**Your Ref.**
**Our Ref.** G24327

**TP No.B Sheet No. 1 of 1**
**Location:** 33a Church Lane, Holmfield, Huddersfield, HD8 9LY

**DATE:** 07/11/24

Depth (m)	Description of Strata	Thickness	Legend	Sample	Test Type Result	Root Information	Depth to Water	Depth (m)
0.20	TURF onto MADE GROUND. Medium dense grey sandy gravel. Gravel is fine to coarse of sandstone, dolomite and concrete.	200		O				0.20
0.50	MADE GROUND. Loose to medium dense dark brown clayey gravelly sand. Gravel is fine to coarse of sandstone, brick, flint and concrete. Roots noted. Trial pit terminated at 0.50m.	300		O				0.50

**Remarks:** Hand excavated to 0.50m  
Trial pit remained stable and dry on completion

**Key:** O Disturbed sample  
Cv Shear vane  
W Water sample





# GEOINVESTIGATE Ltd.

**Your Ref.**
**Our Ref.**

G24327

**RH No.2 Sheet No. 1 of 2**
**Location:** 33a Church Lane, Huddersfield HD8 9LY

**DATE:** 13/12/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
1.40	Brown DRIFT.	1400							
11.7	Orange SANDSTONE.	10300							2.50 5.00 7.50 10.00
21.5	Light grey SILTSTONE.	9800							12.50 15.00 17.50 20.00
23.3	Grey and dark grey MUDSTONE with occasional coal fragments.	1800							22.50
	Grey SILTSTONE. Rotary hole continued on page 2	4900							25.00

**Remarks:** Casing to 1.50m  
 Microdrill rotary open hole borehole to 30m  
 No cores recovered from borehole  
 No gas detected from borehole on completion  
 Full flush returned. No voids encountered.

**Key:**

	Slotted Pipe	<b>O</b> Disturbed sample
	Plain Pipe	<b>Cv</b> Shear vane
	Bentonite	<b>W</b> Water sample
	Gravel Filter	<b>S</b> Standard Penetration Test
		<b>C</b> Cone Penetration Test

**RH2**



# GEOINVESTIGATE Ltd.

Your Ref.

Our Ref.

G24327

RH No.3 Sheet No. 1 of 2

Location: 33a Church Lane, Huddersfield HD8 9LY

DATE: 13/12/24

Depth (m)	Description of Strata	Thick-ness	Legend	Gas Well	Sample	Test Type Result	Flush	Depth to Water	Depth (m)
1.50	Brown DRIFT.	1500							
10.9	Orange SANDSTONE.	9400							2.50  5.00  7.50  10.00
15.0	Light grey SILTSTONE.	4100							12.50  15.00
	Rotary hole terminated at 15.00m								

**Remarks:** Casing to 1.50m  
 Microdrill rotary open hole borehole to 15m  
 No cores recovered from borehole  
 No gas detected from borehole on completion  
 Full flush returned. No voids encountered.

**Key:**

- Slotted Pipe
- Plain Pipe
- Bentonite
- Gravel Filter
- O** Disturbed sample
- Cv** Shear vane
- W** Water sample
- S** Standard Penetration Test
- C** Cone Penetration Test

**RH3**



The Coal  
Authority

# Permit to Enter or Disturb Coal Authority Interests

Permit 29287

**Name and Address of Permit Holder:**

*Byram Construction Ltd  
Long Fall Farm  
Reddisher Road  
Marsden  
HD7 6NF*

**Site Location:**

*35a Church Lane  
Holmfild  
HD8 9LY*

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

***Ground investigation by three boreholes to 30m to determine presence of shallow mine workings*** 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, CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>, H<sub>2</sub>S 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: \_\_\_\_\_ Granted Date: 10/12/2024

For and on behalf of The Coal Authority

*Nominated Representative: Richard Morson, Permitting Manager;  
The Coal Authority, Permitting Office, 200 Lichfield Lane, Mansfield, Notts, NG18 4RG*

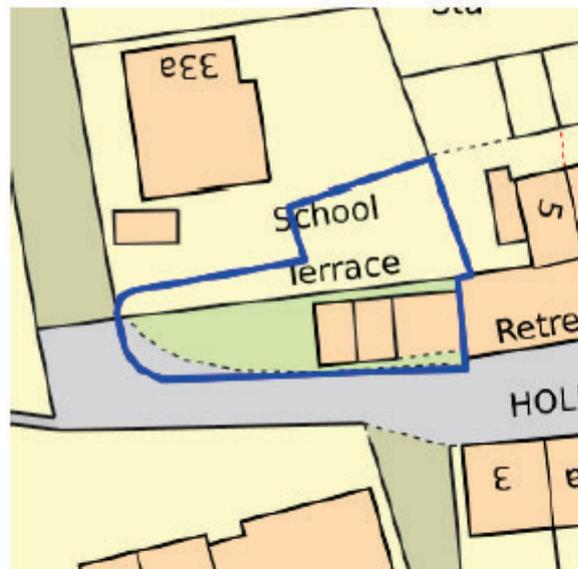


The Coal  
Authority

# Granted Permit Boundary

Permit Ref: 29287

Permit Boundary:



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## **APPENDIX 2**

### Geotechnical Testing



## Geotechnical Testing Results

**Our Ref:** G24327

**Your Ref:**

**Location:** 33a Church Lane, Holmfieled, Huddersfie

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	25.8						
	1.10	19.0						
	1.50	17.4						
	2.00	17.5						
	2.50	14.3						
	3.00	14.6						
2	0.50	12.3	42.4		*	*	*	*
	1.00	10.8						
	1.50	14.0						
	2.00	10.8						
3	0.50	29.6						
	1.00	16.6						
	2.00	17.6						
	2.50	17.7						
	3.00	16.1						
	3.50	13.8						

\* Note - Essentially Non Plastic Material



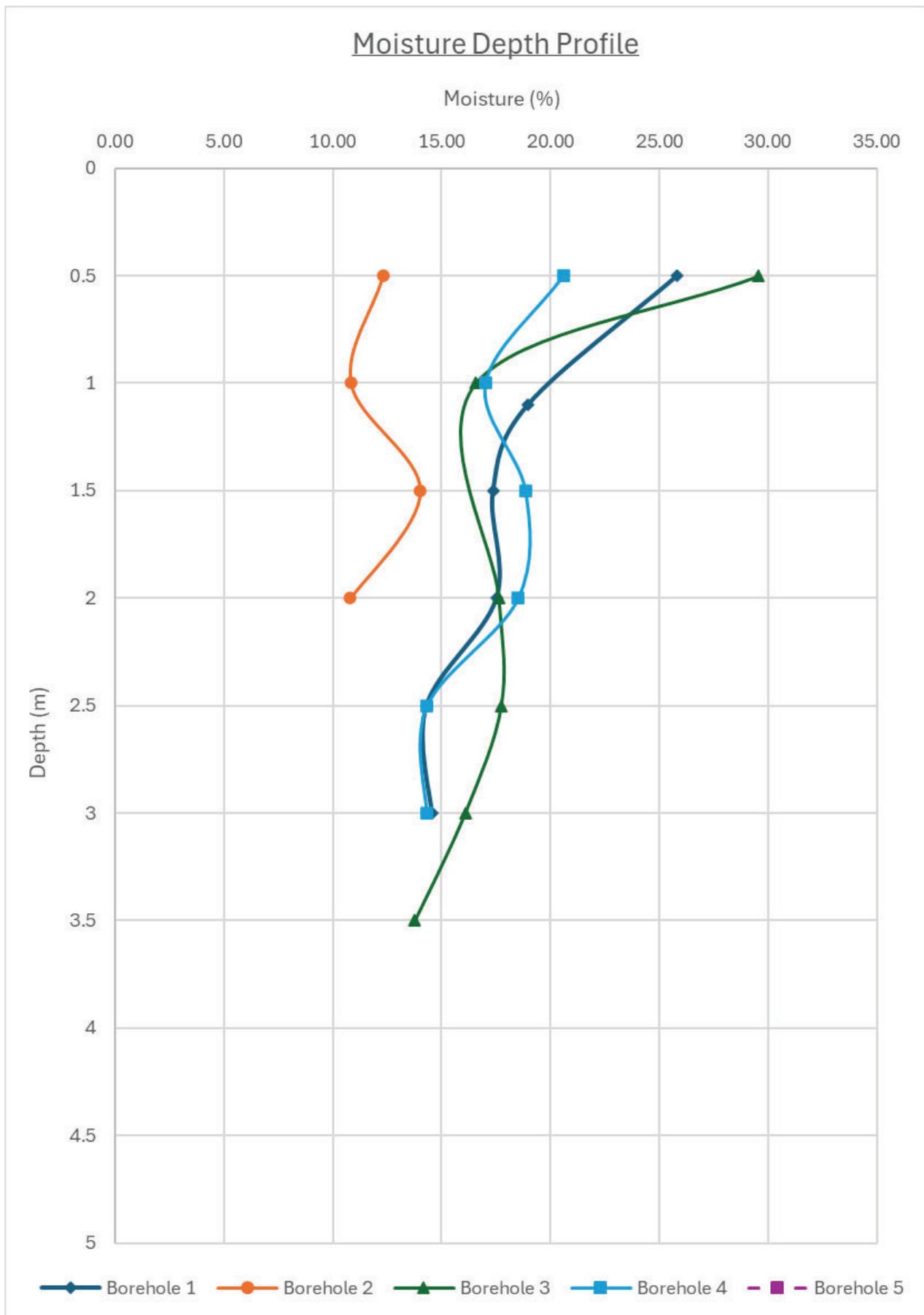
## Geotechnical Testing Results

**Our Ref:** G24327

**Your Ref:**

**Location:** 33a Church Lane, Holmfieid, Huddersfie

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]
4	0.50	20.6						
	1.00	17.0						
	1.50	18.9						
	2.00	18.5						
	2.50	14.3						
	3.00	14.3						



## **APPENDIX 3**

### **I2 Analytical Test Report**



Geoinvestigate□  
Units 3a and 4  
Terry Dicken Industrial Estate  
Ellerbeck Way  
TS9 7AE

i2 Analytical Ltd.  
7 Woodshots Mear  
Croxley Green  
Business Park,  
Watford,  
Herts,  
WD18 8YS

e: enquiries@geoinvestigate.co.uk□  
stuart.howe@geoinvestigate.co.uk

## **Analytical Report Number : 24-056769**

**Project / Site name:** 35A Church Lane, Holmfield HD8 9LY

**Samples received on:**

**Your job number:** G24327

**Samples instructed on/  
Analysis started on:**

**Your order number:** G24327

**Analysis completed by:**

**Report Issue Number:** 1

**Report issued on:**

**Samples Analysed:** 4 soil samples - 2 leachate samples

**Signed:** \_\_\_\_\_

Adam Fenwick  
Key Account Executive  
**For & on behalf of i2 Analytical Ltd**

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting  
leachates - 2 weeks from reporting  
waters - 2 weeks from reporting  
asbestos - 6 months from reporting

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Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.  
Application of uncertainty of measurement would provide a range within which the true result lies.  
An estimate of measurement uncertainty can be provided on request.



dow,

rtical.com

29/11/2024

29/11/2024

05/12/2024

05/12/2024

.td.

Analytical Report Number: 24-056769  
 Project / Site name: 35A Church Lane, Holmfield HD8 9LY  
 Your Order No: G24327

Lab Sample Number				394942	394943	394944	394945
Sample Reference				TPA	TPA	TPB	TPB
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Water Matrix				N/A	N/A	N/A	N/A
Depth (m)				0.20	0.50	0.20	0.50
Date Sampled				12/11/2024	12/11/2024	12/11/2024	12/11/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status				

Stone Content	%	0.1	NONE	68.3	< 0.1	77.2	58.7
Moisture Content	%	0.01	NONE	6.8	17	6	9.4
Total mass of sample received	kg	0.1	NONE	1	0.9	0.8	0.9

#### Asbestos

Asbestos in Soil Detected/Not Detected	Type	N/A	ISO 17025	Not-detected	-	Not-detected	-
Asbestos Analyst ID	N/A	N/A	N/A	DKI	-	DKI	-

#### General Inorganics

pH (L099)	pH Units	N/A	MCERTS	7.5	6.6	8.1	7.9
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0
Water Soluble Sulphate as SO <sub>4</sub> 16hr extraction (2:1)	mg/kg	2.5	MCERTS	20	48	28	65
Water Soluble SO <sub>4</sub> 16hr extraction (2:1)	mg/l	1.25	MCERTS	9.83	24	14.1	32.7
Sulphide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
Organic Matter (automated)	%	0.1	MCERTS	1.8	5.6	1.3	3.1

#### Total Phenols

Total Phenols (monohydric)	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0
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#### Speciated PAHs

Naphthalene	mg/kg	0.05	MCERTS	< 0.05	0.06	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.25
Fluorene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.19
Phenanthrene	mg/kg	0.05	MCERTS	0.12	0.43	0.23	3
Anthracene	mg/kg	0.05	MCERTS	< 0.05	0.1	< 0.05	0.64
Fluoranthene	mg/kg	0.05	MCERTS	0.19	0.95	0.36	3.9
Pyrene	mg/kg	0.05	MCERTS	0.15	0.88	0.32	3.2
Benzo(a)anthracene	mg/kg	0.05	MCERTS	0.13	0.6	0.15	1.4
Chrysene	mg/kg	0.05	MCERTS	0.15	0.57	0.17	1.3
Benzo(b)fluoranthene	mg/kg	0.05	ISO 17025	0.12	0.74	0.14	1
Benzo(k)fluoranthene	mg/kg	0.05	ISO 17025	0.08	0.32	0.06	0.77
Benzo(a)pyrene	mg/kg	0.05	MCERTS	0.09	0.59	0.12	1.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.05	MCERTS	0.06	0.25	0.06	0.46
Dibenz(a,h)anthracene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	0.09
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.05	0.27	0.07	0.52

#### Total PAH

Speciated Total EPA-16 PAHs	mg/kg	0.8	ISO 17025	1.15	5.76	1.69	17.9
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#### Heavy Metals / Metalloids

Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.7	47	7.9	24
Boron (water soluble)	mg/kg	0.2	MCERTS	0.7	0.8	0.6	0.7
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.8	MCERTS	< 1.8	< 1.8	< 1.8	< 1.8
Chromium (III)	mg/kg	1	NONE	22	21	9.1	17
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	22	9.7	18

Analytical Report Number: 24-056769  
 Project / Site name: 35A Church Lane, Holmfield HD8 9LY  
 Your Order No: G24327

Lab Sample Number				394942	394943	394944	394945
Sample Reference				TPA	TPA	TPB	TPB
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied
Water Matrix				N/A	N/A	N/A	N/A
Depth (m)				0.20	0.50	0.20	0.50
Date Sampled				12/11/2024	12/11/2024	12/11/2024	12/11/2024
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Test Limit of detection	Test Accreditation Status				
Copper (aqua regia extractable)	mg/kg	1	MCERTS	18	51	33	35
Lead (aqua regia extractable)	mg/kg	1	MCERTS	28	200	37	420
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	MCERTS	22	25	4.8	18
Selenium (aqua regia extractable)	mg/kg	1	MCERTS	< 1.0	1.5	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	MCERTS	73	110	33	140

#### Petroleum Hydrocarbons

TPHCWG - Aliphatic >EC5 - EC6 <sub>HS_1D_AL</sub>	mg/kg	0.01	MCERTS	-	-	< 0.010	-
TPHCWG - Aliphatic >EC6 - EC8 <sub>HS_1D_AL</sub>	mg/kg	0.01	MCERTS	-	-	< 0.010	-
TPHCWG - Aliphatic >EC8 - EC10 <sub>HS_1D_AL</sub>	mg/kg	0.01	MCERTS	-	-	< 0.010	-
TPHCWG - Aliphatic >EC10 - EC12 <sub>EH_CU_1D_AL</sub>	mg/kg	1	MCERTS	-	-	< 1.0	-
TPHCWG - Aliphatic >EC12 - EC16 <sub>EH_CU_1D_AL</sub>	mg/kg	2	MCERTS	-	-	< 2.0	-
TPHCWG - Aliphatic >EC16 - EC21 <sub>EH_CU_1D_AL</sub>	mg/kg	8	MCERTS	-	-	< 8.0	-
TPHCWG - Aliphatic >EC21 - EC35 <sub>EH_CU_1D_AL</sub>	mg/kg	8	MCERTS	-	-	< 8.0	-
TPHCWG - Aliphatic >EC5 - EC35 <sub>EH_CU+HS_1D_AL</sub>	mg/kg	10	NONE	-	-	< 10	-

TPHCWG - Aromatic >EC5 - EC7 <sub>HS_1D_AR</sub>	mg/kg	0.01	MCERTS	-	-	< 0.010	-
TPHCWG - Aromatic >EC7 - EC8 <sub>HS_1D_AR</sub>	mg/kg	0.01	MCERTS	-	-	< 0.010	-
TPHCWG - Aromatic >EC8 - EC10 <sub>HS_1D_AR</sub>	mg/kg	0.02	MCERTS	-	-	< 0.020	-
TPHCWG - Aromatic >EC10 - EC12 <sub>EH_CU_1D_AR</sub>	mg/kg	1	MCERTS	-	-	< 1.0	-
TPHCWG - Aromatic >EC12 - EC16 <sub>EH_CU_1D_AR</sub>	mg/kg	2	MCERTS	-	-	< 2.0	-
TPHCWG - Aromatic >EC16 - EC21 <sub>EH_CU_1D_AR</sub>	mg/kg	10	MCERTS	-	-	< 10	-
TPHCWG - Aromatic >EC21 - EC35 <sub>EH_CU_1D_AR</sub>	mg/kg	10	MCERTS	-	-	< 10	-
TPHCWG - Aromatic >EC5 - EC35 <sub>EH_CU+HS_1D_AR</sub>	mg/kg	10	NONE	-	-	< 10	-

#### VOCs

MTBE (Methyl Tertiary Butyl Ether)	µg/kg	5	MCERTS	-	-	< 5.0	-
Benzene	µg/kg	5	MCERTS	-	-	< 5.0	-
Toluene	µg/kg	5	MCERTS	-	-	< 5.0	-
Ethylbenzene	µg/kg	5	MCERTS	-	-	< 5.0	-
p & m-Xylene	µg/kg	8	MCERTS	-	-	< 8.0	-
o-Xylene	µg/kg	5	MCERTS	-	-	< 5.0	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 24-056769

Project / Site name: 35A Church Lane, Holmfield HD8 9LY

Your Order No: G24327

<b>Lab Sample Number</b>				394942	394944
<b>Sample Reference</b>				TPA	TPB
<b>Sample Number</b>				None Supplied	None Supplied
<b>Water Matrix</b>				N/A	N/A
<b>Depth (m)</b>				0.20	0.20
<b>Date Sampled</b>				12/11/2024	12/11/2024
<b>Time Taken</b>				None Supplied	None Supplied
<b>Analytical Parameter (Leachate Analysis)</b>	<b>Units</b>	<b>Test Limit of detection</b>	<b>Test Accreditation Status</b>		

#### General Inorganics

pH (automated)	pH Units	N/A	ISO 17025	7.7	8.3
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10
Free Cyanide	µg/l	10	ISO 17025	< 10	< 10
Thiocyanate as SCN	µg/l	200	ISO 17025	< 200	< 200
Sulphate as SO <sub>4</sub>	mg/l	0.045	ISO 17025	0.868	2.06
Total Sulphur	mg/l	0.015	NONE	0.289	0.687
Sulphide	µg/l	5	NONE	< 5.0	< 5.0

#### Total Phenols

Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10
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#### Speciated PAHs

Naphthalene	µg/l	0.01	NONE	0.07	< 0.01
Acenaphthylene	µg/l	0.01	NONE	< 0.01	< 0.01
Acenaphthene	µg/l	0.01	NONE	0.03	< 0.01
Fluorene	µg/l	0.01	NONE	0.03 #	< 0.01 ##
Phenanthrene	µg/l	0.01	NONE	0.12	0.07
Anthracene	µg/l	0.01	NONE	< 0.01	< 0.01
Fluoranthene	µg/l	0.01	NONE	< 0.01	< 0.01
Pyrene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(a)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01
Chrysene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(b)fluoranthene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(k)fluoranthene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(a)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01
Indeno(1,2,3-cd)pyrene	µg/l	0.01	NONE	< 0.01	< 0.01
Dibenz(a,h)anthracene	µg/l	0.01	NONE	< 0.01	< 0.01
Benzo(ghi)perylene	µg/l	0.01	NONE	< 0.01	< 0.01

#### Total PAH

Total EPA-16 PAHs	µg/l	0.16	NONE	0.25	< 0.16
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#### Heavy Metals / Metalloids

Arsenic (dissolved)	µg/l	1	ISO 17025	3.9	1.2
Boron (dissolved)	µg/l	10	ISO 17025	13	12
Cadmium (dissolved)	µg/l	0.08	ISO 17025	< 0.08	< 0.08
Chromium (dissolved)	µg/l	0.4	ISO 17025	2.4	< 0.4
Copper (dissolved)	µg/l	0.7	ISO 17025	4.7	10
Lead (dissolved)	µg/l	1	ISO 17025	11	8.8
Mercury (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5
Nickel (dissolved)	µg/l	0.3	ISO 17025	1.1	< 0.3
Selenium (dissolved)	µg/l	4	ISO 17025	< 4.0	< 4.0
Zinc (dissolved)	µg/l	0.4	ISO 17025	12	7.4

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

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\* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
394942	TPA	None Supplied	0.2	Brown sand with stones
394943	TPA	None Supplied	0.5	Brown loam and sand with vegetation
394944	TPB	None Supplied	0.2	Brown sand with stones
394945	TPB	None Supplied	0.5	Brown sand with stones

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Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)

Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Asbestos identification in Soil	Asbestos Identification with the use of polarised light microscopy in conjunction with dispersion staining techniques	In-house method based on HSG 248, 2021	A001B	D	ISO 17025
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate (Walkley Black Method)	In-house method	L009B	D	MCERTS
Sulphide in soil	Determination of sulphide in soil by acidification and heating to liberate hydrogen sulphide, trapped in an alkaline solution then assayed by ion selective electrode	In-house method	L010-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically (up to 30°C)	In-house method	L019B	W	NONE
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight	In-house method based on British Standard Methods and MCERTS requirements.	L019B	D	NONE
Sulphide in leachate	Determination of sulphide in leachate by ion selective electrode	In-house method	L029-PL	W	NONE
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L038B	D	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES	In-house method based on Second Site Properties version 3	L038B	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Sulphate, water soluble, in soil (16hr extraction)	In-house method	L038B	D	MCERTS
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in soil	Determination of semi-volatile organic compounds (including PAH) in soil by extraction in dichloromethane and hexane followed by GC-MS	In-house method based on USEPA 8270	L064B	D	MCERTS
BTEX and/or Volatile organic compounds in soil	Determination of volatile organic compounds in soil by headspace GC-MS	In-house method based on USEPA 8260	L073B	W	MCERTS
Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	Determination of total petroleum hydrocarbons in soil by GC-FID/GC-MS HS with carbon banding aliphatic and aromatic	In-house method	L076B/L088-PL	D/W	MCERTS
Chromium III in soil	In-house method by calculation from total Cr and Cr VI	In-house method by calculation	L080-PL/L130B	W	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in NaOH and addition of 1,5 diphenylcarbazine followed by colorimetry	In-house method	L080-PL	W	MCERTS
Free cyanide in leachate	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025

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Project / Site name: 35A Church Lane, Holmfield HD8 9LY

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters Heating/Cooling (PrW) DI Process Water (DI PrW)

Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Free cyanide in soil	Determination of free cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	MCERTS
Monohydric phenols in leachate	Determination of phenols in leachate by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	MCERTS
Total cyanide in leachate	Determination of total cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	ISO 17025
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L080-PL	W	MCERTS
Thiocyanate in soil	Determination of thiocyanate in soil by extraction in water followed by acidification followed by addition of ferric nitrate followed by discrete analyser (spectrophotometer)	In-house method	L082B	D	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement	In-house method	L099-PL	D	MCERTS
pH at 20°C in leachate (automated)	Determination of pH in leachate by electrometric measurement	In-house method	L099-PL	W	ISO 17025
Speciated PAHs and/or Semi-volatile organic compounds in leachate	SVOCs and PAHs in leachate	In-house method	L102B		NONE
Thiocyanate in leachate	Determination of thiocyanate in water by discrete analyser (colorimetry)	In-house method based on SMWW 4500-CN-M	L082B	W	ISO 17025
Total Sulphur in leachates	Determination of total sulphur in leachates by acidification followed by ICP-OES	In-house method based on MEWAM 2006 Methods for the Determination of Metals in Soil	L039B	W	NONE

For method numbers ending in 'UK' or 'A' analysis have been carried out in our laboratory in the United Kingdom (Watford).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL' or 'B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30°C.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Quality control parameter failure associated with individual result applies to calculated sum of individuals.

The result for sum should be interpreted with caution

# - Quality control parameter failure associated with this result; other checks applied prior to reporting the data have been accepted. The result should be considered as deviating and should be interpreted with caution. The result is not accredited.

## - Quality control parameter has a high recovery (outside of limit); however the associated result is below the reporting limit, other checks applied prior to reporting the data have been accepted. The result should be considered as being deviating and may be compromised.

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This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
TPA	N/A	S	394942	c	Free cyanide in soil	L080-PL	c
TPA	N/A	S	394942	c	Speciated PAHs and/or Semi-volatile organic compounds in soil	L064B	c
TPA	N/A	S	394942	c	Sulphide in soil	L010-PL	c
TPA	N/A	S	394942	c	Thiocyanate in soil	L082B	c
TPA	N/A	S	394942	c	Total cyanide in soil	L080-PL	c
TPA	N/A	S	394943	c	Free cyanide in soil	L080-PL	c
TPA	N/A	S	394943	c	Speciated PAHs and/or Semi-volatile organic compounds in soil	L064B	c
TPA	N/A	S	394943	c	Sulphide in soil	L010-PL	c
TPA	N/A	S	394943	c	Thiocyanate in soil	L082B	c
TPA	N/A	S	394943	c	Total cyanide in soil	L080-PL	c
TPB	N/A	S	394944	c	BTEX and/or Volatile organic compounds in soil	L073B	c
TPB	N/A	S	394944	c	Free cyanide in soil	L080-PL	c
TPB	N/A	S	394944	c	Speciated PAHs and/or Semi-volatile organic compounds in soil	L064B	c
TPB	N/A	S	394944	c	Sulphide in soil	L010-PL	c
TPB	N/A	S	394944	c	Thiocyanate in soil	L082B	c
TPB	N/A	S	394944	c	Total cyanide in soil	L080-PL	c
TPB	N/A	S	394944	c	Total petroleum hydrocarbons with carbon banding by GC-FID/GC-MS HS in soil	L076B/L088-PL	c
TPB	N/A	S	394945	c	Free cyanide in soil	L080-PL	c
TPB	N/A	S	394945	c	Speciated PAHs and/or Semi-volatile organic compounds in soil	L064B	c
TPB	N/A	S	394945	c	Sulphide in soil	L010-PL	c
TPB	N/A	S	394945	c	Thiocyanate in soil	L082B	c
TPB	N/A	S	394945	c	Total cyanide in soil	L080-PL	c